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RESEARCH ARTICLE

THE STATUS AND FEEDING ECOLOGY OF MENELIK'S BUSHBUCK (*TRAGELAPHUS SCRIPTUS MENELIKI*, NEUMANN, 1902) IN WOF-WASHA FOREST, NORTH SHOA, ETHIOPIA

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ABSTRACT

The status and diet of Menelik's bushbuck (*Tragelaphus scriptus meneliki*) in the Wof-Washa Forest (WWF), central highlands of Ethiopia were studied from January-August, 2013. The highland forest was classified into three habitats, the Natural forest, Plantation and Erica woodland. Transect line count and direct observation procedures were used to record the population size and diet of the species, respectively. A total of 64 and 72 Menelik's bushbucks were counted during the dry and wet seasons, respectively. The population was dominated by adult individuals (65 and 63% during the dry and wet seasons, respectively) and the sex ratio biased towards females (1:1.65). The highest number of animals was counted in transects sampled from the natural forest. A total of 22 plant species of all growth forms were identified as a source of food for Menelik's bushbuck and young leaves were the most used (64%) plant parts. Designating wildlife conservation area, at the regional or federal level, is recommended to conserve the unique highland forest island and to ensure the survival of the isolated endemic antelope population.

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INTRODUCTION

The bushbuck (*Tragelaphus scriptus* Pallas, 1766) is a medium sized African Bovine, distributed in the sub-Saharan Africa except for the extreme arid regions. They range up to 4000 m on the East African mountains (Kingdon, 1997; Stuart & Stuart, 2000). About ten sub-species and several races are regionally recognized for the species (Yalden et al., 1984; Kingdon, 1997). Among these, three subspecies, with overlapping ranges, are believed to occur in Ethiopia (Yalden et al., 1984). The common bushbuck, *T. s. decula*, inhabits most of the northern parts of the country including the Simien Mountains and highlands extending as far south as the Awash River Valley. The endemic Menelik's bushbuck (*T. s. meneliki*), described by Matschie in 1902 (Moodley et al., 2008), dominates the southeastern highlands of Ethiopia including the Bale, Arsi and Chercher highland forests (Bekele and Yalden, 2014). Recent study also reported the species from the Denkoro forest, northern tip of central Ethiopia (Yazezew et al., 2011) that obscures the former reports that restricted its range to the southeastern highlands.

The record from the present study (in the Wof-washa forest, mid-northern central Ethiopian highlands) shows that the range assessment for the species is still incomplete. The third subspecies, *T. s. powelli*, that resembles the Menelik's bushbuck, dominated most forested areas of the central, south and southwestern highlands of Ethiopia (Bekele and Yalden, 2014). Menelik's bushbuck is distinguished from the other subspecies by its long dark brown coat, the white patches on throat, base of neck and inside of legs, and a few white spots on the thighs. The presence of remarkable reddish brown pelage on the head region, black nose stripe and the imperfect white chevron between the eyes and by the absence of the pale dorsal markings (AMWCDO, 1981; Kingdon, 1997). It is generally a highland animal with range extending to the tree line (about 4000 m asl) and favors dense bush habitats in the highland forests (AMWCDO, 1981). Assessing the population ecology of wildlife species (including its habitat preference, feeding and reproductive behavior, and estimating population size) and information on the threats are the center for the management of wildlife species (Fernando et al., 2005). Species based detailed information on these aspects for most Ethiopian mammals is limited (Bekele and Yalden, 2014), and particularly rare for the endemic ones.

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From extremely limited reports, however, Menelik's bushbucks are primarily browsers but grazes occasionally (Dankwa-Wiredu and Euler, 2002). Regardless of lack of detailed information on the range and population estimates, the IUCN status record for the species shows that it is locally fairly abundant with less concerned conservation category (IUCN, 2012). However, complete and reliable estimation of population size, information on habitat preference along its ranges have not been made in Ethiopia because of its furtive behavior (Tefera, 2011). Information available on its ecology and biological details are far from complete and quite patchy as well. This is particularly true for the population in the newly recorded range (the present study area) which is quite away from the protected area networks of the country. In all its ranges, as a result of increasing human population, agricultural expansion and deforestation, the ideal habitats are continually shrunk to pockets of mountain forests and the species often run into frequent conflict with humans (Wronski et al., 2006a). Poaching, disease (e.g. grinderpest) and predators (such as leopard, lions, hyenas, cheetahs, hunting dogs and crocodiles) (Wronski et al., 2006a) are reported as the major threats of the species. However, no information is available for the isolated population of Menelik's bushbuck in the present study area. Monitoring its abundance, feeding behaviors and threats are important to design appropriate management strategies for the specific population. To this end the present study was conducted to generate information for the species from its newly recorded area (Wof-washa forest).

