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Full Length Research Paper

Indigenous knowledge based identification of medicinal plants in Central Zone of Tigray, North Ethiopia

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There are many traditional medicine practitioners in every corner of the world, which can be grouped into spiritual healers and herbalists. Both groups do not tell to others about medicinal plants sometimes even to their descendants. This may have many different reasons, some say the medicine becomes functional if it is used in secret and some do not tell others fearing for competition of market as well as the medicinal plants because their abundance is mostly limited due to over exploitation. This study was conducted in the central zone of Tigray in specific sites called Tanqua-Abergelle, Kola-Tembien and Weri-Leke with the objective of identifying of medicinal plants based on indigenous knowledge. Purposive sampling was used for respondent selection and semi-structured interviews were employed. Then, the collected data were subjected to descriptive statistical method such as percentage and frequency which was employed to analyze and summarize the data on medicinal plants. From the identified medicinal plants, 92 plant species were used to cure human disease and 29 species for animal diseases and another 8 species were used to treat both human and livestock diseases. Even though medicinal plants are very crucial particularly for the people who dwell in remote and rural areas, some medicinal plants are being endangered due to low awareness on management of these plants. Hence, policy makers and other concerned bodies should give emphasis on conservation of medicinal plants.

Key words: Herbalists, medicinal plants, indigenous knowledge, spiritual healers.

INTRODUCTION

Ethiopia is a country bordered by five countries in East Africa (Djibouti, Eritrea, Kenya, Somalia, and Sudan), and has the second-largest population in sub-Saharan Africa after Nigeria. Most of its population lives in country side and depends on natural resources for their livelihoods, economic development, and food security (Biodiversity, 2008).

The country is endowed with a wide range of climatic and environmental conditions holding vast diversity of flora and fauna (Pankhurst, 2001; Yirga, 2010), including wide range of potentially valuable medicinal plants. The use of medicinal plants is as old as human civilization.

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Medicinal plants and traditional medicine play an important role in the health care system of most developing countries.

Medicinal plants are the base for the development of new drugs and the survival of human kind as well as other livestock. Ethiopia has a glorious traditional health care system based on plants, which dates back to several millennia. Traditional medicinal practices are common in Ethiopia in which about 80% of the population in the country use plant-based traditional medicine as their major primary health care system (Dawit, 2001). The majority of Ethiopians rely on indigenous remedies for numerous socio-cultural and economic reasons (Mesfin et al., 2009). Abebe et al. (2001) also reported that 95% of traditional medical preparations in Ethiopia are of plant origin.

Though, the traditional medicine practitioners are the best sources of information about the knowledge of the medicinal plants, it was found very difficult to obtain their traditional medicinal information as they considered their indigenous knowledge as a professional secret, only to be passed orally to their older son, at their oldest age (Jansen, 1981). Moreover, the local indigenous knowledge on medicinal plants is being lost at a faster rate with the increase of modern education, which has made the younger generation to underestimate its traditional values.

The dominant means of acquiring and transferring traditional knowledge is through non formal education and local communication networks. The vast knowledge on traditional uses of plants is not fully documented and most of the knowledge is conveyed from generation to generation by word of mouth (Fassil, 2001; Yirga, 2010).

According to Moravec et al. (2014), local experiences which have been gained through generation to solve indigenous problems are disappearing due to lack of written documents, death of elders, migration of people due to drought and social problems, urbanization, influence of modern veterinary medicine and exotic cultures.

Moreover, environmental degradation, deforestation, agricultural encroachment, over harvesting and/or indiscriminate harvesting and alarming population growth with increasing demand and consumption are also the principal problems which aggravate the rate of extinction of medicinal plants from their habitat and consequently the loss of important resources of globally significant plant species (Tesfaye, 2006).

Hence, documenting traditional medicinal knowledge is important to facilitate discovery of new sources of drugs and promote sustainable use of natural resources. The main aim of this study was then, to identify and document medicinal plants which are traditionally used to cure human as well as animal diseases and recommend an appropriate conservation measure for threatened medicinal plants and maintain the associated knowledge. Furthermore, the part of the tree, shrub or herb that is used for medicinal purpose was assessed with its expected consequence on their regeneration.

MATERIALS AND METHODS

Area descriptions

The study was conducted in the central zone of Tigray, Northern Ethiopia at selected three Wereda, which were Tanqua-Abergelle, Kola-Tembien and Werie-Lekhe (Figure 1). The area agro-ecological setting was lowland, and receives a bimodal type of rainfall with a short rainy season, that often runs from June to September. The study area receives 350 to 650 mm annual rainfall and temperature with 15 to 35°C (Feleke et al., 2016).

Methods

The data were collected in the whole year 2016 in close contact with the community in the study area. Semi-structured questionnaire was prepared to capture the indigenous knowledge of the local people on medicinal plants by following the scientific approach of Yirga (2010). Accordingly, a total of 75 respondents (67 male and 8 female), individuals in the age range of 24 to 81, were purposively selected being as potential informants from the aforementioned three Wereda. These respondents were selected according to the information obtained from local administrators and elderly people of the districts considering factors such as reputable thorough knowledge of wild plants, time availability and willingness to participate. The informants selected from each sampled Peasant association were the most knowledgeable ones as suggested by respective elders and administrators who participated in the selection process. Samples of all medicinal plant species encountered in the study were collected and recorded in their local names and later converted into the scientific name based on researcher own experience, referring to 'Useful Trees and Shrubs for Eritrea" (Bein *et al*., 1996) and useful trees and shrubs for Ethiopia and Flora of Ethiopia (Bekele et al., 1993; Azene, 2007).

Data analysis

The collected data were analyzed using Microsoft Office Excel spreadsheet 2007. This Excel was used to calculate sum, percentages, frequency, tabulate data and draw graphs. The most useful information gathered on medicinal plants reported from local people such as medicinal value, disease treated, part and management used were analyzed.

RESULT AND DISCUSSION

Demographic characteristics of respondents

During the study, sixty-seven (89.3%) male and eight (10.6%) female informants were part of the study. From the total respondents (75 respondents), 52% were found between the age ranges of 46 to 81, followed by 38.7% of the age ranges of 35 to 45 years, while the remaining, 24 to 34 years involvement was 9.3%, which was the least compared to the other age groups (Table 1). The level of illiteracy was high between the age group of 46 to 81 years (Table 1), which can be attributed to lack of access

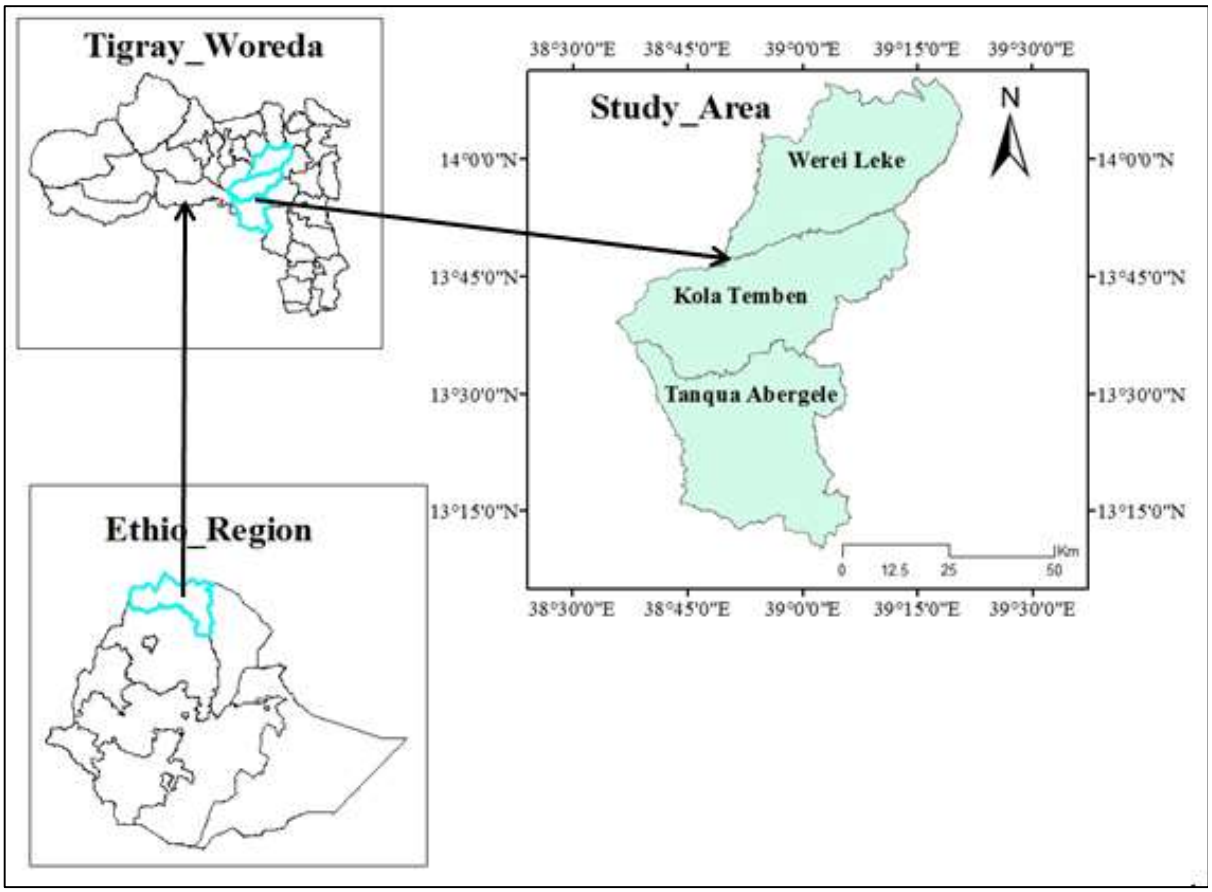

Figure 1. Study area map (Clipped from Ethio-map, 2012).

Table 1. Demographic characteristics of the respondents (N = 75).

Age group	Sex			Educational status		
	M	F	Total	Illiterates	Religious education	Modern education
24-34	6	1	**7**	4	-	3
35-45	26	3	**29**	9	1	19
46-81	35	4	**39**	21	5	13
Total	**67**	**8**	**75**	**34**	**6**	**35**

to education during that time. On the other hand, 65.5% of the age group 35 to 45 years has attained a modern education followed by the 24 to 34 age groups (42.8%). The elder people have higher involvement in religious education than the young age group. The involvement of females in practicing medicinal plants was low compared to males, and hence most of the medicinal plants were mentioned by males. In fact the knowledge of traditional medicinal plants was in the hand of male elders. This was evidenced that informants between the age ranges of 46 to 81 were 52% and of which 89.7% were males (Table 1).

Growth forms and parts of Medicinal plants

Through the interview undertaken at the aforementioned sites, about 129 medicinal plants were identified. This study recorded higher number of medicinal plants than the study of Yirga (2010) or Zerabruk and Yirga (2012). The growth form of the medicinal plants was 41% herbs followed by 33.3% trees, 22% shrubs, and 3.7% both epiphytes and climbers (Figure 2). Nearly half of the identified medicinal plants were herbs and Kandari et al. (2015) also found that herbs are the most dominant medicinal plants in East Hararghe, Eastern Ethiopia.

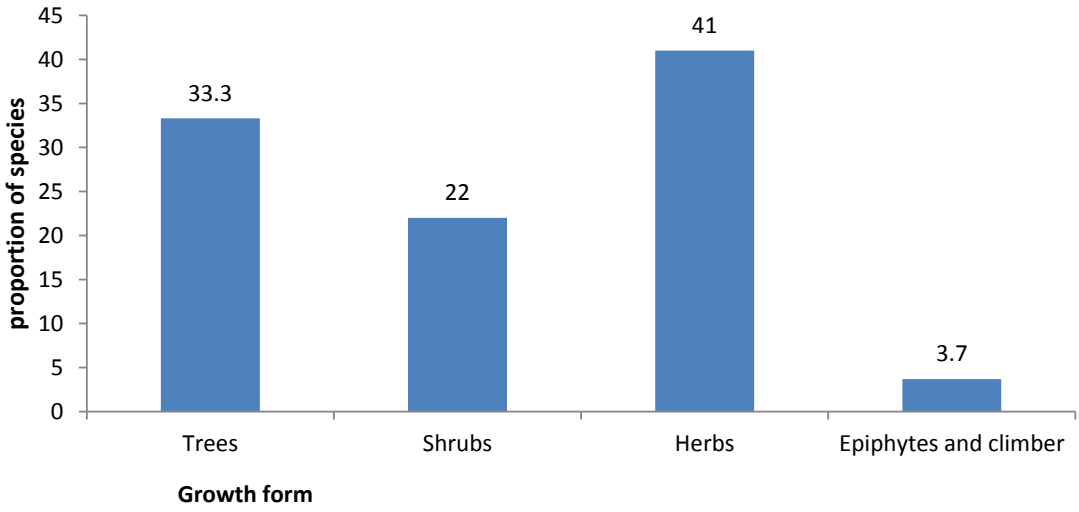

Figure 2. Growth form of the reported medicinal plants used in the area.

