FARSYMABI PROJECT

'A farming system approach to mainstream biodiversity in the agricultural sector: bridging between the national and local levels'

RESEARCH REPORT
HOW DOES DEFORESTATION AFFECT BIRD POPULATIONS ON CHIPANJE CHETU COMMUNITY CONSERVATION AREA?

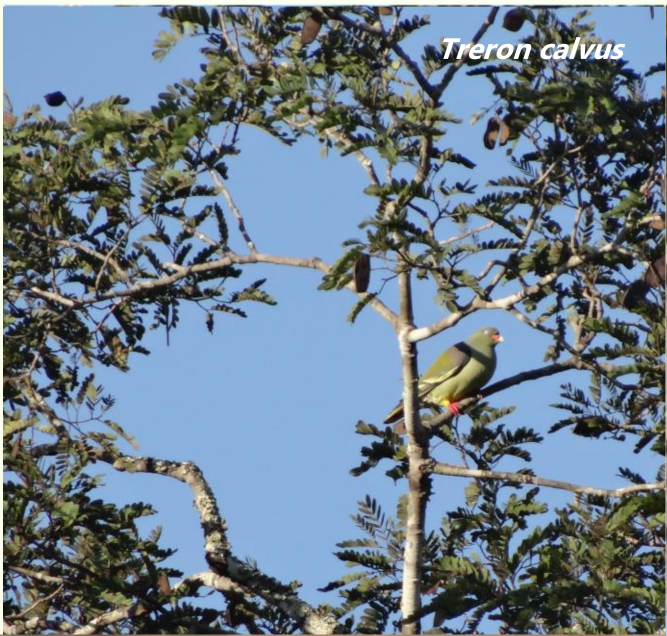

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. EXECUTIVE SUMMARY

This report presents a comprehensive overview of how the deforestation of Chipanje Chetu Community Conservation Area is affecting the diversity and composition of its bird communities, as well as the occurrence of endemic and threatened bird species. This assessment was based on cross-sectional data (from the Chipanje Chetu bird inventory, October 2023) used to compare diversity and composition indicators across habitats that are taken as different stages of deforestation i.e. forests (miombo woodland), fallows, and cropland, simultaneously; across the two communities (Nova madeira and Segundo Congresso); and across the 8 bird communities (clusters) of Chipanje Chetu, rather than by examining changes over a period of time.

Chipanje Chetu represents an early phase in the deforestation process in which species richness is still increasing as an effect of the introduction of open habitats (cropland and fallows) in a continuous of semi-open Miombo woodland.

In this step, high proportions of Miombo endemics and semi-open habitat birds species, as well as high values of Species evenness and low values of abundance are good indicators of well-conserved habitats, and the degradation of these indicators are better early warning signals, when species richness is still growing because of the diversification of the landscape with more areas of cropland and fallows amidst a pristine Miombo matrix (growing beta diversity).

Later on in the deforestation process, landscape diversification will stop as cropland and fallows become the matrix isolating small patches of remaining Miombo woodland; in this step beta diversity will also decline and species richness is expected to also decline, as the remaining small Miombo patches have not anymore a population surplus of Miombo species to colonize the edge with cropland.

On the other hand, the high population levels of crop predators in cropland areas close to the Miombo matrix (seed-predator, granivores in birds and mammals) may require defensive strategies to protect the crops and food security (low productivity of land, and very high average levels of crop destruction each season).

Achieving continuous, and more productive (intensive) farmland in smaller and compact (thus more defensible) cropland patches is expected to increase production, reduce crop raiding and thus increase food security, while halting the deforestation process before a tipping point of overall loss of species richness and full homogenization of biota is reached.

This strategy seems to be the one that is being implemented by Lipilichi, but whereas Lipilichi is focused on big mammals (carnivores and game species), which are protected under the conservation area regulations, we propose to include the proposed Miombo endemics proportion and other abovementioned indicators to monitor the success of such strategy.

II. CONTEXT

The project titled ‘A farming system approach to mainstream biodiversity in the agriculture and planning sectors: bridging between the national and local levels’, also known as the FARSYMABI project, aims to understand the trade-offs and complementarities between the goals of poverty alleviation, food security, and biodiversity conservation, through a farming systems approach.

In the context of developing countries like Mozambique, where small-scale family farming prevails, and where the expansion of farmland has been cited as the primary threat to biodiversity and ecosystem services, this analysis is essential. It identifies the need and strategies for establishing connections between the national policy framework for mainstreaming biodiversity into agriculture and the socio-ecological context of successful local interventions.

The Chipanje Chetu Community Conservation Area (ACCCC) in the Niassa province was selected as one of the case studies of the research project, due to its biological diversity, specificities of the miombo ecosystem, its socio-ecological context, as well as its status as a community conservation area. This case study aims to identify the main problems, potentialities and opportunities, in order to propose strategies and policies adjusted to the context, which will minimize undesirable impacts as well as enhance its potential.

Regarding the bird inventory on Chipanje Chetu, field records of birds in 174 count points and the description of habitat in each point were made, between the 7th and 26th October 2023, in a file with the format exemplified in Appendix VI.I.

This report presents a comprehensive overview of how deforestation affects bird populations, drawing on data from the Chipanje Chetu bird inventory. It concludes with the suggestion of conservation strategies to protect avian biodiversity in this area, as a means to contribute for local ecological functioning and the conservation of miombo endemic species. For an in-depth look at our research methods and findings, please refer to Appendix VII.II.

III. IMPACTS OF DEFORESTATION

III.I. IMPACTS OF DEFORESTATION PER HABITAT

To analyse the impacts of deforestation, we use cross-sectional data to compare areas at different stages of deforestation, i.e. forests (miombo woodland), fallows, and cropland, simultaneously, rather than examining changes over a period of time (Figure 1).

Figure 1. Deforestation gradient of Chipanje Chetu forests (i.e. miombo woodlands)

Only points of miombo woodland or fallow and cropland points located in areas that had been naturally occupied with miombo (assessed through their physiographic position) were selected for bird inventory. Points located in dambos, either cropped or with natural vegetation, were excluded. While preventing us to use these data to explore, e.g. the impacts of rice area expansion (typically grown in dambos), the time and resource constraints of the project led us to opt for focusing on the impacts of farmland expansion on the miombo woodlands alone.

Species richness is statistically higher in cropland than in forest (miombo woodland) (*P<0.05*), with fallows occupying an intermediate position (Figure 2). This increase in species richness along the deforestation gradient was unexpected, but the significance of this pattern for conservation is mitigated by three other reasons.

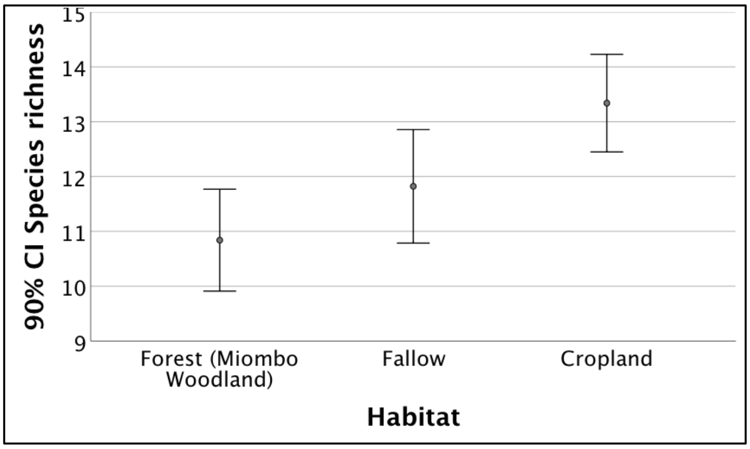

Figure 2. 90% Confidence interval of species richness per habitat

First, this increase in species richness is not translated into a statistically significant increase in species diversity along the deforestation gradient (*P>0.05*), because species evenness (the other component of diversity, in addition to richness) significantly declines between forest and both cropland and fallows (Figure 3A). This decline is explained by the significant increase in abundance along the deforestation gradient (Figure 3B), which means that a small number of abundant species concentrates most of the recorded individuals.

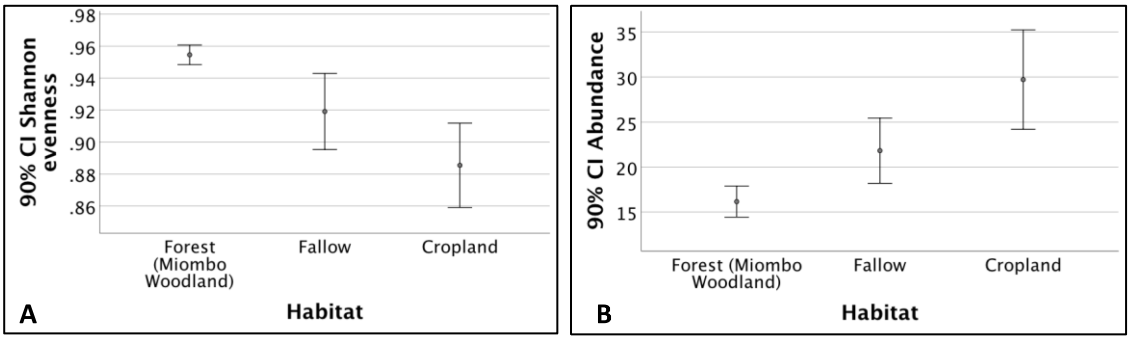

Figure 3. 90% Confidence intervals per habitat of **A.** Shannon evenness; and **B.** Abundance

Second, while species richness grows from forest points to cropland points, there is also, in the same direction, a turnover of species from those using semi-open (Figure 4A) to those using open habitats (Figure 4B). Because some of the species from semi-open habitats are miombo-woodland endemics, whereas some of those characteristic of open habitats are generalist, broadly distributed species, there is also a decline in miombo endemics (Figure 5A) and an increase in large-range species (Figure 5B) along the deforestation gradient. None of the recorded miombo endemics, except the local *Dendropicos stierlingi* (classified as Near Threatened by IUCN red List (IUCN, 2023)), is currently considered of conservation concern, because the biome still covers a large area south of the Equator. However, this may change in the near future with the fast decline in this biome's area (IUCN, 2017). Anyway, this replacement of biome endemic species by broadly distributed cosmopolitan species leads to homogenization of biota, a less visible aspect of global biodiversity loss disguised by an apparent local increase in species richness.

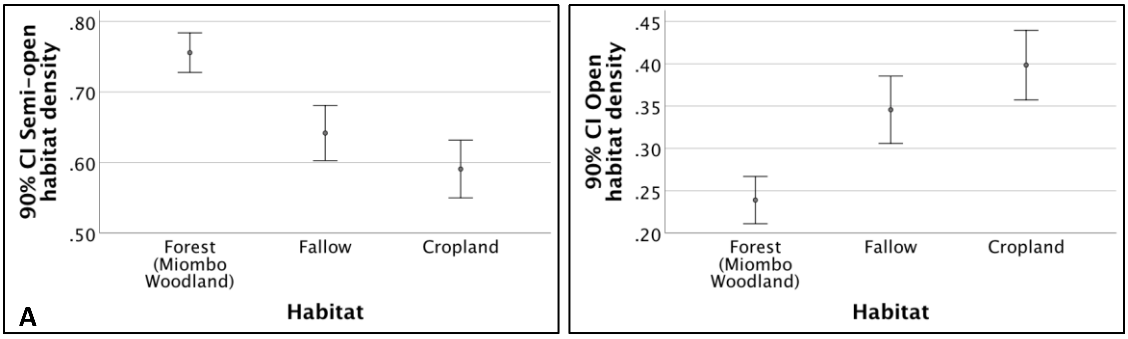

Figure 4. 90% Confidence intervals per habitat of **A.** Semi-open habitat density; and **B.** Open habitat density

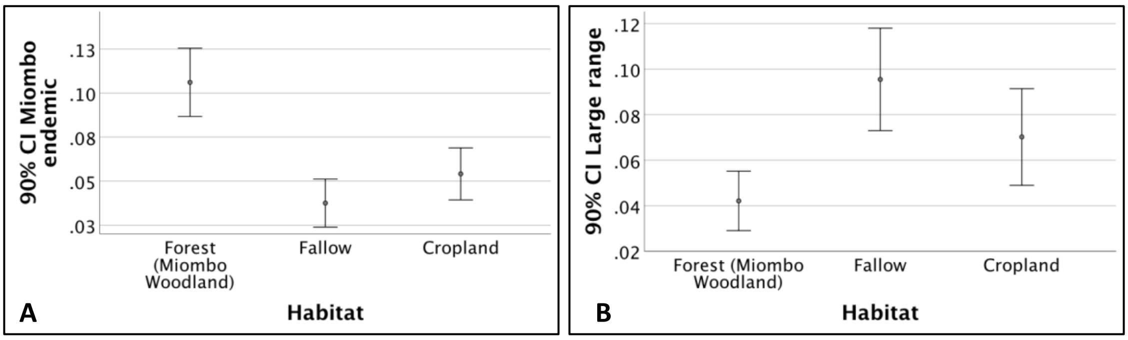

Figure 5. 90% Confidence intervals per habitat of **A.** Miombo endemics; and **B.** Large-range distribution size (species with a distribution range size greater than 15 million km^2)

Third, because Chipanje Chetu, as a whole, is still a well preserved area due to its protected area status and, in particular, its low population density (see FARSYMABI 2nd Workshop report). So, the deforestation is still in its first stages here. This explains why some miombo endemics are frequently recorded in cropland areas closer to the edge, or even surrounded by miombo woods. As it will be made clearer in the descriptions of the Bird community clusters below, these cropland areas correspond to the deforestation front, where cropland is young and close to extensive Miombo woodlands. As deforestation progresses, the Miombo changes from the matrix of the landscape to isolated patches, it is no longer able to populate nearby cropland (that becomes the matrix), which is expected to result in a future decline in species richness from woodland patches to cropland.

In addition, the low human pressure in this protected area also explains the type of threatened species recorded during the fieldwork. In fact, the Bateleur (*Terathopius ecaudatus*), the Martial Eagle (*Polemaetus bellicosus*), the White-headed Vulture (*Trigonoceps occipitalis*) and the Southern Ground-Hornbill (*Bucorvus leadbeateri*) are not restricted-range, endemic species but broadly distributed species, which are almost everywhere rare and declining; they are nowadays restricted to large, pristine protected areas, such as Chipanje Chetu. In this respect, their conservation problem is similar to that of the big mammals that also occur in Chipanje Chetu. The importance of these species doesn't significantly vary ($P > 0.05$) across our habitat types, because their response to deforestation would only be revealed at broader spatial-temporal scales, much beyond the scope of the methods we have applied in our fast assessment of the impacts of deforestation on bird communities.

The recorded richness of families and its evenness (Figure 6A and B, respectively) behaves similarly to species richness and evenness per habitat.

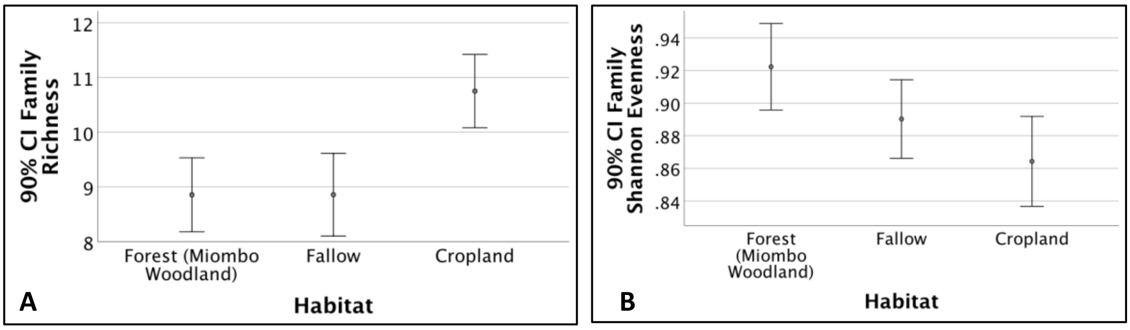

Figure 6. 90% Confidence intervals per habitat of **A.** Family richness; and **B.** Family Shannon evenness

Functional composition, i.e. ground granivores feeding niche, was used to assess the human-wildlife conflict of seed predation by granivore bird species. Seed predation by ground granivores, is practically absent from forests, suggesting ground granivores preference for open habitats, mainly cropland, with plenty of seed-producing plants (both crops and wild species) (Figure 7). The high population levels of crop predators in cropland areas close to the Miombo matrix may require defensive strategies to protect the crops

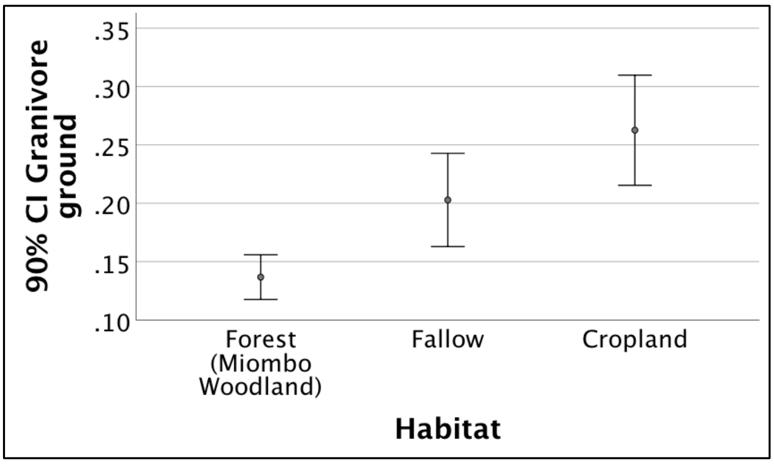

Figure 7. 90% Confidence interval of ground granivores per habitat

III.II. IMPACTS OF DEFORESTATION PER COMMUNITY

A total of 174 count points were carried out in the Chipanje Chetu in a balanced distribution between two communities: 90 count points in Nova Madeira and 84 count points in Segundo Congresso.

These two communities were chosen because they represent two different levels of human pressure, with Segundo Congresso presenting the highest level of population density and thus also of deforestation of miombo woodland to expand farmland. Because of its lower altitude in the long slope between the Sanga Mountain and the river Rovuma, Segundo Congresso is also drier and hotter than Nova Madeira. This results, as verified during fieldwork, in natural miombo woodlands, in general, with lower and less dense tree cover in Segundo Congresso when compared with Nova Madeira.

The results seem to confirm our hypothesis of a greater degradation in Segundo Congresso than in Nova Madeira. First, both species abundance and richness are statistically significant higher in Segundo Congresso than in Nova Madeira (Figure 8A and B). Second, semi-open habitats are significantly higher in Nova Madeira while open habitats are significantly higher in Segundo Congresso (Figure 9A and B). However, these differences do not reflect a significant difference in miombo endemic species between the two communities (*P>0.05*).

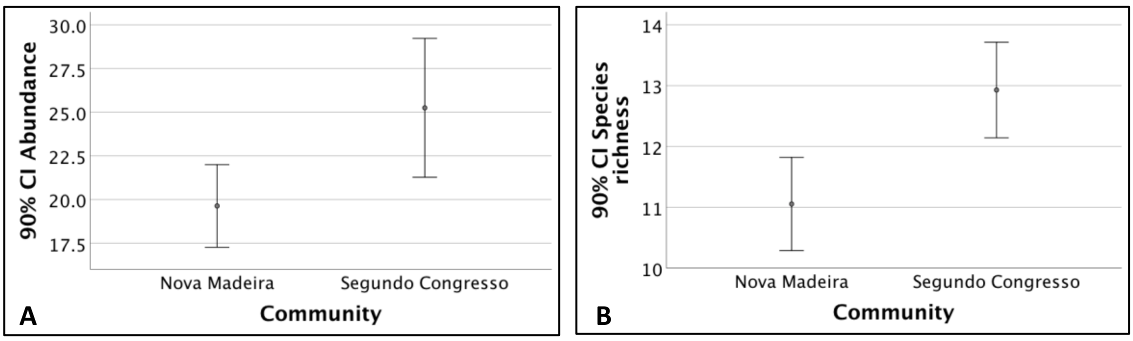

Figure 8. 90% Confidence intervals per community of **A.** Species abundance; and **B.** Species richness

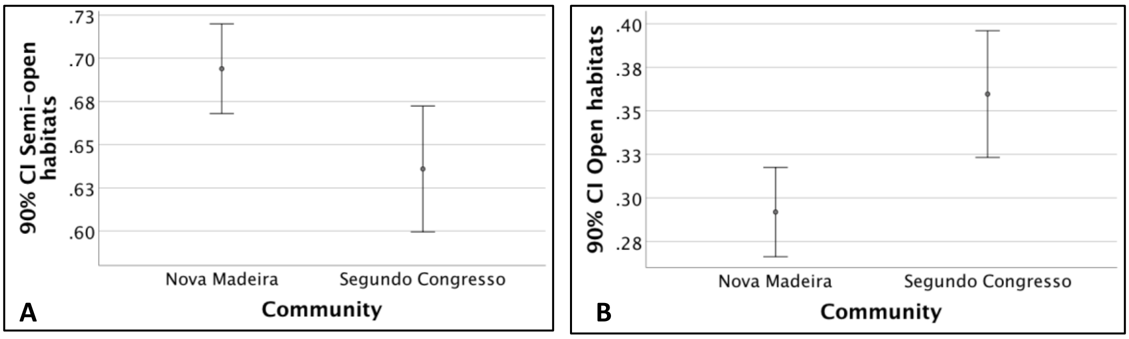

Figure 9. 90% Confidence intervals per community of **A.** Semi-open habitat density; and **B.** Open habitat density

Since the two communities belong to the same ecological domain, that of wet miombo woodlands (Lötter et al., 2021), we decided to merge the data from the two communities for a first cross-section comparison of the different stages of deforestation (in the previous section of the report, i.e. III.I. Impacts of deforestation per habitat). The patterns observed for the abundance, diversity and species composition across stages are, in general, similar in the two communities.

