selected by taking into account the following considerations: (i) whether it was a significant predictor using the F- value and its probability, (ii) how much of the variation in the dependent variable was explained by the model using the adjusted coefficient of determination, and (iii) whether there was collinearity among the independent variables using the tolerance value. The model that had (a) an ANOVA significance probability that was less than 0.05, (b) a relative high adjusted R^2, and (c) relative high tolerance values among the independent variables was selected as the best model. The vegetation variables in the best model were identified as significant habitat factors that influenced avian community structure.

5.3.2 Correspondence analysis

SPSS© analytical software (SPSS, 2005) was used to carry out correspondence analysis between the avian community structure and vegetation structure characteristics as well as the status of the woodland at each plot. The rows in the correspondence analysis consisted of the avian community structure variables (bird species and avian guild type) in the plots while the columns consisted of the status of the woodland in the plot as well as the categorical data on tree size, tree height and % canopy cover. Since no significance statistics are attached to the results of correspondence analysis, a positive or negative correlation coefficient of 50 % and above was considered as significant correspondence in this study.

5.4 Results

5.4 1 Modeling the responses of the avian community structure to habitat factors

5.4.1.1 Modeling the response of avian species richness to habitat factors

Twelve models were produced by linear regression analysis of vegetation variables on avian species richness (Appendix 5.1). Models 5 -12 were all statistically significant in predicting avian species richness from vegetation characteristics. Model 12 was selected among the significant models as the best linear model to predict avian species richness. The vegetation variables in this model are total species richness, sapling density, tree size and tree height. These habitat factors are therefore significant in influencing avian species richness. Summary statistics on coefficients and collinearity statistics are given in Apendix 5.2. The linear regression equation for determining avian species richness (y) is:

$$y = 2.190\ HEIGHT + 0.242\ SAPDEN - 2.060\ DBH - 0.322\ TOTRICH + 5.210$$

From the standardized coefficients, tree height and tree size have the greatest influence on the model. Avian species richness is expected to increase in a woodland with tall trees that have small stems.

5.4.1.2 Modeling the response of avian guild richness to habitat factors

Thirteen models were produced by linear regression analysis for predicting avian guild richness from vegetation characteristics (Appendix 5.3). Models 2 – 13 were statistically significant and out of these, the 13th model was selected as the best predictor of avian guild richness. The habitat factors in the selected model are tree species evenness, tree species diversity and tree size. Therefore these vegetation variables are significant habitat factors in influencing avian guild richness. Summary statistics on coefficients and collinearity statistics are given in Appendix 5.4. The linear equation for predicting avian guild richness (y) is:

$$y = 6.959 + 0.788\ TREEVEN - 0.952\ TREEDIV - 0.223\ DBH$$

From the standardized coefficients, tree species evenness and tree species diversity have the greatest influence on avian guild richness. Avian guild richness is expected to increase in a woodland with low tree species diversity and high tree species evenness.

5.4.1.3 Modeling the response of avian abundance to habitat factors

Twelve models were produced by linear regression analysis of vegetation variables on avian abundance (Appendix 5.5). Models 9 - 12 were statistically significant in predicting avian abundance from vegetation variables. The 12th model was selected as the best among the significant models. The vegetation variables in the best model were tree species diversity, total species richness, sapling density and tree species richness. These are the significant habitat factors influencing avian abundance. Summary statistics on coefficients and collinearity statistics are given in Appendix 5.6. The linear equation for predicting avian abundance (y) is:

$$y = 46.854 + 0.400\ TREEDIV + 0.239\ SAPDEN - 0.425\ TRERICH - 0.293\ TOTRICH$$

From the standardized coefficients, tree species richness and tree species diversity have the greatest influence on avian abundance. Avian abundance is expected to increase in a woodland with low tree species richness and high tree species diversity.

5.4.2 Response of avian species to miombo woodland vegetation structure

5.4.2.1 Correlation between avian species occurrence and tree height

Eleven dimensions were identified in the correspondence analysis between bird species occurrence and tree height. The first and second dimensions accounted for 18.1 % and 16.2 % of the correlation, respectively. Small trees and shrubs were correlated with the first dimension by 27.7% whereas with the second dimension, the correlation was less than 10%. Understorey and canopy trees' correlation with either the first or second dimension was less than 10%. The first dimension divided bird species into those that were correlated with canopy trees and were positively correlated with the first dimension from those that were negatively correlated with the first dimension and correlated with understorey trees, canopy trees and small trees and shrubs (Figure 5.2). Bird species correlated either positively or negatively with the second dimension were also correlated with canopy trees, understorey trees and small trees and shrubs. When the first and second dimensions were graphed as a biplot, bird species and tree height were correlated as shown in Figure 5.2. Twenty bird species were correlated with canopy trees while 13 species and 3 species were correlated with understorey trees and small trees and shrubs, respectively. The detailed bird species correlation with tree height data is given in Table 5.1.

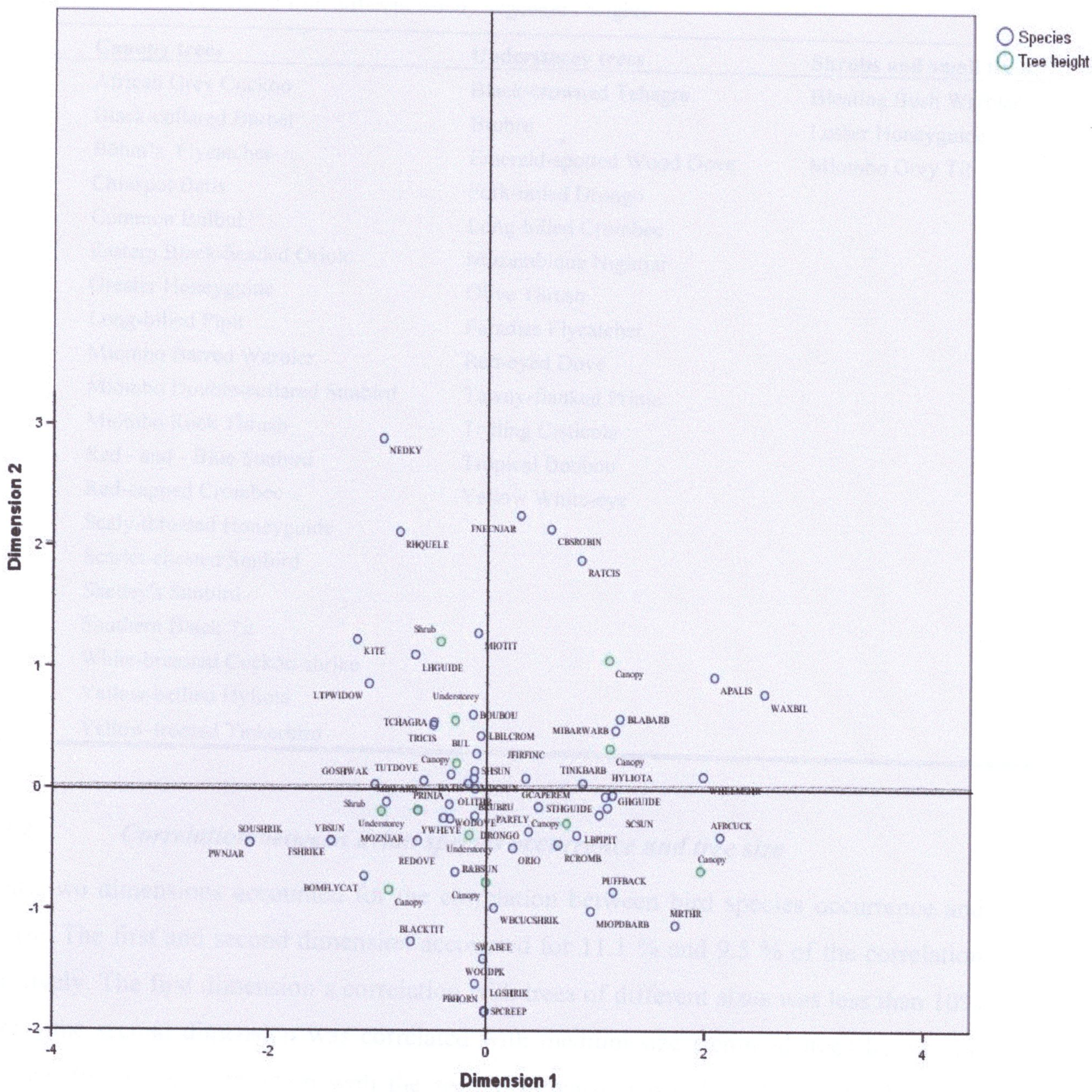


Figure 5.2 Correspondence map of avian species occurrence and tree height. Bird species abbreviations are given below

BUL – Common Bulbul, SHSUN – Shelley's Sunbird, ORIO – Eastern Black-headed Oriole, MBWARB – Bleating Bush Warbler, OLITHR – Olive Thrush, PARFLY – Paradise Flycatcher, RATCIS – Rattling Cisticola, TRICIS – Trilling Cisticola, NEDKY – Neddicky, APALIS – Yellow-breasted Apalis, PRINIA – Tawny-flanked Prinia, REDOVE – Red-eyed Dove, SWABEE – Swallow-tailed Bee-eater, KITE – Black (Yellow-billed) Kite, DRONGO – Fork-tailed Drongo, WOODPK – Bennett's Woodpecker, BLACKTIT – Southern Black Tit, TINKBARB – Yellow-fronted Tinkerbird, MRTHR – Miombo Rock Thrush, MDCSUN – Miombo Double-collared Sunbird, RCROMB – Red-capped Crombec, WHELMSHR – White Helmetshrike, LHGUIDE – Lesser Honeyguide, GHGUIDE – Greater Honeyguide, STHGUIDE – Scaly-throated Honeyguide, MIOTIT – Miombo Grey Tit, BATIS – Chinspot Batis, TCHAGRA – Black-crowned Tchagra, GOSHAWK – Dark Chanting Goshawk, FSHRIKE – Fiscal Shrike, TUTDOVE – Cape Turtle Dove, LBILCROM – Long-billed Crombec, MIBARBWARB – Miombo Barred Warbler, GCAPERE – Green-capped Eremomela, BLABARB – Black Collared Barbet, R&BSUN – Red – and – Blue Sunbird, SCSUN – Scarlet-chested Sunbird, BOUBOU – Tropical Boubou, MOZNJAR – Mozambique Nightjar, FNECNJAR – Fiery-necked Nightjar, PWNJAR – Pennant-winged Nightjar, CBSROBIN – Central Bearded Scrub Robin, AFRCUCK – African Grey Cuckoo, BOMFLYCAT – Böhm 's Flycatcher, MIOPDBARB – Miombo Pied Barbet, PBHORN – Pale-billed Hornbill, SOUSHRIK – Souza's Shrike, LTPWIDOW – Long-tailed Paradise Widow, RHQUELE – Red-headed Quelea, WBCUCSHRIK – White-breasted Cuckoo-shrike, PUFFBACK – Southern Puffback, JFIRFINC – Jameson Firefinch, LBPIPIT – Long-billed Pipit, YWHEYE – Yellow White-eye, SPCREEP – Spotted Creeper, YBSUN – Yellow-bellied Sunbird, LGSHRIK – Lesser Grey Shrike, HYLIOTA – Yellow-bellied Hyliota, BRUBRU – Brubru, BCCEREM – Black –capped Eremomela

Table 5.1 Bird species correlated with different woody vegetation heights

	Canopy trees	Understorey trees	Shrubs and small trees
1	African Grey Cuckoo	Black-crowned Tchagra	Bleating Bush Warbler
2	Black-collared Barbet	Brubru	Lesser Honeyguide
3	Böhm's Flycatcher	Emerald-spotted Wood Dove	Miombo Grey Tit
4	Chinspot Batis	Fork-tailed Drongo	
5	Common Bulbul	Long-billed Crombec	
6	Eastern Black-headed Oriole	Mozambique Nightjar	
7	Greater Honeyguide	Olive Thrush	
8	Long-billed Pipit	Paradise Flycatcher	
9	Miombo Barred Warbler	Red-eyed Dove	
10	Miombo Double-collared Sunbird	Tawny-flanked Prinia	
11	Miombo Rock Thrush	Trilling Cisticola	
12	Red - and - Blue Sunbird	Tropical Boubou	
13	Red-capped Crombec	Yellow White-eye	
14	Scaly-throated Honeyguide		
15	Scarlet-chested Sunbird		
16	Shelley's Sunbird		
17	Southern Black Tit		
18	White-breasted Cuckoo-shrike		
19	Yellow-bellied Hyliota		
20	Yellow-fronted Tinkerbird		

5.4.2.2 Correlation between avian species occurrence and tree size

Twenty-two dimensions accounted for the correlation between bird species occurrence and tree size. The first and second dimension accounted for 11.1 % and 9.5 % of the correlation respectively. The first dimension's correlation with trees of different sizes was less than 10% whereas the second dimension was correlated with medium-size stemmed trees by 33.5%. The other tree sizes' correlation with the second dimension was less than 10%. The first dimension did not separate bird species correlated with trees of different sizes neither did the second dimension. When the first and second dimensions were graphed as a biplot, the bird species were correlated with tree size as shown in Figure 5.3. Fourteen species were correlated with large stemmed trees while 15 species each were correlated with medium-size stemmed trees and small stemmed trees. The detailed correlation between bird species and tree size is given in Table 5.2.

Figure 5.3 Correspondence map of avian species occurrence and tree size. For bird abbreviations see Figure 5.1 above. Tree size abbreviations are as follows: LT – Large stemmed trees, MST – Medium size stemmed trees, ST – Small stemmed trees

Table 5.2 Bird species correlation with trees of different sizes (DBH)

	Large stemmed trees	Medium size stemmed trees	Small stemmed trees
1	African Grey Cuckoo	Black-collared Barbet	Black-capped Eremomela
2	Chinspot Batis	Black-crowned Tchagra	Böhm's Flycatcher
3	Common Bulbul	Bleating Bush Warbler	Brubru
4	Eastern Black-headed Oriole	Cape Turtle Dove	Central Bearded Scrub Robin
5	Greater Honeyguide	Fiery-necked Nightjar	Jameson Firefinch
6	Long-billed Pipit	Fork-tailed Drongo	Long-tailed Paradise Widow
7	Miombo Double-collared Sunbird	Miombo Barred Warbler	Miombo Bleating Warbler
8	Miombo Pied Barbet	Paradise Flycatcher	Miombo Grey Tit
9	Olive Thrush	Rattling Cisticola	Mozambique Nightjar
10	Scarlet-chested Sunbird	Red - and - Blue Sunbird	Pale-billed Hornbill
11	Shelley's Sunbird	Red-capped Crombec	Pennant-winged Nightjar
12	White Helmet Shrike	Scaly-throated Honeyguide	Red-eyed Dove
13	Yellow-breasted Apalis	Souza's Shrike	Red-headed Quelea
14	Yellow-fronted Tinkerbird	Tropical Boubou	Tawny-flanked Prinia
15		Yellow White-eye	Trilling Cisticola

5.4.2.3 Correlation between avian species occurrence and canopy cover

Eleven dimensions were identified in the correspondence analysis between bird species occurrence and canopy cover. The first and second dimensions accounted for 17.0 % and 15.4 % of the correlation, respectively. The different canopy covers were correlated with the first dimension by less than 10% while lightly closed canopy woodland was correlated with the second dimension by 32.4%. The other canopy cover types were correlated with the second dimension by less than 10%. The first dimension divided bird species into those that were positively correlated with the first dimension and correlated with a lightly closed canopy cover woodland from those that were negatively correlated with the first dimension and correlated with both open canopy cover woodland and lightly closed canopy cover woodland. The second dimension did not separate bird species according to their correlation with different woodland canopy cover. When the first and second dimensions were graphed as a biplot, avian species occurrence and canopy cover were correlated as shown in Figure 5.4. Fourteen bird species were correlated with open canopy woodland while lightly closed canopy woodland was correlated with 13 species. The detailed correlation between avian species occurrence and canopy cover is summarized in Table 5.3.

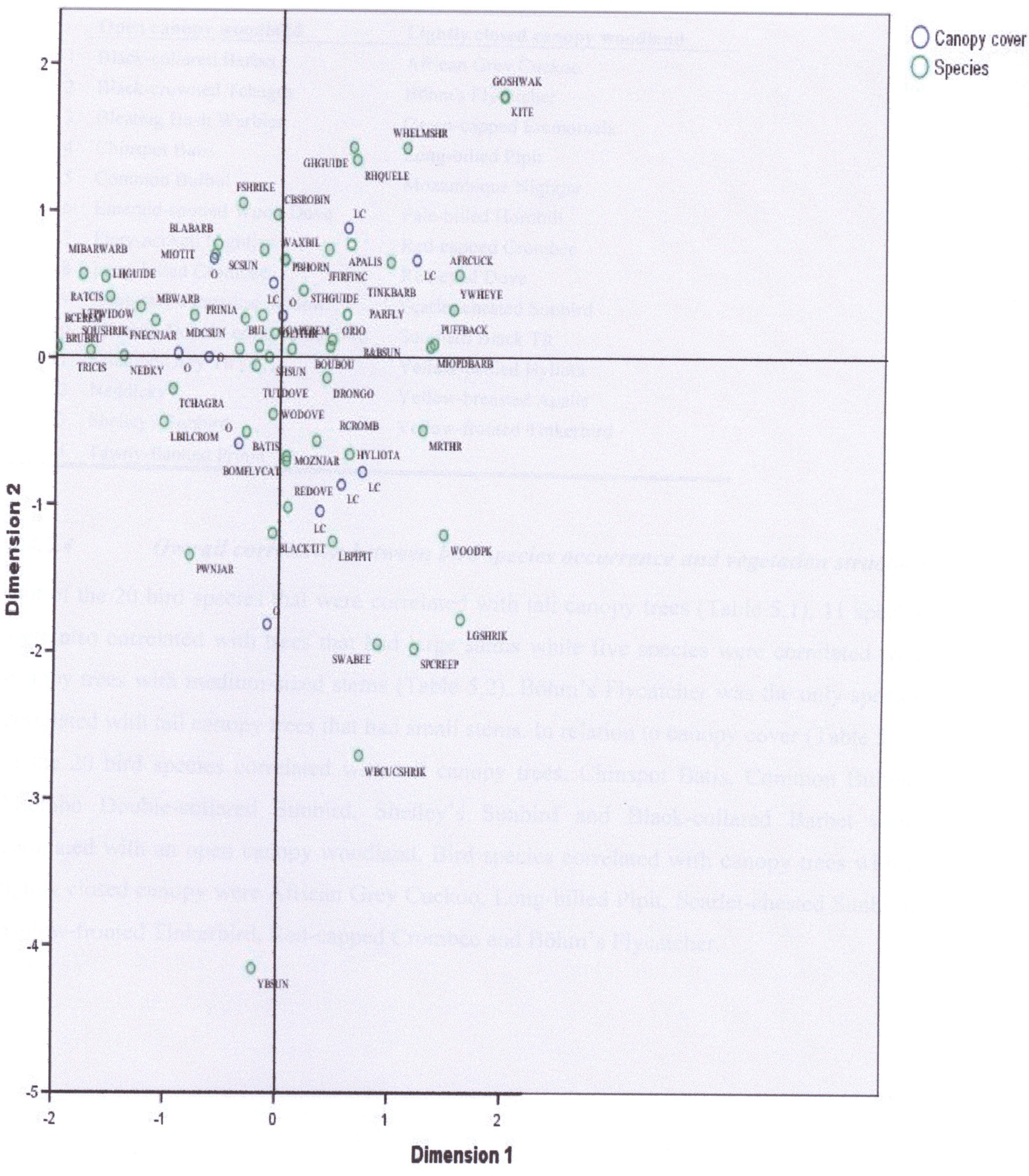


Figure 5.4 Correspondence map of avian species occurrence and woodland canopy cover. For the bird abbreviations, see Figure 5.1. The abbreviations for % canopy cover are as follows: O – Open canopy woodland and LC – Lightly closed canopy woodland.

Table 5.3 Bird species correlated with woodland with different canopy cover

	Open canopy woodland	Lightly closed canopy woodland
1	Black-collared Barbet	African Grey Cuckoo
2	Black-crowned Tchagra	Böhm's Flycatcher
3	Bleating Bush Warbler	Green-capped Eremomela
4	Chinspot Batis	Long-billed Pipit
5	Common Bulbul	Mozambique Nightjar
6	Emerald-spotted Wood Dove	Pale-billed Hornbill
7	Fiery-necked Nightjar	Red-capped Crombec
8	Long-billed Crombec	Red-eyed Dove
9	Long-tailed Paradise Widow	Scarlet-chested Sunbird
10	Miombo Double-collared Sunbird	Southern Black Tit
11	Miombo Grey Tit	Yellow-bellied Hyliota
12	Neddicky	Yellow-breasted Apalis
13	Shelley's Sunbird	Yellow-fronted Tinkerbird
14	Tawny-flanked Prinia	

5.4.2.4 *Overall correlation between bird species occurrence and vegetation structure*

Out of the 20 bird species that were correlated with tall canopy trees (Table 5.1), 11 species were also correlated with trees that had large stems while five species were correlated with canopy trees with medium-sized stems (Table 5.2). Böhm's Flycatcher was the only species correlated with tall canopy trees that had small stems. In relation to canopy cover (Table 5.3), of the 20 bird species correlated with tall canopy trees, Chinspot Batis, Common Bulbul, Miombo Double-collared Sunbird, Shelley's Sunbird and Black-collared Barbet were correlated with an open canopy woodland. Bird species correlated with canopy trees with a lightly closed canopy were African Grey Cuckoo, Long-billed Pipit, Scarlet-chested Sunbird, Yellow-fronted Tinkerbird, Red-capped Crombec and Böhm's Flycatcher.

