BOVINE TRYPANOSOMOSIS AND THEIR VECTORS
IN BAHR ALARAB AND EL DIAIN LOCALITIES
SUDAN-SOUTH DARFUR STATE

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DEDICATION

This work is dedicated to my parents and my brothers
Ebaid and Imad Eldin and to my sisters.
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ABSTRACT

This study was carried out in Eldiain and Bahr Alarab localities, South Darfur State during January 2009, to determine the species of trypanosomes which affect cattle in the area, and identify their vectors. Trypanosomes in cattle were surveyed and 75 blood samples were taken: 25 blood samples from Eldiain locality and 50 blood samples from Bahr Alarab locality (Samaha, Dehell Adabi) which represent sedentary points of nomad's cattle during the summer period, thin blood smears was done and stained with Giemsa stain and examined.

Prevalence rate of bovine trypanosomiasis in the study area was 10.7% (out of 75 samples 8 samples were positive). Only two pathogenic trypanosomes species were identified: (Trypanosoma congolense) 8% and (Trypanosoma vivax) 2.7%.

In Eldiain area, one pathogenic trypanosome species was found, that was (Trypanosoma congolense) in one sample out of 25 samples 4%. In Bahr Alarab, out of 50 samples Trypanosoma congolense was found in 5 samples 10% and (Trypanosoma vivax) was found in two samples 4%.

Nzi traps were deployed in the two areas during January 2009, to collect the vectors which were identified as (Tabanus taeniola), (Atylotus agrestis) and (Stomoxys noritalis), which were active in trypanosome transmission to livestock, (Glossina) flies were not caught in this limited period and season.
المستخلص

أجرت هذه الدراسة بولاية جنوب دارفور في محيط بحر العرب و الضعين اثناء
يناير 2009 لتحديد أنواع طويل التربيناتوسما المسبب لداء المثلقيات في ابقار المنطقة و التعرف
على انواع نوافل المرض.

اجري مسح لدبي انتشار المرض اخضت 75 عينة دم (25 عينة دم من محلية الضعين،
و50 عينة دم من محلية بحر العرب(سماح و دجيل الدابي)، حيث تمثلان مناطق تجمع ابقار
الرجل خلال فترة الصيف، حيث تم عمل المسحات الدموية الرقية المصبوغة بصبغة جيمسا
stain Giemsa

كان معدل انتشار انواع المثلقيات البقرى في منطقة الدراسة 10.7% (من جملة 75 عينة
وكانت 8 عينات موجبة) ، تم التعرف علي نوعين فقط من التربيناتوسما المرضية
تربيناتوسما كونقولينسي (Trypanosoma congolense) 8% وتربيناتوسما فيفاكاس
(Trypanosoma vivax) 2.7% التربيناتوسما المرضية في منطقة الضعين تربيناتوسما
كونقولينسي (Trypanosoma congolense) في عينة واحدة من جملة 25 عينة 4% في
Trypanosoma (في 5 عينات 10% ووجدت تربيناتوسما فيفاكاس (congolense
(Trypanosoma vivax) في عينتين 2.7%

تم نشر عدد من المصائد من النوع اينزى Nzi trap في الضعين و بحر العرب في يناير
2009 لصيد النواقل حيث تم جمع و التعرف على تبانيتسينيولا
(Atylotus agrestis) واستوموکس نوریالیس
(Stomoxys noritalis)

تى نصري مدة الدراسة و موسمها لم يتم جمع ذبابة النسي تى (Glossina).
Chapter One

1.1. INTRODUCTION

Trypanosomosis is a protozoal disease of both man and animals caused by *Trypanosome species*, transmitted by flies. In Sudan, trypanosomiasis was firstly reported in (1904) in cattle which arrived Khartoum from Upper Nile (Karib, 1961). Bovine trypanosomosis is a protozoal disease mainly caused by *Trypanosoma congolense*, *Trypanosoma vivax* and *Trypanosoma brucei*. The disease causes fever, anemia, loss of weight and death. Cattle in Bahr Alarab and Eldiain localities represent the main source of income and milk and meat, for residents of the region. Trypanosomosis in these localities is a major veterinary problem.

This study proposes to evaluate the disease situation in the area in cattle, which had been resident in an area where tsetse flies exist and for a restricted period time. The purpose is to determine whether those cattle resident in such an area contract the disease or not. It is also intended to identify the trypanosomes involved especially if they are tsetse transmissible or not, and part of the investigation is to trap the vectors of trypanosomes in the area to identify them.