III.III. IMPACTS OF DEFORESTATION PER CLUSTER

The collected bird data was also analysed independently of the pre-established habitats used to classify the count points (i.e. forest, fallow or cropland) by running a PC analysis followed by a hierarchical cluster analysis (see Appendix VI.II for detailed methodology and results) to classify the data according to the species abundance, diversity and composition at each count point. The 8-cluster solution was selected for further analyses. The interpretation of the 8 bird communities of Chipanje Chetu, which correspond to these 8 clusters, is fully explained in Appendix VI.II.II. Table 1 presents a short summary of the 8-bird communities four big groups.

Table 1. Summary description of the 8-bird communities (clusters) of Chipanje Chetu

CLUSTER	DESCRIPTION
I. Miombo-woodland bird communities 1. Wood1 2. Wood2	These bird communities, of a relatively pure, semi-open Miombo woodland, are of utmost importance in Chipanje Chetu for the protection of Miombo endemism though they have the lowest levels of abundance and species richness. These communities are located the furthest away from human settlements and main cropland areas.
II. Cropland and woodland bird communities 3. CroplandWood1 4. CroplandWood2 5. CroplandWood3	These bird communities, of cropland-woodland edge landscapes, have the highest levels of species richness and diversity and intermediate levels of Miombo endemism conservation significance. These communities tend to be located in the interface between the Miombo woodland matrix and the patches of older cropland and fallows (centred on the existing settlements). This interface coincides with Miombo areas that have recently been deforested to create the youngest cropland areas.
III. Fallow bird communities 6. FallowWoodCropland 7. OldFallow	Both bird communities of fallows present relatively low levels of abundance, species richness and Miombo-endemic species. Both have relatively high proportions of shrubland species. Cluster 7 (old fallows) are predominantly located in the core of the older cropland patches, far away from the edge of Miombo woodland (where recent deforestation is occurring); Cluster 6 (which includes a significant proportion of woodland points) are located either in the core of the older cropland patches or close to the edge of Miombo woodland (in a position more similar to that of Cropland and woodland clusters).
IV. Old cropland bird communities 8. CroplandFallow	Old cropland and fallows, is the purest cropland bird community, in that woodland birds are almost absent. This bird community records extremely high (the highest) values of abundance, while species diversity and evenness record their minimal values. Records an exceptionally high proportion of Granivore ground (57% of all recorded birds). As regards its conservation value, records the lowest average proportions of Miombo-endemic species. This community is located in the core of the oldest cropland patches, close to human settlements and main roads (mostly in Segundo Congresso, where human pressure and deforestation are more intense, rather than in Nova Madeira). This bird community represents the final stage of the deforestation process.

Species diversity is maximum in cropland-woodland edge bird communities' (CroplandWood1, 2 & 3), closely followed by fallow bird communities (FallowWoodCropland & OldFallow), intermediate in Miombo-woodland bird communities (Wood1 & 2), and minimum in old cropland bird communities (CroplandFallow) (Figure 10).

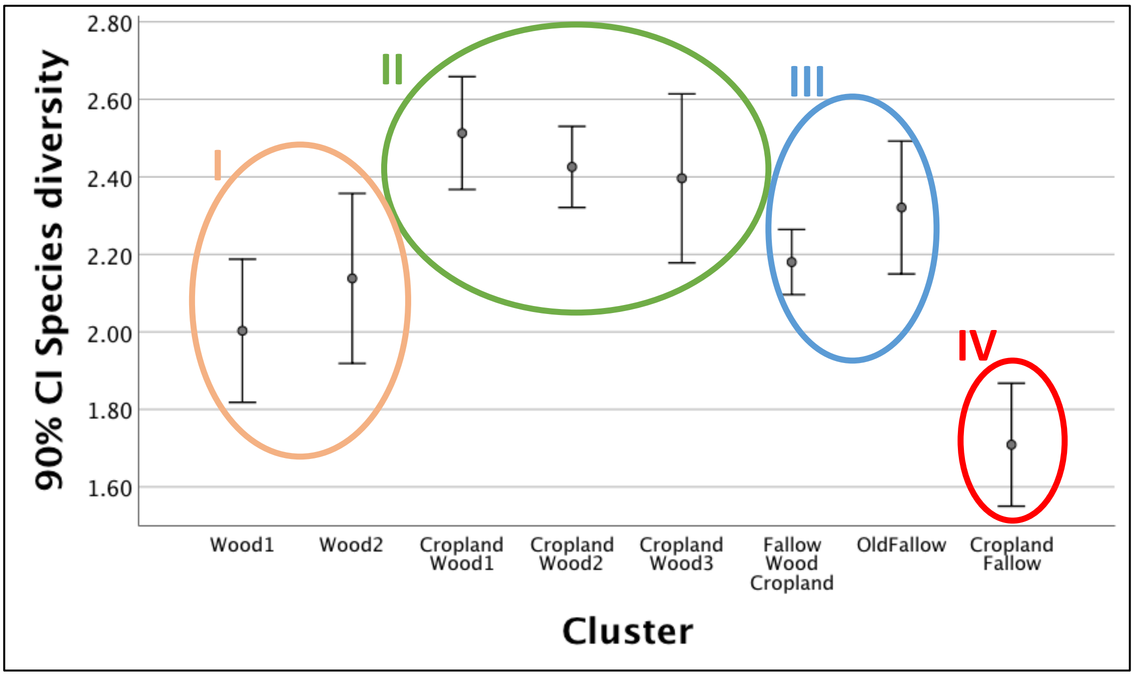

Figure 10. 90% Confidence interval of species diversity (Shannon diversity index) per cluster in Chipanje Chetu (See Table 1 for short summary of the I, II, III & IV big groups of the 8-bird communities)

Though functional diversity (feeding niches) seems to have a concave shape with a maximum in cropland-woodland edge bird communities', i.e. cluster CroplandWood2, it is practically the same among Miombo-woodland, cropland-woodland edge and fallow bird communities (between 1.4 and 1.6) with the exception of old cropland bird communities (CroplandFallow), in which feeding niche diversity is much lower (1) (Figure 11).

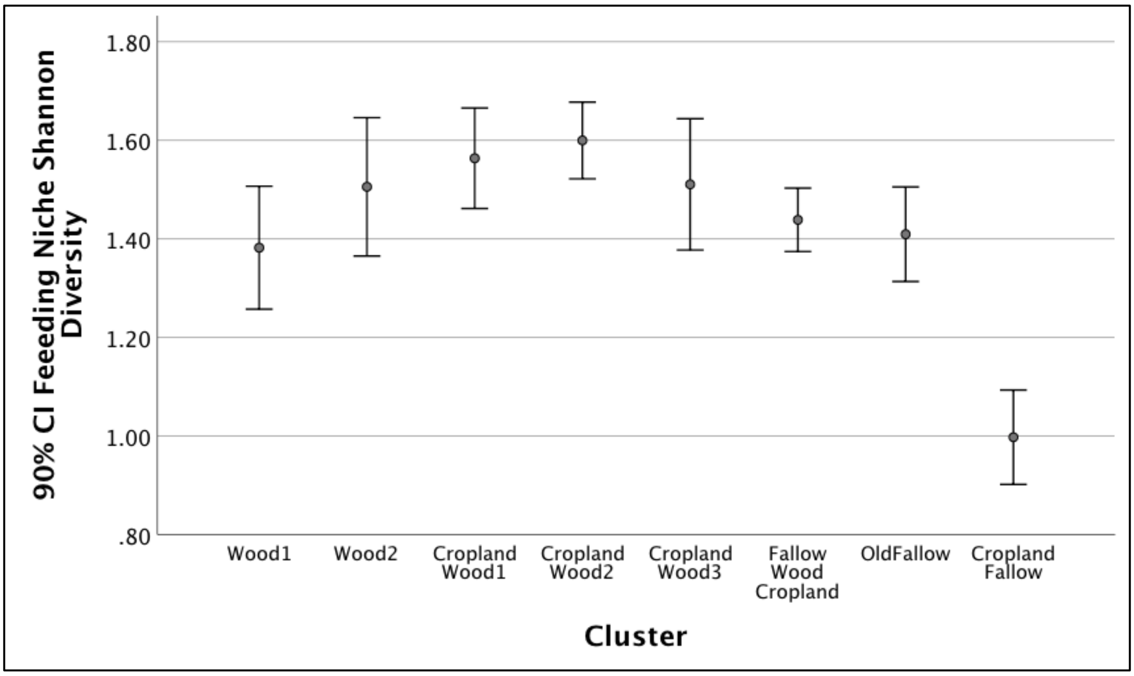

Figure 11. 90% Confidence interval of functional diversity (Shannon diversity index of Pigot et al. (2020) feeding niches) per cluster in Chipanje Chetu

Miombo endemic species proportion has a decreasing tendency from Miombo-woodland to old cropland bird communities, which is the most human-modified habitat (Figure 12).

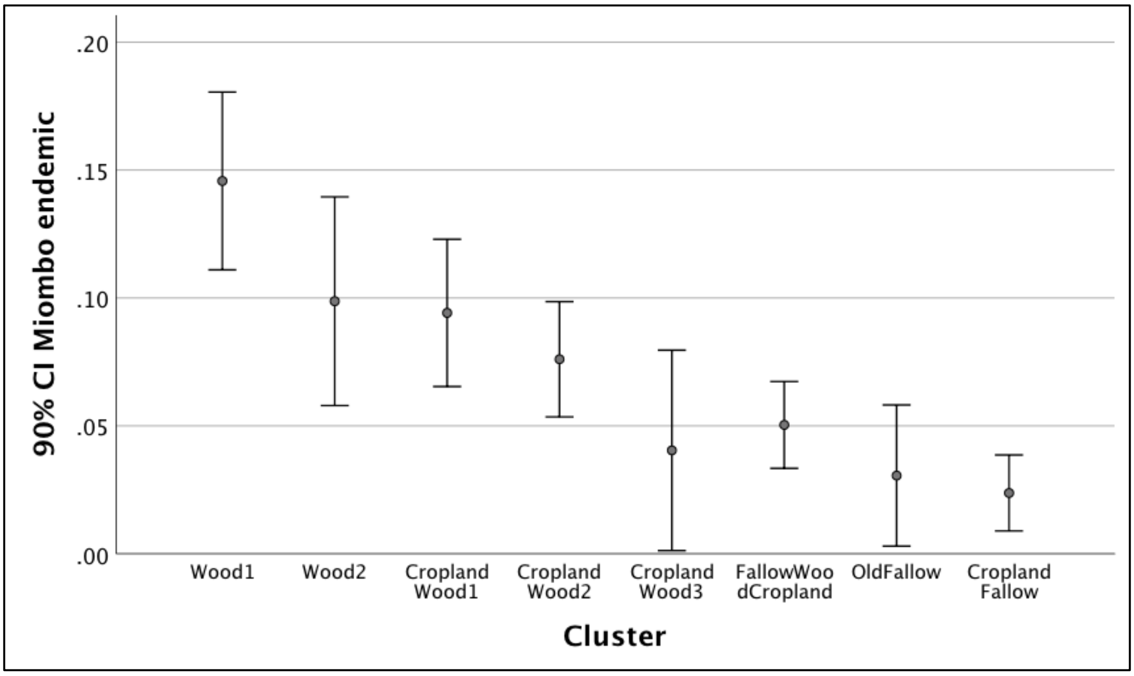

Figure 12. 90% Confidence interval of miombo endemic species proportions per cluster in Chipanje Chetu

IV. DIAGNOSTIC AND STRATEGY

Chipanje Chetu represents an early phase in the deforestation process in which species richness is still increasing as an effect of the introduction of open habitats (cropland and fallows) in a continuous of semi-open Miombo woodland.

In this step, high proportions of Miombo endemics and semi-open habitat birds species, as well as high values of Species evenness and low values of abundance are good indicators of well-conserved habitats, and the degradation of these indicators are better early warning signals, when species richness is still growing because of the diversification of the landscape with more areas of cropland and fallows amidst a pristine Miombo matrix (growing beta diversity).

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VI. APPENDICES

VI.I. BIRD FIELD RECORD

ACCCC	Código do ponto	Data	Hora	Nº Ficha

☐ **Queimado** ☐ **Formiga Guerreira**	**Coberto herbáceo:** ☐ Sem ☐ Algum ☐ Denso ☐ Alto	**Coberto arbustivo:** ☐ Sem ☐ Algum ☐ Abundante	**Coberto arbóreo:** ☐ Sem ☐ Escasso ☐ Algum ☐ Abundante

Tipo de habitat:

☐ **Machamba**	**Ocupação Cultural?**			
☐**Pousio**	**Nº anos?**			
☐**Floresta**	**Manta morta:** ☐ Sem ☐ Alguma ☐ Abundante	**Regeneração natural:** ☐ Sem ☐ Alguma ☐ Abundante	☐ **Fecho de copa**	☐ **Orla** ☐ **Clareira**

Descrição do habitat:

____

Espécies de árvores/arbustos (por ordem de abundância)

1ª______________________________

2ª______________________________

3ª______________________________

4ª______________________________

Outros aspectos relevantes: ______________________________

Nome vulgar	Nome científico	<30m	>30m	Observações/notas
Rola-d'olho-vermelho	*Streptopelia semitorquata*			
Rola do Cabo	*Streptopelia capicola*			
Rola-esmeraldina	*Turtur chalcospilos*			
Rola-de-manchas-azuis	*Turtur afer*			
Abelharuco-pequeno	*Merops pusillus*			
Pica-pau-cardeal	*Dendropicos fuscescens*			
Papa-figos-de-cabeça-preta	*Oriolus larvatus*			
Batis de Moçambique	*Batis soror*			
Picanço-de-almofadinha	*Dryoscopus cubla*			
Picanço-assobiador-de-coroa-castanha	*Tchagra australis*			
Picanço-assobiador-de-coroa-preta	*Tchagra senegalus*			
Picanço-tropical	*Laniarius aethiopicus*			
Drongo-de-cauda-forcada	*Dicrurus adsimilis*			
Prínia-de-flancos-castanhos	*Prinia subflava*			
Andorinha-preta	*Psalidoprocne pristoptera*			
Andorinha-estriada-pequena	*Cecropis abyssinica*			
Tuta-negra	*Pycnonotus barbatus*			
Papa-moscas pálido	*Agricola pallidus*			
Chasco-familiar	*Oenanthe familiaris*			
Beija-flor-de-barriga-amarela	*Cinnyris venustus*			
Viúva-de-rabadilha-amarela	*Euplectes capensis*			
Canário de Moçambique	*Crithagra mozambica*			

VI.II. DETAILED RESEARCH METHODS AND RESULTS

VI.II.I. METHODS NOTE

Field records of birds in 174 count points and the description of habitat in each point were made, between the 7th and 26th October 2023, in a file with the format exemplified in Appendix VI.I. For each bird species, the observed number of individuals in each point was divided between individuals observed at a distance < or >= 30 meters. The format of these records was converted to a point x variable format to be used in the analyses, that includes both the records at < or >= 30 m distance. This inclusion of both distance records was more revealing than if we would only consider records at <30m distance, plus 35 bird species would be lost from the analysis.

The variables included are the following:

- A summary description of the habitat in each point;
- The number of individuals of each bird species;
- 'Abundance' is the total number of individuals of any species observed;
- 'Av p-spec abundance' is average per-species abundance, computed as the quotient between 'Abundance' and 'Species Richness';
- 'Species Richness' is the count of species recorded;
- 'Shannon diversity' is the Shannon diversity index computed for all records (usual formula for the index);
- 'Shannon evenness' is the Shannon evenness index computed for all records ('Shannon evenness' = 'Shannon diversity' / ln ('Species Richness'));
- The proportion of each species in the total number of individuals observed (that is: the proportion of each species in 'Abundance'; the sum of all proportions for the diverse species is 1.000);
- Habitat guilds, according to Tobias et al. (2022):
    - Functional composition: the proportion of each habitat guild species, either 'Forest', 'Shrubland', 'Woodland', 'Grassland', 'Wetland', 'Riverine', 'Rock', or 'Human modified' according to Tobias et al. (2022), in the total number of individuals of any species.
    - Functional diversity:
        - 'Habitat Richness' is the count of habitats guilds recorded;
        - 'Habitat Shannon Diversity' is the Shannon diversity index computed for all habitat guilds records (usual formula for the index);
        - 'Habitat Shannon Evenness' is the Shannon evenness index computed for all habitat guilds records ('Habitat Shannon Evenness' = 'Habitat Shannon Diversity' / ln ('Habitat Richness')).
- Habitat density, according to Tobias et al. (2022):

  - Functional composition: the proportion of each habitat density species, either 'Closed habitat', 'Semi-open habitats', or 'Open habitats' according to Tobias et al. (2022), in the total number of individuals of any species.
  - Functional diversity:
    - 'Habitat Density Richness' is the count of habitat density recorded;
    - 'Habitat Density Shannon Diversity' is the Shannon diversity index computed for all habitat density records (usual formula for the index);
    - 'Habitat Density Shannon Evenness' is the Shannon evenness index computed for all habitat density records ('Habitat Density Shannon Evenness' = 'Habitat Density Shannon Diversity' / ln ('Habitat Density Richness')).
- Feeding niches, according to Pigot et al. (2020):
  - Functional composition: the proportion of each feeding niche species, either 'Vertivore aerial', ' Vertivore air to surface', 'Invertivore aerial', 'Invertivore sally air', 'Invertivore glean arboreal', 'Invertivore bark', 'Invertivore sally surface', 'Frugivore glean', 'Nectarivore glean', 'Vertivore perch', 'Invertivore sally ground', 'Granivore arboreal', 'Invertivore ground', 'Herbivore ground', 'Granivore ground', 'Scavanger ground', 'Generalist', or 'NA' according to Pigot et al. (2020), in the total number of individuals of any species.
  - Functional diversity:
    - 'Feeding Niche Pigot Richness' is the count of Pigot feeding niches recorded;
    - 'Feeding Niche Pigot Shannon Diversity' is the Shannon diversity index computed for all Pigot feeding niches records (usual formula for the index);
    - 'Feeding Niche Pigot Shannon Evenness' is the Shannon evenness index computed for all Pigot feeding niches records ('Feeding Niche Pigot Shannon Evenness' = 'Feeding Niche Pigot Shannon Diversity' / ln ('Feeding Niche Pigot Richness')).
- Feeding niches, according to FARSYMABI classification:
  - Functional composition: the proportion of each feeding niche species, either 'Vertivore aerial', ' Vertivore air to surface', 'Invertivore aerial', 'Vertivore Generalist', 'Invertivore sally air', 'Invertivore glean canopy', 'Invertivore glean understorey', 'Invertivore glean grass', 'Invertivore bark', 'Invertivore sally surface', 'Invertivore Insessorial Generalist', 'Omnivore Omnivore Insessorial', 'Frugivore glean', 'Nectarivore glean', 'Herbivore Omnivore Insessorial', ' Vertivore perch', 'Invertivore sally ground', 'Granivore arboreal', 'Invertivore Generalist', 'Granivore Generalist', 'Scavenger Ground', 'Carnivore Omnivore Terrestrial', 'Invertivore ground', 'Omnivore Omnivore Terrestrial', 'Herbivore Omnivore Terrestrial', or 'Granivore ground' according to FARSYMABI, in the total number of individuals of any species.
  - Functional diversity:

- 'Feeding Niche FARSYMABI Richness' is the count of FARSYMABI feeding niches recorded;
- 'Feeding Niche FARSYMABI Shannon Diversity' is the Shannon diversity index computed for all FARSYMABI feeding niches records (usual formula for the index);
- 'Feeding Niche FARSYMABI Shannon Evenness' is the Shannon evenness index computed for all FARSYMABI feeding niches records ('Feeding Niche FARSYMABI Shannon Evenness' = 'Feeding Niche FARSYMABI Shannon Diversity' / ln ('Feeding Niche FARSYMABI Richness')).