## MATERIALS AND METHODS

### Study area

Wof-Washa is the remnant of intact highland forest in Northern central Ethiopia. It is situated between 9°44'32" and 9°46'26" N latitude and between 39°44'00" and 39°47'19" E longitude (Fig. 1) and covers an area of 8200 ha (Schürmann, 2008). The altitude in the forest ranges from 1,650 to 3,700 m asl. The forest is found on very steep slopes in narrow valleys facing east. The area receives about 1400 mm mean annual rainfall. The bimodal rainfall distribution is characterized by the long wet season (between July and September), and the mid dry season small rain (between March and May). The annual temperature ranges between -8°C and 35°C, with mean minimum of 10 and mean maximum of 20°C.

### Methods

Depending on the dominant vegetation types, the study area was categorized into the natural forest, the Erica woodland and plantation habitats. Based on the extent of vegetation types, a total of 33 transect lines (5 each for the plantation and for Erica woodland and 23 for the natural forest) were established to generate the required population data (Anderson et al., 1978). From these, a total of nine permanent transects (two each from Erica woodland and plantation and five from the natural forest) were randomly selected and surveyed for two seasons. The transect length ranged between 1900 (Erica woodland) and 3200 m (natural forest), and the width was between 50 (natural and plantation habitats) and 80 m (Erica woodland).