1.2. The Objectives of the study are therefore:

1. To determine what species of Trypanosomes affect cattle in the prescribed area.
2. To identify of the vectors involved in transmission of trypanosomes
3. To recommend a suitable method of the disease control.
Chapter Two
LITERATURE REVIEW

2.1. African animal trypanosomosis

2.2. Classification:

According to Kreier and Baker (1993) trypanosomes are classified as follows:

Kindom: Protista
Phylum: Protozoa
Sub phylum: Sarcomastigphora
Class: Zoomastigophora
Sub class: Mastigophora
Order: Kinetoplastida
Sub order: Trypanosomidae
Family: Trypanosomatidae
Genus: Trypanosoma

(Hoare, 1964) divided the genus trypanosoma into two main sections according to the site of multiplication of the trypanosome inside the tsetse fly or vector. The first section is sterocorarian in which trypanosomes develop in the posterior part of the insect gut, so transmission occur through contamination, the other section is salivarian or anterior station development. Trypanosomes are divided to sub genera,
these are *Duttonella*, *Nannomonas*, *Trypanozoan* and *Pycnomonas* with the important species, *Trypanosoma vivax*, *Trypanosoma congoense*, *Trypanosoma brucei*, *Trypanosoma evansi*, *Trypanosoma equiperdum*, *Trypanosoma simiae* and *Trypanosoma suis*, while sterocorarian was divided to *Megatrypanum*, *Herpetosoma* and *Schizotrypanum*.

2.3. **Trypanosomosis Transmission:-**

2.3.1. **Cyclic transmission:**

Trypanosomosis in Africa is mainly transmitted by *Glossina species* (tsetse fly) in which Trypanosomes are capable of developing cyclically in the digestive tract of the fly. Different *Trypanosome species* develop in different regions of digestive tract of the fly, these are *Trypanosoma congoense*, *T. vivax*, *T. brucei*, and *T. suis*, *T. simiae* (Hoare, 1972). Transmission by bugs occurs in *T. cruzi* infections, development of the parasite occur in posterior station position in the insect and after 8-10 days of initial infection the metacyclic trypanosome come out in the bug faeces as it defecates near the site of feeding on the mammalian host. Usually infection occurs when the trypanosome rupped to the wounds made by the insect near the eyes or lips of the host, or when the host ingested infected bugs Soulsby (1982).

2.3.2. **Mechanical transmission:**

2.3.2.1. **By biting flies:**

In this mode of transmission the parasites are taken up with blood. They survive for a short time in the mouth parts of insect (Hoare, 1970). *Tabanidae* and other biting flies are incriminated for this type of transmission in further distance of tsetse main belt and in countries outside Africa. Hoare (1957) put forward the hypothesis that *Trypanosoma vivax* had become established in Mauritius and the New World by adapting completely to mechanical transmission.
2.3.2.2. **By iatrogenic means:**

This can occur when using the same needle or surgical instruments for more than one animal, at sufficiently short intervals while the blood on the needle or instrument did not dry. It's not an uncommon occurrence when animals are vaccinated or treated by injection, or when blood is collected from several animals in a row without changing or disinfecting needles or pins. It also occurs when several animals are subjected at short intervals to a surgical intervention (dehorning, castration, and act) without properly disinfecting the instruments Uilenburg (1998).

2.3.3 **Transmission by other means:**

It is well known that carnivores be infected with *T. evansi* and *T. brucei* by ingesting fresh meat or organs from infected animals, as long as these are still sufficiently fresh to contain live trypanosomes (Uilenburg, 1998).

All trypanosomes species are occasionally transmitted congenitally, from the mother to of spring Uilenburg, (1998).

2.4. **Bovine Trypanosomosis:**

The main cattle trypanosomosis in tsetse infested area is caused by *Trypanosoma congolense*, *T. brucei* and *T. vivax*, the latter one is also distributed outside tsetse belt. Ford (1964) described the situation in Rhodesia and observed that *T. congolense* was the predominant trypanosome, but as the distance increased *T. vivax* became the predominant species. The same observations were reported by Hall (1983) in Sudan. Wiessenhulter (1976) found that the *Trypanosoma vivax* was the only encountered species infecting cattle in dairy herds outside the tsetse belt in Tanzania.

The discovery of *Trypanosoma vivax* in Central and South America had been reported by several reviewers from different countries, Panama
Johnson (1941), Venezuela Tegera (1920), French Guinea (Lager and Vienne, 1919), Brazil and Colombia (Wells et al., 1970), and Wells (1972).

