ADDIS ABABA UNIVERSITY
FACULTY OF VETERINARY MEDICINE

STATUS OF DERMATOPHILOSIS IN URBAN AND PERIURBAN INDIGENOUS AND CROSSBREED CATTLE IN BAHIR DAR AND DEBRE BERHAN TOWNS

BY

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LIST OF ABBREVIATIONS

AAU	Addis Ababa University
ANRS	Amhara National Regional State
ARARI	Amhara regional Agricultural Research Institute
CI	Confidence interval
CSA	Central Statistical Authority
DVM	Doctor of Veterinary Medicine
ELISA	Enzyme Linked Immuno Sorbent Assay
FVM	Faculty of Veterinary Medicine
OIE	Office International Des Epizootics
OR	Odds Ratio
PA	Peasant Association
PAHO	Pan American Health Organization
WHO	World Health Organization
masl	Meter above selevel

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ABSTRACT

A cross sectional study of bovine dermatophilosis was undertaken on a total of 2284 cross-bred and 4628 indigenous cattle in urban and periurban areas of Bahir Dar town (mid altitude) and Debre Berhan town (high altitude). The majority (1590 local and 138 cross-bred) animals were found in mid-altitude while 724 local and 1004 crossbreed were found in high altitude representing Bahir Dar and Debre Berhan, respectively.

Skin lesions were found in 2.4 % of animals examined out of which *Dermatopholus congolensis* was isolated from 22.6 (%). There was a higher prevalence (1.62%) in wet period than (0.46%) in dry period; (5.4 %) in cross-bred than (0.66) local breed cattle; (2.65) *A. variegatum* infested cattle than (0.44%) in *A. variegatum* none infested cattle, and (1.24%) in adult than (0.79 %) in young cattle with statistical significant ($P< 0.05$) difference between them in mid-altitude.

There was also high prevalence (1.04%) in mid-altitude than (0.03%) in high altitude of the two seasons with a statistical significant ($p < 0.05$) difference, but a high prevalence (1.74%) in male than (0.77%) female with none statistical significant ($p> 0.05$) difference. According to the result obtained significantly associated risk factors with dermatophilosis have a high influencing contribution on the occurrence of the disease in the studied area (urban and periurban of Bahir Dar town).

Key words: Dermatophilosis, prevalence, bovine, risk factors, odds ratio

1. INTRODUCTION

Dermatophilosis is a superficial bacterial dermatitis caused by *Dermatophilus congolensis*, which is characterized by exudative crust formation (Evans, 1996). It affects cattle, sheep, goats, horses, wild animals and man.

The disease has a worldwide distribution but severe clinical disease caused by *D. congolensis* is most common in tropical and subtropical regions (Quinn *et al.,* 1999) such as in west, central and east African countries (Hall, 1985). This is due to predisposing factors such as prolonged wetting by rain, high humidity, high temperature, and various ectoparasites that reduce or permeate the natural barriers of the integument that influence the development, prevalence, seasonal incidence, and the development of dermatophilosis (Losos, 1986; Aiello and Mays, 1998).

The disease is transmitted following direct contact with affected animals, a reservoir host and contaminated fomites or mechanical means by both biting and nonbiting flies and ticks (Hubbert *et al.*, 1975).

Different investigators reported the prevalence of dermatophilosis in livestock in different parts of Ethiopia. Prevalence of dermatophilosis in local cattle was reported from 0.55% (Bewket, 1987) to 15.04 % (Moges and Geremew, 2001) and in crossbred cattle from 6.7 % (Bewket, 1987) to 26.9 % (Moges, 2000). The importance of dermatophilosis lies in the economic losses it causes, mainly from down grading of the quality of hides, skin and wool. Other economic losses are due to loss of milk production and weight gain, cost of treatment, death and culling of productive animals and decreased draught power of oxen. Some investigators have assessed the economic impact of dermatophilosis. In African countries, economic losses from bovine hides ranged from 16 % in Kenya to 90 % in Tanzania. In Ethiopia, reports from tanneries show that 30 % of the processed skin is only exported, the remaining being rejected due to loss of quality (Moges, 2000). One of the diseases involved in downgrading the skin is dermatophilosis. However, a wide knowledge gap remains on the associated factors and epidemiology of the disease as a hindrance to devise and implement an effective control measure against the diseases (Moges and Degu,

2000). Sever forms of dermatophilosis in cattle occur in Africa where dermatophilosis is of major economic importance particularly in those programs, where exotic breeds are introduced to improve indigenous stock (Losos,1986) and animals with severe generalized infection often lose condition and movement and prehension are difficult if the feet, lips and muzzle are severely affected (Aiello and May,1998).This in turn could result in reduction on reproductive performance, draft power availability and overall cattle productivity (Chtikobo and Kusino,2004). and many authors (Bewket, 1987, Mulugeta, 1994, Moges and Geremew, 2001, Enquebaher *et. al*.,2003) in Ethiopia have shown that the disease is more severe and frequent in exotic and cross bred cattle than in local cattle therefore there is a fear for the emergence of dermatophilosis as the number and exotic blood level of the improved cattle increases in the selected dairy development project areas. So that as the future trend of the selected development project areas is to increase the amount and quality of milk by increasing the number of crossbred cattle with an increased exotic blood level, this could be realized if only if they are able to prevent and control different diseases (like dermatophilosis) and factors that cause death, infertility, production reduction and quality of milk and also by improving the management system. It is believed that studies have to be conducted in the selected dairy development project areas since there is no recent report about the status of the disease in these areas.

Therefore the objectives of the present work are:

- To determine the prevalence of the disease in two different agro-ecology.
- To asses and show the associations of major epidemiological risk factors which have a direct contribution for the occurrence of the disease.
- To provide a base line data for researchers about the magnitude of the disease in the area to start with.

2. LITERATURE REVIEW

2.1. Disease history

Van Saceghem first described the disease in 1915 as a disease of cattle in the Belgian Congo. Austwick in 1958 placed the organism in the family *Dermatophilaceae* (of the order *Actinomycetales*) and listed the single genus, *Dermatophilus.* He gave three species, *Dermatophilus congolensis* from "bovine streptothricosis*",* *D. dermatonomus* from ovine mycotic dermatitis, and *D. pedis* from strawberry foot rot of sheep, Later, Gordon in 1964 concluded there were a single species (Hungerford *et al.*, 1975).