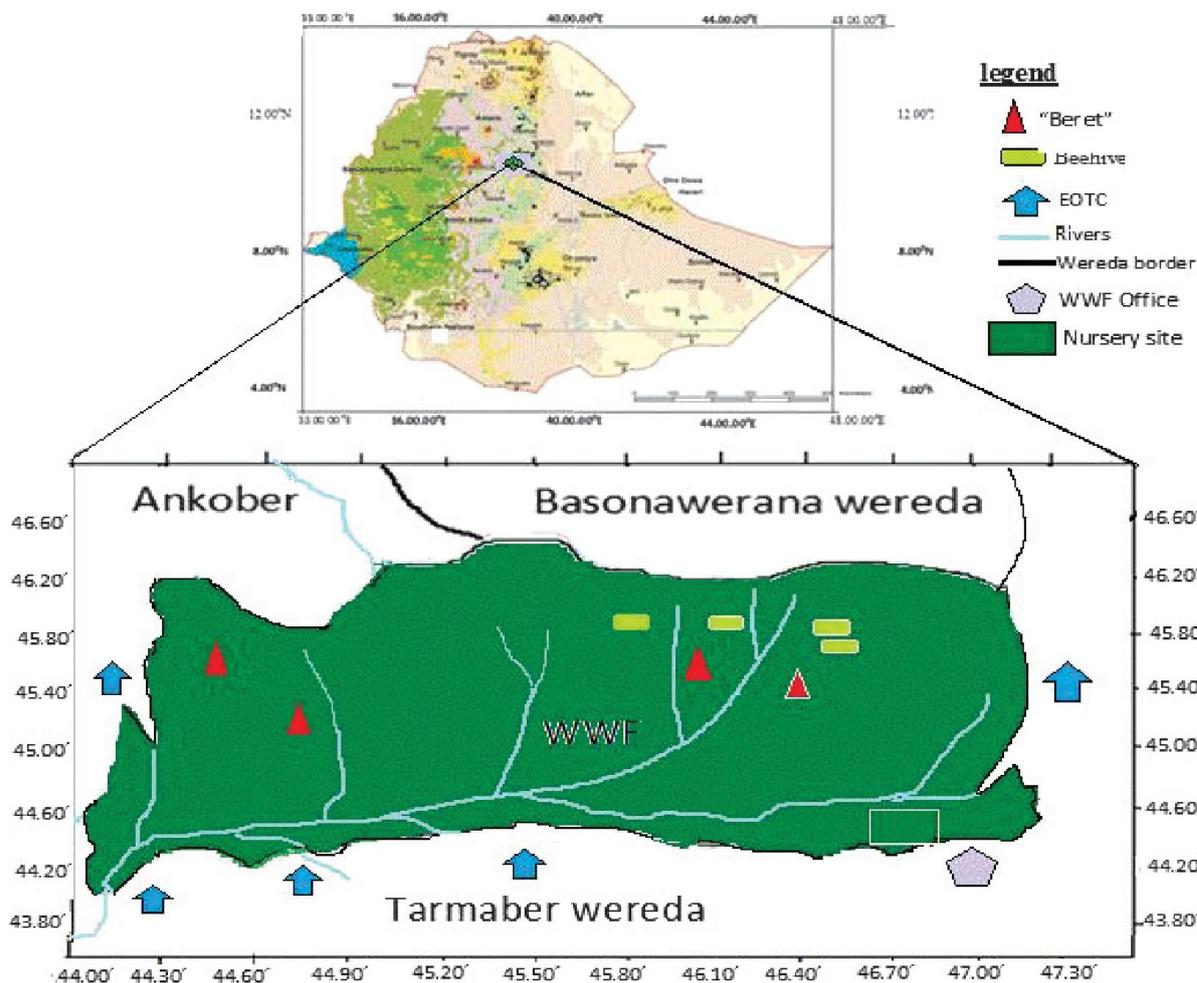


Figure 1. Map of the study area

All habitats were surveyed at the same time and each transect was counted by two individuals. Counting was carried out twice a day between 06:00 and 08:30, in the morning and between 15:00 and 17:30 hrs in late afternoon. Each transect was surveyed twice in a month for three months both during the dry (from January to March) and the wet (from July to September) seasons. During the transect survey, the number, sex and age categories of the observed individuals were recorded. Body size, coat colour and the presence or absence of horns were used to determine sex of individuals. Body size, horn size and shape were used to determine age. Males are horned and dark-brown while females are hornless and light brown in color (Nowak, 1991; Kingdon, 1997). Individuals which were small in size were recorded as young. Habitat preference was determined and compared among habitats based on the number of individual counted from each in both seasons as used by Yazezew *et al.* (2011).

Feeding preference of Menelik's bushbuck was recorded by direct observation from appropriate vantage points using binoculars. When the animal was observed feeding, the plant life form (tree, shrub or herb), the species and parts (leaf, twig, shoot, bark, flower or fruit) were recorded Yazezew *et al.* (2011). Plant identification were made in the field (if vernacular names are known) immediately after the animal/s left the spotted area, or sampled and identified later on. Plant specimen identification was done in the herbarium of Debre Berhan University. Student's t-test was used to compare sex and age differences in the population between seasons and habitats. Habitat preference was determined by comparing the mean numbers of individuals recorded from each transect from all habitats. Comparisons were made at 0.05 levels of significance in all tests.

## RESULTS

The line transect count procedure, from the Wof-Washa highland forest, yielded a total of 64 and 72 Menelik's bushbucks during the dry and wet seasons, respectively. The population was characterized by more adult and more female individuals (Table 1). The number of adult females was relatively higher than the other age groups in both seasons. In both seasons, the sex ratio of adult animals biased towards females, however, the difference was significant only during the wet season ( $t = 8.00$ ,  $df = 1$ ,  $p = 0.001$ ). For both seasons count, the number of young individuals was disproportionately low relative to the number of adult females for both seasons. The number of Menelik's bushbuck counted per transect varied from three to eleven. The highest number was counted in T5 (natural forest), while the least was in T1 (Erica woodland) (Fig. 2). The mean number of individuals counted per transect was relatively higher for natural forest (9 and 8.6 during the wet and dry seasons, respectively) and the least was from Erica woodland (4.5 and 5.5 during wet and dry seasons, respectively).

A total of 1148 feeding activity observations were recorded from scan sampling of Menelik's bushbuck. A total of 22 plant species belonging to 19 families were recorded serving as food for Menelik's bushbuck in Wofwasha highland forest. From these plant species, 39.29% were tree, 32.14% were herb and 28.57% were shrub. The most used plant species was *Maytenus arbutifolia* (13.45% observation), followed by *Cynodon dactylon* (12.36%) while *Mtricalicifolia* was least used (0.93%) (Table 2).

Table 1. Population structure of Menelik's bushbuck during the wet and dry seasons

Age group	Seasons							
	Wet				Dry			
	PF	E-WL	NF	Total	PF	EWL	NF	Total
Adult male	4	3	12	15	4	2	13	19
Adult female	6	4	17	27	6	4	13	23
Sub-adult male	2	2	4	8	1	1	5	7
Sub-adult female	2	2	7	11	0	1	9	10
Young	2	0	5	7	1	1	3	5
<b>Total</b>	<b>16</b>	<b>11</b>	<b>45</b>	<b>72</b>	<b>12</b>	<b>9</b>	<b>43</b>	<b>64</b>

(PF= plantation forest, E-WL=Erica woodland, NF=natural forest)

