Bird Species Diversity and Abundance in the Abiriw Sacred Grove in the Eastern Region of Ghana

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Abstract

The sacred grove concept is one of the strategies developed by many human societies to conserve biological resources using a traditional approach. Sacred groves are currently under threat from anthropogenic activities due to lack of enforcement of traditional edicts to check encroachment. The birds inhabiting the Abiriw Sacred Grove in the Akwapim North District in the Eastern Region of Ghana were surveyed between February and April 2005 to determine the current ecological status of the grove, and to establish a bird species list. The transect count method was used to sample the birds in the grove. A total of 411 individual birds belonging to 22 families and 66 species was recorded, out of which 211 individuals of 41 species occurred in the forest-cultivated land boundary, 111 (36 species) in pristine forest, and 89 (40 species) in secondary forest. A significant proportion of species in the grove were savanna specialists. Similarity indices indicated different levels of degradation of the various blocks. The current situation needs immediate attention to stem the tide of fragmentation and degradation.

Introduction

Throughout the ages, traditional African societies have maintained complex religious and cultural belief systems that guided the conservation of biodiversity using traditional norms such as taboos, totems and myths. Such traditional practices enabled the protection of biological resources from human disturbances and wanton over-exploitation. The establishment of sacred groves, defined as small patches or islands of remaining original habitat (Kingdon, 1989), or forests of various dimensions partially- or fully-protected by local religious and/or cultural agents (Campbell, 2004) ensured the protection of forests surrounding environmentally-sensitive areas, and ranged in size from hundreds of hectares of forest to small areas of about 0.5 ha containing single trees or a few stones (Gordon, 1992).

Because of their perceived links to some deities or ancestral spirits, sacred groves are referred to variously as *nananompow* (ancestral grove or royal mausoleum) (Adarkwa-Dadzie, 1997), *abosompow* or *asoneyeso* (shrine), *mpanyinpow* (ancestral forest), and *nsamanpow* (burial grounds) by the Akans (BSP, 1993; Ntiamoa-Baidu, 1995). Sacred groves serve important ecological and socio-cultural functions by preserving virgin forests, being important refuges for rare and useful local biodiversity, and being sources of herbs for medicinal, social and religious purposes (Dorm-Adzobu *et al.*, 1991; Decher, 1997). There are an estimated 2,000–3,200 sacred groves in Ghana, about 80% of which occur in the southern half of the country (Gordon, 1992).

Because of the linkage between traditional beliefs and deities or ancestral spirits, disobedience or disregard of traditional laws (taboos) attracts severe punishments for culprits, and high prices of atonement, including making sacrifices and performing certain rites to avert any mishaps, ill-health, and death. Unfortunately, this has not been effective deterrent for the reckless use of biological resources by local communities. Today, the traditional belief systems, which were fundamental to the concept of sacred grove conservation, are considered mere superstitions, with the rituals now known to very few people, mostly of the older generation. This situation could be attributed to (i) rapid population growth and its attendant problems of urbanization, migration, and resettlement, (ii) increased dependence on western technology, and (iii) the growing influence of foreign religions and beliefs (Decher, 1997).

Birds constitute one of the common fauna of all habitat types, and because they are responsive to change, their diversity and abundance can reflect ecological trends in other biodiversity (Furness & Greenwood, 1993). Because of their highly-specific habitat requirements, birds become increasingly intolerant of even slight ecosystem disturbance (Schwartz & Schwartz, 1951). An assessment of the abundance and diversity of bird species in sacred groves can, therefore, serve as a good indication of the health of the environment in and around the grove (Bowden, 1990). Jarvinen & Vaisenen (1978) used line-transect data on bird abundance to monitor the effect of habitat change in Nordic countries, and reported that a change in forest structure caused changes in bird populations in Northern Finish forest.

