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A Study on the Status and Population Dynamics of Reed Buck (Redunca redunca) in Dinder National Park – Sudan

دراسة عن وضعية وحركية عشائر الباشمات فى محمية الدندر الاتحادية ـ السودان

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In the end, we will conserve only what we love.

We will love only what we understand.

We will understand only what we are taught.

- Baba Dioum

Dedications

I dedicate this work to my big family particularly my father and my brothers and to my loving children their time in enabled the hour of research, contemplation and writing necessary to complete this thesis. This work is however, dedicated to the memory of my mother whom I still miss every day.

This thesis is also debt to my supervisor Pro. Dr. Ali Saad and to staffs of university of Bahari in particular Dr. Ibrahim Kano and also dedicated in particular to Mr. Paul Peter Awol for his limitless effort and support.

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Acronyms

UNU – Upper Nile University

UB – University of Bahari

WCGA – Wildlife Conservation General Administration

IUCN – International Union for Conservation of Nature

UNESCO – United Nation Education Science and Cultural Organization

RAMSARE- international wetland

DNP- Dinder National Park

Abstract

The Bohor reedbucks (*Reduncaredunca*) were studied in Dinder National Park (DNP), Sudan to investigate their population dynamics and daily activity patterns. The road count methods were employed to determine the population size, age and sex structure, diurnal activity of a herd of reedbuck for every 10 minutes recording intervals. Also the threat factors to the population were observed. There were 153 individual of reedbucks in the study site of which 41% (n = 63) was confined to the EinAshamis Mayas. The sex ratio of reedbuck was 1:1. The population was female biased 51.6% (n = 79) was female excluding kids (juveniles), and 39.2%, (n = 60) as males. More adults (29.4%, n = 45) were observed more than young's (sub-adults),9.8%, (n =15) and kids 9.2%, (n = 14). The herd size of reedbuck showed variation from 3 – 4 individuals of animal. Herds were seen in aggregations of up to 45 individuals of reedbuck during the dry season in EinAshamis Maya. The diurnal activity pattern of reedbuck group showed that most animals were actively feeding throughout early morning and late in afternoon, with a resting period around midday. The nocturnal activity pattern was not recorded due to the fact that no night spot equipment to scan them and no security measurement available during the night hour in the study site. The predation pressure, poaching and habitat degradation were observed as a threat to the reedbuck species in the Dinder National Park. Certain management measures have been suggested.

Key wards:- Dinder National Park, Mayas: RasAmir, AbdelGani, AinElshames,Bohor Reedbuck, Population dynamics, Diurnal activity, Population threat factors

الخلاصه

اجريت الدراسه على مجموعة الباشمات فى حظيرة الدندر الاتحادية - السودان لدراسة حجم وديناميكيات العشائر وانماط النشاط اليومى والمهددات الرئيسية التى تساهم فى تناقص اعدادها السكانية. تم رصد مجموعة حيوان الباشمات عن طريق العد المباشر فى الميدان لتقدير حجم المجموعة وتحديد وتحقيق في عمر العشائر وبنية التركيبة للمجموعة باستخدام منظار الميدان و كتاب المرشد للثدييات. اما لدراسة انماط النشاط فقد تم رصد النشاط اليومي للقطيع مع فترات تسجيل مدتها 10 دقائق. اثناء النهار.

تم تعداد عدد 153 فرد من الباشمات في المحمية منها 41 ٪ (n = 63) كانت تقتصر على ميعة عين الشمس غيرها من الميعات(راس عامر ، موسى ، قيرريصه ، السينت) وكانت نسبة الاناث الى الذكورهى 1: 1 لمجموعة الباشمات وكان عدد الإناث فى المجموعة قد بلغت نسبة 51.6٪ (n = 79) و كانت تشكل الغالبية باستثناء الصغار ، و تشكل الذكور (39.2 ٪ ، n = 60). ولوحظ عدد نسبة الذكورالبالغين (29.4 ٪ ، n = 45) أكثر من نسبة الذكور غيرالبالغين (9.8 ٪ ، n = 15) و الصغار (9.2 ٪ ، n = 14).

لقد لوحظ فى المحمية ان حجم القطيع فى المجموعات المكونة تتروح ما بين 4 – 3 فردا من الباشمات . لقد لوحظ ايضا اثناء الدراسة مشاهدت مجموعة الباشمات فى تجمع يصل 50 – 45 خلال موسم الجفاف فى ميعة عين الشمس.

أظهر نمط النشاط النهاري لمجموعة الباشمات أن معظم افراد المجموعة ترعى و تتغذى بشكل نشط في الصباح الباكر وفي وقت متأخر من فترة الظهيرة ، مع فترة راحة حوالى منتصف النهار. لم يتم تسجيل نمط النشاط الليلي نسبةلعدم وجود معدات رصد ليلية لمسحها ضوئيًا ولعدم توفر الامن والسلامة خلال ساعات الليل في موقع الدراسة. وقد تم رصد بعض المهدادات الرئيسية التى تساهم فى تناقص اعداد حيوان الباشمات والتى تتمثل فى الصيد الجائر والرعى الجائر و صيد السمك فى الميعات خلال فترة الجفاف بداخل الحظيرة وقد لوحظ ضغوط الافتراس كاحد المهددات بالرغم انه وسيلة من وسائل النظم البئية لسيطرة على المجموعة السكانية لها الا انها تمثل المهدد المباشر لتدهور حيوان الباشمات بداخل الحظيرة بعد الصيد غير المشروع وتدهور بيئات الطبيعية فى. حظيرةالدندر القومية تم اقتراح بعض التدابير الادارية لابقاء الانواع المتواجد من مجموعة حيوان الباشمات و الإنواع الاخرى فى الحظيرة .

Chapter One

1. Introduction

1. 1 The bohor reedbuck (***Reduncaredunca***)

The bohor reedbuck (***Reduncaredunca***) is widely spread across Africa from Senegal to Ethiopia and southwards in East Africa to southern Tanzania (Estes 1991). The species can be used as a model for the conservation and management of other reduncine tribes, some of which were similarly abundant and widespread in the study area (e.g. water buck (*Kobus defassa*).

The Reduncini (also known as reduncine antelopes) is a tribe of large to medium sized antelopes found only within Africa. It comprises a diversity of waterbuck, reedbuck, puku, lechwe and kob. According to the taxonomy (Ansell 1971), at least two genera are recognized, namely Redunca and Kobus. All reduncine antelopes share wetlands in the African tropics: these wetlands are all located within the savanna biomes of south-central and northern Africa. Reduncines are tribes which rely on surface water, and so do not occur far from water bodies. As such some of them have adapted to an aquatic life, characterized by the elongated hooves (lechwe). They are entirely grazers and are gregarious, living in small family units (waterbuck and reedbuck) or large herds (lechwe and kob).

An understanding of the population dynamics and ecological factors that contribute to maintaining the abundances of reedbuck species will help to improve the status of the other reduncine antelopes.

For herding ungulates, the size and composition of groups are the basic elements of their social organization (Barrette, 1991; Raman, 1997). External ecological factors such as habitat, seasonal changes, and food quality and abundance influence group size. As well as the knowledge of distribution of animals in relation to their environment is essential for effective game management and range utilization control. Because habitat destruction due to

overgrazing could reduce the fertility and growth rate of animals (Berger, 1978; Clutton-Brock *et al*., 1982; Gerard *et al*., 2002; Hillman, 1986), as well as internal physiological factors connected to the reproductive cycle (Li *et al*., 2007; Lian *et al.* 2005; Lu and Wang, 2004)

The knowledge of distribution of animals in the habitat is of vital importance in population control and habitat management. Human activity has had the largest impact on habitat loss through factors such as the constant extension of agricultural lands and the degradation of pastures due to livestock overgrazing and mineral exploitation (Thouless *et al*., 1991; Kingswood and Blank, 1996).The major physical factors affecting the distribution of animals in any habitat are the availability of water, effect of fire, topography, temperature variability and relative humidity. In areas where artificial permanent waters such as dams and bore holes have been established, the distribution of ungulates that require water for drinking and wallowing is directly influenced by their presence. Thus, water becomes an important ecological factor affecting the distribution of animals in such areas. The objective of the present study is to assess the factors which affect the population of reedbuck and to determine the status of Reedbuck's antelope in Dinder National Park.

1. 2 Population dynamics

Amolakey (2008) has reported about illegal trade and consumption in bushmeat in villages around Boma Park in South Sudan. The main concern of that study was about conservation of different animal species in the park. Thus, the reedbuck antelopewas investigated since there is lack of information on the current status of reedbuck's population and the impact of natural disasters and human activities on it, as well as it is the most venerable species exposed for illegal hunting because it is the most animal found near the water sources.

1. 3The Importance of the Park

The globally DNP arises from its geo-physical location, lies between two floristic regions: the Ethiopian highland plateau and the arid Saharan Sudanian

biomes. The park also lays along the boundary of two major faunal realms i.e. the Palearctic and Ethiopian region. DNP is also situated along the north-south flyway of migratory birds. Thus the protection of the park is of global importance as it provides a refuge for large number of migratory birds and protects endemic species, which live in the region or are permanent inhabitants of the park (DNP management plan 2004)

DNP is a biosphere reserve within the UNESCO network of protected areas since 1974, which is meant to integrate local communities in the conservation and sustainable use of biodiversity. The DNP is also a proposed RAMSAR site.

1.4 The rationale of the research

One of the greatest conservation challenges facing parks, game reserves and sanctuaries in Africa today is the rapid decline of wildlife populations that are being hunted for food and trade. Wildlife resources in the African countries are facing serious threats of destruction and habitat loss as a result of human pressure (Amolakey 2008)

Wildlife tourism is the backbone of many economies in African countries still harbor high diversity of wildlife species. For instance, wildlife tourism industry in Kenya is the second largest economic sector after agriculture, contributing over 12% to the country's Gross Domestic Product. Sustainable tourism industry depends on maintenance of high wildlife diversity in protected areas but its sustainability is threatened by the risk of extinction of many wildlife species in the African countries. One of the species of less concern is the reedbuck antelope (*Redunca redunca*), whose distribution range is so drastically reduced throughout Africa that the species is faced with the risk of extinction in some localities (IUCN 2010).

