ARTICLES

Communal Roosts of African White backed *Gyps africanus* and Hooded Vultures *Necrosyrtes monachus* in Wondo Genet College of Forestry and Natural Resources, Southern Ethiopia

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Abstract

A study on communal roosts of African White-backed *Gyps africanus* and Hooded Vultures *Necrosyrtes monachus* in Wondo Genet College of Forestry and Natural Resources, southern Ethiopia was conducted from January to March 2012 to investigate population dynamics of vultures. The population fluctuation of vultures was estimated by direct counts made at nine roosting sites. The estimated mean abundance of African White-backed Vultures (AWBV) was 35.4 (SD ±7.2) and Hooded Vultures 118.4 (SD ± 14.9) in all roosts. The AWBV showed a stable population all through the months whereas the Hooded Vulture population peaked in March. Each roost site supported a varied number of vultures. No significant difference was noticed in the counts of vultures between the morning and evening. Plantations of exotic *Eucalyptus* sp. and *Podocarpus falcatus* trees should be protected and managed sustainably for the conservation of globally threatened vulture species in the campus.

Introduction

The vulture is the most threatened group of birds in the world, and currently, 14 of 23 (61%) vulture species worldwide are threatened with extinction, and the most rapid declines have occurred in Asia and Africa (Sekercioglu 2006, Anderson 2007, BirdLife International 2011, Ogada *et al*. 2011). Due to severe declines in parts of their range the African White-backed Vulture *Gyps africanus*) and Hooded Vulture (*Necrosyrte smonachus*) are now listed as Endangered species (BirdLife International 2011, 2012, Ogada and Buij 2011). The decline of vultures has serious implications for the species themselves, and potentially for other wildlife and human health (Prakash *et al*. 2003, Louis 2011). Knowledge on the status of vultures is important so as to suggest conservation measures (Wilkinson and Debban 1980). Regular monitoring of large roosts can indicate trends in annual production and population size (Meyer 1994). Conducting research on population dynamics of vultures has been identified as a priority to aid the planning and implementation of effective conservation strategies (Virani *et al*. 2011, Louis 2011, Ogada and Buij 2011, Birdlife International 2011). As a consequence of the recent dramatic population declines of vulture species in the world and the uncertainty with populations in Ethiopia, the Wondo Genet forest landscape populations of the vulture species are considered to be regionally and nationally significant. The area provides diverse niche by way of forest cover, and food source from garbage dumps and slaughterhouse. The present study aims to determine population dynamics of vultures in Wondo Genet College of forestry and Natural Resources (WGCF- NR) and recommend conservation measures for vultures.

Study area

WGCF-NR ($7^0$6'N latitude and 38^0 37'E longitude) is situated 263km south of Addis Ababa and 13km south west of Shashemene town, on the escarpment of Ethiopia rift valley in the southern nation nationalities and people region (Mohammed, 2007) (Figure 1). The area consists of a chain of hills Abaro, Bachilgigisso, Gairmo, Kentere and Cheko that surround the highly populated valley (Belayenesh, 2002). It has a bimodal rainfall pattern with the short rainy season ranging from March to May and the long rainy season lasting for five months from June to October with 1247 mm precipitation annually. The mean monthly temperature is 19.5^{0}C (Teshale, 2003).

The college holds about 1000 hectares of land, of which natural forests accounts for 650 ha, plantation forests 117.3 ha and the rest is occupied by college campus and human settlements. The forest harbours a variety of mammals; Bushbuck (*Tragelaphus scriptus*), Dik-dik *(Madoqua kirkii),* Warthog (*Phacochoerus africanus*), Civet (*Civettictis civetta*), Serval cat (*felis serval*), Leopard (*panthera pardus*), Spotted Hyena (*Crocuta crocuta*), Aardvark (*Orycteropis afer*), White-tailed mongoose *(Ichneumia albicauda),* Colobus Monkey (*Colobus guereza*), Vervet monkey (*Chlorocebus mitis*) and Baboon (*Papio anabus*) (Tola 2005). It is a home for 118 species of birds, of these seven are endemic or near endemic species (Sim 1979). The flora of the college includes indigenous plants species such as Large-leaved cordial *(Cordia africana),* Podo *(Podocarpus falcatus),* African wild olive *(Olea africana)* and exotic species Mexican cypress (*Cupres suslusitanica),* Weeping pine *(Pinus patula),* Silky oak *(Grevillea robusta)*, Eucalyptus spp. (Hjelm 2001).