The Abiriw Sacred Grove in the Akwapim District of the Eastern Region of Ghana was partly destroyed by bushfires in 1983, resulting in loss of biodiversity. Also, because of laxity in enforcing some of the customary laws that deterred human exploitation of the forest resources, there has been increasing over-exploitation of these resources (e.g. logging, fuelwood harvesting, etc.) in the grove. The objectives of this study were, therefore, to (i) assess the abundance and diversity of the bird species inhabiting the Abiriw Sacred Grove as an indication of its current ecological status, and (ii) generate a species list of birds in the grove for conservation action and future research follow-ups.

Materials and methods

Study area

The Abiriw Sacred Grove (05° 48' N; 00° 06' W) is located along the Aburi-Akosombo road, about 110 km north of Accra in the Akuapim North District of the Eastern Region. It has an area of about 400 m^2 and lies at the southern boundary of the town of Abiriw. The area falls within the moist semi-deciduous forest zone, characterized by two annual rainfall peaks. The major rainy season occurs from April to June, while the minor one occurs from September to October. Annual rainfall amounts range from 1,300 mm to 1,800 mm.

The sacred grove is characterized by tree species such as *Celtis adolfi-frederili, C. zenkeri, Triplochiton scleroxylon, Cylico-discus gabunensis,* and *Piptadenia africana.* Common understory species such as *Corynanthe pachyceras, Hymeno istegia afzelii, Lacaniodiscus capanicides, Momdoa myristica* and *Myrianthus* spp. are also present. The dominant shrubs are *Mussaenda erythrophylla*. The brownish soil contains a lot of humus and worm cast.

The site was divided into three blocks based on the vegetation type: (i) pristine forest, a generally non-degraded core forest, (ii) forest-cultivated land boundary, outer forest sharing boundaries with cultivated land, and (iii) secondary forest, characterized by regenerated forest located between the first two blocks. Two-hour transect walks were undertaken to inventory the three blocks, with 300 m walk in the forest-cultivated land boundary, 210 m in the secondary forest, and 190 m in the pristine forest, using existing footpaths as transects. All birds encountered (both visually and vocally) were systematically recorded with counts repeated six times between 26th February and 14th April 2005. There were no width limit on the transects because, while the estimate of distance to visually observed birds were easier, estimate of distance to calls was more difficult, and such estimates would be highly unreliable.

Analysis of data

Bird community diversity for each block was calculated using Shannon Wiener (H) and Simpson indices (D) while the similarities in the three blocks were calculated using Jaccard Index (Cj) given that:

$H = \sum(ni/N * In\ ni/N)$ …….1

$D = \sum[ni*(ni-1)/N*N-1)]$……..…2

$Cj = j/(a + b - j)$……..3

where ni = number of individuals in the i^{th} species, N = total number of individuals recorded, j = number of species found in both sites, 'a' = number of species in site 'A' and 'b' = number of species in site 'B'. The relative abundance (RA) of each species in the different blocks was also calculated.

Results and discussion

Relative abundance and species diversity There were 411 individual birds recorded, comprising 66 species belonging to 22 families. The dominant family was Muscicapidae, comprising 24.2% of the total species, followed in order by Capitonidae (12.1%), Cuculidae (9%), Estrildidae (7.6%), and Pycnonotidae (7.6%). Forty different species were recorded in the secondary forest, while 41 and 36 species were recorded in the forest cultivated land boundary and the Pristine forests, respectively (Table 1). Out of the 40 species encountered in the secondary forest, 27 individuals (67.5%), representing eight species, were identified as pure inhabitants of forest vegetation while 20% were savanna generals. Species from other vegetation zones such as coastal thickets made up 12.5%.