Sudan is one of these African countries facing a decline in its wildlife resources all over its protected areas (DNP action plan 2004). Most of the species of the park have been reduced such as taing, roan antelope, buffalo, water buck, and reedbuck (Minga 1971 and Dosman 1972). For example the bohor reedbuck

became locally extinct in Uganda and Ivory Coast (IUCN 2010) and has been reported to be locally declining in their population in Chad, Cameron and Tanzania. In Sudan according to the study done in DNP by many researches Minga (1971), Dosman (1972), Koul (1994), Abdel Hameed *et al* (1994), and Yassin (2001) they have compared the population of a diverse wild animals in the park and concluded that the population has declined as the reedbuck by 72%, Oribi by 68%, water buck by 85% and tiang is rarely seen in the park. No comprehensive research has been done on reedbuck in Sudan to determine the factors affecting the population to decline except Allam (2006) who studied the biology of reedbuck (*Redunca redunca*) and their interaction with other animals.

Before independence in 1956 no efforts have been made to census the animal species in the parks (DNP management plan 2004). Minga (1971) made a pioneer counts on nine of main Mayas, based on observation without any statistical analysis and unpublished reports. There is a need to conduct a detailed study using modern technique and compare the historical data to identify the specific causes of decline of the Sudanese bohor reedbuck population in Dinder National Park. The information on current status of reedbuck's population and the techniques could then be used to develop appropriate management practices and recommendations could be drawn-out to ensure the sustainable conservation and management of the reedbuck population and other related species in the park.

1. 5 **Research Objectives**

The overall aim of the research is to assess the status of reedbuck (*Redunca redunca*) species and the population dynamics and recommend a sustainable conservation measure in the Dinder National Park (DNP). The research was designed to achieve the following objectives

1) To determine the population status of bohor reedbuck (*Redunca redunca*)
2) To determine the population dynamics of the species through
   a. Sex ratio and age structure
   b. Daily activities

Chapter Two

2. Literature review

2. 1. Introduction

Only a few studies were conducted, and mostly were pioneering counts on nine Mayas of the park, (Minga 1971). Other studies between 1972 and 2001 were comparing the population of wild species within the park including reed buck and most of the species which indicated that species are disappearing from the areas. Other than these studies were Field observations study made in DNP on the biology of reedbucks (*Redunca redunca*) and their interaction with other animals but did not investigate the population dynamics. Recent studies on the reedbuck were feeding behavior, breeding behavior, sex ratio, group size, morph metric measurements, and activities. However, knowledge about numbers and abundance is also very important aspect for conservation (Shorrocks *et al*. 2007, Ogutu *et al*. 2008), but it is just as important to know how these numbers emerge. Following this the general question is: What affects the abundance and distribution of the reed buck in selected Mayas of DNP? According to researchers three factors determine the abundance and distribution patterns, the dispersal capacities of the species, the spatial distribution of abiotic and biotic environment (competitors, predators and pathogens), and the availability and dynamics of resource. This indicates a relationship between distributional areas and niches. To explain abundance and distribution of reedbuck in DNP it is important to investigate of the reedbucks ecological behavior.

Antelopes partitioned the African ecosystem into many small segments (Estes 1991). The African continent provides a lot of ecological opportunities for the bovidae to exploit with regard to habitats and food (Estes 1991). Together with predation, habitat and food determine evolution, adaptation and thus coexistence of bovid species (Sinclair, 1995).

2. 1 Bohor Reedbuck (Redunca redunca): Genus Redunca, description, biology, population status

2. 1. 1 Genus Redunca

2. 1. 1. 1 Common reedbuck (Reduncaarundinum)

The common reedbuck is a medium-sized antelope. Coat fawn or buff in color, with some areaof gray and brown. Undersides are white, including the bushy lower surface of the tail. All four legs have a dark stripe on their lower fronts. At the base of the pointed ears lies a gland that, when active, appears as a black circle of bare skin. Horns found only in males, which have a distinctive forward curving arc from the ridged bases to the smooth tips, forming a "V" structure when viewed from the front; transverse ridges occur on the basal two-thirds, the tips are smooth. Female is similar to the male, but slightly smaller, and without horns. Common reedbuck prefers savannas habitat with tall grasses, but during the dry season woodlands and reed beds with year-round water are frequently used.

The social structure of the common reedbuck is Solitary, in pairs, or in small loose groups. During the dry season, they congregate around water sources, where temporary aggregations of as many as 20 individuals. Males become sexually mature at the age of 18 months, while the females can reproduce at one year of age (12 months). Breeding occurs throughout the year Estes (199) and Kingdon (1997).

The gestation period is 233 days, after which one calf is born.A calf will spend its first 6 weeks hidden in dense grasses, where it is visited by its mother for nursing a few times daily. By 3months, the youngster regularly moves with its mother, and by one year it is independent. They are found across southern, central Africa, extending into Tanzania and then southward, northward and eastern until it reaches South Africa.

2. 1. 1.2 Mountain reedbuck (Redunca fulvorufula)

The mountain reedbuck is the smallest of the reedbuck species, it has grey-fawn upperparts and white under parts, including lower surface of the tail, which is prominent when fleeing. Hair on the neck and head is usually more yellow-fawn and the lower legs are pale then the rest of upper body. Horns, found only in males, ringed at the base, which are short and possess a slight forward curve. Female is similar to the male, but much grayer, slightly smaller, with shorter tail, and without horns. The mountain reedbuck prefers steep rocky slopes with grass cover and scattered bushes and trees, at elevations between 1,400-2,400 m.

Females and young live in small groups of 3-12 individuals. Males are solitary and territorial but associate with females as they pass through their territory. Immature males live in small bachelor group (Estes,1991 and Kingdon1997).

The gestation period is 240 days, after which a single calf is born. The calves are tucked as in all reedbucks away in dense vegetation by their mothers for at least one month and remain hidden there unless visited for nursing.They are found in South Africa.

2. 1. 2Bohor physical descriptions

The bohor reedbuck (*Redunca redunca*) is a small and medium sized antelope. The bohor antelope weightsan average mass of 45 - 65 kg for adult males and 35 - 55 kg for adult females, and a shoulder height of 70 - 90cm for adult male and 69 – 76 cm for adult females (Estes1991 and Kingdon 1997). Only the males carry the short, stout, ringed and forward hooked horn. The Sudanese subspecies cottoni has long thin horn, with wide spread between the tips.The body coat is yellowish to pale red-brown and under parts are white. The tail is short, bushy and brown above, with white under side. There is a bare, grey patch below each ear. The females are similar to males but with thinner necks and without horns.

The physical description of this species is well given by (Estes, 1991 and Kingdon1997).

2. 1. 3Bohor Biology

The gestation period for bohor antelopes is 210 - 220 days and there is no fixedbreeding season (Estes, 1991). Usually a single calf is born and the females after giving birth and are capable of having young every 9 to 14 months. The mothers keep their offspring concealed for as long as eight weeks. The mother keeps within a distance of 20–30 m (66–98 ft) of its calf. Nursing, usually two to four minutes long, involves licking the whole body of the calf and suckling. The infant is suckled usually once in the day and one to two times at night. The female's previous calf usually resists separation. At the age of two months, the calf begins grazing alongside its mother, and seeks protection from her if alarmed. Though after four months the calf is no more licked, it may still be groomed by its mother (Estes, 1991). The calves are weaned at eight to nine months of age. Females become reproductively active after they reach 12 months of age while males reach sexual maturity after 3 – 4 year (Kingdon, 1997). For the mountain and common reedbucks the females leave the herd after giving birth to a calf for two or three months in dense grass or other vegetation, with ewe returning to suckle it once or twice per day. After each suckling session the fawn moves to new lying up location (Estes 1991, and Kingdon 1997).

The bohor antelopes typically are solitary 2 – 7 adult females and one mature male occupy a shared home range but rarely associate together for long periods of time, larger group may form during the dry season. Immature males form bachelor groups (Estes 1991).The male territory varies in the size ranges between 25 – 60 hectare), with each ewe utilizing the range of some 15 – 40 hectare. Rams defend access to ewes rather than entire territories. Bachelor group are generally tolerated by territory holding rams but they are chased off when ewes are in vicinity (Estes 1991). The bohor antelopes are grazer, feeding

on fresh grass. According to Nowak (1999), Bohor reedbucks normally graze early in the morning and late in the evening, though they were observed grazing frequently throughout the night. However, several other workers reported that Bohor reedbucks are exclusively nocturnal, feeding mainly after dusk (Afework *et. al*, 2010). The main predators are lion (*Panthera leo)*, leopard (*Panthera pardus)*, spotted hyena (*Crocuta crocuta)*, African wild dog (*Lycaon pictus)* and Nile crocodile (*Crocodylus nilotcus*). When a threat is detected, the bohor antelopes use the typical predator avoidance strategy which includes freezing in position, crouching low to the ground, or slowly retreating to cover or choruses of variable whistles as form of communication to the whole herds. Factors such as hunting, habitat destruction, predation, cattle grazing and cultivation are reported to be major reasons for restricting the original range of the animal (Hillman 1998, Afework *et, al.*, 2010). The bohor antelopes are generally migratory and seasonal movements are driven by changing water level and vegetation abundance. During the rainy season when forage is plentiful it disperses across floodplains.

Bohor reedbuck prefers moist grassland and swamplands as well as woodland (Yalden *el at.*, 1984). They avoid thick vegetation, closed woodland and thick forest but favour open grassy habitat, for grazing and cover of bushy thicket for breed and hiding their lambs (Estes 1991, Kingdon 1997). The bohor antelopes' habitat consists of grassland with moist savanna and forest and savanna zone, closely tied to river floodplain, reed beds as they need to drink daily or at least regularly.

2. 1. 4 Population status

The bohor reedbuck is now locally extinct in Ivory Coast and Uganda (IUCN 2010). The total number of bohor antelope is estimated to be above 100, 000, larger population occurs in eastern and Central Africa than western Africa (IUCN 2010). The overall population trend is decreasing due to reckless hunting and loss of habitat, natural hazards like drought is also major threat.

While populations have declined in northern Cameroon due to degradation of flood plains through the construction of upstream dams their habitat has been destroyed in Chad and Tanzania due to expansion of agriculture and settlement. In Uganda during the dry season bohor antelopes are hunted with dogs and net. Although bohor antelopes are currently classified by IUCN (2010) as of "Least Concern" if the present trends continue, the bohor reedbuck antelopes' status may eventually decline to threaten status as they disappear in Uganda and Ivory Coast and are declining in Cameroon, Chad and Tanzania (IUCN 2010).

The bohor antelopes have five subspecies which includes *R. r. bohor Ruppell*, also known as the Abyssinian bohor reedbuck. It occurs in southwestern, western and central Ethiopia, and Blue Nile (Sudan).*R. r. cottoni*: It occurs in the Sudds (Southern Sudan), northeastern Democratic Republic of Congo, and probably in northern Uganda. *R. r. donaldsoni* is a synonym.*R. r. nigeriensis*. This subspecies occurs in Nigeria, northern Cameroon, southern Chad and Central African Republic. R. r. redunca, its range extends from Senegal east to Togo. It inhabits the northern savannas of Africa. The relationship of this subspecies to *R. r.nigeriensis* is not clear.*R. r. wardi*: found in Uganda, eastern Democratic Republic of Congo and eastern Africa. *R. r. ugandae* and *R. r. tohi* are synonyms.