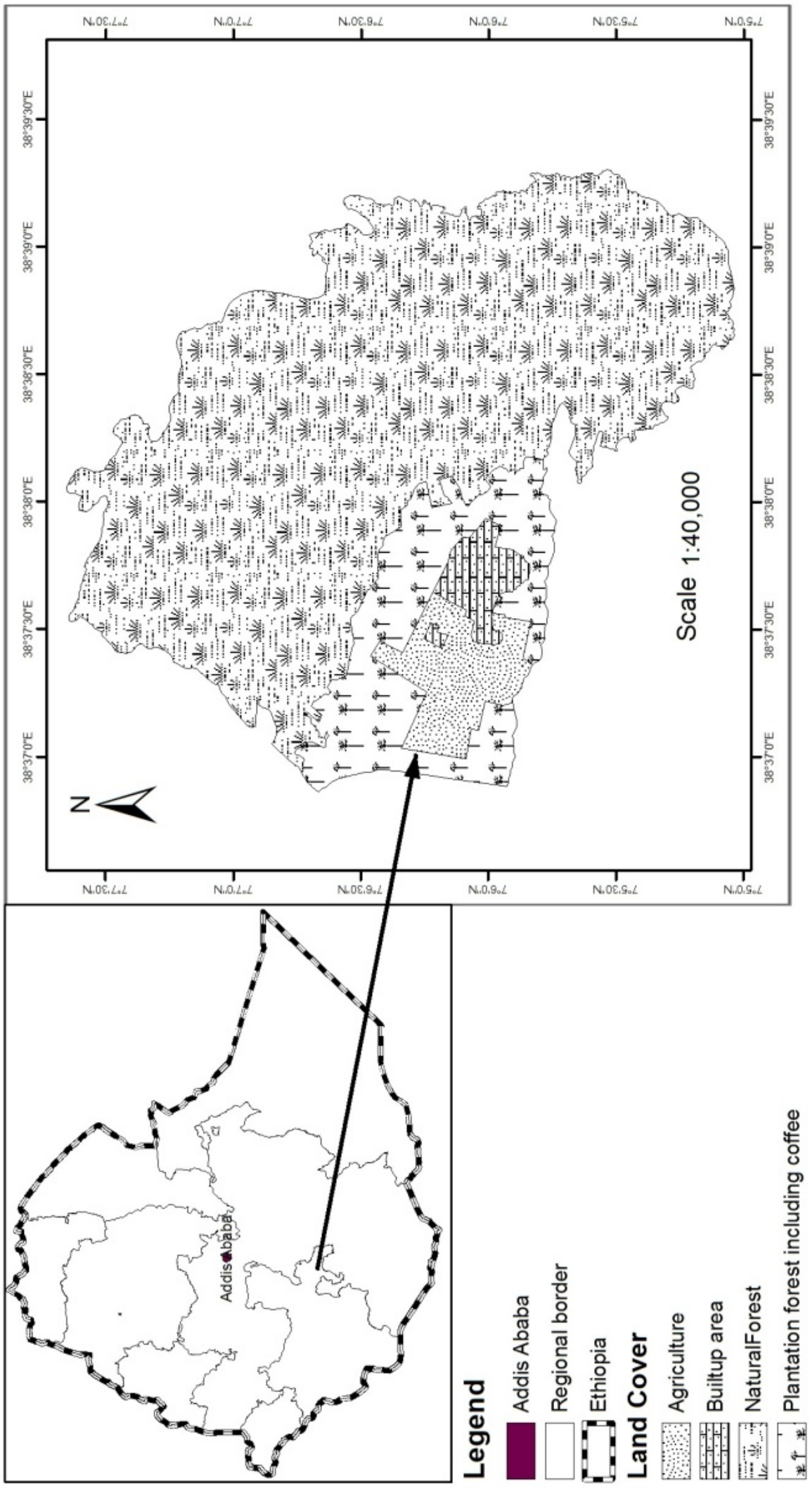

Figure 1 Location of Wondo Genet College of Forestry and Natural Resources

Methods

Communal roosts have been found to be an important source for counting birds in a short time (Fuller and Mosher 1981, Sweeney and Fraser 1986). The communal roost sites were located by detecting the vultures' direction of flight an hour before sunset until half an hour after sunset (Sykes 1985, Sweeney and Fraser 1986, Ssemmanda 2005). Additionally, indirect signs of vulture presence such as white washes and moulted feathers were searched. Data collection was carried out from January to March 2012. To determine the population size of vultures, roost counts were made in the morning (an hour before sunrise) until all vultures left the roost, and again in the evening from 4:30 pm (i.e. before the first bird arrived) until all had settled (Sykes 1985, Sweeney and Fraser 1986, Baral *et al.* 2005; Ssemmanda 2005, McVey 2008) within an area of about 70 ha. At large roosts with more than 50 birds, two observers worked together to count the roosting vultures as they entered the site (Ssemmanda 2005). Nine counts were made at each roost site with three counts in each month. Evening count of the first day (arrived vultures) and morning count of the next day (left vultures) being treated as one count (day average) per roost site. In all, 81 counts (nine roost sites x nine visits) were carried out in the study area. The roost sites were located near to each other with a mean of 43.3 (SD±26) m far apart from each other.

The data were analyzed using SPSS version 16.0. The population size in each roost was estimated by calculating the mean number of vultures counted during the three months censuses. The mean roost size was estimated by the formula: $\sum X_i \, .n_i/N$, where X_i is the mean number of vultures in