

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

**DISTRIBUTION, POPULATION STATUS AND FEEDING BEHAVIOR OF
ORIBI (*Ourebia ourebi*) IN SENKELLE SWAYNE'S HARTEBEEST
SANCTUARY (SSHS)**

BY

WONDIMAGEGNEHU TEKALIGN

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DEDICATION

**This work is dedicated to my beloved mother w/ro
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ABSTRACT

Population status, structure and feeding behavior of Oribi (Ourebia ourebi) was conducted in Senkelle Swayne's Hartebeest Sanctuary (SSHS) from August 2005 to March 2006, which included wet and dry seasons. Total count method was used to determine the current population status, seasonal distribution, habitat association, and sex and age structure of Oribi. Direct observation on selected animal groups was made to study activity patterns. Data on seasonal variation in population size, habitat association and activity pattern was analyzed using SPSS (Statistical Package for Social Sciences) computer software package and compared using one-way analysis of variance (ANOVA). The estimated population of Oribi in the study area was 51 individuals. The population was female biased. The sex ratio of adult males to females was 1.00: 1.26. Oribi were mostly observed as solitary, or in pairs occasionally they form small groups, a male and one or more females and their offspring. They were often associated with Swayne's hartebeest and sometimes fed among domestic livestock for protection. The oribi distribution showed preference to very high utilization for short grass in each vegetation communities. They were observed primarily as grazers on short grasses in both seasons. Themeda triandra was a highly preferable grass by Oribi in the study area. The distribution of Oribi during the wet and dry seasons showed slight variation on the study area in all vegetation communities. However, the tendency of population distribution towards Pennisetum grassland vegetation community increased during both seasons. The group size varied with food abundance and quality. They were mostly active during the early morning and late afternoon. The annual mean proportion of daylight hours spent feeding by Oribi was 54.7%. Morning and evening activity peaks were most obvious during the dry season, with most animals remaining inactive during the midday and hottest hours of the

day. Increase in human and livestock population was observed in the study area. Overgrazing by cattle and encroachment are the primary factors that affect the population status of Oribi by deteriorating the grass quality.

Key words: *Oribi, population status, activity pattern, SSHS*

1. INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Tropical Africa is part of the Ethiopian Zoogeographical Region (Frey, 2000; Delany and Happold, 1979). Climate changes followed by the formation of the world's great mountain chains, led the ruminants of Africa's forests to emerge on to the grasslands, followed naturally by their predators (ETC, 1982). Africa's tropical savannas support the world's most spectacular mammalian fauna with large herds of antelopes (IUCN, 1998).

East Africa is noted for its diversity and abundance of large mammalian herbivores (Kutilek, 1979). The extensive tropical and subtropical savanna biome, which extends from Ethiopia and Southern Sudan to the south of the eastern side of Africa, provides the homeland for the largest number and variety of ungulates (Hirst, 1975). Compared to other regions, Africa has the largest number of endemic families and genera of big games. This high degree of endemism is one of the reasons that made the African fauna so interesting and spectacular. African mammals belong to 50 families and 13 orders (Delany and Happold, 1979). In total, sub-Saharan Africa supports more than 70 antelope species with high aesthetic appeal, which is a greater diversity than achieved by any other group of medium to large sized mammals (IUCN, 1998).

Ethiopia is often known as 'the roof of Africa' due to its mountainous nature (Nievergelt, 1981). Its boundaries encompass the major part of the eastern African highland massif (ETC, 1982). Ethiopia is one of the most physically and biologically diverse countries of the world (Yalden, 1983; Kingdon, 1997). The country is endowed with extensive and unique

environmental conditions, ranging from Ras Dejen (4620 m asl) to Dallol (100 m bsl) at Kobar sink in Afar depressions (Yalden, 1983). The wide range of habitats in Ethiopia, from arid desert, open grassy steppe, and semi-arid savannas to highland forests and Afro-alpine moorlands, supports an exceptionally diverse antelope fauna (Hillman, 1993). The majority of the wildlife species are confined to the montane extremes of the Simien Mountains and Bale Mountains, and the Arid Lowlands of the Rift Valley (EWCO, 1985).

Most antelope species still exist in large numbers in sub-Saharan Africa including Ethiopia. However, they are subjected to increasing ranges of fragmentation of their distribution and reduction or extermination by the local populations (IUCN, 1998). Threats to the survival of antelopes arise fundamentally from the rapid growth of human and livestock populations, and consequent degradation and destruction of natural habitats and excessive off-take by meat hunters (Andebrhan Kidane, 1982; Groombridge, 1992; Jermy *et al.*, 1995; Woldegbriel Gebrekidan, 1996; IUCN, 1998). Antelopes and other large mammals have suffered severely in Ethiopia in the past years, from the effects of over-hunting by the heavily armed local populace, military operations, habitat destruction caused by the activities of increasing populations of both nomadic pastoralists and settled cultivators, and severe droughts (Blower 1969; Brown, 1971; Bolton, 1973; Shibru Tedela, 1995). According to Hillman (1993), despite a widespread and continuing habitat destruction, Ethiopia is not known to have lost any of the 29 species of antelopes, which occurred within its borders.

However, due to man-made and natural degradation processes, this wildlife has largely been restricted within a few wildlife conservation areas of the country (Hillman, 1993). Protection and management given by the Ethiopian Wildlife Conservation Organization (EWCO) during the

1980's, is only on a limited number of protected areas. Many of these areas had major long-term problems of poaching and occupation by local people and their livestock. One of the affected areas is the Senkele Swayne's Hartebeest Sanctuary (Hillman, 1988). After the change of government in 1991 and 1992, wildlife was slaughtered indiscriminately, forests were destroyed, settlements were established and livestock grazing became commonplace in such protected areas (Shibru Tedela, 1995).

The oribi *Ourebia ourebi* (Zimmermann, 1783, as cited in Smithers, 1983) is a small (12-14 kg) highly specialized species of savanna antelope (tribe *Neotragini*). It is widely distributed across open grasslands of Africa, south of the Sahara except Gabon (Kingdon, 1982; Smithers, 1983; Kingdon, 1997). They occur in most countries throughout the sub-Saharan Africa, ranging from Senegal to west and central Ethiopia and southern Somalia, southward into eastern Kenya, across north Botswana and Angola, with patchy and discontinuous distribution south of the equator, Mozambique, Zimbabwe and into central and eastern South Africa (Smithers, 1983; Estes, 1991; Stuart and Stuart, 1997; Frey, 2000) (Fig. 1). The species belongs to Family Bovidae, subfamily Antilopinae. It is the largest antelope family in the Order Artiodactyla (Delany and Happold, 1979; Frey, 2000).

In Ethiopia, oribi occurs mainly within and to the west of the Rift Valley. It survives quite widely in open habitats within its historical range, including some settled areas. It occurs in low to moderate numbers in areas such as Senkele Wildlife Sanctuary, Mago, Gambella, Omo and Maze National Parks. It is Common in Omo National Park, where it occurs throughout the park's northern grasslands and on hills in the south (IUCN, 1998). Recently, a very high number of individuals have been observed in Maze National Park (Fig. 1). However, due to its

shyness, it is not easily observed. It may be more common than is generally realized. Bolton (1973) as cited in Yalden *et al.* (1984) records having seen nearly 70 animals in one day in the Cuchia district of the Omo River. Both Pease (1901) and Powell-Cotton (1902) as cited in Yalden *et al.* (1984) independently recorded this species near the Awash River, in the vicinity of what is now the Awash National Park. At present, it no longer occurs in this area, perhaps having been exterminated or forced to retreat through excessive human activity during the past eighty years.

In the single species of *Ourebia ourebi*, (Nowak, 1991), up to thirteen subspecies have been described occurring on the continent of Africa. Such as: *O. o. ourebi* (South Africa), *O. o. dorcas* (Chad), *O. o. goslingi* (North Zaire), *O. o. montana* (Sudan to west Ethiopia), *O. o. gallarum* (Central Ethiopia), *O. o. kenya* (Kenya), *O. o. aequatoria* (Uganda), *O. o. ugandae* (Uganda), *O. o. cottoni* (Tanzania), *O. o. hastata* (Zaire, Malawi, Zimbabwe), *O. o. quadriscopa* (Senegal to Nigeria), *O. o. rutila* (Angola), and *O. o. haggardi* (Northern Kenya) (Smithers, 1983; Webkenya Development, 2003). Ansell (1971) follows Haltenorth (1963) as cited in Yalden *et al.* (1984) in a taxonomic treatment of northeast African *Ourebia* designated from museum specimens of South Sudan as *aequatoria*, a form that is believed to integrate with *montana* of southeast Sudan and west Ethiopia, which, in turn integrates with *gallarum* of Central Ethiopia. These populations of western and central Ethiopia are isolated by the aridity of the Ogaden region from *O. ourebi haggardi*, which enters Somalia from the south and extends northwards along the valleys of the Webi Shebelle and Juba Rivers. To judge from the distribution map published by Funaioli and Simonetta (1966) as cited in Yalden *et al.* (1984), *haggardi* could penetrate marginally into southeast

Ethiopia and its occurrence in the vicinity of Dolo would not be surprising.

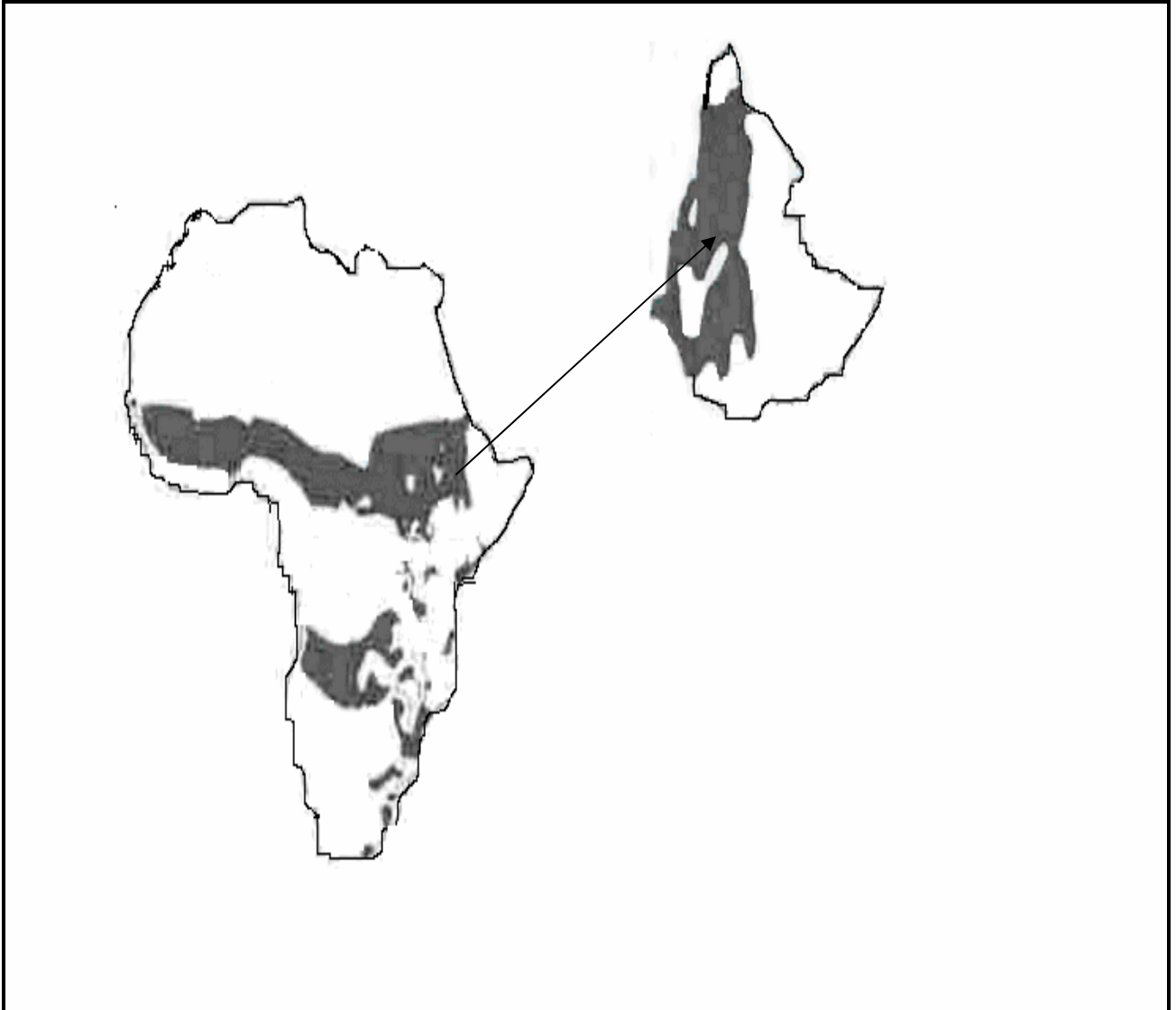


Figure 1. The Distribution of Oribi (*Ourebia ourebi*) in Africa (After Stuart and Stuart, 1997).

Oribi is classified as Lower Risk conservation dependent on the IUCN Red List (IUCN Red List, 2004). It has two subspecies on the Red List such as Haggard's oribi (*Ourebia ourebi haggardi*), which is classified as

vulnerable, and the Kenya oribi (*Ourebia ourebi kenyae*) classified as extinct (IUCN Red List, 2004). In South Africa, their numbers have declined sharply in recent years, and they now exist in only a few formally protected areas. The bulk of oribi occurs on privately owned land. South Africa's latest Red Data Book for mammals (2004) classifies the oribi as "Endangered", due to its rapid decline in recent years caused primarily by habitat destruction and continued persecution by human (EWTOWG, 2001). Oribi populations in many areas are threatened by human activities such as: habitat destruction, over-utilization illegal hunting, inappropriate management, poor law enforcement and lack of awareness (<http://www.ewt.org.za>). The oribi is hunted for food and for sport and its habitat is threatened by agricultural and urban development (Animal Diversity Web, 2004).

Among the four sanctuaries occurring in Ethiopia, the Senkelle Swayne's Hartebeest Sanctuary (SSHS) is the focus of the present study. In addition to the hartebeest, the area harbors other animals such as oribi (*Ourebia ourebi*). The name Senkelle in the local language Oromigna implies to oribi, which was probably the most common in the past (Hillman, 1993).