TABLE 1

Checklist of the birds of the Abiriw Sacred Grove, Abiriw-Akwapim

Species	*Common name*	*Occurrence in blocks*			*Original habitat*	*Status*
		PF	*SF*	*FCLB*		
Muscicapidae						
1. *Apalis shapii*	Sharpe's apalis	"			F	NUR
2. *Camaroptera brachyura*	Grey-backed camaroptera	"	"	"	S	VC
3. *C. chloronata*	Green-backed camaroptera	"	"		S	VC/W
4. *Cisticola cantans*	Singing cisticola			"	S	NUR
5. *C. lateralis*	Whistling cisticola			"	F	NUR
6. *Eremomela pusilla*	Green-backed eremomela	"			S	C
7. *Fraseria ocreata*	Fraser's flycatcher		"		F	NUR/W
8. *Hylia prasina*	Green hylia	"	"	"	F	C/W
9. *Macrosphenus concolor*	Olive longbill		"		F	U
10. *M. flavicans*	Kemp's longbill	"	"		F	NUR
11. *Muscicapa epulata*	Little grey flycatcher			"	F	U
12. *Prinia erythroptera*	Red-winged warbler			"	F	NUR
13. *Stiprornis erythrothorax*	Forest robin	"			F	NUR
14. *Sylvietta brachyura*	Nuthatch warbler	"	"	"	S	NUR
15. *Tauraco persa*	Green-crested touraco	"	"		F	NUR
16. *Terpsiphone rufiventer*	Red-bellied paradise flycatcher		"		F	C
Total species = 16 (24.2 %)						
Capitonidae						
17. *Gymnobucco calvus*	Naked-faced barbet		"	"	F	C
18. *Lybius hirsutus*	Hairy-breasted barbet	"	"	"	F	NUR
19. *L. vieilloti*	Vieillot's barbet	"			S	C
20. *Pogoniulus atro-flavus*	Red-rumped tinker-bird	"	"		F	NUR
21. *P. bilineatus*	Lemon-rumped tinker-bird	"	"	"	FSB	C
22. *P. scolopaceus*	Speckled tinker-bird	"	"	"	F	C
23. *P. subsulphureus*	Yellow-throated tinker-bird	"	"	"	F	NUR
24. *Trachyphonus purpuratus*	Yellow-billed barbet	"	"		F	C/W
Total species = 8 (12.1 %)						
Cuculidae						

25.	*Centropus leucogaster*	Black-throated coucal	“	“		S	C
26.	*C. senegalensis*	Senegal coucal	“	“	“	S	C
27.	*Ceuthmochares aereus*	Yellowbill	“	“	“	F	C
28.	*Chrysococcyx caprius*	Didric cockoo		“		S	SC
29.	*C. cupreus*	Emerald cuckoo	“			S	C
30.	*C. klaas*	Klass cuckoo		“		F	NUR
Total species = 6 (9.0 %)							
Estrildidae							
31.	*Estrilda melpoda*	Orange-cheeked waxbill			“	S	A
32.	*Lonchura bicola*	Black-and-white mannikin			“	FC	C
33.	*L. cucullata*	Bronze mannikin			“	S	C
34.	*Nigrita canicapilla*	Grey-crowned negro-finch	“	“	“	F	C
35.	*N. luteifrons*	Pale-breasted negro-finch	“		“	F	NU
Total species = 5 (7.6 %)							
Pycnonotidae							
36.	*Andropadus curvirostris*	Cameroon sombre greenbul		“		FSB	NUR
37.	*A. latirostris*	Yellow-whiskered greenbul	“	“		F	C/W
38.	*A. virens*	Little greenbul	“	“	“	F	A/W
39.	*Pycnonotus barbatus*	Common garden bulbul	“	“	“	S	A
40.	*Thescelocichla leucopleurus*	Swamp palm bulbul	“			F	C/W
Total species = 5 (7.6 %)							
Columbidae							
41.	*Streptopelia semitorquata*	Red-eyed dove	“	“	“	S/FC	A
42.	*Treron australis*	Green pigeon	“	“		F	C
43.	*Turtur afer*	Red-billed wood-dove	“		“	F	C
44.	*Turtur tympanistra*	Tambourine dove	“	“		F	C
Ploceidae							
45.	*Ploceus cucullatus*	Village weaver			“	CFZ	A
46.	*P. nigricollis*	Spectacled weaver			“	F/CT	NUR
47.	*Quelea quelea*	Red-billed quelea			“	S	-
Accipitridae							
48.	*Accipiter toussenelii*	West African goshawk	“			F	C
49.	*Nephron monachus*	Hooded vulture		“	“	FS	A
Bucerotidae							
50.	*Tockus semifasciatus*	Allied/Pied hornbill	“	“	“	F	VC
51.	Tropicranus albocristatus	*White-crested hornbill*	“	“	“	*F*	*NUR*
Nectariniidae							
52.	*Nectarinia chloropygia*	Olive-bellied sunbird		“	“	F	C
53.	*N. olivacea*	Olive sunbird	“	“	“	CT/F	C
Phasianidae							
54.	*Francolinus ahantensis*	Ahanta francolin	“	“		F	C
55.	*Ptilopachus petrosus*	Stone partridge	“			S	NUR
Alcedinidae							
56.	*Halcyon senegalensis*	Senegal kingfisher		“	“	F	C
Apodidae							
57.	*Cypsiurus parvus*	Palm swift			“	OPP	C
Coraciidae							
58.	*Eurystoma glaucurus*	Broad-billed roller		“		S	C