roost i, n_i the number of observation days at roost i, and N the total number of observation days in all roosts. In a given study period final population estimate for the whole area was obtained by summing the monthly means of individual roosts (Xirouchakis and Mylonas, 2005; Hiwot, 2007). Paired t- test was employed to evaluate the impact of time of counting on the abundance of Vultures. Two way ANOVA was used to assess the effect of roosting sites and months on the abundance of each species and the Tukey's multiple range tests for post-hoc comparisons.

Results

Roost occupancy and time of count

A total of nine roost sites were identified throughout the study site and all were trees located around human settlement. Six (66.7%) of the these were in stands of *Eucalyptus* sp., two (22.2%) in stands of *Podocarpus falcatus* (Figure 2) and one (11.1%) in a stand of *Croton macrostachyus*. Of nine sites, two were occasional and used by Hooded Vultures only and the rest were permanent sites that were used all through the months from January to March. Roosts 1, 2 and 7 (R1, R2 and R7) were utilised relatively more (Table 1). Both the species roosted together in all roosts except the Roost 8 (R8). The total population size of AWBV was 35.4 (SD±7.47) and HV was 117.45 (SD±15) (Table 1).

Morning and evening counts were similar for AWBV (T_{80} =1.489, P = 0.140) and HV (T_{80} = -1.401, P = 0.165) (two-tailed) using 99% confidence interval. Mean differences in morning counts were small compared to the evening counts for AWBV (0.19 ± 1.12(SD)) and (-0.42 ± 2.7(SD)) for HV (Table 1).

Figure 2: Important roost trees AWBV and HV. *Podocarpus falcatus* (R-7) and *Eucalyptus* sp. (R-1) in WGCF-NR, Southern Ethiopia, January -March 2012

Table 1: Vulture counts at communal roosts in WGCF -NR, Southern Ethiopia, January to March 2012

