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Preliminary comparison of birds inhabiting exotic *Acacia* and native bushland habitats in semi-arid east-central Tanzania

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Introduction

In East Africa, studies have found that exotic plantations have negative impacts on birds, causing declines in abundance (Calson 1986, Pomeroy & Dranzoa 1998) and low nesting potential (John & Kabigumila 2007). Further studies on the effects of exotic plantations on birds have shown that the plantations can be appropriate habitats if they are properly designed and managed (John & Kabigumula 2011) and can provide critically needed habitat for birds (Werema & Howell 2016). Despite these studies, there is limited research on the effects of exotic plant species on local biodiversity in Tanzania, yet this understanding is crucial for conservation.

In 1980s an exotic *Acacia insulae-iacobi* (hereafter exotic *Acacia*) was grown at Godegode Village, Mpwapwa District (Dodoma Region) found in east-central Tanzania (6°30′– 6°34′S, 36°32′ – 36°34′E) as a means of afforestation. Since then this exotic *Acacia* has been preferred by villagers at Godegode because of its high growth rate as well as its tolerance of arid areas. Villagers use this tree species as a wind break, for fuelwood, for building material, as fodder, for plot/household fencing and for shade. In addition, the tree helps to control soil erosion and land degradation, and acts as a means of soil and environmental conservation. Currently, at Godegode Village, this tree has established itself in some small valley floodplains in stands of thickets or bushland.

While the exotic *Acacia* is preferred by villagers at Godegode, its effects on local biodiversity are not known. I undertook this preliminary study to assess the effects of the exotic *Acacia* on avian biodiversity, by comparing bird species composition and density in areas of exotic *Acacia* with areas of degraded native bushland. The latter are composed mainly of native *Acacia* spp., *Commiphora* spp. and baobab *Adansonia digitata* trees. I predicted that native bushland would have higher bird abundance and species richness compared to exotic *Acacia* habitats.

Methods

Between 2 and 9 December 2015, I conducted 37 and 32 point counts in native and exotic *Acacia* bushland habitats, respectively. Each point was located at least 150 m from its nearest neighbour. At each point, I recorded all birds seen or heard within a 50 m radius over 10 min, with an initial 2 min allotted for birds to settle. Birds were surveyed during non-rainy days between 06:00 and 11:00, and between 16:00 and 18:00, corresponding to the periods of high bird activity. Birds that flew from behind the observers and those that flew over the study area were excluded.

Data analysis

EstimateS software was used to assess whether most of the species in the two bushland habitats were sampled by drawing species accumulation curves for each of the two habitats and using the number of point counts as sampling effort.

Mean values of bird abundance and richness were used to extrapolate the number of individuals and species per hectare (ha). Prior to analyses, variables were examined for deviations from normality using the Shapiro–Wilk test. Because the data were not normally distributed, the Mann-Whitney U-test was used to assess whether there were significant differences in the number of species and individuals per hectare between the native and exotic *Acacia* bushlands. The African Openbill *Anastomus lamelligerus* was excluded from analyses because only one very large flock was detected. Species order, taxonomy and common names follow Sinclair & Ryan (2010).

Results

In total 71 species (most of which were resident breeders) were recorded in both native and exotic *Acacia* habitats (Appendix 1). All species observed were found in the surrounding native bushlands and about one-third (n = 25) were observed in the exotic *Acacia* habitat, suggesting that species found in the latter habitat were a subset of those found in the former (Appendix 1). Species accumulation curves for the two study sites appeared to reach asymptote, indicating that most of the species were recorded (Fig. 1). There were higher densities of birds (both species and individuals) in the native bushland habitat compared to the exotic *Acacia* bushland (number of species per hectare: Mann-Whitney $U_{32,37} = 104$, $p < 0.0001$; individuals per hectare: Mann-Whitney $U_{32,37} = 221$, $p < 0.0001$) (Appendix 1; Fig. 2). Densities of most species were relatively higher in the native bushland compared to the exotic *Acacia* bushland (Appendix 1). Most species in the exotic *Acacia* bushland were at lower density, except the Laughing Dove *Streptopelia senegalensis* (Appendix 1).

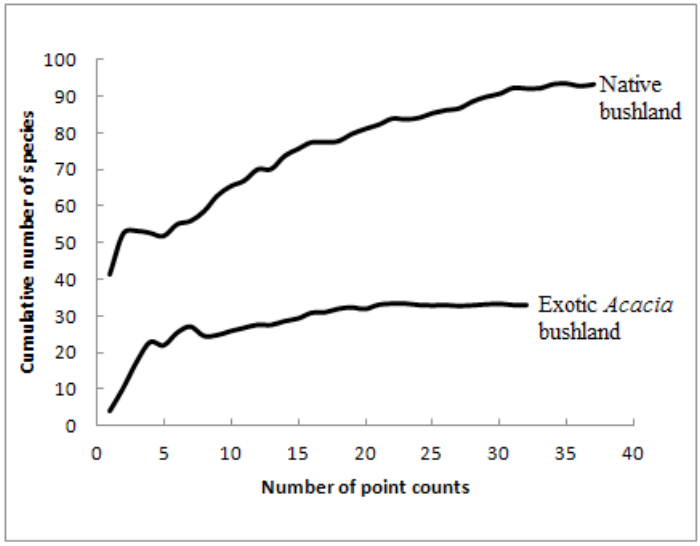


Figure 1. Species accumulation curves for the native and exotic *Acacia* bushlands.

