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I. Introduction

A community of birds usually constitutes several guilds. Species members in the same guild can be considered as functionally equivalent because of high similarities in diet composition and the proportion at which the same food resource is consumed (Poulin et al. 1994, del Rio 2001). It is vital to study guilds in a community of animals to explain its structuring along resource gradient (Terborgh & Robinson 1986, del Rio 200). Various authors studied abundance at the guild level and their focus has been evaluating the explanatory value of food resources (Hutto 1985, Peck 1989, Poulin et al. 1993). The floristic composition, habitat structure and human transformation of habitat affect significantly the availability of food and other resources to birds (Remsen and Robinson 1990, Leso and Kropil2007).Such habitat features in a given landscape together with biotic interactions affect foraging behavior of birds (Leso & Kropil 2007).Birds use these attributes as cues to select habitats in a given environment and such pattern of habitat selection affects significantly the structuring of the community both spatially and temporally (Wiens 1989). For instance vegetation structure is considered as one of the primary forces that influences bird foraging behavior through its effects on food availability and the energetic constraints it incurs in obtaining a given food item (Robinson and Holmes 1982). As result the structuring of birds in a community was significantly influenced by the structure of the vegetation as found in a forest in Ethiopia (Shimelsi et al. 2013) and also in other similar forest the same kind of structural response was found (Shimelis in prep.a,b,c) and plant species richness was also shown to be an important habitat feature to which species richness of forest birds responded to (Gove et al. 2008).

A priori classification of the structuring of a bird community is done in the past but whether that reflects the structuring of the community in nature by being responsive to direct and indirect structuring processes whose ability to do so is determined by the fact that they are not evenly distributed in space and time and also the role of other forces such as competition and predation which by their very nature deplete resources are not studied in detail. Doing so is very important to be able to prove that community structuring is a natural phenomenon determined by resource and consumptive consumer interaction processes. In this paper the birds of the Harena forest in the Bale Mountains National Park were classified a priori in to guilds and whether such

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classification or structure is responsive to natural processes that are relevant to bird communities in a real field scenario was investigated and results are presented. A community of birds is composed of one or more guilds. Each guild constitutes species of similar attributes. From this one can infer that members of two different guilds would have significantly different attributes. This leads to the conclusion that there is significant difference in occupancy spatial samples across an array of guilds and high similarity in species of the same guild. Thus we hypothesized the differentiation in adaptation and niche requirements leads to the natural segregation of species pool of the bird community of the Harena Forest in to guilds. Inherent to this hypothesis is the idea that guilds are significantly different in their occupancy of spatial samples and there is high overlap in the occupancy of spatial samples by species that are members of the same guild that compete for the guild's niche.

II. Methods

a) *Study Area*

The Bale Mountains National Park (6^{0}30'- 7^{o}00' N, 39^{0}30'- 39^{0}55 E) is situated in the south-east highlands of Ethiopia; some 400 km away from Addis Ababa, the capital city of Ethiopia. It encompasses an area of 2200km^{2}. The area contains a landscape ranging from 1500m asl to 4377m asl. The soils are mainly derived from the basaltic and trachytic parent rocks (Hillman, 1986). Five vegetation zones are known to occur in this National park: the Northern Grassland, the Northern woodlands, Ericaceous forest, the Afro alpine moorland & grassland and the Southern Harena forest. The area experience two rainy seasons; heavy rain and small rain. The heavy rain is from July to October, with the highest peak in the August and the small rain from March to June, with the highest peak in April. Records show that this area experiences temperature extremities during the dry season and more or less the same pattern of temperature during the wet season. The highest temperature is 18.4c^{o} in February and the lowest is 1.4c^{o} in January (Hillman, 1986).