Roost	Substrate	Time	Number of AWBV Range	Mean ±SD	Number of HV Range	Mean ±SD
R1	A (N=9)	PM	0-1	0.55 ± 0.53	15-53	28.22 ±13.3
		AM	0-1	0.44 ±0.53	17-49	27.67 ±11.98
		Avg	0-1	0.56 ± 0.53	17-51	28.11 ±12.44
R2	A (N=9)	PM	1-7	1.78 ±2.54	23-71	42.33 ±17.36
		AM	0-7	2.78 ±2.59	21-67	39 ±17.49
		Avg	0-7	2.44 ±2.4	24-69	40.89 ±17.14
R3	A (N=9)	PM	0-3	1 ±1.07	3-12	8.63 ±2.72
		AM	0-1	0.63 ±0.52	3-13	9.25 ±3.2
		Avg	0-2	0.86 ±0.84	3-12	9 ±2.98
R4	A (N=9)	PM	0-4	1.43 ±1.4	2-9	4.43 ±2.57
		AM	0-4	1.29 ±1.5	2-12	6.29 ±3.3
		Avg	0-4	1.43 ±1.4	2-10	5.57 ±2.64
R5	A (N=9)	PM	0-5	2 ±1.63	7-17	9 ±3.79
		AM	0-5	1.86 ±1.68	4-13	8 ±3.21
		Avg	0-5	2 ±1.63	6-15	9 ±3.32
R6	A (N=9)	PM	2-9	3.88 ±2.36	6-25	12.63 ±6.97
		AM	2-9	3.88 ±2.36	6-24	12.88 ±6.58
		Avg	2-9	3.88 ±2.36	6-25	12.88 ±6.85
R7	B (N=9)	PM	13-27	23.22 ±5.12	8-22	15.4 ±4.47
		AM	14-29	24.3 ±4.69	7-21	17.11 ±4.96
		Avg	14-28	23.11 ±4.76	1-21	16.28 ±6.63
R8	C (N=9)	PM	0	0	0-4	2 ±1.27
		AM	0	0	1-3	2 ± 0.63
		Avg	0	0	1-4	2.08 ±0.8
R9	B (N=9)	PM	2-4	2.22 ±0.67	0-4	0.67 ±1.41
		AM	2-4	2.22 ±0.67	0-4	0.67 ±1.41
		Avg	2-4	2.22 ±0.67	0-4	0.67 ±1.41
Total	(N=81)	PM	0-27	34.78 ±7.27	0-71	120.33 ±15.47
		AM	0-29	36.1 ±7.66	0-67	116.56 ±14.52
		Avg	0-28	35.4 ±7.2	0-69	118.45 ±14.9

Note A= *Eucalyptus* sp., B= *Podocarpus falcatus*, C= *Croton macrostachyus*, R=Roost

Population fluctuations

The AWBV mean monthly population did not fluctuate significantly ($F_{2,54}$ = 0.14, P > 0.05) (Figure 3) however they showed a highly significant difference in the mean numbers between the roost sites ($F_{8,54}$ = 100.3, P < 0.001) (Table 2). The Roost site 7 supported the highest number of vultures (Tukey HSD, P < 0.001) and the rest of the sites showed no significant difference (Tukey HSD, P > 0.05).

There was highly significant difference in mean abundance of Hooded vultures between the months ($F_{2,54}$ = 9.8, P < 0.001) (Figure 3). Using multiple comparisons (Tukey HSD), the mean abundance of vultures showed a significant difference between January and March as well as February and March (P < 0.05), but no significant difference between January and February (P > 0.05). The mean number of Hooded Vultures varied considerably between the roost sites (Table 2) ($F_{8,54}$ = 65.4, P < 0.001). These vultures were significantly high at roosts *Eucalyptus citriodora* 1 and 2 (Tukey HSD, P < 0.001) but there was no significant difference at the rest of the roost sites (Tukey HSD, P > 0.05).