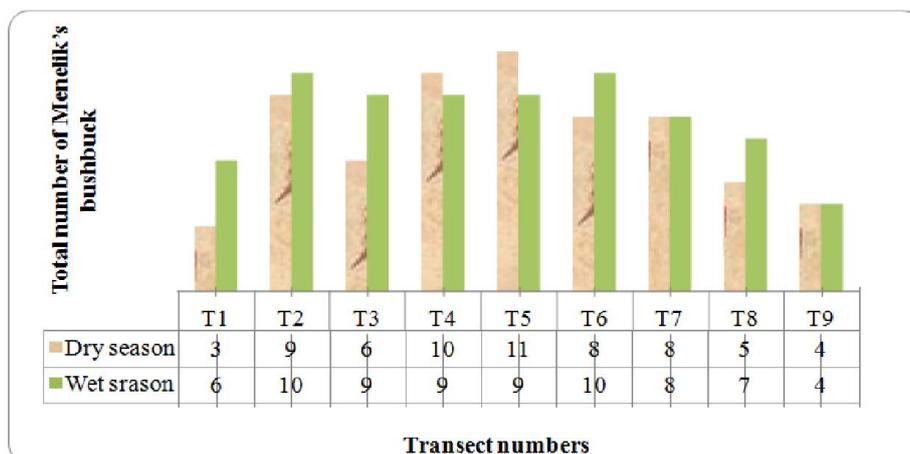


Figure 2. Average number of Menelik's bushbuck per transect both during the dry and wet season

In addition to the wild plant species, 8 species of cereal and garden vegetables, including Gesho (*Rhomusprinooides*), Pepper (*Capsicum annum*), Wheat (*Criticumsatvium*), Barely (*Hordeumvulgare*), Beans (*Viciafaba*), Peas (*Pisumsatvium*), Maize (*Zea mays*) and Cabbage (*Brassica carinata*) were raided by the Menelik's bushbuck, however, as these were occasionally used, were not included in the regular diet list.

Relatively more Menelik's bushbucks were counted during the wet season from natural forest habitat. Similar experience was reported from Denkoro forest (Yazewet *et al.*, 2011). During the dry season, the Wof-Washa forest area experiences sparse vegetation for food and cover and surface water because all are shared by seasonally migrating herders. Pouching also increases during this season.

**Table 2. Plant species, frequency and percentage contribution in the diet of Melilik's Bushbuck, Wofwasha forest, Ethiopia**

Scientific name	Family	Life form	Part consumed	Frequency	%
<i>Carissa spinarum</i>	Apocynaceae	T	Y1,MI,Fr	95	8.04
<i>Ilex mitis</i>	Aquifoliaceae	T	Y1,MI,Sh,St	69	6.01
<i>Maytenusarbutifolia</i>	Celastraceae	S	Y1,MI,Sh,Fr	159	13.45
<i>Juniperusprocera</i>	Cupressaceae	T	Y1	12	1.01
<i>Cyperusfisherianus</i>	Cyperaceae	H	Y1,MI,Sh	95	8.04
<i>Erica arborea</i>	Ericaceae	S	Y1,MI	21	1.78
<i>Medicagopolymorpha</i>	Fabaceae	H	Y1,MI,St,Sh,Fl	57	4.82
<i>Hypericunrevolutum</i>	Hypericaceae	S	Y1,MI,Sh	21	1.78
<i>Metricasalicifolia</i>	Myricaceae	T	Y1,MI,Sh	11	0.93
<i>Myrsine Africana</i>	Myrsinaceae	S	Y1,MI,Sh	117	9.9
<i>Oleaeuropaeacuspadata</i>	Oleaceae	T	Y1,MI	16	1.39
<i>Plantagolanceolata</i>	Plantaginaceae	H	Y1,MI,Sh,St	17	1.44
<i>Hyparrheniahirta</i>	Poaceae	H	Y1,MI,Sh	21	1.78
<i>Cynodondactylon</i>	Poaceae	H	Y1,MI,St,Sh	142	12.36
<i>Eleusineflocifolia</i>	Poaceae	H	Y1,MI,Sh,St	95	8.04
<i>Rumexnervosusvahl.</i>	Polygonaceae	T	Y1,MI,Sh	31	2.62
<i>Rossaabyssinica</i>	Rosaceae	S	Y1,MI,Sh,Fr	27	2.28
<i>Galeriasaxifraga</i>	Rubiaceae	T	Y1,MI	35	2.96
<i>Strigacraterostigma</i>	Scrophulariaae	H	Y1,MI,St,Sh	23	1.94
<i>Dodonaeviscosa</i>	Spaindaceae	S	Y1,MI	39	3.3
<i>Grewiaferruginea</i>	Tiliaceae	T	Y1,MI,Fr,Fl	65	5.5
<i>Hageniaabyssinica</i>	Rosaceae	T	MI	24	2.09
Total				1148	100