Table 5.4 Bird species correlated with trees of different heights and sizes. The letters in parentheses indicate the guild type. For guild abbreviations see Appendix 4.2

	Tall canopy trees with large stems	Tall canopy trees with medium sized stems	Understorey trees with medium sized stems	Understorey trees with small stems
1	African Grey Cuckoo (UCI)	Black-collared Barbet (CSO)	Black-crowned Tchagra (USI)	Brubru (CSI)
2	Chinspot Batis (UCI)	Miombo Barred Warbler (GI)	Fork-tailed Drongo (VGI)	Mozambique Nightjar (AI)
3	Common Bulbul (VGO)	Scaly-throated Honeyguide (CSI)	Paradise Flycatcher (UCI)	Red-eyed Dove (VGV)
4	Eastern Black-headed Oriole (CSO)	Red- and -Blue Sunbird (CSO)	Tropical Boubou (USI)	Tawny-flanked Prinia (USI)
5	Greater Honeyguide (CSI)	Red-capped Crombec (CSI)	Yellow White-eye (CSO)	Trilling Cisticola (USI)
6	Long-billed Pipit (GO)			
7	Miombo Double collared Sunbird (CSO)			
8	Scarlet-chested Sunbird (CSO)			
9	Shelley's Sunbird (CSO)			
10	White Helmet Shrike (UCI)			
11	Yellow-fronted Tinkerbird (CSO)			

Thirteen bird species were correlated with understorey trees (Table 5.1). Out of these 13 species, eleven were also correlated with tree size (Table 5.2). The Olive Thrush was correlated with understorey trees with large stems while five species were correlated with understorey trees with medium-sized stems (Table 5.4). Five bird species were also correlated with understorey trees with small stems (Table 5.4). Of the bird species correlated with understorey trees, the Black-crowned Tchagra and Tawny-flanked Prinia were correlated with open canopy woodland while Mozambique Nightjar and Red-eyed Dove were correlated with lightly closed canopy woodland. Three bird species were correlated with shrubs and small trees (Table 5.1). There was no bird species correlated with shrubs and small trees with large stems while the Bleating Bush Warbler was correlated with short trees with medium-sized stems. The Miombo Grey Tit was correlated with short trees with small stems. Both Miombo Grey Tit and Bleating Bush Warbler were correlated with open canopy woodland.

5.4.3 Response of avian guilds to miombo woodland vegetation structure

5.4.3.1 Correlation between avian guild type and tree height

Eleven dimensions were identified by correspondence analysis as explaining the total correlation between avian guild type and tree height. The first dimension accounted for 31.2 % of the correlation while the second dimension accounted for 24.1 %. Understorey trees were correlated with the first dimension by 57.7% while small trees and shrubs were correlated with the second dimension by 30.9%. Canopy trees' correlation with either dimension was less than 10%. When the first and second dimensions were graphed as a biplot, the correlation between avian guild type and tree height is as shown in Figure 5.5. Canopy trees were correlated with canopy specialised insectivores, canopy specialised omnivores, understorey and canopy insectivores, understorey specialised insectivores, understorey and ground insectivores and generalist vegetarians. Understorey trees were correlated with generalist vegetarians, generalist insectivores, ground insectivores and ground omnivores while shrubs and small trees were correlated with understorey and ground insectivores, generalist vegetarians, generalist omnivores and aerial insectivores.

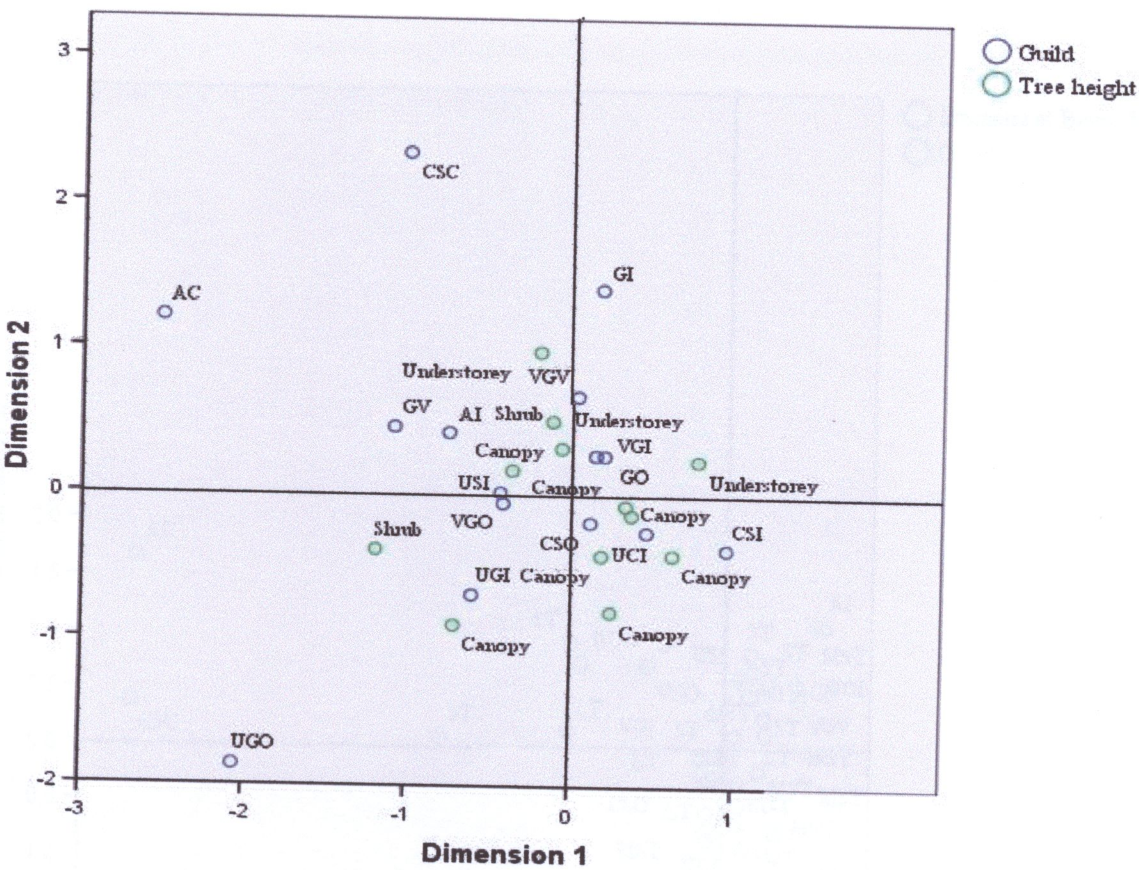


Figure 5.5 Correspondence map of avian guild type and tree height. Avian guild abbreviations are given as follows: AC – Aerial carnivore, CSC – Canopy specialised carnivore, CSI – Canopy specialised insectivore, CSO – Canopy specialised omnivore, USI – Understory specialised insectivore, AI = Aerial insectivore, GI = Ground insectivore, GO = Ground omnivore, GV = Ground vegetarian, UCI = Understory and canopy insectivore, UGI – Understory and ground insectivore, UGO – Understory and ground omnivore, VGI – Generalist insectivore, VGO – Generalist omnivore, VGV – Generalist vegetarian

5.4.3.2 Correlation between avian guild type and tree size

Fourteen dimensions accounted for all the correlation between avian guild type and tree size. The first dimension contributed 25.8 % to the correlation while the second dimension accounted for 17.2 %. The first dimension was correlated with trees of various stem sizes by less than 10% while the second dimension was correlated with medium-sized stems by 25.6%. The correlation of the second dimension with the other stem sizes was less than 10%. When the first and second dimensions were graphed as a biplot, small stemmed trees were correlated with ground insectivores, understorey and ground insectivores, understorey specialiazed insectivores, understorey and ground omnivores and generalist vegetarians. Medium-stemmed trees were correlated with canopy specialized insectivores, understorey and canopy insectivores and aerial insectivores while large stemmed trees were correlated with canopy specialised omnivores, generalist omnivores and ground omnivores (Figure 5.6).

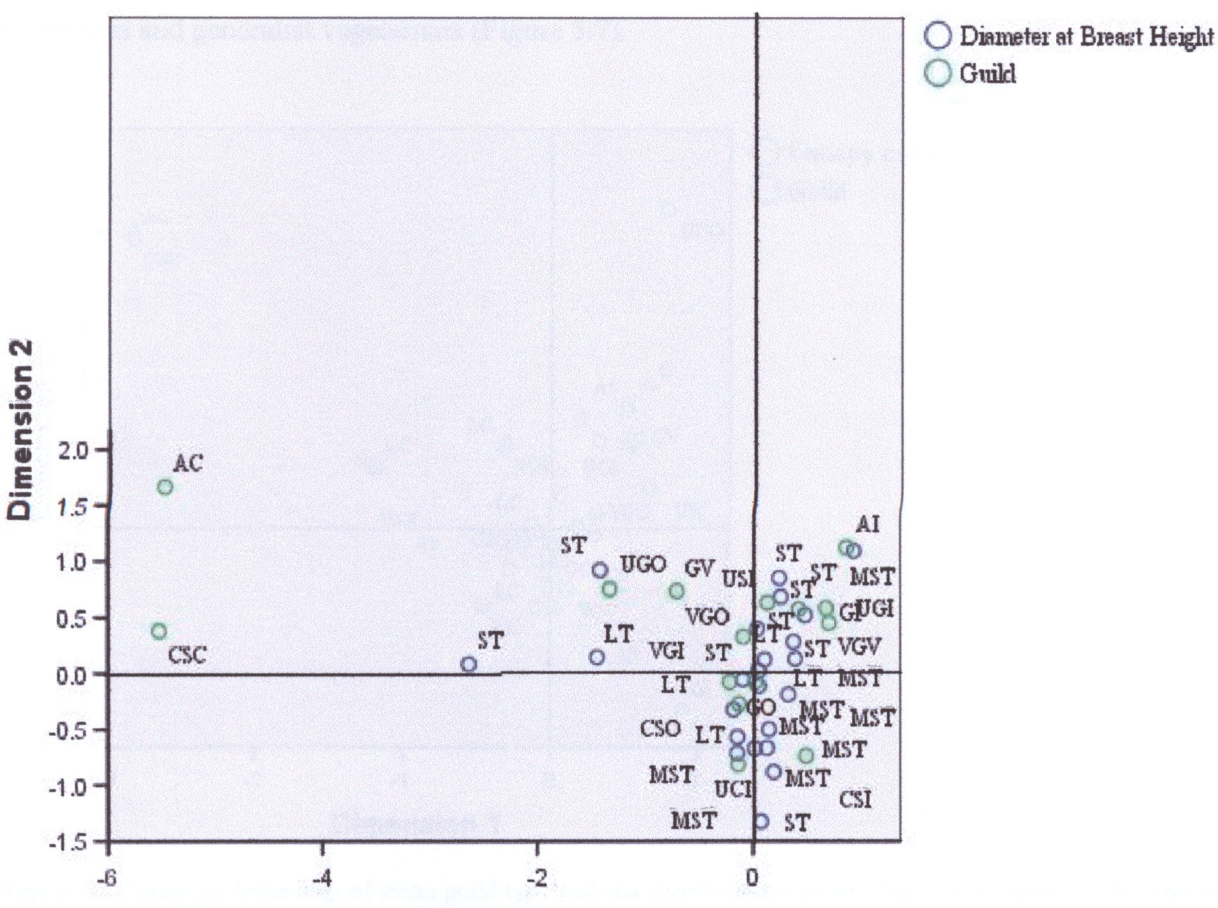


Figure 5.6 Correspondence map of avian guild type and tree size. For bird guild abbreviations see Figure 5.5. Tree size abbreviations are as follows: LT – Large stemmed trees, MST – Medium sized stemmed trees, ST – Small stemmed trees

5.4.3.3 *Correlation between avian guild type and canopy cover*

Eleven dimensions accounted for the total correlation between woodland canopy cover and avian guild type. The first dimension accounted for 25.9% of the correlation while second dimension accounted for 20.9%. The first dimension was correlated with an open canopy by 10.8% whereas the other canopy cover types were correlated with the first dimension by less than 10%. The second dimension was correlated with a lightly closed canopy by 28% while the other canopy cover types were correlated with the second dimension by less than 10%. The first dimension divided bird guilds correlated with an open canopy woodland from those correlated with a lightly closed canopy woodland.When the first and second dimensions were graphed as a biplot, a lightly closed canopy woodland was correlated with canopy specialised insectivores, canopy specialised omnivores, understorey and canopy insectivores and generalist insectivores. An open canopy woodland was correlated with aerial insectivores, ground insectivores, ground omnivores, understorey specialised insectivores, understorey and ground insectivores, generalist omnivores and generalist vegetarians (Figure 5.7).

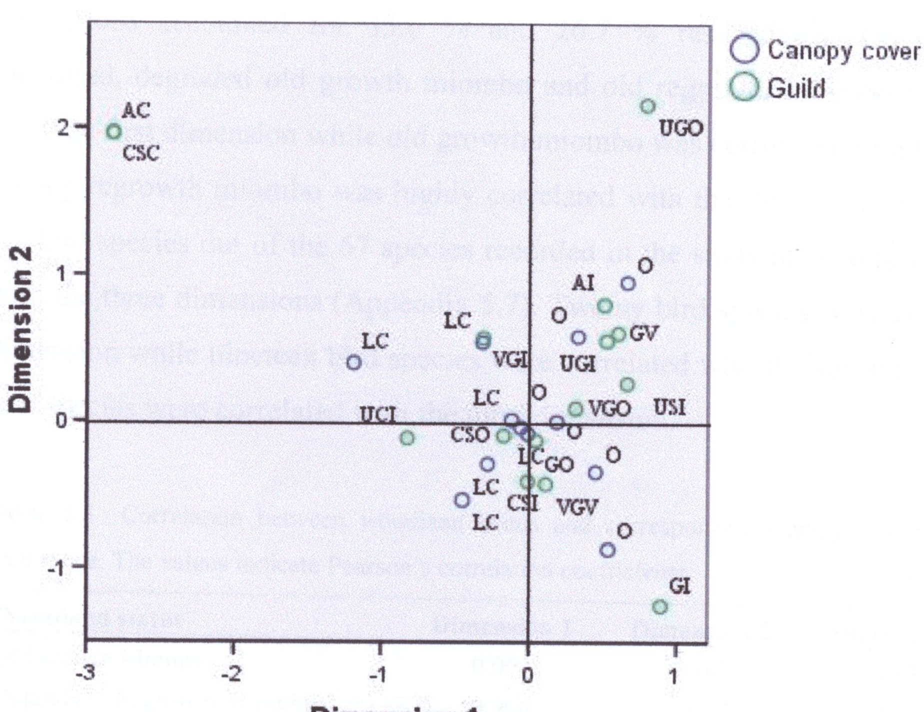


Figure 5.7 Correspondence map of avian guild type and woodland canopy cover. The abbreviations for % canopy cover are as follows: O – Open canopy woodland and LC – Lightly closed canopy woodland. For guild abbreviations see Figure 5.5

5.4.3.4 *Overall correlation between avian guilds and vegetation structure*

Canopy specialized omnivores were correlated with tall canopy trees that have large stems and form a lightly closed canopy while canopy specialized insectivores and understorey and canopy insectivores, were correlated with tall canopy trees that have medium-sized stems and form a lightly closed canopy. Understorey specialized insectivores and understorey and ground insectivores, were correlated with canopy trees that have small stems and form an open canopy. Ground insectivores were correlated with understorey trees that have small stems and form an open canopy while ground omnivores were correlated with understorey trees that have large stems and form an open canopy.

5.4.4 Response of avian species and guilds to miombo woodland degradation

5.4.4.1 *Avian species composition along the woodland degradation gradient*

Three dimensions were identified in the correspondence analysis between bird species occurrence and woodland status. The first dimension accounted for 40.3 % of the correlation between bird species occurrence and woodland degradation while the second and third dimensions accounted for 33.0 % and 26.7 % respectively. Of the three dimensions identified, degraded old growth miombo and old regrowth miombo were highly correlated with the first dimension while old growth miombo was correlated with the second dimension. Young regrowth miombo was highly correlated with the third dimension (Table 5.5). Fifty-six bird species out of the 67 species recorded in the study area were found to be correlated with the three dimensions (Appendix 5.7). Twenty bird species were correlated with the first dimension while nineteen bird species were correlated with the second dimension. Seventeen bird species were correlated with the third dimension.

Table 5.5 Correlation between woodland status and correspondence analysis dimensions of bird species occurrence. The values indicate Pearson's correlation coefficients.

Woodland status	Dimension 1	Dimension 2	Dimension 3	Total
Old growth Miombo	0.000	0.868	0.132	1.00
Degraded old growth Miombo	0.906	0.078	0.016	1.00
Old regrowth Miombo	0.632	0.006	0.362	1.00
Young regrowth Miombo	0.127	0.296	0.576	1.00

When the first and second dimensions were graphed as a biplot (Figure 5.8), bird species were correlated with woodland type as shown in Table 5.6. The first dimension separated bird species correlated with old growth miombo and degraded old growth miombo from those that were correlated with old regrowth miombo and young regrowth miombo. The second dimension separated bird species correlated with old growth miombo from those that were correlated with degraded old growth miombo, old regrowth miombo and young regrowth miombo. Nine bird species were correlated with old growth miombo while degraded old growth miombo was correlated with six species. Old regrowth miombo and young regrowth miombo were correlated with 9 species and 5 species respectively.

Table 5.6 Bird species correlation with different miombo woodland types. Letters in parentheses indicate habitat range distribution of the species: E – Miombo woodland endemics, R – Habitat restricted species and G – Habitat generalist species.

	Old growth Miombo	Degraded old growth Miombo	Old regrowth Miombo	Young regrowth Miombo
1	African Grey Cuckoo (G)	Eastern Black-headed Oriole (G)	Bleating Bush Warbler (G)	Black-collared Barbe (G)
2	Böhm's Flycatcher (E)	Emerald-spotted Wood Dove (G)	Chinspot Batis (G)	Cape Turtle Dove (G)
3	Miombo Barred Warbler (E)	Paradise Flycatcher (G)	Miombo Double-collared Sunbird (R)	Fiery-necked Nightja (G)
4	Miombo Rock Thrush (E)	Red-capped Crombec (E)	Common Bulbul (G)	Green-capped Eremomela (R)
5	Red - and - Blue Sunbird (E)	Tawny-flanked Prinia (G)	Long-billed Crombec (G)	Mozambique Nightja (G)
6	Red-eyed Dove (G)	Central Bearded Scrub-Robin (E)	Shelley's Sunbird (E)	
7	White Helmet Shrike (G)		Olive Thrush (G)	
8	White-breasted Cuckoo-shrike (G)		Scarlet-chested Sunbird (G)	
9	Yellow-fronted Tinkerbird (G)		Souza's Shrike (R)	

Forty-four percent of the species correlated with old growth miombo were miombo endemics while 55.6 % were habitat generalists. In degraded old growth miombo, 40 % of the bird species were miombo endemics while 60 % were habitat generalists. In old regrowth miombo, bird species correlated with this type of woodland consisted of 11.1 % miombo endemics, 22.2 % habitat-restricted birds and 66.7 % habitat generalists. In young regrowth miombo, the bird species correlated with it consisted of 20 % habitat-restricted birds while 80 % were habitat generalists.

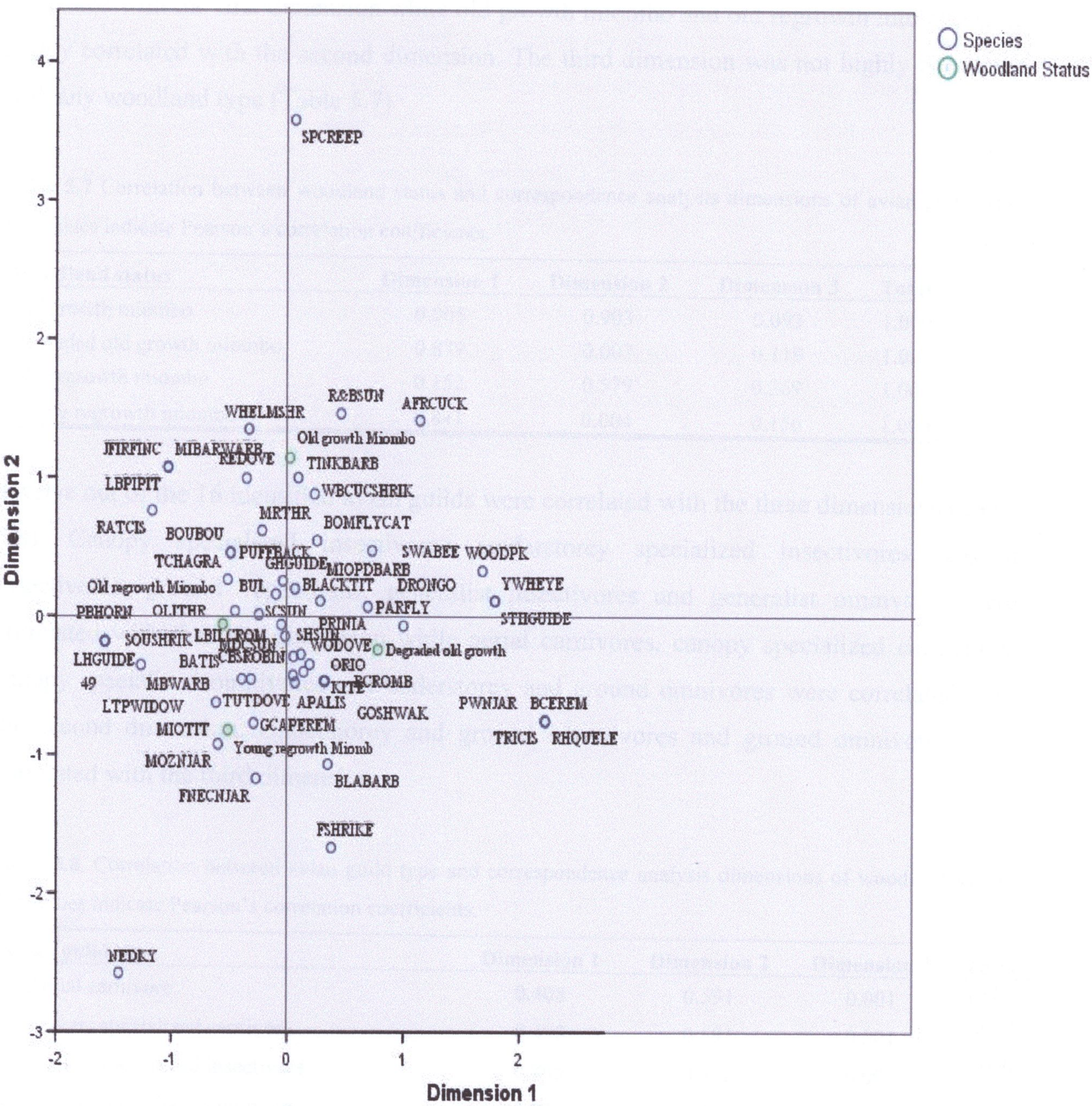


Figure 5.8 Correspondence map of avian species occurrence and woodland status. For bird species abbreviations see Figure 5.2.

5.4.4.2 Avian guild composition along the woodland degradation gradient

Three dimensions were identified in the correspondence analysis between guild type and woodland status. The first dimension accounted for 56.1 % of the correlation between guild type and woodland status while the second and third dimensions accounted for 29.0 % and

14.9 % respectively. Degraded old growth miombo and young regrowth miombo were highly correlated with the first dimension while old growth miombo and old regrowth miombo were highly correlated with the second dimension. The third dimension was not highly correlated with any woodland type (Table 5.7).