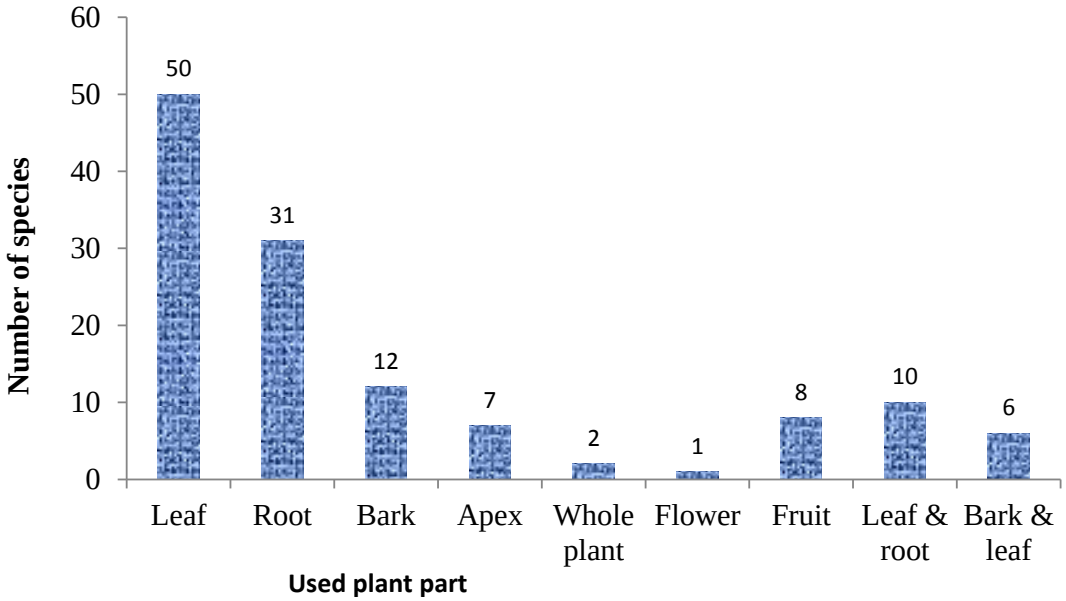

Figure 3. Parts of plants used as medicinal value for both human and livestock purposes.

Currently, their access was limited and found in long distance from their destination. Yirga (2010) and Chekole et al. (2015) indicated that the availability of the medicinal plant in Ethiopia was as wild. From the identified medicinal plants 92 of them were used to cure human disease and 29 species only used for animal disease treatments. There are also 8 plant species used for both animal & human disease treatments. The herbaceous plant forms cannot withstand drought and, in most cases, they are likely being over-utilized (including the whole plants). Contrary to this, other studies undertaken in central eastern Ethiopia (Hunde et al., 2006), in Gimbi district, western Ethiopia (Tolassa, 2007), in Wonago district, southern Ethiopia (Mesfin et al., 2009), and in Mana Angetu district, southeastern Ethiopia (Lulekal et al., 2008) showed that shrubs, followed by herbs and trees are the most frequently used growth forms.

However, this variation could be attributed to the agro-ecological diversity of the study areas that favors different plant forms, and socio-cultural factors which determine specific knowledge in different communities (Reta et al., 2015). For both livestock and human medicinal purposes the leaf, root and bark parts of the plants were mainly used (Figure 3). According to this result, leaf was the

most commonly used plant part accounting for 50 species of the total reported medicinal plants, followed by roots 31 and bark 12 species.

Additionally, there are combined parts used for treatment like 10 species were used for their leaf and root, while bark and leaf for 6 species. Consistent with other studies (Bayafers, 2000; Yineger et al., 2008; Yirga et al., 2011; Chekole et al., 2015), leaves were the most commonly used plant parts for herbal medicine preparations for both livestock and human beings. This mode of traditional medicinal plant practice was important for conservation of medicinal plants because harvesting leaves do not have great pressure to the survival of individual plants as compared to the whole plant collections.

Previous works carried out elsewhere in Ethiopia also revealed that leaves followed by roots were the most common parts (Amenu 2007, Bekalo et al., 2009, Ragunathan and Solomon, 2009). In contrary, other reports showed roots to be the most widely used plant parts (Hunde et al., 2006; Lulekal et al., 2008; Mesfin et al., 2009). Scholars had shown that removal of up to half of tree leaves does not significantly affect plant growth (Yirga, 2011). However, medicinal plant harvest involving roots, rhizomes, bulbs, bark, stems or whole parts have significant consequences both from an ecological point of view and for the survival of the plants (Abebe and Ayehu, 1993; Giday et al., 2003; Hunde et al., 2006).

Medicinal plants and diseases treatments

The local community of the study area had an experience of using medicinal plant on day to day life moment and the most commonly and widely used plants were presented in Table 2 and Table 3.

Human and livestock diseases treated by medicinal plants

The local community was getting vast advantage for their animals and humans health medication from the local available plants. In the present study, a total of 43 human disease and 17 livestock diseases and parasite were identified that can be potentially treated using medicinal plants (Tables 2 and 3). With regard to human diseases, snake bite and abdominal pain were the one which had a high number of medicinal plants used to treat, followed by anthrax, swelling, bone fracture and tonsillitis. However, for most of the human diseases one medicinal plant was used to treat one disease. Hence, if their natural regeneration status is poor there will be a probability of over exploitation of the plants. To some extent, diseases that have many alternative medicinal plants could indicate the frequency of occurrence and importance of the diseases in the area. Despite the large scale environmental degradation and recurrent droughts, there was still rich knowledge on the use of medicinal plants in the districts. As compared to human diseases, diseases of domestic animals in the districts were treated with a relatively fewer number of plant species, which could be due to the less number of diseases affecting the animals. Similar findings were reported by studies conducted in southeast Ethiopia (Wondimu et al., 2007). High number of medicinal plants is used in the treatment of anthrax followed by swelling and this may suggest the high importance or prevalence of the disease in the study districts. The fact that a single plant is most frequently used plant to treat a single or multiple diseases could indicate better efficacy of the plant or its higher abundance in the study area. Most of the plant species reported was also mentioned by authors in studies conducted in Ethiopia (Mesfin et al., 2013; Tekle, 2014, 2015).

Management and use of medicinal plants

In the study, districts marketing medicinal plant was not a common practice in local markets, however in southeast Ethiopia selling of medicinal plants was common (Wondimu et al., 2007). The majority of the medicinal plants was obtained from wild and hence, exposed to various anthropogenic and natural factors.

According to the respondents, 86.7% of them undertake plantation activity; however, only 25% of them were specifically undertaking plantation of medicinal plants around their homestead. Beyond plantation of trees, there is no concerned body that gives training on how to use and conserve the medicinal plants sustainably. Some medicinal plants are rare and endangered this could be explained by the lack of knowledge among ordinary people about the importance of medicinal plants as most of them are only known by few knowledgeable people. Most of the respondents (70.7%) indicate that they have awareness on those problems. If over used, the medicinal plants could have their own impact on health and people understand this fact. The respondents equally (44%) explained that both the traditional and modern medicines are effective in treating ailments (Figure 4). However, 12% of the respondents indicate that both the traditional and modern medicines are effective in treating diseases. This indicates that there are a number of peoples who are dependent on traditional medicinal plants to cure diseases and coincided with other study in Ethiopia (Yirga, 2010; Limenih et al., 2015).

Hence, it is easy to understand that there is a pressure on medicinal plants due to over utilization. From the survey 37.3% of the respondents believe that the abundance of medicinal plants is increasing while 34.7% say the medicinal plants was decreasing due to land degradation, over utilization and less managements. The

Table 2. Medicinal plant species used for human disease in Tigray, their vernacular names in Tigrigna and part of plant utilized.

Treated human diseases	Vernacular name (Tigrigna names)	Scientific name	Plant parts
Scorpio bite	Abetere	*Ziziphus jijube Mill.*	Root
	Hareg Bayta	*Clematis hirsute var. Hirsuta*	Root
	Elam Bikaurya	*Indigofera arrecta Hochst. ex A. Rich.*	Root
Anthrax	Ades	*Myrtus communis L.*	Leaf
	Aftuh	*Plumbago zeylanica L.*	Root
	Engule	*Solanum incanum L.*	Leaf
	Falsha	*Salvadora persica*	Leaf
	Hafaflo	*Zehneria scabra (L.f.)*	Leaf
	Simieza	*Justicia schimperiana*	Leaf
Pneumonia	Aftuh	*Plumbago zeylanica L.*	Root
	Agol	*Withania somnifera (L.) Dunal*	Leaf
	Awhi	*Cordia africana Lam.*	Leaf
	Buna	*Coffea arabica L.*	Fruit
	Teneg	*Medicago polymorpha L.*	Leaf
Dislocated bone	Aftuh	*Plumbago zeylanica L.*	Root
	Gonok	*Dichrostachys cinerea Wight et Arn.*	Epiphytes
	Seraw	*Acacia etbaica Schweinf.*	Epiphytes
Snake bite	Alke	*Cissus petiolata Hook. f.*	Leaf
	Etse Zewye	*Cyphostemma junceum (Webb)*	Root
	Hambhambo bayta	*Cassia arereh Delile*	Root
	Ziwawie	*Erythrina abyssinica Lam.*	Root
	Righe (grass type) + Ziwawie	*Erythrina abyssinica Lam.*	Whole part + Root
Swelling	Amam Gimel	*Heliotropium cinerascens*	Leaf
	Muchele	*Achyranthes aspera*	Leaf
	Tiktiko Ef	-	Leaf
	Tirnakiya	*Verbascum sinaiticum Benth.*	Root
Eye pain	Agol	*Withania somnifera (L.) Dunal*	Leaf
	Hafaflo	*Zehneria scabra (L.f.)*	Leaf
Tonsillitis	Argudi	*Maytenus senegalensis*	Leaf
	Melhas Bieray (Mechelo)	*Achyranthes aspera L.*	Root & Leaf
	Gesho	*Rhamnus prinoides L'Herit.*	Leaf
	Gesho + Geba	*Rhamnus prinoides L'Herit. + Ziziphus spina-christi (L.) Def.*	Leaf Apex & Root
Malaria	Avekado	*Persea americana*	Fruit
	Ere	*Aloe vera*	Leaf
Abdominal pain	Awhi	*Cordia africana Lam.*	Leaf and fruit
	Elam Bikaurya	*Indigofera arrecta Hochst. ex A. Rich.*	Root
	Engule	*Solanum incanum L.*	Root
	Ere	*Aloe vera*	Root
	Hohot	*Rumex nervosus*	Leaf
	Lomin Bayta	*Cucumis pustulatus*	Root

Table 2. Contd.

Amoebae	Awhi	*Cordia africana Lam.*	fruit
Gastritis	Awhi	*Cordia africana Lam.*	fruit
Common cold	Tsaeda Bahrzaf	*Eucalyptus globulus*	Leaf
Skin diseases	Tsaeda Bahrzaf	*Eucalyptus globulus*	Leaf
Evil eye	Chena Barya	*Artemisia abyssinica*	Leaf
Skin wound	Dander	*Argemone mexicana*	Leaf
	Tambuk	*Croton macrostachyus Del.*	Leaf
Tapeworms	Duba	*Cucurbita pepo*	Fruit
	Habo Tselim	*Jasminu gratissimum*	Leaf
Bone fracture	Ere	*Aloe vera*	Root
	Seraw	*Acacia etbaica Schweinf.*	Bark
	Tahsos	*Dodonaea angustifolia*	Leaf
	Lomin Bayta	*Cucumis pustulatus*	Root
	Kasta Anisti	*Asparagus africanus*	Root
	Gonok	*Dichrostachys cinerea Wight et Arn.*	Root
	Girbiya	*Haypoests forskaolii*	Root
Herpes zoster	Ere	*Aloe vera*	Flower
Asthma	Tahsos	*Dodonaea angustifolia*	Leaf
	Gesho	*Rhamnus prinoides L'Herit.*	Leaf
Tinea capitis	Gaba	*Ziziphus spina-christi (L.) Def.*	Leaf
Abdominal pain	Gindae	*Calotropis procera (Ait.)*	Leaf
	Tahsos	*Dodonaea angustifolia*	Epiphytes
Headache	Gonok	*Dichrostachys cinerea Wight et Arn.*	Epiphytes
	Teneg	*Medicago polymorpha L.*	Leaf
Hepatitis	Hohot	*Rumex nervosus*	Leaf Apex
	Weyba	*Terminalia brownii*	Bark, leaf
	Simieza	*Justicia schimperiana*	Leaf
Head ach and depression	Liham	*Syzygium guinensis*	Epiphytes
Bleeding	Lomin	*Citrus limon*	Fruit
	Tirnakiya	*Verbascum sinaiticum Benth.*	Root, Leaf
Pneumonia	Lomin Bayta	*Cucumis pustulatus*	Root
Termite	Nim Kola	*Azadirachta indica A.*	Leaf
Weevils	Nim Kola	*Azadirachta indica A.*	Leaf
Bed Bugs	Nim Kola	*Azadirachta indica A.*	Leaf
toothache	Seti Semhal	*Schoenoplectus corymbosus*	Leaf
Hemorrhoids	Shinfae	*Lepidium sativum*	Bark
Tewsas (Skin disease)	Tambuk	*Croton macrostachyus Del.*	Leaf
Dermatitis	Shetora	*Securidaca longepedunculata*	Leaf
	Teneg	*Medicago polymorpha L.*	Root

Table 2. Contd.

Rabies	Tambuk	*Croton macrostachyus Del.*	Leaf apex
Tiemto	Awhi + ziwawie + mechelo/Tirnaka + Gonok	*Cordia africana+ Erythrina abyssinica Lam.+ Verbascum sinaiticum Benth. + Dichrostachys cinerea*	Leaf
Tinea versicolor	Berbere	-	Leaf
	Se'aa + Ater bahri + Amie	-	Leaf
Paralysis	Komoro + Andel	*Maerua angolensis+ Capparis tomentosa Lam.*	Root, Leaf, Bark
Spheeno megaly	Sur betri + mekan shimti	*Euphorbia candelabrum Kotschy.+Phytolacca dodecandra L 'Herit.*	Root
Himam hirsi (pain during giving a birth)	Kolkual	*Euphorbia abyssinica Gmel.*	Liquid

Table 3. Medicinal plant species used for livestock disease in Tigray, their vernacular names in Tigrigna and part of plant utilized.