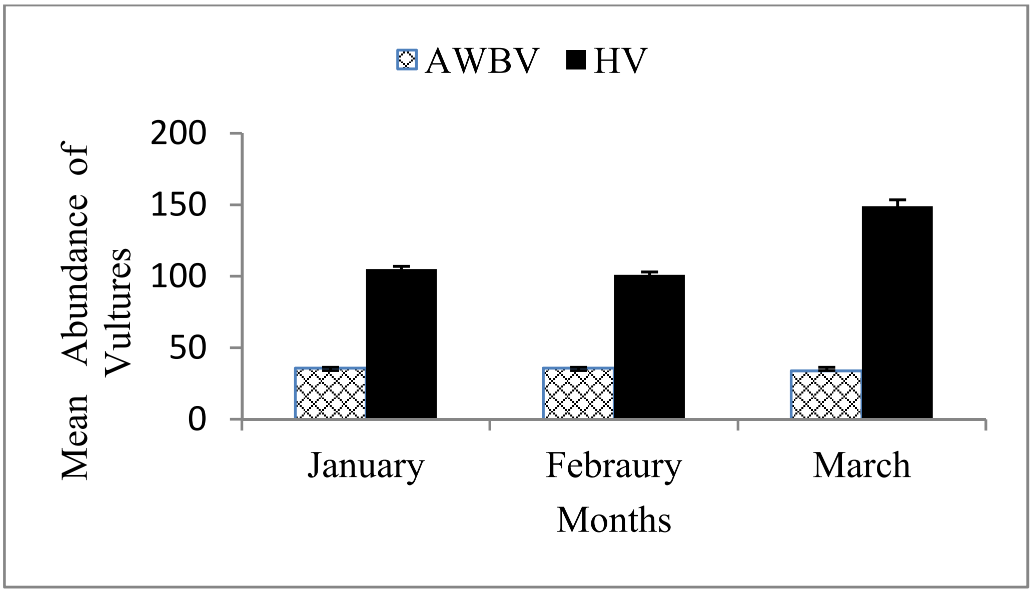

Figure 3: Mean (±SD) monthly population variation of African White-backed and Hooded Vultures in WGCF-NR, Southern Ethiopia, January –March 2012

Table 2: Mean (±SD) monthly population variation of African Whitebacked and Hooded Vultures at each roost sites in WGCF-NR, Southern Ethiopia, January – March 2012

	AWBV			**HV**		
Roost	Jan	Feb	Mar	Jan	Feb	Mar
R1	0.7 ±0.3	0.7 ± 0.3	0.3 ± 0.3	21.7 ±3.2	20.3 ± 2.0	42.3 ±6.3
R2	1.7 ±0.9	3.0 ± 1.5	1.7 ± 1.7	28 ±2.7	29 ±6.6	60.7 ±6.9
R3	2 ± 0	1 ± 0		10 ±1	6 ±1.5	10.7 ±0.7
R4	1.3 ±0.3	1.3 ± 1.3	2 ± 0	5 ±1	6.3 ±2.3	5 ±0
R5	2 ±0.6	2.3 ± 1.5	1 ±0	9.7 ±2.7	9.3 ±1.5	6 ±0
R6	4.3 ±2.1	4 ±1	2.7 ± 0.7	14 ±4.3	7 ±0.0	10.3 ±0.9
R7	21.7 ±2.9	21.7 ± 3.9	24 ± 0.6	11 ±1.7	19 ±1.2	14.2 ±6.1
R8	0	0	0	1 ±0	2.8 ±0.8	2 ±0
R9	2.7 ± 0.7	2 ± 0	2 ±0	0.7 ±0.7	1.3 ±1.3	0.7 ±0
Total	36.4 ± 6.8	36 ± 6.9	33.7 ±8.1	105 ±10.4	101 ±10.7	149.5 ±21

Discussion

Roosts and time of count

The college campus supported the globally Endangered African White-backed and Hooded Vultures. Two observers worked together to count the roosting vultures for the large roosts to minimise under or over estimation of the vultures. Additionally, the counts were done at the right time as used in many other studies for determining vulture population size (Ssemmanda 2005, McVey 2008). Vulture counting both during morning and evening in the present study was found to be effective as this helped in the confirmation of numbers of vultures. The roosts also had open spaces to help identify vulture species which resulted in accurate counts. Sweeney and Fraser (1986) suggests vulture roost counting in the morning, is more reliable due to difficulty in conducting observations in trees with dense foliage at their arrivals in the evening. On the contrary, determining numbers in the evening before darkness was relatively easy, in roost trees with little foliage or dead trees (Ceballos and Donazar 1990, Donazar *et al*. 1996).