Table 5.7 Correlation between woodland status and correspondence analysis dimensions of avian guild type. The values indicate Pearson's correlation coefficients.

Woodland status	Dimension 1	Dimension 2	Dimension 3	Total
Old growth miombo	0.005	0.903	0.093	1.000
Degraded old growth miombo	0.879	0.002	0.119	1.000
Old regrowth miombo	0.152	0.579	0.269	1.000
Young regrowth miombo	0.841	0.004	0.156	1.000

Twelve out of the 16 identified avian guilds were correlated with the three dimensions (Table 5.8). Canopy specialized insectivores, understorey specialized insectivores, ground insectivores, ground vegetarians, generalist insectivores and generalist omnivores were correlated with the first dimension while aerial carnivores, canopy specialized carnivores, canopy specialized omnivores and understorey and ground omnivores were correlated with the second dimension. Understorey and ground insectivores and ground omnivores were correlated with the third dimension.

Table 5.8. Correlation between avian guild type and correspondence analysis dimensions of woodland status. The values indicate Pearson's correlation coefficients.

Avian guild type	Dimension 1	Dimension 2	Dimension 3	Total
1. Aerial carnivore	0.408	0.591	0.001	1.000
2. Canopy specialized carnivore	0.408	0.591	0.001	1.000
3. Canopy specialized insectivore	0.765	0.232	0.003	1.000
4. Canopy specialized omnivore	0.025	0.836	0.14	1.000
5. Understorey specialized insectivore	0.98	0.014	0.005	1.000
6. Ground insectivore	0.896	0.104	0.000	1.000
7. Ground omnivore	0.444	0.028	0.528	1.000
8. Ground vegetarian	0.814	0.057	0.129	1.000
9. Understorey and ground insectivore	0.077	0.066	0.857	1.000
10. Understorey and ground omnivore	0.109	0.775	0.116	1.000
11. Generalist insectivore	0.874	0.04	0.086	1.000
12. Generalist omnivore	0.809	0.165	0.026	1.000

When the first and second dimensions were graphed as a biplot (Figure 5.9), the first dimension separated old growth miombo, old regrowth miombo and young regrowth miombo from degraded old growth miombo while the second dimension separated old growth miombo and young regrowth miombo from old regrowth miombo and degraded old growth miombo. Old growth miombo was correlated with canopy specialized omnivores, understorey and canopy insectivores and generalist omnivores. Degraded old growth miombo was correlated with canopy specialized insectivores, canopy specialized omnivores, understorey and canopy insectivores and generalist insectivores. Old regrowth miombo was correlated with understorey specialized insectivores, understorey and ground insectivores, ground omnivores and generalist vegetarians while young regrowth miombo was correlated with ground vegetarians, ground insectivores, ground omnivores and generalist omnivores.

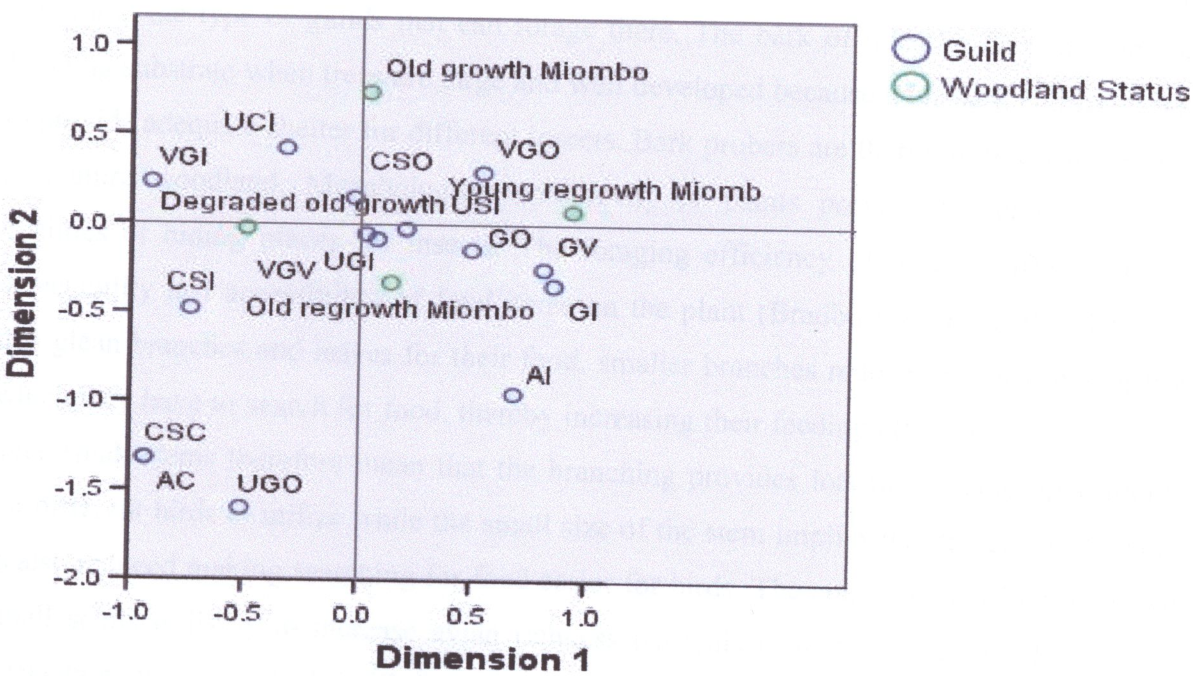


Figure 5.9 Correspondence map of avian guild type and woodland status. For avian guild abbreviations see Figure 5.5.

5.5 Discussion

5.5.1 Vegetation characteristics that influence avian community structure

Tree height and tree size are significant factors influencing avian species richness in the study area according to the linear model developed for predicting avian species richness from vegetation variables. Avian species richness is expected to increase in a woodland which has tall trees with small stems. Foliage height and the size of trees are important determinant of avian diversity because they influence the type of foraging behaviour in birds (Holmes *et al.*, 1979; Vale *et al.*, 1982). The addition of shrubs and then trees along a vegetation gradient from grassland to forest increases foliage layering and complexity by providing supporting structures such as stems and branches which act as foraging regions. The proportion of foliage at different heights is also a function of the branching structure of trees. As trees become taller, they develop more branches. This branching results in increased foraging opportunities for birds leading to increased diversity. Apart from that, the size of the tree will determine the type of guilds that can forage there. The bark of trees become an important foraging substrate when trees are large and well developed because their bark is thick enough to provide adequate shelter for different insects. Bark probers are therefore likely to be found in mature woodland. Morphological complexity of plants provides different types and qualities of hiding places for insects. The foraging efficiency of birds is affected by the detectability and accessibility of food items on the plant (Bradbury *et al.*, 2005). For birds that glean branches and leaves for their food, smaller branches reduce the surface area from which they have to search for food, thereby increasing their feeding efficiency. Tall trees that have small stems therefore mean that the branching provides lots of foraging opportunities for different birds to utilize while the small size of the stem implies that the size of branches is also reduced making searching for food easier for birds. The combination of tall trees with small stems is likely to increase avian richness particularly that of gleaners. This type of vegetation structure which is likely to lead to increased avian richness can be found in both degraded old growth miombo and old regrowth miombo. The disjointed structure of degraded old growth miombo means that one is likely to find trees of various heights and sizes while old regrowth miombo is a regenerating woodland that also has trees of variable heights and sizes. These two woodland types have high vegetation structural diversity (Table 3.5) and are expected to have increased avian richness because the physiognomy of their foliage can support different guilds. Mature woodland is expected to support more bark probers while young regrowth woodland is expected to support more gleaners, therefore old growth miombo and young regrowth miombo are likely to support specialized guilds while old regrowth miombo and degraded old growth miombo can support a variety of guilds leading to increased avian richness. Apart from tree height and tree sizes influencing avian diversity, the abundance and quality of food resources also influence avian diversity (Holmes & Recher, 1986; Powell, 1989). Different plant species provide different food resources to bird species (Figure 5.1a & b). In miombo woodland, the dominant plant species such as *Brachystegia* spp, *Julbernardia* spp and *Pericopsis angolensis* support abundant insect populations (Mbata *et al.*, 2002). Caterpillar outbreaks are a common occurrence particularly in regrowth woodland. A woodland with plant species that offer abundant food resources is likely to have increased avian richness if this is coupled with vegetation structure characteristics which encourage increased avian richness compared to a woodland with the right vegetation structure whose plant species composition does not provide food resources utilized by birds. In this study, the quality and quantity of food resources provided by different plant species was not included in the development of the model. Studies done elsewhere have shown that the availability and abundance of food resources influences the occurrence of bird species. This aspect of habitat selection by birds should be incorporated in the development of future models for predicting avian species richness in miombo woodland. Overall, the model for predicting avian species richness developed in this study is supported by findings of other researchers.

Avian guild richness is significantly influenced by tree species diversity and tree species evenness according to the linear model for predicting avian guild richness from vegetation characteristics. The factors described above as influencing avian species richness also influence avian guild richness. However, the model for predicting avian guild richness emphasizes plant species composition as the most important influence on avian guild richness compared to vegetation structure characteristics. Different guilds feed on different food resources provided by different species of plants. One therefore expects a woodland with high plant species diversity to provide different plant resources leading to increased avian guild richness. For miombo woodland, increased nectar production by plants is found in mature woodland because plant normally produce flowers when they have reached maturity while regrowth woodland has been found to support high populations of insects compared to mature woodland (Clauss, 1992; Mbata *et al.*, 2002). Grasses thrive in woodland with an open canopy compared to a woodland with a closed canopy (Gray *et al.*, 2007). Seed production by grasses is therefore expected to be high in regrowth woodland compared to mature woodland. Increased avian guild richness is expected in a woodland with high tree evenness and low tree species diversity according to the model. Results from section 3.4.3 indicate that there were no significant differences in tree species evenness among the four miombo woodland types. However, there were differences in tree species diversity. Old growth miombo and young regrowth miombo were not significantly different from each other in terms of tree species diversity while degraded old growth miombo and old regrowth miombo were also not significantly different from each other. The highest tree species diversity was in young regrowth miombo (Figure 3.11b). This means that young regrowth miombo and old growth miombo are expected to have low avian guild richness because of their higher tree species diversity while degraded old growth miombo and old regrowth miombo are expected to have higher avian guild richness. The prediction of the model are supported by the fact that in degraded old growth miombo and old regrowth miombo, one expects to find flowering tree plants because both woodland types have mature trees. The presence of a high proportion of understorey trees also supports high insect populations. The open canopy of regrowth woodland allows grasses to thrive while the spatial heterogeneity of degraded old growth miombo means that grasses are able to thrive in patches where there is regrowth woodland. This allows the two woodland types to have a variety of food resources to support different guilds. However, old growth miombo does not support high abundances of insect populations nor does it produce large amounts of grasses. Young regrowth miombo can support high abundances of insect populations and grasses, however, the amount of nectar produced in young regrowth miombo is low. Old growth miombo and young regrowth miombo therefore support specialized guilds whereas degraded old growth miombo and old regrowth miombo can support a variety of guilds.

Avian species richness is closely linked with avian guild richness. High avian richness is expected to lead to high avian guild richness. Although the models of the two avian variables had different significant vegetation variables, they led to the same prediction regarding the type of woodland where one expects to find increased avian species richness and avian guild richness. The model for avian species richness identified degraded old growth miombo and old regrowth miombo as woodland types where one expects increased avian species richness while the model for avian guild richness also identified the same woodland types as the ones where one expects to find increased avian guild richness.

For avian abundance, the interpretation of the results was not straight forward. Tree species richness and tree species diversity were the significant habitat factors in determining avian abundance. From the model, avian abundance is expected to increase in a woodland with low tree species richness and high tree species diversity. High tree species diversity and high tree species richness were both found in young regrowth woodland (Figure 3.11), this means that high avian abundance is expected in young regrowth woodland based on the high tree species diversity. However, high avian abundance is also expected in the other woodland types based on their low tree species richness compared to young regrowth woodland. Therefore high avian abundance can be found in any woodland type. Comparison of avian abundances among different miombo woodland types yielded insignificant differences (Table 4.2 & Table 4.3). As mentioned above, different woodland types provide different food resources, therefore different woodland types are expected to support different types of bird species such that overall avian abundance is not expected to be different among woodland types. One also expect a situation where old growth woodland should have more nectarivores compared to regrowth woodland while regrowth woodland is expected to have more insectivores and granivores compared to old growth woodland. However, results from chapter 4 indicate that there were no significant differences in avian abundance according to dietary guild although the abundance of nectarivores showed a decreasing trend from old growth miombo to young regrowth miombo while the abundance of granivores showed an increasing trend from old growth miombo to young regrowth miombo (Appendix 4.5). The abundance of insectivores did not show any trend along the woodland degradation gradient. Apart from the availability of food resources, avian abundance is also influenced by the availability of nest cover and breeding sites (Vale *et al.*, 1982). The risk of nest predation can force bird species to select habitats that are marginal in terms of quality and quantity of food. Factors that influence the selection of breeding sites among birds should be incorporated in future models for predicting avian richness and abundance in miombo woodlands

Biotic interactions such as competition, predation and parasitism have been found to influence avian community structure apart from vegetation stratification (MacArthur & MacArthur, 1961; MacArthur *et al.*, 1962; Landres & MacMahon, 1980). Habitat characteristics largely determine the number of bird species and individuals that may exploit available resources and survive in a particular habitat while biotic interactions may alter individual foraging characteristics and contribute to partitioning of exploitable resources.

This study was limited to the correlation between vegetation characteristics and avian community structure only. Factors that influence habitat selection in birds such as food availability, nest site availability and intra and interspecific interactions were not included in the analysis. In order for bird - habitat models to have greater predictive power, such information should also be included in the development of models. Future research will focus on the inclusion of such factors in the development of models for miombo woodlands. Studies of the responses of miombo avifauna to woodland degradation are few, infact literature review showed that many studies on birds' responses to habitat degradation and modification have been restricted to bird species found in tropical forested areas particularly those in South America as well as forested areas in western countries. This study was therefore a preliminary study to determine how miombo bird community structure respond to changes in vegetation characteristics, future work will focus on the influence of other factors that were not included in this study.

5.5.2 Correlation between avian species and guilds and miombo woodland structure and degradation

Correspondence analysis results in which avian species and avian guilds were correlated with individual vegetation structure characteristics did not yield as highly correlated results as those in which avian species and avian guilds were correlated with woodland status. In the analyses involving vegetation structure characteristics, about 11 to 22 dimensions were identified by correspondence analysis as explaining all the correlation between vegetation variables and avian variables. This is an indication that the avian species and guilds and individual vegetation variables were not highly correlated. However, when the avian species and guilds were correlated with woodland status, only three dimensions were extracted and these explained all the correlation between the variables. The difference in the correspondence analysis results between the two could be that bird species rarely select only one habitat factor but instead select a combination of different habitat factors which provide them with food, shelter and cover. Correspondence analysis involving woodland status takes into account a combination of different habitat factors. For example, old growth miombo is expected to mainly have tall trees with large to medium-sized stems while young regrowth woodland is expected to have short trees with small stems. Hence the correlation between avian variables and woodland status can be explained by very few dimensions compared to that between avian variables and individual vegetation structure characteristics.

Although correspondence analysis with individual vegetation structure characteristics did not yield highly correlated results, the analysis yielded more details about habitat selection in birds than those of the more highly correlated woodland status. Instead of just correlating bird species with a particular woodland type, the correspondence analysis with vegetation structure characteristics went further by identifying individual habitat factors bird species were selecting in a particular woodland type. The correlation between avian species and trees of different height and sizes (Table 5.4) agrees with the guild type the birds were assigned to. During data collection, some bird species were not observed directly foraging or feeding. Therefore their assignment to different guilds was based on the findings of others (Sigel *et al.*, 2006; Fry *et al.*, 1982-2004; Mackworth –Praed & Grant, 1962-63; Benson *et al.*, 1971). Despite this, species identified by correspondence analysis as being correlated with tall canopy trees were classified as either canopy specialized guilds or understorey and canopy guilds. The Long-billed Pipit and Miombo Barred Warbler were the only species correlated with tall trees that were ground foragers whereas the Common Bulbul was identified as a generalist forager. Species identified as being correlated with understorey trees ranged from canopy specialized guilds, understorey and canopy guilds, understorey specialized guilds, generalist guilds to aerial guilds (Table 5.4). Overall the results of avian species correlation with vegetation structure are supported by findings from literature.

Correspondence analysis results between avian guilds and vegetation structure characteristics revealed that understorey trees are correlated with mainly generalist guilds and ground based guilds while short trees are correlated with generalist guilds, understorey and ground guilds and aerial guilds. Canopy trees are correlated with a variety of guilds from those that specialize in the canopy and understorey to those that are ground based including generalist guilds. The fact that canopy trees are correlated with more guilds stems from the fact that tall trees and their extensive branching provide more foraging opportunities particularly for insectivorous birds because they provide a variety of hiding places for different insects ((Holmes *et al.*, 1979; Vale *et al.*, 1982; Bradbury *et al.*, 2005).

5.5.3 Correlation between avian species and guilds with miombo woodland degradation

Avian species that are correlated with different miombo woodland types are given in Table 5.6. When the avian species composition of species correlated with different woodland types was analyzed in terms of the habitat range distribution of species (Table 5.6), old growth woodland had a slightly higher percentage of miombo endemics compared with regrowth woodland while regrowth woodland had a higher percentage of habitat generalists compared to old growth woodland. In Australian savanna woodland, Hannah *et al.*, (2007) found that as woodland regrowth develops, its avifaunal assemblages increasingly resemble that of intact woodland. Generalist species tend to increase in disturbed habitats because of the influx of opportunistic species that come in to exploit the new resources availed by changes in the habitat structure (Marsden & Pilgrim, 2003; Alo & Turner, 2005). Lampila *et al.*, (2005) found that specialist forest-interior species and non-migratory species are more likely to be behaviorally inhibited from crossing barriers such as matrix habitat created by human activities compared to generalist and migratory species and are therefore likely to have higher abundances in intact habitats than disturbed ones. Birds with smaller geographical ranges have also been found to show the greatest declines in abundance following disturbance (Gray *et al.*, 2007). In addition, the range of habitats utilized by tropical bird species varies with food availability. Species dependent on food resources that are scattered in several habitats and occurring in low abundances tend to show greater overlap in habitat specialization than species whose food resources are concentrated in a few habitats (Karr & Roth, 1971). Avian species composition changed along the degradation gradient with endemic species having a higher percentage in old growth miombo and degraded old growth miombo while the percentage of habitat generalists was higher in old regrowth miombo and young regrowth miombo.

Correspondence analysis results between avian guilds and miombo woodland status revealed that all miombo woodland types in the study area were correlated with generalist bird guilds, however old growth miombo and degraded old growth miombo were the only woodland types correlated with canopy specialized guilds and, understorey and canopy guilds while old regrowth miombo and young regrowth miombo were correlated with understorey specialized guilds and ground-based guilds (Figure 5.9). Old growth miombo had more than 70 % of its trees in the canopy height category while degraded old growth miombo had 44 % of its trees in the canopy height category (Figure 3.15b), therefore, it is likely that there should be a correlation between these two woodland types with canopy specialized guilds. Ground-based guilds were highly correlated with regrowth woodland because they thrive in an open canopy woodland. An intercontinental comparison of determinants of guild structure in forest bird communities by Holmes & Recher, (1986) found that the initial separation of guilds was related to differential use of the vertical strata particularly ground versus above ground foraging. Forest stratification seems to be the major factor segregating species suggesting that foraging opportunities for birds in these forests differ with height. The second major factor segregating guilds was related to differences in foraging methods especially how birds obtained their food (foraging method) and the substrates from which the prey was taken. Vegetation structural diversity allows the co-existence of many guilds without competitive exclusion. In this study, only the primary food habit and the foraging height were used to assign birds to different guilds. The foraging method used by birds was not used. It is expected that degraded old growth miombo and old regrowth miombo that have high vegetation structural diversity (Table 3.5) should have a high diversity of avian guilds and while old growth miombo and young regrowth miombo are expected to have specialist guilds as a result of their low vegetation structural diversity. Results on the correlation between guild type and tree height indicated that canopy trees support more guilds than understorey trees or short trees. However, canopy trees in degraded old growth miombo are expected to support more guilds than those in old growth miombo. This disparity might be the result of the influence of foraging method on guild diversity. The large stems and branches associated with tall canopy trees in old growth miombo affect the detectability and accessibility of food for birds that forage by gleaning. The surface area to search for food increases with large stems and branches and accessing the food might prove difficult because birds cannot grip the large stems and branches.

5.6 Conclusions

Modeling the distribution and abundance of organisms enables the identification of key areas for management and the prediction of changes in the abundance and distribution of organisms resulting from habitat change. From a conservation perspective, predicting the effects of land-use change on biodiversity is essential to inform the decision-making process of strategic planning.

The study set out to test the following hypotheses:

(i) Vegetation characteristics are correlated with avian species richness, avian guild richness and avian abundance,

(ii) Avian species composition changes along the woodland degradation gradient with species from disturbed woodland gradually replacing those of intact woodland and,

(iii) Different bird guilds respond differently to woodland degradation.

The first hypothesis that vegetation characteristics are correlated with avian community structure characteristics was supported by results from this study. Avian species richness is greatly influenced by tree height and tree size while avian guild richness is influenced by tree species diversity and tree species evenness. Avian abundance is greatly influenced by tree species richness and tree species diversity. The models developed to predict avian species richness and avian guild richness are supported by findings from other studies while the model for predicting avian abundance does not seem to be an effective predictor.

The second hypothesis that avian species composition changes along the woodland degradation gradient was supported by results from this study. Old growth miombo and degraded old growth miombo were similar to each other in terms of percentages of miombo endemic species and habitat generalists while old regrowth miombo and young regrowth miombo were similar to each other in terms of percentage of miombo endemics, habitat restricted species and habitat generalists.

The third hypothesis that different bird guilds respond differently to woodland degradation is supported by results from this study. Canopy specialized guilds were correlated with old growth woodland while understorey guilds and ground-based guilds were correlated with regrowth woodland.

CHAPTER 6 CONCLUSIONS

The findings from the whole study can be summarized into two broad conclusions that:

(i) Woodland degradation leads to changes in the vegetation structure and composition of miombo woodland.