Local name	Tigringa name	Scientific name	Plant parts
Anthrax	Ades	*Myrtus communis L.*	Leaf
	Kolkual	*Euphorbia abyssinica Gmel.*	Liquid/mucilage
	Shembewaeta	*Datura stramonium L.*	Root, Leaf
	Shinfae	*Lepidium sativum*	Root
	Hafaflo	*Zehneria scabra (L.f.)*	Root
	Daero	*Ficus vasta*	Bark
	Aftuh	*Plumbago zeylanica L.*	Root
Scabies (skin diseases)	Alendiya	*Ormocarpum pubescens*	Bark
	Tambuk	*Croton macrostachyus Del.*	Leaf
Swelling	Alendiya	*Ormocarpum pubescens*	Leaf
	Kolkual	*Euphorbia candelabrum*	Bark
	Kolkual + Gindae + Kinchib	*Euphorbia candelabrum + Callotropis procera+ Euphorbia tirucalli L.*	Leaf
	Dekuaeta	*Cucumis dipsaceus Ehrenb. ex Spach*	Root
	Alke	*Cissus petiolata Hook. f.*	Leaf
Cataract	Argudi	*Maytenus senegalensis*	Apex part
	Mekan Shibti	*Phytolacca dodecandra*	Root, leaf
Wound	Aserkuka	*Cyphostemma adenocaule*	Root
Bloating	Awhi	*Cordia africana Lam.*	Leaf
	Melhas Bieray	*Achyranthes aspera L.*	Apex part
	Nim Kola	*Azadirachta indica A.*	Leaf
	Gesho	*Rhamnus prinoides L'Herit.*	Leaf
Lice and fleas	Hitsawts	*Calpurnia aurea (Ait.) Benth.*	Leaf
Dislocated bone	Dekuaeta	*Cucumis dipsaceus Ehrenb. ex Spach*	Root
	Tifrarya	*Sida schimperiana Hochst. exA. Rich.*	Root, Bark

Table 3. Contd.

	Kolkual	*Euphorbia abyssinica Gmel.*	Root
	Metselem	*Striga hermonthica*	Leaf
	Elam Bikaurya	*Indigofera arrecta Hochst. ex A. Rich.*	Root
Syneresis cerebral	Simieza	*Justicia schimperiana (Hochst. ex Nees) T. Anders*	Leaf
	Sererit + Bierir + Moder	-	Leaf
Leeches	Nim Kola	*Azadirachta indica A.*	Leaf
	Shembewaeta	*Datura stramonium L.*	Leaf
Affefita (Black leg)	Bierir + Sererit	-	Bark, Leaf
	Tambuk	*Croton macrostachyus Del.*	Apex part
Tapeworms	Tambuk	*Croton macrostachyus Del.*	Bark
Rabies	Tambuk	*Croton macrostachyus Del.*	Fruit
Abortion	Tifrarya	*Sida schimperiana Hochst. exA. Rich.*	Root, Bark
Pasturulosis	Tikur Berbere	*Schinus mole*	Leaf
To reduce aggressiveness of oxen	Tambuk + Metere	*Croton macrostachyus Del. + Buddleia polystachya*	Leaf
Nefregna	Sur betri + kolkual/kinchib	*Euphorbia candelabrum Kotschy and Euphorbia tirucalli L.*	Apex/latex part

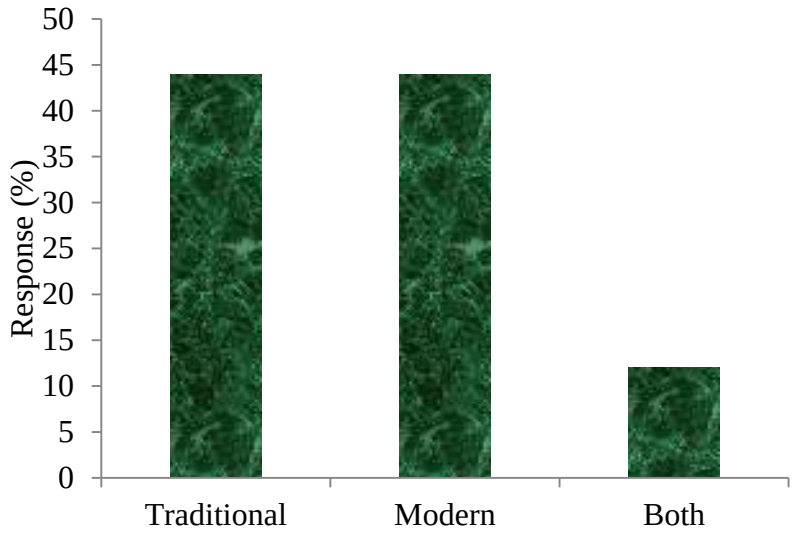

Figure 4. Effectiveness of traditional compared to modern medical treatments from the respondent.

remaining 28% of the respondents stated that the medicinal plants are neither decreasing nor increasing (constant). Local people's perceptions of factors threatening the medicinal plants were pressures from agricultural expansion, over grazing, fuel wood, and seasonal drought have been reported as main factors for environmental degradation as well as the depletion of medicinal plants.

Assefa and Abebe (2014) also stated that expansion of forest area for crop production was found as the dominant factor for the existence and sustainability of wild medicinal plants in southern Ethiopia. As for

conservation status, most of the medicinal plants in the study area have no protection since they are harvested from wild with no evident conservation practices. The few cultivated medicinal plants are being conserved near homes. This urges the need for participation of local people and awareness creation through training or education on sustainable utilization and management of plant resources in general and the medicinal plants in particular.

CONCLUSION AND RECOMMENDATION

Central zone of Tigray owns a high number of medicinal plants treating human and animal diseases and parasites. Herbs took the higher proportion of the reported medicinal plants, which could be an indication of their relatively better abundance as compared to other life forms. Most of the medicinal plants are growing (regenerating) naturally, not supported by plantation. Some respondents were cultivating the medicinal plants in their home, because currently the plants are decreasing their population number and their access becoming limited in some areas. Despite the large scale environmental degradation and recurrent drought, medicinal plants are still playing a significant role in the management of various human and livestock diseases in the study areas. In this case, wise utilization is necessary for sustainability of the plant species. Recurrent drought was reported to have seriously threatened medicinal plant resources in the study area. Despite this fact, there is little effort in the District to cultivate or manage medicinal plants. Thus, awareness is needed to be raised among local people on sustainable utilization and management of the plant resources. *Ex situ* and *in situ* conservation measures should be taken to protect the medicinal plants of the district from further destruction and special attention should be given to the medicinal plants which are the most threatened ones.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Conservation status of bird fauna of South West of Omo National Park, Ethiopia

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A study on the conservation status of bird fauna of South West of Omo National Park (SWONP), South Western Ethiopia was conducted for dry (January - March, 2012) and wet (April - June, 2012) seasons. The study area was stratified based on vegetation (Riverine Forest land (RFL), Grass land (GL), and Bush land (BL)). Using systematic sampling, data was collected on birds in the morning (6:30 - 10:00 am) and evening (4.00 - 6:00 pm) for five days per week. A total of 129 species belonging to 96.12% were resident species and 3.8% were migratory. Among resident species *Psalidoprocne pristoptera, Cecropis abyssinica* and *Hirundo smithii* were the most common species and among migratory *Coracias abyssinicus, Merops supercilosus, Clamator levaillantii, Locustella naevia* and *Tringa glareola* were fairly common species. According to IUCN category, 109 species (83%) were Least Concern, 17 species (13%) have not yet been assessed, 3 species (2%) were vulnerable, 2 species (1%) were endangered and 1 species (1%) was near threatened for their conservation status. Of all recorded avian species based on their feeding assemblage status, 59 species (45.7%) were recorded to be insectivores, 30 species (23.3%) were recorded to be frugivores, 23 species (17.8%) were recorded to be insectivores-frugvores and 17 species (13.2%) were recorded to be omnivores. Vegetation structure complexity and season played great role on the species status, abundance and feeding assemblage status.

Key words: Species status, habitat, vegetation, season.

INTRODUCTION

Ethiopia is gifted with diverse biological resources. The diversity in wildlife is mainly because of the diversity in habitat, climate and different topographic ranges. For this reason, the country is considered among the biodiversity rich nations in the world (Zemede Asfaw, 2001). Even though, the country is rich in biological resources, a few of the wildlife has been threatened to varying degrees (Yalden et al., 1986; Yirmed Demeke et al., 2006). Today, most of the wildlife is mainly restricted to conservation areas such as national parks, wildlife reserves, forest areas and sanctuaries.

There are more than 1850 avian species found in Africa, of these 926 originate in Ethiopia, of which 16 are endemic (Redman et al., 2009). Ethiopia is one of the few countries in the world that possesses a unique and characteristic fauna with a high level of endemism

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(WCMC, 1991). There are 13 species restricted to the geographical region of Ethiopian highlands and thus shared by Ethiopia and Eritrea (Vivero Pol, 2001).

At present threatened bird fauna of Ethiopia are categorized as critically endangered (2 species), endangered (5 species included 4 endemic species), vulnerable (12 species) and near-threatened (14 species with 2 endemic species) (EWNHS, 1996). To keep these various and essential biological resources, Ethiopia has various protected areas. These protected areas represent only a small fraction of the total land mass and represent only a few of the diverse ecosystems of the country. In Ethiopia, protected areas stand for only about 2% of the total area of the country (Hillman, 1993).

Presently, Ethiopia has 22 national parks, 8 wildlife reserves, 3 wildlife sanctuaries and 18 control hunting areas (www.ewca.gov, 2012). All are playing critical conservation roles. In these protected areas, a lot of conservation work has been conducted including avian conservation. Omo National Park is one Ethiopian wildlife protected area which supports many avian species. The avian species of ONP are diversified and yet little research has been conducted concerning birds. According to Ethiopia wildlife and natural historical society (1996), this National Park encompasses more than 312 species of birds.

Omo National Park (ONP), which is the subject of the present study, is one of such places of conservation concern with very little biological information about birds. It is located between South Omo Zone and Bench Maji Zone. In Bench Maji Zone and South Omo Zone, the forest cover has been declining at a very fast rate from Mizan Tefere Zone by the Suri and Dizi ethnic groups and from South Omo Zone by the Mursi, Nyangatom and Idini ethnic groups. This is mainly due to the increase in human and livestock population. This habitat loss is likely to negatively affect the avifauna and other wild animals inhabiting in the area. However, nothing is known about the extent of impact the avifauna of the area. ONP was initially nominated for the conservation of major protection of biodiversity as a National park (Zelealem Tefera, 1994).

This study aimed at providing habitat and season associated bird IUCN status, relative abundance and feeding assemblage status. It was intended to prepare a well-organized bird document to serve researcher, conservationist and bird watcher as baseline information for the area of the SWONP and to provide the final result to Ethiopia wildlife conservation authority to use as database for SWONP avian.

METHODOLOGY

Study area description

The study was conducted in a protected area of ONP in the south west of the park. This National Park is situated in south west of Addis Ababa at 870 km close to Ethio-Sudan and Kenya borders. ONP is found between two administrative zones (South Omo and Bench Maji). It is demarcated by Omo River in the east, by the foothills of the Maji Mountains in the North West and Neruth River in the South. The latitude and longitude is between 5°29'- 6°35'N and 35°33'- 35° 56'E. The total area of this national park is 3566 km^2. Also, this national park area was demarcated in the south by the Nyangatom woreds, in the north by the Surima worda, in the east by the Mursi (Hana) woreda, Mui River in the north and Omo River in the south east (Figure 1).

Omo National Park supports 75 species of mammals, 325 species of birds, 13 species of fish and 11 species of Amphibians were recorded (Hilliman,1993). The most notable mammals are the exceptional herds of Eland and Tiang. The former is the only protected population of the species in the country. The park protects one of the world's largest populations of lesser kudu (park brochure), other wild animals such as common Eland, cheetah, Elephant, Giraffe, Buffalo, lesser kudu, waterbuck, Dik dik, Duiker, lion, Hyena, Orbi, Topi, Lelew hartebeest and Warthog (Hilliam, 1993; Zelalem Tefera, 1994).

The agro-climatic zone of ONP is upper and lower kola zone. The altitude of the area ranges between 450 and 1541 m above sea level (masl) and there are three major physiographic features of the country around ONP: the Great Rift Valley, the lake Turkan basin and the Ethiopian high land massif. The Great Rift Valley, faulting and volcanic activity associated with the park are the principal determinants of the park physical features (Stephenson and Mizuno, 1978). The meteorological information shows that this area receives annual rain fall of 500 to 1000 mm. The rain in the park is erratic and varies from time to time. The main wet season is April up to June. The main dry season is December up to March. The area's mean maximum temperature is 36.68°C with mean minimum temperature of 21.90°C (Zelalem Tefera, 1994). Vegetation of ONP is categorized according to the average rain fall. Sub humid areas received between 700 and 1000 mm per year, semiarid areas received between 400 and 700 mm per year, while arid areas received <400 mm per year. ONP comprises of approximately 20% sub humid, 60% semiarid and 20% arid lands.

The park has different vegetation type, which serve recreational purpose. These include the view point in the peak of mountain in the park. Two known viewpoints near the park head quarter are Mizino and Dirga view points in the east and south west. The scenic beauty of the park on these view point is interesting. In the view point's interesting plains (Tinign, Illilbai, Sai, Birke) with plain game animals, the mountain range, valley and riverine vegetation along Mui River increase the recreational values. In this area, the potential of viewing wildlife, sport hunting, photo safari, river rafting, cultural site and traditional visits are the most commonly conducted tourist activities. Omo National Park has the highest tourist potential, however, the least visited park in the region. In the park, there is tented modern safari operation with full shower and kitchen material to use. This is popular in the country and abroad. To visit this beautiful national park, there are good opportunities in road access by Jima-Maji line in both season.