Corvidae					
59. Corvus albus	Pied crow		"	-	C
Fringillidae					
60. Serinus mozxambicus	Yellow canary		"	S	C
Laniidae					
61. Lanius collaris	Fiscal shrike		"	CT	NUR
Malaconotidae					
62. *Tchagra senegala*	Black-crowned tchagra	"	"	S	C
Piciformes					
63. Mesopicos pyrrhogaster	Fire-bellied woodpecker		"	F	NUR
Platysteiridae					
64. Platysteria castanea	Chestnut wattle-eye	"		F	C
Sturnidae					
65. Lamprotornis splendidus	Splendid glossy starling	"	"	F	NUR
Zosteropidae					
66. Zosteropus senegalensis	Yellow white-eye		"	S	C
Total		36	40	40	

Legend
Plots: PF = Pristine forest, SF = Secondary forest, FCLB = Forest-cultivated land boundary
Habitat: F = Forest, S = Savanna, FSB = Forest-savanna boundary, FC = Forest clearings, CT = Coastal thicket, CFZ = Coastal forest zone, OPP = Oil palm plantations.
Status : NUR = Not uncommon resident, VC = Very common, W = Widespread, C = Common, U = Uncommon, SC = Seasonally common, A = Abundant, NU = Not uncommon.

In the forest-cultivated land boundary, 46.3% of the species encountered were identified as forest specialists (Grimes, 1987), whilst 29.3% were savanna generals. Olaniyan (1968) identified savanna bird species in West Africa and described them as mostly seed-eaters contrary to forest bird species which are fruit-eaters. Since most savanna birds are seed eaters, their presence in a forest area suggests trans-formation of forest vegetation into savanna. Species from other vegetation zones scored 24.4% (Table 1). About 30% of bird species in forest vegetation being savanna specialists suggests a high level of degradation. Also, the high number of bird species that are inhabitants of other vegetation zones in this area indicates that the forest is an island in 'troubled' vegetation, which served as a refuge habitat for bird species in surrounding vegetation. In the pristine forest, 66.8% of the inhabiting species were forest inhabitants, while 25% were savanna species (Table 1). However, the number of savanna species was very low in terms of individual numbers of birds in this block.

The most abundant species in the grove was the little greenbul *(Andropadus virens*) (RA = 8.0), followed by the bronze mannikin *(Lonchura cucullata)* (RA = 7.8), common garden bulbul *(Pycnonotus barbatus)* (RA = 7.5), allied hornbill *(Tockus semifasciatus)* (RA = 6.1), palm swift *(Cypsiurus parvus),* (RA = 5.4), and black-and-white mannikin *(Lonchura bicola)* (RA = 4.6) (Table 2). These six species together make up 39.4% of all the species recorded. The little greenbul and allied hornbill are typical forest birds, while bronze mannikin and common garden bulbul are typical savanna species. The palm swift and black-and-white mannikin occur in or near oil palm plantations and forest clearings, respectively.