2.4.1. The epidemiology of Trypanosomosis:-

The studies cited here mainly concern the two cyclically transmitted trypanosomes in cattle, *Trypanosoma congoense* and *Trypanosoma vivax* and to a lesser degree *Trypanosoma brucei*. Although *T. brucei brucei* only has secondary effects in cattle, *T. brucei gambiense* is of considerable importance to humans as it causes sleeping sickness in West and Central Africa while *T. brucei rhodesiense* causes sleeping sickness in eastern Africa. However, cattle play an important role in the transmission cycle of *T. brucei rhodesiense*. *T. simiae* is rare but very pathogenic to pigs and *T. suis* which are found only in domestic and wild Suids. Thin blood smears and micro-centrifugation are inadequate. Problem areas include multiple *T. vivax* and *T. congoense* infections in cattle and *T. congoense* and *T. brucei* infections in pigs; for example, as to how do they interact to produce symptoms similarly, how can *T. simiae* and *T. congoense* be differentiated in pigs and *T. brucei brucei* and *T. brucei rhodesianse* in cattle.

2.4.2. The vector - tsetse fly:

The tsetse fly is found exclusively in Africa. The limit of its range lies approximately along the 10° N latitude, the Southern limit respond roughly to latitude 20° S, but curves down to Eastern of Africa to 30°S, where the ecoclimate generally is corresponding to more than 1000 mm of rainfall Itard (1981).
2.4.3. **Tabanids - (Horse-fly):**

2.4.3.1. **Distribution:-**

Classifications of many of Sudanese Tabanids are found in the works of King (1910). The later a comprehensive study of *Tabanids* of Sudan was done by Lewis (1953) who reported seventy species under nine Genera of *Tabanids* and their distribution, biology and ecology. Later Yagi (1968), added four species to the seventy species of (Lewis (1953), they were from Messairyya area in West Kurdofan. Yagi and Abdel Razig (1972) described the seasonal abundance of the *Tabanidae* in South Darfur and found that the main species were *Tabanus taeniola*, *Atylotus agrestis*, *Atylotus fuscipes*, *Tabanus biguttatus*, *Ancala latipes*, *Philoiche magrettii* and *Tabanus sufis*.

2.4.4. **Stomoxys:**

Other flies which are incriminated in the transmission of trypanosomosis mechanically are *Stomoxys spp* and *Hippobosca spp* Buxton (1955).

2.4.5. **Clinical Observations:**

Many field and experimental infections are mixed and it is frequently assumed that *Trypanosome congoense*, *T. vivax* and *T. brucei* produce the same disease process, this fact has never been demonstrated and is probably not true Naylor (1971). Since each species of trypanosome may infect several species of animals with different effects and degrees of severity, the clinical signs vary in different mammalian species Stephen (1986), beside trypanosomes are reported to induce immunosuppression in goats (Griffin *et al*, 1980), sheep (Mackenzie *et al*, 1975) and cattle (Holmes *et al*, 1974). However, the disease resulting from mixed infections are more severe than those caused by single
species of trypanosomes Losos (1986). Factors suggested to affect clinical signs were discussed by Stephen (1986) and Losos (1986), indicating the variation of clinical manifestations with the fact that most forms of trypanosomosis do not have pathognomonic clinical signs (Maxei et al, 1979) and Losos (1986).

2.4.6. **The host: animal:-**

The epizootiology of animal trypanosomosis is extremely complicated because the disease affects not only cattle, but also and even to a greater extent, wild animals which constitute omnipresent reservoirs of the disease. Evidence that some Sudanese breeds of goats are trypanotolerant and constitute reservoirs of pathogenic trypanosomes virulent to cattle has been produced (Mahmoud and El Malik, 1977).

2.5. **Diagnosis of Trypanosomosis:**

Clinical diagnosis of individual animals is indicated (Uilenberg, 1998), but is not confirmative (OIE, 1996).

Trypanosomes can be diagnosed by direct parasitological, serological, molecular or chemical techniques.

(Mahmoud and Gray, 1980) Latex fixation test was a rapid, reliable and cheap field test that needs to be devised.

2.5.1. **Parasitological Methods:**

These methods include examination of fresh drop of blood under cover slip as a wet smear, stained thin and thick blood film, those are specific techniques, but their sensitivity is relatively low as parasitaemia is generally low and fluctuating, therefore, a negative result does not always mean that animal is not infected; negative test should be repeated before establishing a final diagnosis OIE (1996). More sensitive parasitological methods depend on the concentration of trypanosomes in
the buffy coat by microhaematocrit centrifugation techniques (Woo, 1970). This technique is efficient and may detect as many as (5) trypanosomes/ml (Kalu et al., 1986). Latex fixation test serodiagnosis is a more sensitive test of infection with trypanosomes. (Mahmoud and Gray, 1980).

The relative efficiency of these several methods of diagnosis may vary between trypanosomes species; the chance may improve by using dark ground/phase contrast and concentration techniques (Murray et al., 1977).