(T=Tree, H=Herb, S=Shrub, Y1=Young leaves, MI=Mature leaves, St=Stem, Sh=Shoot, Fl=Flower, Fr=Fruit)

## DISCUSSION

This was the first record for the isolated viable population of Menelik's bushbuck out of its formerly reported ranges. The southeastern highlands of Ethiopia were often reported as the only range of the endemic Menelik's bushbuck (*T. s. meneliki*) (Yalden *et al.*, 1984; Bekele & Yalden, 2014). Recent reports, from central highlands, such as Denkoro forest (Yazewet *et al.*, 2011) and Menagesha forest (Abebayehu & Tilaye, 2012) and the record from the present study area, revealed the incomplete survey of the species from less accessible pocket forests within the central highlands. The extrapolated population size of bushbuck in the present study area (approximately 315 and 360 individuals for the dry and wet seasons, respectively) was the highest record from areas outside the protected area network. This was probably attributed to the inaccessibility of the topography and mountainous terrain of the area. There was no significant population size difference between seasons, however, excluding data for the young, the population sex ratio biased toward female individuals (1:1.65). The deviation in sex ratio may have different reasons including predation pressure on the highly exploring male individuals (Wronski *et al.*, 2006b). However, the Wof-washa island mountain forest reserved both viable and healthy population that has good prospects for increase and dependable gene reserve. The record for young individuals was relatively small during this study; this might be as a result of the highly cryptic adaptive behavior of young individuals common in such antelopes (Irby, 1981; Taylor, 2004), hence, could have been under-reported during the survey. Distribution and habitat association of animals are determined on the basis of availability of resources including water, food, shelter and breeding sites (Balakrishnan and Easa, 1986) that may change on the seasonal basis.

The dominant habitat in the Wof-washa highland forest is the natural forest. Over 55% of the sampled area for the survey was also conducted in this habitat. The average number of individuals recorded per transect was relatively higher for the natural forest, however, significantly less ( $t=4.165$ ,  $df=2$ ,  $P=0.014 < 0.05$ ) in the Ericaceous habitat. This habitat located towards the highest peak of the mountainous area and may be less hospitable for weather, have scarce food and little cover to be frequented by the animals. Similarly, open vegetation was reported not favored by the species (Okiria, 1980; Yalden & Largen, 1992; Chane, 2010). About 22 plant species of all life forms (39.29% tree, 32.14% herb and 28.57% shrub) were recorded serving as a regular diet for Menelik's bushbucks (Table 3). Three plant species, *Maytenusarbutifolia*, *Cynodondactylon* and *Myrsineafricana* accounted for 34.85% of bushbuck's overall diet during this study.

This special adaptation of bushbucks to utilize a wide range of plant species was reported by several authors (e.g. MacLeod *et al.*, 1996; Haschick and Kerley, 1997). They consumed all plant parts, however, young leaves constituted the largest proportion (64%) of their diet while shoots and stems were used least. Yazewet *et al.* (2011) also reported similar observations. Flowers and fruits are available only on seasonal basis. Illegal settlement, encroachment, unauthorized resource utilization are major problems of wildlife protected areas in Africa. The Wof-washa highland forest area is not designated to any of the wildlife area category either by the regional or federal level. Informants reported that, few decades before, there were few permanent settlements adjacent to the forest; however, the Ericaceous habitat was occasionally used as a seasonal grazing ground for cattle from lowlanders.

Currently, human settlement approached the forest edge and all the forest habitats are regularly visited for resource utilization (grass for thatching, fire and construction wood collection) more during the dry season. In earlier time, trophy hunting was common experience but now wildlife is protected by law. The major wildlife threat of the area, therefore, is habitat modification and loss. In addition, direct observation during this study revealed that some of the animals developed garden raiding habits. This behavior of bushbucks was also reported elsewhere (Adem, 2009), increasing the human-wildlife conflict. The structure of the present population biased to adults. This is not good trend for healthy growing population; however, the recorded significantly high number of female individuals counterbalances the problem so far as there are no external disturbances. Conserving the area is the most essential solution. Therefore, delimiting the boundary and designating the forest as a wildlife conservation area (either at the regional or federal level) is recommended to safeguard the unique highland forest island of the region that hosted the endemic Menelik's bushbuck for millennia.

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