TABLE 2

Numbers of birds and their relative abundance in Abiriw Sacred Grove, Abiriw-Akwapim

Species	*Family*	*Habitats*						*Total individuals*	*Overall RA*
		PF		*SF*		*FCLB*			
		Ind	*RA*	*Ind*	*RA*	*Ind*	*RA*		
1. *Andropadus virens*	Pycnonotidae	8	7.2	12	13.5	13	6.2	33	8.0
2. *Lonchura cucullata*	Estrildidae	–	–	–	–	32	15.2	32	7.8

3.	*Pycnonotus barbatus*	Pycnonotidae	3	2.7	2	2.3	26	12.3	31	7.5
4.	*Tockus semifasciatus*	Bucerotidae	9	8.1	6	6.7	10	4.5	25	6.1
5.	*Cypsiurus parvus*	Apodidae	–	–	–	–	22	10.4	22	5.4
6.	*Lonchura bicola*	Estrildidae	–	–	–	–	19	9.0	19	4.6
7.	*Hylia prasina*	Muscicapidae	9	8.1	6	6.7	1	0.5	16	3.9
8.	*Tauraco persa*	Muscicapidae	8	7.2	4	4.5	–	–	12	2.9
9.	*Nigrita canicapilla*	Estrildidae	4	3.6	2	2.3	4	1.9	10	2.4
10.	*Pogoniulus subsulphureus*	Capitonidae	3	2.7	4	4.5	2	1.0	9	2.2
11.	*Zosteropus senegalensis*	Zosteropidae	–	–	–	–	9	4.3	9	2.2
12.	*Nectarinia olivacea*	Nectariniidae	2	1.8	2	2.3	4	1.9	8	1.9
13.	*Camaroptera brachyura*	Muscicapidae	1	0.9	2	2.3	5	2.4	8	1.9
14.	*Francolinus ahantensis*	Phasianidae	6	5.4	2	2.3	–	–	8	1.9
15.	*Centropus senegalensis*	Cuculidae	1	0.9	1	1.1	5	2.4	7	1.7
16.	*Sylvietta brachyura*	Muscicapidae	4	3.6	1	1.1	2	1.0	7	1.7
17.	*Trachyphonus purpuratus*	Capitonidae	4	3.6	3	3.4	–	–	7	1.7
18.	*Pogoniulus scolopaceus*	Capitonidae	2	1.8	1	1.1	3	1.4	6	1.5
19.	*P. bilineatus*	Capitonidae	2	1.8	1	1.1	3	1.4	6	1.5
20.	*Centropus leucogaster*	Cuculidae	2	1.8	4	4.5	–	–	6	1.5
21.	*Nigrita luteifrons*	Estrildidae	1	0.9	–	–	5	2.4	6	1.5
22.	*Thescelocichla leucopleurus*	Pycnonotidae	6	5.4	–	–	–	–	6	1.5
23.	*Corvus albus*	Corvidae	–	–	–	–	6	2.8	6	1.5
24.	*Ceuthmochares aereus*	Cuculidae	2	1.8	2	2.3	1	0.5	5	1.2
25.	*Treron australis*	Columbidae	4	3.6	1	1.1	–	–	5	1.2
26.	*Streptopelia semitorquata*	Columbidae	2	1.8	2	2.3	1	0.5	5	1.2
27.	*Nephron monachus*	Accipitricidae	–	–	3	3.4	2	1.0	5	1.2
28.	*Tropicranus albocristatus*	Bucerotidae	3	2.7	1	1.1	1	0.5	5	1.2
29.	*Nectarinia chloropygia*	Nectariniidae	–	–	2	2.3	3	1.4	5	1.2
30.	*Lamprotornis splendidus*	Sturnidae	–	–	3	3.4	2	1.0	5	1.2