- Family:
    - Functional composition: the proportion of each family species, either 'Numididae', 'Phasianidae', 'Columbidae', 'Caprimulgidae', 'Apodidae', 'Cuculidae', 'Musophagidae', 'Strigidae', 'Accipitridae', 'Bucerotidae', 'Upupidae', 'Phoeniculidae', 'Meropidae', 'Coraciidae', 'Alcedinidae', 'Lybiidae', 'Indicatoridae', 'Picidae', 'Psittacidae', 'Oriolidae', 'Campephagidae', 'Vangidae', 'Platysteiridae', 'Malaconotidae', 'Dicruridae', 'Monarchidae', 'Laniidae', 'Corvidae', ' Hyliotidae', 'Paridae', 'Alaudidae', 'Macrosphenidae', 'Cisticolidae', 'Hirundinidae', 'Pycnonotidae', 'Zosteropidae', 'Leiotrichidae', 'Sittidae', 'Sturnidae', 'Turdidae', 'Muscicapidae', 'Nectariniidae', 'Ploceidae', 'Estrildidae', 'Viduidae', 'Passeridae', 'Motacillidae', 'Fringillidae', or 'Emberizidae' in the total number of individuals of any species.
    - Functional diversity:
        - 'Family Richness' is the count of families recorded;
        - 'Family Shannon Diversity' is the Shannon diversity index computed for all family records (usual formula for the index);
        - 'Family Shannon Evenness' is the Shannon evenness index computed for all family records ('Family Shannon Evenness' = 'Family Shannon Diversity' / ln ('Family Richness')).
- Range size, according to Tobias et al. (2022):
    - 'Large range' is the proportion of large distribution range size species (species with a distribution range size greater than 15 million km^2), in the total number of individuals of any species.
- Migration, according to Tobias et al. (2022):
    - 'Sedentary' is the proportion of sedentary species in the total number of individuals of any species.
    - 'Partially migratory' is the proportion of partially migratory species in the total number of individuals of any species.
    - 'Migratory' is the proportion of migratory species in the total number of individuals of any species.
- Conservation status, according to IUCN red List (IUCN, 2023):

- 'Proportion Conservation Concern' is the proportion of conservation concern species, classified as 'critically endangered', 'endangered', 'vulnerable', or 'near threatened' by IUCN red List, in the total number of individuals of any species.
  - 'Proportion Threatened' is the proportion of threatened species, classified as 'critically endangered', 'endangered', or 'vulnerable' by IUCN red List, in the total number of individuals of any species.
  - 'Number Conservation Concern' is the count of conservation concern species, classified as 'critically endangered', 'endangered', 'vulnerable', or 'near threatened' by IUCN red List.
  - 'Number Threatened' is the count of threatened species, classified as 'critically endangered', 'endangered', or 'vulnerable' by IUCN red List.
- 'Miombo endemic' is the proportion of miombo endemic species, species that have as habitat the miombo woodland habitat class according to FARSYMABI classification, in the total number of individuals of any species.

Note that in all Shannon Evenness calculations, the index was given a zero value when Richness was equal to 1. This was meant to represent the lowest level of evenness: that when all individuals belong to the same category (species, guild, …).

The average values of all abovementioned variables were computed and compared across these the two communities: Nova Madeira (NM) and Segundo Congresso (SC). The ANOVA p-value and the Squared ETA were computed for each variable to assess whether the resulting differences are significant ($P<0.05$) and to assess the power of each variable to separate points by community when only that variable is used for that separation (size of the Squared ETA). The results of this analysis are in Table I.

The 90% confidence intervals (CI) for the average values of most of these variables (the most significant ones, not all with P<0.05) were also computed across habitats.

The following three habitats were defined and used in the analyses:

- **Forest** (Miombo Woodland);
- **Fallow**;
- **Cropland**.

The three 'Forest', 'Fallow' and 'Cropland' categories were established a priori (based on land cover cartography and satellite images). The classification of each point in these categories was confirmed/amended based on a previous July 2023 visit.

The average values of all abovementioned variables were computed and compared across these 3 habitats. The ANOVA p-value and the Squared ETA were computed for each variable to assess whether the resulting differences are significant ($P<0.05$) and to assess the power of each variable to separate points by habitat type when only that variable is used for that separation (size of the Squared ETA). The results of this analysis are in Table II. The 90% confidence intervals (CI) for the average values of most of these variables (the most significant ones, not all with P<0.05) were also computed across habitats.

These results will be used to select good indicator variables separating well some habitats. For example, in Figure I.A, average 'Species richness' increases from Forest (Miombo Woodland) to Cropland, and thus separates well these two habitats (non-overlapping CIs). Fallows occupy intermediate positions in the average 'Species richness' scale.

Other examples: the species *Oriolus larvatus* is a good indicator of Forest: the CI for its average proportion in this habitat is higher than in any other habitat (Figure I.B). *Pycnonotus barbatus* is a good indicator of Fallows (Figure I.C), and, *Anthus cinnamomeus* is a good indicator of Cropland, with lower average values for both Forest (Miombo Woodland) and Fallows, where the specie has actually not been recorded (Figure I.D).

All species' abundance, diversity and composition variables that passed the ANOVA test (indicated in green in the ANOVA p-value row in Table II), that is: which are good in separating the different habitats, were entered in a Principal Component Analysis (PCA), using the corresponding correlation matrix. A total of 31 variables entered the PCA. The PCA was used to eliminate variable redundancy (that is correlation between the variables) before carrying out a cluster analysis aimed at classifying the count points according to their species' abundance, diversity and composition. The Eigenvalue criterion plus a minimum criterion of retaining at least 50% of the variance in the 31 variables that entered the PCA were used to select the relevant PCs.

The results of the PCA are presented in Table III.A+B. Table III.A presents the 9 selected PCs (the first 9 ones, which have Eigenvalue > 1.000 and retain at least 50% of the variance), and informs that these 9 PCs alone retained 51,5% of all the variance in the 31 variables that entered the PCA. Table III.B presents the interpretation of these PC (using their Varimax-rotated version, which facilitates this interpretation) based on their correlations with the 31 initial variables that entered the PCA. In this table, we can e.g. observe that the PC 1 is a species abundance PC, and that *Euplectes capensis, Uraeginthus angolensis* and *Spermestes cucullata* are species associated with abundance.

The selected 9 PC were then entered in a hierarchical cluster analysis, aimed at classifying the count points according to their species' abundance, diversity and composition. The squared Euclidean distance was used as the distance metric and the Ward method was used as the clustering algorithm.

The resulting dendrogram is presented in Figure II (note that the point codes of points included in each cluster are given in the base of the dendrogram). The 8-cluster solution was selected (represented by the red horizontal line) for further analyses. Other solutions with more clusters (lowering the red line) will possibly reveal more details, but, to keep things simple for this report, we propose the 8 cluster solutions.

The rest of this report is an interpretation of the 8 bird communities of Chipanje Chetu, which correspond to these 8 clusters.

To support this interpretation, the averages of the variables were computed and compared across these 8 clusters. The ANOVA p-value and squared ETA were also computed for each variable (with the same, abovementioned purpose). The results of this analysis are presented in Table IV.

Table V provides a cross table of the 8 clusters with the abovementioned 3 habitats, to study the correspondence between the a-priori established habitats and the 8 bird communities that have been recovered from the cluster analysis of the diversity and species composition of each point based on actual bird records.

Figure III represents the 8 clusters in the map of Nova Madeira (Figure III.A) and Segundo Congresso (Figure III.B).

Table I. Average values of all computed variables by community, with ANOVA p-value and the Squared ETA

Community	N	Abundance	Species richness	Av p-spec abundance	Shannon diversity	Shannon evenness	Numida meleagris	Coturnix coturnix	Coturnix delegorguei	Pternistis afer	Dendroperdix sephaena	Peliperdix coqui	Streptopelia semitorquata	Streptopelia capicola	Turtur chalcospilos	Turtur afer	Treron calvus	Caprimulgus fossii	Cypsiurus parvus	Centropus superciliosus	Pachycoccyx audeberti	Chrysococcyx klaas	Chrysococcyx caprius	Cuculus solitarius	Cuculus clamosus	Cuculus canorus	Gallirex porphyreolophus	Bubo africanus	Elanus caeruleus	Terathopius ecaudatus	Circaetus pectoralis	Circaetus cinereus	Trigonoceps occipitalis	Polemaetus bellicosus	Kaupifalco monogrammicus	Melierax metabates	Accipiter tachiro
NM	90	19,63	11,06	1,70	2,14	0,93	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,06	0,03	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00
SC	84	25,25	12,93	1,90	2,27	0,91	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,06	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,01	0,00	0,00
Total	174	22,34	11,96	1,80	2,20	0,92	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,06	0,03	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00
ANOVA p value		0,042	0,005	0,214	0,054	0,169	0,160	0,302	0,335	0,245	0,302	0,335	0,332	0,464	0,864	0,207	0,300	0,742	0,335	0,244	0,335	0,376	0,302	0,909	0,046	0,148	0,088	0,302	0,302	0,381	0,128	0,814	0,335	0,335	0,053	0,684	0,335
Squared ETA		0,02	0,04	0,01	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,01	0,01	0,00	0,01	0,01	0,01	0,00	0,01	0,00	0,02	0,01	0,02	0,01	0,01	0,00	0,01	0,00	0,01	0,01	0,02	0,00	0,01

Table I. Continuation

Community	N	Accipiter minullus	Bucorvus leadbeateri	Lophoceros pallidirostris	Lophoceros alboterminatus	Upupa epops	Phoeniculus purpureus	Rhinopomastus cyanomelas	Merops apiaster	Merops hirundineus	Merops pusillus	Coracias spatulatus	Coracias caudatus	Eurystomus glaucurus	Halcyon albiventris	Halcyon chelicuti	Halcyon senegalensis	Pogoniulus chrysoconus	Lybius torquatus	Indicator indicator	Campethera abingoni	Dendropicos fuscescens	Dendropicos stierlingi	Dendropicos namaquus	Poicephalus cryptoxanthus	Oriolus larvatus	Oriolus auratus	Ceblepyris pectoralis	Campephaga flava	Prionops plumatus	Prionops retzii	Batis soror	Malaconotus blanchoti	Dryoscopus cubla	Tchagra australis	Tchagra senegalus	Nilaus afer
NM	90	0,00	0,00	0,01	0,00	0,01	0,01	0,00	0,01	0,00	0,03	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,01	0,01	0,00	0,01	0,00	0,00	0,00	0,05	0,01	0,00	0,00	0,00	0,02	0,03	0,00	0,05	0,01	0,04	0,01
SC	84	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,02	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,02	0,00	0,00	0,01	0,00	0,00	0,01	0,04	0,01	0,01	0,00	0,01	0,00	0,04	0,00	0,04	0,00	0,03	0,01
Total	174	0,00	0,00	0,01	0,00	0,01	0,01	0,00	0,01	0,00	0,02	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,02	0,00	0,00	0,01	0,00	0,00	0,01	0,04	0,01	0,00	0,00	0,01	0,01	0,03	0,00	0,04	0,01	0,04	0,01
ANOVA p value		0,069	0,173	0,278	0,315	0,917	0,382	0,170	0,394	0,409	0,054	0,893	0,331	0,122	0,302	0,914	0,143	0,945	0,546	0,037	0,976	0,725	0,302	0,335	0,182	0,073	0,391	0,111	0,363	0,349	0,093	0,112	0,537	0,203	0,402	0,040	0,797
Squared ETA		0,02	0,01	0,01	0,01	0,00	0,00	0,01	0,00	0,00	0,02	0,00	0,01	0,01	0,01	0,00	0,01	0,00	0,00	0,02	0,00	0,00	0,01	0,01	0,01	0,02	0,00	0,01	0,00	0,01	0,02	0,01	0,00	0,01	0,00	0,02	0,00

Table I. Continuation

Community	N	Chlorophoneus sulfureopectus	Laniarius aethiopicus	Dicrurus adsimilis	Terpsiphone viridis	Lanius collaris	Corvus albus	Hyliota flavigaster	Melaniparus pallidiventris	Mirafra africana	Mirafra rufocinnamomea	Sylvietta whytii	Eremomela icteropygialis	Calamonastes stierlingi	Camaroptera brachyura	Cisticola erythrops	Cisticola natalensis	Prinia subflava	Prinia erythroptera	Psalidoprocne pristoptera	Cecropis abyssinica	Hirundo smithii	Hirundo rustica	Pycnonotus barbatus	Zosterops senegalensis	Turdoides jardineii	Salpornis salvadori	Creatophora cinerea	Lamprotornis chloropterus	Lamprotornis chalybaeus	Cinnyricinclus leucogaster	Turdus libonyana	Muscicapa striata	Agricola pallidus	Melaenornis pammelaina	Monticola angolensis	Myrmecocichla arnotti	Oenanthe familiaris	Anthreptes longuemarei
NM	90	0,00	0,07	0,06	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,03	0,00	0,02	0,02	0,00	0,01	0,03	0,00	0,00	0,00	0,00	0,01	0,00	0,04	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00
SC	84	0,00	0,02	0,04	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,00	0,01	0,00	0,02	0,01	0,01	0,01	0,03	0,00	0,00	0,00	0,01	0,00	0,00	0,04	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00
Total	174	0,00	0,05	0,05	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,02	0,00	0,02	0,01	0,01	0,01	0,03	0,00	0,00	0,00	0,00	0,01	0,00	0,04	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00
ANOVA p value		0,231	0,000	0,069	0,360	0,147	0,758	0,302	0,302	0,940	0,132	0,221	0,335	0,000	0,339	0,196	0,335	0,003	0,177	0,817	0,771	0,269	0,744	0,561	0,835	0,151	0,247	0,302	0,065	0,335	0,881	0,496	0,172	0,128	0,335	0,335	0,967	0,140	0,195
Squared ETA		0,01	0,15	0,02	0,00	0,01	0,00	0,01	0,01	0,00	0,01	0,01	0,01	0,11	0,01	0,01	0,01	0,05	0,01	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,01	0,01	0,02	0,01	0,00	0,00	0,01	0,01	0,01	0,01	0,00	0,01	0,01

Table I. Continuation

Community	N	Chalcomitra amethystina	Chalcomitra senegalensis	Cinnyris talatala	Cinnyris venustus	Euplectes capensis	Ploceus ocularis	Anaplectes rubriceps	Lagonosticta rhodopareia	Lagonosticta rubricata	Uraeginthus angolensis	Pyrenestes minor	Estrilda astrild	Spermestes cucullata	Spermestes fringilloides	Vidua macroura	Passer diffusus	Gymnoris superciliaris	Anthus cinnamomeus	Motacilla aguimp	Crithagra mozambica	Crithagra reichardi	Emberiza cabanisi	Emberiza flaviventris	Emberiza tahapisi	Habitat Guild: Functional composition: Forest	Shrubland	Woodland	Grassland	Wetland	Riverine	Rock	Human modified	Habitat Guild: Functional diversity: HabitatGuild_Richness	HabitatGuild_ShannonDiversity	HabitatGuild_ShannonEvenness
NM	90	0,00	0,01	0,00	0,01	0,01	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,00	0,09	0,25	0,54	0,10	0,00	0,00	0,00	0,01	3,30	0,93	0,79
SC	84	0,00	0,03	0,01	0,00	0,07	0,00	0,00	0,01	0,00	0,03	0,00	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,03	0,00	0,01	0,00	0,09	0,27	0,49	0,15	0,00	0,00	0,00	0,01	3,54	0,99	0,81
Total	174	0,00	0,02	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,02	0,00	0,01	0,00	0,09	0,26	0,51	0,12	0,00	0,00	0,00	0,01	3,41	0,96	0,80
ANOVA p value		0,149	0,015	0,006	0,020	0,000	0,519	0,302	0,126	0,104	0,345	0,302	0,889	0,995	0,302	0,172	0,354	0,789	0,695	0,302	0,087	0,297	0,302	0,751	0,302	0,816	0,624	0,085	0,062	0,244	0,302	0,251	0,830	0,078	0,169	0,447
Squared ETA		0,01	0,03	0,04	0,03	0,07	0,00	0,01	0,01	0,02	0,01	0,01	0,00	0,00	0,01	0,01	0,00	0,00	0,00	0,01	0,02	0,01	0,01	0,00	0,01	0,00	0,00	0,02	0,02	0,01	0,01	0,01	0,00	0,02	0,01	0,00

Table I. Continuation

		Habitat density						Feeding niche Pigot																				
		Functional composition			Functional diversity			Functional composition																		Functional diversity		
Community	N	Closed_habitats	Semi_open_habitats	Open_habitats	HabitatDensity_Richness	HabitatDensity_ShannonDiversity	HabitatDensity_ShannonEvenness	Vertivore_aerial	Vertivore_air_to_surface	Invertivore_aerial	Invertivore_sally_air	Invertivore_glean_arboreal	Invertivore_bark	Invertivore_sally_surface	Frugivore_glean	Nectarivore_glean	Vertivore_perch	Invertivore_sally_ground	Granivore_arboreal	Invertivore_ground	Herbivore_ground	Granivore_ground	Scavanger_ground	Generalist	NA	FeedingNichePigot_Richness	FeedingNichePigot_ShannonDiversity	FeedingNichePigot_ShannonEvenness
NM	90	0,01	0,69	0,29	2,18	0,22	0,29	0,00	0,00	0,07	0,04	0,12	0,02	0,03	0,11	0,01	0,01	0,02	0,00	0,07	0,00	0,16	0,00	0,22	0,13	6,51	1,42	0,78
SC	84	0,00	0,64	0,36	2,06	0,24	0,34	0,00	0,00	0,06	0,03	0,12	0,01	0,04	0,12	0,00	0,01	0,02	0,00	0,06	0,00	0,24	0,00	0,14	0,13	6,98	1,46	0,76
Total	174	0,01	0,67	0,32	2,12	0,23	0,31	0,00	0,00	0,06	0,03	0,12	0,02	0,03	0,11	0,00	0,01	0,02	0,00	0,07	0,00	0,20	0,00	0,18	0,13	6,74	1,44	0,77
ANOVA p value		0,011	0,031	0,011	0,063	0,087	0,031	0,069	0,689	0,718	0,505	0,957	0,506	0,112	0,413	0,020	0,378	0,502	0,302	0,341	0,245	0,001	0,335	0,000	0,924	0,084	0,399	0,341
Squared ETA		0,04	0,03	0,04	0,02	0,02	0,03	0,02	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,03	0,00	0,00	0,01	0,01	0,01	0,07	0,01	0,08	0,00	0,02	0,00	0,01

Table I. Continuation

Community	N	Feeding niche FARSYMABI: Functional composition																										Feeding niche FARSYMABI: Functional diversity		
		Vertivore_aerial	Vertivore_air_to_surface	Invertivore_aerial	Vertivore_Generalist	Invertivore_sally_air	Invertivore_glean_canopy	Invertivore_glean_understorey	Invertivore_glean_grass	Invertivore_bark	Invertivore_sally_surface	Invertivore_Insessorial_Generalist	Omnivore_Omnivore_Insessorial	Frugivore_glean	Nectarivore_glean	Herbivore_Omnivore_Insessorial	Vertivore_perch	Invertivore_sally_ground	Granivore_arboreal	Invertivore_Generalist	Granivore_Generalist	Scavenger_Ground	Carnivore_Omnivore_Terrestrial	Invertivore_ground	Omnivore_Omnivore_Terrestrial	Herbivore_Omnivore_Terrestrial	Granivore_ground	FeeedingNicheFarsymabi_Richness	FeeedingNicheFarsymabi_ShannonDivers	FeeedingNicheFarsymabi_ShannonEvenn
NM	90	0,00	0,00	0,07	0,00	0,04	0,10	0,01	0,01	0,02	0,03	0,19	0,08	0,11	0,01	0,03	0,01	0,02	0,00	0,00	0,03	0,00	0,01	0,07	0,00	0,01	0,16	7,40	1,71	0,88
SC	84	0,00	0,01	0,06	0,00	0,03	0,09	0,03	0,01	0,01	0,04	0,09	0,07	0,12	0,01	0,03	0,01	0,02	0,00	0,00	0,04	0,00	0,01	0,06	0,00	0,01	0,24	8,39	1,77	0,85
Total	174	0,00	0,01	0,06	0,00	0,03	0,09	0,02	0,01	0,02	0,03	0,14	0,08	0,11	0,01	0,03	0,01	0,02	0,00	0,00	0,04	0,00	0,01	0,07	0,00	0,01	0,20	7,88	1,74	0,87
ANOVA p value		0,069	0,522	0,718	0,073	0,505	0,526	0,002	0,196	0,506	0,112	0,000	0,540	0,413	0,584	0,720	0,378	0,792	0,302	0,967	0,410	0,335	0,889	0,341	0,335	0,841	0,001	0,005	0,265	0,087
Squared ETA		0,02	0,00	0,00	0,02	0,00	0,00	0,06	0,01	0,00	0,01	0,14	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,01	0,01	0,00	0,07	0,04	0,01	0,02