The ONP lies in one of the most culturally diverse areas in the whole Africa where many elements of nomadic life styles are still protected (Gemedo, 2003). To the west 'surma' or 'suri' who speak Nilo Saharan language reflecting their origin from the Nile basin. They cultivate sorghum and millet in the Maji high lands in west of omo valley and keep large herds of cattle and goats. The Mursi relative characteristics are that 'lip disk' for which they and their relatives use. A young women's lower lip and ears are pierced and stretched by inserting big clay disk up of 12 cm in diameter. The bigger the disk the better a woman's chances of securing a wealth of husband. To the east, the Mursi, a small tribe of some 500

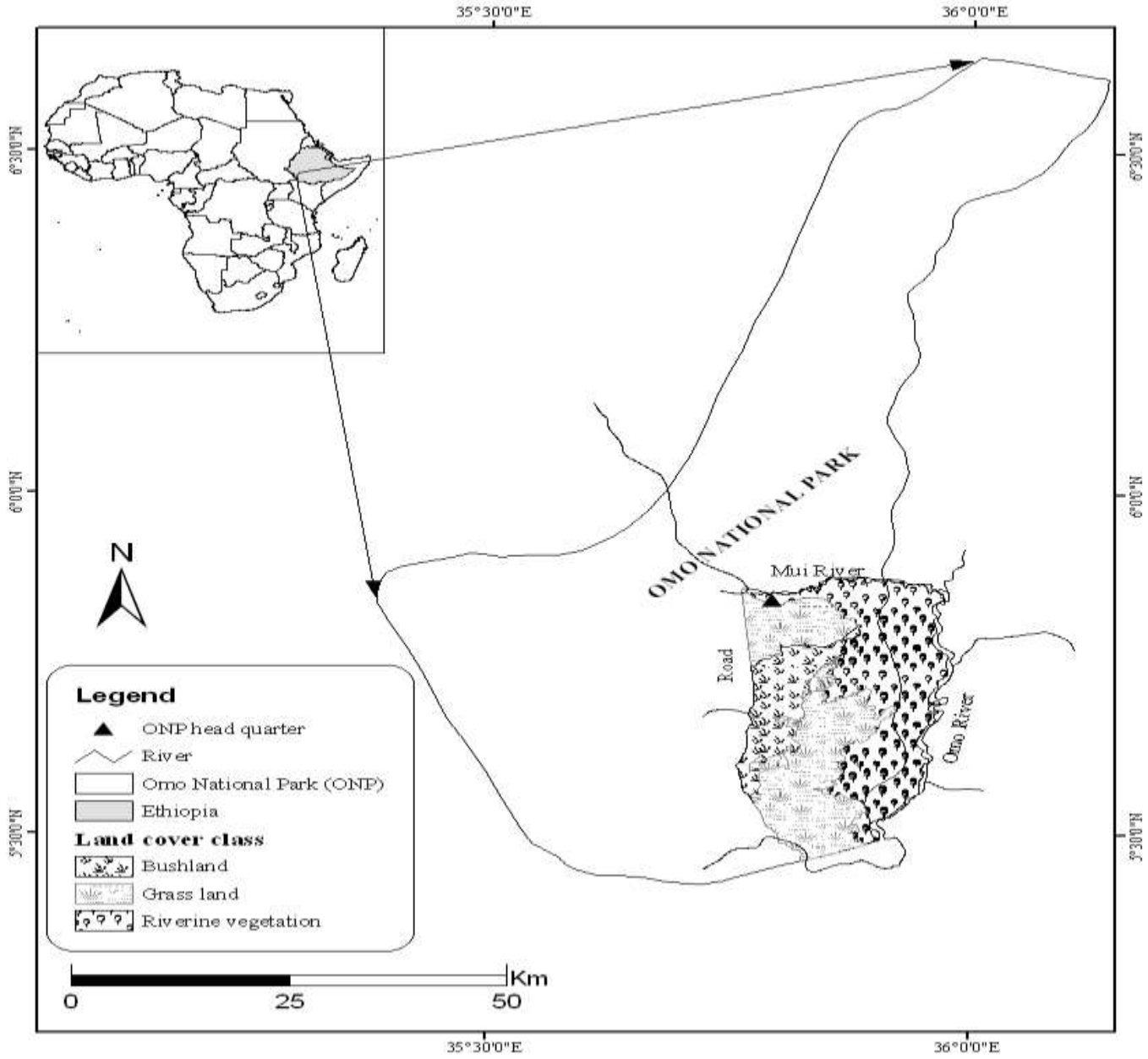

Figure 1. Map of the study area.

people are found. They cultivate maize and sorghum a round river leaves when the water level is low, and also in the fields away from the rivers. They supplement their livelihood with large herds of cattle from which they get meats, blood and milk. Along the Omo River, is a small, somewhat mysterious groups of less than thousand people, the 'Kwegu'. The Kwegu subsists in the river environs where they assist the Mursi to cultivate when the river leaves each year when the flood recedes (Turton, 1987). They mostly fish and hunt. In the south part on the west side of the Omo River are Bume (Nyangatome ethnic group), a primarily nomadic people who rely more on their livestock than the other people of the Omo areas (Stephenson and Mizuno, 1978).

Sampling design

Ecological survey of birds inside ONP in the south west side of the park was carried out during January 2012 to gather relevant information about the study area. Topographical features and vegetation cover of the area were assessed.

Systematic sampling units were selected for all the study area. A number of 38 sampling units representing each habitat type (BL, GL and RFL) were selected based on systematic sampling method. The technique involved dividing the study area into sample units by choosing the location of each habitat with random numbers (Sutherland, 2006). Sample units were selected by systematic to

Table 1. Estimation of a crude ordinal scale of abundance.

Abundance category (Number of individuals per 100 field hours)	Abundance score	Ordinal scale
<0.1	1	Rare
0.1-0.2.0	2	Uncommon
2.1-10.0	3	Frequent
10.1-40.0	4	Common
40.0+	5	Abundant

make sure that the results were generally representatives of the whole study area (Bibby et al., 1992). For counting birds point count method was employed in the RFL and BL, while line transects method were employed in the GL. Systematic random sampling methods were employed for point and line transects methods.

Point count method was undertaken from a fixed location within the sample unit of radius 15 m for 5 min. To minimize disturbance during count, a waiting period of 3 min were applied. Where point count technique was employed, the radial distance from which the avian species occurred was estimated and the type and group number of species were recorded using binoculars. Large numbers of point count locations (more than 15) were identified from each study plot. There were 9 sample unit in RFL and 15 sample unit in BL. In each sample unit (1 × 1 km^2), a total of 20 point count stations were allocated. In each point count station, a minimum distance of 150 to 200 m was employed using GPS to avoid double counting (Sutherland, 2006).

In GL, a total of 14 sample units were selected. In each sample unit, a total of 3 transect lines with a length of 1 km were located. A bird heard and seen were recorded within 50 to 100 m on either side of the transect line making a total width of 200 to 300 m. Transect lines within a sample unit were 250 to 300 m apart from each other to avoid double counting (Bibby et al., 1992, 1998; Hostler and Martin, 2006).

Data analysis

Point count and transect line data were analyzed with respect to (1) Relative abundance, (2) Species diversity, and (3) Using descriptive statistics' (mean and standard deviation) to analyze abundance and percentage expression at different level.

The relative abundance of avian species were determined using encounter rates that give crude ordinal scales of abundance as abundant, common, frequent, uncommon and rare (Bibby et al., 1998). Encounter rate were calculated for each species by dividing the number of birds to hours spent searching, in order to get a figure of avian species per hour for each species. Estimation of a crude ordinal scale of abundance using encounter rates as shown in Table 1

The species IUCN categories was identified based on species IUCN 2010 categories. Excel program was used to draw graphs and tables. Data obtained during the survey was analyzed using SPSS (version 20) statistical package to employ one way analysis of variance (ANOVA) to see the effect of habitat composition on abundance of avian species between in different seasons.

RESULTS

Species status

A total of 129 species of birds were recorded during the study from south west of Omo National Park. Of these, 124 species (96.12%) were residents and 5 species (3.8%) were migratory. Of all migratory species, 2 species (1.5%) included Intra-tropical migrants, 1 species (0.7%) included Intra-African migrant and 2 species (1.5%) were pale arctic migrants (Table 2). The migratory bird detection revealing that there are different bird group which visit SWONP in summer (dry) and winter (wet) season. Of two pale arctic migrants, *Locustella naevia* was recorded in February only (summer visitor) and the other *Tringa glareol* was recorded in April and May (winter visitor). *Coracias abyssinicus* and *Merops superciliosus* were species resident and intra-tropical migrant. *Clamator levaillantii* was uncommon resident and intra African migrants recorded in the park. The only near endemic avian species recorded in the study area was *Agapornis taranta* (Table 2).

Of all species (based on the abundance scale), 88% of the species was recorded as frequent, 6% uncommon, 4% common and 2% abundant (Figure 2 and Table 2).

As per IUCN Red List (2012), 109 species (83%) were least concern, 17 species (13%) have not yet been assessed, 3 species (2%) were vulnerable, 2 species (1%) were endangered and 1 species (1%) was near threatened for their conservation status (Figure 3 and Table 2).

Of 129 avian species based on their feeding guild 59 species (45.7%) were feeding on insect (insectivores), 30 species (23.3%) were feeding on fruit (frugivores), 23 species (17.8%) were feeding on both insect and fruit (insectivores-frugvores) and 17 species (13.2%) omnivores (Table 2 and Figure 4).

Status of birds according to habitats based on crude ordinal scale

During dry season, in BL, 68.4% of the species were recorded to be frequent, 21.05% common, 7.02% abundant and 3.5% uncommon (Tables 3 and 4). In wet season, 73.02% of the species were recorded to be frequent, 22.2% common, 3.17% abundant and 1.6% uncommon (Tables 3 and 7). In GL during dry season, 63.04% of the species were frequent and 36.9% uncommon (Tables 3 and 6). In wet season, 77.7% frequent and 28.8% uncommon (Tables 3 and 9). In RFL

Table 2. Bird species observed in south west of Omo National Park (SWONP).

Ordinal common name	Scientific name	IUCN and Feeding	Status scale
African Harrier- Hawk	*Polyboroides typus*	LC/OM	Uncommon
White-headed Vulture	*Trigonoceps occipitalis*	V/OM	Frequent
Yellow- billed Kite	*Milvuus aegyptius*	LC/OM	Frequent
Hooded Vulture	*Necrosyrtes monachus*	E/OM	Frequent
White-backed Vulture	*Gyps africanus*	E/OM	Frequent
Lappet-faced Vulture	*Torgos tracheliotus*	V/OM	Frequent
Brown Snake-Eagle♥	*Circaetus cinereus*	LC/OM	Frequent
Bateleur	*Terathopius ecaudatus*	NT/OM	Frequent
Dark chanting Goshawk	*Melierax metabates*	LC/IN	Frequent
Tawny Eagle	*Aquila rapax*	LC/OM	Frequent
Long-crested Eagle	*Lophaetus occipitalis*	LC/OM	Frequent
Gabar Goshawk♣	*Micronisus gabar*	LC/IN	Frequent
Woodland Kingfisher	*Halcyon senegalaloides*	LC/OM	Frequent
African pygmy Kingfisher♣	*Ceyx pictus*	LC/OM	Frequent
Half –collared Kingfisher	*Alcedo semitorquata*	NYA/OM	Frequent
Gaint Kingfisher ♣	*Megaceryle maxima*	LC/OM	Frequent
Pied Kingfisher	*Ceryle rudis*	LC/OM	Frequent
Grey-headed kingfisher ♣	*Halcyon leucocephala*	LC/OM	Frequent
Egyptian Goose	*Alopochen aegyptiaca*	LC/IF	Frequent
African Darter	*Anhinga rufa*	LC/IN	Frequent
Cattle Egret	*Bubulcus ibis*	LC/IN	Frequent
Striped Heron	*Butorides striata*	LC/NYA	Frequent
Great Egret♥	*Egretta alba*	LC/IN	Frequent
Grey Heron	*Ardea cinerea*	LC/IN	Frequent
Red-billed Hornbill	*Tockus erythrorhynchus*	LC/FR	Frequent
Jackson's Hornbill	*Tockus jacksoni*	LC/FR	Frequent
African Grey Hornbill♣	*Tockus nasutus*	LC/FR	Frequent
Abyssinia Ground-hornbill	*Bucorvus abyssinicus*	NYA/IF	Frequent
Senegal Thick-knee	*Burhinus senegalensis*	LC/IN	Frequent
Spotted Thick-knee	*Burhinus capensis*	LC/IN	Frequent
Red-fronted Tinkerbird♣	*Pogoniulus pusillus*	LC/FR	Frequent
Black-throated Barbet♣	*Tricholaema melanocephala*	LC/FR	Frequent
Double-toothed Barbet	*Lybius bidentatus*	LC/FR	Frequent
Red –and-yellow Barbet ♣	*Trachyphonus erythrocephalus*	LC/FR	Frequent
Spur-winged Plover	*Vanellus spinosus*	LC/IN	Frequent
Woolly-necked Stork♣	*Ciconia abdimii*	LC/IN	Frequent
Yellow-billed Stork	*Mycteria ibis*	LC/IN	Frequent
Saddle-billed Stork	*Ephippiorhynchus segegalensis*	LC/IN	Frequent
Marabou Stork	*Leptoptilos crumeniferus*	LC/IN	Frequent
Tawny-flanked Prinia ♥	*Prinia subflava*	LC/FR	Frequent
Blue-naped Mouse bird	*Urocolius macrourus*	NYT/FR	Frequent
Speckled Mouse bird	*Colius striatus*	NYT/FR	Common
Bruce's Green Pigeon	*Treron waalia*	LC/IN	Uncommon
Emerald- spotted wood Dove	*Turtur chalcospilos*	LC/FR	Frequent
African Mournig Dove ♥	*Streptopelia decipiens*	NYA/FR	Frequent
Ring- necked Dove	*Streptopelia capicola*	LC/IF	Frequent
Laughing Dove	*Streptopelia senegalensis*	LC/IF	Frequent
Namaqua Dove ♣	*Oenacapensis*	LC/FR	Frequent
Abyssinia Roller☼	*Coracias abyssinicus*	NYA/IF	Frequent

Table 2. Contd.