31.	*Ptilopachus petrosus*	Phasianidae	5	4.5	–	–	–	–	5	1.2
32.	*Andropadus latiroster*	Pycnonotidae	2	1.8	2	2.3	–	–	4	1.0
33.	*Lybius hirsutus*	Capitonidae	2	1.8	1	1.1	1	0.5	4	1.0
34.	*Turtur tympanistra*	Columbidae	3	2.7	1	1.1	–	–	4	1.0
35.	*Camaroptera chloronata*	Muscicapidae	1	0.9	2	2.3	–	–	3	0.7
36.	*Pogoniulus atro-flavus*	Capitonidae	–	–	1	1.1	2	1.0	3	0.7
37.	*Gymnobucco calvus*	Capitonidae	–	–	1	1.1	2	1.0	3	0.7
38.	*Estrilda melpoda*	Estrildidae	–	–	–	–	3	1.4	3	0.7
39.	*Ploceus cucullatus*	Ploceidae	–	–	–	–	3	1.4	3	0.7
40.	*Quelea quelea*	Ploceidae	–	–	–	–	3	1.4	3	0.7
41.	*Tchagra senegala*	Malaconotidae	–	–	1	1.1	2	1.0	3	0.7
42.	*Cisticola cantans*	Muscicapidae	–	–	–	-	2	1.0	2	0.5
43.	*C. lateralis*	Muscicapidae	-	-	-	-	2	1.0	2	0.5
44.	*Eremomela pusilla*	Muscicapidae	2	1.8	-	-	-	-	2	0.5
45.	*Stiprornis erythrothorax*	Muscicapidae	2	1.8	-	-	-	-	2	0.5
46.	*Fraseria ocreata*	Muscicapidae	-	-	2	2.3	-	-	2	0.5
47.	*Macrosphenus flavicans*	Muscicapidae	1	0.9	1	1.1	-	-	2	0.5
48.	*Muscicapa epulata*	Muscicapidae	-	-	-	-	2	1.0	2	0.5
49.	*Prinia erythroptera*	Muscicapidae	-	-	-	-	2	1.0	2	0.5
50.	*Terpsiphone rufiventer*	Muscicapidae	-	-	2	2.3	-	-	2	0.5
51.	*Turtur afer*	Columbidae	1	0.9	-	-	1	0.5	2	0.5
52.	*Ploceus nigricollis*	Ploceidae	-	-	-	-	2	1.0	2	0.5
53.	*Halcyon senegalensis*	Alcedinidae	-	-	1	1.1	1	0.5	2	0.5
54.	*Eurystoma glaucurus*	Coraciidae	-	-	2	2.3	-	-	2	0.5
55.	*Lanius collaris*	Laniidae	-	-	-	-	2	1.0	2	0.5
56.	*Apalis shapii*	Muscicapidae	1	0.9	-	-	-	-	1	0.2
57.	*Macrosphenus concolor*	Muscicapidae	-	-	1	1.1	-	-	1	0.2
58.	*Lybius vieilloti*	Capitonidae	1	0.9	-	-	-	-	1	0.2
59.	*Chrysococcyx caprius*	Cuculidae	-	-	1	1.1	-	-	1	0.2

60.	*C. cupreus*	Cuculidae	-	-	1	1.1	-	-	1	0.2
61.	*C. klaas*	Cuculidae	-	-	1	1.1	-	-	1	0.2
62.	*Andropadus curvirostria*	Pycnonotidae	-	-	1	1.1	-	-	1	0.2
63.	*Accipiter toussenelii*	Accipitridae	1	0.9	-	-	-	-	1	0.2
64.	*Serinus mozxambicus*	Fringillidae	-	-	-	-	1	0.5	1	0.2
65.	*Mesopicos pyrrhogaster*	Picidae	-	-	-	-	1	0.5	1	0.2
66.	*Platysteria castanea*	Platysteiridae	-	-	1	1.1	-	-	1	0.2
Total			108		90		213		411	