2.5.2. **Inoculation of laboratory animals:**

In general inoculation of blood harbouring infective trypanosomes in susceptible laboratory animals is considered an efficient means of diagnosis, though it is of no use with some species of trypanosomes, and it should be applied under certain conditions (Killick-Kendrick, 1968). However, mouse inoculation was the most sensitive method in detecting *T. brucei* (Paris et al., 1982).

2.5.3. **Serological method:**

At present the indirect fluorescent antibody test (IFAT) detection of species-specific antibodies is recommended (OIE, 1996), also, Mahmoud and Malik (1978) were able to follow up the development of *Trypanosoma evansi* infection and antibody response of goats using immunofluorescent antibody test (IFAT). The method had been widely applied for diagnosis of bovine trypanosomosis in Africa (Luckins, 1992). Some of these promising tests tried are those based on enzyme linked immunosorbent assays (ELISA) involving ELISA kits and species-specific monoclonal antibodies and antigens ELISA (Brown et al, 1991; Rebeski et al, 1999). Agglutination tests like card agglutination and latex agglutination test (LAT) in addition to Ab-ELISA have been used by Lukins (1999).
2.5.4. **Molecular biology techniques:**

The principle of molecular tests is the demonstration of the occurrence of sequences of nucleotides, which are specific for trypanosome subgenus, species or even type or strain (Uilenberg, 1998). Polymerase Chain Reaction (PCR) is based on the use of an enzyme, a DNA polymerase enzyme. The technique is an efficient tool for estimation of the prevalence of African trypanosomosis (Solano et al, 1999).

2.6. **Control:**

2.6.1. **Treatment of trypanosomosis:**

This is done through Chemotherapy and chemoprophylaxis. Using trypanocidal drugs for the treatment and or/ prevention is the most widely accepted method for controlling the disease (Tucher, 1982, Losos, 1986). The available drugs are relatively expensive, and in some African countries sales of trypanocides account for more than half of the total sales of veterinary pharmaceuticals (Feldman and Hendrichs, 2001). Chemoprophylactic drugs are used in highly tsetse infested areas and the only difference from curative drugs is that in case of prophylaxis the drug persist longer Uilenberg (1998). Chemotherapy depends on few trypanocides which their effectiveness is diminished by the increased occurrence of chemo-resistance (Leach and Roberts, 1981) and as outlined by Soulsby (1982), Losos (1986) and (Brander et al 1991) these trypanocides are divided on the basis of chemical composition into fours groups:

1. Naphthaldine group (Suramin).
2. Phenanthridine group: this group contains three compounds: *Homidium bromide, Homidium chloride* and *Isometamidium* (Samorin).
(3) Quinoline group: this group includes *Quinapyramine dimethylsulphate* (Antryside sulphate).

(4) Dimidine group: this group comprises *Diminazene aceturate* (Berenil)

The available and common trypanocidal drugs are *Diminazene aceturate* (Berenil®), *Quinapyramine sulphate* and *Quinapyramine chloride* (Antrycide®), and *Isometamidium chloride* (Samorin®), and, Antrypol (Naganol® …act) were used extensively in the past. Cymelarsan is relatively newer drug.

2.6.2. **Drug resistance:**

The use of trypanocidal drugs is affected by factors including: (a) the application of insufficient doses, due in particular to underestimating the weight of animals; (b) the formation of abscesses followed by partial rejection of the drug; (c) a cyst forming reaction which prevents the diffusion of the product; (d) preventive treatment at too long or irregular intervals; (e) halting the application of trypanphlactics while the animals are still exposed to the risk of infection, and (f) the occasional use of preventive drugs in curative treatments Finelle (1973) and Tucher, (1982).

2.6.3. **Vector control:**

In vector control several methods were applied, these included bush clearance to minimize the density of flies by destroying the tsetse shelter and resting sites Ford (1970) finelle (1974) Walker (1986); this method is seldom used now Finelle (1974); because it is ecologically destructive.

Elimination of game animals in order to starve tsetse flies by reducing the source of food Ford (1970). Due to the world concern to conservation of wild life, this method is not practical. It's not even effective as a control method.
2.6.3.1. **Use of insecticides:**

Application of insecticides like chlorinated hydrocarbons chiefly (DDT) and dihedron was used in the past (Finelle, 1974); organophosphorus and pyrethroids are applied in areal spraying. This is a most effective method Allsopp (1984). Synthetic pyrethroids is also applied by dipping or used as a pour–on, but depending on the particular insecticide used, ticks and other ectoparasites may also be reduced. Use of traps and insecticides impregnated targets with or without attractant to suppress tsetse populations (Challier and Laveissi (1973) and (Vale) (1974) and Brandle (1988) were found effective.