(ii) Woodland degradation causes changes in the avian species composition and avian guild composition. Small-scale or low intensity woodland degradation such as single tree selection for timber or charcoal production produces changes in woodland structure that are expected to lead to increased avian species richness and increased avian guild richness. High vegetation structural diversity produced by low intensity silvicultural treatments is beneficial to the avian community structure.

6.1 Challenges facing avifauna conservation in miombo woodland

There are three broad sets of issues that must be addressed in order to conserve Africa's avifauna (Brooks & Thompson, 2001). These are data, planning and implementation issues. For data issues, the most urgent requirement for bird conservation is availability of distributional information because birds cannot be protected if one does not know where they are found, as well as species-specific data regarding bird behaviour and their habitat requirements because this is critical for management purposes. With respect to planning issues, the critical issues are integrating avifauna data into conservation planning at the local level as well as integrating avifauna data with socioeconomic data in order to determine conservation priorities in relation to other social priorities. For implementation issues, the challenge is translating conservation strategy into action on the ground. Strict protection of biodiversity is the fundamental core of conservation implementation but for this to work, the needs of people around protected areas or those that have to be relocated to give way to the creation of protected areas must be addressed. Strict protection is implemented when the biodiversity in the protected area is irreplaceable, however when irreplaceability of species and their habitats is relatively low, there is need to encourage sustainability in natural resource harvest.

BirdLife International has come up with criteria for identifying important bird areas (IBAs) for the conservation of birds. Some of the factors considered when designating an area as an IBA are (i) endemicity in the avifauna (ii) presence of habitat restricted bird species and (iii) species that are in the CITES appendices and IUCN red data lists (BirdLife International, 2000; Leonard, 2005). Miombo woodland is known for its endemic avifauna (Benson & Irwin, 1966). However, miombo woodland is one of the region in Africa lacking any significant prioritization in terms of avifauna conservation.

Avifauna conservation priorities in miombo woodland should focus on conserving the endemic avifauna and its habitat as well as species that are mainly restricted to miombo woodland. Results from this study indicate that miombo endemics were present in all woodland types in the study area although the percentage of endemic species correlated with old growth miombo was slightly higher than in the other woodland types. Results from this study also indicate that low intensity silvicultural treatments are critical for the maintenance of increased species diversity in miombo woodland. Therefore to conserve the avifauna that is endemic and restricted to miombo woodland, there is need to protect old growth miombo as well as reducing woodland degradation in regrowth woodland so that the woodland is allowed to regenerate. In the endemic miombo avifauna as well as species that are restricted to miombo woodland, there are different guild structures. Some species belong to the canopy, understorey and ground guilds. Specific guild requirements should be taken into consideration when designing conservation and management plans for birds. Within old growth miombo, there is need to introduce managed silvicultural treatments that will enhance spatial heterogeneity in the vegetation in order to cater for species that require regrowth woodland for foraging or nesting. Miombo avifauna conservation can only be achieved if there is a multi-sectoral cooperation between organizations involved in avifauna conservation. This cooperation will enable aspects of avifauna conservation and management that are critical for birds to be incorporated into management practices of protected areas. Legislature exist for the protection of woodland in Zambia, similar legislation to allow for increased spatial heterogeneity as a management tool for the promotion of avian species diversity should also be enacted for PFAs.

The models developed in the present study do demonstrate that some level of degradation is actually beneficial to avian diversity. Although little is known about the impact of miombo woodland degradation on birds, the models developed in this study to predict avian species richness and avian guild richness are strong enough to aid in the management of miombo avifauna.

REFERENCES

Aló, D. and T. Turner. 2005. Effects of habitat fragmentation on effective population size in the endangered Rio Grande Silvery Minnow. Conservation Biology **19:** 1138-1148.

Analytical Software. 2003. *Statistix 8 User's manual*. Analytical Software. Tallahassee, USA.

Ansell, W. F. H. 1978. *The mammals of Zambia*. The National Parks and Wildlife Services, Chilanga, Zambia.

Aspinwall, D. R. and C. Beel. 1998. *A field guide to Zambian birds not found in southern Africa*. Zambia Ornithological Society (ZOS), Lusaka, Zambia.

Astle, W.L. 1968-9. The vegetation and soils of Chishinga Ranch, Luapula Province, Zambia. Kirkia **7:** 73-102.

Bawa, K. and R. Seidler. 1998. Natural forest management and the conservation of biological diversity in tropical forests. Conservation Biology **12:** 46-55.

Beck, J., C. H. Schulze, K. E. Linsenmair and K. Fiedler. 2002. From forest to farmland: diversity of geometer moths along two habitat gradients in Borneo. Journal of Tropical Ecology **18:** 33-51.

Begon, M., J. L. Harper and C. R. Townsend. 1990. *Ecology: Individuals, Populations and Communities*. Blackwell Science, MA, USA.

Benson, C. W. and M. P. S. Irwin. 1965a. The birds of *Cryptosepalum* forests, Zambia. Arnoldia **28:** 1-12.

Benson, C. W. and M. P. S. Irwin. 1965b. Some birds from north-western province, Zambia. Arnoldia **29:** 1-11.

Benson, C. W. and M. P. S. Irwin. 1965c. The birds of *Marquesia* thickets in northern Mwinilunga District, Zambia. Arnoldia **30:** 1-4.

Benson, C. W. and M. P. S. Irwin. 1966. The Brachystegia avifauna. Ostrich Supplement **6:** 297-321.

Benson, C. W., R. K. Brooke, R. J. Dowsett and M. P. S. Irwin. 1970. Notes on the birds of Zambia. Part V. Arnoldia **40:** 1-59.

Benson, C. W., R. K. Brooke, R. J. Dowsett and M. P. S. Irwin. 1971. *Birds of Zambia*. Wildlife Conservation Society of Zambia, Collins, London, UK.

Berry, O., M. D. Tocher, D. M. Gleeson and S. D. Sarre. 2005. Effects of vegetation matrix on animal dispersal: genetic evidence from a study of endangered skinks. Conservation Biology **19:** 855-864.

Berryman, A. A. 1997. On the principles of population dynamics and theoretical models.

American Entomologist **43:** 147-151.

Bibby, C. J., N. D. Burgess and D. A. Hill. 1992. *Bird census techniques*. Academic Press, London.

BirdLife International. 2000. *Threatened Birds of the World.* BirdLife International, Cambridge, United Kingdom.

Bishop, J. A. and W. L. Myers. 2005. Associations between avian functional guild response and regional landscape properties for conservation planning. Ecological Indicators **5:** 33-48.

Boaler, S. B. and K. C. Sciwale. 1966. Ecology of a miombo site, Lupa North Forest Reserve, Tanzania. III: effects on the vegetation of local cultivation practices. Journal of Ecology **54:** 577-587.

Borman, M. M. 2005. Forest stand dynamics and livestock grazing in historical context. Conservation Biology **19:** 1658-1662.

Bradbury, R. B., R. A. Hill, D. C. Mason, S. A. Hinsley, J. D. Wilson, H. Balzter, G. Q. A. Anderson, M. J. Whittingham, I. J. Davenport and P. E. Bellamy. 2005. Modelling relationships between birds and vegetation structure using airborne LiLAR data: a review with case studies from agricultural and woodland environments. Ibis **147:** 443-452.

Brooks, T and H. S. Thompson. 2001. Current bird conservation issues in Africa. The Auk **118:** 575-582.

Chazdon, R. L. 2003. Tropical forest recovery: legacies of human impact and natural disturbances. Perspectives in Plant Ecology, Evolution and Systematics **6:** 51-57.

Chidumayo, E. N. 1987a. A survey of wood stocks for charcoal production in the miombo woodlands of Zambia. Forest Ecology and Management **20:** 105-115.

Chidumayo, E. N. 1987b. Species structure in Zambian miombo woodland. Journal of Tropical Ecology **3:** 109-118.

Chidumayo, E. N. 1987c. Woodland structure, destruction and conservation in the copperbelt area of Zambia. Biological Conservation **40:** 89-100.

Chidumayo, E. N. 1988a. Estimating fuelwood production and yield in regrowth dry miombo woodland in Zambia. Forest Ecology and Management **24:** 59-66.

Chidumayo, E. N. 1988b. A re-assessment of effects of fire on miombo regeneration in the Zambian Copperbelt. Journal of Tropical Ecology **4:** 361-372.

Chidumayo, E. N. 1988c. Regeneration of *Brachystegia* woodland canopy following felling for tsetsefly control in Zambia. Tropical Ecology **29:** 24-32.

Chidumayo, E. N. 1989. Early post-felling response of *Marquesia* woodland to burning in the Zambian Copperbelt. Journal of Ecology **77:** 430-438.

Chidumayo, E. N. 1990. Above-ground woody biomass structure and productivity in a Zambezian woodland. Forest Ecology and Management **36:** 33-46.

Chidumayo, E. N. 1993. *Responses of miombo to harvesting: ecology and management.* Stockholm Environment Institute, Stockholm, Sweden.

Chidumayo, E. N. 1997. Effects of accidental and prescribed fires on miombo woodland, Zambia. Commonwealth Forestry Review **76:** 268-272.

Chidumayo, E. N. 2002. Changes in miombo woodland structure under different land tenure and use systems in central Zambia. Journal of Biogeography **29:** 1619-1626.

Chidumayo, E. N. 2004. Development of *Brachystegia-Julbernardia* wood land after clear-felling in Central Zambia: Evidence of high resilience. Applied Vegetation Science **7:** 237-242.

Chidumayo, E. N. and L. Aongola. 1998. *Biodiversity Strategy and Action Plan (BSAP): The Country Study Report.* IUCN & MENR, Lusaka, Zambia.

Chidumayo, E. N. and P. Njovu. 1998. *Ecological and environmental screening of forest areas in the PFAP Area, Zambia.* PFAP Publication, Ndola, Zambia.

Chidumayo, E. N. and S. B. M. Chidumayo. 1984. *The status and impact of woodfuel in urban Zambia.* Department of Natural Resources, Lusaka, Zambia.

Chisanga, E. 1998. *Status and proposed biodiversity management of higher plants in botanical and forest reserves in Zambia.* Draft # 1 IUCN, Lusaka, Zambia.

Chisumpa, S. N. 1990. *Diversity of forest species: an overview of forest resources. Conserving Plant Genetic Resources of Zambia.* Department of Agriculture, Lusaka, Zambia.

Clauss, B. 1992. *Bees and bee-keeping in North-western Province of Zambia.* Mission Press, Ndola, Zambia.

Cochrane, M. A., A. Alencar, M. D. Schulze, C. M. Souza, D. C. Nepstad, P. Lefebvre and E. A. Davidson. 1999. Positive feedbacks in the fire dynamic of closed canopy tropical forests. Science **284:** 1832-1835.

Collar, N. J. and S. N. Stuart. 1985. *Threatened birds of Africa and related Islands. The ICBP/IUCN Red Data Book.* Cambridge, UK.

Collinge, S. K. 2000. Effects of grassland fragmentation on insect species loss, colonization and movement patterns. Ecology **81:** 2211-2226.

Cordiner, R. J. 1968. *Geology and structure of the Kanona area.* Records of the geological survey volume ii. Ministry of Lands and Mines, Geological survey Department, Government Printer, Lusaka, Zambia.

Crick, H. Q. P. 2004. The impact of climate change on birds. Ibis **146:** 48-56.

Davis, A. J., J. D. Holloway, H. Huijbregts, J. Krikken, A. H. Kirk-Spriggs and S. L. Sutton. 2001. Dung beetles as indicators of change in the forests of northern Borneo. Journal of Applied Ecology **38:** 593-616.

Department of National Parks and Wildlife Services. 1998. *Policy for National Parks and Wildlife in Zambia.* National Parks and Wildlife Services, Chilanga, Zambia.

Dodman, T. 1994. *Status and distribution of the Black-cheeked Lovebird Agapornis nigrigenis.* Royal Society for the protection of birds, Cambridge, UK.

Dowsett, R. J. 1973. Comments on some ornithological type-localities in Zambia. Zambia Museums Journal **4**. National Museums, Livingstone, Zambia.

Dowsett, R. J. and A. D. Forbes-Watson. 1993. *Checklist of birds of the Afrotropical and Malagasy Regions.* Tauraco Press, Liege.

Driscoll, D. A. and T. Weir. 2005. Beetle responses to habitat fragmentation depend on ecological traits, habitat condition and remnant size. Conservation Biology **19:** 182-194.

Drysdall, A. R., R. L. Johnson, T. A. Moore and J. G. Thieme. 1972. Outline of the geology of Zambia. Geologie en Mijnbouw **51:** 265-276.

Edwards, T. C., E. T. Deshler, D. Foster and G. G Moisen. 1996. Adequacy of wildlife habitat relation models for estimating spatial distributions of terrestrial vertebrates. Conservation Biology **10:** 263-270.

Fanshawe, D. B. 1971. *The vegetation of Zambia.* Government Printers, Lusaka, Zambia.

Ferrar, A. 1998. *Draft master plan for the development of Zambia's protected areas.* EDF/NPWS Sustainable Wildlife Management Project, Lusaka, Zambia.

Fielding, A. H. and P. F. Haworth. 1995. Testing the generality of bird-habitat models. Conservation Biology **9:** 1466-1481.

Forman, R. T. T. 1995. *Land mosaics: the ecology of landscapes and regions.* Cambridge University Press, Cambridge, UK.

Freer, F. and Y. Hingrat. 2005. Effects of forest fragmentation on a dung beetle community in French Guiana. Conservation Biology **19:** 1103-1112.

Frost, P. 1996. The ecology of miombo woodlands. Pg 11-57 in: B. Campbell, editor. *The Miombo in transition: woodlands and welfare in Africa.* Centre for International Forestry Research, Bogor, India.

Frost, S. K. and P. G. H. Frost. 1980. Territoriality and changes in resource use by sunbirds at *Leonotis leonurus* (Labiatae). Oecologia **45:** 109-116.

Fry, C. H., S. Keith and E. K. Urban, editors. 1982-2004. *Birds of Africa.* Volume I (1982), II (1986), III (1988), IV (1992), V (1997), VI (2000) and VII (2004). Academic Press, San Diego, USA.

Gamma Design Software. 2004. *Geostatistics for the environmental sciences.* Gamma Design Software, Plainwell, Michigan, USA.

Garlick, W. G. 1961. Geomorphology. Pg 11-16 in: F. Mendelsohn, editor. *The geology of the Northern Rhodesian copperbelt.* MacDonald, London.

Golden Software 2003. Grapher ^TM^ *5. User manual.* Golden Software Inc., Colorado, USA.

Grainger, A. 1999. Constraints on modeling the deforestation and degradation of tropical open woodlands. Global Ecology and Biogeography **8:** 179-190.

Gray, M. A., S. L. Baldauf, P. J. Mayhew and J. K. Hill. 2007. The response of avian feeding guilds to tropical forest disturbance. Conservation Biology **21:** 133-141.

Grundy, I. M. 1995. Wood biomass estimation in dry miombo woodland in Zimbabwe. Forest Ecology and Management **72:** 109-117.

Guénette, J.-S. and M.-A. Villard. 2005. Thresholds in forest bird response to habitat alteration as quantitative targets for conservation. Conservation Biology **19:** 1537-1546.

Haefner, J. W. 1981. Avian assembly rules: The foliage gleaning guild. Oecologia **50:** 131-142.

Hall, L. S., P. R. Krausman and M. L. Morrison. 1997. The habitat concept and a plea for standard terminology. Wildlife Society Bulletin **25:** 173-182.

Hannah, D., J. C. Z. Woinarski, C. P. Catterall, J. C. McCosker, N. Y. Thurgate and R. J. Fensham. 2007. Impacts of clearing, fragmentation and disturbance on the bird fauna of Eucalypt savanna woodlands in central Queensland, Australia. Austral Ecology **32:** 261-276.

Harper, K. A., E. MacDonald, P. J. Burton, J. Chen, K. D. Brosofske, S. C. Saunders, S.

Euskirchen, D. Roberts, M. S. Jaiteh and P. Esseen. 2005. Edge influence on forest structure and composition in fragmented landscapes. Conservation Biology **19:** 768-782.

Heady, H. F. and E. B. Heady. 1982. *Range and wildlife management in the tropics.* Intermediate tropical agricultural series. Longman, London.

Herrando, S., L. S. Brotons and S. Llacuna. 2003. Does fire increase the spatial heterogeneity of bird communities in Mediterranean landscapes? Ibis **145:** 307-317.

Holmes, R. T. and H. F. Recher. 1986. Determinants of guild structure in forest bird communities: an intercontinental comparison. Condor **88:** 427-439.

Holmes, R. T. and S. K. Robinson. 1981. Tree species preferences of foraging insectivorous birds in a Northern Hardwood Forest. Oecologia **48:** 31-35.

Holmes, R. T., R. E. Bonney Jr. and S. W. Pacala. 1979. Guild structure of the Hubbard Brook bird community: A multivariate approach. Ecology **60:** 512-520.

Horn, D. J., M. L. Phillips, R. R. Koforo, W. R. Clark, M. A. Sovada and R. J. Greenwood. 2005. Landscape composition, patch size and distance to edges: interactions affecting duck reproductive success. Ecological Applications **15:** 1367-1376.

Howard, G. W. 1988. Recent counts of Wattled Cranes *Bugeranus carunculatus* on the Kafue Flats, Zambia. Scopus **12:** 207-212.

Hudson, A and H. Bouwman. 2007. Different land-use types affect bird communities in the Kalahari, South Africa. African Journal of Ecology **45:** 423-430.

Hutchinson, P. 1974. The climate of Zambia. Zambia Geographical Association occasional study # **7.**

Hutto, R. L., S. M. Pletschet and P. Hendricks. 1986. A fixed-radius point count method for non breeding and breeding season use. Auk **103:** 593-602.

Irwin, M. P. S. 1967. Notes on the birds of Zambia: Part III. Arnoldia **4:** 1-30.

Irwin, M. P. S. and C. W. Benson. 1966a. Notes on the birds of Zambia: Part I. Arnoldia **32:** 1-19.

Irwin, M. P. S. and C. W. Benson. 1966b. Notes on the birds of Zambia: Part II. Arnoldia **37:** 1-21.

Irwin, M. P. S. and C. W. Benson. 1967. Notes on the birds of Zambia: Part IV. Arnoldia **8:** 1-27.

James, F. C. and N. O. Wamer. 1982. Relationships between temperate forest bird communities and vegetation structure. Ecology **63:** 159-171.

Johns, A. D. 1997. *Timber production and biodiversity conservation in tropical rainforests.* Cambridge University Press, Cambridge, UK.

Jones, G. A., K. E. Sieving and S. K. Jacobson. 2005. Avian diversity and functional insectivory on North-Central Florida farmlands. Conservation Biology **19:** 1234-1245.

Karr, J. R. and R. R. Roth. 1971. Vegetation structure and avian diversity in several new world areas. American Naturalist **105:** 423-435.

Keith, G. S. and C. J. Vernon. 1969. Bird notes from northern and eastern Zambia. Puku **5:** 131-139.

Kikkawa, J. 1968. Ecological association of bird species and habitats in eastern Australia. Journal of Animal Ecology **37:** 143—165.

Kolb, A. and M. Diekmann. 2005. Effect of life history traits on responses of plant species to forest fragmentation. Conservation Biology **19:** 929-938.

Konrad, P. M. 1980. *The present status of Wattled Cranes in Africa.* International Crane Foundation, Baraboo, Wisconsin, USA.

Lampila, P., M. Mönkkönen and A. Desrochers. 2005. Demographic responses by birds to forest fragmentation. Conservation Biology **19:** 1537-1546.

Landres, P. B. and J. A. MacMahon. 1980. Guilds and organization: Analysis of an oak woodland avifauna in Sonora, Mexico. Auk **97:** 351-365.

Larsson, C. and Å. M. Hemborg. 1995. Sunbirds (Nectarinia) prefer to forage in dense vegetation. Journal of Avian Biology **26:** 85-87.

Laurance, W. F., M. A. Cochrane, S. Bergen, P. M. Fearnside, P. Delamonica, C. Barber, S. D'Angelo and T. Fernandes. 2001. The future of Brazilian Amazon. Science **291:** 438-439.

Lawton, J. H., D. E. Bignell, B. Bolton, G. F. Bloemers, P. Eggleton, P. M. Hammond, M. Hodda, R. D. Holt, T. B. Larsen, N. A. Mawdsley, N. E. Stork, D. S. Srivastava and A. D. Watt. 1998. Biodiversity inventories, indicator taxa and effects of habitat modification in tropical forest. Nature **391:** 72-76.

Lawton, R. M. 1982. Natural resources of miombo woodland and recent changes in agricultural and land-use practices. Forest Ecology and Management **4:** 287-297.

Leonard, P. 2005. *Important bird areas in Zambia. Priority sites for conservation.* The Zambian Ornithological Society, Lusaka, Zambia.

Lindell, C. A, W. H. Chomentowski and J. R. Zook. 2004. Characteristics of bird species using forest and agricultural land covers in southern Costa Rica. Biodiversity and Conservation **13:** 2419-2441.

Lovejoy, T., R. O. Bierregaard Jr., A. B. Rylands, J. R. Malcolm, C. Quintela, L. H. Harper, K. S. Brown, A. H. Powell, G. V. N. Powell, H. O. Schubert and M. Hays. 1986. Edge and other effects of isolation on Amazon forest fragment. Pg 257-285 in: M. Soulé, editor. *Conservation Biology: the science of scarcity and diversity.* Sinauer Associates, Sunderland, Massachusetts, USA.

Lowore, J. D., P. G. Abbot and M. Werren. 1994. Stackwood volume estimations for miombo woodlands in Malawi. Commonwealth Forestry Review **73:** 193-197.

MacArthur, R. H. 1964. Environmental factors affecting bird species diversity. The American Naturalist **98:** 387-397.

MacArthur, R. H. and E. O. Wilson. 1967. *The theory of Island Biogeography.* Princeton University Press, Princeton, N.J. USA.

MacArthur, R. H. and J. W. MacArthur. 1961. On bird species diversity. Ecology **42:** 594-598.

MacArthur, R. H., J. W. MacArthur and J. Preer. 1962. On bird species diversity II. Prediction of bird census from habitat measurement. The American Naturalist **96:** 167-174.

Mackworth – Praed, C. W. and C. H. B. Grant. 1962. *Birds of the southern third of Africa.* African Handbook of Birds. Series Two Volume One. Longmans, London.

Mackworth – Praed, C. W. and C. H. B. Grant. 1963. *Birds of the southern third of Africa.* African Handbook of Birds. Series Two Volume Two. Longmans, London.

Malaisse, F. P. 1978. The miombo ecosystem. Natural Resources Research **14:** 589-606, Unesco, Paris.