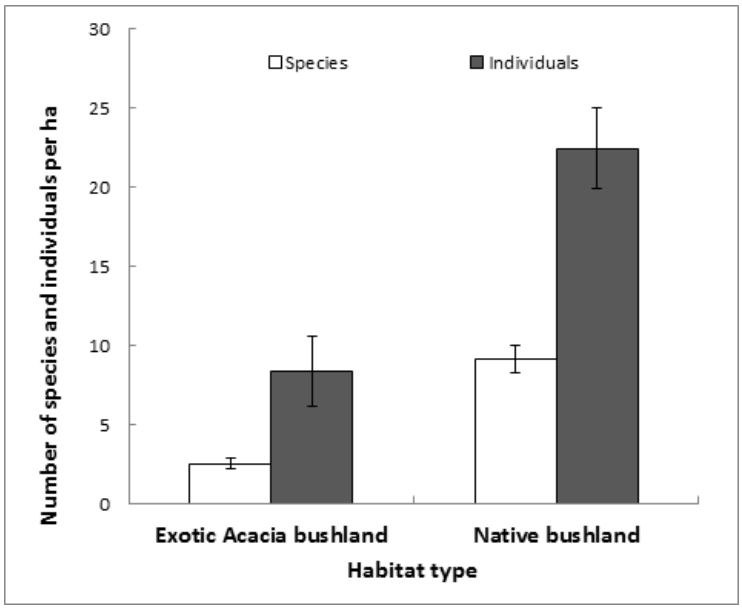


Figure 2. Mean (± SE) number of species and individuals in the native and exotic *Acacia* bushlands.

Discussion

The prediction that native bushlands would have higher bird abundance and species richness compared to exotic *Acacia* bushland was confirmed. Although preliminary due to the brief study period, my results suggest that replacing native vegetation with a monoculture of exotic *Acacia* leads to decreased bird species richness and abundance. Higher species richness and density of birds in native bushlands could be due to the higher diversity and availability of resources in native habitats (see Jacoboski *et al*. 2016).

Lower species richness and abundance in the exotic *Acacia* bushland could be due to a lack of plant species heterogeneity, i.e. simplification of vegetation structure and composition that greatly influences bird communities (see Marsden *et al*. 2001). This suggests that there is a reduced availability of resources, which act as environmental filters, in the exotic plantations than in the native bushlands (Jacoboski *et al*. 2016). Therefore, further growth of the exotic *Acacia* trees at Godegode village is incompatible with bird conservation compared to allowing natural regrowth of native tree species.

Most species in the exotic *Acacia* were at lower density. Only the Laughing Dove was found at higher densities because it visited the River Mkondoa to drink, particularly during the afternoon hours.

While the exotic *Acacia* is preferred by the villagers of Godegode village its spread throughout the entire village landscape and elsewhere needs to be controlled. This tree should only be allowed to grow in a scattered manner amongst the other native trees as a means of increasing vegetation diversity instead of allowing it to form monocultures. Should the entire landscape be dominated by this exotic tree species, the bird fauna (and probably other taxa) will be negatively affected. The conservation of the existing native vegetation is critical for the ecological conditions required by

birds at Godegode village and elsewhere. Despite the small area that was studied, my results suggest that there is a need to discourage further spread of this exotic *Acacia* as the best way of maintaining the biodiversity of this region.

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Appendix 1. Densities of species observed in the native and exotic *Acacia* bushlands. Densities of species were expressed as mean number of individuals per hectare.