The dependence of human population for their survival on the land, coupled with the presence of large number of livestock led to resource conflict between people and the wildlife in and around the Sanctuary (Messena and Bereket Netserab, 1994). Human population growth is the fundamental cause of the current and potential loss of most of the earth's biodiversity. Current growth rates of human populations in most countries in sub-Saharan Africa are between 2.5% and 3.5% per annum (IUCN, 1998). Although protected areas are one of the conservation's oldest devices and remain a cornerstone of conservation policy (Wynne, 1998), they are continually threatened by growing human populations. This is usually the case in the developing world, where growing populations threatens protected areas directly by encroachment of settlements but also through the pressure on all land to become economically productive, for example, as areas for timber production or

livestock grazing. It is important for conservationists to have detailed information on the type of impacts that result from expanding human populations in areas of high biodiversity (Stephens *et al.*, 2001). Human population growth has led to encroachment into wildlife habitats, constriction of species into marginal habitat patches and direct competition with local communities (Siex and Struhsaker, 1999). The main cause of interference by the local community in the Senkele Sanctuary is due to population growth accelerated by cultural factors such as polygamy marriage (Fassil Tekle, 1996). These result in scarcity of land, increase demand for grass and firewood, and foraging land for their livestock.

With increasing human population and encroachment into areas, there is an increasing risk of disease spreading from domestic animals to the wildlife. Strategies to protect valuable wildlife species from introduced disease need to be developed (Bourn and Blench, 1999). Growing densities in livestock populations can create an overlap of diets and forage competition with wild herbivores. This results in overgrazing and decline or local extinction in wild herbivore populations (Mishra *et al.*, 2003).

There have been little studies on oribi (*Ourebia ourebi*) in Ethiopia. Nothing is known about the population status of Senkelle oribi. Therefore, it was crucial to study the population status, distribution and feeding activity of the animal and its interaction with the surrounding environment.

1.2 Literature review

The dwarf antelope tribe (*Neotragini*) is very varied in form and habitat. The only common features of the tribe are their small size, females are 10-20 percent larger and heavier than males (Smithers, 1983). They possess well-developed preorbital glands for scent marking (Macdonald, 1984). The oribi (*Ourebia ourebi*) is the largest of the small antelope

(Stuart and Stuart, 1997; Mduma and Sinclair, 1994) and the most gazelle-like of the *Neotragini* (Estes, 1992) inhabiting temperate open grasslands of sub-Saharan Africa (Gold Spink *et al.*, 2002).

They are graceful slender legged and long-necked small antelope (Webkenya development, 2003). They grow from 92 to 110 cm in length, with a shoulder height of 50-66 cm and weight 12-22 kg (Hayman, 1980; Nowak, 1991; Estes, 1992). The hair is fine and silky, and the general body color is bright sandy rufous (light reddish) to tawny (reddish brown) above, with white on the under-parts, chin and the underside of the tail (Nowak, 1991; Estes, 1992; Walker, 1975). It possesses a distinctive white line of fur over its eye and beneath the ears; there is a bare hairless glandular area, which is usually dark and conspicuous (Walker, 1975; Nowak, 1991; Frey, 2000). The females usually bear a dark crown patch (Walker, 1975; Nowak, 1991). Both sexes have tufts of long hair on the knees (Hayman, 1980; Nowak, 1991; Encyclopedia Britannica, 2004). They have a short, bushy, black tail above and white below (Smithers, 1983; Nowak, 1991). Only male oribi have short thin, erect spike like horns that range from 8-19 cm in length (Smith, 1985; Estes, 1992; Stuart and Stuart, 1997). These rise straight up from the top of the head and curve slightly at an angle of about 45°. These slightly diverge towards the tips and are ringed at the base. The ears are large, narrow and pointed (Walker, 1975; Smithers, 1983). It has very distinct preorbital glands in males that fill most of the space between the eye and mouth and appear as a vertical fold before the front corner of the eye (Hayman, 1980; Frey, 2000). This is an unused and possibly undeveloped in female. Females have four mammae (Nowak, 1991, Estes, 1992) (Plate 1).

Oribi (*Ourebia ourebi*) are sometimes confused with steenbok (*Raphicerus campestris*). They have the same coat color and the same type of horns

as the oribi but somewhat smaller about 55 cm at the withers and 15 kg in weight (Fiorenza, 1983). The tail of the steenbok is the same color as the upper parts and their white face markings are never as distinct as those of the oribi. In addition, oribi have longer and thinner necks than steenbok. Like the steenbok, horns are widely spaced at the base, but differ from those of the steenbok as they are strongly ridged towards the bases. The horns of steenbok are smooth throughout their length (Smithers, 1983). Oribi have also smaller and less rounded ears than steenbok's (Estes, 1992). The Grysbok (*Raphicerus sharpie*) have also the same type of horns, but darker coat than the oribi and even smaller than the steenbok about 50 cm at the withers and 10 kg in weight (Fiorenza, 1983).

Oribi prefer an open habitat. They occur on open grassland or flood plain, with or without a sparse scattering of trees and bushes (Hayman, 1980; Smithers, 1983). They prefer short grasses with patchy areas of tall grasses to provide hiding places. They like grasslands that are not extremely tall or dense and with some bushes for protection and avoid steep slopes and habitats dominated by woodland or bush (Estes, 1992; Frey, 2000).



Plate 1. Physical features of Oribi (*Ourebia ourebi*) male.

The feeding niches of African ruminants have been classified in terms of the quality, quantity and principal composition of the vegetation (Gordon and Illus, 1996). Oribi is the only neotragine that is primarily a grazer although browses occasionally especially in the dry season, when drought occurs and fresh grass are less common, and is water independent (Kingdon, 1982; Estes, 1992; Frey, 2000; Smithers, 1983; Stuart and Stuart, 1997). The oribi is Africa's smallest grazing ungulate (Hofmann, 1989; Estes, 1997). In the dwarf antelopes, the length of time food stays in the rumen is so low that they have to choose vegetation of a high nutritive quality (Macdonald, 1984). This herbivorous mammal was recorded to eat at least eleven different herbs and foliage from seven different trees. It has also been known to visit mineral licks every three days (Estes, 1992; Kingdon, 1982; Frey, 2000,). It is among the first herbivores to utilize a post-burn flush, when the growth is still too short and sparse to satisfy larger grazers (Estes, 1992). Once the wild fire is through, they return to the area to graze fresh green grasses (Webkenya, 2003). Mortality among oribi is more pronounced during the months of July to October, as a result of decline in the crude protein content of the food during the winter months. This leads to a lowering of their condition, rendering them to the effects of climatic stress and disease (Smithers, 1983).

Oribi are most often encountered solitarily, in pairs or a male and one or two females and their offspring's (Smithers, 1983). These parties occasionally join up to form small groups, on average six individuals (Smithers, 1983; Nowak, 1991; Frey, 2000). Adult males mark their territory with secretions from their preorbital glands. They patrol their area, marking the grass with combinations of black secretions from the preorbital glands, urination and defecation (Smithers, 1983; Brashares and Arcese, 1999; Frey, 2000). Nowak (1991) described that both sexes

mark and defend the territory, but according to Estes (1992), females actively defend the territory against intruders of their own sex.

They are active mostly during the day (Frey, 2000) and information on nocturnal activity is sketchy (Estes, 1992). Typical activity peaks early and late in the day and on moonlit nights (Hayman, 1980; Estes, 1992). They lie in grass with their heads erect, keeping a watchful eye around them (Smithers, 1983). If suddenly disturbed, they will give the snorting whistle alarm call as they bound off stotting with a rocking-horse motion (Hayman, 1980; Smithers, 1983). Often they do not attempt to flee until an intruder is within a few meters, remaining motionless in the grass, relying on camouflage (Nowak, 1991). When flushed, they will bound up now and then as they run, holding their heads erect, enabling them to scan the surrounding ground (Hayman, 1980; Smithers, 1983; Nowak, 1991). After running for a couple of hundred meters, they stop and gaze back at the source of disturbance (Smithers, 1983; Stuart and Stuart, 1997). They are capable of traveling speeds of up to 40-50 km/hr (Kingdon, 1982).

Ourebia ourebi breeds throughout the year with its peak season in October and November (Openshaw, 1993). Young are born in tropical zone most of the time shortly before or during rainy season. In sub-tropical zone, they breed late spring to early summer (Hayman, 1980). The single offspring generally is born from August to December, following a gestation period of about 210 days (Smithers, 1983; Nowak, 1991; Estes, 1992; Openshaw, 1993). The oribi has a polygamous mating system. The males maintain territory and share it with one to two or more females (Thirgood, *et al.*, 1992; Estes, 1992). Females are able to conceive as early as ten months old and males are sexually active by fourteen months (Hayman, 1980; Estes, 1992). The life span is 8 to 12 years, but up to 14 years in captivity (Walker 1975; Hayman, 1980;

Webkenya, 2003). The females hide their offspring in clumps of grass when they move off to feed, returning to suckle them from time to time (Hayman, 1980; Smithers, 1983). Young suckle 3 times a day, for 1-5 minutes. After a week, they start green food, after a month first cud chewing, and after 2 months weaning, having reached 4/5ths of the adult size. Females can conceive again 1-10 days after giving birth (Hayman, 1980). Males remain with females throughout the year even though they do not invest directly in the 'care' of their calf (Kleiman, 1977; Brotherton and Manser, 1997).

Both sexes could contribute indirectly to the protection of the group, through increased vigilance (Baldellov and Henzi, 1992; Hannon and Martin, 1992). However, surprisingly, little is known about the effects of predators on oribi (Mduma and Sinclair, 1994). The natural enemies of the oribi are lions, leopard, caracals, hyenas, hunting dogs, jackals, crocodiles and pythons. The young are also threatened by jackals, eagles, genets, wildcat, rattles and baboons (Frey, 2000, Webkenya, 2003).

The seasonal variations in the availability of the required resources affect aspects of ungulate ecology such as its population distribution (Fryxell, 1987), habitat preference and activity patterns (Duncan, 1983). The seasonal distributions of animals are linked with shifting distribution of critical resources (Inglis, 1976). Foraging efficiency plays an important part in determining group size. Group size varies not only between habitats, but also between seasons (Hanley, 1982).

One of the most difficult problems facing those concerned with wildlife conservation in Africa is the tremendous toll taken by poachers (Philip, 1961). Local people have exploited Ethiopia's wildlife for subsistence. However, traditional method of hunting has never decimated wildlife (Andebrhan Kidane, 1982). The meat of these animals (Oribi) is excellent

quality (tender) and as a result, they are hunted extensively. Although their population has been greatly reduced, they apparently are not in danger of immediate extinction (Walker, 1975). Abundant in some areas but seriously threatened in others, e.g. the Eastern Cape, South Africa. The greatest number, possibly as many as 100,000 are located in West Africa although even there, it has lost ground to habitat destruction (Stuart and Stuart, 1997). The combination of continued agricultural and urban development, bush encroachment and increasing vulnerability to poachers threatens the persistence of *Ourebia ourebi* (Frey, 2000).

Conservation and management of wildlife require regular survey to provide a basis for measuring trends in population size and distribution (Elkan and Techamba, 1995). Protected areas exist to provide a safe environment for this species. Oribi (*Ourebia ourebi*) was probably very common in the past in the study area since Senkele means Oribi in the local dialect (Hunting Technical Services, 1976), but at present the number has dwindled. IUCN has listed the species as “Lower Risk, but Conservation Dependent”. This means that if current conservation efforts stop, the species would be in greater danger of extinction (Frey, 2000).

1.3 Objectives of the study

General Objective

The objective of this research is to assess the current population status of oribi in Senkelle Swayne's Hartebeest Sanctuary

Specific Objectives

- ♣ To assess the current population size of oribi in Senkelle Swayne's Hartebeest Sanctuary
- ♣ To determine the population structure
- ♣ To assess the distribution, feeding behavior and the major activity patterns
- ♣ To identify the impacts of livestock, human and other natural threats that affect the survival of the animal
- ♣ To suggest possible solutions for the existing problems.

2. DESCRIPTION OF THE STUDY AREA

2.1 Location and topography

Senkele Swayne's Hartebeest Sanctuary is one of the principal Wildlife Conservation Areas of Ethiopia (Hillman, 1993). The area is located in south central Ethiopia, 320 km by road from Addis Ababa (Mekebeb Eshetu, 2003) (Fig. 2). The Sanctuary is currently under the Oromia Administrative Region of the Federal Democratic Government of Ethiopia, on the western side of the Great Ethiopian Rift Valley, at coordinates between 7° 10' N and 38° 15' E (Messana and Bereket Netserab, 1994; Fassil Tekle, 1996). Access is achieved either from Shashamene, 4 km away from the village of Aje, or from the south-eastern side of Lake Awasa, coming through the villages of Shemana Kedida and Lalima Hill. The Sanctuary is bound to the east by the Tesisa, Borena and Lalima hills, which overlook a steep escarpment that drops to 1800 m and then descends to the western shore of Lake Awassa (Fassil Tekle, 1996) (Fig. 3). The Sanctuary was established in 1976 to save the most viable population of the Swayne's Hartebeest (*Alcelaphus buselaphus swaynei*), which are endemic and endangered sub-species (EWCO, 1990; Hillman, 1993; Messana and Bereket Netserab, 1994; Shibru Tedela; 1995; Dereje Hailu, 2003).