Table I. Continuation

Community	N	Family: Functional composition																																			
		Numididae	Phasianidae	Columbidae	Caprimulgidae	Apodidae	Cuculidae	Musophagidae	Strigidae	Accipitridae	Bucerotidae	Upupidae	Phoeniculidae	Meropidae	Coracidae	Alcedinidae	Lybiidae	Indicatoridae	Picidae	Psittacidae	Oriolidae	Campephagidae	Vangidae	Platysteiridae	Malaconotidae	Dicruridae	Monarchidae	Laniidae	Corvidae	Hyliotidae	Paridae	Alaudidae	Macrosphenidae	Cisticolidae	Hirundinidae	Pycnonotidae	Zosteropidae	Leiotrichidae	Sittidae
NM	90	0,00	0,00	0,11	0,00	0,00	0,01	0,01	0,00	0,02	0,01	0,01	0,01	0,04	0,02	0,00	0,02	0,01	0,01	0,00	0,06	0,00	0,02	0,03	0,18	0,06	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,05	0,05	0,03	0,00	0,00	0,00
SC	84	0,00	0,00	0,12	0,00	0,00	0,01	0,02	0,00	0,02	0,01	0,01	0,01	0,03	0,01	0,00	0,03	0,00	0,01	0,01	0,04	0,01	0,01	0,04	0,09	0,04	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,04	0,05	0,03	0,00	0,00	0,00
Total	174	0,00	0,00	0,11	0,00	0,00	0,01	0,02	0,00	0,02	0,01	0,01	0,01	0,03	0,02	0,00	0,03	0,00	0,01	0,01	0,05	0,01	0,02	0,03	0,14	0,05	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,05	0,05	0,03	0,00	0,00	0,00
ANOVA p value		0,160	0,429	0,427	0,742	0,335	0,455	0,088	0,302	0,938	0,372	0,917	0,692	0,545	0,456	0,387	0,655	0,037	0,924	0,182	0,044	0,076	0,440	0,112	0,000	0,069	0,360	0,147	0,758	0,302	0,302	0,215	0,221	0,304	0,860	0,561	0,835	0,151	0,247
Squared ETA		0,01	0,00	0,00	0,00	0,01	0,00	0,02	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,02	0,02	0,00	0,01	0,11	0,02	0,00	0,01	0,00	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,00	0,01	0,01

Table I. Continuation

													Functional diversity			Range Size	Migration			Conservation status				
Community	N	Sturnidae	Turdidae	Muscicapidae	Nectariniidae	Ploceidae	Estrildidae	Viduidae	Passeridae	Motacillidae	Fringillidae	Emberizidae	Family_Richness	Family_ShannonDiversity	Family_ShannonEvenness	Large range	Sedentary	Partially_migratory	Migratory	Proportion_ConservationConcern	Proportion_Threatened	Number_ConservationConcern	Number_Threatened	Miombo endemic
NM	90	0,05	0,00	0,02	0,03	0,01	0,06	0,00	0,00	0,00	0,02	0,01	8,72	1,86	0,89	0,06	0,87	0,06	0,07	0,01	0,01	0,09	0,09	0,07
SC	84	0,05	0,00	0,01	0,04	0,07	0,08	0,00	0,01	0,00	0,04	0,01	10,26	2,03	0,89	0,07	0,83	0,09	0,08	0,01	0,01	0,11	0,10	0,06
Total	174	0,05	0,00	0,01	0,03	0,04	0,07	0,00	0,01	0,00	0,03	0,01	9,47	1,95	0,89	0,07	0,85	0,08	0,07	0,01	0,01	0,10	0,09	0,07
ANOVA p value		0,738	0,496	0,038	0,139	0,000	0,483	0,172	0,708	0,482	0,068	0,948	0,002	0,006	0,973	0,594	0,083	0,080	0,472	0,805	0,992	0,705	0,886	0,524
Squared ETA		0,00	0,00	0,02	0,01	0,07	0,00	0,01	0,00	0,00	0,02	0,00	0,05	0,04	0,00	0,00	0,02	0,02	0,00	0,00	0,00	0,00	0,00	0,00

Table II. Average values of all computed variables by habitat, with ANOVA p-value and the Squared ETA

Habitat	N	Abundance	Species richness	Av p-spec abundance	Shannon diversity	Shannon evenness	Numida meleagris	Coturnix coturnix	Coturnix delegorguei	Pternistis afer	Dendroperdix sephaena	Peliperdix coqui	Streptopelia semitorquata	Streptopelia capicola	Turtur chalcospilos	Turtur afer	Treron calvus	Caprimulgus fossii	Cypsiurus parvus	Centropus superciliosus	Pachycoccyx audeberti	Chrysococcyx klaas	Chrysococcyx caprius	Cuculus solitarius	Cuculus clamosus	Cuculus canorus	Gallirex porphyreolophus	Bubo africanus	Elanus caeruleus	Terathopius ecaudatus	Circaetus pectoralis	Circaetus cinereus	Trigonoceps occipitalis	Polemaetus bellicosus	Kaupifalco monogrammicus	Melierax metabates	Accipiter tachiro	Accipiter minullus
01_Forest	62	16,16	10,84	1,47	2,18	0,95	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,06	0,05	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00
02_Fallow	56	21,82	11,82	1,78	2,19	0,92	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,06	0,02	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
03_Cropland	56	29,71	13,34	2,18	2,25	0,89	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,06	0,02	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00
Total	174	22,34	11,96	1,80	2,20	0,92	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,06	0,03	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00
ANOVA p value		0,000	0,008	0,001	0,660	0,000	0,244	0,351	0,351	0,401	0,351	0,408	0,043	0,872	0,000	0,450	0,745	0,601	0,351	0,349	0,351	0,941	0,351	0,292	0,587	0,170	0,140	0,408	0,351	0,094	0,814	0,439	0,408	0,408	0,342	0,604	0,408	0,023
Squared ETA		0,09	0,05	0,07	0,00	0,09	0,02	0,01	0,01	0,01	0,01	0,01	0,04	0,00	0,10	0,01	0,00	0,01	0,01	0,01	0,01	0,00	0,01	0,01	0,01	0,02	0,02	0,01	0,01	0,03	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,04

Table II. Continuation

Habitat	N	Bucorvus leadbeateri	Lophoceros pallidirostris	Lophoceros alboterminatus	Upupa epops	Phoeniculus purpureus	Rhinopomastus cyanomelas	Merops apiaster	Merops hirundineus	Merops pusillus	Coracias spatulatus	Coracias caudatus	Eurystomus glaucurus	Halcyon albiventris	Halcyon chelicuti	Halcyon senegalensis	Pogoniulus chrysoconus	Lybius torquatus	Indicator indicator	Campethera abingoni	Dendropicos fuscescens	Dendropicos stierlingi	Dendropicos namaquus	Poicephalus cryptoxanthus	Oriolus larvatus	Oriolus auratus	Ceblepyris pectoralis	Campephaga flava	Prionops plumatus	Prionops retzii	Batis soror	Malaconotus blanchoti	Dryoscopus cubla	Tchagra australis	Tchagra senegalus	Nilaus afer	Chlorophoneus sulfureopectus	Laniarius aethiopicus
01_Forest	62	0,00	0,02	0,00	0,01	0,01	0,00	0,02	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,01	0,00	0,01	0,01	0,00	0,00	0,01	0,07	0,02	0,01	0,00	0,02	0,02	0,06	0,00	0,05	0,00	0,03	0,00	0,00	0,03
02_Fallow	56	0,00	0,00	0,00	0,01	0,00	0,00	0,02	0,00	0,02	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,05	0,01	0,05	0,00	0,00	0,08
03_Cropland	56	0,00	0,01	0,00	0,01	0,01	0,00	0,01	0,00	0,03	0,00	0,01	0,01	0,00	0,00	0,00	0,01	0,01	0,01	0,00	0,01	0,00	0,00	0,01	0,03	0,01	0,00	0,00	0,00	0,01	0,01	0,00	0,03	0,00	0,03	0,01	0,00	0,03
Total	174	0,00	0,01	0,00	0,01	0,01	0,00	0,01	0,00	0,02	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,02	0,00	0,00	0,01	0,00	0,00	0,01	0,04	0,01	0,00	0,00	0,01	0,01	0,03	0,00	0,04	0,01	0,04	0,01	0,00	0,05
ANOVA p value		0,571	0,002	0,889	0,447	0,273	0,524	0,611	0,246	0,433	0,596	0,036	0,179	0,351	0,218	0,576	0,493	0,463	0,056	0,149	0,048	0,408	0,408	0,164	0,000	0,044	0,198	0,766	0,026	0,102	0,000	0,296	0,061	0,000	0,095	0,026	0,810	0,000
Squared ETA		0,01	0,07	0,00	0,01	0,02	0,01	0,01	0,02	0,01	0,01	0,04	0,02	0,01	0,02	0,01	0,01	0,01	0,03	0,02	0,03	0,01	0,01	0,02	0,10	0,04	0,02	0,00	0,04	0,03	0,16	0,01	0,03	0,09	0,03	0,04	0,00	0,12

Table II. Continuation

Habitat	N	Dicrurus adsimilis	Terpsiphone viridis	Lanius collaris	Corvus albus	Hyliota flavigaster	Melaniparus pallidiventris	Mirafra africana	Mirafra rufocinnamomea	Sylvietta whytii	Eremomela icteropygialis	Calamonastes stierlingi	Camaroptera brachyura	Cisticola erythrops	Cisticola natalensis	Prinia subflava	Prinia erythroptera	Psalidoprocne pristoptera	Cecropis abyssinica	Hirundo smithii	Hirundo rustica	Pycnonotus barbatus	Zosterops senegalensis	Turdoides jardineii	Salpornis salvadori	Creatophora cinerea	Lamprotornis chloropterus	Lamprotornis chalybaeus	Cinnyricinclus leucogaster	Turdus libonyana	Muscicapa striata	Agricola pallidus	Melaenornis pammelaina	Monticola angolensis	Myrmecocichla arnotti	Oenanthe familiaris	Anthreptes longuemarei	Chalcomitra amethystina
01_Forest	62	0,06	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,00	0,00	0,02	0,01	0,00	0,00	0,00	0,01	0,00	0,04	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00
02_Fallow	56	0,04	0,01	0,00	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,04	0,00	0,01	0,01	0,00	0,01	0,05	0,00	0,00	0,00	0,00	0,01	0,00	0,05	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00
03_Cropland	56	0,06	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,02	0,00	0,04	0,02	0,02	0,02	0,02	0,00	0,00	0,00	0,01	0,01	0,00	0,03	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,00
Total	174	0,05	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,02	0,00	0,02	0,01	0,01	0,01	0,03	0,00	0,00	0,00	0,00	0,01	0,00	0,04	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00
ANOVA p value		0,452	0,376	0,125	0,010	0,408	0,408	0,208	0,209	0,229	0,351	0,000	0,332	0,009	0,351	0,000	0,560	0,000	0,344	0,021	0,358	0,004	0,076	0,615	0,503	0,351	0,578	0,351	0,558	0,065	0,120	0,586	0,351	0,351	0,008	0,413	0,045	0,770
Squared ETA		0,01	0,01	0,02	0,05	0,01	0,01	0,02	0,02	0,02	0,01	0,14	0,01	0,05	0,01	0,13	0,01	0,09	0,01	0,04	0,01	0,06	0,03	0,01	0,01	0,01	0,01	0,01	0,01	0,03	0,02	0,01	0,01	0,01	0,06	0,01	0,04	0,00

Table II. Continuation

Habitat	N	Chalcomitra senegalensis	Cinnyris talatala	Cinnyris venustus	Euplectes capensis	Ploceus ocularis	Anaplectes rubriceps	Lagonosticta rhodopareia	Lagonosticta rubricata	Uraeginthus angolensis	Pyrenestes minor	Estrilda astrild	Spermestes cucullata	Spermestes fringilloides	Vidua macroura	Passer diffusus	Gymnoris superciliaris	Anthus cinnamomeus	Motacilla aguimp	Crithagra mozambica	Crithagra reichardi	Emberiza cabanisi	Emberiza flaviventris	Emberiza tahapisi
01_Forest	62	0,02	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,04	0,00	0,00	0,00
02_Fallow	56	0,02	0,00	0,00	0,04	0,00	0,00	0,01	0,00	0,03	0,00	0,02	0,02	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,01	0,00	0,01	0,00
03_Cropland	56	0,01	0,00	0,00	0,07	0,00	0,00	0,01	0,00	0,03	0,00	0,02	0,06	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,02	0,00	0,01	0,00
Total	174	0,02	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,02	0,00	0,01	0,00
ANOVA p value		0,132	0,273	0,978	0,006	0,298	0,351	0,288	0,353	0,036	0,408	0,417	0,012	0,351	0,574	0,326	0,612	0,020	0,351	0,638	0,008	0,408	0,095	0,408
Squared ETA		0,02	0,02	0,00	0,06	0,01	0,01	0,01	0,01	0,04	0,01	0,01	0,05	0,01	0,01	0,01	0,01	0,04	0,01	0,01	0,06	0,01	0,03	0,01

		Habitat Guild										
		Functional composition								Functional diversity		
Habitat	N	Forest	Shrubland	Woodland	Grassland	Wetland	Riverine	Rock	Human modified	HabitatGuild_Richness	HabitatGuild_ShannonDiversity	HabitatGuild_ShannonEvenness
01_Forest	62	0,07	0,24	0,62	0,06	0,00	0,00	0,01	0,00	3,05	0,83	0,75
02_Fallow	56	0,09	0,30	0,47	0,13	0,01	0,00	0,00	0,01	3,57	1,00	0,81
03_Cropland	56	0,11	0,25	0,44	0,18	0,00	0,00	0,00	0,02	3,66	1,07	0,83
Total	174	0,09	0,26	0,51	0,12	0,00	0,00	0,00	0,01	3,41	0,96	0,80
ANOVA p value		0,190	0,080	0,000	0,000	0,349	0,351	0,329	0,374	0,000	0,000	0,016
Squared ETA		0,02	0,03	0,16	0,12	0,01	0,01	0,01	0,01	0,10	0,14	0,05

Table II. Continuation

		Habitat density						Feeding niche Pigot																				
		Functional composition			Functional diversity			Functional composition																		Functional diversity		
Habitat	N	Closed_habitats	Semi_open_habitats	Open_habitats	HabitatDensity_Richness	HabitatDensity_ShannonDiversity	HabitatDensity_ShannonEvenness	Vertivore_aerial	Vertivore_air_to_surface	Invertivore_aerial	Invertivore_sally_air	Invertivore_glean_arboreal	Invertivore_bark	Invertivore_sally_surface	Frugivore_glean	Nectarivore_glean	Vertivore_perch	Invertivore_sally_ground	Granivore_arboreal	Invertivore_ground	Herbivore_ground	Granivore_ground	Scavanger_ground	Generalist	NA	FeedingNichePigot_Richness	FeedingNichePigot_ShannonDiversity	FeedingNichePigot_ShannonEvenness
01_Forest	62	0,01	0,76	0,24	1,97	0,20	0,28	0,00	0,00	0,04	0,03	0,16	0,03	0,06	0,11	0,01	0,01	0,02	0,00	0,06	0,00	0,14	0,00	0,17	0,16	6,56	1,47	0,81
02_Fallow	56	0,01	0,64	0,35	2,23	0,23	0,31	0,00	0,00	0,04	0,04	0,11	0,00	0,02	0,15	0,00	0,00	0,01	0,00	0,09	0,00	0,20	0,00	0,21	0,11	6,43	1,40	0,77
03_Cropland	56	0,01	0,59	0,40	2,18	0,26	0,35	0,00	0,00	0,11	0,04	0,09	0,01	0,01	0,09	0,00	0,01	0,02	0,00	0,06	0,00	0,26	0,00	0,17	0,11	7,23	1,43	0,73
Total	174	0,01	0,67	0,32	2,12	0,23	0,31	0,00	0,00	0,06	0,03	0,12	0,02	0,03	0,11	0,00	0,01	0,02	0,00	0,07	0,00	0,20	0,00	0,18	0,13	6,74	1,44	0,77
ANOVA p value		0,273	0,000	0,000	0,001	0,002	0,012	0,023	0,588	0,000	0,871	0,002	0,004	0,000	0,034	0,978	0,485	0,451	0,351	0,124	0,401	0,000	0,408	0,237	0,015	0,035	0,463	0,002
Squared ETA		0,02	0,16	0,14	0,08	0,07	0,05	0,04	0,01	0,11	0,00	0,07	0,06	0,16	0,04	0,00	0,01	0,01	0,01	0,02	0,01	0,09	0,01	0,02	0,05	0,04	0,01	0,07

Table II. Continuation

		Feeding niche FARSYMABI																												
		Functional composition																										Functional diversity		
Habitat	N	Vertivore_aerial	Vertivore_air_to_surface	Invertivore_aerial	Vertivore_Generalist	Invertivore_sally_air	Invertivore_glean_canopy	Invertivore_glean_understorey	Invertivore_glean_grass	Invertivore_bark	Invertivore_sally_surface	Invertivore_Insessorial_Generalist	Omnivore_Omnivore_Insessorial	Frugivore_glean	Nectarivore_glean	Herbivore_Omnivore_Insessorial	Vertivore_perch	Invertivore_sally_ground	Granivore_arboreal	Invertivore_Generalist	Granivore_Generalist	Scavenger_Ground	Carnivore_Omnivore_Terrestrial	Invertivore_ground	Omnivore_Omnivore_Terrestrial	Herbivore_Omnivore_Terrestrial	Granivore_ground	FeeedingNicheFarsymabi_Richness	FeeedingNicheFarsymabi_ShannonDiversity	FeeedingNicheFarsymabi_ShannonEvenness
01_Forest	62	0,00	0,01	0,04	0,00	0,03	0,12	0,03	0,00	0,03	0,06	0,12	0,12	0,11	0,01	0,03	0,01	0,02	0,00	0,00	0,04	0,00	0,00	0,06	0,00	0,00	0,14	7,73	1,82	0,92
02_Fallow	56	0,00	0,00	0,04	0,00	0,04	0,08	0,01	0,02	0,00	0,02	0,18	0,06	0,15	0,01	0,02	0,00	0,01	0,00	0,00	0,03	0,00	0,02	0,09	0,00	0,01	0,20	7,36	1,66	0,86
03_Cropland	56	0,00	0,01	0,11	0,00	0,04	0,07	0,01	0,01	0,01	0,01	0,12	0,05	0,09	0,01	0,03	0,01	0,03	0,00	0,01	0,04	0,00	0,01	0,06	0,00	0,01	0,26	8,57	1,73	0,82
Total	174	0,00	0,01	0,06	0,00	0,03	0,09	0,02	0,01	0,02	0,03	0,14	0,08	0,11	0,01	0,03	0,01	0,02	0,00	0,00	0,04	0,00	0,01	0,07	0,00	0,01	0,20	7,88	1,74	0,87
ANOVA p value		0,023	0,057	0,000	0,530	0,871	0,002	0,002	0,009	0,004	0,000	0,022	0,000	0,034	0,582	0,555	0,485	0,248	0,351	0,008	0,590	0,408	0,008	0,124	0,351	0,145	0,000	0,020	0,058	0,000
Squared ETA		0,04	0,03	0,11	0,01	0,00	0,07	0,07	0,05	0,06	0,16	0,04	0,14	0,04	0,01	0,01	0,01	0,02	0,01	0,06	0,01	0,01	0,06	0,02	0,01	0,02	0,09	0,04	0,03	0,13

Table II. Continuation

		Family																																				
		Functional composition																																				
Habitat	N	Numididae	Phasianidae	Columbidae	Caprimulgidae	Apodidae	Cuculidae	Musophagidae	Strigidae	Accipitridae	Bucerotidae	Upupidae	Phoeniculidae	Meropidae	Coraciidae	Alcedinidae	Lybiidae	Indicatoridae	Picidae	Psittacidae	Oriolidae	Campephagidae	Vangidae	Platysteiridae	Malaconotidae	Dicruridae	Monarchidae	Laniidae	Corvidae	Hylotidae	Paridae	Alaudidae	Macrosphenidae	Cisticolidae	Hirundinidae	Pycnonotidae	Zosteropidae	Leiotrichidae
01_Forest	62	0,00	0,00	0,12	0,00	0,00	0,01	0,02	0,01	0,02	0,02	0,01	0,01	0,03	0,02	0,00	0,02	0,00	0,02	0,01	0,09	0,01	0,04	0,06	0,12	0,06	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,03	0,02	0,01	0,00
02_Fallow	56	0,00	0,01	0,11	0,00	0,00	0,02	0,01	0,00	0,01	0,00	0,01	0,00	0,04	0,01	0,00	0,03	0,00	0,00	0,00	0,03	0,01	0,00	0,02	0,20	0,04	0,01	0,00	0,02	0,00	0,00	0,00	0,00	0,07	0,03	0,05	0,00	0,00
03_Cropland	56	0,00	0,00	0,09	0,00	0,00	0,01	0,01	0,00	0,03	0,01	0,01	0,01	0,04	0,02	0,00	0,02	0,01	0,01	0,01	0,04	0,00	0,01	0,01	0,10	0,06	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,05	0,10	0,02	0,00	0,00
Total	174	0,00	0,00	0,11	0,00	0,00	0,01	0,02	0,00	0,02	0,01	0,01	0,01	0,03	0,02	0,00	0,03	0,00	0,01	0,01	0,05	0,01	0,02	0,03	0,14	0,05	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,05	0,05	0,03	0,00	0,00
ANOVA p value		0,244	0,344	0,095	0,601	0,351	0,228	0,140	0,408	0,019	0,009	0,447	0,169	0,889	0,026	0,619	0,387	0,056	0,002	0,164	0,000	0,237	0,014	0,000	0,000	0,452	0,376	0,125	0,010	0,408	0,408	0,092	0,229	0,008	0,000	0,004	0,076	0,615
Squared ETA		0,02	0,01	0,03	0,01	0,01	0,02	0,02	0,01	0,05	0,05	0,01	0,02	0,00	0,04	0,01	0,01	0,03	0,07	0,02	0,13	0,02	0,05	0,16	0,12	0,01	0,01	0,02	0,05	0,01	0,01	0,03	0,02	0,06	0,12	0,06	0,03	0,01