2.6.3.2. **Biological control:**

Recently application of sterile insect technique has been achieved a success in Zanzibar by systematic releases of sterile tsetse fly males among the target tsetse population (Feldman and Hendrichs, 2001), this method is very specific and not polluting Uilenberg (1998), but limited to confined areas like isolated islands only, but two techniques may be recognized: breeding of pathogenic organisms which prey on tsetse pupae; and genetic control which involves sterilization of male tsetse and transmission of lethal genes Finell (1974).
Chapter Three

MATERIALS AND METHODS

3.1. **Description of the study area:**

3.1.1 **Geographical location**

South Darfur State is situated in the West part of Sudan covering 139,800 km² extended between latitudes 9° 55’-13° 6’ N and longitudes 23° 33’-27° 55’ E. It is bordered by North Darfur State to the North, West Darfur State to the West, West Kurdofan State to the East and West Bahr El Gazal State to the South. The State also shares international borders with the Republic of Central Africa to the Southwest. The study area is situated between longitude 11ºE and latitude 26.5ºS and it is located in the South – Eastern part of South Darfur State.

3.2. **Climate:**

The climate of South Darfur State varies from the semi –desert climate in Northern parts of Darfur to the rich savanna woodland in its Southern parts. The climate is generally dry and hot during summer and warm/hot during the rainy season (July –October) and moderately cool during the winter (November-February) (Hall et al 1983).

3.2.1. **Temperature:**

The mean maximum (May–July) and minimum (January) temperature varies from 35°C down to 20°C in the Northern parts, 34°C down to 21°C in the central parts, and 40.7°C down to 15.9°C in the Southern parts of the State (Hall et al 1983).

3.2.2. **Rainfall:**

The rainy season extends from June to October. The annual rainfall ranges between 400-500mm in the Northern part of State with a high
variability of rainfall from year to year. In the central areas the annual rainfall is between 500-600mm and variability of rainfall is low.

3.3. Soils:

There are different types of soils notice in the study area.

3.3.1. The sandy soils:

These types of soils extend over the Northern and central parts of the State, and they are often interrupted by some flood plains (Valeys).

3.3.2. The heavy clay soils:

They are located in the Southern parts of the State and are relatively alkaline.

3.3.3. The flood plains and basin soils:

These are very fertile soils made up of silt, silt loam, alluvial and clay soils. They are dominant in the Southern parts of the State. Adam (2003).

3.4. Range and vegetation:

According to a review and work plan for agricultural technology generation within Western Savanna Development Corporation Report (1988) and (Hall et al.1983) and the natural vegetation in the study area forms 3 distinct ecological zones.

3.4.1. The semi dry zone (A):

This zone extends over the Northern part of the State, where the vegetation is described as semi-desert grassland; this vegetation has been affected by drought, desertification and overcultivation. At present the dominant grass and herb species are: *Artistida pulmosa* (Bayad), *panicum turgidum* (Tomam), *Cenchrus biflorus* (Haskaneet), *Eragrostis spp* (Banu). The dominant trees are low stature *Acacia mellifera* (Kitr) *Acacia nubicca* (Laot) and *Balanitis egpytica* (Heglieg).
3.4.2. The semi-dry zone (B).

This zone occupies the central part of the State. Vegetation is noticed as thorny savanna formation consisting of tall *acacia Senegal* (Hashab), *Acacia seyal* (Taleh) trees. Although pasture production capacity is high, but the rangeland vegetation is affect by overgrazing due to overstocking of livestock in wet-season-grazing areas and watering points.

The main range plant species and herbs are: *Dactyoctenium aegytium* (Abu asabe), *Chloris virgata* (Afan El khadeem), *Sporobolus marginatus* (Um aleh), *Schoenefedia gracilis* (Um metareda), *Echionchloa colonum* (Differa), *Pennisetus pedicellatum* (Um dufufu) and *Zorina glachidiata* (Luseig).

3.4.3. The semi-humid zone:

The Southern part of study area is included in this zone here the vegetation is considered to be rich woodland savanna. The main trees species are: *Tamarindus indica* (Aradeib), *Combertum spp* (Habil), *Anogeisus leiocarpus* (Sahab), *Terminalia lasifora* (Darot), *Diospyros mespiliformis* (Joghan), *Mitragyna enermis* (Ingato) and *Acacia seyal* (Taleh).

3.4.4. Baggara cattle repeated pattern zone:

The above areas called (Dar) or the home land of cattle owning tribes of Darfur, which are lying approximately around latitude 11 °N and consist of patches of sand dunes alternating with patches of non cracking clay soil that end in low land areas in which water flows during the rainy season to form seasonal swamps. The main range of grasses and plant species are: *Echinochoa colonum* (Differa), *Andropogon sp* (Abu rakhees), *Sporobolus marginatus* (Um aleh), *Acacia Senegal* (Hashab),
Acacia nilotica (Garad), Acacia seyal (Taleh), Albizia amara (Arad), Tamarindus indica (Aradeib).