Dermatophilosis (streptothricosis*)* is a superficial bacterial dermatitis caused by the Actinomyces *Dermatophilus congolensis* and is characterized by exudation and crust formation (Evan, 1996). It is given different names depending on the host species affected. In cattle, goats and horses it is called cutaneous streptothricosis and in sheep as lumpy wool or strawberry foot rot (Aiello and Mays l, 1998) and mycotic dermatitis (Radostits *et al.*, 1994). Other local names include Senkobo skin disease in central Africa, Kirchi in Nigeria and Saria in Nyasaland (Radostits *et al.*, 1994).

2.2. Etiology

2.2.1. Classification and habitat

Dermatophilus congolensis is a pleomorph bacterium, which belongs to the family Dermatophilaceae of the order Actionomycetales (Seifert, 1996). It is facultative anaerobic, gram-positive, and non-acid-fast, characterized by branched filaments with transverse and longitudinal septation (PAHO, 2001). The branching filaments measure less than 1 mm in diameter (Quinn *et al.*, 1999). When the filaments mature, they fragment and release motile, flagellate and infective spores, called zoospores (PAHO, 2001), which measure from 0.5 to 1.1 mm in diameter (Losos, 1986). The natural habitat of *D. congolensis* in unknown (Barlough, 1989; Aiello and Mays, 1998). It probably has a saprophytic existence in soil (Scanlan, 1988; Barlough, 1989 and Aiello and Mays, 1998).

It has been isolated only from the integument of animals (Scanlan, 1988, Aiello and Mays, 1998). Viable organisms have been found in crusts and scabs on affected animals for as long as 42 months after infection (Barlough, 1989; Evans, 1996).

2.2.2. Morphology and stain reaction

When pus cannot be found, diagnosis is made more difficult. Crusts may be grounded up and made into smears for microscopic examination, but the most helpful techniques remain skin biopsy and culture (Rebhun *et al.* 1995).Scabs from lesions and a small piece of affected skin should be taken with a pair of forceps so as to avoid human infection by direct contact and put into a dry sterile container for further laboratory investigation (Hall, 1985). It may be demonstrated in smears made from scabs emulsified in water or in impression smears from the base of freshly removed adherent scabs. Alternatively scabs can be soaked overnight in sterile water or saline to sufficiently moisten them so that the undersurface of the scab can be used to make effective impression smears by firmly pressing this surface onto a microscope slide. Smears are air dried, fixed by heating or immersion in methanol for 5 minutes (OIE, 2002) and stained by Gram's Method, Giemsa or methylene blue, and examined for the presence of branching filament composed of multiple parallel rows of coccid cells (Sewell and Brocklesby, 1990). The hyphae and coccid stain deep purple while the epithelial cells are light blue and the nuclei of leukocytes are dark blue (Carter, 1984). Gram staining does not give as good results as Giemsa because it may over stain the background and does not clearly show the characteristic laddering of the coccoid forms (OIE, 2002). The characteristic segmenting appearance seen in tissue is often not seen in gram-stained smears from cultures. These may at times show cocci only, but they usually show Gram-positive branched filamentous organisms. Motile zoospores can be shown after growth in tryptose broth (Carter, 1984).

2.2.3. Cultural characteristics

The organism is not fastidious and grows well on unenriched media such as tryptose agar. It does not grow on sabouraud dextrose agar, dermatophyte test medium (Carter, 1984; Barlough, 1989) or on most agars containing antibiotics (Barlough, 1989). This organism grows best at 37^0C for 72 hrs under 5-10 % CO_2 (Losos, 1986; Bisping and Amtsberg, 1988; Quinn *et al.,* 1999). When cultured from contaminated sites, special techniques

involving filtration, or selective media (OIE, 2002) and chemotaxis or Haalstra's method (Hubbert *et al.*, 1975; Gyles and Thoen, 1993; OIE, 2002; Quinn *et al.*, 1999) are necessary. To overcome this difficulty passage through rabbits has been used (PAHO, 2001). Uncontaminated specimen can be taken by aspirating exudates from unopened pustules. Pinpoint colonies surrounded by small zones of beta-hemolysis, are evident, after 24 hours incubation at 37^{O}C, after incubation for 3-4 days, colonies are considerably larger. They may be wrinkled or smooth, convex, and varying in color from grayish white to bright orange (Carter, 1984). In solid medium pitting may be observed with early growth (Koneman *et al.*, 1988) and a thick floccular sediment develops in broth after a week (Seifert, 1996).

2.2.4. Biochemical characteristics

Dermatophilus congolensis produces acid from glucose, fructose, galactose, inulin, and serum-enriched maltose but not from dulcitol, lactose, mannitol, or salicin; occasional strains have been reported to produce acid in sucrose. This organism is quite proteolytic; it hydrolyses urea, peptonises litmus milk, hydrolyses casein, and liquefies gelatin and loeffler's inspissated serum. Catalase is produced, but nitrates are not reduced nor is indol formed (Merchant and Packer, 1983).

2.3. Epidemiology

2.3.1. Geographical distribution

The pathogenic actinomycetes have a worldwide distribution but severe clinical disease caused by *D. congolensis* is most common in tropical and sub-tropical regions (Table 2) (Quinn *et al.*, 1999). The disease is widespread in west, central and east African countries (Hall, 1985). *D. congolensis* causes infections in many species of domesticated and wild animals and man (Losos, 1986; Sewell and Brocklesby, 1990; Carter and Chengappa, 1991) but the infection is common in cattle, sheep, horses and goats (Merchant and Packer, 1983). Recent studies indicated that the disease is widely prevalent, especially in cattle (Carter and Chengappa, 1991). Highly productive European cattle (Carter and Chengappa, 1991; Seifert, 1996) and crosses with local breeds (Losos, 1986) are very susceptible while

N'dama, Mutura, Dinka and West African shorthorns are much less affected. Apparently this also depends on breed-specific differences in the layer of lower fatty acids, which protects the skin of the animals as well as specific activity of phagocytes of the different breed (Sewell and Brocklesby, 1990). Rabbits and mice are susceptible to experimental infection (Merchant and Packer, 1983).