Malimbwi, R. E., B. Solberg and E. Luoga. 1994. Estimation of biomass and volume in miombo woodland at Kitulangalo Forest reserve, Tanzania. Journal of Tropical Forest Science **7:** 230-242.

Marini, M. A. and F. I. Garcia. 2005. Bird conservation in Brazil. Conservation Biology **19:** 665-671.

Marsden, S. J. and J. D. Pilgrim. 2003. Factors influencing the abundance of parrots and hornbills in pristine and disturbed forests on New Britain NPG. Ibis **145:** 45-53.

Martin, S. C. 1996. The effect of burning on the regeneration of miombo woodland in

Kasanka National Park, Zambia. Chapter 5 in: D. Burnham and P. Riordan, editors. *Biological Research in Kasanka National Park, Zambia.* Manchester Metropolitan University, Manchester, UK.

Mathieu, J., J.-P. Rossi, P. Mora, P. Lavelle, P. E. Martins, C. Rouland and M. Grimaldi. 2005. Recovery of soil macrofauna communities after forest clearance in Eastern Amazonia, Brazil. Conservation Biology **19:** 1598-1605.

Mbata, K. J., E. N. Chidumayo and C. M. Lwatula. 2002. Traditional regulation of edible caterpillar exploitation in the Kopa area of Mpika district in northern Zambia. Journal of Insect Conservation **6:** 115-130.

McCune, B. and M. J. Mefford. 1999. *Multivariate analysis of ecological data 4.0.* MjM Software, Gleneden Beach, Oregon, USA.

McIntyre, N. E. 1995. Effects of forest patch size on avian diversity. Landscape Ecology **10:** 85-99.

Ministry of Environment and Natural Resources (MENR). 1994. *The National Environment Action Plan.* MENR, Lusaka, Zambia.

Ministry of Environment and Natural Resources (MENR). 1997. *Zambia Forest Action Plan.* The ZFAP Secretariat, MENR, Lusaka, Zambia.

Ministry of Environment and Natural Resources (MENR). 1998. *National Forestry Policy.* MENR, Lusaka, Zambia.

Newmark, W. D. 2005. A 16-year study of forest disturbance and understory bird community structure and composition in Tanzania. Conservation Biology **20:** 122-134.

Nol, E., C. M. Francis and D. M. Burke. 2005. Using distance from putative source woodlots to predict occurrence of forest birds in putative sinks. Conservation Biology **19:** 836-844.

Oyama, S. 1996. Regeneration process of the miombo woodland at abandoned citemene fields of northern Zambia. African Study Monographs **17:** 101-116.

Parker, T. H., B. M. Stansberry, C. D. Becker and P. S. Gipson. 2005. Edge and area effects on the occurrence of migrant forest songbirds. Conservation Biology **19:** 1157-1167.

Peters, D. V. 1974. *Land usage in Serenje District.* Rhodes- Livingstone papers # 19. Institute for African studies UNZA, Manchester University Press.

Powell, G. V. N. 1989. On the possible contribution of mixed species flocks to species richness in neotropical avifaunas. Behavioural Ecology and Sociobiology **24:** 387-393.

ecology and conservation of a fragmented forest. Yale University Press, New Haven, Connecticut, USA.

Strang, R. M. 1974. Some man-made changes in successional trends on the Rhodesian highveld. Journal of Applied Ecology **111:** 249-263.

Strømgaard, P. 1985. A subsistence society under pressure: The Bemba of northern Zambia. Africa **55:** 40-59.

Stromgaard, P. 1986. Early secondary succession on abandoned shifting cultivator's plots in the miombo of South Central Africa. Biotropica **18:** 97-106.

Tabarelli, M. and C. Gascon. 2005. Lessons from fragmentation research: improving management and policy guidelines for biodiversity conservation. Conservation Biology **19:** 734-739.

Trapnell, C. G. 1953. *The soils, vegetation and agriculture of North-eastern Rhodesia*. Government Printer, Lusaka, Zambia.

Trapnell, C. G. 1959. Ecological results of woodland burning experiments in Northern Rhodesia. Journal of Ecology **47:** 129-168.

Turner, M. G., R. H. Gardner and R. V. O'Neill. 2001. *Landscape ecology in theory and practice: pattern and process*. Springer-Verlag, New York, USA.

Vale, T. R., A. J. Parker and K. C. Parker. 1982. Bird communities and vegetation structure in the United States. Annals of the association of American geographers **72:** 120-130.

Vernon, C. J. 1973. Vocal mimicry by southern African birds. Ostrich **44:** 23-30.

Vernon, R. 1983. *Field guide to important arable weeds of Zambia*. Department of Agriculture, Mt. Makulu Central Research Station, Chilanga, Zambia.

Vesey-FitzGerald, D. F. 1963. Central African grasses. Journal of Ecology **51:** 243-274.

Waltert, M., K. S. Bobo, N. M. Sainge, H. Fermon and M. Muhlenberg. 2005. From forest to farmland: habitat effects on afrotropical forest biodiversity. Ecological Applications **15:** 1351-1366.

Watson, J. E. M., R. J. Whittaker and D. Freudenberger. 2005. Bird community responses to habitat fragmentation: how consistent are they across landscapes? Journal of Biogeography **32:** 1353-1370.

White, F. 1962. *The forest flora of Northern Rhodesia*. Oxford University Press, London, UK.

White, F. 1983. *The Vegetation of Africa*. UNESCO, Paris, France.

Whitman, A. A., J. M. Hagan III and N. V. L. Brokaw. 1997. A comparison of two bird survey techniques used in a subtropical forest. Condor **99:** 955-965.

Wiegand, T., E. Revilla and K. A. Moloney. 2005. Effects of habitat loss and fragmentation on population dynamics. Conservation Biology **19:** 108-121.

Wilson, J. D., M. J. Whittingham and R. B. Bradbury. 2005. The management of crop structure: a general approach to reversing the impact of agricultural intensification on birds? Ibis **147:** 453-463.

Wilson, M. F. 1974. Avian community organization and habitat structure. Ecology **55:** 1017-1029.

Wilson, M. F. and T. A. Comet. 1996. Bird communities of northern forests: ecological correlates of diversity and abundance in the understory. Condor **98:** 350 – 362.

Winterbottom, J. M. 1978. Birds. Pg 949-979 in: M. J. A. Werger, editor. *Biogeography and ecology of southern Africa*. Dr W. Junk publishers, The Hague.

World Bank. 1990. *Zambia urban household energy strategy*. ESMAP, Washington D.C., USA.

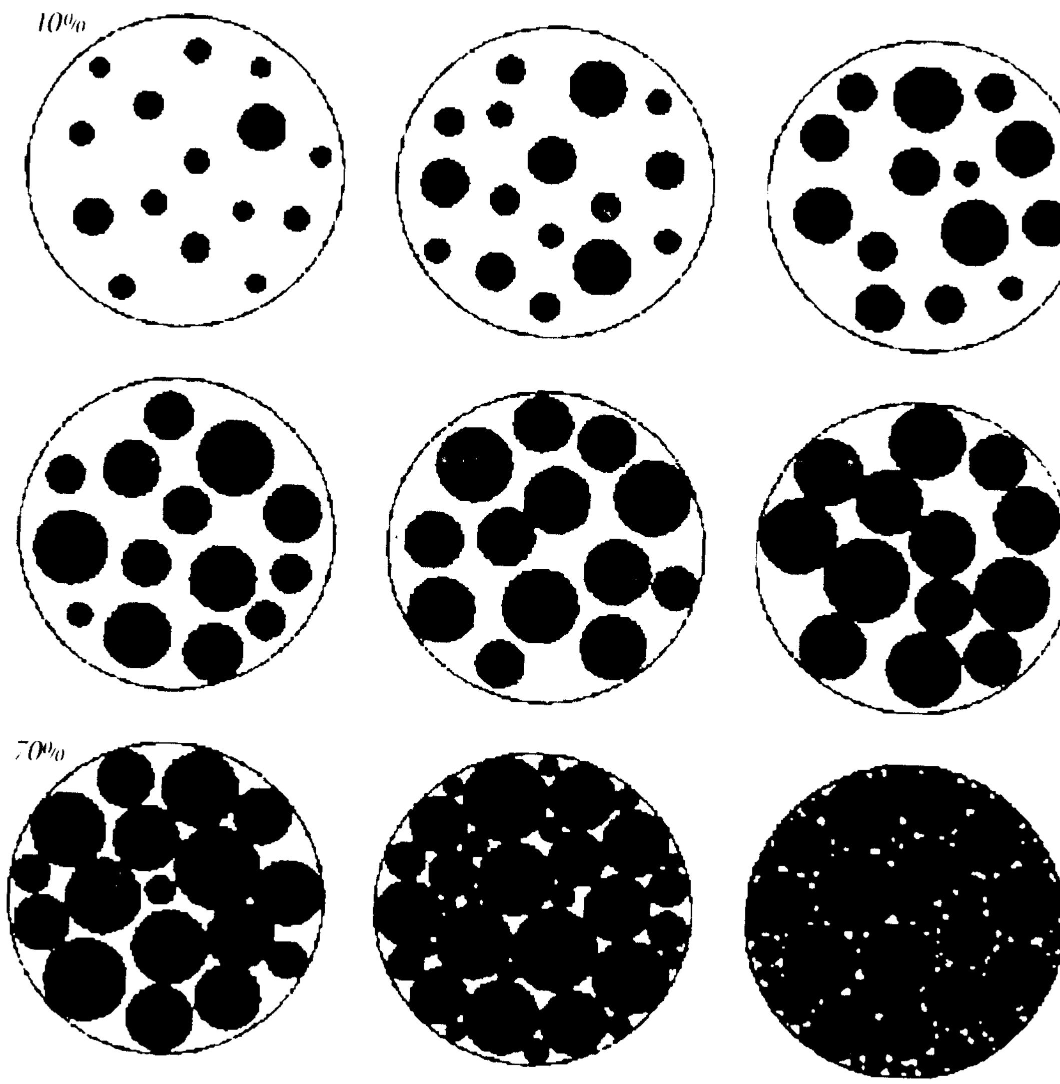
Wunderle, J. M., M .R. Willig and L. M. P. Henriques. 2005. Avian distribution in tree fall gaps and understorey of *terra firme* forest in lowland Amazon. Ibis **147:** 109-129.

Yates, C. J. and P. G. Ladd. 2005. Relative importance of reproductive biology and establishment ecology for the persistence of a rare shrub in a fragmented landscape. Conservation Biology **19:** 239-249.

Zambian Ornithological Society (ZOS). 1990. *Common birds of Zambia*. Associated Printers, Lusaka, Zambia.

APPENDICES

Appendix 3.1 Diagrams used for visually estimating percentage canopy cover. Adapted from the Birds in Forested Landscapes project (BFL), Cornell University, USA.



Appendix 3.2 Plant species recorded in plant census plots in Serenje District, Zambia. Nomenclature follows White, (1962) and Fanshawe, (1971).

	Name	Family
1	*Blepharis buchneri* Lindau	Acanthaceae
2	*Lannea discolor* (Sond.) Engl.	Anacardiaceae
3	*Lannea schweinfurthii* (Engl.) Engl.	Anacardiaceae
4	*Ozoroa reticulata* (Baker f.) R. Fern & A. Fern	Anacardiaceae
5	*Anisophyllea boehmii* Engl.	Anisophylleaceae
6	*Hexalobus monopetalus* (A. Rich) Engl. & Diels	Annonaceae
7	*Xylopia odoratissima* Welw. ex Oliv.	Annonaceae
8	*Steganotaenia araliacea* Hochst.	Apiaceae
9	*Cussonia arborea* Hochst ex A. Rich	Araliaceae
10	*Asparagus africanus* Lam.	Asparagaceae
11	*Aloe mzimbana* I. Verdc. & Christian	Asphodelaceae
12	*Bidens pilosa* L.	Asteraceae
13	*Bidens schimperi* Sch. Bip. ex Walp.	Asteraceae
14	*Erythrocephalum zambesianum* Oliv. & Hiern	Asteraceae
15	*Helichrysum kirkii* Oliv. & Hiern	Asteraceae
16	*Vernonia petersii* Oliv. & Hiern ex Oliv.	Asteraceae
17	*Distephanus divaricatus* (Streetz) H. Rob. & B. Kahn	Asteraceae
18	*Tecomaria capensis* (Thunb.) Spach.	Bignoniaceae
19	*Myrianthus holstii* Engl.	Cecropiaceae
20	*Parinari curatellifolia* Planch. ex Benth	Chrysobalanaceae
21	*Garcinia livingstonei* T. Anderson	Clusiaceae
22	*Gloriosa superba* L.	Colchicaceae
23	*Combretum molle* R. Br.	Combretaceae
24	*Aneilema hockii* De Wild.	Commelinaceae
25	*Commelina africana* L	Commelinaceae
26	*Byrsocarpus orientalis* (Baill.) Baker	Connaraceae
27	*Cyperus rotundus* L.	Cyperaceae
28	*Fimbristylis dichotoma* (L.) Vahl	Cyperaceae
29	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae
30	*Cephalaria pugens* Szabó	Dipsacaceae
31	*Monotes africanus* A. DC.	Dipterocarpaceae
32	*Monotes discolor* R. E. Fr.	Dipterocarpaceae
33	*Diospyros batocana* Hiern	Ebenaceae
34	*Maprounea africana* Müll.Arg.	Euphorbiaceae
35	*Pseudolachnostylis maprouneifolia* Radcl.-Sm.	Euphorbiaceae

36	*Uapaca kirkiana* Müll.Arg.	Euphorbiaceae
37	*Uapaca nitida* Müll.Arg.	Euphorbiaceae
38	*Uapaca sansibarica* Pax	Euphorbiaceae
39	*Abrus precatorius* L.	Fabaceae
40	*Aeschynomene abyssinica* (A. Rich.) Vatke	Fabaceae
41	*Aeschynomene bracteosa* Welw. ex Baker	Fabaceae
42	*Albizia antunesiana* Harms	Fabaceae
43	*Brachystegia boehmii* Taub.	Fabaceae
44	*Brachystegia floribunda* Benth.	Fabaceae
45	*Brachystegia longifolia* Benth.	Fabaceae
46	*Brachystegia microphylla* Harms.	Fabaceae
47	*Brachystegia spiciformis* Benth.	Fabaceae
48	*Brachystegia taxifolia* Harms.	Fabaceae
49	*Chamaecrista mimosoides* (L.) Greene	Fabaceae
50	*Crotalaria lanceolata* E. Mey.	Fabaceae
51	*Crotalaria natalitia* Meisn.	Fabaceae
52	*Dalbergia nitidula* Baker	Fabaceae
53	*Desmodium dregeanum* Benth	Fabaceae
54	*Dolichos kilimandscharicus* Taub	Fabaceae
55	*Eriosema buchananii* Baker f.	Fabaceae
56	*Erythrophleum africanum* (Welw. ex Benth) Harms	Fabaceae
57	*Indigofera schimperi* Jaub. & Spach.	Fabaceae
58	*Isoberlinia angolensis* (Welw. ex Benth) Hoyle & Brennan	Fabaceae
59	*Julbernardia paniculata* (Benth) Troupin	Fabaceae
60	*Pericopsis angolensis* (Baker) Meeuwen	Fabaceae
61	*Pterocarpus angolensis* DC.	Fabaceae
62	*Swartzia madagascariensis* Desv.	Fabaceae
63	*Vigna frutescens* A. Rich.	Fabaceae
64	*Chironia palustris* Burch.	Gentianaceae
65	*Hypoxis goetzei* Harms	Hypoxidaceae
66	*Gladiolus laxiflorus* Baker	Iridaceae
67	*Vitex doniana* Sweet	Lamiaceae
68	*Grewia bicolor* Juss.	Malvaceae
69	*Corchorus tridens* L.	Malvaceae
70	*Memycylon flavovirens* Baker	Melastomataceae
71	*Ficus wakefieldii* Hutch.	Moraceae
72	*Syzygium guineense guineense* (Willd.) DC.	Myrtaceae
73	*Syzgium guineense macrocarpum* (Willd.) DC.	Myrtaceae
74	*Nephrolepis cordifolia* (L.) C. Presl	Nephrolepidaceae
75	*Ochna pulchra* Hook. f.	Ochnaceae

76	*Biophytum crassipes* Engl.	Oxalidaceae
77	*Sesamum angolense* Welw.	Passifloraceae
78	*Brachiaria serrata* (Thunb.) Stapf	Poaceae
79	*Eleusine coracana* (L.) Gaertn.	Poaceae
80	*Chloris pycnothrix* Trin.	Poaceae
81	*Digitaria eriantha* Steud.	Poaceae
82	*Diheteropogon amplectens* (Nees) Clayton	Poaceae
83	*Eragrostis aspera* (Jacq.) Nees	Poaceae
84	*Eragrostis racemosa* (Thunb.) Steud.	Poaceae
85	*Heteropogon contortus* (L.) Roem. & Schult.	Poaceae
86	*Hyparrhenia rufa* (Nees) Stapf	Poaceae
87	*Loudetia simplex* (Nees) C. E. Hubb.	Poaceae
88	*Panicum pectinellum* Stapf	Poaceae
89	*Rottboellia cochinchinensis* (Lour.) Clayton	Poaceae
90	*Setaria pumila* (Poir) Roem & Schult.	Poaceae
91	*Sporobolus fibrosus* Cope	Poaceae
92	*Sporobulus pyramidalis* P. Beauv.	Poaceae
93	*Urochloa mosambicensis* (Hack.) Dandy	Poaceae
94	*Securidaca longipedunculata* Fresen.	Polygalaceae
95	*Protea angolensis* Welw.	Proteaceae
96	*Clematis welwitschii* Hiern ex Kuntze	Ranunculaceae
97	*Fadogia triphylla* Baker	Rubiaceae
98	*Gardenia imperialis* K. Schum.	Rubiaceae
99	*Rothmannia engleriana* (K. Schum.) Keay	Rubiaceae
100	*Vangueriopsis lanciflora* (Hiern) Robyns ex R. D. Good	Rubiaceae
101	*Mimusops zeyheri* Sond.	Sapotaceae
102	*Striga asiatica* (L.) Kuntze	Sapotaceae
103	*Strychnos cocculoides* Baker	Strychnaceae
104	*Strychnos pugens* Soler.	Strychnaceae
105	*Strychnos spinosa* Lam.	Strychnaceae
106	*Xerophyta equisetoides* Baker	Velloziaceae
107	*Cyphostemma cirrhosum* (Thunb.) Desc. ex Wild & R. B. Drumm.	Vitaceae

Appendix 3.3 Correlation matrix of the principal components of vegetation structure and composition in Serenje District, Zambia and Measures of Sampling Adequacy (MSA) values of each vegetation variable.

	TREEDIV	TRERICH	TREDEN	TOTRICH	TOTDIV	CCOVER	TOTBA	TREEBA	DBH	HEIGHT
TREEDIV	1	0.744	0.463	0.305	0.348	0.168	0.205	-0.168	-0.071	-0.036
TRERICH	0.744	1	0.661	0.448	0.452	-0.049	0.228	-0.24	-0.271	-0.278
TREDEN	0.463	0.661	1	0.207	0.153	-0.387	-0.006	-0.531	-0.584	-0.586
TOTRICH	0.305	0.448	0.207	1	0.978	0.082	0.039	0.009	-0.011	-0.021
TOTDIV	0.348	0.452	0.153	0.978	1	0.138	0.087	0.068	0.063	0.057
CCOVER	0.168	-0.049	-0.387	0.082	0.138	1	0.412	0.454	0.57	0.595
TOTBA	0.205	0.228	-0.006	0.039	0.087	0.412	1	0.686	0.674	0.655
TREEBA	-0.168	-0.24	-0.531	0.009	0.068	0.454	0.686	1	0.948	0.909
DBH	-0.071	-0.271	-0.584	-0.011	0.063	0.57	0.674	0.948	1	0.994
HEIGHT	-0.036	-0.278	-0.586	-0.021	0.057	0.595	0.655	0.909	0.994	1
MSA	***0.641***	***0.689***	***0.779***	***0.54***	***0.55***	***0.9***	***0.79***	***0.59***	***0.601***	***0.596***

TREEDIV - Tree species diversity. TRERICH - Tree species richness. TREDEN - Stem density. TOTRICH - Total plant species richness. TOTDIV- Total plant diversity. CCOVER - % Canopy cover. TOTBA - Stand basal area cover. TREEBA - Mean tree basal area cover. DBH - Diameter at breast height and HEIGHT - Tree height

Appendix 3.4 Distribution of plant census plots in different miombo woodland types in Serenje District, Zambia. The first number after the name of the study site represents the transect number while the second number represents the plot number along the transect.

Old growth plots	Degraded old growth plots	Old regrowth plots	Young regrowth plots
Serenje 11	Serenje 13	Serenje 14	Kanona 12
Serenje 12	Serenje22	Serenje 15	Kanona 32
Serenje 21	Serenje 23	Serenje 24	Kanona 34
Serenje 33	Serenje 31	Serenje 25	Kafunda 32
Serenje 35	Serenje 34	Serenje 32	Kafunda 34
Kanona 21	Kanona 11	Kanona 13	Kafunda 41
Kanona 25	Kanona 24	Kanona 14	Kafunda 44
Kanona 35	Kafunda 12	Kanona 15	
Kafunda 14	Kafunda 15	Kanona 22	
	Kafunda 22	Kanona 23	
	Kafunda 23	Kanona 31	
	Kafunda 25	Kanona 33	
	Kafunda 31	Kafunda 11	
	Kafunda 33	Kafunda 13	
	Kafunda 35	Kafunda 21	
	Kafunda 42	Kafunda 24	
		Kafunda 43	
		Kafunda 45	

Appendix 3.5 Structural and floristic characteristics of four miombo types in Serenje District, Zambia. Values are mean ± SE per plot.