In Sudan the status of the animal populations in the park has been greatly affected by the various activities of the communities living in and around the reserve. Although the ecosystems inside the reserve are still intact, the populations of larger ungulates are steadily and rapidly declining through poaching. Some species have already disappeared such as giraffe, and other reaching the point of extinction as tiang. While common species such as reedbuck, oribi, roan antelope, water buck are dramatically decreasing (Minga 1971).

2. 1. 5 Mayas status

The status of most of the Mayas' (Meadows), which maintain many ungulate species in terms of water and grazing resources, have been silted up and have become unproductive (Abdel Hameed *et al.,* 1999). Some of the Mayas' feeder channels have been blocked resulting in not receiving water directly from Dinder River or from khors Galegu and Masaweek. Consequently the number of ungulates will be reduced.

2. 1. 6 Site descriptions

The study area is Maya in National park at Dinder; Mayas according to Abdel Hameed et al (1999) are wetland meadow formed due to the meandering character of the channel and the nature of the flow of its waters, found along the floodplains of the rivers. They occupy low lying basins, meanders and oxbow. They are crescent shapes with or without clear banks. They are varying in area from less than 200 m^2 to 4.5 km^2. They are classified as productive and nonproductive habitat, based on their carrying capacities, and water retention potential (Abdel Hameed 1983, and Hashim 1987).

2. 1. 6. 1 RasAmir

Lake Ras Amir is the largest Maya in the park, composed of an area of 4.5 km2 which is located13 km northeast Galegu. These Mayas used to hold water throughout the year before 70th but recently it usually dried up after the rainy season. The bed of Maya Ras Amir is almost devoid of vegetation, except for a few herbs and scattered shrubs. There is a borehole that pumps water to the beds of the Maya when they dry up. It serves as a good habitat for waterfowl when it is completely full with floodwater (Abdel Hameed 1983).

2. 1. 6. 2 Abdel Gani

This Maya is connected to khor Galago through a feeder and fills the Maya only when there is floods but when the flood is below average the Maya acts as a drainage system to the surrounding higher ground (Abdel Hameed et al 1999)

2. 1. 6. 3 Ein Alshamis

Ein Alshamis is an area of 1.8 km^2 which is located in the eastern bank of Dinder River. Maya Ein Alshamis used to maintain a large biomass of wild ungulates in the early seventies. At present it has almost completely been silted up and therefore loses its ability to hold water till the end of the dry season (Abdel Hameed et al 1999).

2.1. 6. 4 Grerrisa

Grerrisa is the largest Maya along the western bank, attractive site due aggregations of a diverse of mammals and birds. In 80th the water storage capacity was good, but after 90th it dried up in dry season. A well has been dug and water is pumped in it in dry season (Hashim 1987).

Plate 1 AbdelGani Maya in DNP during dry season 2018

Photograph 2: Maya AbdelGani in Dinder National Park

Chapter Three
3. Materials and Methods

3. 1 Study Area

3. 2 Dinder National Park (DNP)

3. 2. 1 Location

Dinder National Park is one of the oldest parks in Africa. It was established in 1935 following the London Convention of 1933 for the conservation of African flora and fauna. It's bordered by three States: Sennar, Gedarif and the Blue Nile, in addition to the international border between Sudan and Ethiopia in the Southeast. It's traversed by the river Rahad at latitude 12^{o}26'N and longitude 35^{o} 02'E, and then to the northwestern direction up to lat. 12^{o} 42' N and long. 34^{o} 48'Eat Dinder River. Then continues again up to lat. 12^{o} 32'N and long. 34^{o} 32' E along khor Kennan and finally to the southeast to lat. 11^{o}55'N and long. 34^{o} 44'E, (Figure 1)

3.2.2 Topography

Dinder National Park falls within the flat plains of the Southern Blue Nile. On the southeastern portion of the Park, towards the Ethiopian Plateau, isolated highlands occur. The two seasonal rivers, Rahad and Dinder bring water to the Park during the rainy season. They descend from the Ethiopian highlands and flow in a northwesterly direction across the flat plain to empty their waters into the Blue Nile River (Abdel Hameed 1983).

3.2.3 Climates

The climate of the Park is characterized by two seasons: the hot and humid rainy season (May-November) and cool and dry season (December-March. The normal rainy season is from May to November. The peak is in August. During the rainy season, the maximum temperature is approximately 30^{o}C and the minimum is approximately 20^{o}C. The maximum temperature sometimes exceeds 40^{o}C in April and May and then drops suddenly by the first rains of the new season

Figure 1 map of Sudan with an arrow showing Dinder National Park, source management plan 2004

3.2.4 Soil

Holsworth (1968) and Dasmann (1972) who has described two types of soils in DNP: the vertisols are dark, heavy clays and "self-ploughing" soils often known as the black cotton soil, and entisols dominate the eastern limits of the Park towards the foothills of the Ethiopian plateau and along riverbanks. This type of soils occurs in patches of sandy loam and sandy clay.

3.2.5 Water Resources

The Rahad and Dinder rivers are the largest tributaries of the Blue Nile. They both drain parts of the Ethiopian highlands. They have nearly the same lengths, identical hydrology and comparable volumes of annual flows. River Rahad flows through the northern boundary of DNP, while the Dinder River flows through the centre of the Park see Figure (2).

3.2.5.1 Mayas

These are wetland meadows found along the flood plains of the rivers. They have been formed due to the meandering character of the channel and the nature of flow of its waters. They occupy low-lying basins, meanders and oxbows. They are generally crescent shaped with slight and /or no clear banks.

Mayas vary in area from less than $200m^2$ up to $4.5km^2$. Their use for grazing has been studied by Abdel Hameed (1983), Hashim (1987). They classified as productive and non-productive habitats, based on their carrying capacities and water retention potential.

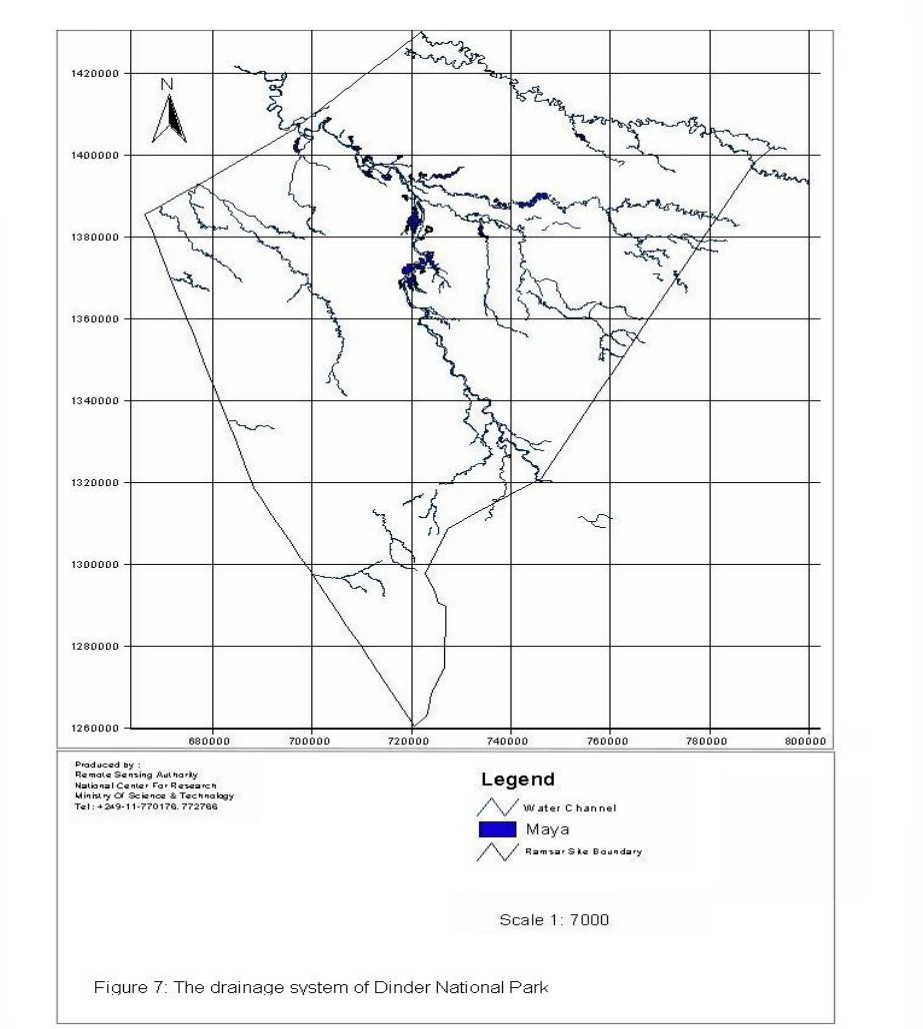

Figure 2 the water resources system of Dinder National Park, source management plan for DNP 2004

3.2.6 Flora

The vegetation of the Park has been studied by many researches; according to Harrison and Jackson (1958), they classified the vegetation in Dinder area as the *Acacia seyal- Balanites* Savanna with grass area zone, and *Anogeissus-Combretum* hartmannianum savanna woodland zone. Abdel Hameed and *Et, al* (1999) recognized three types of ecosystems: *A. seyal - Balanites,* riverine forest, and the Mayas (Meadows) ecosystems (see Appendix 4) for common plants in DNP.

3.2.7 Fauna

Dinder National Park was known to have hosted a variety of wild species in the past according to Harrison (1958), he classified them into: mammals, birds and reptiles (crocodiles). (See Appendix 5 and 6) shows the complete list of mammal and bird.

3. 3. Data collection

This chapter uses data on three aspects: reedbuck population dynamics, activity pattern and questionnaire. The following sections describe in detail how each data type was collected.

3.3. 1 Reedbuck population survey

To assess the population of the reedbuck (*Redunca redunca*) road count method was employed. The collected data help to estimate the population size as well as determining the population general information (sex ratio, age classes and group size), and activity patterns. Thus all data collected was not limited to the information of the population status of reedbuck but for the population dynamic of the species in the park. According to (Thomas and Tylor.,2006) defined the transect lines as lines placed at random or systematically, or parallel line and the length of the line depend on the observer ability to concentrate (Barraclough, 2000). The transect lines should be placed with a certain spacing to avoid overlap of sightings, the speed at which the observer moves along the line

should be slow enough to detect all animals on and along the line, but fast enough to avoid double count (Greenwood and Robinson, 2009).