Rufous-crowned Roller ♣	*Coracias naevius*	LC/FR	Frequent
Levaillant's Cuckoo ϴ	*Clamator levaillantii*	LC/FR	Frequent
White-browed Coucal♥	*Centropus superciliosus*	LC/IF	Frequent
Black Cuckoo	*Cuculus clamosus*	LC/IF	Frequent
Yellow bill	*Ceuthmochares aereus*	NYA/IF	Frequent
Blue-headed Coucal♥	*Centropus monachus*	LC/IN	Frequent
Fork- tailed Drongo	*Dicrurus adsimilis*	LC/IN	Frequent
Red-cheeked cordon-blue	*Uraeginthus bengalus*	NYA/IN	Frequent
Purple Grenadier	*Uraeginthus ianthinogaster*	LC/IN	Frequent
Red-billed Firefinch	*Lagonosticta senegala*	LC/IN	Frequent
Black Saw-wing	*Psalidoprocne pristoptera*	LC/IN	Abundant
Lesser Striped Swallow	*Cecropis abyssinica*	LC/IN	Abundant
Red-rumped Swallow	*Cecropis daurica*	LC/IN	Common
Wire-tailed Swallow	*Hirundo smithii*	LC/IN	Common
Greater Honey guide	*Indicator indicator*	NYA/IN	Frequent
Lesser Honey guide	*Indicator minor*	NYA/IN	Frequent
Grey-backed Fiscal♣	*Lanius excubitorius*	LC/IN	Frequent
Northern White-crowned Shrike	*Eurocephalus rueppelli*	LC/FR	Frequent
Sulphur- breasted Bush-Shrike	*Telophorus sulfureopectus*	LC/IF	Frequent
Black-crowned Tchagra	*Tchagra senegalus*	LC/FR	Frequent
Slate-coloured Boubou	*Laniarius funebris*	LC/IN	Frequent
Brubru♣	*Nilaus afer*	LC/IN	Frequent
Black-headeed Gonolek	*Laniarius erythrogaster*	NYA/FR	Frequent
Northern Carmine Bee-eater	*Merops nubicus*	LC/IN	Frequent
Little Bee-eater	*Merops pusillus*	LC/IN	Frequent
Madagascar Bee-eater ☼ ♥	*Merops superciliosus*	LC/IN	Frequent
African Paradise Flycatcher	*Terpsiphone viridis*	LC/IN	Frequent
African Pied Wagtail	*Motacilla aguimp*	LC/FR	Frequent
Grass land Pipit♣	*Cinnamomeus*	NYA/IN	Frequent
Northern Black Flycatcher	*Melaenornis edolioides*	LC/IN	Frequent
African Grey Flycatcher	*Bradornis microrhynchus*	LC/IN	Frequent
African Dusky Flycatcher	*Muscicapa adusta*	LC/IN	Frequent
White-bellied Go-away-bird	*Corythaixoides leucogaster*	LC/FR	Frequent
Eastern Grey Plantain-eater	*Crinifer zonurus*	LC/FR	Frequent
Eastern Violet-backed Sunbird♣	*Anthreptes orientalis*	LC/IN	Frequent
Hunter's Sunbird ♥	*Chalcomitra hunter*	LC/IN	Frequent
Beautiful Sunbird	*Cinnyris pulchellus*	LC/IN	Frequent
Shining Sunbird	*Cinnyris habessinicus*	LC/IN	Frequent
Variable Sunbird	*Cinnyris venustus*	LC/IN	Frequent
Helmeted Guineafowl	*Numida meleagris*	LC/IF	Frequent
White- bellied Bustard ♣	*Eupodotis senegalensis*	LC/IN	Uncommon
Kori Bustard	*Ardeotis kori*	LC/IN	Uncommon
Black-headed Oriole	*Oriolus larvatus*	LC/FR	Frequent
Swainson's Sparrow	*Passer swainsonii*	LC/IF	Frequent
Yellow-spotted Petronia	*Petronia pyrgita*	LC/FR	Frequent
White- bellied Bustard ♣	*Eupodotis senegalensis*	LC/IN	Uncommon
Kori Bustard	*Ardeotis kori*	LC/IN	Uncommon
Black-headed Oriole	*Oriolus larvatus*	LC/FR	Frequent
Swainson's Sparrow	*Passer swainsonii*	LC/IF	Frequent
Yellow-spotted Petronia	*Petronia pyrgita*	LC/FR	Frequent

Table 2. Contd.

Long-tailed Cormorant	*Phalacrocoraax africanus*	LC/IN	Frequent
Crested Francolin	*Dendroperdix sephaena*	LC/IF	Frequent
Yellow-necked Spurfowl ♥	*Pternistis leucoscepus*	LC/IN	Frequent
Violet Wood-hoopoe ♥	*Phoeniculus damarensis*	LC/FR	Frequent
Cardinal Woodpecker	*Dendropicos fuscescens*	LC/IN	Frequent
Nubian Woodpecker ♥	*Campethera nubica*	LC/IN	Frequent
Breaded Woodpecker	*Dendropicos namaquus*	LC/IN	Frequent
White-headed Buffalo-Weaver	*Dinemellia dinemelli*	LC/IF	Frequent
White-browed Sparrow- Weaver	*Plocepasser mahali*	LC/FR	Frequent
Little Weaver ♣	*Ploceus luteolus*	LC/IF	Frequent
Red-headed Weaver	*Anaplectes rubriceps*	LC/IF	Frequent
Village Weaver♣	*Plooceus cucullatus*	LC/IF	Frequent
Little Grebe	*Tachybaptus ruficollis*	LC/IN	Uncommon
White-crested Helmet shrike	*Prionops plumatus*	NYA/IF	Frequent
Meyer's Parrot	*Poicephalus meyeri*	LC/FR	Frequent
Black-winged Lovebird♣¤	*Agapornis taranta*	LC/FR	Frequent
Common Bulbul	*Pycnonotus barbatus*	LC/IN	Common
Black-winged Stilt	*Himantopus himantopus*	LC/IN	Frequent
Secretary bird	*Sagittarius serpentarius*	V/IF	Uncommon
Wood Sandpiper♣◊	*Tringa glareola*	LC/IN	Uncommon
Hamerkop♣	*Scopus umbretta*	LC/IN	Frequent
Verreaux's Eagle-Owl	*Bubo lacteus*	LC/IN	Frequent
Pearl-spotted Owlet♥	*Glaucidium albertinum*	LC/IN	Frequent
Common Ostrich	*Struthio comelus*	LC/IF	Frequent
Rupp ell's Starling	*Lamprotornis purpuriptera*	NYA/FR	Frequent
Superb Starling	*Lamprotornis superbus*	LC/FR	Frequent
Shelley's Starling♣	*Lamprotornis shelleyi*	LC/FR	Frequent
Red-billed Oxpecker	*Buphagus erythrorhynchus*	LC/IN	Common
Yellow- billed Oxpecker ♣	*Buphagus africanus*	LC/IN	Frequent
Common Grasshopper Warbler◊♥	*Locustella naevia*	LC/IN	Uncommon
Hadada Ibis	*Bostrychia hagedash*	LC/IN	Frequent
Sacred Ibis♣	*Threskiornis aethiopicus*	LC/IN	Frequent
Dusky Babbler♥	*Turdoides tenebrosa*	LC/IN	Frequent
African Trush	*Turdus pelios*	NYA/IF	Frequent

♥ **=**Dry season only recorded species, ♣ **=**Wet season only recorded species, ☼ **=**Resident and perhaps intra -Tropical migrants, Θ =Resident and intra-African migrant, ◊ =Pale arctic migrant**,** ■=Endemic and unmarked species are resident avian, and (LC = Least concern, E= Endangered, NT = near threatened, V= Vulnerable and NYA **=** Not yet assessed) and (IN= Insectivores, FR= Frugivores, IF= Insectivores-Frugivores and OM= Omnivores).

during dry season 52.9% of the species were frequent, 44.12% common and 2.9% abundant (Tables 3 and 5). In wet season, 56.4% of the species were uncommon, 41.02% frequent and 2.56% abundant (Tables 3 and 8).

DISCUSSION

South West of Omo National Park supported resident, migratory and globally threatened bird species. The park was identified as an important refuge for resident bird species (124 species). This may be due to the effect of biotic and a biotic factor such as continuous habitat resource availability, vegetation structure complexity of the study area and adaptive nature of species to physical feature of ONP (Jarvinen, 1983). Black winged love bird *Agapornis taranta* is endemic to Ethiopia and Eretria. Viveropol (2001) species which are endemic to just country add a particular interest to its fauna.

The IUCN red list (IUCN, 2010) indicated that the study area supported endangered (1 species), vulnerable (3 species), near threatened (1 species), and not yet

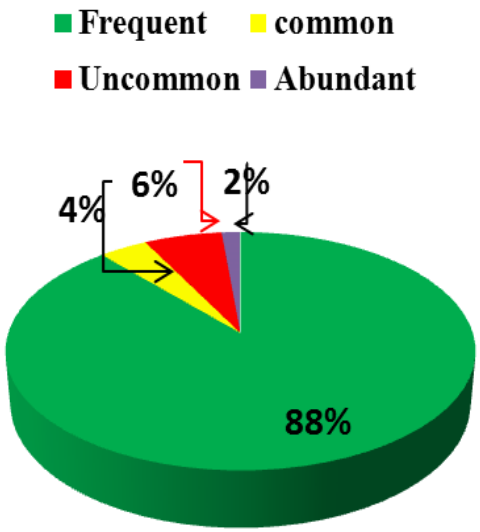

Figure 2. The percentage of bird species curd ordinal scale.

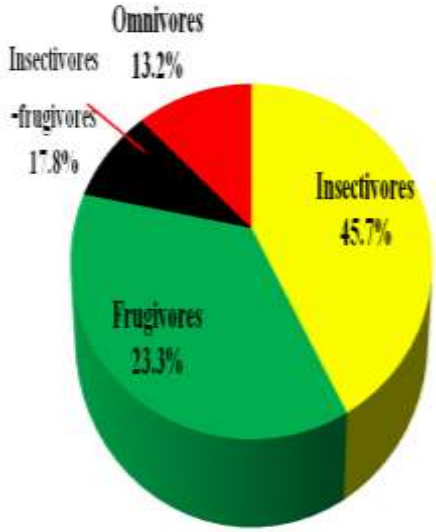

Figure 4. Feeding guild status of Birds in SWONP.

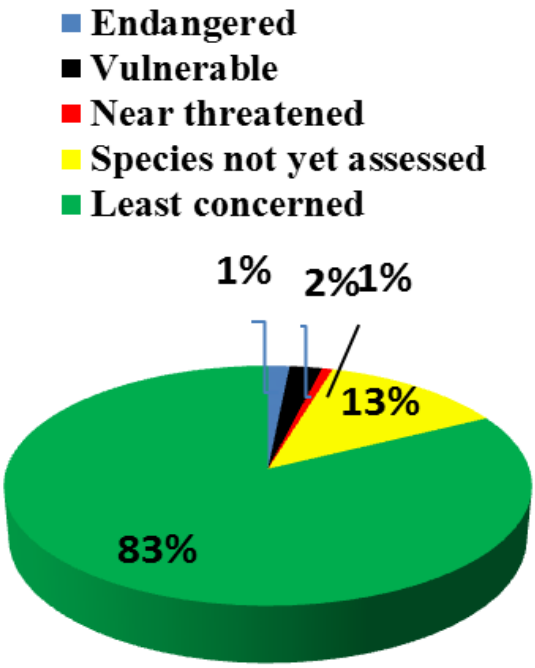

Figure 3. IUCN Status of Birds in SWO NP.

assessed (17 species) species of birds. The abundance of these globally threatened species in the park found to be common. This is promising issue for threatened species conservation on global scale. Today, the IUCN Red List of threatened species remains the authoritative source on baseline information to know conservation status of globally threatened species and to manage them (Rodrigues et al., 2006).

As the crude ordinal scale indication, most species were frequent throughout the habitats. This may be due to the habitat quality of study area. The crude ordinal categories of abundance derived from encounter rate data were very important in annotating the species list (Robertson and Lily, 1998). So, a total of 88% of species were found to be frequent, 8% species were uncommon, 2% of species were abundant and 2% of species common.

Conclusion

The present study revealed that SWONP supported a variety of avifauna due to availability of mosaic of habitats. Both resident and migratory species of birds were recorded from the park, however, the residents had dominated. The globally threatened species took shelter in the park in high abundance. The variation in the species and numbers among habitat and between seasons is observed. The habitat heterogeneity and seasonal variability in forage availability affected the distribution and abundance of birds in the park.

Therefore the department of ONP staff, EWCA and the regional and federal bureau of culture and tourism should take over the responsibility of managing this resource properly supported by scientific information. Findings of this study identified important sites holding bird diversity, conservation priority species and which hold value for planning management plan for wildlife in general and birds in particular. Researchers' finding

Table 3. The relative abundance of bird species during dry and wet season using Encounter rates (Tables 4, 5, 6 , 7, 8 and 9).