3.5. Husbandry practices:

The two main livestock production systems practiced in the study area were:

3.5.1. Sedentary system:-

In the Northern parts of the State (Eldiaain area) the livestock owners are used to herd their animals around their villages for the whole year. This type of grazing in addition to periodic change in climate and intensive cultivation on (Goz) soils has resulted in low production of rangeland.

3.5.2. Migratory system:

Cattle owners are the larger group among the migratory livestock keepers. Their movement depends on the availability of forage and water points across the State and a long certain routes.

The movement occurs annually at the beginning of rainfall, usually during May, from the South towards the North, at that time the rangeland in the South (Bahr Alarab area) is either overgrazed or destroyed by fire. Livestock owners stay in the North from July to September, then they start their Southward migration.

3.6. Parasitological methods:-

3.6.1. Thin blood smears:

3.6.2. Detection of trypanosomes:

A total of 75 blood samples were collected during (January 2009) from Baggara cattle in Bahr Alarab and Eldiain and thin blood smears
was made. Tested cattle were of different ages (less than 2 years, more than 2 and more than 4 years).

A drop of blood was placed on a clean slide; another slide (spreader) was placed at an angle of approximately 30° to the first slide, and drawn back to make contact with the blood droplet. The blood was allowed to run along the edge of the spreader, and was then quickly and steadily pushed to the other end of the slide, drawing the blood out into a thin film. The slide was dried quickly by waving in the air, fixed for 3 minutes in absolute methanol, and stained for 30 minutes with 10% diluted Giemsa stain in buffered water. After staining the slide was washed gently under tap water and allowed to dry. It was examined under x100 oil immersion objective lens, using a light microscope (Olympus, Japan).

3.7. **Fly surveys:**

3.7.1. **Trapping:**

Nzi trap is available and simple to use and simple to make, about 1 meter height and three triangular sides of blue cloth, the insides consisted of a black cloth to attract flies. The upper part of the trap was covered with a light piece of white transparent cloth that led to a small cage that was covered with a separate piece of the transparent cloth. Trees are known to be used by vectors as resting sites. In each location two traps were placed with 100m distance, to which an open containers of Phenol and Octinol are attached used as fly attractant. Flies were collected once a day. These traps were placed in Bahr Alarab locality (Samaha, Dehell Adabi and Eldiain, during (January and February 2009) in different sites. Traps were deployed in open areas near water bodies and which were surrounded by broad–leafed trees.
Chapter Four
RESULTS

4.1. Trypanosomes survey:
A total of 75 samples were examined in January 2009. The prevalence rate of bovine trypanosomosis was 10.7% in the study area where 8 samples were found positive.

4.2. Trypanosoma species:
In 75 samples of the examined mass *Trypanosoma congoense* was found in 6 samples 8%, thus constituting the dominant species encountered. *Trypanosoma vivax* appeared in 2 samples 2.7%. Table: 1

4.3. The prevalence rate in cattle in different sites in the study area:
In this survey it appeared that the prevalence rate of trypanosomosis is higher in Bahr Alarab cases out of 50 samples 14% from two areas and from different ages and sexes (Dehell Adabi West site of Bahr Alarab, trypanosome was detected in 3 samples out of 25 samples 12%, and in Samaha middle Bahr Alarab area, trypanosome was detected in 4 samples out of 25 samples 16%, these are shown in Table: 1

In Eldiain area in sedentary livestock from different sites composed of different ages and sexes, trypanosome was detected in one sample out of 25 samples 4%. Table: 2

4.4. Fly surveys:
During one month of survey in January 2009 in Bahr Alarab and Eldiain localities the only existing species of trypanosomosis vectors is *Atylotus agrestis* figure., *Stomoxys noritalis*. figure.2 *Tabanus taeniola* figure.3.*Table (3)*
Table (1): **Prevalence rate of trypanosome species in Bahr Alarab**  
*(Samaha & DihellAdabi) and Eldiain*

<table>
<thead>
<tr>
<th>Site</th>
<th>No. examined</th>
<th>Trypanosome spp</th>
<th>No. infection</th>
<th>Total +ve %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samaha (BahrAlarab)</td>
<td>25</td>
<td><em>T. congolense</em></td>
<td>3(12%)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>T. vivax</em></td>
<td>1(4%)</td>
<td></td>
</tr>
<tr>
<td>Dehell Adabi (BahrAlarab)</td>
<td>25</td>
<td><em>T. Congolense</em></td>
<td>2(8%)</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>T. vivax</em></td>
<td>1(4%)</td>
<td></td>
</tr>
<tr>
<td>Eldiain</td>
<td>25</td>
<td><em>T. Congolense</em></td>
<td>1(4%)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>T. vivax</em></td>
<td>0(0%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>75</strong></td>
<td></td>
<td><strong>8</strong></td>
<td><strong>10.7</strong></td>
</tr>
</tbody>
</table>

* T. congolense 6(75) (8%).