In the field the transect lines follow road and they are not straight but according to (Shorrocks, 2007) this does not really matter. This was the case for the transect lines driven in this study. The aim was to cover the study area and the transect lines covered different habitat types.

A vehicle (Toyota – Land cruiser – 4WD) was used to carry out the data collection on the line transects. The advantage using a car concerned safety reason and the antelopes are less frightened by cars than on foot as well as time secured. More time was available for other research tasks after survey during the day. The speed during data collection was very slow10 – 15 km/hrs which was the first and the second gear without or with little use of the accelerator. Two persons observed both sides of transect line as I could not carry out data collection alone I was assisted by student of wildlife science of Juba University.

Generally, data collection on transect lines covered different time of day with two started and ended times were set: 7am to 11am. It was aimed to sample each transect once a day only. In DNP data collection on transect line took place in February 2018 (from 7th to 27th in dry season). Generally each transect was driven 2 times during each survey – beginning data collection at predefined starting and ending times. Only reedbuck loop was sampled in two surveys in different day. To minimize counting bias the ground counts were conducted in the morning when most animals were actively feeding. More time was spent in Maya areas. During the survey all animals observed were recorded regardless how far they are from the line. Due to this, all animals observed were written on a designed sheet a brief identification notes of the counted individual see Appendix (2) : date – time of the day (start – end times) – distance - group – individual – sex and age categories. These are main information needed for basic analysis.

The data recorded during counts included number of reedbuck individual in each age group and by sex where feasible. Reedbuck was visually identified to sex and age classes with the aid of binoculars using combinations of sexually dimorphic physical characteristics, such as dimorphic morphology of the external genitalia, coat color, age-specific differences in body size, presence, shape and size of horns as described by Sinclair, 1995). For instance, male reedbuck has horns, but females do not. Contrary, male topi and hartebeest have larger thicker horns than females. The calves of all species were not sexed because the males and females were indistinguishable in the field, except in a few cases. However, reedbucks are sexed and classified wherever possible into three age classes, kids (birth – 12 months), yearling or sub-adult (young 12 – 24 months) and adults (older than 24 months).

In age classification among female group of reedbuck especially between young sub-adult and adult it is difficult to distinguish between them on the basis of body size in these two, age class is closely similar at the time of survey but among male however, the sub-adult (young) age class can be distinguish on the basis of horn development. Therefore, animals were classified as kids (K), Young male (YM), Young female (YF), Adult male (AM) and Adult female (AF).

3. 3. 2 Activity patterns

In theory behavior is measured predominant by scan observation (Martin and Bateson1993) whereby a group of animals are rapidly scanned once every 10 minutes and the behavior of each recorded at that instant.

In practice observation should be carried out either from a vehicle or on foot from a hidden positioning and animal watched with binocular from distance varying between 500 and 300 m. If animals are disturbed behavioral recording delayed until they appear to ignore the observation. For observations at distances <100 m, the behavior pattern as feeding, lying down, walking, standing at rest, vigilance and other activities such as defecation/urination, ritual

plays, soil licking, fighting/chasing, drinking, suckling, courtship (sniffing and mounting) were recorded and categorized as a total number of different day activities performed. Follow this, group of bohor reedbucks were tracked to record their diurnal activity patterns only due to the fact that the nocturnal activity was very difficult to be observed because no modified scan equipment facilities that can be used during the night hours starting from 18:00 to 06:00hrs for scan the nocturnal pattern activities. Accordingly bohor reedbuck was scanned once every 10 minute in a hidden tree position. Based on the location of their preferred grazing and bedding sites, observation were carried out by tracking on foot, with appropriate distance between 10 and 100m. For the diurnal activity patterns, the group was observed from 07:00 to 17:00 hr during the dry season for five days. Observations of each day were compiled as the total number of different activities performed for twelve 1-hr periods; i.e., 06:00-07:00, 07:00-08:00 and 17:00-18:00 hr (Seddon and Ismail, 2002; Afework *et al*, 2010) and the proportion of each activity in relation to the total activities was computed.

3.3.3 Questionnaire

The data of the site study were collected from respondents (officers and game scouts) in DNP, in which informal questionnaire about the species existence, problems facing the park, reedbuck poach in the area, population trend and the predators used to feed on reedbuck in the park, thus provides answers to standard questionnaire. Basic questions were easily answered but information related to the number of species, their behavior, sex, ages structure and activity pattern were collected directly from the field in the park.

Based on field survey conducted in DNP in Sudan, officers and game scouts were interviewed according to the study site. Four areas allocated in the park and Galago the center of the park and the head of the campus. The data of the site were collected from thirty (one officer and 29 game scout of varied ranks) and provided answers to 30 standard structure questions. The names of

respondents were not recorded. One group discussion were used to check the reliability of information collected in the park such as species present in the area, involvement of the villagers in hunting or any other illegal activities in the park. Reedbuck poaching and their activity pattern such as time of feeding and frequency of drinking, and their predators that feed on them. Anti-poaching unit operation and the tools and equipment for operation system used to apply wildlife law in the park.

3.4 Data Analysis

All data collected were coded and entered in the designed sheet in the computer. Processing and analysis were performed by using micro-soft excel, in order to check the population status and population dynamic in different transect lines group composition in DNP, only the data from the survey count were considered. To assess daily activity of the species, the survey data of activity pattern were used as well as data from questionnaire for population trend, species predator and anti-poaching unit system for law enforcement.

Statistical tests were performed to evaluate the difference between observations. The Chi-square test was used to check the significance of the observed difference correlation between data. All statistical analyses were preformed with tables, figures and graphs.

Plate 2 Transect line at study site in DNP during dry season 2018

Chapter Four
4. Results

4. 1. Reedbuck population survey

A total of 153 individuals of reedbuck were counted during the dry season 2018. The present results as indicated in Table (1), the population size is varied between the transect line as it showed a district movement pattern, particular in transect RasAmir and Ein Alshamis. More individuals were counted in transect line EinAshamis and this was because in this transect line which ended with Maya has little or no disturbance at all, that is to say there is no human factor or any activities related to the human such as fishing, rearing of cattle, collection of firewood or honey and no illegal hunting.

4. 1. 1 Sex and Age Categories

The population varies between the individual ages and sexesas indicated in Table (1). There were 153 head reedbuck counted in the study site of which 41.2% (n = 63) was confined to Galago – Ein Alshamis road. However, the population variation between the transect line Galago-RasAmir, Galago-Grerrisa, G-Musa and Galago-Asenat was not significant (chi X^2 = 8.7, 3, 6.5 and 6.1 respectively at 4 d.f., $p>0.05$) and it is significant in transect line Galago – Ein Alshamis (Chi- X^2 = 20.6 at 4 d.f, $p<0.05$).

The proportion of age's structure of adult reedbucks in study area as indicated in Figure (3) was higher than the lower age's structure and showed significant differences(Chi- X^2 = 22.0, 21.5 at 4 d.f, $p<0.05$) but there was no significant difference at lower ages structure(Chi- X^2 = 5.9, 8.0, and 7.6 at 4 d.f, $p>0.05$).

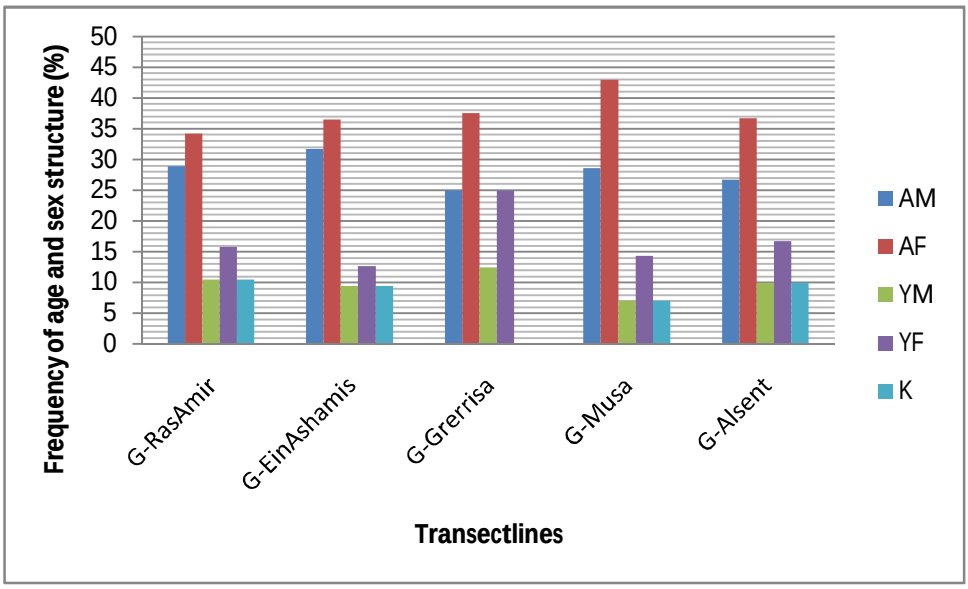

Figure 3 Variation of ages and sex categories in percentage over transect lines

Table 1 comparison of total individual animal counted with age and sex structure of bohor reedbuck in different transect lines in DN

Transect line	Total count					Total Row ± SD	Percent (%)	Chi- X^2 d.f = 4
	Age and Sex Structure							
	AM	AF	YM	YF	K			
Galago-RasAmir	11	13	4	6	4	38 ± 3.6	24.8	8.7*
Galago- Ein Alshamis	20	23	6	8	6	63 ± 6.6	41.2	20.6
Galago – Grerrisa	2	3	1	2	0	8 ± 1.6	5.2	3.0*
Galago – Musa	4	6	1	2	1	14 ± 1.8	9.2	6.5*
Galago – Alsenat	8	11	3	5	3	30 ± 3	19.6	6.1*
Total	45 ± 6.3	56± 6.9	15± 1.9	23± 2.4	14 ± 2.1	153±8.2		Total Chi-X^2 44.9
Percent %	29.4	36.6	9.8	15.0	9.2	100 %		
Chi – X^2 (d.f = 4)	22.0	21.5	5.9*	8.0*	7.6*	Total Chi –X^2 (65.0)		

Value Mean ± SD, AM = Adult male, AF = Adult female – YM -= Young male, YF = Young female, K = Kids,

Value are not significantly different at $p>0.05$, value * are significantly different at $p<0.05$