Habitat	Season	Rank				
		Rare	Uncommon	Frequent	Common	Abundant
BL	Dry	0	2	39	12	4
	Wet	0	1	46	14	2
	Both	0	8	60	12	5
GL	Dry	0	17	29	12	1
	Wet	0	13	32	12	1
	Both	0	15	31	12	1
RFL	Dry	0	0	18	15	1
	Wet	0	22	16	0	1
	Both	0	15	16	8	2

BL: Bush land; GL: grass land; RFL: riverine forest land.

Table 4. Relative abundance of avian in the bush land habitat during the dry season.

Species	No. of individuals in 10 field hours	Abundance score	Rank
Rupp ell's long tailed starling	9.81	3	Frequent
Helmeted Guineafowl	10.58	4	Common
Red-billed Horn bill	9.81	3	Frequent
Black headed Gonolek	3.74	3	Frequent
White-bellied Go-away-bird	11.52	4	Common
Hooded vulture	5.29	3	Frequent
Lappet-faced vulture	4.67	3	Frequent
Northern Black flycatcher	7.78	3	Frequent
Red billed ox pecker	21.79	4	Common
African mourning Dove	38.92	4	Common
African Grey Flycatcher	118.32	5	Abundant
Long crested Eagle	20.24	4	Common
Hamerkop	12.45	4	Common
Hunter's sun bird	38.92	4	Common
Grey Heron	43.59	5	Abundant
Red billed fire finch	12.61	4	Common
Purple Grenadier	5.45	3	Frequent
Pied King Fisher	7.32	3	Frequent
Common Bulbul	21.17	4	Common
African Darter	1.56	2	Uncommon
Speckled mouse bird	17.75	4	Common
White-browed Sparrow Weaver	10.43	4	Common
White headed buffalo Weaver	5.6	3	Frequent
Pearl spotted owlet	3.11	3	Frequent
African Fish Eagle	5.29	3	Frequent
Black saw-wing	65.23	5	Abundant
Shining sun bird	5.6	3	Frequent
Yellow-necked spur fowl	6.07	3	Frequent
Bateleur	3.58	3	Frequent
Swainson's Sparrow	5.76	3	Frequent

Table 4. Contd.

Cardinal Wood pecker	2.96	3	Frequent
Dusky Babbler	7.47	3	Frequent
African paradise fly catcher	8.25	3	Frequent
Abyssinian Roller	8.41	3	Frequent
Red-rumped Swallow	35.65	4	Common
Black-crowned tchagra	6.38	3	Frequent
Lesser striped swallow	101.05	5	Abundant
Dark chanting Goshawk	5.14	3	Frequent
Beautiful sun bird	4.98	3	Frequent
Tawny-Eagle	5.14	3	Frequent
White-backed vulture	5.76	3	Frequent
Brown-snake Eagle	4.67	3	Frequent
Blue headed coucal	26.47	3	Frequent
Meyer's (brown) parrot	4.67	3	Frequent
Red-capped cordon-blue	7.32	3	Frequent
Yellow Spotted Petronia	9.65	3	Frequent
Burbur	3.58	3	Frequent
Blue-naped Mouse bird	9.49	3	Frequent
Nubian Woodpecker	0.93	2	Uncommon
Wood land king fisher	4.05	3	Frequent
Violet wood-hoopoe	5.6	3	Frequent
Tawny-flanked Prinia	4.2	3	Frequent
Sulphur-breasted Bush-Shrike	4.82	3	Frequent
Fork tailed Drogon	7.78	3	Frequent
Ring-necked Dove	8.87	3	Frequent
Emerald-spotted wood dove	5.45	3	Frequent
Verreaux's Eagle-Owl	6.92	3	Frequent

Table 5. Relative abundance of avian in the Riverine forest land habitat during the dry season.

Species	No. of individuals in 10 field hours	Abundance score	Rank
Grey Heron	9.58	3	Frequent
Woodland Kingisher	9.84	3	Frequent
White bellied Go- away-bird	5.45	3	Frequent
Saddle billed Stork	10.11	4	Common
Reed (Long-tailed) cormorant	11.71	4	Common
African Darter	12.24	4	Common
Hamerkop	7.45	3	Frequent
Greater Egret	10.65	4	Common
Striped Heron	10.91	4	Common
Yellow-billed Stork	13.84	4	Common
African fish Eagle	7.72	3	Frequent
Dark chanting Goshawk	8.25	3	Frequent
Tawny Eagle	11.18	4	Common
Black winged Stilt	11.97	4	Common
Senegal Thick-Knee	10.91	4	Common
Gaint Kingfisher	13.84	4	Common
African Mourning Dove	14.9	4	Common
Black-winged Love Bird	4.52	3	Frequent

Table 5. Contd.

Eastern Grey plantain-eater	4.26	3	Frequent
Levaillant's Cuckoo	9.58	3	Frequent
Black Cuckoo	4.52	3	Frequent
Yellow bill Coucal	7.72	3	Frequent
Speckled mouse bird	8.78	3	Frequent
Pied king fisher	5.32	3	Frequent
African Pygmy king fisher	8.78	3	Frequent
Cardinal Wood pecker	5.32	3	Frequent
Black saw-wing	63.61	5	Abundant
African pied wagtail	12.51	4	Common
African Trush	9.31	3	Frequent
African paradise fly catcher	15.17	4	Common
Black-headed Oriole	11.44	4	Common
Lesser Honey guide	2.39	3	Frequent
Common Bulbul	21.03	4	Common
Violet Wood-hoopoe	6.92	3	Frequent

Table 6. Relative abundance of avian in the grass land habitat during the dry season.

Species	No. of individuals in 10 field hours	abundance score	Rank
Yellow billed kite	2.55	3	Frequent
Secretary birds	1.44	2	Uncommon
White-bellied Bustard	1.99	2	Uncommon
Lesser honey guide	2.77	3	Frequent
Ring-necked dove	4.21	3	Frequent
Common ostrich	2.43	3	Frequent
Dark chanting Goshawk	2.21	3	Frequent
Spotted Thick knee	2.65	3	Frequent
African Harrier Hawk	2.21	2	Uncommon
Spur-winged plover	3.54	3	Frequent
White-backed vulture	3.54	3	Frequent
Lappet-faced vulture	1.21	2	Uncommon
Hooded vulture	1.54	2	Uncommon
Northern carmine bee-eater	6.09	3	Frequent
African pied wagtail	3.65	3	Frequent
Woolly necked stork	1.99	2	Uncommon
Cattle Egret	3.87	3	Frequent
Marabou Stork	2.76	3	Frequent
Hadada Ibis	1.43	2	Uncommon
Greater Egret	3.87	3	Frequent
Jackson's Horn bill	3.09	3	Frequent
Brown-Snake Eagle	1.88	2	Uncommon
Tawny Eagle	1.66	2	Uncommon
Bateleur	5.09	3	Frequent
Kori Bustard	2.1	3	Frequent
Brue's Green Pigeon	0.55	2	Uncommon
Pearl-spotted Owlet	1.1	2	Uncommon
Verreaux's Eagle-Owl	1.54	2	Uncommon
Blue-naped Mouse bird	2.61	3	Frequent

Table 6. Contd.

Slate-coloured Boubou	2.54	3	Frequent
Madagascar Bee-eater	1.66	2	Uncommon
Rufous-crowned Roller	3.54	3	Frequent
African Grey Horn bill	2.54	3	Frequent
Double toothed Barbet	2.98	3	Frequent
Nubian wood pecker	1.22	2	Uncommon
Tawny-flanked Prinia	2.67	3	Frequent
Variable sunbird	3.43	3	Frequent
Yellow billed Oxpecker	2.86	3	Frequent
Superb Starling	3.32	3	Frequent
Red headed Weaver	3.76	3	Frequent
White headed buffalo Weaver	4.09	3	Frequent
Little Grebe	1.54	2	Uncommon
Black winged Stilt	2.1	2	Uncommon
Wood sand Piper	0.77	2	Uncommon
Grey Heron	4.53	3	Frequent
Grasshopper Warbler	1.43	2	Uncommon

Table 7. Relative abundance of avian in the Bush land habitat during the wet season.

Species	No. of individuals in 10 field hours	Abundance score	Rank
Namaqua Dove	4.69	3	Frequent
Black-winged Love bird	1.41	2	uncommon
Grey Headed Kingfisher	4.85	3	Frequent
African Pygmy Kingfisher	2.97	3	Frequent
Rufous-crowned Roller	6.73	3	Frequent
Village Weaver	6.42	3	Frequent
Little Weaver	19.09	4	common
White- headed Buffalo Weaver	3.91	3	Frequent
Red- fronted Tinker bird	2.5	3	Frequent
Black- throated Barbet	3.44	3	Frequent
Double toothed Barbet	3.13	3	Frequent
Eastern violet-backed Sunbird	2.82	3	Frequent
Yellow and Red-Barbet	3.28	3	Frequent
Black-headed Gonolek	6.42	3	Frequent
Brubru	8.29	3	Frequent
Shelley' starling	6.57	3	Frequent
Grey-backed Fiscal	3.91	3	Frequent
Northern Black flycatcher	9.7	3	Frequent
African Dusky Flycatcher	14.39	4	common
Crested francolin	13.3	4	common
White-crested Helmet shrike	3.59	3	Frequent
Red billed fire finch	12.83	4	common
Common Bulbul	23.63	4	common
Speckled mouse bird	19.87	4	common
Swainson's Sparrow	7.67	3	Frequent
Cardinal Wood pecker	5.79	3	Frequent
Abyssinian Roller	11.42	4	common
Lesser striped swallow	88.11	5	Abundant

Table 7. Contd.

Tawny-Eagle	7.19	3	Frequent
Meyer's (brown) parrot	6.1	3	Frequent
Blue-naped Mouse bird	13.46	4	common
Fork tailed Drogon	8.14	3	Frequent
Ring-necked Dove	9.86	3	Frequent
Rupp ell's long tailed starling	12.52	4	common
Red-billed Horn bill	11.74	4	common
Hooded Vulture	7.82	3	Frequent
Red billed ox pecker	4.07	3	Frequent
Long crested eagle	2.66	3	Frequent
Grey Heron	7.04	3	Frequent
Half-collared Kingfisher	8.29	3	Frequent
African Fish Eagle	6.1	3	Frequent
Shining sun bird	5.01	3	Frequent
Bateleur	3.44	3	Frequent
African paradise fly catcher	7.35	3	Frequent
Wire- tailed Swallow	62.28	5	Abundant
Dark chanting Goshawk	4.44	3	Frequent
Beautiful sun bird	8.14	3	Frequent
White -headed vulture	6.88	3	Frequent
Red-capped cordon-blue	10.64	4	common
Yellow Spotted Petronia	13.46	4	common
Northern-White crowned Shrike	6.57	3	Frequent
Emerald-spotted wood Dove	12.21	4	common
Helmeted Guinea fowl	13.3	4	common
Lappet-faced vulture	5.95	3	Frequent
Greater Honey Guide	.7.82	3	Frequent
African Darter	3.75	3	Frequent
Black-crowned tchagra	8.14	3	Frequent
Little bee-eater	7.04	3	Frequent
Wood land kingfisher	6.1	3	Frequent
Breaded Woodpecker	3.13	3	Frequent
White-browed Coucal	4.54	3	Frequent
Lesser honey guide	5.32	3	Frequent
White-headed vulture	2.35	3	Frequent

Table 8. Relative abundance of avian in the Riverine forest land habitat during wet season.

Species	No. of individuals in 10 field hours	Abundance score	Rank
White-bellied Bustard	3.28	3	Frequent
Yellow-billed Stork	14.76	4	Common
African Mourning Dove	13.35	4	Common
Black winged Stilt	14.52	4	Common
Senegal Thick-Knee	13.35	4	Common
Eastern Grey plantain-eater	5.6	3	Frequent
Yellow bill Coucal	9.84	3	Frequent
African pied wagtail	11.48	4	Common
Black-headed Oriole	11.71	4	Frequent
Common Bulbul	19.44	4	Common

Table 8. Contd.

Violet Wood-hoopoe	9.14	3	Frequent
Cardinal Wood pecker	5.85	3	Frequent
Black saw-wing	53.42	5	Abundant
Levaillant's Cuckoo	8.67	3	Frequent
Black Cuckoo	5.38	3	Frequent
Pied king fisher	5.15	3	Frequent
Black-winged Love Bird	4.45	3	Frequent
Ring-necked Dove	11.95	4	Common
Tawny Eagle	8.43	3	Frequent
Dark chanting Goshawk	6.56	3	Frequent
African fish Eagle	6.79	3	Frequent
Hamerkop	7.02	3	Frequent
Reed (Long-tailed) cormorant	10.31	4	Common
Greater Egret	12.42	4	Common
African Darter	8.67	3	Frequent
White bellied-Go-away bird	11.01	4	Common
Helmeted Guinea fowl	13.58	4	Common
Grey Heron	11.12	4	Common
Woodland Kingfisher	7.49	3	Frequent
Striped Heron	10.78	4	Common
Speckled mouse bird	8.67	3	Frequent
African Pygmy king fisher	9.13	3	Frequent
African Trush	8.9	3	Frequent
Lesser Honey guide	5.39	3	Frequent
African paradise fly catcher	17.57	4	Common
White-backed Vulture	10.54	4	Common
Hooded Vulture	5.15	3	Frequent
Lappet-faced Vulture	4.68	3	Frequent
Marabou Stork	2.34	3	Frequent

Table 9. Relative abundance of avian in the grass land habitat during wet season.