b) *Bird Census*

Birds were counted using the point count technique considered the most suitable census method for forest birds (Gibbons et al. 1996). Counting stations were selected randomly (Greenwood 1996, Sutherland 1996) on a 1: 50,0000 topographic map after the study area was stratified in to the five recognized vegetation zones (Hillman 1986). Sample sites were selected in such a way that there was a minimum distance of 200 m between any two. A total of 10 minutes was spent at each site allowing three minutes for birds to get accustomed to the intrusion of the census team. Counts were conducted visually and by ear with one observer conducting the counts throughout the census. In every habitat type a minimum of two days was spent learning the songs of specialized habitat occupants.

c) *Census on Habitat Parameters*

At every bird counting point 50 m by 50 m quadrats were established to collect data on variables listed in table 1. The number of individuals of every tree species in each quadrat was counted by a biologist with a knowledge of the botany of the site. Percent coverage of the different components habitat structure were estimated visually within the quadrats (Bullock 1996). The proportion of the vegetation on the ground with sign of grazing was estimated visually in four 2 m by 2 m quadrats nested within the larger quadrat. We counted the number of temporary ramshackle shelters built by shepherds in each counting point. The proportion of the land that was converted for the purposes of cultivation and also for paths and other purposes was also estimated relative to the overall structure of the habitat in a counting point. The number of stamps of trees that were cut by humans was counted in each quadrat to determine the extent of logging.

Table 1: Habitat variables measured at bird counting stations

Vegetation	Environmental	Land use
Tree species abundance	Elevation	% grazed vegetation
% tree canopy	% bare ground	Temporary shelters of shepherds
% bush	% dead organic matter	Percent agriculture
% shrub		Percent foot paths
% herb		Tree cutting

d) *Analyses of Habitat Data*

Using data on the abundance of woody plant species encountered at bird counting stations, an ordination sample sites was conducted. To determine whether this classification of the forest clusters sample sites in to five vegetation zones results in different clusters of samples discriminant function analysis for differences was conducted to generate habitat clusters distinguished in to five zones. By this I mean sample cells were constrained by five habitat categories which on its own is a classification means and the Discriminant Function Analysis was carried out.

e) A priori guild determination

A 77 species large species pool of birds obviously constitutes several guilds each with interacting species members the co-occurrence of which is constrained naturally by the availability of a limited array of shared resources across micro habitats with in one site. Human transformation of habitat modifies the pattern of such an interaction favoring some species and marginalizing less adept species. Because interspecific interactions are more intense within each guild than amongst guilds I hypothesize that the effects of underlying habitat parameters and human modification of the forest manifests itself at the scale of each guild rather than the whole bird community. Proceeding with this thought I identified guilds with their species membership. Using published data on morphological adaptations related to feeding, general feeding habits, habitat occupancy and familial affiliations I created classification variables by assigning species cells a 0 code if the variable of interest did not apply to a species and a code of 1 if the species in question has such attribute.

f) Determining guild distribution from census data

Once the types of avian guilds were identified, habitat membership of a sample was used as a constraining categorical variable and samples with the observed abundance of each species were used as column variables in Discriminant Function Analysis (DFA) to determine clustering of guilds based on the spatial clumping of the collective abundance construct of each. This helped determine whether the a priori guild classification was reflected on the clustering or structuring of species across samples in accordance with their determined guild membership.

III. Results

Ordination of habitats of the forest on the basis of abundances of woody plants resulted in the classification of the forest in to five vegetation zones which in its actuality was the clustering of census locations covering all variations in vegetation composition (Figure 1).