The 200 km² Sanctuary in 1972 was reduced to about 58 km² in 1973, and then to 36.4 km² (Messana and Bereket Netsereab, 1994). At present, less than 28 km² of the Sanctuary remains, as the rest of it was taken over by the farmers living nearby. The northern and southern part of the sanctuary harbors huts and expanded farmland belonging to the Arsi people in the Oromia Region. The western part of the Sanctuary is

demarcated by huts belonging to the Arsi people, on the

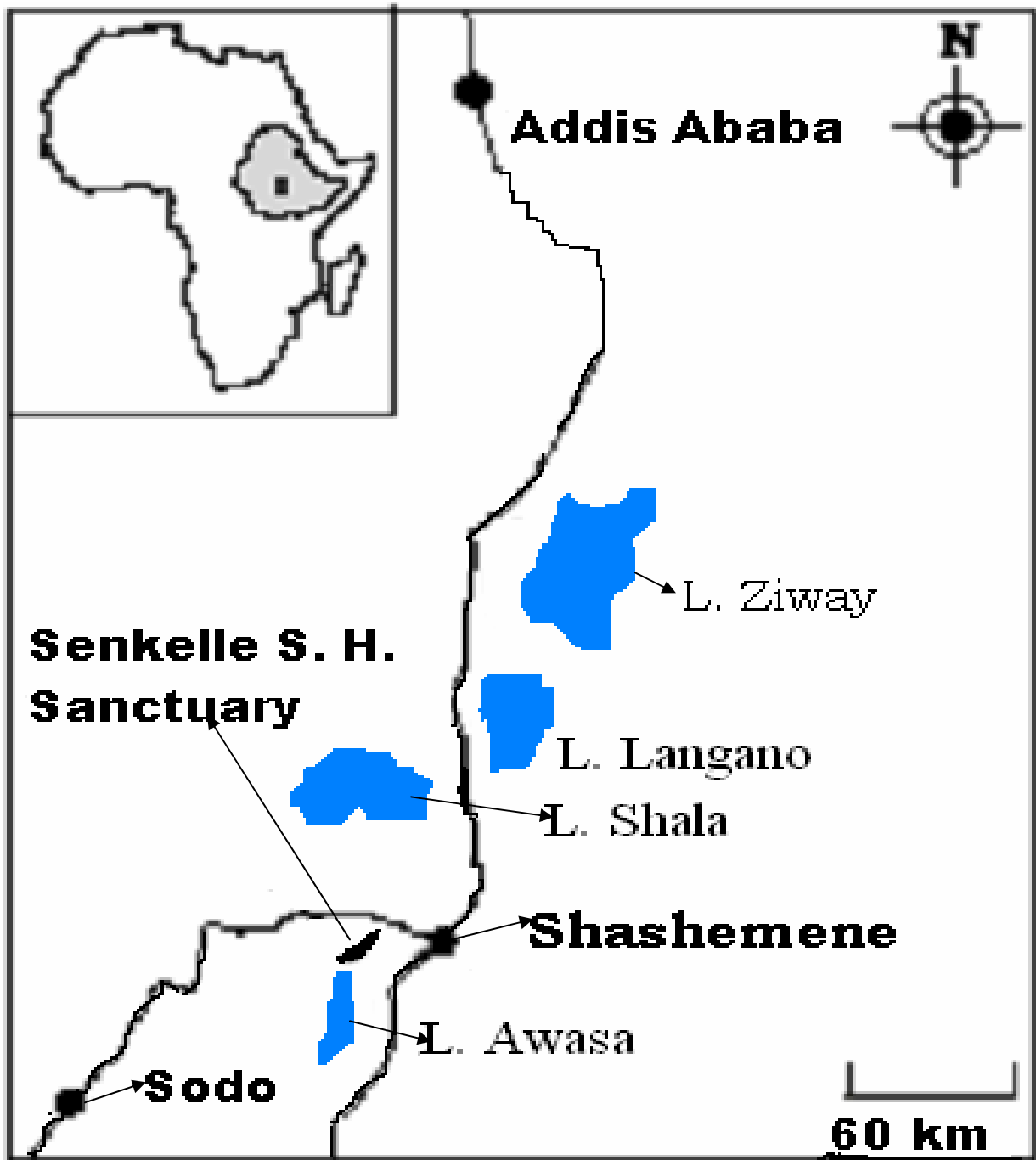


Figure 2. Location of Senkelle Swayne's Hartebeest Sanctuary.

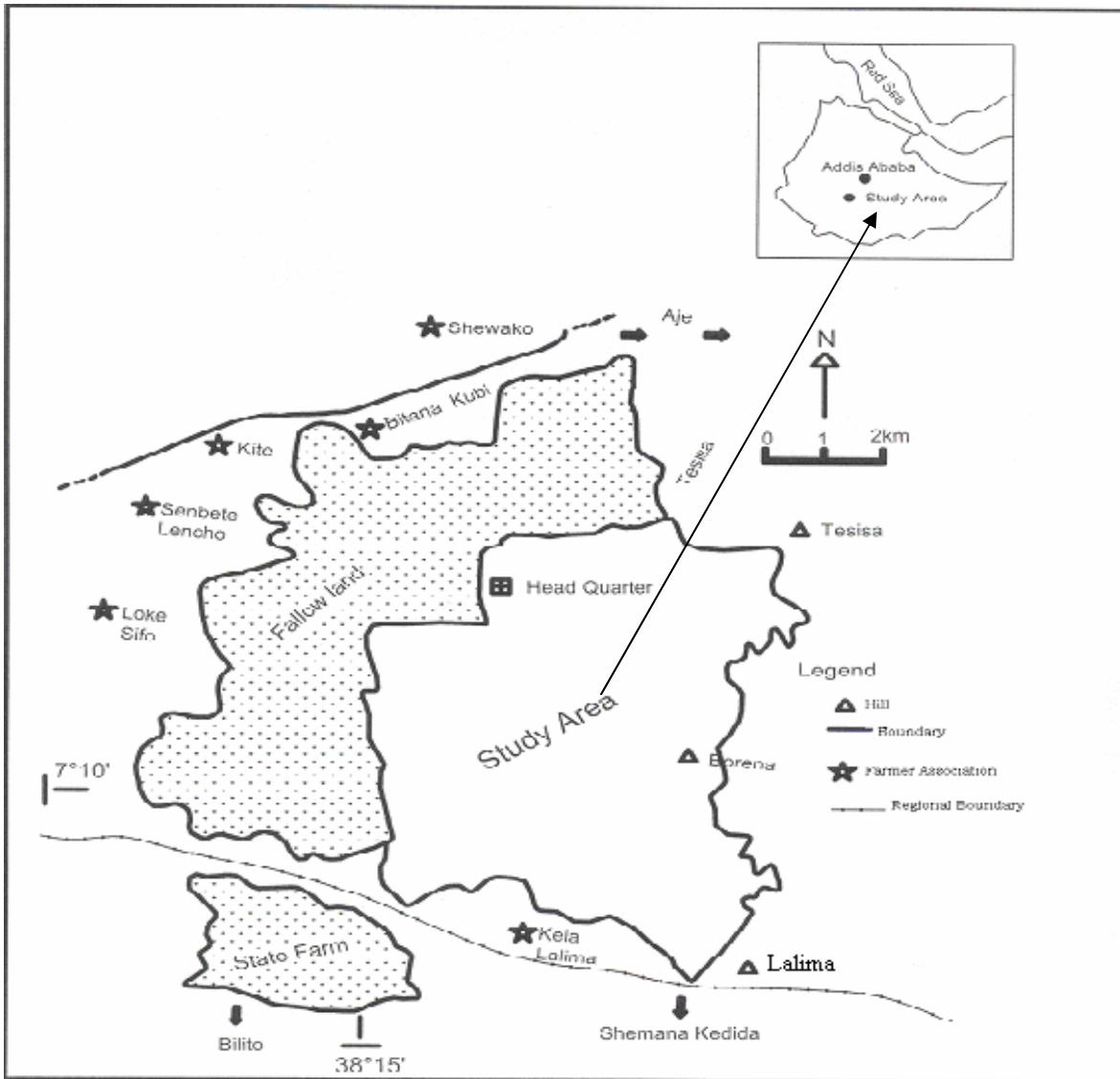


Figure 3. Map of Senkele Swayne's Hartebeest Sanctuary.

former state farm (now fallow-land), which remained uncultivated since 1991 (Fig. 3). A gently undulating plain dissected by a number of valleys

characterizes the topography within the sanctuary. The altitude ranges between 2000 and 2100 m asl.

2.2 Geology and soil

The main geological formation in the Senkele area is ignimbrite, which has given rise to heavy textured, dark sandy loam to clay topsoils. It is moderately deep on the open plains but shallower on sloping land. Subsoils vary from gritty, brownish and sandy loams to clay, often with several alternating horizons (Messana and Bereket Netsereab, 1994; Hunting Technical Services, 1976). Soils are very erodible, with gullies forming rapidly upon removal of the vegetation along tracks or on steeper slopes. The results of analysis of soils sampled in 1990 from nine locations indicate that there are no striking differences in soil characteristics associated with the main vegetation communities in the area (Fassil Tekle, 1996).

2.3 Climate

The average rainfall at Senkele, measured over four years (1991-1994), is 1,116 mm per annum. It has a moderately bimodal pattern of rainfall, typical of the 'Woinadega' Agro-ecological Zone of Ethiopia (600-1200 mm annual rainfall). The three-month dry season, from November to January, is followed by the 'Belg' rains, which peak in April-May, and the 'Kremt' rains, from June to August which peak in September. However, during the study period there was no 'Belg' rains (small rainy seasons). The mean monthly temperature is relatively constant throughout the year but diurnal variations can be considerable. Monthly maximum

temperatures range between 26°C in the dry and early wet seasons and 21°C in the late wet season. Monthly minimum temperatures are lowest during the dry season, falling to 8-9°C on some occasions, and rising to their maximum values of 14-15°C between March and May. Predictably, the relative humidity follows the rainfall pattern. Monthly minimum values increase from 30-40% during the dry season to 50-60% during the wet season. Mean maximum values fluctuate slightly around 80%. During the dry season, cloud cover is at a minimum and wind speeds are at their annual maximum contributing to the high levels of evapotranspiration associated with tropical climate patterns.

2.4 Vegetation

The principal vegetation type in the Sanctuary is described as montane savanna and comprises different habitat associations such as savanna woodland, natural grassland (with fewer trees and shrubs) and, in the valleys, rich shrubland (bush) (Birdlife International, 2003). Generally, it is an open savanna with scattered woodland. The natural vegetation of the Sanctuary is one of the major sources of livestock grazing land, fuel wood consumption, house construction and fencing materials for the surrounding people.

A previous study identified five vegetation associations in the Senkele plains: savanna woodland, valley complex, natural grassland, fallow and cultivated areas (Hunting Technical Service, 1976). However, Messana and Bereket Netsereab (1994) have identified three distinct vegetation communities during the formulation of a management project. These are: *Pennisetum* Grassland (PG), *Pennisetum* Grassland Type 2 (P₂) and Mixed Grassland (MG) (Fig. 4).

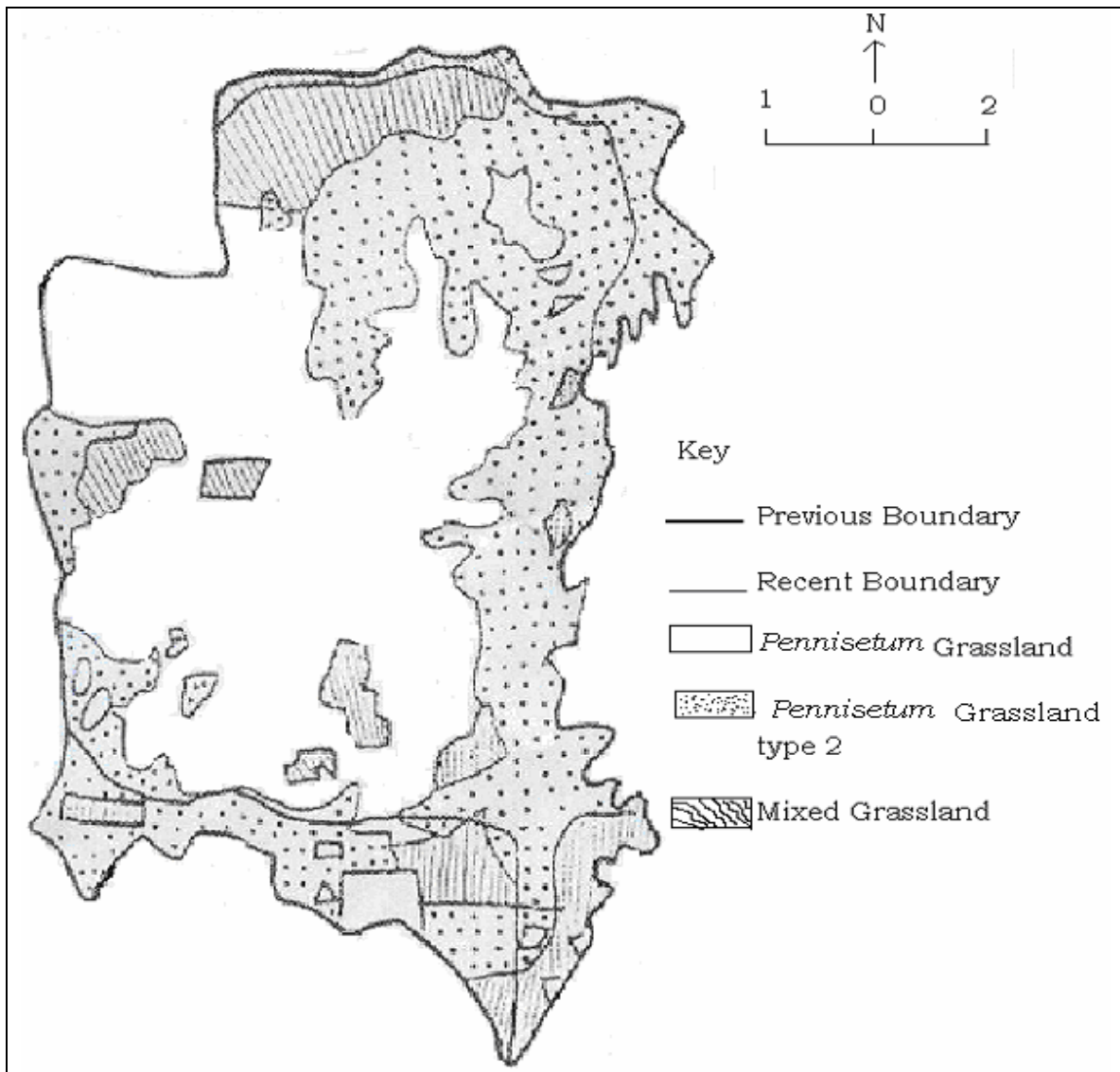


Figure 4. Vegetation communities of the Sanctuary.

2.5 Fauna

In addition to the Oribi (*Ourebia ourebi*), the most common wild herbivores, which occur in the Senkele Sanctuary, are Swayne's Hartebeest (*Alcelaphus buselaphus swaynei*), Bohor Reedbuck (*Redunca*

redunca), Warthog (*Phacochoreus aethiopicus*), and Greater kudu (*Tragelaphus strepsiceros*). Many rare species include Common Duiker (*Cephalophus grimmia*) and, among the primates, Vervet Monkey (*Cercopithecus aethiops*) in a restricted forest area.