The disease is seasonal in incidence, most causes occurring during the rainy seasons (Swell and Brocklesby, 1990; PAHO, 2001) and at the end of spring, when insects (PAHO, 2001) and ticks (Losos, 1986) are most abundant. Maceration of the epidermis during heavy rainfall is considered to reduce resistance to invasion and moisture facilitates release of infective zoospores and their penetration in to the skin (Gyles and Thoen, 1993).

Various reports mostly DVM theses show the wide spread distribution of dermatophilosis in livestock in Ethiopia (Table 1). These investigations have attempted to identify the risk factors involved in the epidemiology of the disease. For examples the following have reported that exotic breeds and their crosses are most susceptible than local zebu cattle (Desta, 1985; Bewket, 1987; Mulugeta, 1994; Degu, 1998; Moges and Geremew, 2001; Enquebaher *et. al*.,2003, Gashaw, 2001).

Table 1: Prevalence of Dermatophilosis in different parts of Ethiopia

	Altitude (masl)	Breed			Season		Age (in year)						Sex	
		Local	Cross	Local + Cross	Dry	Wet	<1	01-Mar	<3	>3	Adult	Young	M	F
Desta (1985)	1890	_	_	0.69	_									
Kiros (1985)	1850	0	13.3	_	_									
Beweket (1987)	1500-3500	0.55	6.7	0.58	_									
Mulugeta (1994)	2450	4.6	15	9.2	_				4.7	11			5	
Tesfaye (1994)	2070	5	_	_	_		0	1.69*	0	8.25*			7.2	
Moges and Degu (1999)	700-3100	4.8	12.8	5.1	3.6	6			2	6.5			5.1	
Moges (2000)	750-2000	3.2	26.9	_										
Gashaw (2001)	1400-3320	2.9	14.6	3.9	_						4.2	2.8	3.5	2.12.21
Hagos and Tibbo. (2001)	900-1900	2.61	_	_	_						2.15	3.6	3.2	
Moges and Geremew (2002)	2400-2500	15.4	20	15.2	_		5.7	13.8		18.1				
Enquibahir,et.al, (2003)	1580-2600	4.7	11.9	5.2	4.8	5.7	3.4	17.5		15.3				
Alem (2004) (Melkawakena)	Low land				8.8	42								
" Assela	High land				2.2	12.6								
" Modjo	Mid land				2.1	12.1								
" Agarfaa	High land				2.9	11.8								

1.69*= 1-2 years, 0*= 2-6 years,*8.25= >6 years, M= Male, F= Female

Table 2: Prevalence of dermatophilosis in different countries

Auther	Country	Cattle	Sheep	Goats	Camel	Horse
Nooruddin and Khalegue, 1986	Bangladesh	13.51	-	-	-	-
Pal, 1995	India	11.76	-	3.13	0	1/23
Drager, 1977	Botswana	5	-	-	-	-
Nawathe *et al*., 1985	Nigeria	8.2	-	-	-	-
Samui and Hugh-Jonsen, 1990	Zambia	5	-	-	-	-
Belem et al.,1988	Burkina Faso	2.63	1.2	0.66	-	-
Morrow *et al*., 1991	United Kindom	4.21	3.8	9.4	-	5/44
Yeruham *et al*., 2000 (b)	Israel	10-66.6 *	-	-	-	-

*= Dermatophilosis out break

2.3.2. Source of infection

Infected animals, including symptomless carriers are the major sources of infection (Sewell and Brocklesby, 1990). During dry periods foci of infection may persist in protected areas such as the axillae and skin folds on cattle and sheep (Hubbert *et al.,* 1975). Thorns from bushes and lawns from pasture grasses can also take up the spores and infect susceptible animals (Seifert, 1996).

2.3.3. Transmission

Mode of infection is directly via skin abrasions or existing lesions (Hubbert *et al.,* 1975; Hungerford *et al.,* 1975) and transmission is by spores (Hall, 1985) following direct contact with affected animals (Barlough, 1989) that are reservoir hosts and contaminated fomites (Hubbert *et al.,* 1975; Evans, 1996), or mechanical means by both biting and non-biting flies and ticks (Hubbert *et al.,* 1975; Evans, 1996). Aerial transmission has also been reported (Hall, 1985). It is believed that the disease is not contagious in the ordinary sense, because attempts to experimentally produce the progressive form of the skin disease failed (Swell and Brockelesby, 1990). However, the disease is transmitted by contact only if any reduction in systemic or local skin resistance favors establishment of infection and subsequent disease (Aiello and Mays, 1998).

2.3.4. Predisposing factors

Predisposing factors such as prolonged wetting by rain, high humidity, high temperature, and various ectoparasites that reduce or permit the natural barriers of the integument influence the development, prevalence, seasonal incidence, and transmission of dermatophilosis (Losos, 1986; Aiello and Mays, 1998). Skin defects may be microscopic and can be caused by trauma, or maceration of insect bite (Barlough, 1989) such as ticks and biting flies, thorns or other wounds (Sewell and Brocklesby, 1990). Intercurrent diseases also predispose animal to development of dermatophilosis (Losos, 1986; Sewell and Brocklesby, 1990). Infestation with *A. variegatum* would appear to be the most important contributing factor in the occurrence of bovine dermatophilosis in the tropics (Marrow, 1995). Among the biting insects reported to

predispose to dermatophilosis include *Stomoxys*, *Tabanus* and *Musca* species (Mogos, 2000; Hagos and Markos, 2003).

2.4. Clinical signs

The incubation period varies from a few days to a week and cannot be determined under field conditions. Lesions range from a small, nodule-like formations to large patches, and in advanced cases, whole regions of the body are covered by hard crusts (Losos, 1986). The lesions commence as papule and pustules, which coalesce into extensive scabs or exudates, coagulates causing the hairs to stick together and stand erect giving the so-called "Paint brush" effect (Sewell and Brocklesby, 1990; Hungerford *et al.*, 1975). The occurrence of a severe form of the disease in the tropics is often associated with infestation with *A. varigatum* ticks (Swell and Brocklesby, 1990). Clinical signs in cattle vary in severity according to the site and extent of skin lesions. Unless large areas of the skin are affected the systemic clinical signs are minimal.

Syndromes last from 15 days to many months (Losos, 1986). Animals with severe generalized infections often lose condition, and movement and prehension are difficult if the feet, lips, and muzzle are severely affected (Aiello and Mays, 1998).