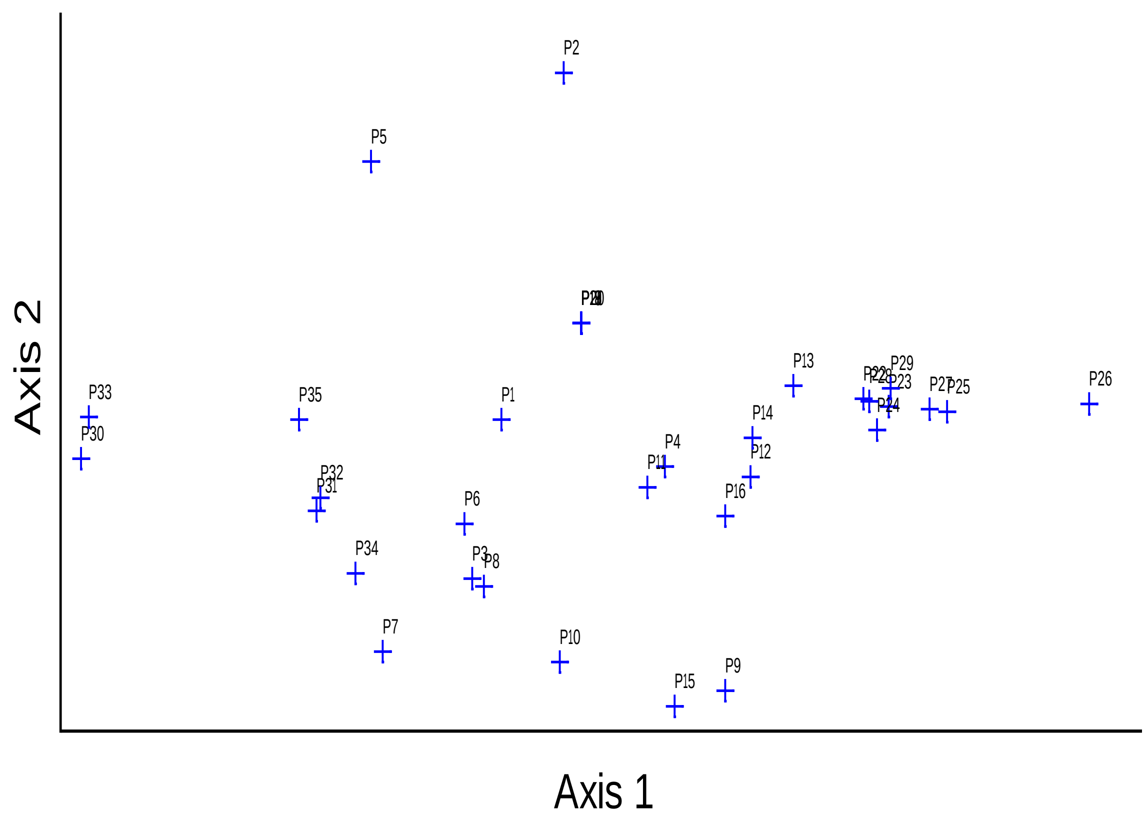

Figure 1: Clusters of bird counting point samples determined using the abundance of woody plant species

Results of the DFA showed that there are five habitat types that were differentiated significantly from each other (Figure 2). The first function significantly separated sample sites (Chi-square = 264.7, $P < 0.001$) by accounting for 57 % of the variation in the floristic data. The second function accounted for 42.3 % of the overall difference amongst groups of samples in woody plant species composition with very high significance (Chi-square = 153, $P < 0.001$).