Crested Porcupine (*Hystrix cristata*), Aardvark (*Orycteropus afer*) and Abyssinian Hare (*Lepus habessinicus*) as well as several species of rodents are also observed. The large carnivores have traditionally been hunted for sport or as pests by the local pastoralists. Lion (*Panthera leo*) was reported in the area previously (Hunting Technical Service, 1976). Leopard has been observed in 1995 in the more wooded areas. Spotted Hyaena (*Crocuta crocuta*) is very rare, and has never been observed in packs of more than three animals. In contrast, and perhaps as a result of the decline in the larger carnivores, Jackals (*Canis aureus*) have increased in number and may be the most important predators of oribi, especially the calf.

2.6 Human settlement and land use system

In the Senkele Plains, the dominant land users up to 1940 were the pastoralists. Subsequently, the influx of new elite following the Italian war (1936-1941), led to the development of mechanized farming in the area. In the late sixties, areas of pasture in the area were increasingly brought under cultivation and the pressure on the remaining pasture was intensified (Messana and Bereket Netsereab, 1994).

Crop production is the main activity followed by livestock rearing. The principal crop of the area is maize (*Zea mays*) and potato (*Solanum tuberosum*) but in limited areas haricot beans (*Phaseolus vulgaris*) are also harvested. Siraro Woreda in general and the study area in particular is characterized by greater number of livestock. The Arsi mixed farming

farmers border the Sanctuary. These farmers have large number of cattle. In contrast to the number of cattle, the farmers have limited grazing land. Most of the area is cultivated with less fallow land. The farmers use the young crop as forage. This large number of cattle and scarcity of grazing land have made the local people highly dependent on the sanctuary for grazing.

Before 1990, the number of settlers in and around of the Sanctuary was non-existent. After 1991, people started to show resistance against EWCO through a variety of action such as occupation of the territory, livestock grazing and fire wood collection in the Sanctuary. Those who occupied the land built huts along the border of the Sanctuary and expanded their farmland (Nishizaki, 2004) (Fig. 5).

2.7 Water resources

Water is one of the basic needs of all living things. However, in Siraro Woreda as a whole, there is a shortage of water for human and cattle use. The only water source for the area especially around the Sanctuary is the rain. The rainwater, which is obtained during the rainy season, is accumulated in a man made pond. This can be used for a month or two after the end of the rainy season. During the rest of the dry season, the local people and their livestock are subjected to go long distances to get water. In general, water deficit is observed throughout the Woreda and specifically in and/or around the Sanctuary.

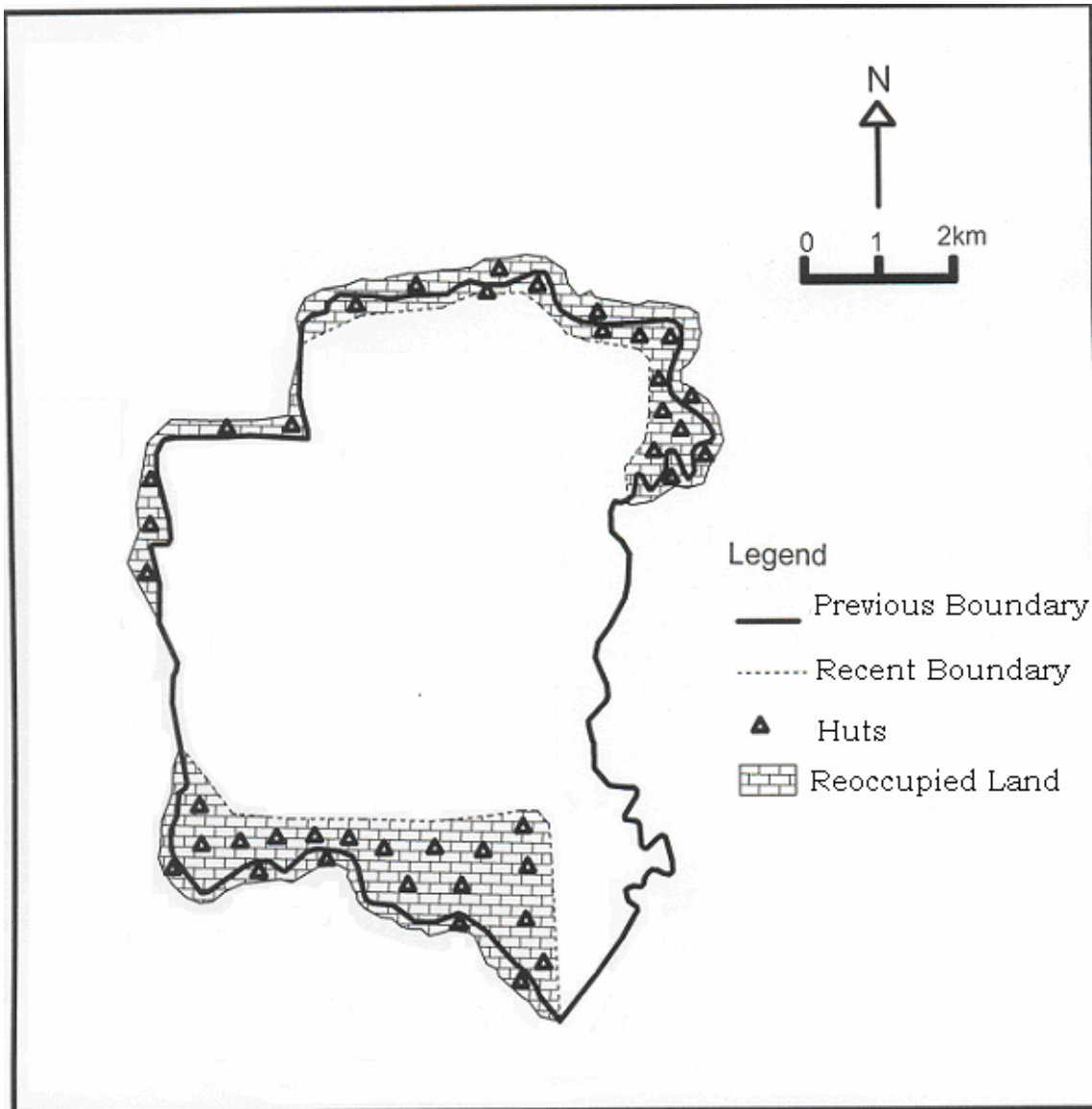


Figure 5. Map showing the previous and present boundary of the area.

3. MATERIALS AND METHODS

3.1 Duration of the study

The study was carried out from August 2005 to March 2006 to cover wet and dry seasons. The total period spent in data collection was four months. These four periods represent the three seasons experienced in and around the Senkele Swayne's Hartebeest Sanctuary, the heavy rain,

small rain and dry season and thus gave representative samples for the whole year. Quantitative data were collected during these wet and dry seasons on the population size and structure, vegetation type, habitat utilization and distribution, and diurnal activity patterns with special emphasis on the feeding behavior of oribi. The impact of the local people on the oribi and Senkele Swayne's Hartebeest Sanctuary (SSHS) was also assessed, with special reference to conservation activities.

3.2 Division of the study area

Prior to the intensive investigation, a preliminary survey was made in the proposed study area in August 2005. During the preliminary observation period, the distribution of oribi in the study area was assessed and the classification of vegetation type was carried out in line with the previous observation. The survey revealed that the vegetation cover and topography of the area was no more homogenous. For the purpose of this investigation, the entire study area was divided into five blocks based on artificial and natural boundaries such as roads and vegetation composition of the area (Fig. 6). 'Blocks' in this context refer to small areas with natural and artificial boundaries that can easily be identified on the map as well as on the ground. The distance between consecutive blocks varied depending on the vegetation cover.

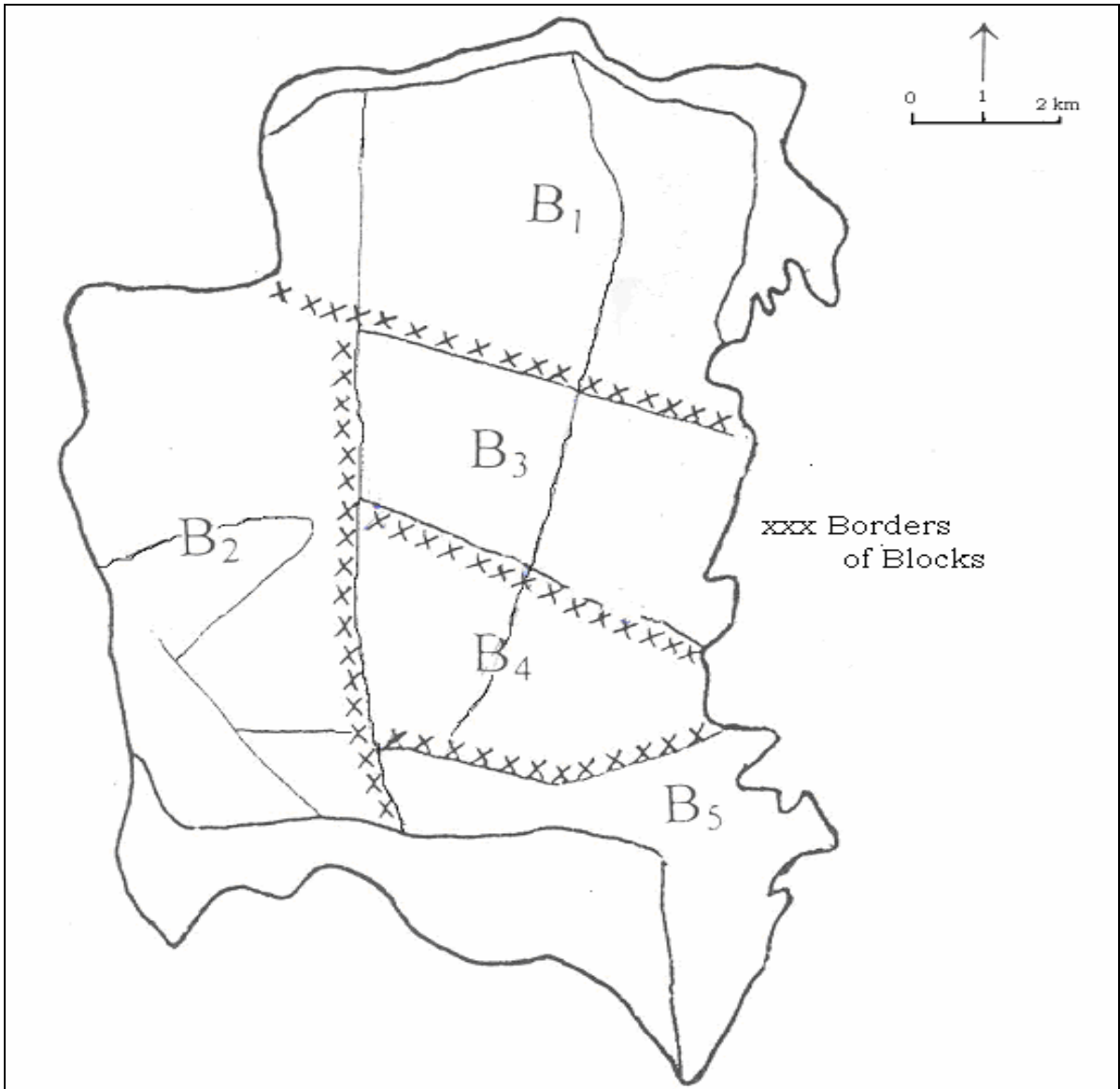


Figure 6. Division of the study area into five blocks.

3.3 Population assessment

Total count method based on silent detection was applied throughout the study period to determine the population size of oribi as adopted by Norton-Griffiths (1978), Melton (1983), Caughly and Sinclair (1994), Wilson *et al.*, (1996), Sutherland (1996), and Andanje and Ottchilo

(1999). The direct observational technique is most appropriate for medium to large sized animals that live in relatively open habitats and on fairly flat terrain (Norton-Griffiths, 1978 and Wilson *et al.*, 1996). Hence, the most direct way to estimate the abundance of a biological population, total count method, was chosen as described by Burnham *et al.*, (1980).

The direct observation and counting of population was carried out using unaided eye and /or by using binoculars. Due to the lack of vehicle and fuel, almost all observations had to be made on foot with a few exceptions. A total of four counts were carried out in each of the wet and dry seasons. The census was conducted from 07:00 to 10:00 hr in the morning and 16:00-18:00 hr in the late afternoon when the animals were most active and when visibility was good. Each count was completed in one day with the help of two to three experienced scouts of the Sanctuary. Group size, age, total number in the herd and other special features of the animal encountered were used to avoid double counting. Data were recorded on prepared data sheets (Appendix 1). During the count, records were also taken on the numbers of domestic stocks on the separate notebook using total count method.

3.4 Sex and age Structure

The sex and age composition of oribi were also recorded during the census. The individual or individuals in a herd were recorded as adult male (AM) or adult female (AF), and young, based on the works of Bowyer (1984), Hillman (1986), Kingdon (1997), and Fischer and Linsenmair (1999).

Age and sex determination were carried out based on body size, presence or absence of horn, size of horn, and development of preorbital gland. Male age was determined by estimating horn length in relation to ear length and number of annuli on horns (Brashares and Arcese, 2002). Sex ratios for the herds were obtained from direct count of the animals using the methods of Woolf and Harder (1979), Melton (1983) and Hillman (1986).

3.5 Group size

During each total count, the size of each herd (group) of oribi was recorded before further subdividing into the respective sex and age categories. When the distance between individuals was less than 50 meters, they were considered as members of the same group (herd), following Lewis and Wilson (1979), Hillman (1987), Borkowski and Furubayshi (1998). Single animals are included within the term 'group' for the purposes of analysis (Arcese *et al.*, 1995). All counts are considered to be fully representative as no additional animals were flushed from cover during detailed examination of habitats.