Table II. Continuation

														Functional diversity			Range Size	Migration			Conservation status				
Habitat	N	Sittidae	Sturnidae	Turdidae	Muscicapidae	Nectariniidae	Ploceidae	Estrildidae	Viduidae	Passeridae	Motacillidae	Fringillidae	Emberizidae	Family_Richness	Family_ShannonDiversity	Family_ShannonEvenness	Large range	Sedentary	Partially_migratory	Migratory	Proportion_ConservationConcern	Proportion_Threatened	Number_ConservationConcern	Number_Threatened	Miombo endemic
01_Forest	62	0,00	0,05	0,01	0,01	0,04	0,00	0,02	0,00	0,00	0,00	0,04	0,00	8,85	1,96	0,92	0,04	0,88	0,05	0,07	0,01	0,01	0,13	0,11	0,106
02_Fallow	56	0,00	0,05	0,00	0,01	0,03	0,04	0,07	0,00	0,01	0,00	0,02	0,01	8,86	1,86	0,89	0,10	0,84	0,08	0,09	0,00	0,00	0,02	0,02	0,038
03_Cropland	56	0,00	0,05	0,00	0,02	0,02	0,07	0,13	0,00	0,01	0,01	0,03	0,01	10,75	2,01	0,86	0,07	0,83	0,10	0,07	0,01	0,01	0,14	0,14	0,054
Total	174	0,00	0,05	0,00	0,01	0,03	0,04	0,07	0,00	0,01	0,00	0,03	0,01	9,47	1,95	0,89	0,07	0,85	0,08	0,07	0,01	0,01	0,10	0,09	0,067
ANOVA p value		0,503	0,940	0,065	0,390	0,058	0,005	0,000	0,574	0,556	0,040	0,053	0,187	0,002	0,157	0,032	0,004	0,124	0,009	0,607	0,064	0,069	0,070	0,057	0,000
Squared ETA		0,01	0,00	0,03	0,01	0,03	0,06	0,09	0,01	0,01	0,04	0,03	0,02	0,07	0,02	0,04	0,06	0,02	0,05	0,01	0,03	0,03	0,03	0,03	0,14

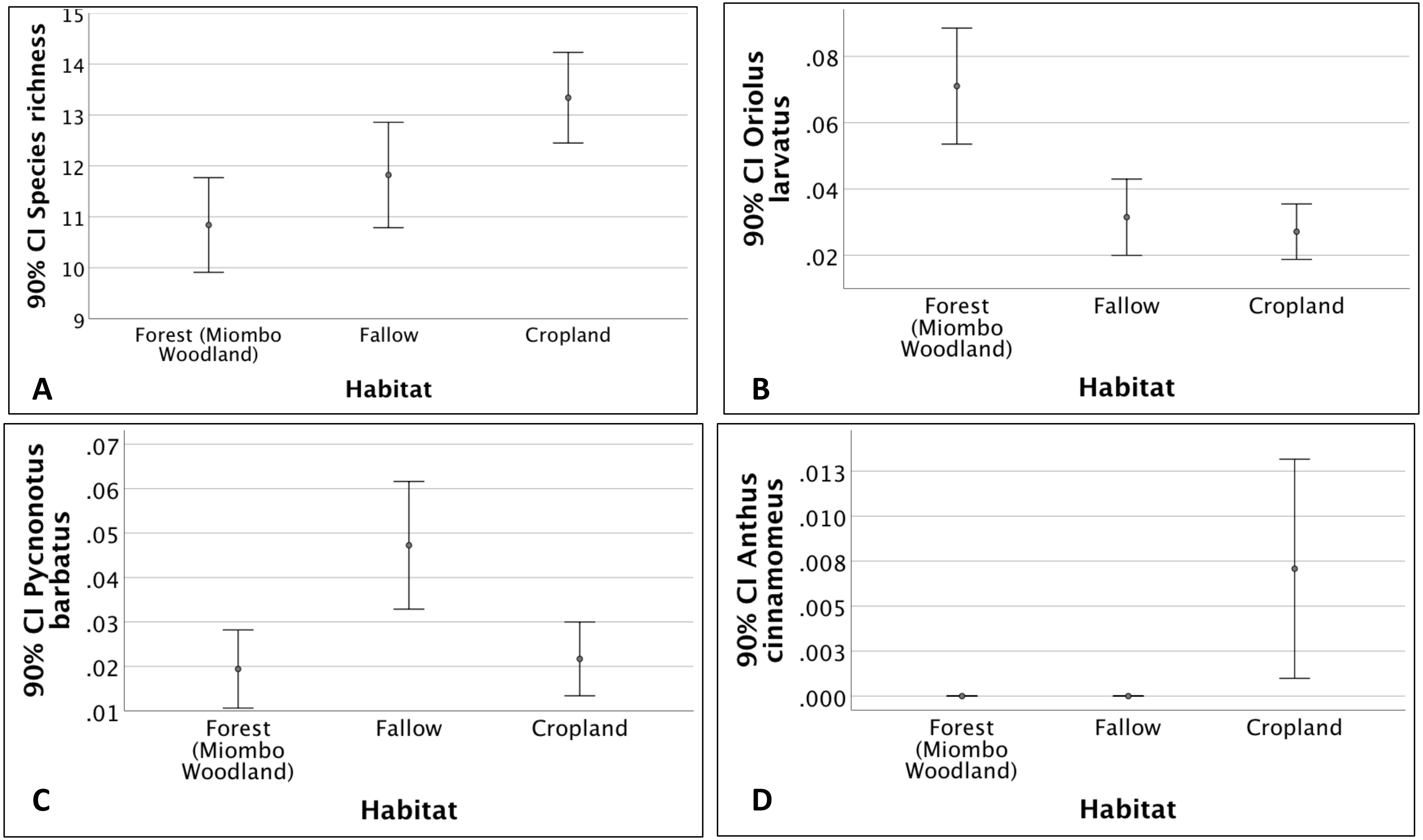

Figure I. Confidence Intervals (90%) per habitat of **A.** Species richness, **B.** Proportion of *Oriolus larvatus,* **C***.* Proportion of *Pycnonotus barbatus,* and **D***.* Proportion of *Anthus cinnamomeus*

Table III.A. Total explained variance by each non-rotated PC and PCs with eigenvalue > 1.000

Total Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,95	12,736	12,736	3,95	12,736	12,736
2	2,15	6,939	19,675	2,15	6,939	19,675
3	1,74	5,619	25,295	1,74	5,619	25,295
4	1,59	5,131	30,426	1,59	5,131	30,426
5	1,45	4,688	35,114	1,45	4,688	35,114
6	1,32	4,27	39,384	1,32	4,27	39,384
7	1,29	4,154	43,538	1,29	4,154	43,538
8	1,24	4,011	47,549	1,24	4,011	47,549
9	1,22	3,921	51,47	1,22	3,921	51,47
10	1,17	3,763	55,233	1,17	3,763	55,233
11	1,13	3,657	58,89	1,13	3,657	58,89
12	1,06	3,423	62,314	1,06	3,423	62,314
13	1,02	3,298	65,612	1,02	3,298	65,612
14	1	3,209	68,821			
15	0,97	3,141	71,962			
16	0,9	2,908	74,869			
17	0,88	2,825	77,695			
18	0,82	2,64	80,335			
19	0,73	2,354	82,689			
20	0,7	2,243	84,932			
21	0,66	2,125	87,057			
22	0,65	2,084	89,141			
23	0,59	1,905	91,046			
24	0,59	1,895	92,941			
25	0,55	1,781	94,723			
26	0,42	1,369	96,092			
27	0,41	1,336	97,428			
28	0,37	1,181	98,609			
29	0,28	0,89	99,498			
30	0,14	0,451	99,949			
31	0,02	0,051	100			

Extraction Method: Principal Component Analysis

Table III.B. Interpretation of each rotated PC (only PC with eigenvalue > 1.000 that retain at least 50% of the variance) based on the 31 variables that entered the analysis

Component Matrix	Component								
Variables	1	2	3	4	5	6	7	8	9
Abundance	0,931								
Species richness	0,447	0,186	0,551			0,283			
Av p-spec abundance	0,902		-0,19	-0,105					
Shannon evenness	-0,886		0,214						
Streptopelia semitorquata	-0,122	-0,136	-0,141	0,142	0,279		-0,241	-0,237	0,323
Turtur chalcospilos	-0,309	0,365	-0,252	-0,248	-0,226	0,196	-0,27		0,228
Accipiter minullus			0,484	-0,258	-0,225	-0,3		-0,132	0,243
Lophoceros pallidirostris	-0,179	0,353	-0,226	0,117	-0,332	0,225	-0,157		0,216
Coracias caudatus			0,284	0,548	0,172	-0,235	-0,279	-0,127	
Dendropicos fuscescens	-0,122	0,27		0,123				-0,237	-0,164
Oriolus larvatus	-0,308		-0,348			-0,496	0,195		0,185
Oriolus auratus		0,124	0,249	-0,245			0,202	-0,325	-0,327
Prionops plumatus		0,125	0,194	0,148	0,382		-0,365	-0,107	
Batis soror	-0,284	0,342		-0,17	0,339			0,311	-0,367
Tchagra australis	-0,108	-0,321	0,208		0,225	0,332	-0,14	0,206	0,376
Nilaus afer			0,5	-0,347	-0,189	-0,281	0,218	-0,239	0,304
Laniarius aethiopicus	-0,25	-0,658	-0,241		-0,107			-0,128	
Corvus albus		-0,363			0,315	-0,211	0,339	0,338	0,164
Calamonastes stierlingi	-0,219	0,416	0,167	-0,136	0,318		-0,209	0,17	-0,232
Cisticola erythrops		-0,355	0,183	-0,264	-0,146	-0,203		0,18	-0,24
Prinia subflava	-0,117	-0,519			-0,301	0,297			-0,153
Psalidoprocne pristoptera		0,139	0,255	0,474	-0,437	0,166	0,206	0,231	
Hirundo smithii	0,176					0,338	0,359		
Pycnonotus barbatus		-0,357	0,266		0,313	0,238	0,258		0,11
Myrmecocichla arnotti			0,201	0,617		-0,208			-0,102
Anthreptes longuemarei		0,206		-0,187					
Euplectes capensis	0,71		-0,111	-0,129		-0,149	-0,168	0,209	
Uraeginthus angolensis	0,258	-0,175		-0,106	-0,302	-0,236	-0,297	0,192	-0,119
Spermestes cucullata	0,405		-0,189			0,179	0,335	-0,421	
Anthus cinnamomeus				0,271	-0,189		0,137		-0,299
Crithagra reichardi	-0,121	0,36	-0,15				0,288	0,479	0,316

Extraction Method: Principal Component Analysis,

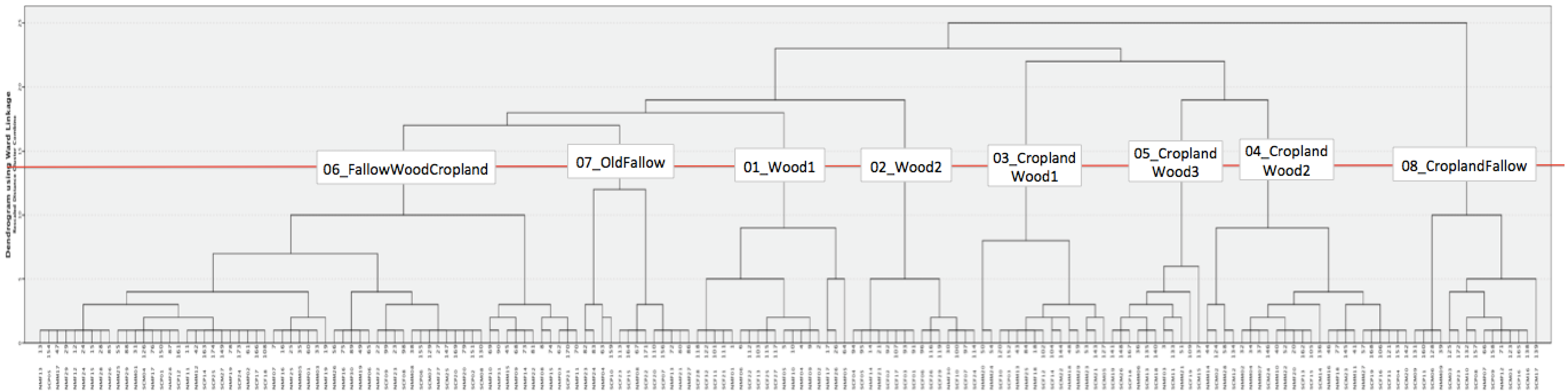

Figure II. Dendrogram of the cluster analysis of species abundance, diversity and composition of each point

Table IV. Average values of all computed variables by cluster, with ANOVA p-value and the Squared ETA

CLUSTER	N	Abundance	Species richness	Av p-spec abundance	Shannon diversity	Shannon evenness	# SPECIES	Numida meleagris	Coturnix coturnix	Coturnix delegorguei	Pternistis afer	Dendroperdix sephaena	Peliperdix coqui	Streptopelia semitorquata	Streptopelia capicola	Turtur chalcospilos
01_Wood1	18	12,67	8,83	1,44	2,00	0,96	41	0,00	0,00	0,00	0,00	0,00	0,01	0,02	0,08	0,09
02_Wood2	15	14,40	10,20	1,39	2,14	0,96	43	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,06	0,04
03_CroplandWood1	15	22,87	14,53	1,56	2,51	0,95	66	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,07	0,02
04_CroplandWood2	24	25,92	14,38	1,78	2,43	0,93	82	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,05	0,02
05_CroplandWood3	11	25,55	14,91	1,77	2,40	0,89	62	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,05	0,01
06_FallowWoodCropland	63	16,90	10,79	1,54	2,18	0,95	96	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,07	0,03
07_OldFallow	13	15,62	11,77	1,34	2,32	0,97	45	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,07	0,03
08_CroplandFallow	15	62,00	13,93	4,40	1,71	0,66	61	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,01
Total	174	22,34	11,96	1,80	2,20	0,92	129	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,06	0,03
ANOVA p value		0,000	0,000	0,000	0,000	0,000	-	0,927	0,973	0,973	0,978	0,973	0,278	0,238	0,186	0,000
Squared ETA		0,51	0,21	0,56	0,24	0,73	-	0,01	0,01	0,01	0,01	0,01	0,05	0,05	0,06	0,26

CLUSTER	Turtur afer	Treron calvus	Caprimulgus fossii	Cypsiurus parvus	Centropus superciliosus	Pachycoccyx audeberti	Chrysococcyx klaas	Chrysococcyx caprius	Cuculus solitarius	Cuculus clamosus	Cuculus canorus	Gallirex porphyreolophus	Bubo africanus	Elanus caeruleus	Terathopius ecaudatus	Circaetus pectoralis	Circaetus cinereus	Trigonoceps occipitalis	Polemaetus bellicosus	Kaupifalco monogrammicus	Melierax metabates	Accipiter tachiro
01_Wood1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,02	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,00
02_Wood2	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,01	0,00	0,01
03_CroplandWood1	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00
04_CroplandWood2	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,00	0,01	0,01	0,00	0,00	0,00	0,00	0,00
05_CroplandWood3	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,01	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,00
06_FallowWoodCropland	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00
07_OldFallow	0,00	0,01	0,00	0,01	0,01	0,00	0,00	0,00	0,02	0,02	0,00	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00
08_CroplandFallow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00
ANOVA p value	0,970	0,839	0,862	0,085	0,548	0,517	0,317	0,517	0,183	0,000	0,169	0,622	0,278	0,035	0,656	0,868	0,867	0,973	0,973	0,249	0,410	0,155
Squared ETA	0,01	0,02	0,02	0,07	0,03	0,04	0,05	0,04	0,06	0,15	0,06	0,03	0,05	0,09	0,03	0,02	0,02	0,01	0,01	0,05	0,04	0,06

Table IV. Continuation

CLUSTER	N	Accipiter minullus	Bucorvus leadbeateri	Lophoceros pallidirostris	Lophoceros alboterminatus	Upupa epops	Phoeniculus purpureus	Rhinopomastus cyanomelas	Merops apiaster	Merops hirundineus	Merops pusillus	Coracias spatulatus	Coracias caudatus	Eurystomus glaucurus	Halcyon albiventris	Halcyon chelicuti	Halcyon senegalensis	Pogoniulus chrysoconus	Lybius torquatus	Indicator indicator
01_Wood1	18	0,00	0,00	0,04	0,00	0,02	0,01	0,00	0,00	0,00	0,02	0,00	0,00	0,03	0,00	0,01	0,00	0,02	0,01	0,01
02_Wood2	15	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,05	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,01	0,00
03_CroplandWood1	15	0,01	0,00	0,00	0,00	0,00	0,01	0,00	0,02	0,00	0,04	0,01	0,00	0,02	0,00	0,00	0,00	0,02	0,01	0,01
04_CroplandWood2	24	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,00
05_CroplandWood3	11	0,00	0,00	0,00	0,00	0,01	0,01	0,00	0,01	0,00	0,01	0,02	0,05	0,01	0,00	0,00	0,00	0,00	0,02	0,01
06_FallowWoodCropland	63	0,00	0,00	0,00	0,00	0,01	0,01	0,00	0,02	0,00	0,02	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,02	0,00
07_OldFallow	13	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00
08_CroplandFallow	15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00
Total	174	0,00	0,00	0,01	0,00	0,01	0,01	0,00	0,01	0,00	0,02	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,02	0,00
ANOVA p value		0,000	0,740	0,000	0,596	0,202	0,722	0,431	0,483	0,898	0,438	0,002	0,000	0,043	0,035	0,212	0,378	0,237	0,650	0,619
Squared ETA		0,15	0,03	0,31	0,03	0,06	0,03	0,04	0,04	0,02	0,04	0,12	0,55	0,08	0,09	0,06	0,04	0,05	0,03	0,03

CLUSTER	N	Campethera abingoni	Dendropicos fuscescens	Dendropicos stierlingi	Dendropicos namaquus	Poicephalus cryptoxanthus	Oriolus larvatus	Oriolus auratus	Ceblepyris pectoralis	Campephaga flava	Prionops plumatus	Prionops retzii	Batis soror	Malaconotus blanchoti	Dryoscopus cubla	Tchagra australis	Tchagra senegalus	Nilaus afer	Chlorophoneus sulfureopectus
01_Wood1	18	0,00	0,01	0,00	0,00	0,02	0,12	0,00	0,00	0,00	0,01	0,00	0,03	0,00	0,04	0,00	0,03	0,00	0,00
02_Wood2	15	0,01	0,02	0,00	0,00	0,02	0,05	0,04	0,01	0,00	0,01	0,02	0,15	0,00	0,05	0,00	0,03	0,00	0,00
03_CroplandWood1	15	0,00	0,01	0,00	0,00	0,00	0,03	0,03	0,01	0,00	0,00	0,01	0,03	0,00	0,04	0,01	0,04	0,05	0,00
04_CroplandWood2	24	0,00	0,01	0,00	0,00	0,01	0,03	0,00	0,00	0,00	0,00	0,01	0,03	0,00	0,03	0,00	0,04	0,00	0,00
05_CroplandWood3	11	0,00	0,01	0,00	0,00	0,01	0,03	0,00	0,01	0,00	0,06	0,04	0,02	0,00	0,04	0,01	0,02	0,00	0,00
06_FallowWoodCropland	63	0,01	0,01	0,00	0,00	0,01	0,04	0,01	0,01	0,00	0,01	0,01	0,02	0,00	0,05	0,00	0,04	0,00	0,00
07_OldFallow	13	0,00	0,00	0,00	0,00	0,01	0,05	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,04	0,06	0,06	0,00	0,00
08_CroplandFallow	15	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,00	0,00
Total	174	0,00	0,01	0,00	0,00	0,01	0,04	0,01	0,00	0,00	0,01	0,01	0,03	0,00	0,04	0,01	0,04	0,01	0,00
ANOVA p value		0,917	0,586	0,973	0,973	0,414	0,000	0,000	0,672	0,699	0,000	0,619	0,000	0,495	0,607	0,000	0,201	0,000	0,679
Squared ETA		0,02	0,03	0,01	0,01	0,04	0,18	0,19	0,03	0,03	0,15	0,03	0,42	0,04	0,03	0,60	0,06	0,71	0,03