Vegetation variable/0.01ha plot	Old growth miombo (n = 9)	Degraded old growth miombo (n = 16)	Old regrowth miombo (n = 18)	Young regrowth miombo (n = 7)
Canopy cover (%)	51.11 ± 4.984	36.88 ± 4.607	26.11 ± 4.601	6.429 ± 0.922
Tree basal area cover (dm²)	13.86 ± 1.527	6.19 ± 1.350	5.08 ± 0.743	1.78 ± 0.303
Tree DBH (cm)	35.19 ± 2.014	22.08 ± 2.227	20.77 ± 1.691	12.68 ± 1.113
Tree height (m)	14.97 ± 0.633	10.84 ± 0.734	10.51 ± 0.588	7.63 ± 0.459
Sapling density	28.78 ± 4.881	46.50 ± 7.373	26.44 ± 3.796	25.43 ± 3.747
Sapling species diversity	1.20 ± 0.088	1.19 ± 0.077	0.92 ± 0.124	1.12 ± 0.191
Sapling species evenness	0.75 ± 0.040	0.78 ± 0.035	0.71 ± 0.071	0.75 ± 0.062
Sapling species richness	5.11 ± 0.423	4.88 ± 0.364	3.39 ± 0.405	4.57 ± 0.649
Stem density	17.22 ± 1.588	19.50 ± 2.255	18.17 ± 2.371	48.00 ± 3.786
Stand basal area (dm²)	226.11 ± 18.947	86.87 ± 8.331	79.68 ± 11.441	104.13 ± 21.236
Total species diversity	3.48 ± 0.033	3.54 ± 0.028	3.26 ± 0.057	3.55 ± 0.080
Total species richness	32.56 ± 1.069	34.75 ± 1.006	26.78 ± 1.220	35.43 ± 2.543
Tree species diversity	1.43 ± 0.145	1.38 ± 0.105	1.21 ± 0.130	1.85 ± 0.146
Tree species evenness	0.70 ± 0.063	0.70 ± 0.040	0.64 ± 0.054	0.74 ± 0.049
Tree species richness	7.78 ± 0.434	7.50 ± 0.645	6.28 ± 0.604	12.57 ± 1.251

Appendix 4.1 Bird species recorded in bird census plots in Serenje District, Zambia. Nomenclature follows Benson *et al.*, (1971) and that used by Dowsett & Forbes-Watson, (1993). Letters in parentheses indicate the habitat range distribution of the species. E – Miombo endemics, R – Habitat- restricted species and G – Habitat generalists. For avian guild abbreviations see Appendix 4.2

	Common name	Scientific name	Frequency of detection	Diet and foraging height guild
1	Red-and-blue Sunbird (E)	*Anthreptes anchietae* Bocage	0.032	CSO
2	Long-billed Pipit (R)	*Anthus similis* Jerdon	0.012	GO
3	Yellow-breasted Apalis (G)	*Apalis flavida* Strickland	0.008	UCI
4	Chinspot Batis (G)	*Batis molitor* Hahn and Küster	0.092	UCI
5	Bleating Bush Warbler (G)	*Camaroptera brachyura* Vieillot	0.028	GI
6	Miombo Barred Warbler (E)	*Camaroptera undosa* Reichenow	0.02	GI
7	Bennett's Woodpecker (G)	*Campethera bennettii* Smith	0.02	UCI
8	Mozambique Nightjar (G)	*Caprimulgus fossi* Hartlaub	0.032	AI
9	Fiery-necked Nightjar (G)	*Caprimulgus pectoralis* Cuvier	0.012	AI
10	Rattling Cisticola (G)	*Cisticola chiniana* Smith	0.008	USI
11	Neddicky (R)	*Cisticola fulvicapilla* Vieillot	0.016	UGI
12	Trilling Cisticola (R)	*Cisticola woosnami* Olgilvie - Grant	0.004	USI
13	Striped Crested Cuckoo (G)	*Clamator levaillantii* Swainson	0.002	UCI
14	White-breasted Cuckoo-shrike (G)	*Coracina pectoralis* Jardine and Selby	0.012	UCI
15	African Grey Cuckoo (G)	*Cuculus gularis* Stephens	0.02	UCI
16	Fork-tailed Drongo (G)	*Dicrurus adsimilis* Bechstein	0.168	VGI
17	Southern Puffback (R)	*Dryoscopus cubla* Shaw	0.02	UCI
18	Cabanis's Bunting (R)	*Emberiza cabanisi* Reichenow	0.002	GO
19	Black-collared Eremomela (E)	*Eremomela atricollis* Bocage	0.004	CSI
20	Yellow-bellied Eremomela (G)	*Eremomela icteropygialis* Lafresnaye	0.002	CSI
21	Green-capped Eremomela (R)	*Eremomela scotops* Sundevall	0.028	CSI
22	Central Bearded Scrub Robin (E)	*Erythropygia barbata* Finsch and Hartlaub	0.028	UGO
23	Fawn-breasted Waxbill (G)	*Estrilda paludicola* Heuglin	0.012	GV
24	Yellow-bellied Hyliota (R)	*Hyliota flavigaster* Swainson	0.008	CSI
25	Greater Honeyguide (G)	*Indicator indicator* Sparrman	0.024	CSI

26	Lesser Honeyguide (G)	*Indicator minor* Stephens	0.008	CSI
27	Scaly-throated Honeyguide (R)	*Indicator variegatus* Lesson	0.024	CSI
28	Jameson Firefinch (G)	*Lagonosticta rhodopareia* Heuglin	0.004	GV
29	Tropical Boubou (G)	*Laniarius aethiopicus* Gmelin	0.02	USI
30	Fiscal Shrike (G)	*Lanius collaris* Linnaeus	0.008	GI
31	Lesser Grey Shrike (G)	*Lanius minor* Gmelin	0.004	GI
32	Souza's Shrike (R)	*Lanius souzae* Bocage	0.004	GI
33	Black-collared Barbet (G)	*Lybius torquatus* Dumont	0.016	CSO
34	Pennant-winged Nightjar (R)	*Macrodipteryx vexillarius* Gould	0.004	AI
35	Dark Chanting Goshawk (G)	*Melierax metabates* Heuglin	0.008	CSC
36	Swallow-tailed Bee-eater (G)	*Merops hirundineus* Lichtenstein	0.032	CSI
37	Black (Yellow-billed) Kite (G)	*Milvus migrans* Boddært	0.008	AC
38	Miombo Rock Thrush (E)	*Monticola angolensis* Souza	0.016	UGI
39	Böhm's Flycatcher (E)	*Muscicapa boehmi* Reichenow	0.036	UCI
40	Miombo Double-collared Sunbird (R)	*Nectarinia manoensis* Reichenow	0.176	CSO
41	Scarlet-chested Sunbird (G)	*Nectarinia senegalensis* Linnaeus	0.044	CSO
42	Shelley's Sunbird (E)	*Nectarinia shelleyi* Alexander	0.324	CSO
43	Yellow-bellied Sunbird (G)	*Nectarinia venusta* Shaw and Nodder	0.004	CSO
44	Brubru (G)	*Nilaus afer* Latham	0.008	CSI
45	Eastern Black-headed Oriole (G)	*Oriolus larvatus* Lichtenstein	0.088	CSO
46	Miombo Grey Tit (E)	*Parus griseiventris* Reichenow	0.036	CSO
47	Southern Black Tit (G)	*Parus niger* Vieillot	0.036	CSO
48	Yellow-fronted Tinkerbird (G)	*Pogoniulus chrysoconus* Temminck	0.068	CSO
49	Tawny-flanked Prinia (G)	*Prinia subflava* Gmelin	0.176	USI
50	White Helmet Shrike (G)	*Prionops plumatus* Shaw	0.028	UCI
51	Common Bulbul (G)	*Pycnonotus barbatus* Desfontaines	0.276	VGO
52	Red-headed Quelea (G)	*Quelea erythrops* Hartlaub	0.008	GV
53	Spotted Creeper (R)	*Salponis spilonotus* Franklin	0.004	UCI
54	Cape Turtle Dove (G)	*Streptopelia capicola* Sundevall	0.08	VGV
55	Red-eyed Dove (G)	*Streptopelia semitorquata* Rüppell	0.044	VGV
56	Long-billed Crombec (G)	*Sylvietta rufescens* Vieillot	0.044	UGI

57	Red-capped Crombec (E)	*Sylvietta ruficapilla* Bocage	0.016	CSI
58	Black-crowned Tchagra (G)	*Tchagra senegalus* Linnaeus	0.052	USI
59	Paradise Flycatcher (G)	*Terpsiphone viridis* Müller	0.032	UCI
60	Pale-billed Hornbill (E)	*Tockus pallidirostris* Finsch and Hartlaub	0.004	CSO
61	Miombo Pied Barbet (R)	*Tricholaema frontata* Cabanis	0.032	CSO
62	Arrow-marked Babbler (G)	*Turdoides jardineii* Smith	0.002	USO
63	Olive Thrush (G)	*Turdus olivaceus* Linnaeus	0.112	GO
64	Emerald-spotted Wood Dove (G)	*Turtur chalcospilos* Wagler	0.108	VGV
65	Long-tailed Shrike (G)	*Urolestes melanoleucus* Jardine	0.002	UCI
66	Long-tailed Paradise Widow (G)	*Vidua paradisaea* Linnaeus	0.024	GV
67	Yellow White-eye (G)	*Zosterops senegalensis* Bonaparte	0.02	CSO

Appendix 4.2 Bird guilds recorded in bird census plots in Serenje, District, Zambia including their abbreviations and proportions.

	Guild	Abbreviation	Number of species (% of total number of species)
1	Aerial carnivore	AC	1(1%)
2	Canopy specialized carnivore	CSC	1(1%)
3	Canopy specialized insectivore	CSI	10 (15%)
4	Canopy specialized omnivore	CSO	13 (19%)
5	Understorey specialized insectivore	USI	5 (7%)
6	Understory specialized omnivore	USO	1 (1%)
7	Aerial insectivore	AI	3 (4%)
8	Ground insectivore	GI	5 (7%)
9	Ground omnivore	GO	3 (4%)
10	Ground vegetarian	GV	4 (6%)
11	Understory and canopy insectivore	UCI	12 (18%)
12	Understory and ground insectivore	UGI	3 (4%)
13	Understory and ground omnivore	UGO	1 (1%)
14	Generalist insectivore	VGI	1 (1%)
15	Generalist omnivore	VGO	1 (1%)
16	Generalist vegetarian	VGV	3(4%)

Appendix 4.3 Distribution of plant census plots in different clusters based on bird abundance by species data in Serenje District, Zambia. The first number after the name of the study site represents the transect number while the second number represents the plot number along the transect.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
1	Serenje 12	Kanona 14	Serenje 13	Serenje 11	Kanona 11
2	Serenje 15	Kanona 15	Kafunda 14	Serenje 24	Kanona 13
3	Serenje 21	Kanona 24	Kafunda 22	Serenje 25	
4	Serenje 22	Kanona 35	Kafunda 25	Serenje 31	
5	Serenje 23	Kafunda 21		Serenje 33	
6	Serenje 34	Kafunda 41		Serenje 35	
7	Kanona 22			Kanona 31	
8	Kanona 23			Kanona 33	
9	Kanona 25			Kafunda 12	
10	Kanona 34			Kafunda 15	
11	Kafunda 11			Kafunda 23	
12	Kafunda 13			Kafunda 24	
13	Kafunda 31				
14	Kafunda 32				
15	Kafunda 33				
16	Kafunda 34				
17	Kafunda 35				
18	Kafunda 42				
19	Kafunda 43				
20	Kafunda 44				
21	Kafunda 45				

Appendix 4.4 Spatial autocorrelation results for the avian community transect data in Serenje District, Zambia. R^2 is the adjusted coefficient of determination from the linear regression analysis; range is the distance from the beginning of a transect at which spatial autocorrelation in the data ends and NS means the linear regression model of the transect data was not significant.

Transect	Avian species richness	Avian guild richness	Pooled bird abundance	Abundance of endemics
Serenje 1	NS	$R^2 = 0.44$; Range = 881.6m	NS	NS
Serenje 2	NS	NS	NS	$R^2 = 0.29$; Range = 478.1m
Serenje 3	NS	NS	$R^2 = 0.59$; Range = 600.0m	$R^2 = 0.41$; Range = 833.1m
Kanona 1	$R^2 = 0.30$; Range = 829.7m	NS	$R^2 = 0.50$; Range = 798.5m	NS
Kanona 2	$R^2 = 0.41$; Range = 1169.1m	$R^2 = 0.33$; Range = 848.7m	NS	NS
Kanona 3	NS	NS	NS	NS
Kafunda 1	NS	NS	NS	NS
Kafunda 2	$R^2 = 0.76$; Range = 600m	$R^2 = 0.53$; Range = 600.0m	$R^2 = 0.69$; Range = 600.0m	$R^2 = 0.78$; Range = 600m
Kafunda 3	NS	NS	NS	NS
Kafunda 4	$R^2 = 0.39$; Range = 801.9m	$R^2 = 0.40$; Range = 753.4m	$R^2 = 0.31$; Range = 722.3m	$R^2 = 0.83$; Range = 1467.0m

Transect	Abundance of habitat generalist birds	Abundance of habitat restricted birds	Abundance of omnivores	Abundance of nectarivores	Abundance of insectivores	Abundance of vegetarians
Serenje 1	NS	$R^2 = 0.47$; Range = 940.0m	$R^2 = 0.55$; Range = 249.0m	NS	$R^2 = 0.33$; Range = 140.3m	NS
Serenje 2	NS	NS	$R^2 = 0.51$; Range = 3153.0m	$R^2 = 0.51$; Range = 3242.4m	NS	NS
Serenje 3	$R^2 = 0.63$; Range = 600.0m	$R^2 = 0.62$; Range = 600.0m	NS	NS	NS	NS
Kanona 1	NS	NS	NS	NS	$R^2 = 0.59$; Range = 1186.5m	NS
Kanona 2	$R^2 = 0.85$; Range = 600.0m	NS	$R^2 = 0.44$; Range =	$R^2 = 0.25$; Range =	NS	NS

			600.0m	600.0m		
Kanona 3	NS	NS	NS	R^2 = 0.38; Range = 600.0m	NS	R^2 = 0.26; Range = 600.0m
Kafunda 1	NS	NS	NS	R^2 = 0.56; Range = 600.0m	R^2 = 0.60; Range = 1051.4m	R^2 = 0.44; Range = 600.0m
Kafunda 2	NS	R^2 = 0.67; Range = 3065.0m	NS	R^2 = 0.67; Range = 600.0m	NS	NS
Kafunda 3	NS	NS	R^2 = 0.40; Range = 1231.5m	NS	NS	NS
Kafunda 4	NS	NS	R^2 = 0.53; Range = 600.0m	NS	NS	NS

Appendix 4.5 Table of pooled avian variables in different habitats and in different seasons in Serenje District, Zambia. Values are means and standard errors per plot.

Avian variable	**Old growth miombo (n = 9)**	**Degraded old growth miombo (n = 16)**	**Old regrowth miombo(n = 18)**	**Young regrowth miombo (n = 7)**
Avian species richness	3.00 ± 0.332	2.61 ± 0.259	2.86 ± 0.277	2.67 ± 0.371
Avian guild richness	2.75 ± 0.350	2.29 ± 0.158	2.45 ± 0.218	2.51 ± 0.273
Overall avian abundance	6.40 ± 0.819	6.00 ± 0.809	5.78 ± 0.848	5.12 ± 1.195
Abundance of endemics	1.62 ± 0.299	1.10 ± 0.214	1.45 ± 0.187	1.33 ± 0.303
Abundance of habitat restricted birds	1.41 ± 0.407	1.18 ± 0.317	1.05 ± 0.298	0.69 ± 0.334
Abundance of habitat generalists	3.32 ± 0.419	3.76 ± 0.463	3.43 ± 0.534	3.46 ± 0.866
Abundance of omnivores	1.06 ± 0.262	1.04 ± 0.278	1.54 ± 0.298	0.93 ± 0.246
Abundance of nectarivores	2.06 ± 0.360	1.73 ± 0.324	1.26 ± 0.230	1.21 ± 0.439
Abundance of vegetarians	0.28 ± 0.073	0.46 ± 0.141	0.42 ± 0.104	0.69 ± 0.389
Abundance of	2.24 ± 0.490	3.27 ± 0.478	2.85 ± 0.617	1.98 ± 0.489

insectivores

Cool and dry season	Old growth miombo (n = 9)	Degraded old growth miombo (n = 16)	Old regrowth miombo(n = 18)	Young regrowth miombo (n = 7)
Avian species richness	3.48 ± 0.631	2.22 ± 0.448	2.48 ± 0.272	2.24 ± 0.499
Avian guild richness	2.63 ± 0.422	1.92 ± 0.311	1.97 ± 0.218	1.96 ± 0.377
Overall avian abundance	8.59 ± 2.056	5.52 ± 1.428	4.71 ± 0.704	4.68 ± 1.536
Abundance of endemics	2.18 ± 0.632	0.93 ± 0.299	1.27 ± 0.287	1.26 ± 0.346
Abundance of habitat restricted birds	2.75 ± 1.178	1.67 ± 0.654	1.06 ± 0.317	0.36 ± 0.179
Abundance of habitat generalists	3.33 ± 0.678	3.06 ± 0.943	2.46 ± 0.461	3.43 ± 1.390
Abundance of omnivores	1.00 ± 0.322	1.25 ± 0.382	1.86 ± 0.632	1.00 ± 0.345
Abundance of nectarivores	2.56 ± 0.621	2.22 ± 0.572	1.75 ± 0.344	0.64 ± 0.322
Abundance of vegetarians	0.22 ± 0.121	0.69 ± 0.400	0.36 ± 0.113	0.29 ± 0.149
Abundance of insectivores	1.17 ± 0.799	2.34 ± 0.743	2.14 ± 0.610	0.36 ± 0.179

Hot and dry season	Old growth miombo (n = 9)	Degraded old growth miombo (n = 16)	Old regrowth miombo(n = 18)	Young regrowth miombo (n = 7)
Avian species richness	3.48 ± 0.724	3.65 ± 0.565	3.78 ± 0.521	3.11 ± 0.518
Avian guild richness	3.75 ± 0.748	3.16 ± 0.440	3.49 ± 0.498	3.25 ± 0.447
Overall avian abundance	5.91 ± 1.697	7.76 ± 1.596	7.02 ± 1.495	4.68 ± 1.527
Abundance of endemics	1.11 ± 0.564	1.31 ± 0.631	1.81 ± 0.497	1.30 ± 0.332
Abundance of habitat restricted birds	0.78 ± 0.222	1.31 ± 0.575	0.94 ± 0.424	0.71 ± 0.565
Abundance of habitat generalists	4.16 ± 1.257	5.02 ± 0.926	4.79 ± 1.070	2.95 ± 1.064
Abundance of	1.00 ± 0.333	0.63 ± 0.155	2.00 ± 0.464	0.57 ± 0.297

omnivores				
Abundance of nectarivores	1.33 ± 0.645	1.69 ± 0.888	0.83 ± 0.316	1.57 ± 0.948
Abundance of vegetarians	0.44 ± 0.242	0.25 ± 0.144	0.61 ± 0.282	1.00 ± 0.845
Abundance of insectivores	4.22 ± 1.516	5.63 ± 1.268	3.94 ± 1.068	2.71 ± 0.680
Hot and wet season	**Old growth miombo (n = 9)**	**Degraded old growth miombo (n = 16)**	**Old regrowth miombo(n = 18)**	**Young regrowth miombo (n = 7)**
Avian species richness	2.05 ± 0.307	1.96 ± 0.287	2.31 ± 0.312	2.64 ± 0.730
Avian guild richness	1.89 ± 0.309	1.78 ± 0.234	1.89 ± 0.251	2.34 ± 0.510
Overall avian abundance	4.71 ± 1.060	4.73 ± 1.296	5.61 ± 0.886	5.99 ± 2.458
Abundance of endemics	1.58 ± 0.428	1.05 ± 0.284	1.26 ± 0.313	1.42 ± 0.751
Abundance of habitat restricted birds	0.70 ± 0.434	0.56 ± 0.199	1.13 ± 0.330	1.00 ± 0.478
Abundance of habitat generalists	2.47 ± 0.608	3.18 ± 1.018	3.03 ± 0.503	4.00 ± 1.729
Abundance of omnivores	1.17 ± 0.408	1.25 ± 0.614	0.75 ± 0.199	1.21 ± 0.324
Abundance of nectarivores	2.28 ± 0.672	1.28 ± 0.368	1.19 ± 0. 432	1.43 ± 0.659
Abundance of insectivores	1.33 ± 0.527	1.84 ± 0.554	2.47 ± 0.597	2.86 ± 1.045
Abundance of vegetarians	0.17 ± 0.083	0.44 ± 0.176	0.28 ± 0.092	0.79 ± 0.625

Appendix 5.1 Regression ANOVA results of various linear models for predicting avian species richness from vegetation variables. Vegetation variable abbreviations are:

CCOVER – Canopy cover; DBH – Tree diameter at breast height HEIGHT – Tree height; TREEBA – Mean tree basal area cover; SAPDEN – Sapling density; SAPDIV – Sapling species diversity; SAPEVEN – Sapling species evenness; SAPRICH – Sapling species richness; TREDEN – Stem density; TREEDIV – Tree species diversity; TREEVEN – Tree species evenness; TOTBA – Stand basal area cover; TOTDIV - Total plant species diversity; TOTRICH – Total species plant richness and TRERICH – Tree species richness

Model	Source of variation	Sum of Squares	df	Mean Square	F- value	P	Adjusted R^2
1	Regression	247.443	15	16.496	1.484	0.166(a)	0.129
	Residual	377.937	34	11.116			
	Total	625.380	49				
2	Regression	247.344	14	17.667	1.636	0.118(b)	0.154
	Residual	378.036	35	10.801			
	Total	625.380	49				
3	Regression	246.871	13	18.990	1.806	0.080(c)	0.176
	Residual	378.509	36	10.514			
	Total	625.380	49				
4	Regression	245.530	12	20.461	1.993	0.054(d)	0.196
	Residual	379.850	37	10.266			
	Total	625.380	49				
5	Regression	244.016	11	22.183	2.210	0.035(e)	0.214
	Residual	381.364	38	10.036			
	Total	625.380	49				
6	Regression	240.607	10	24.061	2.439	0.023(f)	0.227
	Residual	384.773	39	9.866			
	Total	625.380	49				
7	Regression	240.109	9	26.679	2.770	0.013(g)	0.245
	Residual	385.271	40	9.632			
	Total	625.380	49				
8	Regression	239.133	8	29.892	3.173	0.007(h)	0.262
	Residual	386.247	41	9.421			
	Total	625.380	49				
9	Regression	222.464	7	31.781	3.313	0.007(i)	0.248
	Residual	402.916	42	9.593			
	Total	625.380	49				
10	Regression	200.226	6	33.371	3.375	0.008(j)	0.225
	Residual	425.154	43	9.887			
	Total	625.380	49				
11	Regression	178.633	5	35.727	3.519	0.009(k)	0.204
	Residual	446.747	44	10.153			
	Total	625.380	49				
12	Regression	152.440	4	38.110	3.626	0.012(l)	0.177
	Residual	472.940	45	10.510			
	Total	625.380	49				

a Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, TRERICH, CCOVER, TREDEN, SAPEVEN, TOTBA, TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH
b Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, SAPDIV, TRERICH, CCOVER, TREDEN, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH
c Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, SAPDIV, TRERICH, CCOVER, TREDEN, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, DBH

d Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, SAPDIV, CCOVER, TREDEN, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, DBH
e Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, SAPDIV, CCOVER, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, DBH
f Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, SAPDIV, CCOVER, TOTBA , TREEBA, SAPRICH, TREEDIV, DBH
g Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, CCOVER, TOTBA , TREEBA, SAPRICH, TREEDIV, DBH
h Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, CCOVER, TOTBA , TREEBA, TREEDIV, DBH
i Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, CCOVER, TOTBA , TREEBA, DBH
j Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, CCOVER, TREEBA, DBH
k Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEBA, DBH
l Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, DBH