3.6 Distribution and vegetation type utilization

During each census, the type of vegetation where the animals were observed and the food taken was recorded for each season (Martinka, 1969; Campton *et al.*, 1988). Utilized vegetation type refers to the habitat where most oribi were observed grazing alone or in groups at a definite time (Andere, 1981). The location of each herd and the vegetation type at each location was recorded. The method of Larson *et al.* (1978) and Norton- Griffiths (1978) was used to describe the dry and wet seasons distribution and utilization of the vegetation type. An animal was followed during active feeding time to observe the plant species that was consumed. For this, a focal animal was chosen and observed with the help of a binocular and/or naked eye depending on the distance of observation. The place where the animal was feeding was spotted. Immediately after the animal moved away from the site, freshly cut plants were carefully examined; samples were collected, and brought to a herbarium for identification.

3.7 Diurnal activity pattern

All identifiable daily activity was recorded on separate behavioral data sheet (Appendix 2). Wilson *et al.* (1996) and Sutherland (1996) used silent detection method for daily activity observation of most animals. Data collection of diurnal activity pattern of oribi was made by observation of free-ranging animals using unaided eye and/or binoculars. Selecting suitable vantage points especially hilltops facilitated the observation. To record the activity pattern of oribi, the methods described by Leuthold (1971), Jarman and Jarman (1973), Guy (1976), Mitchell (1977), Irby (1982), Brashares and Arcese (2002) were used. The activity of each oribi individual in each group under observation was recorded and ticked on the sheet at five-minute intervals. When unique activity was observed, it was recorded on separate notebook as it occurs. Alternate focal periods were used between morning (6-10 a.m.), mid-day (10 a.m. to 2 p.m.) and late afternoon (2-6 p.m.) sessions. Observation was carried out for 5 consecutive days for each study period. A total of 20 days were used for the whole study period. Animals were classified as 'inactive' (pooled sitting and standing without motion) or 'active' (walking, running, feeding, grooming, etc.). The major activities were recorded as 'feeding' (whether the animal is grazing or browsing) 'walking' (if the animals were walking at a steady pace), 'sitting/lying' (head up or down in the open or in the shade), 'standing' (if not engaged in any other activities) and 'other activities' (watching, grooming, courting/mating, urinating, defecating, sniffing of genitalia, running, antagonism towards other oribi).

3.8 Assessment of the impact of the local people

In order to assess the impacts of the local people towards oribi, and the Sanctuary in general, interviews and discussions were carried out with local respected and knowledgeable elderly people, any member of the community, school communities, scouts, warden of the Sanctuary and local government officials. The interviews and discussions were carried out using the questionnaire prepared for this purpose (Appendix 3). The questionnaire was pre tested by small number of interviews before conducting main interviews among some group of population, which is not included in the main sample group to make it more practical. Four farmer associations were selected for household questionnaire study. Each farmer association differed from the other in its geographical location and household numbers. The four farmer associations Loke Sifo, Kite Tesisa, Senbete Lencho and Kela Lalima had 1529, 238, 792 and 828 households, respectively (CSA, 1995). A total of 80 individuals were interviewed and the questionnaire was administered to members of the household in a random manner alternating male and female respondents and different age groups as much as possible. Informal interviews with the residents were also carried out whenever opportunities allowed during the study period at various sites. Oromigna language was used as a mode of communication and Amharic was also used occasionally. Total count on number of huts inside and surrounding the Sanctuary and domestic livestock's was also carried out. The data were pooled together and SPSS version 12 was used for statistical analysis and analyzed using descriptive statistics and one-way ANOVA.

4. RESULTS

4.1 Population assessment

The results of each total count of oribi population in the study area for both wet and dry seasons are given in Table 1. The maximum number of Oribi (*Ourebia ourebi*) population counted was 63 during the dry season II and the minimum number was 40 during wet season I. There were no marked differences in the total number of oribi in the wet and dry seasons ($P>0.05$). However, there is a slight increase in the dry season compared to the wet season.

Table 1. Total counts of Oribi during wet and dry seasons.

| Season | B-1 | B-2 | B-3 | B-4 | B-5 | Fallow land | Total |
|--------|--------|--------|-------|-------|--------|----------------|-------|
| Wet I | 13.00 | 18.00 | 6.00 | 4.00 | 9.00 | - | 50.00 |
| Wet II | 8.00 | 6.00 | 6.00 | 5.00 | 10.00 | 5.00 | 40.00 |
| Mean | 10.50 | 12.00 | 6.00 | 4.50 | 9.50 | 2.50 | 45.00 |
| Dry I | 8.00 | 6.00 | 12.00 | 15.00 | 9.00 | 1.00 | 51.00 |
| Dry II | 11.00 | 10.00 | 14.00 | 15.00 | 13.00 | - | 63.00 |
| Mean | 9.50 | 8.00 | 13.00 | 15.00 | 11.00 | 0.50 | 57.00 |
| Mean | 10.00± | 10.00± | 9.50± | 9.75± | 10.25± | 1.50± | 51.00 |
| ± SE | 0.63 | 1.47 | 1.07 | 1.58 | 0.49 | 0.62 | |

The average number of oribi counted during the wet and dry seasons was 45 and 57 respectively (Table 1 and Fig. 7). The mean oribi population of wet and dry seasons count was 51 individuals. Among blocks, the highest average number was in Block 5 and the lowest counted average

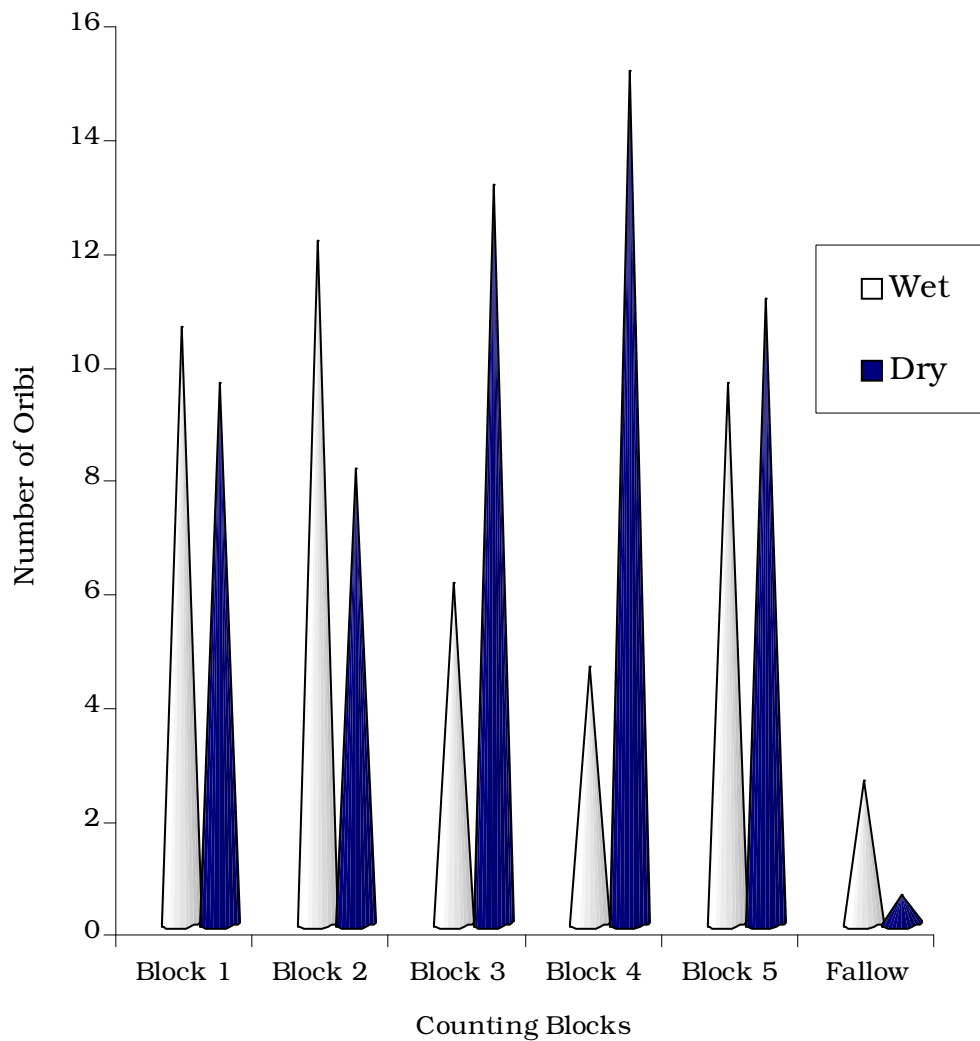


Figure 7. Number of Oribi in each block during both seasons.

number was in the fallow-land (previous state farm), out side the Sanctuary. The total number counted in the other blocks also approach to the highest counted number as in Block 5. More number of oribi was observed during the wet season in Blocks 1 and 2 and in the fallow-land than the dry season. However, there was no significant difference observed in all cases ($P>0.05$). On the other hand, more number of oribi was observed in the dry season in Blocks 3, 4 and 5 than the wet season. However, a significant difference was observed only in the case of Block 3 and Block 4 ($P<0.05$). In general, there was no significant difference observed between wet and dry seasons ($P>0.05$).

4.2 Sex and age structure

The oribi populations were categorized into sex and age groups based on the observations during the total counts in each blocks (Table 2). Out of an average of 51 individuals counted during the present study period, 41.2% were adult males, 51.7% adult females and 7.1% were young. The sex ratio of adult males to adult females was 1.00:1.23 and 1.00:1.28 during wet and dry seasons, respectively. In addition, the sex ratio of adult female to young was 1.00:0.16 and 1.00:0.12 during wet and dry seasons, respectively. There was no significant difference in the sex ratio observed during both seasons ($P>0.05$). On average 92.9% of the total population were adults and only 7.1% constituted young.

Table 2. Age and sex structure of Oribi during wet and dry seasons.

| Season | Adult Male | Adult Female | Young | Total | Sex Ratio | |
|------------|------------|--------------|-------|--------|-----------|-----------|
| | | | | | AM: AF | AF: Young |
| Wet | 18.50 | 22.75 | 3.75 | 45.00 | 1.00:1.23 | 1.00:0.16 |
| Dry | 23.50 | 30.00 | 3.50 | 57.00 | 1.00:1.28 | 1.00:0.12 |
| Mean | 21.00 | 26.37 | 3.63 | 51.00 | 1.00:1.26 | 1.00:0.14 |
| Percentage | 41.20 | 51.70 | 7.10 | 100.00 | | |

4.3 Group size

The total number of groups, the range of group size and mean group size of Oribi is shown in Table 3. Groups of up to seven were recorded, but such groups scatter in all directions. The group size ranged 1-7

individuals. *Ourebia ourebi* commonly observed in groups of up to five individuals. Such groups did not contain more than one or two adult males but often have more than one or two adult females. They were mostly observed solitary or in pairs and occasionally they form a few families. During the study period oribi were emerging in groups of three to five in the morning and evening to graze and browse. They were often associated with Swayne's hartebeest, and sometimes fed among domestic livestock for protection.

Table 3. Group size of Oribi (*Ourebia ourebi*) in different seasons.

| Season | Number of oribi | Group Number | Range of group size | Mean group size |
|--------|-----------------|--------------|---------------------|-----------------|
| Wet | 45 | 55 | 1-7 | 4.4 |
| Dry | 57 | 69 | 1-5 | 2.6 |
| Mean | 51 | 62 | 1-6 | 3.5 |

The group size differed within the wet and dry seasons. The highest range of group size was recorded during the wet season (1-7) with the mean group size of 4.4. However, the total number of groups observed during the wet season was minimum (55). While during the dry season the total number of oribi groups observed was highest (69) but the range of group size was smallest (1-5) with the mean group size of 2.6. Large group sizes of oribi (up to 7) were aggregated during the wet season, while during the dry season they split in smaller number of groups and are distributed in a wider area during the wet season.

Individual groups varied in size from one to seven across the area, with a modal group size of two (Fig 8). There were no significant differences in the group size across sites ($P>0.05$). The largest groups were found on the 'short' grasslands and the smallest within woodland and long grasses.

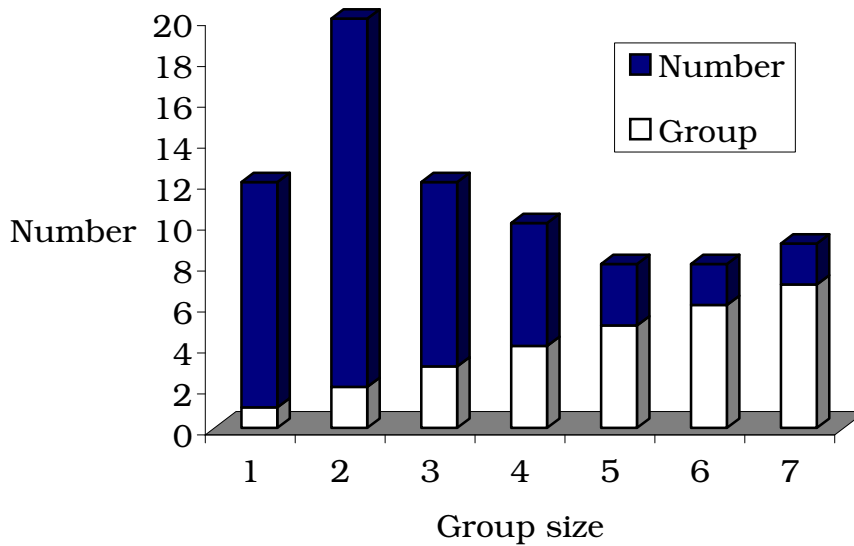


Figure 8. Distribution of group sizes of oribi.

4.4 Distribution and vegetation type utilization

The oribi population was distributed into four vegetation communities (Table 4 and Fig. 9). The oribi distribution showed a very high utilization for short grass in each vegetation communities. *Ourebia ourebi* were observed primarily as grazers, mainly preferred to graze or eat short grasses in both seasons. But also observed as they browse on foliages and young shoots during the dry season. The distribution of the animal varied according to the season. The table shows (Table 4) the number of oribi seen in each vegetation type and expressed in percentage of he total number of animals seen during wet and dry seasons of the study period. The highest numbers of oribi were observed in all vegetation types during the dry season than the wet season except the fallow land ($P > 0.05$) (Table 4 and Fig. 9). The tendency of population distribution towards *Pennisetum* grassland (PG) increased during both wet and dry seasons i.e. 44.4% and 42.1%, respectively. While in *Pennisetum* grassland type 2 (P_2) community and mixed grassland (MG), the mean distribution was

equivalent, i.e. on average 29.4% and 24.5 % respectively. The P₂ and MG vegetation communities were utilized more during the dry season than the wet season. Comparably, very small numbers of oribi population (2.9%) were observed moving out of the study area into the fallow-land (the former state farm) during the late wet season and early dry season due to the vegetation and the relative safety of the Sanctuary.