Table IV. Continuation

CLUSTER	N	Laniarius aethiopicus	Dicrurus adsimilis	Terpsiphone viridis	Lanius collaris	Corvus albus	Hyliota flavigaster	Melaniparus pallidiventris	Mirafra africana	Mirafra rufocinnamomea	Sylvietta whytii	Eremomela icteropygialis	Calamonastes stierlingi	Camaroptera brachyura	Cisticola erythrops	Cisticola natalensis	Prinia subflava	Prinia erythroptera	Psalidoprocne pristoptera	Cecropis abyssinica
01_Wood1	18	0,03	0,05	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,04
02_Wood2	15	0,01	0,05	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,06	0,00	0,00	0,00	0,00	0,00	0,00	0,00
03_CroplandWood1	15	0,02	0,08	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,02	0,00	0,02	0,00
04_CroplandWood2	24	0,02	0,06	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,00	0,02	0,00	0,11	0,02
05_CroplandWood3	11	0,02	0,09	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,00	0,03	0,00
06_FallowWoodCropland	63	0,08	0,06	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,02	0,00	0,03	0,00	0,00	0,02
07_OldFallow	13	0,07	0,02	0,03	0,00	0,06	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,02	0,00	0,03	0,00	0,00	0,00
08_CroplandFallow	15	0,02	0,02	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,01	0,01
Total	174	0,05	0,05	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,02	0,00	0,02	0,01
ANOVA p value		0,000	0,098	0,108	0,786	0,000	0,035	0,155	0,210	0,511	0,585	0,973	0,000	0,782	0,089	0,517	0,019	0,806	0,000	0,157
Squared ETA		0,20	0,07	0,07	0,02	0,21	0,09	0,06	0,06	0,04	0,03	0,01	0,25	0,02	0,07	0,04	0,10	0,02	0,46	0,06

CLUSTER	N	Hirundo smithii	Hirundo rustica	Pycnonotus barbatus	Zosterops senegalensis	Turdoides jardineii	Salpornis salvadori	Creatophora cinerea	Lamprotornis chloropterus	Lamprotornis chalybaeus	Cinnyricinclus leucogaster	Turdus libonyana	Muscicapa striata	Agricola pallidus	Melaenornis pammelaina	Monticola angolensis	Myrmecocichla arnotti	Oenanthe familiaris	Anthreptes longuemarei
01_Wood1	18	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01
02_Wood2	15	0,00	0,00	0,03	0,00	0,00	0,00	0,00	0,01	0,00	0,03	0,01	0,00	0,02	0,00	0,00	0,00	0,00	0,01
03_CroplandWood1	15	0,00	0,02	0,03	0,00	0,00	0,00	0,00	0,01	0,01	0,03	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,01
04_CroplandWood2	24	0,03	0,02	0,02	0,00	0,00	0,00	0,00	0,01	0,00	0,02	0,00	0,00	0,01	0,00	0,00	0,01	0,00	0,00
05_CroplandWood3	11	0,01	0,00	0,03	0,01	0,00	0,00	0,04	0,01	0,00	0,04	0,00	0,00	0,02	0,00	0,00	0,02	0,00	0,00
06_FallowWoodCropland	63	0,00	0,01	0,03	0,01	0,00	0,00	0,00	0,01	0,00	0,04	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00
07_OldFallow	13	0,00	0,00	0,09	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00
08_CroplandFallow	15	0,02	0,00	0,02	0,00	0,00	0,00	0,00	0,01	0,00	0,07	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total	174	0,01	0,01	0,03	0,00	0,00	0,00	0,00	0,01	0,00	0,04	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00
ANOVA p value		0,000	0,694	0,000	0,767	0,851	0,973	0,035	0,992	0,155	0,900	0,817	0,371	0,340	0,517	0,973	0,001	0,955	0,198
Squared ETA		0,17	0,03	0,15	0,02	0,02	0,01	0,09	0,01	0,06	0,02	0,02	0,04	0,05	0,04	0,01	0,14	0,01	0,06

Table IV. Continuation

																										Habitat Guild										
																										Functional composition								Functional diversity		
CLUSTER	N	Chalcomitra amethystina	Chalcomitra senegalensis	Cinnyris talatala	Cinnyris venustus	Euplectes capensis	Ploceus ocularis	Anaplectes rubriceps	Lagonosticta rhodopareia	Lagonosticta rubricata	Uraeginthus angolensis	Pyrenestes minor	Estrilda astrild	Spermestes cucullata	Spermestes fringilloides	Vidua macroura	Passer diffusus	Gymnoris superciliaris	Anthus cinnamomeus	Motacilla aguimp	Crithagra mozambica	Crithagra reichardi	Emberiza cabanisi	Emberiza flaviventris	Emberiza tahapisi	Forest	Shrubland	Woodland	Grassland	Wetland	Riverine	Rock	Human modified	HabitatGuild_Richness	HabitatGuild_ShannonDiversity	HabitatGuild_ShannonEvenness
01_Wood1	18	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,08	0,00	0,00	0,00	0,07	0,29	0,53	0,09	0,00	0,00	0,02	0,00	2,94	0,89	0,82
02_Wood2	15	0,01	0,02	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,03	0,00	0,00	0,00	0,05	0,20	0,72	0,02	0,00	0,00	0,00	0,00	2,67	0,67	0,69
03_CroplandWood1	15	0,00	0,02	0,00	0,00	0,03	0,00	0,01	0,00	0,01	0,03	0,00	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,00	0,10	0,24	0,52	0,13	0,00	0,00	0,00	0,02	3,73	1,02	0,78
04_CroplandWood2	24	0,00	0,01	0,00	0,00	0,01	0,00	0,00	0,01	0,01	0,02	0,00	0,03	0,03	0,00	0,00	0,00	0,01	0,02	0,01	0,00	0,03	0,00	0,00	0,00	0,16	0,24	0,43	0,14	0,00	0,01	0,00	0,02	3,83	1,18	0,88
05_CroplandWood3	11	0,00	0,01	0,00	0,00	0,05	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,09	0,28	0,52	0,11	0,00	0,00	0,00	0,00	3,73	0,95	0,73
06_FallowWoodCropland	63	0,00	0,02	0,00	0,01	0,02	0,00	0,00	0,00	0,00	0,02	0,00	0,00	0,02	0,00	0,00	0,01	0,01	0,00	0,00	0,01	0,01	0,00	0,01	0,00	0,07	0,28	0,52	0,11	0,01	0,00	0,00	0,01	3,35	0,95	0,80
07_OldFallow	13	0,00	0,02	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,02	0,00	0,00	0,00	0,08	0,39	0,45	0,07	0,01	0,00	0,00	0,00	3,46	1,03	0,86
08_CroplandFallow	15	0,00	0,01	0,00	0,00	0,24	0,00	0,00	0,01	0,00	0,09	0,00	0,06	0,19	0,02	0,00	0,00	0,00	0,00	0,00	0,02	0,01	0,00	0,00	0,00	0,10	0,14	0,42	0,34	0,00	0,00	0,00	0,00	3,73	0,93	0,73
Total	174	0,00	0,02	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,02	0,00	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,02	0,00	0,01	0,00	0,09	0,26	0,51	0,12	0,00	0,00	0,00	0,01	3,41	0,96	0,80
ANOVA p value		0,835	0,811	0,004	0,363	0,000	0,375	0,155	0,290	0,649	0,002	0,155	0,042	0,000	0,155	0,588	0,682	0,818	0,002	0,517	0,637	0,000	0,155	0,647	0,155	0,026	0,001	0,000	0,000	0,548	0,517	0,294	0,664	0,000	0,000	0,003
Squared ETA		0,02	0,02	0,12	0,04	0,32	0,04	0,06	0,05	0,03	0,12	0,06	0,08	0,24	0,06	0,03	0,03	0,02	0,12	0,04	0,03	0,21	0,06	0,03	0,06	0,09	0,14	0,15	0,24	0,03	0,04	0,05	0,03	0,16	0,20	0,12

Table IV. Continuation

		Habitat density						Feeding niche Pigot																				
		Functional composition			Functional diversity			Functional composition																		Functional diversity		
CLUSTER	N	Closed_habitats	Semi_open_habitats	Open_habitats	HabitatDensity_Richness	HabitatDensity_ShannonDiversity	HabitatDensity_ShannonEvenness	Vertivore_aerial	Vertivore_air_to_surface	Invertivore_aerial	Invertivore_sally_air	Invertivore_glean_arboreal	Invertivore_bark	Invertivore_sally_surface	Frugivore_glean	Nectarivore_glean	Vertivore_perch	Invertivore_sally_ground	Granivore_arboreal	Invertivore_ground	Herbivore_ground	Granivore_ground	Scavanger_ground	Generalist	NA	FeedingNichePigot_Richness	FeeedingNichePigot_ShannonDiversity	FeedingNichePigot_ShannonEvenness
01_Wood1	18	0,00	0,72	0,28	1,94	0,23	0,33	0,00	0,00	0,07	0,02	0,11	0,01	0,03	0,10	0,00	0,02	0,02	0,00	0,05	0,00	0,19	0,00	0,17	0,21	5,78	1,38	0,81
02_Wood2	15	0,01	0,80	0,20	1,87	0,17	0,24	0,00	0,00	0,01	0,05	0,15	0,02	0,15	0,12	0,00	0,01	0,04	0,00	0,05	0,00	0,11	0,00	0,13	0,16	6,67	1,51	0,82
03_CroplandWood1	15	0,02	0,65	0,34	2,27	0,23	0,30	0,01	0,00	0,06	0,06	0,17	0,01	0,03	0,10	0,00	0,00	0,03	0,00	0,04	0,00	0,16	0,00	0,19	0,14	7,47	1,56	0,79
04_CroplandWood2	24	0,01	0,64	0,35	2,13	0,25	0,36	0,00	0,00	0,19	0,03	0,10	0,01	0,03	0,09	0,00	0,01	0,02	0,00	0,08	0,00	0,14	0,00	0,20	0,09	7,67	1,60	0,80
05_CroplandWood3	11	0,01	0,65	0,34	2,18	0,23	0,32	0,00	0,01	0,04	0,02	0,14	0,01	0,02	0,11	0,00	0,01	0,05	0,00	0,09	0,00	0,15	0,00	0,23	0,13	7,82	1,51	0,74
06_FallowWoodCropland	63	0,01	0,69	0,30	2,14	0,22	0,30	0,00	0,00	0,05	0,04	0,13	0,02	0,02	0,12	0,01	0,01	0,02	0,00	0,07	0,00	0,18	0,00	0,20	0,13	6,37	1,44	0,79
07_OldFallow	13	0,02	0,66	0,32	2,23	0,25	0,33	0,00	0,00	0,01	0,02	0,12	0,00	0,03	0,17	0,00	0,00	0,01	0,00	0,15	0,00	0,15	0,00	0,17	0,16	6,08	1,41	0,78
08_CroplandFallow	15	0,00	0,46	0,53	2,20	0,23	0,33	0,00	0,00	0,04	0,01	0,03	0,00	0,00	0,11	0,00	0,00	0,01	0,02	0,02	0,00	0,57	0,00	0,12	0,07	7,07	1,00	0,53
Total	174	0,01	0,67	0,32	2,12	0,23	0,31	0,00	0,00	0,06	0,03	0,12	0,02	0,03	0,11	0,00	0,01	0,02	0,00	0,07	0,00	0,20	0,00	0,18	0,13	6,74	1,44	0,77
ANOVA p value		0,294	0,000	0,000	0,087	0,297	0,419	0,000	0,832	0,000	0,563	0,012	0,524	0,000	0,682	0,363	0,805	0,129	0,155	0,001	0,978	0,000	0,973	0,264	0,001	0,001	0,000	0,000
Squared ETA		0,05	0,18	0,18	0,07	0,05	0,04	0,15	0,02	0,31	0,03	0,10	0,04	0,42	0,03	0,04	0,02	0,06	0,06	0,14	0,01	0,47	0,01	0,05	0,13	0,14	0,25	0,42

Table IV. Continuation

CLUSTER	N	Feeding niche FARSYMABI – Functional composition: Vertivore_aerial	Vertivore_air_to_surface	Invertivore_aerial	Vertivore_Generalist	Invertivore_sally_air	Invertivore_glean_canopy	Invertivore_glean_understorey	Invertivore_glean_grass	Invertivore_bark	Invertivore_sally_surface	Invertivore_Insessorial_Generalist	Omnivore_Omnivore_Insessorial	Frugivore_glean	Nectarivore_glean	Herbivore_Omnivore_Insessorial	Vertivore_perch	Invertivore_sally_ground	Granivore_arboreal	Invertivore_Generalist	Granivore_Generalist	Scavenger_Ground	Carnivore_Omnivore_Terrestrial	Invertivore_ground	Omnivore_Omnivore_Terrestrial	Herbivore_Omnivore_Terrestrial	Granivore_ground	Functional diversity: FeedingNicheFarsymabi_Richness	FeedingNicheFarsymabi_ShannonDiversity	FeedingNicheFarsymabi_ShannonEvenness
01_Wood1	18	0,00	0,01	0,07	0,00	0,02	0,09	0,01	0,00	0,01	0,03	0,09	0,15	0,10	0,00	0,03	0,02	0,02	0,00	0,00	0,08	0,00	0,00	0,05	0,00	0,01	0,19	6,67	1,71	0,93
02_Wood2	15	0,00	0,01	0,01	0,01	0,05	0,09	0,06	0,00	0,02	0,15	0,07	0,12	0,12	0,02	0,04	0,01	0,04	0,00	0,00	0,03	0,00	0,00	0,05	0,00	0,00	0,11	8,20	1,92	0,94
03_CroplandWood1	15	0,01	0,01	0,06	0,00	0,06	0,14	0,01	0,01	0,01	0,03	0,14	0,08	0,10	0,00	0,01	0,00	0,03	0,00	0,00	0,05	0,00	0,01	0,04	0,01	0,01	0,16	9,00	1,88	0,87
04_CroplandWood2	24	0,00	0,00	0,19	0,01	0,03	0,09	0,01	0,00	0,01	0,03	0,12	0,05	0,09	0,01	0,03	0,01	0,02	0,00	0,01	0,07	0,00	0,00	0,08	0,00	0,00	0,14	9,13	1,92	0,88
05_CroplandWood3	11	0,00	0,01	0,04	0,00	0,02	0,13	0,01	0,00	0,01	0,02	0,21	0,05	0,11	0,00	0,01	0,01	0,09	0,00	0,02	0,00	0,00	0,01	0,09	0,00	0,01	0,15	9,18	1,87	0,84
06_FallowWoodCropland	63	0,00	0,01	0,05	0,00	0,04	0,09	0,02	0,02	0,02	0,02	0,19	0,07	0,12	0,01	0,03	0,01	0,02	0,00	0,00	0,01	0,00	0,01	0,07	0,00	0,01	0,18	7,24	1,72	0,89
07_OldFallow	13	0,00	0,00	0,01	0,00	0,02	0,09	0,01	0,02	0,00	0,03	0,15	0,07	0,17	0,00	0,03	0,00	0,01	0,00	0,00	0,02	0,00	0,06	0,15	0,00	0,00	0,15	6,92	1,77	0,92
08_CroplandFallow	15	0,00	0,00	0,04	0,00	0,01	0,02	0,00	0,01	0,00	0,00	0,05	0,02	0,11	0,00	0,03	0,00	0,01	0,02	0,00	0,07	0,00	0,01	0,02	0,00	0,01	0,57	8,47	1,15	0,56
Total	174	0,00	0,01	0,06	0,00	0,03	0,09	0,02	0,01	0,02	0,03	0,14	0,08	0,11	0,01	0,03	0,01	0,02	0,00	0,00	0,04	0,00	0,01	0,07	0,00	0,01	0,20	7,88	1,74	0,87
ANOVA p value		0,000	0,718	0,000	0,864	0,563	0,036	0,000	0,089	0,524	0,000	0,000	0,000	0,682	0,411	0,953	0,805	0,000	0,155	0,001	0,001	0,973	0,000	0,001	0,155	0,776	0,000	0,000	0,000	0,000
Squared ETA		0,15	0,03	0,31	0,02	0,03	0,09	0,18	0,07	0,04	0,42	0,18	0,19	0,03	0,04	0,01	0,02	0,20	0,06	0,14	0,13	0,01	0,21	0,14	0,06	0,02	0,47	0,15	0,30	0,65

Table IV. Continuation

CLUSTER	N	Family – Functional composition: Numididae	Phasianidae	Columbidae	Caprimulgidae	Apodidae	Cuculidae	Musophagidae	Strigidae	Accipitridae	Bucerotidae	Upupidae	Phoeniculidae	Meropidae	Coraciidae	Alcedinidae	Lybiidae	Indicatoridae
01_Wood1	18	0,00	0,01	0,19	0,00	0,00	0,00	0,02	0,02	0,02	0,04	0,02	0,01	0,02	0,03	0,01	0,03	0,01
02_Wood2	15	0,00	0,00	0,11	0,00	0,00	0,00	0,03	0,00	0,04	0,00	0,01	0,00	0,05	0,01	0,00	0,03	0,00
03_CroplandWood1	15	0,00	0,00	0,10	0,00	0,00	0,01	0,01	0,00	0,02	0,00	0,00	0,01	0,06	0,03	0,01	0,03	0,01
04_CroplandWood2	24	0,00	0,00	0,08	0,00	0,00	0,01	0,02	0,00	0,02	0,02	0,01	0,00	0,03	0,02	0,00	0,02	0,00
05_CroplandWood3	11	0,00	0,00	0,09	0,00	0,00	0,02	0,01	0,00	0,02	0,00	0,01	0,01	0,02	0,07	0,00	0,02	0,01
06_FallowWoodCropland	63	0,00	0,01	0,12	0,00	0,00	0,01	0,01	0,00	0,02	0,00	0,01	0,01	0,04	0,01	0,00	0,03	0,00
07_OldFallow	13	0,00	0,00	0,14	0,00	0,01	0,04	0,02	0,00	0,01	0,01	0,01	0,00	0,02	0,00	0,00	0,02	0,00
08_CroplandFallow	15	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,00	0,00	0,01	0,00
Total	174	0,00	0,00	0,11	0,00	0,00	0,01	0,02	0,00	0,02	0,01	0,01	0,01	0,03	0,02	0,00	0,03	0,00
ANOVA p value		0,927	0,705	0,000	0,862	0,085	0,005	0,622	0,278	0,423	0,000	0,202	0,827	0,594	0,000	0,212	0,720	0,619
Squared ETA		0,01	0,03	0,18	0,02	0,07	0,11	0,03	0,05	0,04	0,24	0,06	0,02	0,03	0,26	0,06	0,03	0,03

CLUSTER	N	Picidae	Psittacidae	Oriolidae	Campephagidae	Vangidae	Platysteiridae	Malaconotidae	Dicruridae	Monarchidae	Laniidae	Corvidae	Hyliotidae	Paridae	Alaudidae	Macrosphenidae	Cisticolidae	Hirundinidae	Pycnonotidae	Zosteropidae	Leiotrichidae
01_Wood1	18	0,01	0,02	0,12	0,00	0,01	0,03	0,10	0,05	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,01	0,04	0,00	0,00	0,00
02_Wood2	15	0,02	0,02	0,09	0,01	0,03	0,15	0,09	0,05	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,06	0,00	0,03	0,00	0,00
03_CroplandWood1	15	0,01	0,00	0,06	0,01	0,01	0,03	0,15	0,08	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,04	0,04	0,03	0,00	0,00
04_CroplandWood2	24	0,01	0,01	0,03	0,00	0,01	0,03	0,10	0,06	0,00	0,00	0,00	0,00	0,00	0,01	0,01	0,03	0,18	0,02	0,00	0,00
05_CroplandWood3	11	0,01	0,01	0,03	0,01	0,10	0,02	0,10	0,09	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,02	0,04	0,03	0,01	0,00
06_FallowWoodCropland	63	0,01	0,01	0,05	0,01	0,02	0,02	0,18	0,06	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,07	0,03	0,03	0,01	0,00
07_OldFallow	13	0,00	0,01	0,05	0,00	0,00	0,03	0,23	0,02	0,03	0,00	0,06	0,00	0,00	0,01	0,00	0,06	0,00	0,09	0,00	0,00
08_CroplandFallow	15	0,00	0,00	0,01	0,00	0,00	0,00	0,04	0,02	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,02	0,04	0,02	0,00	0,00
Total	174	0,01	0,01	0,05	0,01	0,02	0,03	0,14	0,05	0,01	0,00	0,01	0,00	0,00	0,00	0,00	0,05	0,05	0,03	0,00	0,00
ANOVA p value		0,440	0,414	0,000	0,709	0,016	0,000	0,000	0,098	0,108	0,786	0,000	0,035	0,155	0,447	0,585	0,001	0,000	0,000	0,767	0,851
Squared ETA		0,04	0,04	0,18	0,03	0,10	0,42	0,18	0,07	0,07	0,02	0,21	0,09	0,06	0,04	0,03	0,13	0,33	0,15	0,02	0,02