Appendix 5.2 Table of coefficients and collinearity statistics for linear models predicting avian species richness from vegetation variables.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-17.29	34.24		-0.51	0.62		
	TREEDIV	2.46	5.17	0.34	0.47	0.64	0.03	29.55
	TREEVEN	-0.91	9.63	-0.05	-0.09	0.93	0.07	14.08
	TOTRICH	-0.30	0.50	-0.50	-0.60	0.55	0.03	38.40
	TOTDIV	2.83	14.30	0.17	0.20	0.84	0.02	42.92
	SAPRICH	-0.67	1.09	-0.32	-0.62	0.54	0.07	14.79
	SAPEVEN	-3.05	6.35	-0.18	-0.48	0.63	0.13	7.87
	SAPDIV	3.00	5.39	0.36	0.56	0.58	0.04	23.25
	SAPDEN	0.06	0.04	0.39	1.79	0.08	0.37	2.68
	TOTBA	-0.02	0.01	-0.37	-1.28	0.21	0.22	4.63
	TRERICH	-0.17	0.50	-0.15	-0.33	0.74	0.09	11.03
	TREDEN	0.03	0.07	0.12	0.44	0.66	0.23	4.43
	CCOVER	0.05	0.03	0.30	1.46	0.15	0.42	2.38
	TREEBA	1.90	1.17	2.90	1.62	0.11	0.01	180.41
	DBH	-4.01	2.56	-10.87	-1.57	0.13	0.00	2695.07
	HEIGHT	9.42	5.95	8.42	1.58	0.12	0.00	1590.42
2	(Constant)	-17.87	33.20		-0.54	0.59		
	TREEDIV	2.00	1.93	0.28	1.04	0.31	0.24	4.22
	TOTRICH	-0.30	0.49	-0.50	-0.62	0.54	0.03	38.14
	TOTDIV	2.94	14.04	0.18	0.21	0.84	0.02	42.61
	SAPRICH	-0.65	1.04	-0.31	-0.62	0.54	0.07	14.00
	SAPEVEN	-3.05	6.26	-0.18	-0.49	0.63	0.13	7.87
	SAPDIV	2.93	5.26	0.35	0.56	0.58	0.04	22.78
	SAPDEN	0.06	0.03	0.38	1.89	0.07	0.42	2.39
	TOTBA	-0.02	0.01	-0.36	-1.31	0.20	0.23	4.44
	TRERICH	-0.13	0.34	-0.12	-0.39	0.70	0.19	5.40
	TREDEN	0.03	0.07	0.12	0.44	0.67	0.24	4.13
	CCOVER	0.05	0.03	0.30	1.48	0.15	0.42	2.37
	TREEBA	1.91	1.15	2.92	1.66	0.11	0.01	178.23
	DBH	-4.04	2.50	-10.95	-1.62	0.11	0.00	2652.29
	HEIGHT	9.48	5.83	8.47	1.63	0.11	0.00	1570.62
3	(Constant)	-11.70	15.03		-0.78	0.44		

	TREEDIV	2.00	1.90	0.28	1.05	0.30	0.24	4.22
	TOTRICH	-0.20	0.11	-0.34	-1.92	0.06	0.54	1.84
	SAPRICH	-0.57	0.95	-0.27	-0.60	0.55	0.08	11.88
	SAPEVEN	-2.45	5.48	-0.14	-0.45	0.66	0.16	6.19
	SAPDIV	2.46	4.71	0.29	0.52	0.60	0.05	18.77
	SAPDEN	0.06	0.03	0.37	1.93	0.06	0.45	2.24
	TOTBA	-0.02	0.01	-0.37	-1.36	0.18	0.23	4.37
	TRERICH	-0.12	0.33	-0.11	-0.36	0.72	0.19	5.21
	TREDEN	0.03	0.07	0.11	0.42	0.68	0.25	4.07
	CCOVER	0.05	0.03	0.30	1.49	0.14	0.42	2.37
	TREEBA	1.93	1.13	2.95	1.71	0.10	0.01	177.20
	DBH	-4.09	2.46	-11.08	-1.67	0.10	0.00	2631.42
	HEIGHT	9.61	5.72	8.59	1.68	0.10	0.00	1552.54
4	(Constant)	-12.95	14.44		-0.90	0.38		
	TREEDIV	1.54	1.40	0.22	1.10	0.28	0.43	2.35
	TOTRICH	-0.22	0.10	-0.36	-2.20	0.03	0.61	1.63
	SAPRICH	-0.56	0.94	-0.26	-0.60	0.55	0.08	11.87
	SAPEVEN	-2.38	5.41	-0.14	-0.44	0.66	0.16	6.19
	SAPDIV	2.41	4.65	0.29	0.52	0.61	0.05	18.75
	SAPDEN	0.06	0.03	0.37	1.94	0.06	0.45	2.24
	TOTBA	-0.02	0.01	-0.41	-1.64	0.11	0.27	3.75
	TREDEN	0.03	0.07	0.10	0.38	0.70	0.25	4.01
	CCOVER	0.05	0.03	0.30	1.50	0.14	0.42	2.37
	TREEBA	1.97	1.11	3.01	1.78	0.08	0.01	175.22
	DBH	-4.23	2.39	-11.47	-1.77	0.09	0.00	2560.06
	HEIGHT	10.03	5.53	8.96	1.81	0.08	0.00	1487.28
5	(Constant)	-12.99	14.28		-0.91	0.37		
	TREEDIV	1.77	1.26	0.25	1.41	0.17	0.52	1.93
	TOTRICH	-0.21	0.09	-0.35	-2.19	0.03	0.64	1.55
	SAPRICH	-0.58	0.92	-0.28	-0.63	0.53	0.08	11.82
	SAPEVEN	-2.98	5.12	-0.18	-0.58	0.56	0.18	5.67
	SAPDIV	2.74	4.52	0.33	0.61	0.55	0.06	18.12
	SAPDEN	0.06	0.03	0.37	1.94	0.06	0.45	2.22
	TOTBA	-0.02	0.01	-0.35	-1.72	0.09	0.38	2.63
	CCOVER	0.05	0.03	0.27	1.48	0.15	0.48	2.09
	TREEBA	2.03	1.09	3.11	1.87	0.07	0.01	171.41
	DBH	-4.39	2.33	-11.90	-1.89	0.07	0.00	2482.45
	HEIGHT	10.34	5.41	9.23	1.91	0.06	0.00	1457.09
6	(Constant)	-12.64	14.14		-0.89	0.38		
	TREEDIV	1.62	1.22	0.23	1.33	0.19	0.54	1.85
	TOTRICH	-0.22	0.09	-0.37	-2.43	0.02	0.69	1.46
	SAPRICH	-0.26	0.73	-0.12	-0.35	0.73	0.13	7.42
	SAPDIV	0.58	2.57	0.07	0.22	0.82	0.17	5.94
	SAPDEN	0.06	0.03	0.35	1.90	0.06	0.46	2.19
	TOTBA	-0.02	0.01	-0.35	-1.72	0.09	0.38	2.63
	CCOVER	0.05	0.03	0.28	1.56	0.13	0.48	2.07

	TREEBA	1.97	1.07	3.01	1.84	0.07	0.01	169.60
	DBH	-4.26	2.30	-11.53	-1.85	0.07	0.00	2456.35
	HEIGHT	10.00	5.33	8.93	1.87	0.07	0.00	1440.18
7	(Constant)	-13.48	13.48		-1.00	0.32		
	TREEDIV	1.61	1.20	0.23	1.34	0.19	0.54	1.85
	TOTRICH	-0.22	0.09	-0.36	-2.45	0.02	0.70	1.44
	SAPRICH	-0.12	0.36	-0.05	-0.32	0.75	0.53	1.90
	SAPDEN	0.05	0.03	0.34	2.04	0.05	0.57	1.75
	TOTBA	-0.02	0.01	-0.36	-1.88	0.07	0.41	2.43
	CCOVER	0.05	0.03	0.28	1.56	0.13	0.49	2.05
	TREEBA	2.03	1.02	3.10	1.98	0.05	0.01	159.13
	DBH	-4.39	2.19	-11.90	-2.01	0.05	0.00	2281.97
	HEIGHT	10.33	5.06	9.23	2.04	0.05	0.00	1327.60
8	(Constant)	-13.32	13.33		-1.00	0.32		
	TREEDIV	1.58	1.18	0.22	1.33	0.19	0.55	1.83
	TOTRICH	-0.23	0.08	-0.38	-2.82	0.01	0.82	1.22
	SAPDEN	0.05	0.02	0.31	2.23	0.03	0.79	1.27
	TOTBA	-0.02	0.01	-0.37	-1.93	0.06	0.41	2.41
	CCOVER	0.04	0.03	0.26	1.58	0.12	0.57	1.75
	TREEBA	2.04	1.01	3.11	2.01	0.05	0.01	159.05
	DBH	-4.39	2.16	-11.89	-2.03	0.05	0.00	2281.86
	HEIGHT	10.32	5.01	9.22	2.06	0.05	0.00	1327.54
9	(Constant)	-13.57	13.45		-1.01	0.32		
	TOTRICH	-0.19	0.08	-0.31	-2.48	0.02	0.96	1.05
	SAPDEN	0.04	0.02	0.24	1.86	0.07	0.90	1.11
	TOTBA	-0.01	0.01	-0.27	-1.52	0.14	0.49	2.05
	CCOVER	0.04	0.03	0.26	1.61	0.11	0.57	1.75
	TREEBA	1.91	1.02	2.92	1.88	0.07	0.01	157.72
	DBH	-4.43	2.18	-12.00	-2.03	0.05	0.00	2281.35
	HEIGHT	10.56	5.05	9.44	2.09	0.04	0.00	1325.75
10	(Constant)	-13.76	13.65		-1.01	0.32		
	TOTRICH	-0.19	0.08	-0.32	-2.51	0.02	0.96	1.04
	SAPDEN	0.05	0.02	0.29	2.25	0.03	0.95	1.05
	CCOVER	0.04	0.03	0.25	1.48	0.15	0.57	1.74
	TREEBA	1.79	1.03	2.73	1.74	0.09	0.01	156.70
	DBH	-4.38	2.22	-11.87	-1.98	0.05	0.00	2280.86
	HEIGHT	10.42	5.12	9.31	2.03	0.05	0.00	1325.29
11	(Constant)	-15.00	13.81		-1.09	0.28		
	TOTRICH	-0.18	0.08	-0.30	-2.30	0.03	0.98	1.02
	SAPDEN	0.04	0.02	0.26	2.00	0.05	0.98	1.02
	TREEBA	1.67	1.04	2.55	1.61	0.12	0.01	155.78
	DBH	-4.30	2.25	-11.65	-1.91	0.06	0.00	2279.40
	HEIGHT	10.52	5.19	9.40	2.03	0.05	0.00	1325.06
12	(Constant)	5.21	5.78		0.90	0.37		
	TOTRICH	-0.19	0.08	-0.32	-2.47	0.02	0.99	1.01
	SAPDEN	0.04	0.02	0.24	1.85	0.07	0.98	1.02

DBH	-0.76	0.44	-2.06	-1.73	0.09	0.01	84.69
HEIGHT	2.45	1.33	2.19	1.84	0.07	0.01	84.56

Appendix 5.3 Regression ANOVA results of various linear models for predicting avian guild richness from vegetation variables. For vegetation variable abbreviation see Appendix 5.1 above

Model	Source of variation	Sum of Squares	df	Mean Square	F- value	P	Adjusted R^2
1	Regression	78.877	15	5.258	1.958	0.052(a)	0.227
	Residual	91.303	34	2.685			
	Total	170.180	49				
2	Regression	78.877	14	5.634	2.160	0.033(b)	0.249
	Residual	91.303	35	2.609			
	Total	170.180	49				
3	Regression	78.843	13	6.065	2.390	0.020(c)	0.269
	Residual	91.337	36	2.537			
	Total	170.180	49				
4	Regression	78.824	12	6.569	2.660	0.011(d)	0.289
	Residual	91.356	37	2.469			
	Total	170.180	49				
5	Regression	77.353	11	7.032	2.879	0.008(e)	0.297
	Residual	92.827	38	2.443			
	Total	170.180	49				
6	Regression	75.783	10	7.578	3.131	0.005(f)	0.303
	Residual	94.397	39	2.420			
	Total	170.180	49				
7	Regression	71.913	9	7.990	3.253	0.005(g)	0.293
	Residual	98.267	40	2.457			
	Total	170.180	49				
8	Regression	67.461	8	8.433	3.366	0.005(h)	0.279
	Residual	102.719	41	2.505			
	Total	170.180	49				
9	Regression	60.836	7	8.691	3.338	0.006(i)	0.250
	Residual	109.344	42	2.603			
	Total	170.180	49				
10	Regression	57.923	6	9.654	3.698	0.005(j)	0.248
	Residual	112.257	43	2.611			
	Total	170.180	49				
11	Regression	53.015	5	10.603	3.982	0.005(k)	0.233
	Residual	117.165	44	2.663			
	Total	170.180	49				
12	Regression	47.854	4	11.963	4.401	0.004(l)	0.217
	Residual	122.326	45	2.718			
	Total	170.180	49				
13	Regression	41.987	3	13.996	5.022	0.004(m)	0.198

	Residual	128.193	46	2.787		
	Total	170.180	49			

a Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, TRERICH, CCOVER, TREDEN, SAPEVEN, TOTBA, TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH
b Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, TRERICH, CCOVER, TREDEN, SAPEVEN, TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH
c Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, TRERICH, CCOVER, SAPEVEN, TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH
d Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, CCOVER, SAPEVEN, TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH
e Predictors: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, CCOVER, SAPEVEN, TREEBA, TREEDIV, TOTDIV, DBH
f Predictors: (Constant), HEIGHT, TOTRICH, TREEVEN, SAPDIV, CCOVER, SAPEVEN, TREEBA, TREEDIV, TOTDIV, DBH
g Predictors: (Constant), TOTRICH, TREEVEN, SAPDIV, CCOVER, SAPEVEN, TREEBA, TREEDIV, TOTDIV, DBH
h Predictors: (Constant), TOTRICH, TREEVEN, SAPDIV, SAPEVEN, TREEBA, TREEDIV, TOTDIV, DBH
i Predictors: (Constant), TOTRICH, TREEVEN, SAPDIV, SAPEVEN, TREEBA, TREEDIV, DBH
j Predictors: (Constant), TOTRICH, TREEVEN, SAPDIV, TREEBA, TREEDIV, DBH
k Predictors: (Constant), TOTRICH, TREEVEN, SAPDIV, TREEDIV, DBH
l Predictors: (Constant), TOTRICH, TREEVEN, TREEDIV, DBH
m Predictors: (Constant), TREEVEN, TREEDIV, DBH

Appendix 5.4 Table of coefficients and collinearity statistics for linear models predicting avian guild richness from vegetation variables.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		Beta	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-22.98	16.83		-1.37	0.18		
	TREEDIV	-3.42	2.54	-0.92	-1.35	0.19	0.03	29.55
	TREEVEN	8.84	4.73	0.88	1.87	0.07	0.07	14.08
	TOTRICH	-0.46	0.24	-1.48	-1.90	0.07	0.03	38.40
	TOTDIV	11.11	7.03	1.30	1.58	0.12	0.02	42.92
	SAPRICH	-0.36	0.53	-0.33	-0.68	0.50	0.07	14.79
	SAPEVEN	-4.22	3.12	-0.48	-1.35	0.18	0.13	7.87
	SAPDIV	3.15	2.65	0.72	1.19	0.24	0.04	23.25
	SAPDEN	0.02	0.02	0.20	0.95	0.35	0.37	2.68
	TOTBA	0.00	0.01	0.00	0.00	1.00	0.22	4.63
	TRERICH	0.03	0.25	0.05	0.12	0.90	0.09	11.03
	TREDEN	0.00	0.04	-0.03	-0.10	0.92	0.23	4.43
	CCOVER	0.02	0.02	0.26	1.36	0.18	0.42	2.38
	TREEBA	0.94	0.58	2.75	1.63	0.11	0.01	180.41
	DBH	-1.68	1.26	-8.71	-1.34	0.19	0.00	2695.07
	HEIGHT	3.30	2.92	5.65	1.13	0.27	0.00	1590.42
2	(Constant)	-22.99	16.52		-1.39	0.17		
	TREEDIV	-3.42	2.49	-0.92	-1.37	0.18	0.03	29.25
	TREEVEN	8.85	4.57	0.88	1.94	0.06	0.07	13.52
	TOTRICH	-0.46	0.24	-1.48	-1.93	0.06	0.03	38.19
	TOTDIV	11.11	6.86	1.30	1.62	0.11	0.02	42.10
	SAPRICH	-0.36	0.52	-0.33	-0.70	0.49	0.07	14.35
	SAPEVEN	-4.23	3.03	-0.48	-1.40	0.17	0.13	7.62
	SAPDIV	3.15	2.56	0.72	1.23	0.23	0.04	22.27
	SAPDEN	0.02	0.02	0.20	0.97	0.34	0.38	2.66

	TRERICH	0.03	0.24	0.05	0.12	0.90	0.09	10.86
	TREDEN	0.00	0.03	-0.03	-0.11	0.91	0.29	3.47
	CCOVER	0.02	0.02	0.26	1.40	0.17	0.43	2.32
	TREEBA	0.94	0.57	2.75	1.66	0.11	0.01	179.22
	DBH	-1.68	1.24	-8.71	-1.36	0.18	0.00	2693.90
	HEIGHT	3.30	2.88	5.65	1.15	0.26	0.00	1585.48
3	(Constant)	-23.15	16.23		-1.43	0.16		
	TREEDIV	-3.39	2.44	-0.91	-1.39	0.17	0.03	28.78
	TREEVEN	8.75	4.42	0.87	1.98	0.06	0.08	13.01
	TOTRICH	-0.47	0.23	-1.49	-2.01	0.05	0.03	36.98
	TOTDIV	11.25	6.66	1.32	1.69	0.10	0.02	40.79
	SAPRICH	-0.37	0.51	-0.34	-0.74	0.47	0.07	14.04
	SAPEVEN	-4.19	2.96	-0.47	-1.41	0.17	0.13	7.50
	SAPDIV	3.16	2.52	0.72	1.25	0.22	0.04	22.25
	SAPDEN	0.02	0.02	0.20	1.05	0.30	0.40	2.50
	TRERICH	0.02	0.22	0.03	0.09	0.93	0.11	9.24
	CCOVER	0.02	0.02	0.27	1.52	0.14	0.47	2.11
	TREEBA	0.92	0.54	2.70	1.71	0.10	0.01	167.52
	DBH	-1.64	1.18	-8.52	-1.39	0.17	0.00	2507.24
	HEIGHT	3.21	2.75	5.51	1.17	0.25	0.00	1485.66
4	(Constant)	-22.95	15.85		-1.45	0.16		
	TREEDIV	-3.20	1.12	-0.86	-2.86	0.01	0.16	6.22
	TREEVEN	8.45	2.85	0.84	2.97	0.01	0.18	5.54
	TOTRICH	-0.47	0.23	-1.49	-2.04	0.05	0.03	36.82
	TOTDIV	11.24	6.57	1.32	1.71	0.10	0.02	40.78
	SAPRICH	-0.38	0.49	-0.34	-0.77	0.45	0.07	13.65
	SAPEVEN	-4.22	2.90	-0.48	-1.45	0.15	0.14	7.40
	SAPDIV	3.19	2.46	0.73	1.30	0.20	0.05	21.73
	SAPDEN	0.02	0.02	0.21	1.10	0.28	0.42	2.40
	CCOVER	0.02	0.02	0.27	1.54	0.13	0.48	2.10
	TREEBA	0.92	0.53	2.70	1.73	0.09	0.01	166.92
	DBH	-1.63	1.15	-8.46	-1.41	0.17	0.00	2468.41
	HEIGHT	3.18	2.68	5.45	1.19	0.24	0.00	1453.63
5	(Constant)	-19.98	15.29		-1.31	0.20		
	TREEDIV	-3.44	1.07	-0.92	-3.23	0.00	0.17	5.71
	TREEVEN	8.88	2.78	0.88	3.20	0.00	0.19	5.33
	TOTRICH	-0.41	0.22	-1.32	-1.90	0.06	0.03	33.57
	TOTDIV	9.55	6.16	1.12	1.55	0.13	0.03	36.27
	SAPEVEN	-2.72	2.15	-0.31	-1.26	0.21	0.24	4.12
	SAPDIV	1.48	1.04	0.34	1.42	0.16	0.25	3.95
	SAPDEN	0.01	0.01	0.12	0.80	0.43	0.64	1.56
	CCOVER	0.02	0.02	0.25	1.46	0.15	0.49	2.06
	TREEBA	0.96	0.53	2.81	1.82	0.08	0.01	165.44
	DBH	-1.72	1.14	-8.92	-1.51	0.14	0.00	2443.01
	HEIGHT	3.40	2.65	5.82	1.28	0.21	0.00	1437.64
6	(Constant)	-19.86	15.22		-1.30	0.20		