English name	Species name	Native bushland	Exotic *Acacia* bushland
African Openbill	*Anastomus lamelligerus*	4.96	0.00
Hadeda Ibis	*Bostrichia hagedash*	0.03	0.00
Helmeted Guineafowl	*Numida meleagris*	0.64	0.00
Coqui Francolin	*Peliperdix coqui*	0.07	0.00
Red-necked Spurfowl	*Pternistis afer*	0.33	0.00
Small Button-Quail	*Turnix sylvaticus*	0.03	0.00
Water Thick-knee	*Burhinus vermiculatus*	0.13	0.00
Red-eyed Dove	*Streptopelia semitorquata*	0.50	0.08
Ring-necked Dove	*Streptopelia capicola*	0.07	0.00
Laughing Dove	*Streptopelia senegalensis*	2.68	3.98
Emerald-spotted Wood Dove	*Turtur chalcospilos*	0.36	0.04
Tamborine Dove	*Turtur tympanistria*	0.03	0.00
Namaqua Dove	*Oena capensis*	0.07	0.04
Brown Parrot	*Poicephalus meyeri*	0.03	0.00
Fisher's Lovebird	*Agapornis fischeri*	0.33	0.08
Diderick Cuckoo	*Chrysococcyx caprius*	0.13	0.00
Red-chested Cuckoo	*Cuculus solitarius*	0.10	0.00
White-browed Coucal	*Centropus superciliosus*	0.06	0.04
Speckled Mousebird	*Colius striatus*	0.66	0.40
Blue-naped Mousebird	*Urocolius macrourus*	1.32	0.00
African Pygmy-Kingfisher	*Ispidina picta*	0.00	0.04
Brown-hooded Kingfisher	*Halcyon albiventris*	0.03	0.00
Little Bee-eater	*Merops pusillus*	1.02	0.12
Rufous-crowned Roller	*Coracias naevius*	0.07	0.00
Lilac-breasted Roller	*Coracias caudatus*	0.07	0.00
Tanzania Red-billed Hornbill	*Tockus ruahae*	0.03	0.00
Red-fronted Tinkerbird	*Pogoniulus pusillus*	0.03	0.00
Spot-flanked Barbet	*Tricholaema lacrymosa*	0.23	0.00
Fappet Lark	*Mirafra rufocinnamomea*	0.07	0.00
Fisher's Sparrowlark	*Eremopterix leucopareia*	0.26	0.00
Barn Swallow	*Hirundo rustica*	0.10	0.00
Lesser-stripped Swallow	*Hirundo abyssinica*	0.50	0.00
Mosque Swallow	*Hirundo senegalensis*	0.26	0.00
Fork-tailed Drongo	*Dicrurus adsimilis*	0.23	0.00
Pied Crow	*Corvus albus*	0.06	0.00
Dark-capped Bulbul	*Pycnonotus tricolor*	1.16	0.52
Northern Brownbul	*Phyllastrephus strepitans*	1.13	0.28
Sombre Greenbul	*Andropadus importunus*	0.10	0.11
Yellow-bellied Greenbul	*Chlorocichla flaviventris*	0.03	0.16
Kurrichane Thrush	*Turdus libonyanus*	0.03	0.00
White-browed Robin Chat	*Cossypha heuglini*	0.17	0.16
Spotted Palm-Thrush	*Cichladusa guttata*	0.10	0.00
White-browed Scrub Robin	*Cercotrichas leucophrys*	0.30	0.12

English name	Species name	Native bushland	Exotic *Acacia* bushland
Rattling Cisticola	*Cisticola chiniana*	0.52	0.00
Tawny-flanked Prinia	*Prinia subflava*	0.10	0.12
Grey-backed Camaroptera	*Camaroptera brevicaudata*	0.36	0.32
African Grey Flycatcher	*Bradornis microrhynchus*	0.33	0.00
Chinspot Batis	*Batis molitor*	0.07	0.00
Black-backed Puffback	*Dryoscopus cubla*	0.36	0.08
Brubru	*Nilaus afer*	0.13	0.00
Tropical Boubou	*Laniarius major*	0.13	0.00
Slate Coloured Boubou	*Laniarius funebris*	0.76	0.48
Orange-breasted Bush-Shrike	*Chlorophoneus sulfureopectus*	0.03	0.00
Brown-crowned Tchagra	*Tchagra australis*	0.20	0.12
Nothern-white Crowned Helmet Shrike	*Eurocephalus rueppelli*	0.03	0.00
Ashy Starling	*Cosmopsarus unicolor*	0.36	0.08
Superb Starling	*Lamprotornis superbus*	0.17	0.00
Violet-backed Starling	*Cinnyricinclus leucogaster*	0.00	0.00
Scarlet-chested sunbird	*Chalcomitra senegalensis*	0.03	0.12
Western Violatet-backed Sunbird	*Anthreptes longuemerei*	0.17	0.00
Variable Sunbird	*Cinnyris venustus*	0.40	0.00
Beautiful Sunbird	*Cynnyris pulchella*	0.06	0.00
African Yellow White-eye	*Zosterops senegalensis*	0.36	0.07
Red-billed Firefinch	*Lagonosticta senegala*	1.06	0.16
Swahili Sparrow	*Passer suahelicus*	0.20	0.16
Village Weaver	*Ploceus cucullatus*	1.16	0.32
Vitelline Masked Weaver	*Ploceus vitellinus*	0.83	0.00
Green-winged Pytilia	*Pytilia melba*	0.10	0.00
Blue-capped Cordonbleu	*Uraeginthus cyanocephalus*	0.40	0.00
Purple Glenardier	*Granatina ianthinogaster*	0.06	0.00
White-bellied Canary	*Crithagra dorsostriata*	0.60	0.00
Reichenow's Seed-eater	*Crithagra reichenowi*	0.03	0.16