Table IV. Continuation

														Functional diversity			Range Size	Migration			Conservation status				
CLUSTER	N	Sittidae	Sturnidae	Turdidae	Muscicapidae	Nectariniidae	Ploceidae	Estrildidae	Viduidae	Passeridae	Motacillidae	Fringillidae	Emberizidae	Family_Richness	Family_ShannonDiversity	Family_ShannonEvenness	Large range	Sedentary	Partially_migratory	Migratory	Proportion_ConservationConcern	Proportion_Threatened	Number_ConservationConcern	Number_Threatened	Miombo endemic
01_Wood1	18	0,00	0,05	0,00	0,00	0,04	0,00	0,00	0,00	0,00	0,00	0,09	0,00	7,39	1,81	0,95	0,03	0,90	0,04	0,06	0,01	0,01	0,11	0,11	0,15
02_Wood2	15	0,00	0,04	0,01	0,02	0,06	0,00	0,01	0,00	0,00	0,00	0,03	0,00	8,53	1,96	0,94	0,04	0,88	0,03	0,09	0,01	0,01	0,13	0,13	0,10
03_CroplandWood1	15	0,00	0,05	0,00	0,01	0,03	0,04	0,07	0,00	0,00	0,00	0,03	0,01	11,20	2,22	0,94	0,06	0,87	0,07	0,06	0,01	0,01	0,20	0,20	0,09
04_CroplandWood2	24	0,00	0,04	0,00	0,02	0,02	0,01	0,09	0,00	0,01	0,02	0,04	0,00	11,42	2,15	0,90	0,09	0,75	0,17	0,07	0,00	0,00	0,08	0,08	0,08
05_CroplandWood3	11	0,00	0,08	0,00	0,04	0,02	0,06	0,02	0,00	0,00	0,00	0,00	0,01	11,82	2,14	0,87	0,06	0,77	0,17	0,07	0,00	0,00	0,09	0,09	0,04
06_FallowWoodCropland	63	0,00	0,05	0,01	0,01	0,04	0,02	0,05	0,00	0,01	0,00	0,01	0,01	8,62	1,92	0,91	0,06	0,88	0,05	0,08	0,01	0,01	0,11	0,10	0,05
07_OldFallow	13	0,00	0,03	0,01	0,00	0,02	0,00	0,02	0,00	0,01	0,00	0,04	0,00	8,38	1,92	0,93	0,18	0,83	0,11	0,06	0,00	0,00	0,00	0,00	0,03
08_CroplandFallow	15	0,00	0,08	0,00	0,00	0,01	0,24	0,37	0,00	0,00	0,00	0,03	0,00	10,80	1,48	0,63	0,05	0,87	0,05	0,08	0,00	0,00	0,00	0,00	0,02
Total	174	0,00	0,05	0,00	0,01	0,03	0,04	0,07	0,00	0,01	0,00	0,03	0,01	9,47	1,95	0,89	0,07	0,85	0,08	0,07	0,01	0,01	0,10	0,09	0,07
ANOVA p value		0,973	0,844	0,817	0,163	0,477	0,000	0,000	0,588	0,494	0,010	0,000	0,650	0,000	0,000	0,000	0,000	0,003	0,000	0,998	0,734	0,694	0,713	0,628	0,000
Squared ETA		0,01	0,02	0,02	0,06	0,04	0,32	0,42	0,03	0,04	0,10	0,17	0,03	0,20	0,21	0,46	0,16	0,12	0,29	0,00	0,03	0,03	0,03	0,03	0,19

Table V. Cluster x Habitat cross-tabulation

	Habitat			
Cluster	Forest	Fallow	Cropland	Total
01_Wood1	17	1	0	18
02_Wood2	15	0	0	15
03_CroplandWood1	4	2	9	15
04_CroplandWood2	4	4	16	24
05_CroplandWood3	2	1	8	11
06_FallowWoodCropland	18	30	15	63
07_OldFallow	2	11	0	13
08_CroplandFallow	0	7	8	15
Total	62	56	56	174

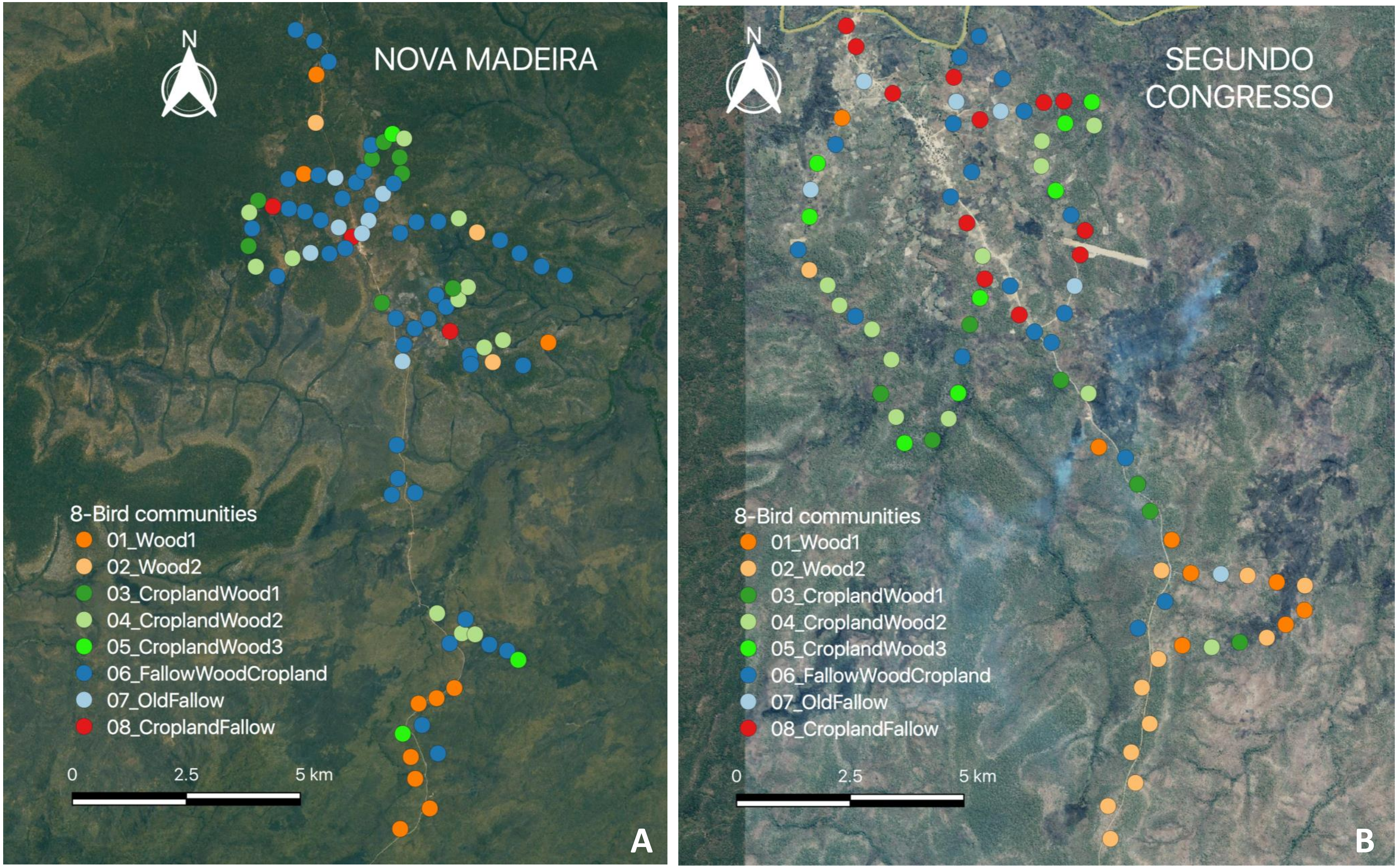

Figure III. Map of the 8-bird communities clusters of **A.** Nova Madeira, and **B.** Segundo Congresso

VI.II.II. THE 8 BIRD COMMUNITIES OF CHIPANJE CHETU

(Cluster interpretation)

A) Miombo woodland bird communities

32 (out of 62) points selected to represent Miombo-woodland habitats were included in two clusters (cf. clusters 1, and 2; Fig. II, Table V). These two clusters are (almost) pure in terms of habitat: Miombo points represent all (cluster 2) or almost all (17 in 18; cluster 1) points included in these clusters.

The other 30 Miombo points (almost half) have, however, been included in many other clusters (only cluster 8, Cropland and fallows, has no Miombo points at all; cf. Table V), where they represent 15 to 29% of all points in the cluster.

The two pure woodland clusters, together with clusters 6 (Fallows, woodlands and cropland) and 7 (Old fallows) do group in a single, higher-order cluster characterized by a significant presence of fallow and woodland points (Fig. II). The set of these 4 clusters, and, in particular, clusters 1 and 2 (pure Miombo woodland) present the lowest levels of Abundance, Average per-species abundance and Species richness, and the highest levels of Species evenness.

The two Miombo-woodland clusters, in particular cluster 2, present the highest average proportions of woodland species (53-72%; table IV), and the lowest habitat richness and diversity, thus confirming (now, based on bird records) their relatively pure woodland habitat nature. The same two clusters also record the highest average proportions of semi-open habitat birds (72-80%; table IV) and the lowest average proportions of open habitat birds. The presence of forest birds and closed habitat birds is, however, minimal in these two clusters (Table IV). They clearly represent semi-open, woodland as opposed to closed, forest or open, grassland habitats.

These two clusters record the maximum average proportions of the feeding niche Omnivore insessorial (e.g. *Oriolus larvatus* and *O. auratus*), and the maximum average levels of Feeding niche evenness (Table IV). They also record maximum levels of family-level Taxonomic evenness.

As regards their conservation significance, these two clusters, in particular cluster 1, record the highest average proportions (10-15%, Table IV) of Miombo-endemic species, and the lowest average proportions (3-4%) of large range, cosmopolitan species. Thus, clusters 1 and 2, in particular cluster 1, include the single most important habitat in Chipanje Chetu to protect Miombo endemism.

The two Miombo-woodland clusters also record the highest average proportions of fully sedentary species (88-90%), probably revealing the high degree of ecological niche filling by resident, breeding species, which would block the community permeability to migratory species.

In both communities (Nova Madeira and Segundo Congresso), these two clusters only include the most “remote” points, that is: points located at the highest distance from human settlements and main cropland areas, which coincide with the largest woodland patches (Fig. III).

C1. Miombo woodland 1 (cluster 1)

This is a relatively heterogeneous cluster, in terms of the diversity and composition of the bird community, as it includes two sub-clusters that merge relatively late in the clustering process (Fig.II). There is thus some species turnover (beta diversity) across the different points included in the cluster.

Together with cluster 2, this cluster presents low levels of Abundance, Average per-species abundance and Species richness, and a high level of Species evenness – the maximum of Species evenness was actually recorded in this cluster.

The species composition of this Miombo woodland community is characterized by maximum importance of *Turtur chalcospilos*, *Lophoceros pallidirostris*, *Eurystomus glaucurus*, *Oriolus larvatus*, and *Crithagra reichardi*, which, in average, represent 36% of all recorded birds (Table IV). Among species that do not reach significant differences across clusters (ANOVA test), *Peliperdix coqui* and *Bubo africanus* are exclusive of this cluster, while many reach here their maximal average proportions: *Streptopelia semitorquata*, *Streptopelia capicola*, *Terathopius ecaudatus*, *Melierax metabates*, *Upupa epops*, *Halcyon chelicuti*, *Pogoniulus chrysoconus*, *Indicator indicator* (ex aequo with cluster 5), *Cecropis abyssinica*, *Oenanthe familiaris*, *Chalcomitra senegalensis* (Table IV).

When compared with the other Miombo-woodland cluster (cluster 2), this cluster has a higher proportion of shrubland and a lower proportion of woodland and semi-open habitat species; it also has higher average Habitat richness, diversity and, in particular, evenness than cluster 2 (Table IV). All of these patterns indicate a slightly richer, more complex micro-habitat structure in cluster 1 (possibly related with termitaria, clearings or other contrasting micro-habitats within the Miombo).

As regards Feeding-niche composition, it has, in common with cluster 2, a medium proportion of Invertivore glean canopy, and a high (actually the highest) proportion of Omnivore insessorial (Table IV). Differently from cluster 2, it has higher proportions of Invertivore aerial, granivore generalist (the highest proportion) and granivore ground, and lower proportions of Invertivore glean understorey and sally to surface. Because of these differences in feeding-guild composition, cluster 1 has a slightly lower value of Feeding niche richness and diversity than cluster 2 (Table IV).

As regards family-level Taxonomic composition, this cluster records the highest average proportions of the following families: Columbidae, Bucerotidae, Oriolidae, and Fringillidae. It also has the lowest value of family-level Taxonomic richness and the maximum of family-level Taxonomic evenness. In this, it is similar to (although more extreme than) cluster 2 (and also clusters 6 and 7, which group with the two woodland clusters at a higher level).

Cluster 1 is the one with the highest proportion of Miombo endemics (15%) and the lowest proportion of large-range cosmopolitan species (very closely followed by cluster 2 in the latter aspect). Custer 1 is thus the one with the highest conservation value in this respect.

Cluster 1 is also the one with the highest proportion sedentary species (90%), probably reflecting high ecological niche filling, which may be blocking the permeability of the resident bird community to migratory species.

The distribution of this high-conservation-value Miombo-woodland cluster is well balanced between Nova Madeira (9 woodland points) and Segundo Congresso (8 woodland points).

C2. Miombo woodland 2 (cluster 2)

This cluster is the most homogenous of our 8 clusters, in terms of the diversity and composition of the bird communities it encompasses: it forms in the clustering process earlier than any other cluster (Fig.II). It is also quite distinct from other clusters: it is the last to merge with the other clusters (that is the most distinct) within the first group of clusters (clusters 1, 2, 6 and 7; Fig.II). This means low species turnover (beta diversity) among different points within the cluster, but high species turnover between this cluster and the others.

Together with cluster 1, this cluster presents low average levels of Abundance, Average per-species abundance and Species richness, and a high average level of Species evenness – very close to the maximum of average Species evenness, which is recorded in cluster 1.

This Miombo woodland community has maximum importance of *Oriolus auratus*, *Batis soror*, *Calamonastes stierlingi*, and *Cinnyris talatala*, which, in average, represent 27% of all recorded birds (Table IV). High levels of relative importance were also recorded for *Turtur chalcospilos*, and *Oriolus larvatus*, which reach their maximum in cluster 1 and represent another 9% of all recorded birds (Table IV). Among species that do not reach significant differences across clusters (ANOVA test), *Accipiter tachiro* and *Emberiza cabanisi* are exclusive of this cluster, while many other reach here their maximal average proportions: Cuculus canorus, Gallirex porphyreolophus, Circaetus cinereus, Kaupifalco monogrammicus, Merops apiaster, Campethera abingoni, Dendropicos fuscescens, Poicephalus cryptoxanthus, Agricola pallidus, Anthreptes longuemarei, Chalcomitra amethystina, and Pyrenestes minor (Table IV).

This cluster has the highest average proportions of woodland, and semi-open habitat species of all clusters. When compared with the other Miombo-woodland cluster (cluster 1), it has a lower proportion of shrubland species, and lower average Habitat richness, diversity and, in particular, lower habitat evenness than cluster 1 (Table IV), which indicates a slightly poorer, simpler micro-habitat structure than that of cluster 1.

As regards Feeding-niche composition, it has, in common with cluster 1, a medium proportion of Invertivore glean canopy, and a high proportion of Omnivore insessorial (Table IV). Differently from cluster 1, it has lower proportions of Invertivore aerial, granivore generalist and granivore ground, and higher (actually, the highest of all clusters) proportions of Invertivore glean understorey and sally to surface. Because of these differences in feeding-guild composition, cluster 2 has slightly higher values of Feeding-niche richness, diversity and evenness (actually, the highest among all clusters for the latter two) than cluster 1 (Table IV). This means the highest functional (feeding-niche) diversity and evenness of all clusters (the latter only slightly higher than that of the other Miombo woodland cluster, cluster 1).

As regards family-level Taxonomic composition, this cluster records the highest average proportions of the Platysteiridae. It also has a low value of family-level Taxonomic richness and a high value of family-level Taxonomic evenness. In this, it is similar to (although less extreme than) cluster 2 (and also clusters 6 and 7, which group with the two woodland clusters at a higher level).

Cluster 2 has a high proportion of Miombo endemics (10%; lower than the maximum of 15% in cluster 1) and a low proportion of large-range cosmopolitan species (very close to the minimum in cluster 1). Custer 2 has thus significant conservation value, in this respect, being however second to cluster 1.

Cluster 2 has a high average proportion sedentary species (88%), only second to cluster 1, probably reflecting high ecological niche filling.

Summarizing, Miombo woodlands in cluster 2 seem to have a slightly simpler microhabitat structure, slightly higher (the highest) functional (feeding-niche) diversity, a lower (while still significant) conservation value, and slightly lower niche filling.

Differently from cluster 1 (whose distribution is well balanced between the two communities), Miombo woodlands in cluster 2 seem more frequent in Segundo Congresso (12 points) than in Nova Madeira (3 points).

B) Cropland and woodland bird communities

33 (out of 56) points selected to represent cropland habitats were included in three clusters (cf. clusters 3, 4 and 5; Fig. II, Table V). In these clusters, cropland points represent 60-72%, woodland points, 17-27%, and the proportion of fallow points is at most equal to (in two cases, half of) that of woodland points (Table V). Two other clusters also include cropland points (clusters 6 and 8), but, in these clusters, the proportion of fallow points exceeds by much that of woodland points (which are even absent in cluster 8) (Table V).

The three Cropland and woodland clusters (clusters 3, 4 and 5) group together in a single, higher-order cluster (Fig. II). These clusters present the highest levels of Species richness and diversity among all clusters, and intermediate levels of Species evenness (only slightly below those of the previous two Miombo woodland clusters), Abundance and Average per-species abundance (both well above those of the previous two Miombo woodland clusters) (Table IV). These values indicate a position of the three Cropland and woodland clusters that is intermediate between that of the previous two Miombo clusters and that of the open-habitat clusters described below in this report.

The three cropland and woodland clusters present higher proportions of forest (the highest among all clusters, in cluster 4) and grassland birds, and similar proportions of shrubland and woodland birds (the latter much lower, in cluster 4) than that those of the two Miombo woodland clusters.

Habitat richness and diversity are high in these three clusters (the former are the highest among all clusters), which indicates mixed, probably cropland-woodland edge landscapes. The proportions of semi-open and open-habitat species are here at intermediate levels – the former clearly below, and the latter clearly above those of the two previous Miombo woodland clusters. This also reflects cropland-woodland edge landscapes, which possibly also explains the abovementioned highest levels of species richness and diversity.

Although not sharing any common theme in terms of functional (feeding-niche) composition, these three cropland and woodland clusters consistently record the highest average Functional (feeding-niche) richness and diversity levels, with average Functional (feeding-niche) evenness levels below those of the two Miombo woodland clusters (Table IV). These levels of niche complexity may also reflect the mixed, woodland-cropland edge nature of these habitats.

Together with Species and Functional (feeding-niche) richness and diversity, family-level Taxonomic richness and diversity levels are also maximal in these three clusters. The fact of these clusters presenting relatively high average proportions of Dicruridae also indicates edge habitats, with both trees and open areas.

As regards their conservation significance, two of these three clusters (clusters 3 and 4) record average proportions of Miombo-endemic species that are intermediate between those of the two Miombo-woodland clusters and those of the remaining clusters (Table IV). The average proportions of large-range, cosmopolitan species are here higher than in the two Miombo-woodland clusters. These intermediate levels of conservation significance may also reflect transition woodland-cropland habitats.

Two of these three Cropland and woodland clusters (clusters 4 and 5) record the lowest average proportions of fully sedentary species (75-77%), probably revealing a low degree of ecological niche filling by resident species, which makes the corresponding bird communities more open to migratory species.

In both communities (Nova Madeira and Segundo Congresso), the Cropland and Woodland points included in these three clusters tend to be located in the interface between the Miombo woodland matrix and the patches of older cropland and fallows (centred on the existing settlements) (Fig. III). This interface coincides with a fringe of Miombo areas that have recently been deforested to create the youngest cropland areas in both communities. These location details help explaining the origin of the mixed, woodland-cropland edge habitats that were inferred (above) from the the analysis of bird data.

C3. Cropland and woodland 1 (cluster 3)

The core of this cluster is very homogeneous, in terms of the diversity and composition of the bird community, although a 2-points sub-cluster is only integrated in the cluster in a later stage of the clustering process (Fig. II). This is the most distinctive of the three Cropland and woodland clusters: it only merges with clusters 4 + 5 very late in the clustering process.

As with clusters 4 and 5 (the other two Cropland and woodland clusters), this cluster presents very high levels of Species richness and diversity (the highest in the latter case) and intermediate levels of Species evenness, Abundance and Average per-species abundance (Table IV).