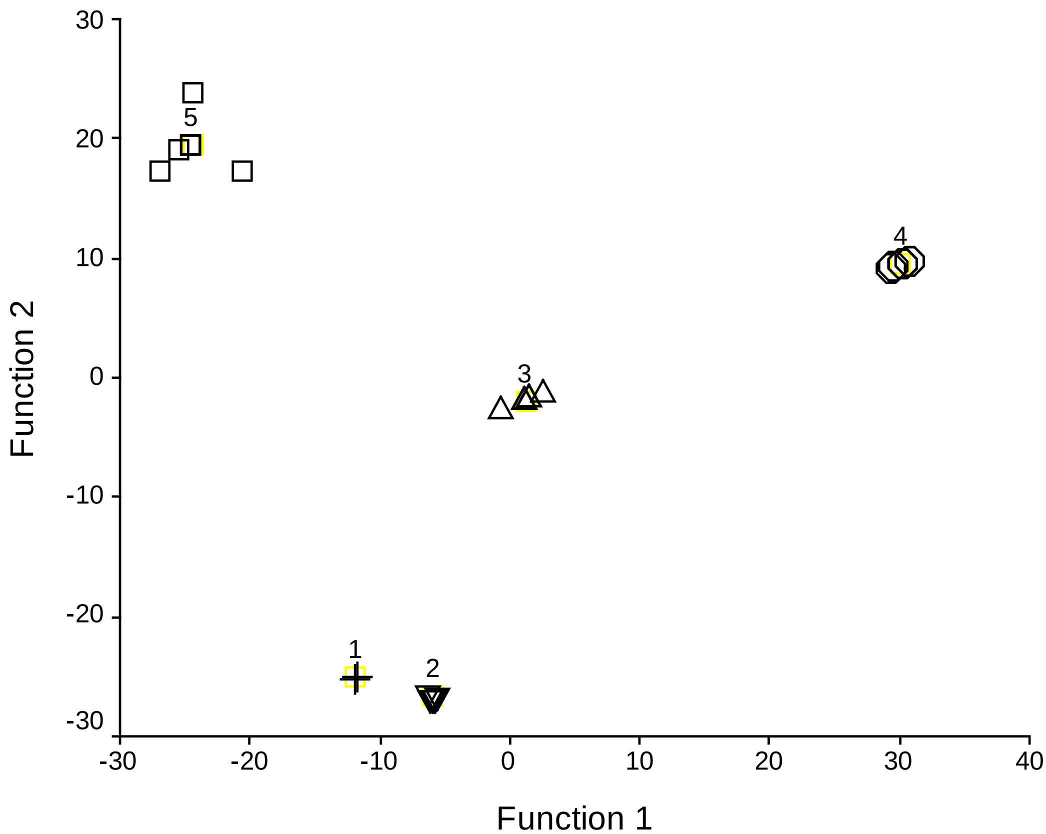

Figure 2: Groups of samples that were significantly different in woody plant species composition

When we evaluated the variation in the mean abundance of all woody plant species across this gradient sample grouping we didn't find significant results. When we considered only the species that are considered to be indicators of the five vegetation zones the variation in mean abundance as was determined by a Generalized Linear Modeling (GLM) was significant (Pillia's Trace = 3.4, F = 3.3, P < 0.001; Wilk's Lambda = 0.003, F = 7.8, P < 0.001). The vertical structural construct of the habitat varied significantly across sample groups as determined by a multivariate analysis of variance (Pillai's Trace = 1.8, F = 3, P < 0.001; Wilk's Lambda = 0.08, F = 3.3, P < 0.001).The overall intensity of human use of the forest did also differ significantly across habitat types (Pillai's Trace = 2.03, F =4.8 , P < 0.001; Wilk's Lambda = 0.02, F = 8.5 , P < 0.001).

Analysis to determine avian guilds and to evaluate of the response of the collective species abundance construct in each to underlying habitat parameters

The resident bird community of the Harena Forest constitutes 77 resident bird species that were recorded as being present in more than three decades. Prior to our surveys the total species list of the forest was 69 (Hillman 1993) and eight more new additions for the forest and the Park resulted from my survey.

A hierarchical cluster analysis was conducted to classify the 77 species large bird community in to guilds a priori. Adendrogram of species similarity was produced (Figure 3).Inferences of guild identification was made at comparable depths of the dendrogram where a minimum of about 65 % of similarity information was accounted for. This identified 9 guilds for the whole resident bird community.

To determine whether species in the bird community were clustered in accordance with the apriori guild membership in a dimension of habitat membership of samples Discriminant Function Analysis was done and results were generated. Guilds differentiated significantly according to the spatial clumping of the collective abundance construct of their species members (Figure 4). The first function accounted for 64.1 % of the variation in the data set high statistical significance (Chi-square = 442.1, P < 0.001). The second function did also separate the guilds according to their respective combined abundances across samples significantly (Chi-square = 368, P < 0.001) by accounting for 22.3 % of the variation in the data set. This result demonstrated guilds responded to habitat parameters in significantly different ways and the high overlap amongst samples in guild composition suggests interspecific interaction is more intense within a guild than amongst them. Since what was presented in figure 4 can be interpreted as five types of guild occupancies which reflected the available determined five habitat niches depicted in figure 2.