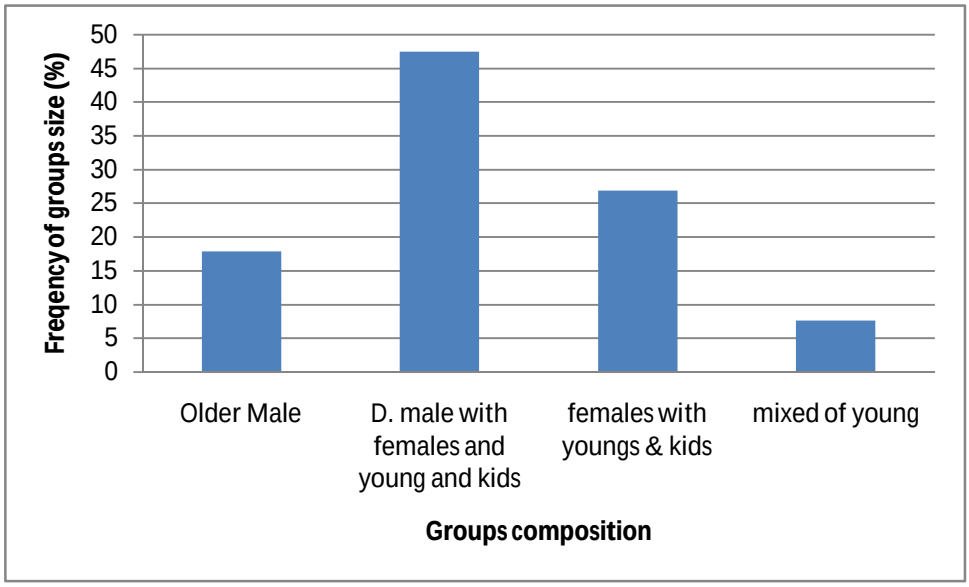

Figure 4 Variation of groups' size composition of bohor reedbuck in (%) in different kinds of groups of study site in DNP during dry season 2018

Sex ratio of bohor reedbuck population was about 1:1 and it was biased toward female as shown in Table (1).For all transect lines census, the population of bohor reedbucks were female biased 51.6% (n = 79) as female excluding kids (juveniles), and 39.2% (n = 60) as male. More male adults (29.4%, n = 45) were observed than sub adults (9.8%, n = 15) and juveniles (9.2%, n = 14). The herd size of reedbucks showed variation from 2 to 4. Herds were seen in aggregation of up to 45 individuals during the dry season in EinAshamis Maya. Bohor reedbuck showed a transect movement pattern. More individual of reedbuck were counted in transect A and B during the morning census in dry season. The female accounted for 51.6% excluding juveniles and 39.2% male of the total population of reedbuck at study site. However, the sub adult group contributed 24.8% individual to the total population and the juveniles contributed 9.2% to the population at the study site.

Bohor reedbuck showed a movement pattern with different transect lines particularly Galago – RasAmir Maya and Galago - Ein shames Maya. More

individual were counted in transect Galago - Ein Alshamis during the surveyTable (1) and Figure (3) and this is because food and water were available and no habitat destruction or any human movement were noticed within the area

Females represented 39%of the total population of bohor reedbuck in the survey area and the difference was significant at $p > 0.05$ in Ras Amir, Grerrisa and Musa and not significant at $p < 0.05$ in Ein Ashamis. The adult bohor reedbuck comprises of (adult male in different blocks of 29 %. The adult and young (sub adult) ratio was 1:1 approximately for the whole census and the difference was significant at $p<0.05$. The young (sub-adult) group contributed about 26% individual to the total population during the survey in the dry season. Kids contributed only 8% individual of total population of reedbuck as represented in Table (1) and Figure (3).

4. 1. 1Herd size and group composition

The herd size of Bohor reedbuck at study area ranged between 2 and 10 individuals and the standard deviation was 3.6, 6.6, 1.6, 1.8, and 3for different transects Galago-RasAmir, EinAshamis, Grerrisa, Musa, and Alsenat respectively (Table1).

In the field bohor reedbuck observed in different group, which do not commonly stand for long period of time Figure (4), these include group formed by dominant male with adults, young females and kids. Another group comprised of bachelor adults and young females. The third group formed by young males only. The last groups are older isolated male of reedbucks or sometimes form groups of individuals. Regardless of the grouping, however, the herds of reedbuck population were loose and dispersed in all directions.

4. 2 Activity patterns

4. 2. 1 Diurnal activity

During the dry season the diurnal activity pattern of Bohor reedbuck group as shown in Table (2) and Table (3) indicated that most animals were actively feeding throughout early morning and late afternoon with a resting period around mid day. Feeding activity began early and intensified between 07:00 – 09:00 hrs, 09:00 – 11:00 hrs then it gradually diminished between 11:00 – 13:00 hrs and 13:00 – 15:00 hrs. This time mostly used for lying down and ruminating. Feeding restarts again between 15:00 – 17:00 and increased again up to late 17:00 – 19:00 hrs (see Figure 5 and Table 3).As a part of their diurnal activity reedbuck in the park used to move regularly from one location such as bedding site to another such as grazing or watering site which may involve crossing of the transects.

Summarized of the diurnal activities of bohor reedbuck of which feeding was dominant followed by lying down, walking, vigilance, others and standing at rest and the standing at rest activities were among minor activities performed by the species during the dry season.

During the scanning of the diurnal activities feeding activity realized to begin very early in the morning intensified between 08:00 to 11:00 am and ceased between 12:00 – 15:00 pm which represented the time used by the species for lying down and rumination, then feeding restarted again after 16:00 pm and continued up to late 20:00 pm.

4. 2. 2 Nocturnal activities

Nocturnal activities patterns were not scanned due to lack of night tools and equipments and no modified scan equipment facilities which can be used to scan the activity pattern of bohor reedbuck during the night, moreover no security measurement. The nocturnal activity during the night hours starting from 18:00 pm to 06:00 am and this time in the park was very difficult to observe any activities without equipments for that purposes.

Table 2 comparison of Five days of diurnal activities within period of 10 minute time interval in AbdelGani Maya in DNP during dry season 2018

Activity / **Day**	**F**	**LD**	**W**	**SR**	**V**	**O**	**Total**
Day 1	25	16	10	3	7	6	**67**
Day 2	20	13	8	3	6	5	**55**
Day 3	23	14	9	3	7	6	**62**
Day 4	27	17	11	4	8	7	**74**
Day 5	26	16	11	4	8	7	**72**
Total	121	76	49	17	36	31	**330**
A.M.	24.6	15.1	9.8	3.4	7.2	6.2	**66**
Percent %	**36.7**	**23**	**14.8**	**5.2**	**10.9**	**9.4**	**100**

A.M = arithmetic's means, F = Feeding, LD = Lying down, W = Walking, SR = Standing at rest, V = Vigilance, O = Others, Other* = Defending, urinating, ritual playing, soil licking, fighting, chasing, suckling, drinking, courtship

Table 3 comparison of diurnal activity of bohor reedbuck in (%) and the time spent every two hours at study site in DNP with 10 minute time interval

Activity	Time spent (hrs)					Total	Percent %
	7 – 9	9 – 11	11– 13	13 – 15	15 – 17		
Feeding (F)	8	7	1	3	6	25	**39.1**
Lying down (LD)	0	1	6	5	2	14	**21.9**
Walking (W)	1	2	3	3	0	9	**14.1**
Standing at rest (RS)	0	1	1	0	1	3	**4.7**
Vigilance (V)	2	1	1	1	2	7	**10.9**
Other* (O)	1	1	2	1	1	6	**9.3**

F = Feeding, LD = Laying down, W = Walking, SR = Standing at rest, V = Vigilance, O = Others* = Defending, urinating, ritual playing, soil licking, fighting, chasing, suckling, drinking, courtship

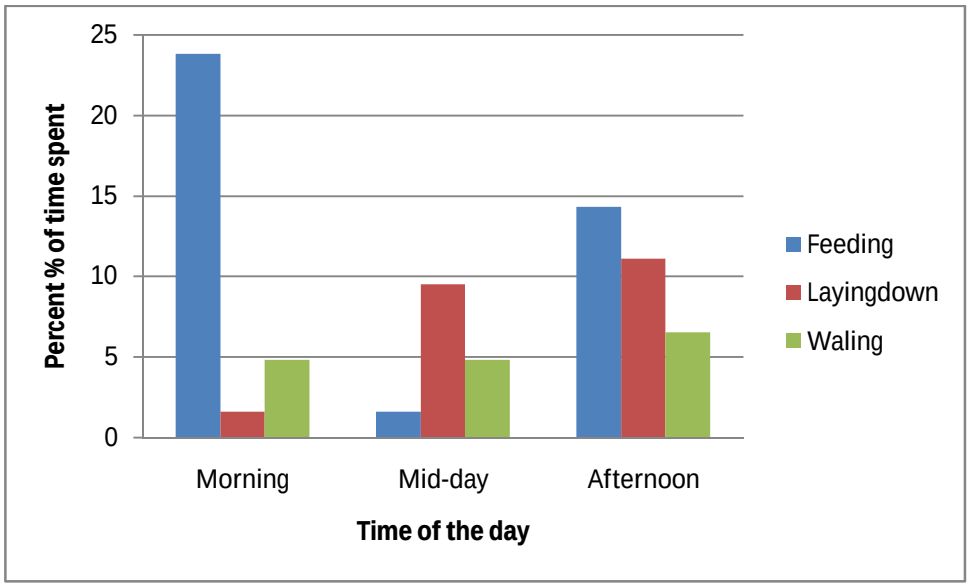

Figure 5 the time spent (%) on feeding, lying down and walking of the diurnal activity pattern of bohor reedbuck

4.3 Questionnaire

4. 3 Sample size

As formal interviewed in the field survey at least 29 game scouts were interviewed comprised ranks including one officer (game warden) in the study site.

The wildlife game scouts were asked whether wild animals are present in the area or not, the total respondents interviewed in each location agree that the wildanimals are present in the area (Table 4).

Table 4 Total respondents to the question "Is wild animals present in the area?"

Location	yes	No	Percent %
Galago	23	0	79.30
RasAmir	3	0	10.35
Grerrisa	3	0	10.35
Total	29	0	100%
Percent %	100%	0%	

4. 3. 1 The problems and challenges

In survey, the game warden who's in charge of protection and preserving to-gather with wildlife game scouts whose responsible for the check points in the reserve were asked for the problems and the challenges facing the operations and wildlife anti-poaching units and which illegal activities that frequently occurs in the DNP although the efforts is in place. The result showed that among different challenges and problems facing DNP were fishing, poaching, collection (honey and firewood) are the most threat facing the reserve then followed by fire clearing for cultivations(Table5) the result suggested that the availability of water in the most Maya increases fishing in DNP hence this activity inside the reserve leads to other illegal activities.