* T. vivax 2(75) (2.7%).
Table (2): The effect of age on tryps prevalence

<table>
<thead>
<tr>
<th>Site</th>
<th>T. species</th>
<th>less than 2yrs</th>
<th>more than 2yrs</th>
<th>More than 4yrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahr Alarab</td>
<td>T. c</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>T. v</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Eldiain</td>
<td>T. c</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>T. v</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table (3): Flies trapped in the study area

<table>
<thead>
<tr>
<th>Site</th>
<th>Atylotus agrestis</th>
<th>Tabanus taeniola</th>
<th>Stomoxys noritalis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahr Alarab</td>
<td>43</td>
<td>56</td>
<td>51</td>
<td>150</td>
</tr>
<tr>
<td>Eldiain</td>
<td>0</td>
<td>0</td>
<td>41</td>
<td>41</td>
</tr>
</tbody>
</table>
Chapter Five

5.1. Discussion

South Darfur State was severely affected by drastic climate changes, which have resulted in drought, destruction of vegetation, soil degradation due to reduction of rainfall (Musa and Musa 2003); these factors were complicated by extensive movement of livestock over limited areas. Consequently, overstocking and competition on pasture and water points occurred. Moreover, as a result of the present civil conflicts, migration of nomads from the Northern and Eastern parts to the Southern parts of the State ceased avoiding civil unrest causing increased animal population in the Southern parts of the State, this situation increased the risk of infection with infectious and vector transmitted diseases.

The impact of trypanosomosis in South Darfur State is tremendous due to the wide distribution of biting flies throughout different climatic zones of the region (Abdel Karim et al 1989).

The overall aim of this study was to avail baseline information about the prevalence of the Bovine Trypanosomosis, and to identify morphologically the trypanosomes species and their vectors in cattle in Bahr Alarab & Eldiain localities. The study revealed an overall trypanosomosis prevalence rate of (10.7\%).

The results of this survey indicated a wide variation in the prevalence of trypanosomosis in cattle and variation of trypanosome species. The dominant species of trypanosomes in the study areas was *Trypanosoma congolense* (8\%), and *Trypanosoma vivax* (2.7\%) which could be due to availability of the biting flies. In the Northern part of the area, the prevalence was generally low and infection could be associated with the movement of livestock in and out of the tsetse–infected areas in
the presence of other blood-sucking flies. These results are agreed with Adam (2003). This is verified by low prevalence rates among resident animals kept at a remote distance from tsetse-infected areas when compared with infection rates in migratory livestock, a result that agreed with Hall et al (1983) and Adam (2003) and Mohamed Alamin (2005).

Prevalence rates were greater during the early dry season (November–January), and this coincided with the advancement of tsetse flies after the wet season, probably due to flooding of the pupal sites and scarcity of animal hosts Hall et al (1984). Furthermore tabanids reach their peak of abundance in October Abdul Karim (1980). This correlates with the increasing trypanosome infection rates. Thus indicating their role in spreading the disease. Hall et al (1984), thought it to be of minor importance. Tabanids are the dominant fly vector caught and plays a major role in increasing trypanosome infection. This may explained the high prevalence of the disease (10.7%) in the study area. Furthermore, the lack of security in Northern parts of the study area enforced the nomads to stay longer in Bahr Alarab. Patterns of the livestock migration in South Darfur State observed in this study did not differ from those described by Hall et al, (1983, 1984) Adam (2003) and Mohamed Alamin, (2005). The implication of this migration still exists. It supports the maintenance of the disease and the emergence of new infections. In addition, tsetse flies are known to be carried by cattle and other game animals (Osman and Musa, 1979) and also by moving objects like vehicles Jordan (1986).

Only two main pathogenic Trypanosome species were found during the present survey. This disagrees with Adam (2003) who found three main pathogenic Trypanosoma species, T. congoense, T. vivax, T. brucei. This is probably due to the season of study, or the diagnostic methods used which have a varying degree of sensitivity Paris et al (1982). Our results disagree with Hall et al (1983) found that T. vivax infections were more
prevalent than *T. congoense* infections in the same area. The existence of *T. vivax* outside tsetse–infected areas is mainly a matter of mechanical transmission Stephen (1986). In Nigeria, Folkers and Jones–Davis, (1966). Similar results were earlier by Ford (1964) in Rhodesia and by Clifford (1968) in Uganda.