In adult cattle the characteristic lesions, are thick, horny crusts, varying in color from cream to brown. In the early stages the crust is very tenacious and attempts to lift them cause pain. Beneath the crusts there is granulation tissue and some pus. In the later stages, the dermatitis heals and the crusts separate from the skin but are held in place by penetrating hairs. In young calves, plaque and crust formation do not occur. There is extensive hair loss with tufting of the fibers, heavy dandruff and thickening and folding of the skin in the later stages. Sub clinical carriage form of the disease is common in most herds (Radostits *et al.*, 1994).

The position of the lesions varies with the predisposing conditions. In periods of high rainfall the lesions tend to occur along the backs of animals where there in a heavy infestation with amblyomma ticks, the lesions are present in the predilection sites of the ticks: dewlap, axillae, udder, scrotum and escutcheon (Quinn *et al.*, 1999). Lesions

initiated by biting flies are found primarily on the back (Aiello and Mays, 1998). In the dry season, in tropical regions, when feed is scarce the lesions are on the muzzle, head and lower limbs due to the animal foraging in thorn-covered scrub (Quinn *et al.*, 1999). However the predilection sites of *D. congolensis* in cattle occur on the neck, body, or back of the udder and many extend over the sides and down the legs and the ventral surface of the body. Commonly they commence along the back from the withers to the rump and extend half way down the rib cages.

In cases without complications and in the dry season, the lesions heal spontaneously in about three weeks (PAHO, 2001). Animals seriously affected lose condition, become weak and being unable to forage and may die from starvation (Hall, 1985). Deaths occasionally occur, particularly in calves and lambs, because of generalized disease with or without secondary bacterial infection (Aiello and Mays, 1998).

2.5. Pathogenesis

It appears necessary for the skin to be damaged before infection can take place. There are three natural barriers to infection: the hair or wool, the film of sebaceous wax on the skin, and the stratum corneum (Sewell and Brocklesby, 1990). It is suggested that skin surface lipids of cattle may not have bacteriostatic action against *D. congolensis* but rather provide a mechanical barrier (Adekeye and Timoszyk, 1983). Zoospores germinate to produce hyphae, which penetrate into the living epidermis and subsequently spread in all directions from the initial focus. Hyphal penetration causes an acute inflammation reaction. Natural resistance to the acute infection is due to phagocytosis of the infective zoospores but once infection is established, there is little or no immunity. In most acute infection, the filamentous invasion of the epidermis ceases in 2-3 weeks, and the lesions heal spontaneously. In chronic infections, the affected hair follicles and scabs are sites from which intermittent invasions of non-infected hair follicles and epidermis occur. The invaded epithelium cornifies and separates in the form of a scab (Aiello and Mays, 1998).

2.6. Diagnosis

The microscopic unique appearance in tissue or lesions (Carter, 1984) together with the seasonal occurrence of the disease in an endemic area is characteristic confirmation of the diagnosis (Sewell and Blocklesby, 1990)

Although cellular morphology is characteristic, biochemical reaction may help confirm the identification (Koneman, 1988). On the basis of the following biochemical properties: catalase (+), urease (+), gelatin (+), glucose, fructose, maltose (+), and sucrose, salicine, xylose _ (-) (Carter, 1984). Demonstration and identification of *D. congolensis* by immunofluorescence is a reliable and very sensitive method of diagnosis (OIE, 2002). In difficult case and when infection of organs other than the skin is suspected, histopathological examination of biopsy or necropsy material is advisable (OIE, 2002). A variety of serological tests have been applied in studies of the epidemiology and pathogenesis of dermatophilosis. At present the ELISA remains more suitable as a research and investigation method than for routine diagnosis (Barre, 1997; Maillard *et al*., 1997; OIE, 2002).

When other diagnostic techniques fail, animal inoculation can be used to isolate *D. congolensis*. Rabbits are clipped at the inoculation sites, which are swabbed with ether and then lightly scarified with a needle, while avoiding hemorrhages (Cottral, 1978; OIE, 2002) applying 0.3 ml of a suspension of ground exudative crust or 0.3 ml of a 3-day –old 10% serum broth culture (Cottral, 1978). Some serous exudation may be seen and scab formation will occur after approximately 72 hours. These lesions will normally be uncontaminated, and *D. congolensis* can be demonstrated in the scabs or isolated from them (OIE, 2002).

2.6.1. Differential diagnosis

It includes *Dermatomycoses* in most species, warts and lumpy skin disease in cattle (Aiello and Mays, 1998). *D. congolensis* is a gram-positive microorganism having characteristics similar to both the fungi and the bacteria. Its size and chemical composition distinguish it as a bacterium, but it forms a branched mycelium, which fragment into motile coccoid

elements resembling the spores of a fungus (Hall, 1985). Actinomycetes comprise a heterogonous group of prokaryotes that have the ability to form gram-positive, branching filaments of less than 1mm in diameter. However, fungi are eukaryotes and their filaments (hyphae) are always greater than 1mm in width (Quinn *et al.*, 1999).

It differs from *Actinomyces, Nocardia,* and *Streptomyces* by its production of motile zoospores and by the peculiar way in which the hyphae or filaments segment (Carter, 1984). Photosensitization will cause sunscald, swelling of face and ears, with scabbing, after grazing on sensitizing plants.

2.7. Treatment

There is no completely satisfactory treatment for a case that shows very extensive involvement or those being constantly re-infected or exposed to predisposing causes. In general terms, better results are obtained during dry hot weather and in dry climates (Radostits *et al.,* 1994).

Since acutely infected animals usually heal rapidly and spontaneously, treatment is indicated only for cosmetic reasons. Usually, chronic infections can be rapidly and effectively cured with a single intramuscular injection of procaine penicillin (22000 IU/kg) and streptomycin (22 mg/kg) (Aiello and Mays, 1998); and with intravenous iodide therapy (Buxton and Fraser, 1977). If this fails, the penicillin-streptomycin combination can be administered for 5 days (Aiello and Mays, 1998) or a single injection of long-acting oxytetracycline at (20 mg/kg can be substituted for bovine (Evans, 1996).