Table 5 Comparison of illegal activities in DNP and total respondents to the question "the problems and challenge facing the park's anti-poaching unit"

Location	Poacher	Honey collectors	Fire wood collectors	Fishers	Fire
Galago	20	19	17	22	15
RasAmir	3	3	2	3	1
Grerrisa	3	2	2	3	0
Total	26	24	21	28	16
Percent %	21.7	20.9	18.3	24.3	13.9

Plate 3 Traditional tools used for fishing in Maya at DNP during dry season 2018

4. 3. 2 Reedbuck poaching

Based on survey and interviewed of wildlife warden when asked whether he observed reedbuck poaching in the area or not. The result showed that the total respondents agreed that reedbuck and other species are poached in the reserve (Table 6) and the poachers are mostly from the villages around the park, only one respondent did not agreed that there was no poaching since last 10 years back.

Table 6 Total Frequency in (%) which response to the question on "Is reedbuck poached in the park?"

Study site	Yes	No	Nil	Total
Galago	17	3	3	23
Ras Amir	3	0	0	3
Grerrisa	3	0	0	3
Total	23	3	3	29
Percent %	79.30%	10.35%	10.35%	100%

4. 3. 3 Common hunting tools

In the field an officer and the game scout were asked about common hunting tools and equipments usually used by the poachers in the park. The results in Table (7) showed that the most hunting tools used were guns (43.1%)then followed by trap and bows and arrows and the tools that not commonly used were snares.

Table 7 Total of respondents in (%) which response to the question on "what are the common hunting tools and weapons used illegally by the poachers in the park?"

Common tools / Site	Guns	Trap	Spears	Dog	Snares	Bows & arrows
Galago	22	17	2	1	0	8
RasAmir	3	3	0	0	0	1
Grerrisa	3	3	0	0	0	2
Total	28	23	2	1	0	11
Percent%	43.1	35.4	3.1	1.5	0	16.9

4. 3. 4 Population trend

The result showed in Table (8) that for the population trend of reedbuck was decreasing when the wildlife officer and the game scouts were asked whether reedbuck population changed over last five years.

Table 8 Comparison of total respondents to the question about the population trend of bohor reedbuck for the last five year in the park

location	No change	Increased	Decreased	Total
Galago	3	6	14	23
RasAmir	1	0	2	3
Grerrisa	1	2	0	3
Total	5	8	16	29
Percent %	17.2	27.6	55.2	100

4. 3. 5 Reedbuck predators

Based on field survey the result showed that the lion (*Pantheraleo*) is the most common predator that preys on reedbuck Table (9). Most of the respondents 58.6 % agreed that the lions are the species which used to prey on bohor reedbuck in DNP, followed by hyena (*Crocuta crocuta*) and others species such as jackal Plate (4).

Table 9 Comparison of total respondents to the question about common species prey on reedbuck in Dinder National Park

Area	Lion	Hyena	Monkey	Others
Galago	2	1	0	0
RasAmir	1	1	0	1
Grerrisa	14	5	1	3
Total	17	7	1	4
Percent %	58.6	24.1	3.5	13.8

Plate 4 a case of predation on bohor reedbuck at study site in DNP during dry season 2018

4. 3. 6 Reedbuck pattern, grazing and watering

In survey the respondents showed that the population pattern of reedbucks were pair (45.7%) then followed by single (32.6%) and only (21.7%) showed that they were in group as shown in Table (10).

Table 10 Comparison of total respondent to question on the frequent constituent pattern of bohor reedbuck in DNP

Area	Group	pair	single	Total
Galago	9	18	11	38
RasAmir	1	1	2	4
Grerrisa	0	2	2	4
Total	10	21	15	46
Percent %	21.7	45.7	32.6	100

For grazing as indicated in Table (11) the result showed that reedbuck started grazing in early morning.

Table 11 Total respondents on question "when usually bohor reedbuck starts grazing in the park?"

Area	Early morning	Mid-day	Evening	Total
Galago	22	1	0	23
RasAmir	3	1	0	3
Grerrisa	3	0	0	3
Total	28	1	0	29
Percent %	96.6	3.4	0	100

For frequent drinking water when the interviewer where asked on the time for reedbuck to drink water the result showed that the frequency was twice a day according 82.8% respondents agreed that and only 10.4% in the once a day and 6.8 more than a day Table (12).

Table 12 Total respondents on question "How many times Bohor reedbuck frequently drink water"

Area	Once	Twice	More	Total
Galago	2	20	1	23
RasAmir	1	2	0	3
Grerrisa	0	2	1	3
Total	3	24	2	29
Percent %	10.4	82.8	6.8	100

4. 3. 7 Laws enforcement

The law enforcement was evaluated through anti-poaching activities in the study area which conducted by game scout patrol teams from Galago wildlife Comps in the center of the Park. The result in Table(13) showed that the patrol teams sent once every week to tackle the poaching activities in the park using land cruiser during the dry season armed with weapon but in the wet season they used tractor and when movement were difficult they go on foot if necessary.

According to the information acquired through interviews with wildlife game warden in Galago comps in Park is attempting to do a lot to control the illegal hunting and more effort was being put to reduce poaching by increasing the number of game posts in different sites of the park to apprehend the hunting for a long time. When wildlife game scouts were interviewed to whether the poaching is there they agreed and said that the poachers come from the near villages around the park and when wildlife game warden was asked whether there is any other illegal activities in the park he said the activities such as livestock grazing, wood collection, honey collection, clearing for cultivation was minor compared with fishing practice which is very high in the park. In any case, if one compares the observations and information gained in the field, they provide the real picture. It is quite evident that the poaching is still common, and therefore the poaching still exists.

Table 13 Total respondents to the question on "How often do you send the game scouts for patrolling in the park"

Area	Once a week	Every Two weeks	Every month	Total
Galago	15	8	0	23
RasAmir	1	2	0	3
Grerrisa	3	0	0	3
Total	19	10	0	29
Percent %	65.5	34.5	0	100

4. 3. 8 Means and Equipment for patrolling

The means and equipment used for patrolling is four wheel drive truck(Land cruiser)and tractors used during the wet season and when the movement of the tractor was difficult they patrol on food when necessary Table (13).

Table 14 Total respondents to the question "Means used for patrolling in the park"

Area	Land cruiser	Tractor	Foot	Others
Galago	17	4	1	1
RasAmir	2	0	1	0
Grerrisa	1	1	1	0
Total	20	5	3	1
Percent %	69	17.2	10.3	1.5

Chapter Five

5. Discussion

This survey provides important pioneering steps in investigation of the status and the population dynamic, activity pattern and threats to reedbuck population in Dinder Nation Park (DNP).

The survey resulted in observed on 153 animals of reedbuck along the five transect lines, a total scanned of diurnal activity pattern of reedbuck for consecutive five days, every ten minute time intervals, one case of predation on reedbuck and observations of human activities such as grazing of livestock, fishing and other illegal activities which lead to poaching of the species in the park.

5. 1 Population size

A total of 153 animals of reedbuck population size include 24.8% in Galago - RasAmir, 41.1% Galago - EinAshamis, 5.2% Galago - Grerrisa, 9.2% Galago - Musa and 19.0% Galago - Alsenit. However, the result showed the land use pattern of the surrounding transect s based on their security for animal species, as such the aggregation and concentration of reedbuck were observed in Maya EinAshamis where fodder, water and security were available. Similar result were obtained by Allam (2006) who reported that the animals were found in aggregation in the center of the park around water pool where green fodder and water were available in the dry season. However, Balakrishnan and Ndhlovu (1992) stated that wild animals avoid localities where human activities are frequent and high. This was clearly observed in Grerrisa Mayas and RasAmir Mayas where there was fishing activities in frequent, as well as, Musa Mayas where grazing of livestock were of commonly occurrence.

5. 1. 1 Age and Sexes Categories

The results showed that there was variation between the ages and sex structure among the different categories and between the transect line in the parks.The population dynamics of reedbuck of study site were unknown. The population was biased toward female. Moreover, in assessing the age categories of reedbuck is biased toward 66 % adult (n = 101). Similar results were reached by Tadesse *el al*., (2012). However, this biased result toward adults is unfavorable for the population dynamic of reedbuck in the future.

In the present study the sex ratio of the adult individuals was 1: 1 and between the young (sub adult) groups was proportionally 1:1 and the finding agreed with many studies which reported that the sex ratio is 1; 1 since the breeding behavior of reedbuck is harem forming (Skinner and smithers 1990, Taylor 2004).

5. 1. 2 Group Compositions

In the field and as the results showed a different group of reedbuck were identified and observed in the study area and this includes a dominant male with 2 – 3 adult females and young females and kids which comprised of 2 – 4 individual animal. A group of bachelor of 2 – 7 young male, other group comprised of adult and younger female about 2 - 6 and isolated older male with females and sometimes without females groups, and this was in agreement with Estes (1991), Afework et al (2010); Taylor (2004) which reported that reedbucks are known to form a group of different individual composition.

5. 2 Diurnal Activity

The pattern of diurnal activity in reedbuck is specified during the period of early morning and late afternoon. In park DNP, reedbucks were observed to be actively feeding throughout early morning and late afternoon with a resting period around the midday. Similarly in work done by Roberts and Dunbar 1991. They accept reedbuck nocturnal behavior but considered environmental

factors such as habitat fragmentation and shortage of food that forced their activity at least to be during a certain time of the day (early morning and late afternoon).

Many studies (Jarman, 1974, Mloszewskmi, 1983, Beekman, and Prins, 1989) reported of rumination in ungulates are closely correlated with resting period that occur intermediately during feeding bunts. However, the reedbuck population at park,their resting pattern occurs around the midday which is the time mostly used for lying and ruminating. Likewise, Mitchell 1976 reported pattern of resting for animals are in a suitable shade to avoid heat stress.

Feeding was the major diurnal activity of reedbuck during the time of day, then followed by lying down, walking, vigilance and others and the minor diurnal activity for reedbuck was standing at rest.

5. 3 Threats

Wild animals such as Jackals, caracal, hyena leopard and cheetahwere predated on reedbucks. In present study at least one case of predation were observed on reedbuck predated by the lion. Other factors that could play key role in reedbuck reduction and direct threats in addition to the predation are poaching via weapon and habitat degradation through grazing of livestock, fishing and cultivation of crops and uncontrolled burning which were actively practiced by the people entering the park illegally for collection of honey, collection of firewood but the controlled burning mostly by wildlife soldiers are useful for recover of vegetation in the reserve. These uncontrolled burning removes the suitable vegetation cover hiding of the species hence exposing them to high level of predation by lion and hyena as well as poaching Iry (1979), Robert and Dunbar (1991), Taylor (2004).