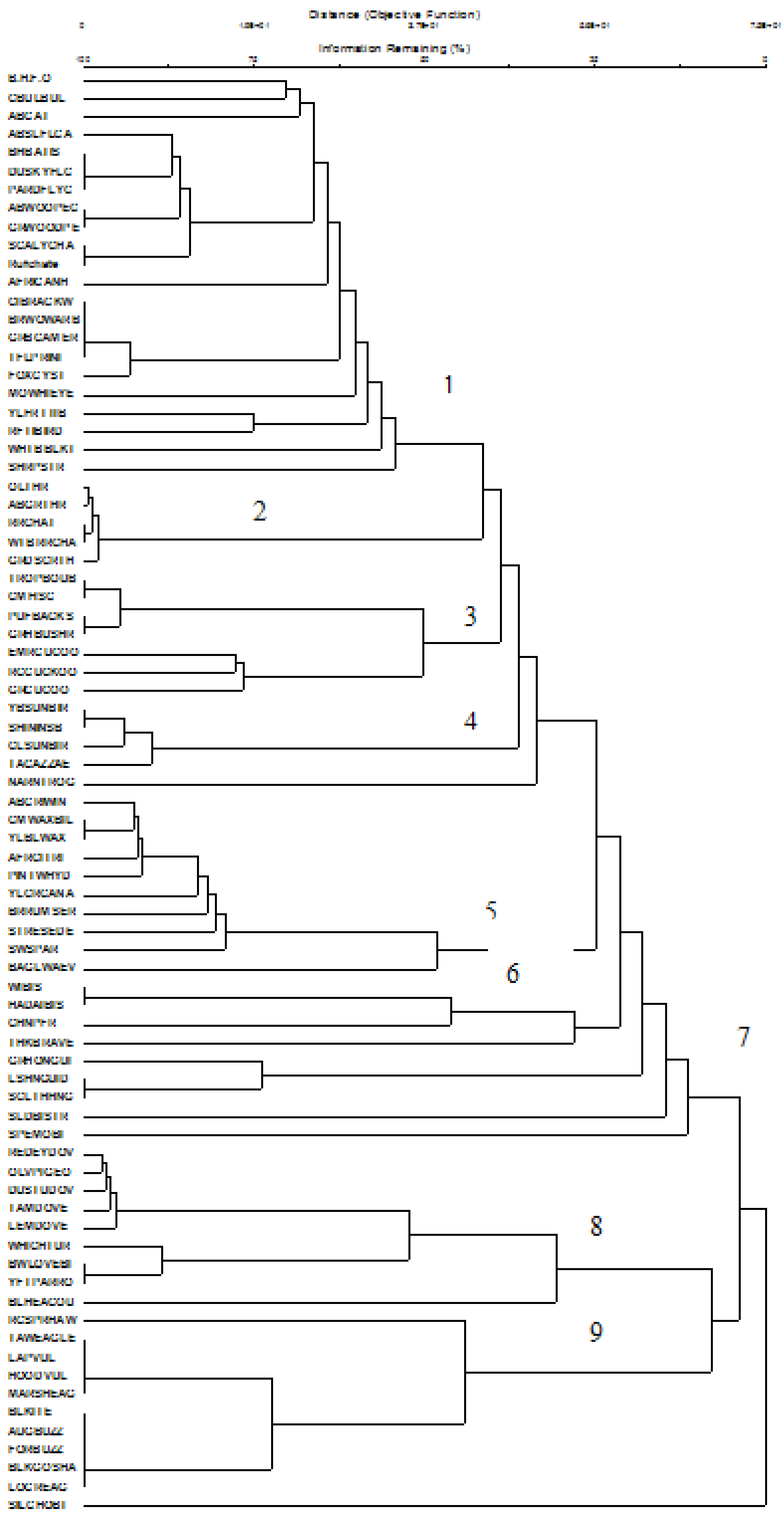

Figure 3: Guild classification according to species similarity in their attributes