This Cropland and woodland community has maximum importance of *Accipiter minullus* and *Nilaus afer*, which, in average, represent together only 6% of all recorded birds (Table IV). High levels of relative importance were also recorded for *Eurystomus glaucurus*, *Oriolus auratus*, and *Estrilda astrild*, which together represent another 9% of all recorded birds (Table IV). Among species that do not reach significant differences across clusters (ANOVA test), *Melaniparus pallidiventris*, *Lamprotornis chalybaeus*, and *Anaplectes rubriceps* are exclusive of this cluster, while many other reach here their maximal average proportions: *Turtur afer*, *Bucorvus leadbeateri*, *Merops pusillus*, *Halcyon senegalensis*, *Ceblepyris pectoralis*, *Prinia erythroptera*, *Muscicapa striata*, *Lagonosticta rubricata*, *Vidua macroura*, *Emberiza flaviventris*, *Emberiza tahapisi* (Table IV). Some of these species are typical Miombo dwellers (e.g. *Oriolus auratus*, *Melaniparus pallidiventris*, and *Ceblepyris pectoralis*), others are more generic woodland species (e.g. *Nilaus afer*), while others use denser (e.g. *Lagonosticta rubricata*) or open habitats (e.g. *Estrilda astrild*, *Merops pusillus*, *Prinia erythroptera*, and *Vidua macroura*); another (*Eurystomus glaucurus*) has been often observed in large trees in open areas close to the edge of Miombo patches. This is well reflected in the relatively balanced proportions of different habitat guilds and habitat density guilds, and in the high level of habitat guild richness in this cluster, which indicate its woodland-cropland edge nature.

As regards Feeding-niche composition, this cluster has the highest average proportions of Vertivore aerial, Invertivore glean canopy, and Invertivore sally air – a mix which is very telling about the importance of both the tree and open elements in the habitat of these community. This cluster has very high values of Feeding-niche richness and diversity (Table IV), which mean one of the highest functional diversity value among all clusters.

As regards family-level Taxonomic composition, this cluster records the highest average proportions of several families, such as the Meropidae, the Campephagidae and the Emberizidae. It also has some of the highest values of family-level Taxonomic richness, diversity (the highest) and evenness.

Cluster 3 has a relatively high proportion of Miombo endemics (9%), which is only second to the two Miombo-woodland clusters, and an intermediate proportion of large-range, cosmopolitan species (6%). Custer 3 has thus significant conservation value, while lower than those of clusters 1 and 2.

Cluster 3 has a relatively high average proportion sedentary species (87%), only second to those of the two Miombo-woodland clusters, probably reflecting high ecological niche filling in this cluster. In this, as well as in its conservation value, cluster 3 is intermediate between the pure Miombo woodland clusters and the other two Cropland and woodland clusters (clusters 4 and 5).

The distribution of cluster 3 is well balanced between Segundo Congresso (7 points) and Nova Madeira (8 points).

C4. Cropland and woodland 2 (cluster 4)

Cluster 4 comprises two sub-clusters that only merge in a relatively late stage of the clustering process (Fig. II), which means some internal heterogeneity within the cluster. The dendrogram shows it is relatively more similar to cluster 5 than to cluster 3 (Fig. II).

As with clusters 3 and 5 (the other two Cropland and woodland clusters), this cluster presents very high levels of Species richness and diversity, and intermediate levels of Species evenness, Abundance and Average per-species abundance (Table IV).

This Cropland and woodland community has maximum importance of *Psalidoprocne pristoptera*, *Hirundo smithii* and *Anthus cinnamomeus*, which, in average, represent together 16% of all recorded birds (Table IV). High levels of relative importance were also recorded for *Estrilda astrild* (3% of all recorded birds; Table IV). Among species that do not reach significant differences across clusters (ANOVA test), *Pachycoccyx audeberti*, *Chrysococcyx caprius*, *Cisticola natalensis*, *Melaenornis pammelaina*, *Motacilla aguimp* are exclusive of this cluster, while other reach here their maximal average proportions: *Circaetus pectoralis*, *Rhinopomastus cyanomelas*, *Campephaga flava*, *Mirafra africana*, *Sylvietta whytii*, *Hirundo rustica* and *Lamprotornis chloropterus* (Table IV). Some of these species are typical Miombo dwellers (e.g. *Sylvietta whytii* and *Lamprotornis chloropterus*), others are more generic woodland/shrubland species (e.g. *Campephaga flava*), while others use forest (edge) (e.g.

Psalidoprocne pristoptera) or open habitats (e.g. *Hirundo smithii*, *Anthus cinnamomeus Estrilda astrild* and *Cisticola natalensis*).

This cluster has the highest proportion of forest species (16%) and the lowest proportion of woodland species (43%), but still presents relatively balanced proportions of different habitat guilds and habitat density guilds. It records the highest levels of habitat guild richness, diversity and evenness, which indicate its woodland-cropland edge nature.

As regards Feeding-niche composition, this cluster has the highest average proportions of Invertivore aerial (swallows) and relatively high proportions of Granivore generalist and Invertivore ground. It also has very high values of Feeding-niche richness and diversity (Table IV), which are among the highest of all clusters.

As regards family-level Taxonomic composition, this cluster records the highest average proportions of several families, such as the Hirundinidae and Motacillidae. It also has some of the highest values of family-level Taxonomic richness, diversity and evenness (Table IV).

Cluster 4 has a relatively high proportion of Miombo endemics (8%), which is only second to the two Miombo-woodland clusters and cluster 3, and a relatively high proportion of large-range, cosmopolitan species (9%) (Table IV). Custer 4 has thus some conservation value, which is nevertheless lower than those of clusters 1 and 2.

Cluster 4 has the lowest average proportion sedentary species (75%) (Table IV).

The distribution of cluster 4 is well balanced between Segundo Congresso (12 points) and Nova Madeira (12 points) (Table V).

C5. Cropland and woodland 3 (cluster 5)

Cluster 5 forms early in the clustering process (Fig. II), which means it is quite homogeneous. The dendrogram shows it is relatively more similar to cluster 4 than to cluster 3 (Fig. II).

As with clusters 3 and 4 (the other two Cropland and woodland clusters), this cluster presents very high levels of Species richness and diversity (the highest for the former), and intermediate levels of Species evenness, Abundance and Average per-species abundance (Table IV).

This Cropland and woodland community has maximum importance of *Elanus caeruleus*, *Coracias spatulatus*, *Coracias caudatus*, *Halcyon albiventris*, *Prionops plumatus*, *Hyliota flavigaster*, *Creatophora cinerea* and *Myrmecocichla arnotti*, which, in average, represent together 20% of all recorded birds (Table IV). Among species that do not reach significant differences across clusters (ANOVA test), some reach also here their maximal average proportions: *Chrysococcyx klaas*, *Rhinopomastus cyanomelas*, *Indicator indicator*, *Prionops retzii*, *Chlorophoneus sulfureopectus*, *Dicrurus adsimilis*, *Zosterops senegalensis*, and *Ploceus ocularis* (Table IV). Most of these of these species are woodland species, some of which typical Miombo dwellers (e.g. *Coracias spatulatus* and *Hyliota flavigaster*); a few are open-habitat species (e.g. *Elanus caeruleus* and *Coracias caudatus*).

This cluster presents balanced proportions of the different habitat guilds and habitat density guilds, which are quite similar to those of cluster 3. It records high levels of habitat guild richness and diversity, which indicate its woodland-cropland edge nature.

As regards Feeding-niche composition, this cluster has the highest average proportions of Invertivore insessorial generalist, Invertivore sally ground and Invertivore generalist. It has the highest value of Feeding-niche richness and high values of Feeding-niche diversity and evenness (Table IV).

As regards family-level Taxonomic composition, this cluster records the highest average proportions of several families, such as the Coraciidae, Vangidae and Hyliotidae. It also has the highest value of family-level Taxonomic richness, and very high levels of family-level Taxonomic diversity and evenness (Table IV).

Cluster 5 has a relatively low proportion of Miombo endemics (4%), which is comparable to those of the three, more open-habitat communities that follow. It has a intermediate proportion of large-range, cosmopolitan species (6%) (Table IV), Custer 5 has thus a reduced conservation value.

Cluster 5 has a quite low average proportion of sedentary species (77%) (Table IV).

Cluster 5 is more represented in Segundo Congresso (8 points) than in Nova Madeira (3 points).

C) Fallow bird communities

41 (out of 56) points selected to represent fallow habitats were included in two clusters (cf. clusters 6 and 7; Fig. II, Table V). While fallow points are the main habitat type in both, there are significant differences between these two clusters as regards habitat types: in cluster 6, only 48% of the points are fallows, and the other half of points is well distributed between woodland and cropland points; in cluster 7, fallows represent 85% and the other 15% are woodland points (there are no cropland points in cluster 7) (Table V). 7 in 11 fallow points in cluster 7 are relatively old (more than 8 years old).

These two fallow clusters group in a single, higher-order cluster, which then groups with the two Miombo woodland clusters (Fig. II).

Both of these clusters present relatively low levels of Abundance and Species richness, similarly with the two Miombo-woodland clusters (Table IV). The other abundance and diversity indicators differ markedly between the two (cf. the individual clusters descriptions).

They have both relatively high proportions of shrubland species (maximal in cluster 7).

Although not sharing clear common themes in terms of functional (feeding-niche) composition, they share relatively low levels of Functional (feeding-niche) richness and relatively high levels of Functional (feeding-niche) evenness, a pattern that is similar to that of the two Miombo-woodland clusters (Table IV).

Family-level Taxonomic richness is relatively low in these two clusters, also similarly to the two Miombo-woodland clusters (Table IV).

As regards their conservation significance, the average proportions of Miombo-endemic species are relatively low in both clusters (3-5% of all recorded birds, Table IV). The average proportions of large-range, cosmopolitan species are relatively high – actually very high (the highest) in cluster 7.

The average proportions of fully sedentary species are medium-high (83-87%).

While cluster 6 is more represented in Nova Madeira (44 points) than in Segundo Congresso (19 points), cluster 7 is distributed in a balanced way between the two communities (Table V).

In both communities, cluster 7 (old fallows) points are predominantly located in the core of the older cropland patches, far away from the edge of Miombo woodland (where recent deforestation is occurring); cluster 6 (including a significant proportion of woodland points) is located either in the core of the older cropland patches or close to the edge of Miombo woodland (in a position more similar to that of Cropland and woodland clusters) (Fig. III).

C6. Fallows, woodlands and cropland (cluster 6)

Cluster 6 is a very large (63 points) and quite heterogeneous cluster: it includes three distinct sub-clusters that only join to form the whole cluster relatively late in the clustering process (Fig. II). This reveals some species turnover (beta diversity) across points within the cluster, which is also reflected with a very high number of species recorded in points included in the cluster (96 species) when compared to the average number of species per point, or species richness (ca. 11 species) (Table IV). This is also probably related with a relatively balanced participation of woodland, fallow and cropland points within the cluster (Table V).

As with cluster 7, this cluster presents relatively low levels of Abundance and Species richness, similarly with the two Miombo-woodland clusters (Table IV). It has slightly lower species diversity than cluster 7 (Table IV).

Cluster 6 has maximum importance of only two species: *Laniarius aethiopicus* and *Prinia subflava*, two woodland/shrubland species, which represent together only 9% of all recorded birds (Table IV). Among species that do not reach significant differences across clusters (ANOVA test), *Coturnix coturnix*, *Coturnix delegorguei*, *Dendroperdix sephaena*, *Caprimulgus fossii*, *Trigonoceps occipitalis*, *Polemaetus bellicosus*, *Dendropicos stierlingi*, *Dendropicos namaquus*, *Malaconotus blanchoti*, *Eremomela icteropygialis*, *Turdoides jardineii*, *Monticola angolensis* and *Passer diffusus* are exclusive of this cluster; other reach also here their maximal average proportions: *Pternistis afer*, *Centropus superciliosus*, *Phoeniculus purpureus*, *Merops hirundineus*, *Lybius torquatus*, *Dryoscopus cubla*, *Camaroptera brachyura*, *Cisticola erythrops*, *Salpornis salvadori*, *Cinnyris venustus* and *Emberiza flaviventris* (Table IV). Many of these numerous species, which represent, in a balanced way, woodland, shrubland and more open, grassland habitats, only occurred in a single point, which explains the significant species turnover (beta diversity) among points within this heterogeneous cluster.

This cluster presents balanced proportions of the different habitat guilds and habitat density guilds, which are quite similar to those of clusters 1, 2, 3 and 5. It records, however a much lower level of habitat guild richness than those of the three Cropland and woodland clusters (clusters 3, 4 and 5), which indicates that, differently from these clusters, cluster 6 does not represent woodland edge landscapes.

As regards Feeding-niche composition, this cluster has a high average proportion of Invertivore insessorial generalist (19%, close to the maximum of 21%, in cluster 5). Together with cluster 7, this cluster has relatively low levels of Functional (feeding-niche) richness and relatively high levels of Functional (feeding-niche) evenness, a pattern that is also similar to that of the two Miombo-woodland clusters (Table IV).

As regards family-level Taxonomic composition, this cluster records the highest average proportion of Cisticolidae and a high proportion of Malaconotidae. As in cluster 7 and the two Miombo-woodland clusters (clusters 1 and 2), Family-level Taxonomic richness is relatively low in cluster 6 (Table IV).

Cluster 6 has a relatively low proportion of Miombo endemics (5%), which is comparable to those of clusters 5, 7 and 8. The average proportion of large-range, cosmopolitan species is intermediate (6%) (Table IV). Thus, cluster 6 has a relatively low conservation value. However, as seen in the list of species above, some valuable Miombo endemics (e.g. *Dendropicos stierlingi* and *Monticola angolensis*) may occur in some points within cluster 6.

Cluster 6 has a relatively high average proportion of fully sedentary species (87%) (Table IV), which may indicate some niche filling that closes the ecosystem to incoming migrants.

Cluster 6 is more represented in Nova Madeira (44 points) than in Segundo Congresso (19 points) (Table V).

Cluster 6 (which includes a significant proportion of woodland points) is located either in the core of the older cropland patches (as cluster 7) or close to the edge of Miombo woodland (in a position more similar to that of the Cropland and woodland clusters 3, 4 and 5) (Fig. III).

C7. Old fallows (cluster 7)

In spite of being a small cluster (13 points), cluster 7 is the internally most heterogeneous cluster, as it forms later than any other cluster in the clustering process (Fig. II). This may reveal some species turnover (beta diversity) across points within the cluster (Table IV). The cluster is, however, quite homogenous in terms of habitat-type composition: 11 of its 13 points are fallows, in particular old (>8 years old) fallows (Table V).

As with cluster 6, this cluster presents relatively low levels of Abundance and Species richness, similarly with the two Miombo-woodland clusters (Table IV). Cluster 7 has the lowest value of Average per-species abundance, and has slightly higher species diversity than cluster 6 (Table IV).

Cluster 7 has maximum importance of the following species: *Cuculus clamosus*, *Tchagra australis*, *Corvus albus* and *Pycnonotus barbatus*, which represent together 22% of all recorded birds (Table IV). *Corvus albus* was mostly observed in points in this cluster because of their proximity to villages, where this scavenger searches for food. High levels of relative importance were also recorded for *Laniarius aethiopicus* and *Prinia subflava*, which together represent another 10% of all recorded birds (Table IV). Note that these two species reach their maximum importance in cluster 6, the other cluster representing fallow bird communities. Among the species that do not reach significant differences across clusters (ANOVA test), *Cypsiurus parvus* is exclusive of cluster 7; others reach also here their maximal average proportions: *Treron calvus*, *Cuculus solitarius*, *Lophoceros alboterminatus*, *Tchagra senegalus*, *Terpsiphone viridis*, *Mirafra rufocinnamomea*, *Turdus libonyana*, and *Gymnoris superciliaris* (Table IV). A number of these species are shrubland dwellers.

This cluster presents the highest proportion of shrubland birds (a remarkable 39%); as a result, the proportions of woodland and grassland birds are smaller than those of cluster 6. As in cluster 6, habitat guild richness is much lower than in the three Cropland and woodland clusters (clusters 3, 4 and 5), which indicates that, differently from these clusters, cluster 7 does not represent woodland edge landscapes.

As regards Feeding-niche composition, cluster 7 has the highest proportions of both Carnivore Omnivore Terrestrial and Invertivore Ground; it also has a relatively high average proportion of Invertivore Insessorial Generalist. Although not passing the ANOVA test, Frugivore glean have also their maximum in cluster 7. Together with cluster 6, this cluster has relatively low levels of Functional (feeding-niche) richness and relatively high levels of Functional (feeding-niche) evenness, a pattern that is similar to that of the two Miombo-woodland clusters (Table IV).

As regards family-level Taxonomic composition, this cluster records the highest average proportions of Cuculidae, Malaconotidae, Corvidae and Pycnonotidae; and a high proportion of Cisticolidae. As in cluster 6 and the two Miombo-woodland clusters (clusters 1 and 2), Family-level Taxonomic richness is relatively low in cluster 7 (Table IV).

Cluster 7 has a very low proportion of Miombo endemics (3%), which is comparable to those of clusters 5, 6 and 8. The average proportion of large-range, cosmopolitan species is maximum in cluster 7, with a remarkable 17% (Table IV). Thus, cluster 7 has a relatively low conservation value.

Cluster 7 has an intermediate value of average proportion of fully sedentary species (83%) (Table IV).

Cluster 7 is distributed in a balanced way between Nova Madeira and Segundo Congresso (Table V). In both communities, cluster 7 (old fallows) points are predominantly located in the core of the older cropland patches, far away from the edge of Miombo woodland (where recent deforestation is occurring) (Fig. III).

D) Old cropland bird communities

Cluster 8, Old cropland and fallows, is the only cluster that does not include any Miombo woodland point. It includes 8 cropland points and 7 fallow points, 4 of which are young fallows (Table V). Although only including 14% of the 56 cropland points, it represents the purest cropland bird community, in that woodland birds are almost absent. In this sense it is markedly different from the Cropland and woodland clusters 3, 4 and 5, all of which include a significant component of woodland birds.

This is the most distinctive bird community in Chipanje Chetu, as it only joins the set of all other clusters in the last step of the clustering process (Fig. II). It has some internal heterogeneity reflected in 2 sub-clusters that only merge relatively late (Fig. II). This means some beta diversity (species turnover) within the cluster, which is also reflected in a total of 61 species recorded in the cluster points (which compares with an average (alpha) species richness of only 13.9 species per point).

This cluster records extremely high (the highest) values of Abundance and per-species average abundance, and a relatively high average species richness. Species diversity and evenness (the latter much below the average values of all other clusters) record here their minimal values among all clusters.

As regards habitat, this cluster records the maximum proportion of grassland birds and the minimum proportions of woodland and shrubland birds (table IV). Habitat guild richness is relatively high (table IV), which may reflect the significant beta diversity within the cluster. As regards habitat density, this cluster records the maximum proportion of open habitat birds (more than half of all recorded birds) and the minimum of semi-open habitat birds (table IV). The habitat contrast with all other clusters is very marked.

As regards functional (feeding-niche) composition, cluster 8 records an exceptionally high proportion of Granivore ground (57% of all recorded birds), by far the highest among all clusters (table IV). It also records a relatively high average proportion of Granivore generalist and the maximum (although not significant) proportion of Granivore arboreal. This marked, abundance-based concentration in the Granivore guilds leads to minimal values of Functional evenness and diversity in this cluster (table IV).

A similar pattern occurs with family-level taxonomic composition: the granivore families Ploceidae (24%) and Estrildidae (37%) reach here marked maxima among all clusters, and, as a result, family diversity and evenness reach, in this cluster, marked minima (table IV).

As regards its conservation value, cluster 8 records the lowest average proportions (2%, Table IV) of Miombo-endemic species, while the average proportions of large range, cosmopolitan species is not particularly high.

Unexpectedly, cluster 8 records a relatively high average proportion of fully sedentary species (87%, Table IV), while the proportion of fully migratory is also comparatively high.

12 out of 15 points in this cluster are located in Segundo Congresso, where human pressure and deforestation are more intense, with only 3 points in Nova Madeira. In both communities, the points included in this cluster are generally located in the core of the oldest cropland patches, close to human settlements and main roads (Fig. III).

All of these results lead to select this cluster as representing well the bird community corresponding to the final stage of the deforestation process, where the cropland habitat is far away from the edge of any remaining Miombo-woodland patch. As such, the set of indicators commented in this section provides as a good identifier of extreme deforestation situations.

C8. Old cropland and fallows (cluster 8)

The Old cropland and fallows bird communities corresponding to cluster 8 have maximum average importance of *Euplectes capensis*, *Uraeginthus angolensis*, *Estrilda astrild*, and *Spermestes cucullata*, which, in average, represent together 58 % of all recorded birds (Table IV). Among species that do not reach significant differences across clusters (ANOVA test), *Spermestes fringilloides* is exclusive of this cluster, while other reach here their maximal average proportions: *Numida meleagris*, *Lanius collaris*, *Cinnyricinclus leucogaster*, *Lagonosticta rhodopareia*, *Crithagra mozambica* (Table IV). Most of these species are granivore and/or typical dwellers of open habitats, and there is a clear absence of typical woodland birds, which associates these bird communities with cropland and fallows far from the edge of Miombo woodlands.

VI.II.III. REFERENCES

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