Legend
PF = Pristine forest**,** SF = Secondary forest**,** FCLB = Forest-cultivated land boundary, Ind = Number of individuals, RA = Relative abundance

Species richness and representation

Eighty nine individual birds were encountered in the secondary forest, while 111 and 211 individuals were recorded in the pristine forest and forest-cultivated land boundary, respectively. Shannon-Wiener indices (H) of 0.012, 0.011 and 0.012 were obtained for the secondary forest, forest-cultivated land boundary and the pristine forest, respectively. The reverse Simpson index (i.e. 1-D) yielded values of 0.99, 0.93 and 0.96 for the secondary forest, forest-cultivated land boundary and the pristine forest, respectively, suggesting that the secondary forest had the highest bird species diversity. This is further supported by the values for the Shannon -Wiener index (Table 3). The Jaccard Index of Similarity (Cj) between the secondary and pristine forest yielded a value of 0.46, while the similarity between the secondary forest and the forest- cultivated land boundary was 0.36. The pristine forest and forest-cultivated land boundary had a similarity of 0.29. Since a Jaccard index of '1' implies complete similarity and '0' denotes complete dissimilarity, the values revealed little or no similarity between the blocks in terms of bird usage. Since the habitat choice of birds is highly specific (Schwartz & Schwartz, 1951) and driven by plant communities, variations in bird communities for the various blocks suggests different habitat types which could be reflecting different levels of habitat degradation.

TABLE 3

Major bird families recorded in different habitats at Abiriw Sacred Grove

Family	*PF*				*SF*				*FCLB*			
	Sp	*%*	*Ind*	*%*	*Sp*	*%*	*Ind*	*%*	*Sp*	*%*	*Ind*	*%*
Muscicapidae	9	25	29	25.0	7	17.5	15	16.9	7	17.1	16	7.6
Capitonidae	7	19.4	16	19.4	7	17.5	12	13.5	5	12.2	11	5.2
Cuculidae	4	11.1	6	11.1	5	12.5	9	10.1	2	4.9	6	2.8
Estrildidae									5	12.2	63	29.9
Pycnonotidae	4	11.1	19	11.1	4	10.0	17	19.1	2	4.9	39	18.5
Columbidae	4	11.1	10	11.1	3	7.5	4	4.5	2	4.9	2	1.0
Ploceidae									2	4.9	5	2.4
Bucerotidae	2	5.6	12	5.6	2	5.0	7	7.9	2	4.9	11	5.2
Nectariniidae					2	5.0	4	4.5	2	4.9	7	3.3
TOTAL	30		92		30		68		29		160	
H (Shannon-Wiener)	0.012	0.012	0.011									
1-D (Reverse Simpson	0.96	0.99	0.93									

Cj (Jaccard Similarity): PF/SF = 0.46, SF/FCLB = 0.36, PF/FCLB = 0.29

Conclusion and recommendations

The study established that the Abiriw Sacred Grove harbours a sizable number of bird species from savanna and other vegetation zones such as coastal thickets, even the primarily vegetation is forest. The traditional norms and taboos which previously prevented people from exploiting forest resources and products from the grove appeared to have been relaxed, resulting in general forest degradation. This adversely affected forest bird species and also opened up the forest for habitation by bird species from other habitats. Similarity indices indicated a trend of fragmentation in the grove, with the various fragments at different levels of degradation.

It is recommended that a buffer zone of about 20 m should be created along the boundaries of the grove to prevent encroachment by estate developers who build too close to the grove. Furthermore, existing regulations should be vigorously enforced by the traditional authorities in the area, and new ones introduced, with severe sanctions applied to offenders to serve as a deterrent. Traditional award ceremonies should be instituted as one of the highlights of the annual yam festival to serve as incentives to individuals and organizations which contribute to biodiversity initiatives involving the grove.

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