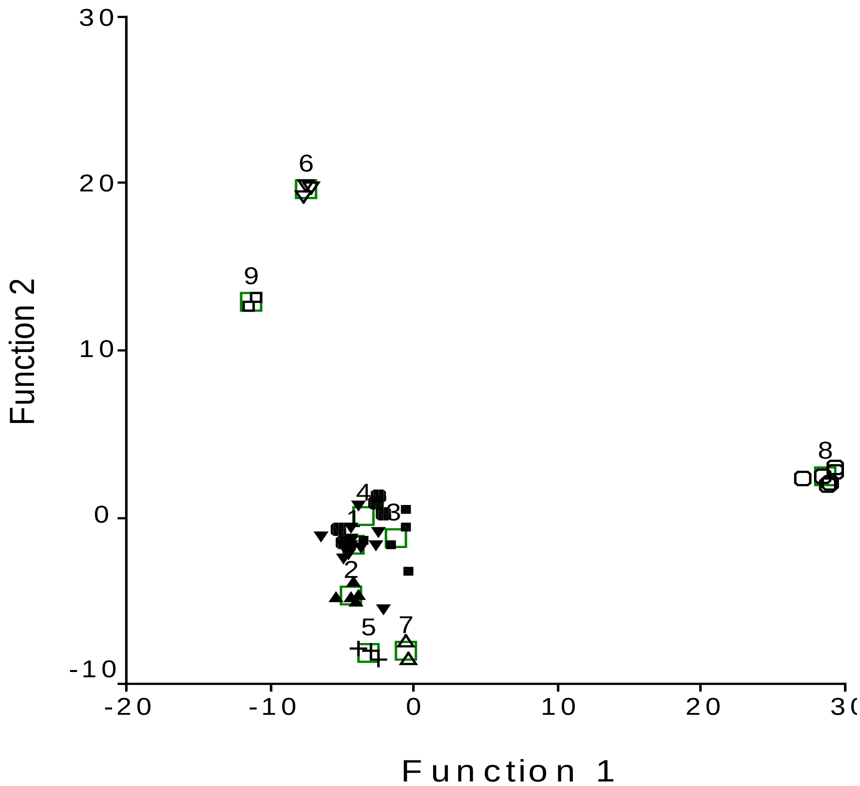

Figure 4: The spatial clumping of guilds according to the collective abundance construct of their species members

IV. Discussion

In this paper whether community structuring in to guilds makes sense in real field scenario was investigated. Members of a guild were determined on the basis of their natural adaptive features and known niche requirements and the investigation was whether this determined collective response to resource or factors underlying the mode of existence of resource including interspecific competition was the object of the investigation. To summarize the results bird guilds classified apriori were utilizing the forest in a manner that reflected the number of available habitat niches within the forest. All members of a guild were going for the same types of patches which can be considered as a measure of interspecific niche overlap. This can be taken as evidence that interspecific competition was higher within a guild than amongst guilds and together with the distribution of the collective niche of species it determined the structuring of the bird communities in to 9 guilds in a real field scenario. Furthermore the results indicated birds have tight interactive relationships with bottom processes as consumers higher up affecting them and being affected by them. The models presented can be taken as evidences of birds shaping the mode of existence of bottom biota and vise versa.

The results in this paper can be interpreted as the collective numerical response of the forest bird community to habitat quality which is taken as a segregation of collective abundance construct of the community as result of changes in habitat quality. This indicates there is a community total numerical response to habitat quality which indicates as much as the birds are affected by what offered naturally along certain habitat gradients they too affect habitat as consumers of all sorts of life components in this forest ecosystem shaping the states of the various attributes of the natural system. Such bottom-up and top-bottom interactions are vital in making sure a forest ecosystem such as this is productive and birds paly pivotal role in making sure the right and favorable conditions are met in such an ecosystem that maintains the balanced cycling of goods and services rendered to humans by such a pristine system as determined by Shimelis (2016) and Shimelis (2017a,b,c).

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