Sudan was no exception as a series of studies indicated that biting flies were found to possess an important role in maintaining *T. vivax* infection outside tsetse–infested areas (Hall *et al* 1983) (Abdel Karim *et al* 1989) (Hall *et al* 1983) Suleiman (1992).

Furthermore, *Trypanosoma brucei* infected cattle is scantily and not easily detected Stephen (1986), this agreed well with the fact that no *T. brucei* were detected in this study, probably due to the method used in the study was unsuitable to detect it. The fact that nomads are forced to go further South in the tsetse bush where they spend a longer time there (A/Rahman *et al* 1997) beside the long–term use of trypanocides, especially (Berenil®), considering factors affecting the use of trypanocidal drugs discussed by Finnelle (1973) and Tucher (1982), this together with the *Trypanosoma congoense*, and *T. vivax* obtained in this study, may suggests the probability of the existence of a resistance problem concerning *T. congoense* and (Berenil®), a situation that demands further study. The fact that no tsetse flies were caught in Bahr Alarab & Eldiain, may be due to the time of the study unsuitable to the tsetse fly development, because it’s dry contrast to the results obtained by Adam (2003), who reported that tsetse flies were encountered along the tributaries of the river Bahr Alarab, this may be due to different enviromental conditions due to different season.

More *Tabanids* were caught than other flies, only *Tabanus taeniola*, *Atylotus agrestis* and *Somoxys spp* in Bahr Alarab, and *Stomoxys spp* were caught in Eldiain area, this is in contrast to the results
obtained by Abdel Karim (1980) in Nyala, and Adam (2003) there was reported *Tabanus bigutatus*, and no *stomoxys spp* were caught may be due to different sites of studies was conducted in the South Darfur State, also this result disagreed with Mohamed Alamin (2005) who recorded *Tabanus sufis* only in South Darfur State probably due to different sites in the State or methods of collection, however no *Tabanus sufis* was caught in this study.

In general, trypanosomosis in cattle is of epidemiological importance since different animal species usually exist in the same pasture and grazing land. Finally this study resulted in finding that the main trypanosome species is *T. Congolense*, *T. vivax* and their vectors which were incriminated in transmission are *Tabanus taeniola*, *Atylotus agrestis*, and *Stomoxys spp*, this agreed with A/Rahman (2002) from Khartoum and Blue Nile State and these findings suggested the importance of mechanical transmission in the epidemiology of trypanosomosis in tsetse free areas Karib (1961) and Raymond (1990).
5.2. CONCLUSION & RECOMMENDATIONS

During this survey of trypanosomes vectors only three genera of flies were caught in Bahr Alarab, *Atylopus agrestis*, *Tabanus taeniola* and *Stomoxys spp*, in Eldiaín locality, genus *Stomoxys* was caught. In this study high prevalence (10.7%) of bovine trypanosomosis was recorded at Bahr Alarab and Eldiaín localities in (January 2009). Bovine trypanosomes infection was found to be high among migrated cattle at Bahr Alarab (14%) and low in Eldiaín (8%) in sedentary dairy cattle. *Trypanosoma congolense* and *Trypanosoma vivax* was the only species of trypanosomes encountered. High prevalence rate of *Trypanosoma congolense* (8%) and low prevalence of *Trypanosoma vivax* (2.7%) was recorded in BahrAlarab. *Trypanosoma congolense* was the only pathogenic trypanosome species found in Eldiaín area its prevalence rate was (4%). Further studies are required to determine the followings:

1. Study of drug resistance and sensitivity to drugs of *Trypanosoma vivax* and *Trypanosoma congolense* stock circulating in the area
2. Introduce the more sensitive and specific diagnostic techniques such as ELISA and PCR detection of trypanosomes infection to determine their prevalence.
3. Use of traps and targets as method of the vectors control.
Figure: 1

Family: Tabanidae
Genera: Atylotus
Species: *Atylotus agrestis*

BahrAlarab (January 2009)
Figure: 2

Family: *Muscidae*

Genera: *Stomoxys*

Species: *Stomoxys noritalis*

BahrAlarab (January 2009)
Family:  *Tabanidae*

Genus:  *Tabanus*

Species:  *Tabanus taeniola*

Bahr Alarab. (January 2009)
Figure: 4

NZI trap and insects caught- Sudan - South Darfur state
Bahr Alarab (January 2009)
Figure: 5

Water points (where tsetse flies and animals meet)

Sudan-South Darfur State

Bahr Alarab (January 2009)
Figure: 6

Different species of animals herded together

Sudan - South Darfur State

Bahr Alarab (January 2009)
Sampling and processing method
(January 2009)
Figure 8: South Darfur State
References