Table 4. Number of Oribi observed in different vegetation zones.

| Season | Total count | <i>Pennisetum</i> grassland | P ₂ (Type 2) | Mixed grassland | Fallow land |
|--------|-------------|-----------------------------|-------------------------|-----------------|-------------|
| Wet | 45 | 20 (44.4%) | 12.5 (27.8%) | 10.0 (22.2%) | 2.5 (5.6%) |
| Dry | 57 | 24 (42.1%) | 17.5 (30.7%) | 15.0 (26.3%) | 0.5 (0.9%) |
| Mean | 51 | 22 (43.1%) | 15.0 (29.4%) | 12.5 (24.5%) | 1.5 (2.9%) |

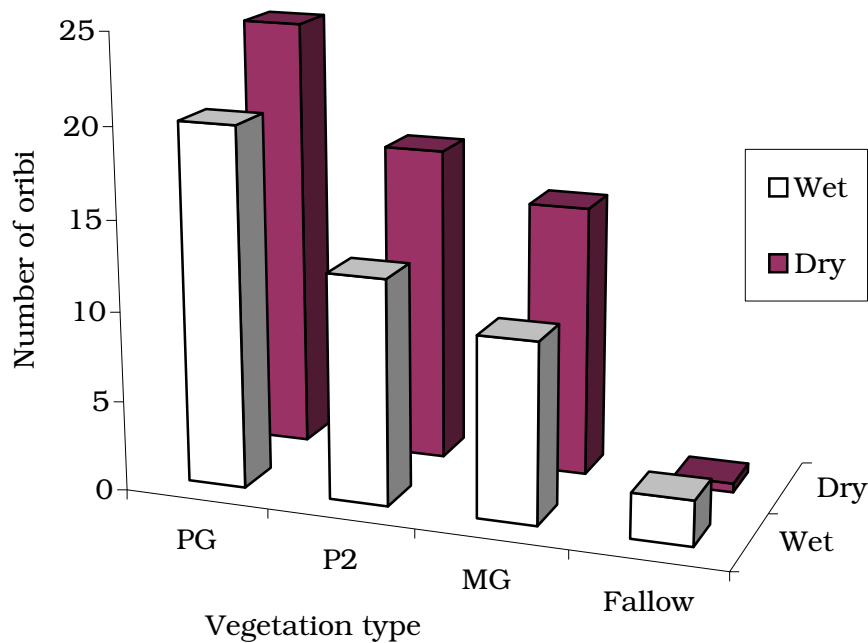


Figure 9. Number of oribi population observed at different vegetation zones.

Oribi normally fed during the late afternoon and early morning. They favored moist grassland on flat to gently sloppy area with actively growing short grass for food adjacent to long grass which is required to provide cover from predators, as well as shelter for the young. Oribi were observed selecting certain species and parts of grass. They leave when the grass becomes too long. They were often associated with Swayne's hartebeest and sometimes fed among domestic livestock. Oribi showed a high preference for eating grasses in burnt areas during the dry season. They were observed to utilize post-burn green grasses (Plate 2).

Ten species of grasses, fourteen species of herbs and shrubs and seven species of principal trees were randomly selected from the study area and identified in the herbarium (Appendix 4). Among these plants, twenty-two (22) species were identified as being eaten by oribi in Senkelle, among which nine (9) species were utilized and appeared to be more preferable species throughout the year from their sighting frequency data collected on feeding behavior. These were: *Themeda triandra* (Oat grass), *Hyparrhenia hirta* (thatch grass), *Pennisetum shimperi*, *Melinis repens*, *Cyndon dactylon* (almost exclusively in the fallow land area), and *Acacia* species, such as, *Acacia abyssinica*, *Acacia clavigera*, *Acacia lahai* and *Acacia albida*. Oribi preferred mostly grass species throughout the year. Out of a total of 288 feeding behavioral observations, 256 were spent on foraging grass species (Table 5). There was no seasonal difference in the percentage frequency of grass species consumption between the wet and dry seasons ($P > 0.05$). *Themeda triandra* was the most preferred diet accounting for 59.8% of the total sight frequency of grass intake.

The tree and shrub layer in Senkelle is dominated by acacia species and *Clematis hirsuta*. The most common species was *Acacia abyssinica*,

followed by *Acacia lahai*, *Acacia albida* and *Croton macrostachys*. Shrub cover in fallow land was limited to a few regenerating acacia species.

Table 5. Sighting frequency of oribi on the grass species.

| Grass species | Sighting frequency | Percentage (%) |
|--------------------------------|--------------------|----------------|
| <i>Themeda triandra</i> | 153 | 59.8 |
| <i>Pennisetum schimperi</i> | 35 | 13.7 |
| <i>Melinis repens</i> | 27 | 10.5 |
| <i>Hyparrhenia hirta</i> | 23 | 9.0 |
| <i>Cyndon dactylon</i> | 18 | 7.0 |
| Total | 256 | 100.0 |



Plate 2. Oribi (*Ourebia ourebi*) on post-burn green grass.

Fire favored *Themeda triandra*, which was a highly preferable grass species in the study area by oribi. They were also observed to visit mineral licks three times during the study period. Oribi was not observed drinking water, even when it was available in the area from my observation.

4.5 Diurnal activity pattern

Data on the various activities recorded throughout the study period were condensed to form five major activity states, namely: 1) feeding (grazing or browsing), 2) standing, 3) sitting/lying (in the open or in the shade), 4) walking, and 5) other activities. Data from 20 days continuous contact provided 240 hours of observation. Percentage of oribi observed in various activities at different times of the day between 0600 and 1800 hrs are given in Table 6 and Fig. 10. The average proportion of animals engaged in each of the above activities for the whole day is as follows: 1) feeding, 54.7%, 2) standing, 8.6%, 3) sitting/lying, 19.9%, 4) walking, 8.6%, and 5) other activities, 8.3%. The annual mean proportion of day light hours spent feeding was 54.7%. Almost equivalent amount of time was spent on standing and/or walking (8.6%), while the remaining was spent on sitting or lying and other activities.

Feeding

Unless the temperature is very cold and rainy, the oribi commence grazing at about 0600 hours. This activity continued until 1000 hours. Then, they select suitable cover to lie down and ruminate for a variable length of time. This period was often interrupted by brief feeding activity. Feeding may take place at all hours of the day until dusk but drastic reduction in feeding activity was seen between 1100 and 1400 hours.

There were two peaks in feeding, one in the early morning between 0600-1000 hours, and another in the late afternoon between 1600-1800 hours.

Resting/Idling

The proportion of animals under bushes or tall grasses (shades) and/or in the open was highest during the middle of the day between 1000 to 14000 hours. Most animals remain inactive during the noon hours, the hottest period. The amount of time spent in open area decreases as the day becomes warm, with a corresponding increase in resting the shade. Animals were also observed to lie down rarely.

Walking

Animals were recorded as walking even if only over short distances when engaged in feeding. Females often led and perhaps initiated these walks. At certain times during the day, the group of oribi walk, often long distances and recommence feeding.

Other activities

During resting period, they lie in grass with their heads erect, keeping a watchful eye around them in all directions. When they feel there is no danger, they continue their usual activities. If suddenly disturbed, they produce an alarm call, a soft whistle (phi-phi-phi) sound that helps keep the group in vocal contact and run away. After running for a few distances, they stop and look back at the source of disturbance. Other activities such as, grooming, sniffing of genitalia, urination, defecation, fighting, and other social activities were mainly observed during the warm resting periods between 1100 to 1300 hours. During these hours,

activities such as breast-feeding, male sniffing the female's genitalia area, marking a grass stem with preorbital glands, urinating and defecating in sequence, fighting each other and chasing occur.

Table 6. Diurnal activity patterns of Oribi (*Ourebia ourebi*).

| Time | Feeding | Standing | Sitting /Lying | Walking | Others |
|-----------|---------|----------|-------------------|---------|--------|
| 0600-0700 | 69.9 | 3.7 | 3.5 | 14.6 | 8.2 |
| 0700-0800 | 67.7 | 2.3 | 6.6 | 15.5 | 7.8 |
| 0800-0900 | 70.6 | 2.4 | 8.3 | 11.4 | 7.3 |
| 0900-1000 | 61.1 | 3.3 | 16.6 | 10.9 | 8.2 |
| 1000-1100 | 47.9 | 11.3 | 26.8 | 5.9 | 8.1 |
| 1100-1200 | 37.5 | 11.1 | 35.6 | 4.9 | 10.9 |
| 1200-1300 | 36.9 | 16.4 | 32.7 | 3.8 | 10.1 |
| 1300-1400 | 30.6 | 21.8 | 37.9 | 3.8 | 6.0 |
| 1400-1500 | 45.7 | 12.8 | 29.6 | 5.0 | 6.9 |
| 1500-1600 | 49.2 | 10.0 | 22.7 | 8.4 | 9.8 |
| 1600-1700 | 66.5 | 5.2 | 10.9 | 10.5 | 6.9 |
| 1700-1800 | 72.7 | 2.3 | 7.3 | 9.0 | 8.8 |
| Mean | 54.7 | 8.6 | 19.9 | 8.6 | 8.3 |

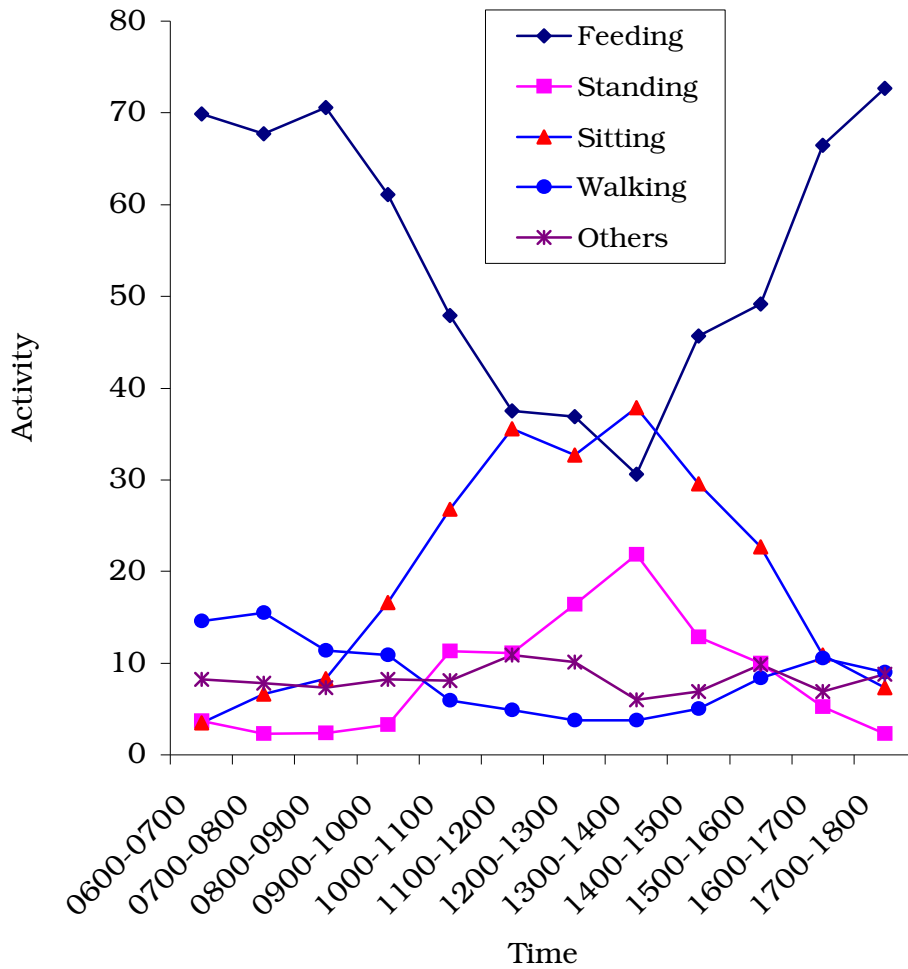


Figure 10. Diurnal activity pattern of oribi (*Ourebia ourebi*).

4.6 Assessment of the impact of local people

Interviews and discussions that were held with the local communities (Plate 3), local governmental officials and school communities made it possible to understand the attitude of the local people towards conservation efforts and impacts on the oribi, and the sanctuary as a whole. The views of local communities revealed during the questionnaire survey are comparable with the findings of the present investigation on the

decline of oribi population in the area. Attitude of local communities towards wildlife are important elements to ensure the long-term survival of wildlife resources. Among 80 interviewed individuals 87.5% of them had a negative attitude, 7.5% had a positive attitude and 5% neutral attitude towards the wildlife and the Sanctuary as a whole. The following factors are considered as major threats that may affect the status of oribi in the study area.

4.6.1 Habitat loss and fragmentation

Most of loss of habitat types and species composition occurred mainly due to livestock grazing, which led to disappearance of high forage species and encroachment of shrubs and trees. The expansion of large amount of acacia seedlings in grassland habitat in many parts of the sanctuary increased bush encroachment (Plate 4). Cutting of trees for the sake of fuel wood and for timber production has been a common practice in and/or around the sanctuary. Deforestation is increasing from time to time, leading to permanent destruction of the habitat. Local people cut trees (e.g. *Acacia* spp., *Terminalia glaucescens*, *Albizia schimperiana*) for house construction. About 23 trees were observed when cut by the local communities and laid down on the ground through out the study period. Over 150 women (each with a donkey) have been observed collecting firewood from inside and around the border of the sanctuary per month.



Plate 3. Discussion held with the local communities.

The dominant grass species, *Pennisetum schimperi* was harvested for use in house construction. The current growth of human population resulting in increase in the demand for food, farmland and other natural products has already had a huge effect on the sanctuary.



Plate 4. Increased bush encroachment in the Sanctuary.