5. 4 Limitations and constrains

- The limited of personnel budget for this work may limit the cover in transect line and conduct only one season instead of two seasons dry and wet ,
- The limited sample size (n = 153) may make it harder to determine variation error from the analyses of data. However, use of different analytical methods which produced similar result indicate the small size did not valid the finding.
- Difficult of conducting another survey in wet season that could be compared to population size of dry season to assess the significant difference between two seasons. may be better understanding of population dynamics could be achieved if data were available for all antelopes in the park
- Data on reedbuck activity pattern were collected only for 5 days but better result could have been obtained if data were collected for a longer period of time covering months and two seasons.
- The use of ground tackling lead to collection of only diurnal activity pattern data, further reedbuck activity pattern data need to be collected probably through radio-tackling to cover day and night in both dry and wet seasons. This would provide more sight into reedbuck activity pattern and habitat use in the park.
- Only diurnal time activity pattern for reedbuck was done in dry season due to lack of night spot equipment and security measurement. Collection of both diurnal and nocturnal data using radio collars can greatly improve the understanding of time budget of Bohor reedbuck and habitat selection.

6. Conclusions and Recommendations

6. 1 Conclusion

The results of this study provide important data on the status and population dynamic, diurnal activity pattern and direct threats to bohor reedbuck in the park. This information be critical for planning and management of existence population of reedbuck and any others ungulates in the park.

. From these results it is possible to conclude that:

1) The existing population reedbucks in DNP, are unique in their habitats selection and in behavior activities which are modified by environment.
2) The population status of reedbuck in the park has a good size and age composition to conduct other status and behavior studies of the species.
3) Some conservation procedure is needed to maintain sufficient habitat not to be subjected to excessive degradation and to reducing human depredations on population of these antelopes

6. 2 Recommendations

- There is a need for additional and complementary information on both diurnal and nocturnal data using radio collars can greatly improve the understanding of time budget of Bohor reedbuck and habitat selection. This will also include data on the breeding behavior activity of Bohor reedbuck in both seasons.
- The conservation of the existing population of Bohor reedbuck and any others ungulates in the park requires two major strategies.

a. The first strategies to maintain the habitat of their aquatic and the surrounding habitat.

b. The second strategies require reducing human depredation on population of these ungulates. Ultimately the two strategies include the following

- The coexistence of woody plants and grasses is an important characteristic features of habitat and is maintained by continues practicing of control burning is of vital important to provide appropriate habitat which determine reproductive and other behavior to the ungulates in the park.

- Reduce excessive competition with domestic herbivores by providing alternative habitat for grazing away from core zone of ungulates habitat are essential.
- The law enforcement efforts should be improved by improving anti-poaching efforts and conduct a frequent security patrol in areas known to be hot spot for poachers or for any illegal activities in the park which will be more effective than patrolling the whole park.
- Recruitment of more wildlife game scouts and maintaining patrol vehicles as well as weapons and ammunitions to ensure the existence of the force in the park.
- Game scouts motivation could be improved by creating and funding a special anti-poaching Unit as well as provision of specialized training and more equipment such as radios, binoculars and wet weather gear.
- An important management tool in conservation programmers in Africa is to develop community-based conservation projects where human living in or around conservation areas benefit directly from wildlife revenue.
- Employment of a team of community youth as an eco—guard to be an agent for reporting any hunting incidents to the park authorities.
- Have frequent public meetings between the park authorities and local communities to create awareness and educate the community of the importance of wildlife resources and their existence in the park.

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Appendix 1

Questionnaires For (P.A. Manager)

Date:_____ Questionnaire number_____

Name of interviewer _____

Park/Protected Area_____

Age i) 20 -30 years ( ) ii) 30 – 40 years ( )

iii) 40 – 50 years ( ) iv) Over 50 year ( )

Designation/Rank i) Officer ( ) ii) Game Scout ( )

1) What is the area under your jurisdiction? I) Ras Amir ( ) ii) AbdelGani ( )

iii) Ein Es-Shamis ( ) iv) Gerarresa ( )

2) For how long have you worked in this area? i) 1 - 3years ( ) ii) 3 -5 years ( ) iii) 5 – 10 years ( ) iv) 10 years and More ( )

3) What are the games species present in your area?

……

……

……

……..

4) What are problems facing the park?

i. Poacher
ii. Honey collectors
iii. Firewood collectors
iv. Fishers
v. Fire

5) Have you observed reedbuck poaching in the park? If yes where are they usually poached?

……

……

……

……

……..

6) What changes in population trend of reedbuck have you noticed over last 5 years?

i. Increased ( )

ii. Decreased ( )

iii. No change ( )

7) What are predators that used to feed on reedbuck?

i. Lion ( )

ii. Hyenas ( )

iii. Monkeys ( )

iv. Others ( )

8) What is the basic constituent of reedbuck?

i. Young ( )

ii. Juvenile ( )

iii. Adult ( )

iv. Mixture ( )

9) When do they begin grazing?

i. Early morning ( )

ii. Midday ( )

iii. Evening ( )

10) How many times they go for water?

i. Once ( )

ii. Twice ( )

iii. More ( )

11) What is the population pattern of reedbuck?

i. Group ( )

ii. Pairs ( )

iii. Individual ( )

12) Is there illegal hunting in the Region?

i) Yes ( ) ii) No ( )

13) How often do you send law enforcement officers/rangers to patrol the PA?

i) Once a week ( ) ii) Every two week ( )

iii) Every month ( )

14) To which part of the P.A do you usually send the patrol teams and why?

……

……

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……

……..

16) Do you consider your law enforcement personnel adequately prepared for the task?

i) Yes ( ) ii) No. ( ) If no, why not and what do you suggest should be done?

.....

.....

.....17) Which specific areas do the poachers come from?

……

……

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……

……

18) Have you seen any change in illegal hunting incidents over the last five years?

i) Yes ( ) ii) No

19) What is the most common tool used for illegal hunting?(rank them)

a) Guns_(rifles, gum3,) ( )

b) Traps ( )

c) Spears ( )

d) Dogs ( )

e) Snares ( )

f) Bow and arrows ( )

20) Are there efforts in place to reduce illegal hunting in the region?

1) Yes ( ) 2) No ( )

21) What is the main drivers/cause of illegal hunting in and around your P.A.?

_____

_____

_____

22) Do you think the existence of illegal activities is affecting the animal populations in and around your P.A. and in other areas?

i) Yes ( ) ii) No

23) What do you think is the solution to the problem in priority?

i) Court and punishment

ii) Confiscations of tools and weapons

iii) Fining

iv) All

24) The frequency of patrolling in the park

i)1 – 3 times ii) 3 – 5 times iii) More than 5 times

25) Tool of patrolling in the park during the wet season

i) Tractor ii) foot iii) Others

26) Difficulties facing patrolling in the park

i) Unprepared road ii) lack of vehicles iii) others

27) Means of patrolling in the dry season

ii) Motor cars ii) Camel iii) on foot

28) The coverage of the check station (points) in the park

i) Covering all areas ii) some areas

29) Is there anything you want to share with us about illegal activities in DinderN.P and the environment?

i) Yes ( ) ii) No ( )

استبيان ادارة الحياة البرية

التاريخ ..... رقم

المعاينة:.....

الاسم ..... المحمية اوالمنطقة او النقطة .....

1. العمرا. 20 – 30 سنة ( ) ب. 30 – 40 سنة ( )
   ج. 40 – 50 سنة ( ) د. اكثرمن 50 سنة ( )
2. الرتبةأ- ضابط ( ) ب- رتباخرى ( )
3. المنطقةاوالنقطةالتىتعملبهاأ- راسعامر ( ) ب- عبدالغنى ( )
   ج- عينالشمس ( ) د- قريريصة ( )
4. الفترةالتىغملتفيهبالمنطقةأ- 1 – 3 سنة ( ) ب 3 – 5 سنوات ( )
   ج- 5 - 10 سنوات ( ) د- 10 سنواتفاكثر ( )
5. ماهىالانواعالموجودةبالمنطقة؟

.....

.....

.....

6. المشاكل التى تواجه المحمية
   أ. الصيادة ( )
   ب. جمع العسل ( )
   ت. جمع الحطب ( )
   ث. السماكة ( )
   ج. النار والحرائق ( )
7. هللاحظتصيدظبىالباشماتفىالمحمية؟اذاكانالاجابةبنعمفىاىمنطقةيتمصيدهاعادة؟

.....

.....

8. هللاحظتتغيرفيعددمجموعةالباشماتخلال 5 سنواتالماضية
   أ. فى تزايد ( )
   ب. فى تناقص ( )
   ت. لم تتغير ( )
9. ماهىالمفترساتالتىتتغذىعلىظبىالباشمات

أ. اسود ( )

ب. الضباع ( )

ت. القرود ( )

ث. اخرى ( )

10.الافراد الاساسية المكونة للمجموعة الباشمات

.أ. افراد صغار ( )

ب.افراد كبار ( )

ت.افراد مختلطة ( )

ث. اخرى ( )

11.متىتبداظبىالباشماتمرعىوالكلاعادة

أ. فىصباحباكر ( )

ب. فىمنتصفاليوم ( )

ت. فى المساء ( )

12.عدد مرات شرب الماء للباشمات

أ. مرة واحدة ( )

ب. مرتين ( )

ت. اكثر ( )

13.المجموعةالنموذجيةلاعدادظبىالباشماتعادةتكونعلىشكل

أ. مجموعات ( )

ب. ازواج ( )

ت. افراد ( )

14.هلهناكصيدجائرفىالمنطقة؟ نعم ( ) لا ( )

15.كيفترسلقوةالحمايةللمروروداخلالحظيرة

أ. مرة كل اسبوع ( )

ب. كل اسبوعين ( )

ت. كل شهر ( )

16.فىايمنطقةترسلقوةالحمايةللمرورالاستكشافعادةولماذا؟

.....

.....

.....

17.من ابن ياتى الصياده؟

.....