Population fluctuation

The roosting population of AWBV was found to be stable, which might be on account of food availability from the cafeteria and slaughter house of the college that results in high survival of the immature vultures. Additionally, the campus has wide forested areas that harbour many species of wild ungulates and carnivores, which may also provide high food availability from leftovers of the carnivores with respect to the surrounding unprotected areas. According to Murn and Anderson (2008) *Gyps* sp. vultures forage over wide areas (>100 km per day) in search of food, however they return back to their traditional roost sites. Nevertheless, there were fluctuations in their abundance at each roost site in the College. The population variation of AWBV at each site could be due to an interchanging of vultures among roosts. Similar results were found by Sweeney and Fraser (1986) for vultures at communal roosts in southern Virginia, USA. However, difference in the mean abundance of this species between the roosts may be the consequence of the characteristics of each roost tree. Ceballos and Donazar (1990) expressed that variation observed among roosts with respect to tree selection resulted in different characteristics within a given woodlot of the roost site. That is, tall trees having large basal diameter with foliaged branches and open space around the maximum diameter of the crown were noted as trees selected for roost sites of the vulture species.

The roosting population of HV showed a fluctuation which peaked in March. The peak is due to the arrival of vultures from elsewhere to exploit food sources in the college, which provides them with a constant source of food. Although this month is the major Orthodox Christian Fasting season in Ethiopia when slaughtering of animals is largely reduced (Hiwot 2007), in the study area the number of slaughtered animals was constant in order to serve the college community and cafeterias of the college. Moreover, an increase of slaughtered animals was seen when the college hosts national and international trainings, meetings and conferences. This may attract other vultures from the vicinity areas for searching food, where there was minimum number of slaughtered animals. Gbogbo and Awotwe-Pratt (2008) recorded HV migration from elsewhere to the Legon Campus of the University of Ghana in Accra due to the large quantity of waste generated and dumped on the campus. This is also consistent with our results and many other studies (Ceballos and Donazar 1990, Stolen 1996, 2000, Margalida and Boudet 2003, Parra and Telleria 2004, Hiwot 2007, Dermody *et al.* 2011).

In addition to this, the college also provides food sources for vultures from carcasses of wild ungulates remained from the carnivores, refuse dumps and effluent. In response to the food availability the number of these vultures was increased in the existing roosts in March and formed new roosts (Roost 8). Vultures are known to form new roosts coinciding with the appearance of a new food source that is available regularly in space and time and this has also been recorded in Spanish roosts (Ceballos and Donazar 1990, Donazar *et al.* 1996, Margalida and Boudet 2003). Ssemmanda (2005) reported that HVs roost within a 100m radius of their feeding sites and they also appear not to move long distances between feeding and roosting sites confirming that local food availablity can be a determining factor in the formation of vulture roosts (Sweeney and Rraser 1986, Coleman and Fraster 1989). The use of protected areas in this college is compatible with a number of recent studies that have suggested that vultures in Africa are becoming increasingly restricted to protected areas due to food shortages and changing land use practices in unprotected areas (Thiollay 2006a, 2007a, Virani *et al.* 2011, Louis 2011).

Conservation issues

Protection of large roost sites is essential to the long-term conservation of the Endangered

AWBV and HV. Forest management of the college should control cutting and lopping branches of *Eucalyptus sp.* and *Podocarpus falcatus* in and around the built-up area to provide roost substrates for vultures. Additionally, the forest cover of the college, which is source of food for vultures, should be managed in a sustainable manner. The available food sources for vultures in the college should be protected from being poisoned. Since the present study was carried out only in winter season, it needs conducting further research in different seasons so as to understand the seasonal population dynamics of vultures in large areas of the country for further conservation measures.

Conclusion

The college campus supported communal roosts of AWBV and HV. In the study area, there are permanent and ephemeral vulture roosts found near human settlements. The area records high numbers of HV 118.4 (SD± 14.9) and AWBV 35.4 (SD±7.2). The campus had a stable roosting population of AWBV but fluctuating population of HV that peaked in March. Counting of vultures as they departed the roost at sunrise and entered it at sunset was similar. Of the total nine identified roost sites, six (66.7%) were in stands of *Eucalyptus* sp., two (22.2%) in stands of *Podocarpus falcatus* and 1 (11.1%) in a stand of *Croton macrostachyus*. AWBV and HV roosted together in all roosts except the ephemeral roost of HV on *Croton macrostachyus*. Food availability and protection seemed to be the responsible actors for presence of communal roosts of vultures in the campus.

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Key words: communal roost, *Gyps africanus*, *Necrosyrtes monachus,* Wondo Genet, Ethiopia.

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