4.6.2 Human disturbance

The status of oribi has been affected by the occupation of suitable habitats by pastoralists, the daily activities of the local people that settled in and/or around the sanctuary and over 50 constant passage of human beings on horseback, foot and by shouting along the sanctuary. Every morning local people with large number of donkeys were observed passing through the

sanctuary and return back home with wood and grass. About 75 females of the surrounding area per day also spend their time in the sanctuary by collecting firewood and thatch grass for selling or to make household furniture. In the census count of huts inside and surrounding the Sanctuary, there were 112 newly constructed huts and 117 formerly built huts were found inside the Sanctuary at Kela Lalema and Kite Tesisa sides. In all corners bordering the sanctuary, there are 1767 huts (Plate 5). The number of people in the surrounding six farmer associations near the Sanctuary was estimated to be 24,183 in 2004 (Table 7). The number of people in 2004 increased by about 30.4% compared to that of 1999 data (Table 8). They grow mainly maize and potatoes. Such expansion of farming land mainly on the southern part of the sanctuary is one of the most important threats to the oribi and generally to the constriction of the sanctuary. Oribi sometimes leave the sanctuary and enter the farmers land at night and consume mostly maize at young stage, millet and other cereal crops. The settlers chase the oribi away from their farmland by shouting, whistling, throwing stone and by shouting whip.



Plate 5. Huts constructed bordering the Sanctuary.

Table 7. Number of human population at SSHS (2004) (Source: Siraro Woreda Agricultural Office, 2004).

| Farmer's association | Males | Females | Total |
|----------------------|-------|---------|-------|
| Loke Sifo | 2721 | 2917 | 5638 |
| Senbete Lencho | 1960 | 2116 | 4076 |
| Kite Tesisa | 1914 | 2060 | 3974 |
| Kela Lalima | 1879 | 2050 | 3929 |
| Shewako | 1279 | 1327 | 2606 |
| Bitena Kubi | 2001 | 1959 | 3960 |
| Total | 11754 | 12429 | 24183 |

Table 8. Number of human population at SSHS (1999)
(Source: Siraro Woreda Agricultural Office, 1999).

| Farmer's association | Males | Females | Total |
|----------------------|-------|---------|-------|
| Bitena Kubi | 1138 | 1142 | 2280 |
| Sifo | 1215 | 965 | 2180 |
| Shewako | 910 | 1136 | 2046 |
| Tesisa | 846 | 1096 | 1942 |
| Kela | 864 | 158 | 1022 |
| Kite | 757 | 1588 | 2345 |
| Loke Kencha | 1236 | 1224 | 2460 |
| Lencho | 1262 | 1297 | 2559 |
| Total | 8228 | 8606 | 16834 |

4.6.3 Livestock abundance

The increasing number of livestock around the sanctuary was one of the important factors affecting the status and distribution of oribi. The data obtained from Siraro Woreda Agricultural Office (2004) shows that there are about 59,821 domestic animals (Table 9 and Fig. 11). The 1999's SWAO data indicates that, there were about 52,263 domestic livestock (Table 10). The data comparisons between the two indicate that, the number of livestock increased by 12.6%. The Arsi mixed farming farmers bordering the Sanctuary had large number of cattle but have no sufficient grazing land. According to the local people on the discussion, the advantage of having large number of livestock is mainly as a source of money to dowry during marriage ceremony. It can also be used as a reflection of their wealth among the society. From my observation, the large number of cattle and scarcity of grazing land had made the local people highly dependent on the sanctuary for grazing. Others from far areas also utilize the Sanctuary. During the late dry season to late wet season, they use the Sanctuary as a temporary settlement area and for livestock feeding.

The dominant herbivores over the whole study area are cattle, goats, sheep, donkeys, horses and mules. The presence of thousands of livestock competes directly for food with oribi and other wildlife in the Sanctuary. Livestock distribution throughout the Sanctuary increased especially during the wet and late dry seasons, when the grasses were at grazable size. During the wet season, the number of livestock counted inside the Sanctuary was 28,940 and during the dry season, these were only 6,500

(Plate 6). The open palatable grasslands have been changed to unpalatable grassland and dominated by various species of *Acacia* (Plate 7).

Table 9. Number of livestock population surrounding SSHS (2004) (Source: SWAO, 2004).

| Farmer's association | Cattle | Horse | Mule | Donkey | Sheep | Goat |
|----------------------|--------|-------|------|--------|-------|------|
| Bitena Kubi | 4976 | 54 | 9 | 714 | 812 | 1311 |
| Loke Sifo | 6276 | 64 | 11 | 627 | 2115 | 2192 |
| Shewako | 6587 | 46 | 10 | 579 | 1720 | 1114 |
| Kite Tesisa | 7721 | 59 | 26 | 847 | 1915 | 2184 |
| Kela Lalima | 5877 | 21 | 16 | 504 | 1240 | 1579 |
| Senbete Lencho | 6332 | 76 | 4 | 312 | 919 | 972 |
| Total | 37769 | 320 | 76 | 3583 | 8721 | 9352 |

Table 10. Number of livestock population surrounding SSHS (1999) (Source: SWAO, 1999).

| Farmer's association | Cattle | Horses | Mules | Donkeys | Sheep | Goats |
|----------------------|--------|--------|-------|---------|-------|-------|
| Bitena Kubi | 3992 | 78 | 15 | 400 | 942 | 1012 |
| Sifo | 4565 | 72 | 12 | 356 | 1544 | 844 |
| Shewako | 4633 | 42 | 14 | 280 | 1256 | 604 |
| Tesisa | 3212 | 70 | 9 | 350 | 839 | 1523 |
| Kela | 4774 | 81 | 10 | 408 | 1222 | 1031 |
| Kite | 4892 | 41 | 8 | 286 | 1103 | 792 |
| Loke Kencha | 2781 | 79 | 11 | 360 | 998 | 655 |

| | | | | | | |
|--------|-------|-----|----|------|------|------|
| Lencho | 3885 | 91 | 6 | 405 | 1122 | 558 |
| Total | 32734 | 554 | 85 | 2845 | 9026 | 7019 |

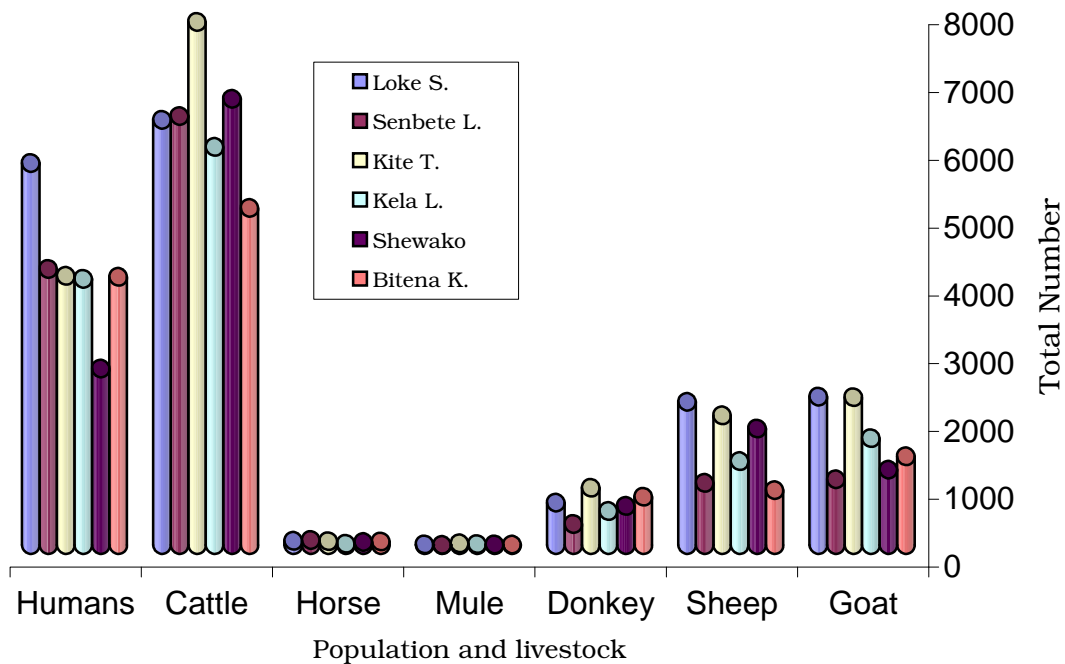


Figure 11. Number of human and livestock population around SSHS
(Source: SWAO, 2004).



Plate 6. Livestock abundance in the Sanctuary.



Plate 7. Dominate *Acacia* species and unpalatable tall grasses in the area.

4.6.4 Poor burning practices

The loss of grasslands is a very real threat to the survival of oribi because oribi is a grassland specialist and cannot survive elsewhere. The burning program was carried out in the study area by the pastoral community, aimed at improving the forage resources (grasslands) to the local livestock population. Since livestock utilizes the natural grasslands primarily during the wet season, the majority of fires had been ignited during the mid-dry season, expecting the 'Belg' rains to encourage grass growth (Plate 8).



Plate 8. Poor burning practice by local communities.

The oribi population benefited greatly from the dry season fires by utilizing the freshly burnt natural grasslands (Plate 2). Initially, the animals spent only short periods of time and fed on the ash residues, but within a couple

of weeks they spent longer periods and feeding extensively on the new shoot.

4.7 Predation

The possible natural enemies or predators of oribi in the study area are common jackal (*Canis aureus*), spotted hyena (*Crocuta crocuta*) and leopard (*Panthera pardus*). Hyena droppings were frequently observed in the Sanctuary. Both leopards and spotted hyenas could kill oribi adult and calves. The oribi population has been observed when killed by jackals during the study period (Plate 9). Jackals frequently attack the calves of antelopes and domestic animals in the area and also a group of four jackals was seen killing an adult female during the study period.



Plate 9. Female oribi (*Ourebia ourebi*) and common jackal (*Canis aureus*) nearby on the fallow-land.

5. DISCUSSION

In the total count of oribi population in the Senkelle Swayne's Hartebeest Sanctuary (SSHS), no significant difference was observed between the counting of wet and dry seasons. However there is a slight increase in the late dry season than the wet season may be due to birth. The reason for the difference may be due to the maximum growth of grass in relation to their small size (Plate 4) that made counting more difficult. Mduma and Sinclair (1994) described oribi to occur close to rocks during the dry season and in areas with long grass during the wet season. These are used for cover against predators in the Serengeti National Park, Tanzania. During the dry season II, the maximum numbers of oribi were counted due to the burnt grass, which encouraged the growth of green fresh grass, which is high quality forage. This made them more visible to count (Plate 1). There were no oribi counted outside the Sanctuary in the fallow land during the wet season I and dry season II. However, small numbers of oribi were counted in the fallow land during wet season II and dry season I. This may be following the movement of Swaynee's Hartebeest (*Alecelaphus buselaphs swaynei*) out of the Sanctuary, as a

result of the appearance small insects on the *Pennisetum* grass that may bite them (Messana and Bereket Netsereab, 1994). The significant association with larger resident ungulates also suggested that oribi were avoiding predators (Mduma and Sinclair, 1994) or may be due to grazing facilitation.

The study shows that the male to female sex ratio is unequal. The male oribi populations are less than the females. The average sex ratio for the adults was 1.00:1.26. In Gorangoza National Park an adult sex ratio of 1.00:1.40 was recorded (Estes, 1992). The possible reasons for an unequal sex ratio may be due to an increased predation pressure on males, due to greater boldness and the emigration of subordinate males to less favorable habitats (Estes, 1974). Males actively defended the territory against intruders. Fires sweep through long grasslands every dry season, leaving little and sometimes no cover in oribi territories for concealment against predators (Estes, 1992). In addition, most of the time, the adult males are solitary and are exposed to danger (Smithers, 1983). The oribi has been considered a possible connecting link between monogamous and polygynous mating systems, solitary and gregarious forms of organization (Estes, 1992). Estes (1974) suggested that in most gregarious antelopes adult sex ratios generally vary from 1.00:1.50 to 1.00:2.00 in favor of females. Polygyny and territoriality may co-occur when the sex ratio is skewed towards females or the sex ratio may become skewed towards females because of the dispersion of females which allows males to defend more than one female while excluding other males (Brashares and Arcese, 2002).

The average adult female to young ratio was 1.00:0.14. The considerable decline of young population may be due to oribi calves are more susceptible to predators, particularly by common jackal. In addition, the grassland habitat may not be suitable for calves due to the ongoing

encroachment of bush and the burning practices by the local communities in the area during the dry season (Plates 4 and 5).

A wide range of group sizes was recorded during the study, although a modal group size of two is consistent with a monogamous mating system. However, significant numbers of large groups were recorded. These varied both in size and sex composition. Although variation in group size is common in larger, more mobile ungulate species, differences in group size amongst small, more sedentary species are more difficult to explain (Thirgood, 1996). Groups were largest on those sites with limited cover. These results suggest that a function of grouping in oribi may be concerned with vigilance duties; males may be more committed to the defense of the territorial boundaries (Mduma and Sinclair, 1994). A group of oribi usually monitors in all directions and is alarmed by any one of the group members when disturbed. Hannon and Martin (1992) described both sexes of oribi could contribute indirectly to the protection of the group, through increased vigilance. The oribi group were also alarmed by association with other herbivores such as hartebeest, domestic livestock and also some bird species like francolins when there is danger.

Based on the result, the aggregation of large group of oribi population in the wet season in a limited area and splitting in to smaller groups and dispersal to a wider area may be due to their selective feeding behavior to get more preferable forage. Frey (2000) described this typical of small-bodied antelopes, which are selective feeders in order to disperse widely to get for better food.

The distribution of oribi to wider area of all vegetation communities might be to avoid the unpalatable tall *Pennisetum* grassland and due to shortage of foraging access. Oribi were distributed more during the dry season in P₂ (Type-2) and MG communities than the wet season because

they may get more protection or hiding position from the disturbances of domestic livestock and due to the presence of more scattered woody plants for shading. They may also get more palatable soft grass. Owen-Smith (1982) reported that during the dry season, there is an increase in feeding time with decreasing food availability for several African grazing animals. Feeding in the woody cover vegetation community may help them to overcome the heat and to conserve water loss. Generally, higher number of oribi was observed during the dry season than that of the wet season in all vegetation communities. However, in the fallow-land highest number was observed during the wet season compared to the dry season. Oribi was moving out of the Sanctuary to the fallow-land following the movement of Swayne's hartebeest. This is because, when the people and their livestock migrate from the area and also due to the appearance of bruchid larvae on the large grasses of *Pennisetum* which may bite them (Lamprey *et al.*, 1974). Areas of natural grassland, which have never been cultivated, are invariably dominated by *Pennisetum schimperi* that is a tall very coarse unpalatable grass, which had invaded all other vegetative associations. It is considered to be of little value as forage and is usually associated with overgrazed grasslands (Edwards and Bogdan, 1951). Lewis and Wilson (1979) confirmed that the animal living without drinking free water could get their entire water requirement from the vegetation they eat.