.....هلهناكتغيرخلال 5 سنوتالماضىفىعملياتالصيدالجائر؟ نعم (

) لا ( )

18.ماهىالوسائلالمستخدمةلىصيدالجائر

أ. االسلحة ( )

ب. الشراك ( )

ت. الحراب ( )

ث. كلاب ( )

ج. النشاب ( )

ح. القوس والسهام ( )

19.ماهىالالياتالمستخدمةلردعالصيدالجائر؟

أ. عربات لاندكروزر ( )

ب. تركترات ( )

ت. ماشيا (راجلا) ( )

ث. اخرى ( )

20.عدد مرات المرور داخل الحظيرة

أ. مرة واحدة ( )

ب. 3 – 5مرات ( )

ت. اكثر من 5 مرات ( )

21.الصعوباتالتىتواجهعمليةردعالمخلفينلقنونالصيدوالحظائر

أ. طرق غير معبده ( )

ب. شح الاليات و العربات ( )

ت. اخري ( )

22.الصعوباتالتىتواجهافرادحمايةالحيةالبريةفىالحظائر

أ. الاسلحة و العتاد ( )

ب. الادوات الحادة ( )

ت. الاخرى ( )

23.وسائل الحركة فى فترة الخريف

أ. المواتر ( )

ب. الابل ( )

ت. الاقدام اوالارجل ( )

24.عددنقاطالتفتيشفىالحظيرة؟

أ. نقاط تغطى كل المناطق ( )

ب. نقاط فى بعض المناطق ( )

25.وسائلالاتصالبينالنقاطورئاسةالحظيرة

أ. الموبايلات الذكية ( )

ب. الراديو ( )

26.حالات انتشار وباء وامراض بالمنطقة

أ. قبل 20 سنة ( )

ب. قبل 10 سنوت ( )

ت. اقل من10 سنوت ( )

27.الحيوانات الاكثر تاثر

أ. الحيواناتالاليفةداخلالحظائر ( )

ب. الحيوانات البرية ( )

28.اكثرالحيواناتالاليفةالتىطموربداخلالحظائر

أ. الابقار ( )

ب. الخرفان و الاغنام ( )

ت. الاثنين معا ( )

29.ايشىتودمشاركتهاواضافته

.....

.....

Appendix 2

Total count and age and sex categories of Bohor Reedbuck (Reduncaredunca) population in seasons

Date

Mayas name

season

Starting time

ending time

Serial number	Group	individual	Age and sex categories					
			AM	AF	YM	YF	K	Total

AM = Adult Male, AF = Adult Female, YM = Young Male, YF= Young Female, K = Kids

Appendix 3

Diurnal Activity pattern and the time budget of Bohor reedbuck (redunca redunca) at Mayas

Date

Mayas name Season

Starting time ending time

Activity	Time Budget											
	6:00 -7:00	**7:00 – 8:00**	**8:00 – 9:00**	**9:00 – 10:00**	**10:00 –11:00**	**11:00 –12:00**	**12:00 –13:00**	**13:00 –14:00**	**14:00 –15:00**	**15:00 –16:00**	**16:00 – 17:00**	**17:00 -18:00**
Feeding												
Lying dawn												
Walking												
Standing at rest												
Vigilance												
Others*												

* Defending, urinating, ritual playing, soil licking, fighting, chasing, suckling, drinking, courtship

Appendix 4

List of Common Plant species in Dinder National Park

Scientific name	**English name**
Acacia mellifera	Kitir
Acacia nilotica	Sunt
Acacia nubica	Laot
Acacia seiberana	Kuk
Acacia senegal	Hashab
Acacia seyal var. fistula	Sofar abiad
Acacia seyal var. seyal	Talh
Adansonia digitata	Tabaldi
Albizia aylmeri Sireira	
Anogeissus leiocarpus	Al Sahab
Balanites aegyptiaca	Higleig
Boscia senegalensis	Mukheit
Calatropis profera	Oshar
Capparis decidua	Tundub
Combretum aculeatum	Shuheit
Combretum glutinosum	Habil
Commiphora Africana	Gafal
Cordia Africana	
Crateva adansonii	Dabkar
Dalbergia melanoxylon	Abanous
Dichrostachys cinerea	Kadad
Diospyros mespiliformis	Gughan
Entada africana	Sesaban
Faidherbia albida	Haraz
Ficus sycomorus	Gumeiz

Gardenia lutea	Abu Gawi
Grewia flavensis	Gregdan
Grewia mollis	Basham
Grewia tenax	Gudeim
Hyphaene thebaica	Dom
Lannea fruticosa	Layoun
Lonchocarpus laxiflora	Khashash Abiad
Maytenus senegalensis	Youi
Mimosa pigra	Shgarat alfass
Oxytenanthera abyssinca	Gana
Piliostigma reticulatum	Abu Khameira
Piliostigma thonningii	Abu Khameira
Pseudocedrela kotschyi	Druba
Pterocarpus lucens	Taraya
Salix safsaf	Safsaf
Sterculia setigera	Tar Tar
Stereospermum kunthianum	Khash Khash
Tamarindus indica	Aradeib
Tamarix aphylla	Tarfa
Terminalia brownii	Subagh
Xeromphis nilotic	Um mideko
Ziziphus abyssinica	Nabag El Feel
Ziziphus spina-christi	Sidir
Astercanthe longifolia	Abu Rakhies
Aristida funiculata	Ghabash
Aristida mutablis	Gaw
Asparagus africana	Umm Mushbut
Beckeropsis uniseta	Umm furaw

Blepharis lenariifolia	Moreib
Borreria verticillata	Bighail
Brachiaria deflexa	Simsim Elgidad
Brachiaria obtusiflora	Umchir
Brachiaria ramose	Um chir
Burgia spp.	
Cassia tora	Kawal
Celosia argentea	Danab Elkadis
Chloris gayana	Afan Elkhadim
Chorchorus olitorious	Mulikiyia

Appendix 5

Common mammals of Dinder National Park

Scientific name	**English name**
Caracal caracal	Caracal
Chlorocebus aethiopicus	Vervet monkey
Civetticus civetta	Civet cat
Crocuta crocuta	Spotted hyena
Damaliscus korrigum	Tiang
Erythrocebus patac	Patas Monkey
Gazella runfifrons	Red-fronted Gazelle
Hippotragus equinus	Roan antelope
Hyaena hyaena	Striped hyaena
Hystrix cristata	Porcupine
Kobus defassa	Waterbuck
Leptailurus serval	Serval cat
Loxodonta africana	Elephant
Lycaon pictus	Wild dog
Mellivora capensis	Ratel (honey badger)
Orycteropus afer	Aardvark
Ourebia ourebia	Oribi
Panthera leo	Lion
Panthera pardus	Leopard
Papio anubis	Baboon
Phacochoerus aethiopicus	Warthog
Redunca redunca	Reedbuck
Syncerus caffer caffer	Buffalo
Tragelaphus imberbis	Greater Kudu
Tragelaphus imberbis	Lesser Kudu
Tragelaphus scriptus	Bushbuck

Appendix 6

List of common bird species in Dinder National Park

Scientific name	English name
Struthio camelus	Ostrich
Pelecanuse rufescens	Pink-backed Pelican
Ardea cinerea	Grey Heron
Aredea melanocephala	Black-headed Heron
Ardeola ralloides	Squacco Heron
Bubulcus ibis	Cattle Egret
Egretta garzetta	Little Egret
Ardea purpurea	Purple Heron
Egretta intermedia	Yellow-billed Egret
Anastomus lamelligerus	Open-billed Stork
Ciconia abdimii	Abdim's Stork
Ciconia episcopus	Wooly-necked Stork
Ephippiorhynchus senegalensis	Saddle-billed Stork
Leptoptilos crumeniferus	Marabou
Mycteria ibis	Yellow-billed stork
Botrychia hagedash	Hadida
Plegadis falcin ellus	Glossy Ibis
Threskiornis aethiopicus	Sacred Ibis
Platalea alba	African Spoonbill
Dendrocygna bicolor	Fulvous Whistling Duck
Dendrocygna viduata	White-faced whistling Duck
Alopchen aegyptiacus	Egyption Goose
Anas platyhynchos	Mallard
Anas querquedula	Garganey
Plectropterus gambensis	Spur-winged Goose
Sarkidorins melanotos	Knob-billed Duck
Gyps rueppellii	Ruppell's Vulture
Neophron monachus	Hooded Vulture
Neophron percnopterus	Egyption Vulture
Circus macrourus	Pallid Harrier
Accipiter minulhus	Little Sparrowhawk
Polyboroides radiatus	Harrier Hawk
Labhactus occipitalis	Long-crested Eagle

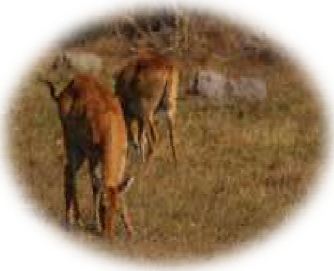
Melierax gabar Gabar	Goshawk
Melierax metabates	Dark-chanting Goshawk
Haliaeetus vocifer	Fish Eagle
Milvus nigrans	Black kite
Chelictinia riocourii	Swallow-tailed kite
Falco biarnicus	Lanner Falcon
E. tinnunculus	Kestrel
Francolinus clappertoni	Clapperton's Francolin
Numida meleagris	Crested Guinea fowl
Otis arabs	Arabian Bustard
Actophilornis africanus	Jacana
Charadrius	Ringed Plover
Vanellus Spinosus	Spur-winged Plover
Actis hy poleucos	Common Sandpiper
Tringu goaveola	Wood Sandpiper
Tringa nebularia	Greenshank
Tringa stagnatilis	Marsh sandpiper
Tringa tetanus	Redshank
Calidris ferruginea	Curlew Sandpiper
Himantopus himantopus	Black-winged Stilt
Burhinus oedicemus	Stone Curlew
Oena capensis	Namaqua Dove
Streptopelia dicipiens	Mourning Dove
Streptopelia senegalensis	Laughing Dove
Streptopelia vinacea	Vinaceous Dove
Turtur abyssinicus	Black-billed Wood Dove

Appendix 7

The lists of ungulates behavior used as a guide to assess the activities of Bohor reedbuck during this study is

Based on photograph of some antelopes including Bohor reedbuck I used to study activity patterns of Bohor reedbuck in Dinder National Park (DNP).

Feeding behavior



The animal stands with the head bowed onto the Grass layers.
or the animal moves with the head bowed down,
the activity is considered in 'grazing'.

Walking behavior

Walking comprises all forms of movements exhibited by the animals indifferent whether the movements are slow (walk) or fast

Lying dawn behavior:

Resting can occur while animal is lying on the ground.

Mostly the legs are under the body.

The belly and the legs can be on the surface to the ground

Standing at rest behavior

Standing at rest occurs while the animal is standing.

Vigilant behavior

The animals show a face and a general body staring attentively into a direction. Vigilant behaviors also occur while the animal is standing or lying down.

Others behaviors

Displaying behaviors such as males run towards females and towards other males belong to this category, as well as courtship, fighting, chasing and defending between males.

Behavior patterns of urinating, ritual playing, soil licking, suckling, drinking are also considered,

Behavior patterns of mating is included in this other behavior