Topical treatment of streptothricosis is not generally effective, although numerous drugs and chemicals have been given extensive trials without marked success (Hall, 1985; Radostits *et al.*, 1994). These external treatments with no curative value include the use of arsenicals, copper sulphate, quaternary ammonium compounds, and formalin because the majority of hyphae are inaccessible in the follicle sheaths (Buxton and Fraser, 1977; Radostits *et al.*, 1994). However, satisfactory result have been obtained using 1% alum dips (PAHO, 2001) bathing with a providence iodine shampoo or chlorhexidine solution

daily for 7 days followed by treatment one to two times weekly until there is clinical resolution (Evans, 1996) and topical application of iodine compounds, copper sulfate or other solutions by removal of scabs with a brush and mild soap (Carter and Chengappa, 1991).

2.8. Control and prevention

Prevention is aimed at reducing exposure to prolonged moisture, minimizing skin trauma avoiding contact with affected animals (Barlough, 1989) and isolating or eliminating chronically sick animals (Aiello and Mays, 1998; PAHO, 2001).

Insecticides applied externally are frequently used to control biting insects (Aiello and Mays, 1998) and treated regularly with acaricide to keep the animal free from ticks, especially *A. varigatum*. Thorny plants should be removed from grazing areas and the provision of shelter from rain for animals at night, especially for horses. It is also possible to increase herd resistance by selective breeding from resistant individuals. Intercurrent disease, such as demodectic mange, lumpy skin disease, globidiosis and trypanosomosis should also be treated and controlled (Sewell and Brocklesby, 1990). Tick control programme (Morrow, 1995) in the north of the Island of Lesser Antilles. (Barre, 1997) and especially eradication programme of *A. varigatum* conducted in Caribbean (Morrow *et al*., 1991) had resulted in a significant reduction in prevalence of the disease.

2.9. Immunity

Recovery from the natural infection does not confer immunity (Losos, 1986; Sewell and Brocklesby, 1990). Natural resistance to the acute infection is due to phagocytosis of the infective zoospores, but once infection is established, there is little or no immunity (Aiello and Mays, 1998). Delayed hypersensitivity is indirectly involved in the prevention of epidermal invasion (Losos, 1986; Sewell and Brocklesby, 1990). Attempts to produce immunity by vaccination have been unsuccessful (Sewell and Brocklesby, 1990). The failure of trials to vaccinate against dermatophilosis may depend on the fact that the granulocytes do not come in contact with the zoospores, which germinate in the superficial

cell layers of the epidermis (Seifert, 1996). No vaccine is available currently (OIE, 2002). Vaccines designed for the prevention of dermatophilosis in the field may need to include a range of local antigenic variant of *D. congolensis*, if common protective antigens cannot be identified. Further studies are required to examine the antigenic variability of *D. congolensis* isolates and to determine strain specific antigens and their role in immunity to Dermatophilosis (How and Lloyd, 1990).

2.10. Economical importance and public health consideration

2.10.1 Economic importance

The importance of dermatophilosis lies in the economic losses it causes, due to the damage to leather, wool, and pellets (Aiello and Mays, 1998; PAHO, 2001). Affected animals lose condition and especially animals chronically affected occasionally die (Hall, 1985).

Severe forms of disease in cattle occur in Africa where dermatophilosis is of major economic importance particularly in those programs where exotic breeds are introduced to improve indigenous stock (Losos, 1986). In some African countries, losses of cattle skin range from 16% (Kenya) to 90% (Tanzania) of its quality. The total annual national cost of bovine dermatophilosis in 1985 was conservatively estimated to be some K.6.9 million (US $3 m million) (Samui and Hugh-Jones, 1990). The disease also could compromise reproductive performance, draft power availability and overall cattle productivity, particularly during the rainy season in Sanyati smallholder farming area of Zimbabwe (Chatikobo and Kusina, 2004). Losses occur in production of hides, beef, and milk as well as through the high morality in introduced exotic breeds (Losos, 1986). An average loss of milk production of 30 % cow/day in affected animals (Yerham *et al*., 2000 (a)) was reported. Extensive use of expensive antibiotics on a herd basis is not economically possible (Losos, 1986). In Ethiopia a loss of 19000 Birr was estimated only in three small size dairy farms in north western zone due to death of 51 animals (Asegedech and Infante, 1994).

2.10.2 Public health consideration

Pustular dermatitis is the typical lesions of dermatophilosis in man (Hubbert et al., 1975). Human cases have arisen from direct contact with animal lesions. Man is probably quite resistant to infection, as the number of human cases is small despite the frequency of the disease in animals (PAHO, 2001). The majority of the reported cases have occurred in people handling affected large animals (Barlough, 1989). In the few known cases, the disease is characterized by purples and multiple pustules on the hands and forearms that contain serous or yellowish white exudates. Up on rupturing, they leave a reddish crater form of cavity. The lesions healed in 3 to 14 days, leaving a purplish red scar (PAHO, 2001). Laboratory workers should be aware of the infectiousness of *Dermatophilus* for human skin (Cottral, 1978) and every care should be taken with hygiene (Hungerford et al., 1975).

3. MATERIALS AND METHODS

3.1. Study area

The study was conducted in two *woredas* (districts) of the Amhara National Regional State namely, Basona Werana of North Shoa zone and Bahir Dar Zuria of West Gojjam Zone (Fig 1). These *woredas* are selected based on their being selected as dairy development sites of the region and supply milk for Debre Berhan and Bahir Dar towns, respectively. Basona Werana *woreda* is situated north east part of the country at an altitude of 2800 masl. It has varying agroecological zones comprising of *wurch* (0.6%), *dega* (54.4%), *weyina dega* (21.5%) and *kola* (23.5%). The annual minimum and maximum temperature ranges from 2.4–8.5 ^{0}C to 18.3-23.3 ^{0}C, respectively. The annual average rain fall ranges from 800–1000 mm and mean relative humidity is 68 ^{0}C. From the total area of the *woredas*, 22,886 hectare is used for grazing land and 5969 hectare of land covers bushes and Shrubs.

Bahir Dar zuria is found at an altitude of 1802 masl and has got a warm humid climate with an average annual rain fall of 700mm and annual mean temperature ranges from 12.4 ^{o}C - 27 ^{o}C. The climate in the *woreda* is mainly *woyina dega* (CSA, 2001).

3.2. Study population

According to the recent census (CSA, 2003) the total cattle population of Amhara Regional State is estimated to be 10,512,777 that are relatively divided in equal parts between male and female. The majority of cattle population is found in rural areas, while the remaining small population is accounted for urban areas. The majorities (99.5 %) of cattle population in the region are local breeds and the balance cross-bred and exotic breeds. The latter are in urban and periurban areas. The target population of Basona Werana *woreda* is 77,593 local and 11,423 cross-bred cattle where as that of Bahir Dar Zuria *woreda* is 2,500 cross-bred

cattle and 206,766 local zebu cattle (CSA, 2003). This study was conducted in cross-bred and indigenous zebu cattle breed (Table 3 and Annex 4 and 5).