Time devoted to feeding was at a maximum during the dry season. It then gradually decreased during the late wet season. An increase in feeding time with decreasing food availability in the dry season has been reported for several African grazers (Owen-Smith, 1982). During the present study, the annual mean proportion of diurnal time spent feeding by oribi at Senkelle, was estimated to be 54.7% and ranged from a minimum at the height of, at the end of wet season, to a maximum at the dry season. Lying/sitting showed a similar pattern, although variation was less. Whereas walking and standing displayed with maximum values recorded during the dry season and minimum values during the late wet season. The reason is probably due to better grazing availability, which requires less movement in search of suitable pastures. The levels of other activities were at their maximum in the early wet season.

The morning and evening activity peaks were most obvious during the dry season, with most animals remaining inactive during the hottest hours of the day. As the wet season progressed, feeding and other activities continued for longer period and, by the end of the wet season, even at mid-day, more than 30% of oribi were still active. Shading behavior in response to high temperature was most conspicuous in the late dry and early wet seasons. In the remaining periods, shading behavior was very seldom observed, even during the hottest hours of the day (1200-1400 hrs). At Senkelle, oribi make significant use of shade only in the hottest months/periods and then only during the warmest hours of the day. Food availability, weather condition, nutritive demand and protection from predation may be the determining factors for a slight variation in the wet and dry seasons activity patterns (Delany and Happold, 1979; Roberts and Dunbar, 1991).

The data obtained from SWAO (2004) indicates that, there is a great increase in human and livestock population in the study area compared to the data from 1999. With increasing human pressure in and around conservation areas, human-wildlife interactions are becoming more common (Corti *et al.*, 2002). Oribi and other wildlife in the Sanctuary have suffered from the ever-increasing human population pressure in and/or around, through commonly practiced activities, such as: large number of livestock grazing, firewood collection, cutting of grass, continuous movement of the people through the Sanctuary and cultivation of the land by the settled communities in and/or around the area. The overgrazing and settlement encroachment are considered primary factors that affect the population status of oribi, by deteriorating the grass quality of the Sanctuary. Moreover, this enhances bush encroachment in the area. The effect of overgrazing by livestock population for many years has resulted in

a significant change on the vegetation cover. One of the accepted causes of bush encroachment is the reduction of grasses, e.g. by overgrazing, which allows more water to penetrate to deeper soil layers thus becoming available for woody growth (Messana and Bereket Nestereab, 1994). Moreover the presence of large numbers of livestock in the area may also contribute to the regeneration of shrubs in another way. The ingestion of *Acacia* pods by herbivores may promote seed dispersion and facilitate germination. Fire may facilitate the germination of newly growing acacia seedlings, which is going to dominate the area gradually (Plate 6). This leads to the decline of the quality and productivity of palatable grazing grassland and domination of unpalatable plant species such as *Pennisetum schimperi*. Although fire may thus facilitate the germination of *Acacia* seeds, prescribed burning in the late dry season can be used as a powerful tool to reduce bush encroachment and increase forage productivity (Lamprey *et al.*, 1974). Bolton (1969) reported that, wild ungulates in the grassland plains suffer from disturbances by human and domestic livestock. Expansion of settlement and human activities in the conservation areas of Ethiopia can cause great disturbance to wildlife (Schloeder, 1996). It is important to devise ways in the future for the conservation of wildlife in collaboration with the local community (Lakew Birhanu, 2001). It is known that wildlife conservation is effectively achieved only with the cooperation and support of the local people (Balakrishnan and Ndhlovu, 1992).

During the group discussion and interview held with the local communities, most of them were not happy and did not volunteer to tell the facts about the interaction with the Sanctuary, since they did not get enough benefit from the tourist income and other sources of the Sanctuary. The only benefit obtained was getting the vehicle during emergency case to take patients to the nearby health center and hiring as daily laborers during maintenance of the road. The attitudes of the

local communities toward the Sanctuary were almost the same. They need to live harmoniously with the conservation area, by utilizing the Sanctuaries resources as a free grazing land for their livestock and fuel wood collection site. Even though they pretend, as they had not been causing problems in the Sanctuary, they knew well as they are creating pressure on the wildlife in the area. The local population, especially those having cattle need the area to be conserved, not for the sake of the wildlife of the Sanctuary but for the need of their livestock. Some other people with scarce of farmland, want the area for farming activities. In general, the common understanding of the community was, if they have improved standard of living, especially having potable water and other infrastructures, such as school, health center, road, market, etc. they believe that the pressure on the Sanctuary will decrease in the future.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

The Oribi (*Ourebia ourebi*), which is a highly specialized grassland-inhabiting antelope, was probably common in the past in the Senkelle Plains. However, the present study on the population assessment of oribi that was carried out in the Senkelle Sanctuary and the interview held with the local communities indicated that the population status of oribi is very much declining in number.

Discussions with local communities, especially the elderly people and Sanctuary management staffs have revealed that the decline in the status of oribi occurred in the past due to destruction of habitat, human disturbance, livestock grazing, human settlement, cultivation, uncontrolled burning practice and illegal hunting by the local communities. A system of competitive co-existence between livestock, oribi and other wild herbivores seems to have evolved. Particularly during the wet season, there is a certain degree of spatial overlap and of potential competition over forage resources between wild and domestic herbivores. The Sanctuary provides important wet season grazing areas for the local pastoral communities. One of the main means of conflict between the Sanctuary management and the local communities in the area is the utilization of resources belonging to the Sanctuary by livestock and the communities.

The rapidly increasing populations of the area surrounding the Sanctuary has led to shortage of land, fuel wood, water and other resources. The increasing human and livestock population density with the absence of participatory management system has accelerated degradation of the natural ecosystem and loss of wildlife. The communities surrounding the Sanctuary are poor and have so many problems associated with the absence of participatory planning, lack of effective and realistic laws and policies, leading to the degradation of the natural resources and devastation of biodiversity.

It is very important to alleviate such problems by establishing effective protection and management of oribi population within its range. The need to protect the oribi population demands great effort. The Sanctuary management and EWCD should take immediate conservation measure to save the animal. The Sanctuary area should be protected from

overgrazing by domestic livestock. Protecting the Sanctuary from any illegal activities by regular patrolling inside the Sanctuary is crucial. Wildlife has to be seen as a source from which local communities can draw either directly or indirectly to fulfill their basic needs from the tourist income and service giving institutions. It is necessary, not only for the good of oribi but also for long-term benefits of the community. Wildlife is not seen independent of communities who live in the vicinities of the Sanctuary. The local and national governments should protect the biodiversity of the Sanctuary through the declaration of effective and realistic laws and policies that regulate such illegal human activities through the establishment of community based management program. The status and conservation needs of the oribi (*Ourebia ourebi*) should be well assessed in the study area and other parts of Ethiopia. If the above threatening conditions continue in the study area, the Senkelle Oribi will become critically endangered, unless immediate and effective conservation measures are taken.

6.2 Recommendations

The population status of oribi has declined in SSSHS alarmingly, mainly due to adverse human activities and livestock abundance. The further expansion of settlements, destruction of habitats, livestock grazing and bush encroachment are going to be serious problems in the area. To alleviate such threats, immediate conservation measures should be taken for sustainable survival of oribi and other wildlife in the Sanctuary.

Effective conservation measure should be carried out through an extension work to create public awareness among the local community. The local people should develop their awareness on conservation of wildlife, so that they appreciate the benefits of natural resources. It is important to integrate the use of full indigenous knowledge and modern conservation systems to develop a deeper understanding of the species and their ecosystems.

The sharing of benefits with the communities living adjacent to the Sanctuary will reduce conflict between wildlife managers and local communities. There should be close link between the Sanctuary authority and the local communities living around. Local communities should be immediately involved in designing, planning, implementation and evaluation of the wildlife conservation program.

Implementation of rural development should be designed to move the local people to the buffer zone to reduce human activities in the Sanctuary. Buffer zones should be established to reduce the movement of wildlife from crop raiding outside the Sanctuary during the crop growing period, by planting indigenous trees, which are useful to local community for fuel wood and for construction purposes.

Realistic and effective re-settlement program should be offered, by taking the needs and aspirations of the local communities and by giving awareness to alleviate the continuing extensive settlement around the Sanctuary and the greater need for the natural resources of the Sanctuary. These should be assisted by establishment of service giving institutions, such as: clean water supply, clinics, schools and electricity. This may help to increase the confidence of the communities towards the wildlife conservation program.

The number of tourist visitors to the Senkelle Sanctuary is surprisingly low. So, the posting of standard road-signs, production of brochures and maps, should publicize it. Signposts should be placed using flagship species, such as the Swayne's Hartebeest, Oribi, etc. in the vicinity of the Sanctuary on the main road in every few kilometers to invite and attract the tourists.

Employing additional a minimum of ten game scouts for effective and regular patrolling of the Sanctuary area is indispensable. An effective system of patrolling the Sanctuary and other management activities based on the radio communication between the Sanctuary headquarters, the EWCO head office and the three stations within the Sanctuary, supported by the direct visual control over the whole area is crucial.

It is important to improve both the quality and the quantity of forage availability within the Sanctuary. It could be achieved by adopting a more effective vegetation management program based on controlled burning and selective ploughing of the natural grasslands within the Sanctuary. Both the burning and ploughing programs should be controlled and monitored by the Sanctuary authorities. The experience and vested interests of pastoral communities is crucial for the implementation of such vegetation management program.

There should be an effective and realistic management policy for the Senkelle Sanctuary, to control illegal human settlement and farming activities. It should therefore, aim at reconciling the interests of conservation and local pastoral communities.

It is quite important to up-grade the skills of game-scouts of the Sanctuary to make them knowledgeable in matters of wildlife conservation and enforcement of all the legal measures. In addition,

strict follow up and immediate anti-corruption measures should be taken by the Sanctuary authorities and the head office of EWCO, on assigned game scouts in the three stations of the Sanctuary.

The ongoing labour incentive operation on the road construction and maintenance in the Sanctuary benefits the local communities by providing employment. However, it should be equipped with a Tractor and Grader for the construction of sustainable road.

The Sanctuary management staff should have good facilities with the appropriate manpower, equipment and budget. And also the border of the Sanctuary should be clearly demarcated and well known by the local communities, the governmental officials and the EWCD.

Gazettment of the Sanctuary should also be given priority. In fact legislation does not by itself ensure habitat preservation, but it represents an important starting point.

7. REFERENCES

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Appendix 3. Questionnaire (Interview addressed to local people around the SSHS)

1. Name of the household_____
2. Village_____ 3. Age_____
3. Ethnic group_____ 6. Religion_____
7. Marital Status (Single/Married)_____
8. If married, number of wives_____
9. Family size_____ 10. Occupation_____
11. Educational Background_____
12. Source of income: 1/Farming/Agriculture 2/ Herding
3/Trading 4/ Two or all of the above
5/Others, specify
13. How long have you lived in the area?
14. Do you know oribi (Senkelle, Oromigna language)? A) Yes B) No
15. Why was the Sanctuary named under this animal (Oribi) in your language (Oromigna)?
16. What other wild animals do you observe in your surrounding area?
17. Where can oribi mainly be found in the area? During: A/ Wet season B/ Dry season C/ The whole year
18. Do you find Oribi around the community or village? A/ Yes B/ No
19. Do you know the reason for their movement? A/ Yes B/ No. If yes, why?
20. What are the main crops grown by the local community around the Sanctuary?
21. Have oribi ever raided your crops? Yes/No. If yes, what kinds of crops were damaged? At what time of the day/night? Why they prefer that time?
22. How much damage approximately do oribi cause on your crops?
23. What control measures have been taken?

24. Do you think the oribi population is increasing, decreasing or stable? Why?
25. If declining, what do you think the reasons for the population decline?
26. Do people around the Sanctuary practice hunting? Yes/No? If yes, which animal? For what purpose?
27. Is there any benefit obtained from the Sanctuary? Yes/No? If yes, in what form do you get the benefit? Grazing/Fuel wood collection/Employment/Benefit from tourists/Service giving institutions/Others, specify? If you say no, what do you suggest for future work?
28. Do you think that oribi and other wildlife should be conserved? Yes/No? If yes, why?
29. What should be done for the conservation program of oribi and other wildlife in the Sanctuary?
30. What do you think to improve the interaction between the Sanctuary management and the local people?

Thank You

Appendix 4. Identified vegetation types in the study area (SSHS)

| Grass species | Herbs and shrubs | Principal tree species |
|--|---|---|
| <i>Pennisetum schimperi</i> | <i>Verbascum sinaticum</i> | <i>Acacia</i> spp. (dominant tree) |
| <i>Hyparrhenia hirta</i> (thatch grass) | <i>Clematis hirsuta</i> | a. <i>Acacia abyssinica</i> |
| <i>Themeda triandra</i> (oat grass) | <i>Vernonia bipontini</i> | b. <i>Acacia clavigera</i> |
| <i>Rhynchelytrum repens</i> <i>Chloris</i> spp. | <i>Cassia</i> spp. (Legume) | c. <i>Acacia lahai</i> |
| <i>Batriochloa radicans</i> <i>Digitaria scalarum</i> | <i>Physalis minima</i> | d. <i>Acacia albida</i> |
| <i>Cynodon dactylon</i> (serdo) | <i>Arulocarpus sphaerostigma</i> <i>Polygonum</i> spp. | <i>Croton macrostachys</i> <i>Protea gaugedi</i> |
| <i>Melinis repens</i> | <i>Cyperus rotundus</i> (sedge) | <i>Albizia schimperana</i> |
| <i>Sporbulus</i> spp. | <i>Indigofera</i> spp. (Legume) | |
| | <i>Euphorbia schimperana</i> <i>Tagetes minuta</i> <i>Alysicarpus guartinianus</i> (Legume) | |
| | <i>Lippia veranica</i> <i>Buchnera hispida</i> | |

DECLARATION

I declare that the thesis is based on my original work and has not been presented for a degree in any other university. All sources of materials used for this thesis have been dully acknowledged.

Name: Wondimagegnehu Tekalign Beyene

Signature_____

Date_____

This work has been presented with my approval as supervisor:

Prof. Afework Bekele

Signature_____

Date_____