Species	No. of individuals in 10 field hours	Abundance score	Rank
Northern Carmine-bee eater	3.54	3	Frequent
Wood sand Piper	1.62	2	Uncommon
Kori Bustard	1.24	2	Uncommon
Egyptian Goose	3.16	3	Frequent
Little Grebe	1.82	2	Uncommon
Spur winged Plover	4.31	3	Frequent
Sacred Ibis	2.39	3	Frequent
Black winged Stilt	1.91	2	Uncommon
White-bellied Bustard	0.95	2	Uncommon
Lesser honey guide	2.87	3	Frequent
Common ostrich	3.26	3	Frequent
White-backed vulture	3.64	3	Frequent
Lappet-faced vulture	1.19	2	Uncommon
Hooded vulture	1.53	2	Uncommon
Black-crowned Tchagra	2.68	3	Frequent
Jackson's Horn bill	3.64	3	Frequent

Table 9. Contd.

African Grey Horn bill	2.68	3	Frequent
Red headed Weaver	4.31	3	Frequent
White headed buffalo Weaver	3.83	3	Frequent
Yellow billed kite	1.91	2	Uncommon
Gabar Goshawk	1.53	2	Uncommon
Dark chanting Goshawk	2.11	3	Frequent
African Harrier Hawk	2.29	3	Frequent
Cattle Egret	4.31	3	Frequent
Pearl-spotted Owlet	2.11	3	Frequent
Tawny Eagle	1.91	3	Frequent
Marabou Stork	2.68	3	Frequent
Brue's Green Pigeon	0.67	2	Uncommon
Yellow billed Oxpecker	2.58	3	Frequent
Rufous-crowned Roller	4.98	3	Frequent
Double toothed Barbet	2.68	3	Frequent
Superb Starling	3.74	3	Frequent
Abyssinian Ground horn bill	3.35	3	Frequent
Nubian wood pecker	1.43	2	Uncommon
Little-bee eater	3.25	3	Frequent
Tawny-flanked Prinia	2.68	3	Frequent
Blue-naped Mouse bird	6.42	3	Frequent
Laughing Dove	4.79	3	Frequent
Abyssinia Roller	4.98	3	Frequent
African pied wagtail	6.42	3	Frequent
Brown-Snake Eagle	1.44	2	Uncommon
Bateleur	4.02	3	Frequent
Verreaux's Eagle-Owl	1.72	2	Uncommon
Grass land Pipit	3.54	3	Frequent

should be interpreted in the ground practically and used for better conservation of biodiversity.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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On-farm description and status of Nuer (Abigar) cattle breed in Gambella Regional State, Ethiopia

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This study was conducted in Gambella Regional State (GRS) in order to characterize the Abigar cattle breed phenotypically at its breeding tract. It was done purposively in four selected districts of the region using extensive field surveys, morphological measurements and focused group discussions on the origin, distribution, current status and future threats, production and reproduction characteristics of Abigar cattle at its production environment. By using semi-structured questionnaire, 160 cattle owners were interviewed and qualitative and quantitative data were recorded for mature 200 female and 100 male cattle. Milk yield monitoring of 95 lactating Abigar cows was assessed in and around Gambella district for three months long. The data were entered into Excel sheet and analyzed using SPSS (2007) software package. The study has shown that Abigar cattle are the most dominant both in the Nuer and Anywaa zones of the region. The breed possesses unique features that can be used in identifying the breed from other indigenous breeds. The breed has got large body size, long-curved horns, gray and white dominant coat colors as well as ease of management by all gender groups due to its recognized docile character. The average age at puberty, age at first calving and calving interval were found to be 36.2, 42.5 and 14.1 months, respectively under extensive management. In addition, the breed has better production and reproduction capabilities despite the high heat load, recurrent drought and repeated disease prevalence in the region. However, a decreasing trend of the breed had been noticed in the studied areas in recent years mainly due to disease outbreaks and lack of medication, ethnic conflicts, cattle raiding and high expansion of commercial crop production. Thus, a well-coordinated and community driven participatory *in situ* conservation strategy has great significance to ensure the maintenance, future use and improvement of the breed for enhancement of food security of the pastoral and agro-pastoral communities in the region.

Key words: Abigar, cattle, breed, Nuer, Anywaa, pastoral, agro-pastoral.

INTRODUCTION

Ethiopia is considered as home of huge diversity of animal genetic resources, possessing high population of livestock comprising mostly of the indigenous genotype; adapting variable agro-ecologies and farming systems. Animal genetic resources provide alternative forms of high quality food, major source of income and livelihood, and very crucial in strengthening social and cultural linkages of indigenous people living in marginal areas

(Cardellino, 2006). In these areas, where crop production is unavailable due to physical and climatic barriers, there exists only a considerable livestock production (Maass et al., 2012) and a relatively feasible livelihood strategy in order to buffer and maintain food security, which has been practiced as a main-stay of life and coping strategy at resilient ecosystems (FAO, 2006). This production system has accounted for over 40% of the world agricultural output at the global level. Under such circumstances, the multiple functions of livestock at marginal areas (Bayer et al., 2003), such as food, source of income, employment opportunity and socio-cultural values, is considered as a major priority which coincides with the fitness of the indigenous genotype with the prevailing traditional husbandry practices (Leshan and Standslause, 2013). This is further enhanced by the hardy nature of the animals and also relatively productive which may be due to the adaptation accumulated through long periods of exposure to the low level of management as well as the stressful environmental factors (Bayer et al., 2003).

Indigenous cattle are an integral constituent of most of the production systems in Ethiopia and serve multiple functions and roles in majority of the rural community. Of the indigenous genotypes known in Ethiopia, the Abigar cattle are classified as 'Sanga' and they are found principally in the border area between Ethiopia and Sudan with larger extension in Ethiopia covering the Akobo area of Gambella (Alberro and Haile-Mariam, 1982a). The breed is found around the White Nile of Sudan and Ethiopia, highly distributed and populated in the adjacent lowlands of Southwest Ethiopia; it has been reared and maintained by the Nuer tribes of Gambella Regional State (DAGRIS, 2007). Abigar cattle breed is the sole dominant cattle type found throughout the region and providing valuable support to the socio-cultural and economic activities of pastoral and agro-pastoral communities (GRS, 2003). It provides majority of the milk and milk product requirements of people in the region. The breed is considered as productive taking into account, the prevailing high environmental stressors and extensive management provided to the animals. Among the indigenous cattle breeds, Abigar is known for its tolerance to tse-tse fly challenge, high heat load, periodic flooding and possessing of good milking and beef production qualities at its breeding tract (GRS, 2003). Despite the high significance of the breed in supporting and improving livelihood of people in the pastoral and agro-pastoral areas in Gambella, there is little information available for this cattle breed to figure out its current status and for further intervention in designing to implement appropriate breeding programs and conservation strategies.

Thus, this study was designed to gather basic information on its origin and distribution, current status and threats, adaptability attributes, morphological features as well as its production and reproduction characteristics at its breeding tract.

MATERIALS AND METHODS

Study area description

This study was conducted in Gambella Regional State (Figure 1) which is about 800 km away from the capital city of Ethiopia, Addis Ababa. Geographically, the region is situated within latitudes 6°22' and 8°30' N and longitudes of 33°10' and 35°50' E.

Broadly speaking, the region is divided into three major administrative zones, that is, Nuer, Anywaa and Mejengir, which are further divided into eleven districts. Traditional livestock production system prevails in the entire region and the major livelihoods comprised of cattle rearing, fishing and bee keeping in the Nuer, Anywaa and Mejengir zones, respectively.

Most of the rangeland in the region is characterized as open grass land with an extensive plain topographic feature (PADS, 2004) which has got an altitude ranging between 300 and 2300 m.a.s.l. The region is characterized by arid and semi-arid ecologies coupled with pronounced humid characteristics. It experiences a relatively harsh environmental condition of having unreliable, low and erratic rainfall which varies between 900 and 1500 mm in the lower altitudes of the region. The mean annual temperature ranges between 17.3 and 28.3°C with the highest absolute maximum temperature occurring in the middle of March and is about 45°C (GRS, 2003). The major cultivated crops in the region include maize, sorghum, groundnut, sesame and cotton. The natural vegetation in Gambella Regional State (GRS) is characterized as savannah grassland with scattered wood and shrub lands. Poorly drained vertisol is the characteristic soil type of the grass land, particularly in Itang and Lare districts.

Sampling and data collection

Preliminary survey was done before commencing the actual study to explore the overall features of cattle production in the region and further to modify the questionnaire for simplicity of interviewing the cattle owners. Based on information obtained from the preliminary survey and experts of the regional agricultural offices, four districts in the region (Abobo, Gambella, Itang and Jikawo) were purposively selected taking into account the major breeding sites of Abigar cattle breed, population size and production potential of each district. A total of twelve (12) villages were selected from the four districts to gather information on the breed's characteristics, management by the owners and its diversity in the region. Accordingly, 160 cattle owners (40 households per district) were selected randomly and interviewed using semi-structured questionnaire. In the meantime, Abigar cattle owned by the respondents were also used to take qualitative and quantitative

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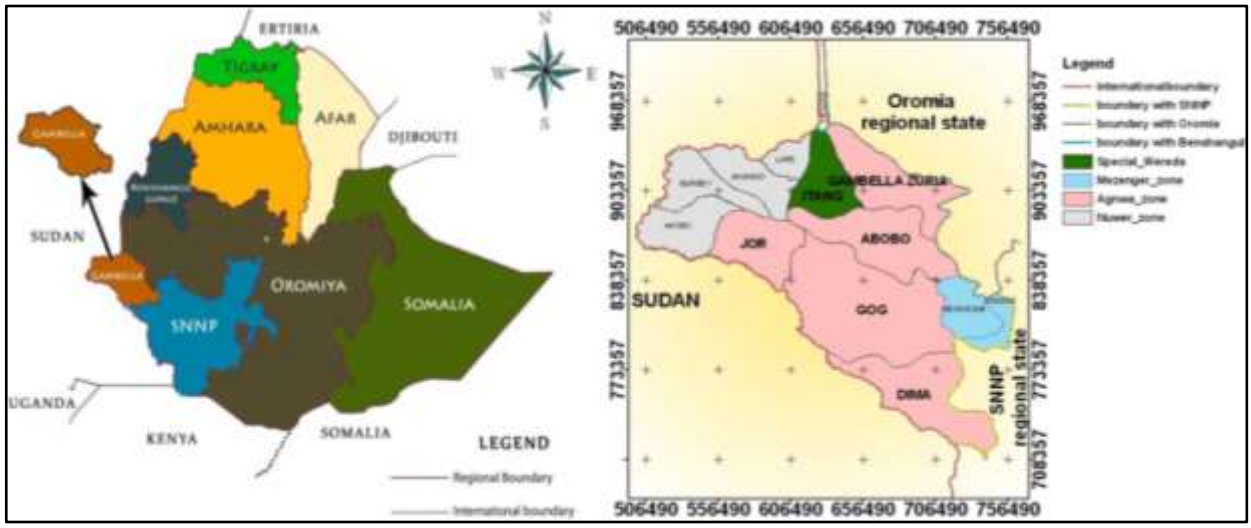

Figure 1. Map of Gambella Regional State (Riek, 2016).

measurements. A total of 300 mature Abigar cattle (200 females and 100 males) were randomly selected for the entire study. Extensive focus group discussions with elder Abigar cattle owners were made at each village (on average 3-15 persons per village participated) and the local languages were interpreted by respective development agents. In addition, pictures were taken from individual animals, grazing fields and management practices of the breed. Data were entered into Excel sheet (2007) and the required statistical parameters were analyzed using SPSS (2007) software package.

RESULTS AND DISCUSSION

Origin and distribution of the breed

The Abigar cattle are classified under the 'Nioltic Sanga' and are the sub-type of Nuer cattle found principally in the border areas between Ethiopia and Sudan with larger extension into Ethiopia covering the Akobo area of Gambella (Alberro and Haile-Mariam, 1982a). The term 'Sanga' is originally an Ethiopian word which refers to 'bull'. This would be an evidence that Ethiopia could possibly be considered as the origin and center of dispersal of Sanga type breeds which were evolved through interbreeding between the Longhorn, Shorthorn and Zebu type cattle commencing before 3000 to 4000 years ago (Payne and Wilson, 1999) and still, the process is continuing. The Abigar cattle are found along the white Nile in Southern Sudan (mainly bred by Nuer, Dinka and Shilluk tribes) and in the adjacent lowlands of Southwest Ethiopia including Itang, Jekawo and Akobo districts of Gambella Regional State, mainly bred by the Nuer and Anywaa tribes (Alberro and Haile- Mariam, 1982a).

The word 'Abigar' derived its name from Abigar people (Nuer ethnic group) who actually possess deep-rooted indigenous knowledge and putting pronounced effort for the better management and maintenance of the breed. They always show high priority against the other breeds and are known for their traditional management for the continued use and improvement of the breed. In fact, the word Abigar is derogatory to people across the region and livestock producers preferably like to name the breed as "Nuer breed" or "Anywaa breed" by referring the ethinc group names' who dominantly rear the breed. However, several literatures use and cite the name 'Abigar' but it is recommended to use the already acceptable names (Nuer breed or Anywaa breed) by the local people as naming has its own factor as a source of conflict among tribes.

The study further showed that the origin of the Abigar cattle has been strongly associated with that of the ethnic group (Nuer) maintaining the breed for several decades in the region. During the focused group discussions, majority of the elder people usually explain that 'Nuer cattle' means 'Nuer people' and vice versa which ensures and provides evidence on the systematic and continuous roles being played by those people in developing and maintaining the breed against drought, disease outbreaks, parasite attacks, genetic admixture and cattle raiders. In line with this reality, the entire life and livelihood of the Nuer community heavily depends on rearing Abigar cattle for their socio-economic and cultural needs on the vast area of the Gambella rangeland (Ketema, 2007). The current study and other related literatures strongly support the claim that the border area between Ethiopia and Sudan, specifically the districts occupied by the Nuer people, is believed to be the original breeding sites of Abigar cattle (Alberro and Haile-

Table 1. Ranking of tolerance/resistance of Abigar cattle for some stress factors.