Table 3 Distribution of study population and sample size of the study area.

Study site	District (PA)	Cattle		Sample size	
		local	Cross	local	cross
Mid land	Woramit	8144	46	399	20
	Sebatamit	4746	17	307	5
	Dishet Abarage	5250	41	363	15
	Yigoma	3718	95	311	25
	Bahir Dar town	2818	1930	210	72
	Sub total	24676	2129	1590	138
High land	Fagi	3602	2530	214	165
	Angolela	3443	3114	204	203
	wushawushign	2521	1251	144	81
	Bakelo	1561	1294	82	84
	Debre Berhan town	-	7240	80	471
	Subtotal	11127	15429	724	1004
Total		35803	17558	2314	1142

Figure 1: Map of the study area

3.3. Study design

The study design used was cross-sectional and conducted in urban and periurban areas of Bahir Dar town (mid altitude) and urban and periurban of Debre Berhan town (high altitude) in two seasons (dry and wet) from September 2004 to April 2005.

3.3.1. Sampling method

Systematic random sampling method was followed for the study in Bahir Dar and Debre Berhan towns including four peasant associations around each town. The study was carried out using simple random sampling method by sampling local and cross-bred cattle after

every 15 th among the cattle found in the study areas until the required sample size was fulfilled.

3.3.2. Sample size

The sample size determination on local and cross-bred cattle to be clinically investigated was calculated according to Thrusfield (1995). The following points were considered for this purpose: 10% prevalence, 2% accepted error at 95% confidence level. Since the disease is assumed to vary in the two different study sites (agro-ecological zones), the sample size obtained using the simple random sampling formula was multiplied by 2. The following formula (Thrusfieled, 1995) was applied in sample size calculation with the simple random sampling technique.

$$n = \frac{1.962 * P_{exp}(1-P_{exp})}{d2}$$

Where, n= sample size

P_{exp} = expected prevalence

d = desired absolute precession

Accordingly 1728 cattle were examined from each study sites per season. The sample size calculated for each agroecological zone was proportionally distributed for the local and cross-bred cattle found in the study areas. Therefore 138 cross and 1590 local breed cattle in urban and periurban areas of Bahir Dar Zuria *wereda* and 724 local and 1004 cross-bred cattle in urban and periurban areas of Basona Werena *wereda* were investigated. The sampling frame and number of animals examined are shown in Tables 3. Since seasons were also included in the design, equal numbers of animals were further surveyed during each of the seasons. Accordingly, overall 6912 cattle were investigated of which 4628 and 2284 are local and cross-bred cattle respectively.

A questionnaires format regarding the perception of the farmers on dermatophyllosis, and possible risk factors that would contribute to the disease was conducted using structured questionnaire to livestock owners during sample collection.Annex (1).

3.3.3. Sample collection

Animals were visually inspected for any skin lesions. In additions the owners were asked for any skin lesions on the selected sites of the body of animals. The lesions when present were closely inspected. The characteristics of the skin and lesions including exudates, loss of hair, scab formation, nodular formation, thickening of the skin and other visible lesions were recorded. After visual inspection and palpation of external surface for dermatophilosis like skin lesion, samples were collected by deep scrapping with scalpel blade. The samples were transported with ice pack to the laboratory and processed for culture and direct microscopic examination. Ticks were collected from the attachment sites manually and kept in 70% alcohol for subsequent identification. Identification of the collected ticks were carried out according to Walker, *et. al*. (2003).

3.3.4. Direct microscopy

Smears were made directly from exudates, pus and from the under side of freshly removed scabs or from collected scrapings, macerated in sterile physiological saline, crushed by pistil and mortar, and strained with gauze. The filtrate in the centrifuge tubes was subjected to be centrifuged at 1500 rpm for 3 min. Smears were prepared from the sediment, air dried, fixed by immersion in methanol or by heat, stained with Giemsa and examined under oil immersion microscope for the presence of typical branched, double raw of filamentous bacteria, *D. congolensis*, according to the methods given by Quinn *et al*., 1994.

3.3.5. Bacterial isolation

Cultural examination was conducted for those skin scraping lesions which were negative for direct microscopic examination(Giemsa stained smears).Since scab material contains many contaminants before culturing using the Haalstra's method (Quinn *et al*., 1994) were developed to overcome this problem. The technique employs grinding up a small amount of scab material and placing in 2ml distilled water in a bijou bottle for 3-5 hours at room temperature and keeping the container with lead removed, in a candle jar at room temperature for 16 minutes. A loop full of fluid from the surface was removed and incubated into a 5 % sheep blood agar containing polymixin B at a proportion of 127 mg/ l, MacConkey agar and Sabouraud's dextrose agar plates. The inoculated plates were

incubated aerobically at 37 ^{0}C for 48-72 hours. After colonies appeared on the sheep blood agar, the bacteria were identified by sugar fermentation tubes, TSI and urea agar slope, Voges-Proskaur, Methyl red and Indole, for biochemical tests (Annex 2).

3.3.6. Data analysis

The data obtained were stored in excel stored sheet. Stata computer software (Stata Corp. 2001) was used for analyses logistic regression were used to investigate differences and association between risk factors (explanatory variables) and outcome variables (status variables).

Factors of epidemiological relevance such as breed, age, seasons, sex, location, and tick (*A. variegatom*) infestation were measured to have some degree of dependency in contrast to those without the factor of interest.

Univariate and multivariate logistic regression was employed to see the association between the potential risk factors and the dermatophilosis prevalence. Odds ratio (OR) is the ratio of the odds of disease occurring among animals exposed to a variable and the odds of the disease occurring among animals not exposed (Thrusfield, 1995). Odds ratio (OR) was used to indicate the degree of risk factor association with the disease occurrence signified by 95 % confidence interval. Factors with odds ratio greater than one were considered as risk factors and those with OR less than one were protective factor.