	TREEDIV	-3.74	1.00	-1.00	-3.75	0.00	0.20	5.04
	TREEVEN	9.29	2.72	0.93	3.42	0.00	0.19	5.15
	TOTRICH	-0.41	0.22	-1.32	-1.91	0.06	0.03	33.57
	TOTDIV	9.71	6.13	1.14	1.58	0.12	0.03	36.23
	SAPEVEN	-3.32	2.01	-0.37	-1.65	0.11	0.28	3.63
	SAPDIV	1.82	0.95	0.42	1.92	0.06	0.30	3.29
	CCOVER	0.02	0.01	0.22	1.31	0.20	0.52	1.94
	TREEBA	0.94	0.52	2.76	1.80	0.08	0.01	165.18
	DBH	-1.69	1.13	-8.76	-1.49	0.15	0.00	2439.97
	HEIGHT	3.34	2.64	5.72	1.26	0.21	0.00	1436.52
7	(Constant)	-11.64	13.87		-0.84	0.41		
	TREEDIV	-3.79	1.00	-1.02	-3.78	0.00	0.20	5.03
	TREEVEN	9.52	2.73	0.95	3.49	0.00	0.20	5.12
	TOTRICH	-0.43	0.22	-1.37	-1.98	0.06	0.03	33.46
	TOTDIV	9.84	6.17	1.15	1.59	0.12	0.03	36.22
	SAPEVEN	-2.78	1.98	-0.31	-1.40	0.17	0.29	3.47
	SAPDIV	1.72	0.95	0.39	1.81	0.08	0.31	3.27
	CCOVER	0.02	0.01	0.23	1.35	0.19	0.52	1.94
	TREEBA	0.31	0.16	0.91	1.97	0.06	0.07	14.87
	DBH	-0.26	0.10	-1.34	-2.61	0.01	0.06	18.16
8	(Constant)	-12.64	13.99		-0.90	0.37		
	TREEDIV	-3.56	1.00	-0.96	-3.56	0.00	0.20	4.89
	TREEVEN	9.14	2.74	0.91	3.33	0.00	0.20	5.07
	TOTRICH	-0.44	0.22	-1.41	-2.02	0.05	0.03	33.39
	TOTDIV	10.13	6.23	1.19	1.63	0.11	0.03	36.17
	SAPEVEN	-3.23	1.97	-0.36	-1.64	0.11	0.30	3.37
	SAPDIV	2.10	0.92	0.48	2.29	0.03	0.34	2.98
	TREEBA	0.26	0.16	0.76	1.68	0.10	0.07	14.00
	DBH	-0.20	0.09	-1.06	-2.24	0.03	0.07	15.27
9	(Constant)	9.94	1.69		5.88	0.00		
	TREEDIV	-3.11	0.98	-0.83	-3.18	0.00	0.22	4.50
	TREEVEN	8.19	2.73	0.82	3.00	0.00	0.21	4.84
	TOTRICH	-0.09	0.05	-0.30	-2.00	0.05	0.68	1.47
	SAPEVEN	-1.95	1.84	-0.22	-1.06	0.30	0.35	2.84
	SAPDIV	1.74	0.91	0.40	1.92	0.06	0.36	2.80
	TREEBA	0.23	0.16	0.66	1.44	0.16	0.07	13.73
	DBH	-0.17	0.09	-0.86	-1.85	0.07	0.07	14.27
10	(Constant)	9.66	1.67		5.77	0.00		
	TREEDIV	-3.07	0.98	-0.82	-3.14	0.00	0.22	4.50
	TREEVEN	7.71	2.70	0.77	2.86	0.01	0.21	4.71
	TOTRICH	-0.10	0.05	-0.32	-2.13	0.04	0.69	1.45
	SAPDIV	1.04	0.62	0.24	1.68	0.10	0.76	1.31
	TREEBA	0.21	0.16	0.63	1.37	0.18	0.07	13.67
	DBH	-0.16	0.09	-0.84	-1.79	0.08	0.07	14.22
11	(Constant)	8.90	1.59		5.58	0.00		
	TREEDIV	-2.92	0.98	-0.78	-2.97	0.00	0.23	4.44

	TREEVEN	6.46	2.57	0.64	2.52	0.02	0.24	4.17
	TOTRICH	-0.09	0.05	-0.28	-1.91	0.06	0.71	1.41
	SAPDIV	0.85	0.61	0.19	1.39	0.17	0.80	1.25
	DBH	-0.04	0.03	-0.22	-1.66	0.10	0.89	1.12
12	(Constant)	8.80	1.61		5.47	0.00		
	TREEDIV	-3.00	0.99	-0.80	-3.03	0.00	0.23	4.42
	TREEVEN	6.90	2.57	0.69	2.68	0.01	0.24	4.11
	TOTRICH	-0.06	0.04	-0.20	-1.47	0.15	0.84	1.19
	DBH	-0.04	0.03	-0.21	-1.60	0.12	0.89	1.12
13	(Constant)	6.96	1.02		6.80	0.00		
	TREEDIV	-3.55	0.93	-0.95	-3.82	0.00	0.26	3.79
	TREEVEN	7.91	2.51	0.79	3.15	0.00	0.26	3.82
	DBH	-0.04	0.03	-0.23	-1.73	0.09	0.90	1.11

Appendix 5.5 Regression ANOVA results of various linear models for predicting avian abundance from vegetation variables. For vegetation abbreviations see Appendix 5.1 above.

Model	Source of variation	Sum of Squares	df	Mean Square	F-value	P	Adjusted R^2
1	Regression	4054.647	15	270.310	1.034	0.447(a)	0.01
	Residual	8889.833	34	261.466			
	Total	12944.480	49				
2	Regression	4054.483	14	289.606	1.140	0.361(b)	0.039
	Residual	8889.997	35	254.000			
	Total	12944.480	49				
3	Regression	4022.716	13	309.440	1.249	0.288(c)	0.062
	Residual	8921.764	36	247.827			
	Total	12944.480	49				
4	Regression	3981.211	12	331.768	1.370	0.224(d)	0.083
	Residual	8963.269	37	242.251			
	Total	12944.480	49				
5	Regression	3926.708	11	356.973	1.504	0.170(e)	0.102
	Residual	9017.772	38	237.310			
	Total	12944.480	49				
6	Regression	3866.942	10	386.694	1.661	0.125(f)	0.119
	Residual	9077.538	39	232.757			
	Total	12944.480	49				
7	Regression	3717.569	9	413.063	1.791	0.100(g)	0.127
	Residual	9226.911	40	230.673			
	Total	12944.480	49				

8	Regression Residual Total	3651.388 9293.092 12944.480	8 41 49	456.424 226.661	2.014	0.069(h)	0.142
9	Regression Residual Total	3640.271 9304.209 12944.480	7 42 49	520.039 221.529	2.347	0.041(i)	0.161
10	Regression Residual Total	3400.412 9544.068 12944.480	6 43 49	566.735 221.955	2.553	0.033(j)	0.160
11	Regression Residual Total	3331.334 9613.146 12944.480	5 44 49	666.267 218.481	3.050	0.019(k)	0.173
12	Regression Residual Total	3318.732 9625.748 12944.480	4 45 49	829.683 213.906	3.879	0.009(l)	0.190

a **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, TRERICH, CCOVER, TREDEN, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH

b **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, TRERICH, TREDEN, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH

c **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, TRERICH, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, TOTDIV, DBH

d **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, TREEVEN, SAPDIV, TRERICH, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, DBH

e **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, SAPDIV, TRERICH, SAPEVEN, TOTBA , TREEBA, SAPRICH, TREEDIV, DBH

f **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, SAPDIV, TRERICH, SAPEVEN, TREEBA, SAPRICH, TREEDIV, DBH

g **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, SAPDIV, TRERICH, TREEBA, SAPRICH, TREEDIV, DBH

h **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, TRERICH, TREEBA, SAPRICH, TREEDIV, DBH

i **Predictors**: (Constant), HEIGHT, TOTRICH, SAPDEN, TRERICH, TREEBA, TREEDIV, DBH

j **Predictors**: (Constant), TOTRICH, SAPDEN, TRERICH, TREEBA, TREEDIV, DBH

k **Predictors**: (Constant), TOTRICH, SAPDEN, TRERICH, TREEBA, TREEDIV

l **Predictors**: (Constant), TOTRICH, SAPDEN, TRERICH, TREEDIV

Appendix 5.6 Table of coefficients and collinearity statistics for linear models predicting avian abundance from vegetation variables.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		Beta	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-69.34	166.05		-0.42	0.68		
	TREEDIV	25.99	25.10	0.80	1.04	0.31	0.03	29.55
	TREEVEN	-22.82	46.70	-0.26	-0.49	0.63	0.07	14.08
	TOTRICH	-1.76	2.40	-0.65	-0.73	0.47	0.03	38.40
	TOTDIV	29.58	69.34	0.40	0.43	0.67	0.02	42.92
	SAPRICH	-5.13	5.27	-0.53	-0.97	0.34	0.07	14.79
	SAPEVEN	-25.07	30.79	-0.32	-0.81	0.42	0.13	7.87
	SAPDIV	25.43	26.14	0.67	0.97	0.34	0.04	23.25
	SAPDEN	0.28	0.17	0.38	1.64	0.11	0.37	2.68
	TOTBA	-0.04	0.07	-0.16	-0.53	0.60	0.22	4.63
	TRERICH	-2.85	2.42	-0.56	-1.18	0.25	0.09	11.03
	TREDEN	0.12	0.36	0.10	0.34	0.74	0.23	4.43
	CCOVER	0.00	0.17	0.01	0.03	0.98	0.42	2.38
	TREEBA	5.37	5.69	1.80	0.95	0.35	0.01	180.41
	DBH	-10.06	12.39	-5.99	-0.81	0.42	0.00	2695.07
	HEIGHT	22.83	28.86	4.48	0.79	0.43	0.00	1590.42
2	(Constant)	-69.34	163.66		-0.42	0.67		
	TREEDIV	26.00	24.73	0.80	1.05	0.30	0.03	29.54
	TREEVEN	-22.80	46.02	-0.26	-0.50	0.62	0.07	14.08
	TOTRICH	-1.76	2.36	-0.64	-0.74	0.46	0.03	38.31
	TOTDIV	29.52	68.29	0.40	0.43	0.67	0.02	42.86
	SAPRICH	-5.11	5.15	-0.53	-0.99	0.33	0.07	14.55
	SAPEVEN	-25.18	30.00	-0.33	-0.84	0.41	0.13	7.69
	SAPDIV	25.47	25.72	0.67	0.99	0.33	0.04	23.15
	SAPDEN	0.28	0.16	0.38	1.74	0.09	0.41	2.45
	TOTBA	-0.04	0.07	-0.16	-0.54	0.60	0.22	4.51
	TRERICH	-2.85	2.38	-0.56	-1.20	0.24	0.09	11.02
	TREDEN	0.12	0.33	0.10	0.35	0.73	0.25	3.93
	TREEBA	5.38	5.60	1.81	0.96	0.34	0.01	180.24
	DBH	-10.09	12.18	-6.01	-0.83	0.41	0.00	2680.37
	HEIGHT	22.90	28.32	4.50	0.81	0.42	0.00	1576.17
3	(Constant)	-67.05	161.54		-0.42	0.68		
	TREEDIV	24.46	24.04	0.75	1.02	0.32	0.03	28.62
	TREEVEN	-18.38	43.76	-0.21	-0.42	0.68	0.08	13.04
	TOTRICH	-1.66	2.32	-0.61	-0.72	0.48	0.03	37.82
	TOTDIV	27.51	67.23	0.37	0.41	0.68	0.02	42.57
	SAPRICH	-5.10	5.09	-0.53	-1.00	0.32	0.07	14.55
	SAPEVEN	-26.76	29.30	-0.35	-0.91	0.37	0.13	7.52
	SAPDIV	25.93	25.37	0.68	1.02	0.31	0.04	23.09
	SAPDEN	0.27	0.16	0.37	1.73	0.09	0.41	2.43

	TOTBA	-0.03	0.06	-0.11	-0.43	0.67	0.28	3.62
	TRERICH	-2.61	2.25	-0.51	-1.16	0.25	0.10	10.11
	TREEBA	5.75	5.43	1.93	1.06	0.30	0.01	173.84
	DBH	-11.00	11.76	-6.55	-0.94	0.36	0.00	2560.83
	HEIGHT	24.65	27.54	4.84	0.90	0.38	0.00	1527.98
4	(Constant)	-8.40	73.68		-0.11	0.91		
	TREEDIV	25.30	23.68	0.78	1.07	0.29	0.04	28.40
	TREEVEN	-20.39	42.99	-0.23	-0.47	0.64	0.08	12.87
	TOTRICH	-0.73	0.50	-0.27	-1.47	0.15	0.56	1.80
	SAPRICH	-4.35	4.70	-0.45	-0.93	0.36	0.08	12.70
	SAPEVEN	-20.88	25.24	-0.27	-0.83	0.41	0.18	5.71
	SAPDIV	21.66	22.86	0.57	0.95	0.35	0.05	19.18
	SAPDEN	0.26	0.15	0.35	1.70	0.10	0.43	2.33
	TOTBA	-0.03	0.06	-0.13	-0.53	0.60	0.29	3.47
	TRERICH	-2.56	2.23	-0.50	-1.15	0.26	0.10	10.08
	TREEBA	5.86	5.37	1.97	1.09	0.28	0.01	173.41
	DBH	-11.28	11.61	-6.71	-0.97	0.34	0.00	2552.04
	HEIGHT	25.56	27.14	5.02	0.94	0.35	0.00	1518.00
5	(Constant)	-15.89	71.23		-0.22	0.82		
	TREEDIV	14.89	8.78	0.46	1.70	0.10	0.25	3.99
	TOTRICH	-0.75	0.49	-0.27	-1.51	0.14	0.56	1.79
	SAPRICH	-3.69	4.44	-0.38	-0.83	0.41	0.09	11.56
	SAPEVEN	-19.53	24.82	-0.25	-0.79	0.44	0.18	5.63
	SAPDIV	19.15	22.01	0.50	0.87	0.39	0.06	18.15
	SAPDEN	0.23	0.14	0.32	1.66	0.11	0.49	2.03
	TOTBA	-0.03	0.06	-0.13	-0.50	0.62	0.29	3.45
	TRERICH	-1.82	1.57	-0.36	-1.16	0.25	0.19	5.13
	TREEBA	6.04	5.30	2.03	1.14	0.26	0.01	172.61
	DBH	-11.71	11.45	-6.97	-1.02	0.31	0.00	2536.08
	HEIGHT	26.54	26.78	5.21	0.99	0.33	0.00	1509.21
6	(Constant)	-10.07	69.60		-0.14	0.89		
	TREEDIV	15.49	8.62	0.48	1.80	0.08	0.26	3.92
	TOTRICH	-0.69	0.47	-0.25	-1.44	0.16	0.59	1.69
	SAPRICH	-4.11	4.31	-0.43	-0.95	0.35	0.09	11.13
	SAPEVEN	-19.69	24.58	-0.25	-0.80	0.43	0.18	5.63
	SAPDIV	20.75	21.57	0.54	0.96	0.34	0.06	17.77
	SAPDEN	0.25	0.14	0.34	1.80	0.08	0.51	1.96
	TRERICH	-2.21	1.36	-0.43	-1.63	0.11	0.26	3.91
	TREEBA	5.52	5.15	1.85	1.07	0.29	0.01	166.15
	DBH	-10.90	11.23	-6.49	-0.97	0.34	0.00	2484.87
	HEIGHT	24.35	26.17	4.78	0.93	0.36	0.00	1469.17
7	(Constant)	-8.96	69.28		-0.13	0.90		
	TREEDIV	14.14	8.41	0.44	1.68	0.10	0.27	3.77
	TOTRICH	-0.78	0.46	-0.29	-1.72	0.09	0.64	1.57
	SAPRICH	-1.88	3.28	-0.20	-0.57	0.57	0.15	6.49
	SAPDIV	6.43	12.01	0.17	0.54	0.60	0.18	5.56

	SAPDEN	0.23	0.14	0.32	1.71	0.10	0.52	1.92
	TRERICH	-2.13	1.35	-0.42	-1.58	0.12	0.26	3.89
	TREEBA	5.09	5.10	1.71	1.00	0.32	0.01	164.36
	DBH	-10.06	11.13	-5.99	-0.90	0.37	0.00	2463.18
	HEIGHT	22.43	25.94	4.40	0.86	0.39	0.00	1456.79
8	(Constant)	-17.12	66.99		-0.26	0.80		
	TREEDIV	14.29	8.34	0.44	1.71	0.09	0.27	3.76
	TOTRICH	-0.74	0.44	-0.27	-1.66	0.11	0.66	1.51
	SAPRICH	-0.36	1.62	-0.04	-0.22	0.83	0.62	1.61
	SAPDEN	0.20	0.12	0.27	1.65	0.11	0.63	1.58
	TRERICH	-2.24	1.32	-0.44	-1.69	0.10	0.26	3.80
	TREEBA	5.68	4.93	1.91	1.15	0.26	0.01	156.76
	DBH	-11.48	10.71	-6.83	-1.07	0.29	0.00	2323.27
	HEIGHT	25.79	24.96	5.06	1.03	0.31	0.00	1371.63
9	(Constant)	-16.10	66.07		-0.24	0.81		
	TREEDIV	14.19	8.23	0.44	1.72	0.09	0.27	3.75
	TOTRICH	-0.77	0.41	-0.28	-1.88	0.07	0.76	1.32
	SAPDEN	0.19	0.11	0.26	1.76	0.08	0.81	1.24
	TRERICH	-2.25	1.30	-0.44	-1.73	0.09	0.26	3.78
	TREEBA	5.72	4.87	1.92	1.17	0.25	0.01	156.51
	DBH	-11.46	10.59	-6.83	-1.08	0.29	0.00	2323.20
	HEIGHT	25.67	24.67	5.04	1.04	0.30	0.00	1370.96
10	(Constant)	50.79	15.32		3.31	0.00		
	TREEDIV	15.59	8.13	0.48	1.92	0.06	0.27	3.65
	TOTRICH	-0.81	0.41	-0.30	-1.97	0.06	0.76	1.31
	SAPDEN	0.18	0.11	0.25	1.69	0.10	0.81	1.24
	TRERICH	-2.50	1.28	-0.49	-1.94	0.06	0.27	3.66
	TREEBA	0.89	1.48	0.30	0.60	0.55	0.07	14.40
	DBH	-0.48	0.86	-0.29	-0.56	0.58	0.07	15.35
11	(Constant)	46.28	12.92		3.58	0.00		
	TREEDIV	12.94	6.55	0.40	1.98	0.05	0.41	2.41
	TOTRICH	-0.81	0.41	-0.30	-2.00	0.05	0.76	1.31
	SAPDEN	0.17	0.11	0.24	1.66	0.10	0.82	1.22
	TRERICH	-2.12	1.09	-0.41	-1.95	0.06	0.37	2.68
	TREEBA	0.10	0.40	0.03	0.24	0.81	0.92	1.08
12	(Constant)	46.85	12.56		3.73	0.00		
	TREEDIV	12.99	6.48	0.40	2.00	0.05	0.42	2.41
	TOTRICH	-0.80	0.40	-0.29	-2.01	0.05	0.78	1.29
	SAPDEN	0.18	0.10	0.24	1.68	0.10	0.82	1.22
	TRERICH	-2.18	1.05	-0.43	-2.07	0.04	0.39	2.56

Appendix 5.7 Correlation between avian species occurrence and correspondence analysis dimensions of woodland status. The values indicate Pearson's correlation coefficients.

	Species	Dimension 1	Dimension 2	Dimension 3	Total
1	Scaly-throated Honeyguide	0.996	0.004	0.000	1.000
2	Yellow White-eye	0.996	0.004	0.000	1.000
3	Olive thrush	0.991	0.006	0.004	1.000
4	Bennett's Woodpecker	0.963	0.034	0.003	1.000
5	Fork-tailed Drongo	0.947	0.009	0.044	1.000
6	Trilling Cisticola	0.884	0.092	0.024	1.000
7	Pennant-winged Nightjar	0.884	0.092	0.024	1.000
8	Red-headed Quelea	0.884	0.092	0.024	1.000
9	Black-collared Eremomela	0.884	0.092	0.024	1.000
10	Paradise Flycatcher	0.854	0.004	0.142	1.000
11	Swallow-tailed Bee-eater	0.695	0.263	0.041	1.000
12	Long-tailed Paradise	0.689	0.049	0.263	1.000
13	Black-crowned Tchagra	0.604	0.145	0.251	1.000
14	Rattling Cisticola	0.564	0.216	0.220	1.000
15	Lesser Honeyguide	0.534	0.006	0.460	1.000
16	Pale-billed Hornbill	0.534	0.006	0.460	1.000
17	Souza's Shrike	0.534	0.006	0.460	1.000
18	Fawn-breasted Waxbill	0.534	0.006	0.460	1.000
19	Yellow-bellied Sunbird	0.534	0.006	0.460	1.000
20	Lesser Grey Shrike	0.534	0.006	0.460	1.000
21	African Grey Cuckoo	0.38	0.529	0.091	1.000
22	Mozambique Nightjar	0.311	0.675	0.014	1.000
23	Common Bulbul	0.309	0.001	0.69	1.000
24	Scarlet-chested Sunbird	0.289	0.7	0.011	1.000
25	Tropical Boubou	0.279	0.22	0.501	1.000
26	Southern Puffback	0.279	0.22	0.501	1.000
27	Miombo Pied Barbet	0.193	0.027	0.780	1.000
28	Böhm's Flycatcher	0.152	0.618	0.230	1.000
29	Green-capped Eremomela	0.126	0.802	0.072	1.000
30	Emerald-spotted Wood Dove	0.121	0.874	0.005	1.000
31	Red-eyed Dove	0.116	0.83	0.054	1.000
32	Long-billed Crombec	0.113	0.551	0.335	1.000
33	Black-headed Oriole	0.103	0.296	0.601	1.000
34	Neddicky	0.094	0.267	0.640	1.000
35	Black-collared Barbet	0.094	0.783	0.123	1.000

36	Yellow-breasted Apalis	0.091	0.174	0.734	1.000
37	Black (Yellow-billed) Kite	0.091	0.174	0.734	1.000
38	Red-capped Crombec	0.091	0.174	0.734	1.000
39	Dark Chanting Goshawk	0.091	0.174	0.734	1.000
40	Yellow-breasted Hyliota	0.091	0.174	0.734	1.000
41	Brubru	0.091	0.174	0.734	1.000
42	Miombo Rock Thrush	0.079	0.576	0.345	1.000
43	Southern Black Tit	0.074	0.592	0.333	1.000
44	White-breasted Cuckoo-shrike	0.071	0.911	0.018	1.000
45	White Helmet Shrike	0.063	0.936	0.001	1.000
46	Red and Blue Sunbird	0.056	0.511	0.433	1.000
47	Fiery-necked Nightjar	0.042	0.711	0.247	1.000
48	Shelley's Sunbird	0.036	0.046	0.918	1.000
49	Fiscal Shrike	0.026	0.448	0.526	1.000
50	Tawny-flanked Prinia	0.024	0.619	0.357	1.000
51	Cape Turtle Dove	0.02	0.911	0.069	1.000
52	Yellow-fronted Tinkerbird	0.009	0.98	0.011	1.000
53	Miombo Double-collared Sunbird	0.003	0.205	0.792	1.000
54	Greater Honeyguide	0.003	0.137	0.859	1.000
55	Central Bearded Scrub Robin	0.002	0.143	0.855	1.000
56	Spotted Creeper	0.000	0.842	0.158	1.000