Stress factors	Level of adaptation	Mixed N=40	Pastoral N=40	Agro-pastoral N=80	Overall N=160
Heat tolerance	Good	55	62.5	68.8	63.8
	Moderate	27.5	25	25	25.6
	Less	17.5	12.5	6.2	10.6
Drought tolerance	Good	57.5	75	68.8	67.5
	Moderate	27.5	15	18.8	20
	Less	15	10	12.5	12.5
Disease resistance	Good	50	60	73.8	64.4
	Moderate	30	17.5	23.8	23.8
	Less	20	22.5	2.5	11.9
Resistance to parasites	Good	55	82.5	66.2	67.5
	Moderate	35	17.5	26.2	26.2
	Less	10	0	7.5	6.2
Withstand feed shortage	Good	65	65	77.5	71.2
	Moderate	20	27.5	21.2	22.5
	Less	15	7.5	1.2	6.2
Withstand water shortage	Good	62.5	75	65	66.9
	Moderate	35	15	28.8	26.9
	Less	2.5	10	6.2	6.2

Mariam, 1982a) which indeed extends in all territories occupied by the Nuer people in the region. These days, Abigar cattle are commonly being reared by other tribes in the region as well as nearby districts of Oromiya region for milk production, source of income, payment of dowry and blood feud, strengthening social and cultural linkages. Next to the Nuer zone, large population of the breed is also found within the Anywaa zone which has paramount significance for supporting their crop production practices. According to the focus group discussion, the Anywaa people had actually started livestock rearing since few decades ago due to the efforts from serious extension work as well as due to the awareness they got from Nuer people during the dry mobility season while crossing over and reaching the Anywaa districts. The elderly Anywaa people also described their great interest and preference of rearing the Abigar breed for its hardy nature and productivity potential.

Moreover, it is common to find Abigar cattle in the adjacent districts of Oromiya region such as Denbidollo, Shebel, Gimbi and Bure (Tasew and Duguma, 2012) in considerable number and distribution in which the breed has been used for milk production, fattening practices and draft power production.

Adaptability features of Abigar cattle

Abigar cattle possess unique adaptive traits that enable them to survive, produce and reproduce under high temperature and heat loads, frequent disease outbreaks and challenges. More than half of the respondents reported that Abigar cattle relatively have better level of tolerance or resistance to most of the existing stressors as compared to the other cattle breeds in the region which ranges from 63.8% for heat tolerance to 71% for withstanding feed shortage (Table 1) as compared to all other indigenous cattle breeds existing in the region.

Such adaptation is very critical under low input production systems which may be developed gradually within locally adapted livestock breeds as they had been evolved parallel with all the confounding pressures in arid and semi-arid ecosystems (Leshan and Standslause, 2013). This will have a direct significance in ensuring food security, conservation and sustainable utilization of the resource by the local people.

Typical features of Abigar cattle

Abigar cattle have long body length, big body size and

Table 2. Overall least square means of quantitative traits in the male and female sample population.

Dependent variables*	Female (N=200)		Male (N=100)	
	Overall average	CV (%)	Overall average	CV (%)
Mouth circumference	39.2	4.0	39.8	3.3
Face length	43.9	3.5	44.3	4.2
Ear length	17.5	7.9	17.8	6.6
Horn length	44.6	20.4	39.0	19.0
Neck length	43.5	4.0	43.3	5.5
Dewlap width	13.3	25.9	15.1	17.7
Canon bone length	21.8	5.6	22.5	4.2
Canon bone circumference	14.9	6.6	15.7	6.9
Heart girth	142.5	3.3	148.9	4.0
Height at withers	114.0	2.4	118.3	2.7
Body length	122.2	4.7	122.7	4.4
Pelvic width	34.7	3.9	33.8	4.7
Navel flap width	4.8	21.1	-	-
Teat length	4.1	16.3	-	-

Figure 2. Typical Abigar cow.

medium height with an excellent body conformation accompanied by straight back and good heart girth (Table 2). The horns are either medium or very long in most cases which project forward and upward with curved and lyre shapes. They do have straight facial profile, small hump and sloppy rump in both sexes. White and gray coat colors are very dominant in the population in all the study areas which might have an association with the natural adaptation against the prevailing high temperature and heat load in the region (Kebede, 2016) (Figures 2, 3, 4, 5 and 6). Both sexes of Abigar cattle are docile and can easily be managed by children and women. This breed is also popular for its good walkability and high endurance characteristics during long distance mobility in the dry periods while driven in search of good pasture and drinking water (Ketema, 2007) (Figure 7).

Reproductive performance

The age at puberty for female Abigar cattle was found to be in the range of 34 to 40 months on average and could

Figure 3. Typical Abigar calves.

Figure 4. Typical Abigar bull.

reach sexual maturity within 38 and 41.5 months which showed slight variations in the prevailing production systems and management. As a result, the mean age at first calving was found to be 45.4, 44 and 40.3 months, respectively in the mixed, pastoral and agro-pastoral areas which might be due to the differences in indigenous knowledge in cattle management such as free herd mobility and feed resource availability. However, the mean reproductive life span of Abigar breeding bulls was found to be 6 years old after attaining maturity and the local people usually practice castration of young bulls when they reach 47.4 months of age in order to control unintentional or unwanted breeding before reaching full sexual maturity at 4 years.

Figure 5. Typical Abigar heifer.

Figure 6. Typical Abigar ox.

Production attributes of Abigar cattle

The field survey and milk yield monitoring assessments indicated the milk yield production potential of the breed, which varied from 0.47 to 5 L across the available production systems and the districts studied. The result has shown that the mean milk yield recorded from Abigar cows' ranged within 1.3 and 3 L (Table 3) without considering the amount of milk suckled by calves. The values of milk yield showed slight variations in the studied areas which may be due to the variations associated with cattle management and resource availability. For

Figure 7. Dry season mobility of Abigar cattle herd (long distance trekking).

instance, in addition to huge indigenous knowledge of the Nuer people regarding cattle management, they do exercise herd mobility freely over the rangeland (generally natives exercise better) and would access better water and grazing sites. In addition, both the Nuer and Anywaa people are known for their ethno veterinary knowledge and practices which might have significant influence on controlling some diseases and parasites and ultimately improve the production and productivity potential of their herds. Moreover, the actual milk recording was done in a single season from a few 'dairy cows' and there was also a serious outbreak of disease and drought during the study period in which many deaths of cattle were noticed.

The age at first calving interval ranges from 34 to 45 months with an average calving interval of 14 months. As compared to other indigenous cattle breeds, which have shown high mortality rates and are facing tough pressures to survive, the Abigar cattle breed was able to give better daily milk yield of 2.9 L (this study and GRS (2003)), mean lactation length of 8 to 9 months which is larger than the national average (6 months for indigenous cattle with 1.85 L of milk per day) (CSA, 2009) (Table 3).

It is also in agreement with Mureja (2002) in which Abigar cow could give 1-4 L of milk yield per day under traditional management. Moreover, Abigar cattle have larger calf crop production (7.4 to 10 calves) potential during their reproductive life span. However, the current milk yield is slightly lower than that of a previous study (3 to 5 L/day) reported by Alberro and Haile-Mariam (1982a), which might have been associated with the high disease outbreaks and drought incidences, which had occurred in the region when this particular study was carried out.

Major threats and current status of Abigar cattle

Disease outbreaks and recurrent drought

Despite possessing highly valued traits which could potentially play significant food and nutrition contributions at the national and international levels, the current study has shown the gradually decreasing trend of Abigar cattle population in the region due to some practically observed threats. As noted from the various focus group discussions with elder cattle owners and experienced experts, it is common to find several disease outbreaks which usually kill large number of cattle of all age groups and consequently disturbing the livelihood pillars of many households. This problem usually exacerbates the situation badly as it is mostly coupled with lack of veterinary services and drug supply in the region; bringing more serious tension in the livestock sector in general and Abigar cattle in particular. The loss of cattle due to trypanosomiasis, CBPP, brucellosis and foot and mouth disease, is very common in the region, sometimes causing the loss of more than half of, or even, the whole herd of cattle; particularly in times of drought due to lack of feed shortage and associated problems. Through time, recurrent drought has caused multifaceted challenges and is considered as one of the top threats of livestock production in the Gambella Regional State. Thus, because of frequent drought, both disease prevalence and feed shortage has become very critical and bring socio-economic instabilities on cattle owners due to the loss of large number of cattle in the study areas.

Table 3. Measured milk yield (lit/day) performance of Abigar cattle in Gambella district.

Village	Stages of Lactation	N	Mean	SD	Min	Max	CV (%)
	Early (0-3 months)	9	2.1	0.514	0.6	2.8	24.4
Addis Sefer	Mid (4-6 months)	11	1.7	0.399	0.5	2.7	23.6
	Late (≥ 7 months)	11	1.5	0.523	0.4	2.3	34.2
	Early (0-3 months)	12	2.1	0.535	1.5	2.9	25.7
Baro Mado	Mid (4-6 months)	12	1.6	0.394	0.9	2.9	24.0
	Late (≥ 7 months)	9	1.3	0.628	0.5	2.7	47.2
	Early (0-3 months)	17	1.6	0.475	1.2	2.5	29.3
Jejebe	Mid (4-6 months)	9	1.5	0.564	0.3	3.0	36.9
	Late (≥ 7 months)	6	1.3	0.769	0.3	2.2	59.2
	Early (0-3 months)	38	1.9	0.542	0.6	2.9	28.8
Overall	Mid (4-6 months)	31	1.6	0.441	0.3	3.0	27.1
	Late (≥ 7 months)	26	1.4	0.605	0.3	2.7	43.2

*N = Number of milking cows per lactation stage, SD = standard deviation, Min = minimum, Max = maximum, CV = coefficient of variation.

Cattle raiding and conflicts

Next to disease and drought constraints, cattle owners had been highly discouraged by cattle raiders who usually come either from Sudan or nearby surroundings, which would be more difficult when frequent mobility is required during the dry season (late December to early May) because of severe feed shortages. In these periods, livestock owners must drive their herds more than 30-100 km per day within the rangeland. However, they may eventually reach the danger zone of being life threatening and/or losing their cattle by well-armed thieves (Jal, 2014). In addition to the grazing sites, cattle raiding could possibly be done at night by attacking and fighting seriously and intentionally with livestock owners (Phillip, 2017). In those days for instance, it has become very apparent that thousands of Abigar cattle were driven and taken to Sudan by the Murle ethnic group (cross boarder cattle raiders) after killing and wounding the owners from the Nuer zone. Some villages had been still free of any settlement during the study period due to the displacement and destruction of their belongings. For instance, the same event had occurred in April 2016, which caused the loss of 208 Nuer lives and 108 children were abducted in the Nuer Zone by those armed Murle who came from South Sudan (Addis Admas Newspaper, 23 April, 2016).

In certain cases, rampant cattle raiding has been taking place at the intra-ethnic level (the Lou-Nuer and Jikany-Nuer) as those people had started to use the stolen livestock to pay dowry (Phillip, 2017; Jal, 2014) within their own community. Among these raiders, it is common to find inter- (between Anyuwaa and Nuer) and intra-ethnic (among the Nuer clans) conflicts (Riek, 2016; Jal, 2014) while people are crossing from one territory to another in search of better gazing or feed resources (Borchgrevink and Lie, 2009; Medhane, 2007) in the dry season and this will cause the loss of human life and livestock, destruction of property and bringing further decline in the rangeland resources and enhancing potential land degradation (Jal, 2014; Dereje, 2009).

Population pressure and expansion of commercial crop farming

In addition to the above production threats, there is high population pressure by the native people because of their cultural affinity towards increasing the size of their family by polygamy. Population pressure has also been a real concern as there is ever increasing flow of immigrants from Sudan and this would show an increasing human-livestock population and hence, bringing shrinkage of grazing lands and potential source of conflicts. Finally, the alarming and huge expansion of investment for commercial crop agriculture in the region is considered as the a big and serious concern for the fate of animal genetic resources in the region including Abigar cattle, resulting in the over dwindling of grazing lands, deforestation as well as deterioration of the rangeland. In the study period alone, the land investment and administration agency of the region approved and handed over thousands of hectares of land to local and foreign investors (Nakachew, 2009) for commercial rice,

cotton and sesame productions (Keeley et al., 2014). Despite these heavy threats imposed on the breed, it has received little attention and there are no established/ planned conservation measures and strategies for maintaining the breed in a sustainable basis for future use and further improvement.

CONCLUSION AND RECOMMENDATIONS

Abigar cattle breed has been bred and maintained under pastoral and agro-pastoral production systems mainly by the Nuer people in which the origin and major breeding tract is found to be Gambella Regional State. Though the largest population and distribution of the breed is evident in the Nuer zone, it has been significantly reared in the Anywaaa zones as well as in the adjacent districts of Oromiya region due to its preferred traits for milk production, beef production and draft production potential. The breed is also characterized as having docile character, long body length, big body size, medium height, mostly long-curved horns and dominantly white and gray coat colors in the population. Despite the prevailing high heat load, disease challenges and recurrent drought, the breed is known as possessing better productive and reproductive potential and showing less mortality rate as compared to other indigenous breeds found in the region which actually requires survival rather than being productive due to the high intensity of environmental stressors in the region. However, the current study has indicated a decreasing trend of the breed because of repeated disease and drought prevalence, cattle raiders, conflicts and expansion of commercial crop production. The regional government should also give due attention to cooperation, to resolve the available threats and maintain the rangeland ecosystem against the currently expanding crop farming. Thus, community based *in situ* conservation strategy is highly recommended to curb the available threats and improve its maintenance for sustainable utilization of Abigar cattle breed.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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