First, the association of individual risk factor with an outcome variable was screened by univariate logistic regression. Those variables with substantial biological relevance and or significantly associated with the outcome variable at 5 % significance level in the univariate analysis were selected for multivariate analysis using multiple logistic regression to their independent effect. In the multivariate analysis a model was fitted for each outcome (status) variable by eliminating non significant variables ($p > 0.05$) using a backward stepwise elimination.

4. RESULT

4.1. Prevalence of skin lesions

A total of 6912 cattle were investigated for skin lesions similar to that caused by *Dermatophilus congolensis* in two agro ecological zones namely, humid lowland and cool highlands of Northwest Ethiopia. In both local and cross-bred, 2.4% had one or more skin lesions. There were more skin lesions in cross-bred cattle (2.8%) than local animals (2.2%). The difference in the prevalence of skin lesions between the two breeds was however, not statistically significant ($p< 0.05$).

There were only 18 (0.26%) skin lesions similar to dermatophilosis in cool highland as compared to 146 (2.1%) in the mid highland agro ecological zone of the total animals investigated. The highest skin lesions (4.8%) were observed during the wet season in humid midland. This difference between the two agro ecological zones was highly significant ($p<0.001$). The prevalence of skin lesions in cool highland was 0.52% and that of humid midland was relatively high (4.2%) (Table 4).

4.2. Severity of skin lesions

The severity of skin lesions were categorized in to three as light +, moderate ++, and severe +++ based on the extent of the lesions. Of the total 164 skin lesions 108 (65.8%), 12 (7.3 %) and 26 (15.9%) were light, moderate and severe, respectively. This classification was carried out according to Morrow *et. al*. (1989).

Table 4: The frequency of skin lesions in cattle in humid midland cool highland agroecological zones in Northwest Ethiopia (September, 2004 to April, 2005)

Agroecology	Season	Local breed		Cross-bred		Frequency and(%) of skin lesion Total
		No. examined	Frequency and (%) of skin lesion	No. examined	Frequency and (%) of skin lesion	
Humid mid-land	Wet	1590	76 (4.77)	138	38 (27.53)	114(6.56)
	Dry	1590	19 (1.19)	138	13 (9.42)	32(1.85)
Sub total		3180	95 (2.98)	276	51 (18.47)	146 (4.22)
Cool highland	Wet	724	5 (0.69)	1004	8 (0.79)	13(0.75)
	Dry	724	0	1004	5 (0.49)	5(0.28)
Sub total		1448	5 (0.34)	2008	13 (0.64)	18 (0.52)
Total		4628	100 (2.16)	2284	64 (2.80)	164(2.37)

4.3. Prevalence of Dermatophilosis

A total of 6912 cattle comprising of 4628 local indigenous and 2284 cross-bred dairy cattle were clinically investigated for skin lesions and other factors predisposing to dermatophilosis. The prevalence of dermatophilosis caused by *D. congolensis* confirmed by direct smear and/or cultural identification is given in Table 5. Overall prevalence of dermatophilosis was 0.54 % (36) of which 0.5 % (22) and 0.6 % (14) were identified for indigenous and cross-bred cattle, respectively. There was no significant difference ($p > 0.05$) in the prevalence of *D. congolensis* infection between the cross-bred and indigenous cattle. However, there was a relatively higher percentage of infection in cross-bred animals as compared to local indigenous cattle breeds. Despite skin lesions were relatively high in the cool highland study area, there was only a single case where the organism was detected, and based on the information from the owner this animal was purchased from the Abay river basin, which is lowland and climatically hot and dry. So the results with regard to risk factors and distributions refer to only the humid midland study area.

The summary of the prevalence at different risk levels of infection for dermatophilosis is given in Table 6 and Annex 6. In the humid midland too, prevalence was higher during the wet season (1.62%) as compared to dry season (0.46%) with an average of 1.04%. The impact of wet season was similar for both breeds.

The highest prevalence (5.4 %) was observed in cross-bred cattle as compared to indigenous cattle (0.66 %). Prevalence was also high in animals older than 18 months (1.24 %) while it was only 0.79 % in young animals. The prevalence of dermatophilosis was higher in male animals (1.74 %) as compared to female animals (0.77 %). In both seasons the prevalence of dermatophilosis was higher (2.65 %) in cattle infested with ticks than tick free animals (0.44 %).

4.4. Univariate analysis of risk factors

The summary of univariate analysis of risk factors for dermatophilosis is shown in Table 6. Of the five different risk factors considered for analysis only breed, season, tick and age were found significantly ($p < 0.05$) associated with the infection, respectively whereas there was no significant,($p > 0.05$) association between sex and *D. congolensis* infection.

4.5. Multivariate analysis of risk factors

After univariate analysis of potential risk factors, those which are significantly associated with the disease are subjected to multivariate analysis using logistic regression. In this multivariate analysis at 5 % significant level breed, season and tick were significantly associated with the disease (Table 7).

Table 5: Prevalence of bovine skin lesions in two selected humid midland and cool highland areas of Northwest Ethiopia (September 2004 to April 2005).

Agroecological zone	**Season**	**Cattle investigated (No./%)**		***Dermatophilus congolensis* positive animals**		**Total Positive**
		Total	**With lesion**	**Giemsa**	**Culture**	
Humid Midland	Wet	1728	114 (6.56%)	19	9	28 (1.62%)
	Dry	1728	32 (1.85%)	7	1	8 (0.46%)
	Subtotal	3456	149 (4.31%)	26	10	36 (1.04%)
Cool Highland	Wet	1728	13 (0.75%)	1	-	1 (0.06%)
	Dry	1728	5 (0.29%)	-	-	-
	Subtotal	3456	18 (0.52%)	1		1 (0.03%)
Total		6912	164 (2.37%)	27	10	37 (0.54%)

Table 6: Summary of the univariate analysis of risk factors and their association with *Dermatophilus congolensis* infection using logistic regression.

Variables	Animals examined		95 % CI	OR	OR 95%CL	p-value
	Total	Test positive				
Sex	3456	36 (1.04 %)	0.70-1.38			0.08
• Male	977	17 (1.74 %)	0.92-2.56			
• Female	2479	19 (0.77 %)	0.42-1.11			
Age	3456	36 (1.04 %)	0.70-1.38	3.3	1.44-7.57	0.005
• Young	1525	12 (0.79 %)	0.34-1.23			
• Adult	1931	24 (1.24 %)	0.75-1.74			
Breed	3456	36 (1.04 %)	0.70-1.38	7.6	3.88-.5.16	0.000
• Indigenous zebu	3181	21 (0.66 %)	0.38-0.94			
• Cross	276	15 (5.43 %)	2.76-8.11			
Season	3456	36 (1.04 %)	0.70-1.38	3.5	1.61-7.79	0.002
• Wet	1728	28 (1.62 %)	1.03-2.22			
• Dry	1728	8 (0.46 %)	0.14-0.78			
Tick infestation	3456	36 (1.04 %)	0.70-1.38	6.2	3.03-12.63	0.000
• Yes	943	25 (2.65 %)	1.63-3.68			
• No	2513	11 (0.44 %)	0.18-0.70			

Table 7: Summary of the multivariate analysis of risk factors and their association with *Dermatophilus congolensis* infection using logistic regression.

Variable	**OR**	**95 % CI for OR**	**p-value**
Breed	7.97	3.94-16.09	0.000
Season	4.30	1.92-9.59	0.000
Tick	7.35	3.55-15.19	0.000

In the final model, Breed, Season and tick infestation were significantly associated with Dermatophilosis.

5. DISCUSSION

The study was carried out in wet and dry period in the two study areas which are representative of mid altitude (in and around Bahir Dar town) and high altitude (in and around Debrebrihan town). In the dry and wet seasons a total of 3456 (local and cross-bred) cattle were investigated for dermatophilosis.

The prevalence of dermatophilosis in relation to the two altitudes indicated that there was a higher prevalence of the disease in the mid altitude and only single case which was purchased in the hot lowland areas of the river Abay basin, therefore, all factors related to *Dermatophilus congolensis* infection are for humid midland only. .

The over all prevalence of dermatophilosis in this study (1.04%) in mid altitude is in line with the report of 0.69% (Desta, 1985) who also investigated the disease in the same study area. Extremely low prevalence in cool high altitude areas was also inline with the reports of Enquebaher *et.al*, (2003), 0.1% prevalence report

The prevalence of the disease in this study in local cattle was found to be 0.66% and 0.07% in mid and high altitude, respectively. A comparable prevalence was from nil to 4.9% (Kiros, 1985; Bewket, 1987; Hagos, 2001; Gashaw 2001; Mulugeta, 1994; Moges and Degu, (1999)) were reported in local cattle in Ethiopia. In this study the higher prevalence of the disease observed in cross-breds (5.4%) and local zebu (0.66%). The midland indicates the possible association of the disease with breed. This is in agreement with previous report from 11.9%-26.9% Ethiopia (Kiros, 1985; Mulugeta, 1994; Moges and Degu, 1999; Moges, 2000; Gashaw, 2001; Enquebaher *et. al*., 2003). Koney and Morrow (1990)) also reported a higher prevalence in exotic cattle (8.4% and 31.7) Friesian and Jersey crosses, respectively than in local cattle in Ghana.

Others (Moges and Geremew, 2001) reported a prevalence of 15% in higher altitude areas of Ethiopia. The difference with our findings is probably due to difference between the study site where tick infestation and high humidity and other external parasites are common. The contribution of shrubs and strain of the bacteria has also been mentioned else where (Gashaw 2001; Enquebaher *et. al*., 2003).

A defect in design is not also to be ruled out where these workers probably have sampled clinical cases or in intensive farms where the whole animals might even be infected.

This study also showed that the statistical significant ($p < 0.05$) difference in the prevalence of the disease in wet and dry seasons. The prevalence of the disease in cattle was higher in the wet season (1.6%) than the (0.46%) of the dry season. The finding of this study is similar with reports of (6%, 3.6%) by Moges, (2000), for wet and dry and (5.7%, 4.8%) by Enquebaher *et.* ***al,*** 2003, for wet and dry period respectively. The highest occurrence (35%) was recorded in cross-bred kept under poor management during the rainy season indicates the association of the disease in cattle with wet season, breed (cross-bred) and poor management (Moges, 2000).

A statistically significant ($p< 0.05$) difference between the prevalence rate of the disease in adult (1.24%) and young (0.79%) was observed in cattle in the present study for the humid mid altitude. This is in agreement with reports of several authors: Moges and Degu, 1999, Moges and Geremew, 2002, Gashaw 2001. This may be explained by due to less exposure of younger age groups to the possible predisposing factors such as ticks, insects, thorny bushes, ox- pecker birds, rain etc. (Gashaw,2001) and adult Ethiopian cattle in extensive grazing were reported to have higher prevalence than young, most of which were kept indoors(Moges and Degu, 1999). In the contrary although higher prevalence was recorded in adult than young significant influence of age on the disease could not be demonstrated. Enquebaher *et. al,* (2003) Hagos, (2001) reported that dermatophilosis infections were significantly higher in young animals than in adults. Young cattle were 1.7 to 3.5 times are at risk from *Dermatophilus* spp. obviously, the immune system of young animals is poorly developed and this might be the reason why they suffered from most of the skin diseases (Hagos, 2001).

There was no statistically significant ($p> 0.05$) difference in prevalence rates in males and females in this study. This matched with the report of Abu-Samra, 1980; Mulugeta 1994; Moges and Degu, 1999; Moges and Geremew,2002; Gashaw 2001; Enquebaher *et. al*, 2003, Hagos (2001) who reported that male and female are equally susceptible to dermatophilosis infection. In the contrary to the above findings Samui and Hugh-Jones,(1990a) have reported that female cattle were found to be more susceptible to

dermatophilosis than males, except in the younger animals where both sexes appeared to be susceptible. Gashaw, (2001) and Moges and Geremew, (2001) had reported that the slightly higher prevalence in males can be explained by the fact that males are used for traction Hagos,(2001) and threshing of crops, use of the same yoke for different oxen at different times (Moges and Degu, (1999) and work overload in the mixed crop livestock production(Moges and Geremew, 2001), expose them to skin abrasion and damage. The controversy pertaining the influence of sex and age on the occurrence and establishment of clinical dermatophilosis needs a detailed study.

A close association was found between infestation with *A. varigatum* and the occurrence of dermatophilosis (Koney,*et.al.,* 1996) and is proved to predisposing and transmit *Dermatophilus congolensis* in cattle (Buxton, 1977).The possible mechanisms mentioned in the literature include transmission of dermatophilosis and the creation of skin wounds and hypersensitivity reaction by the tick which become infected with the organism (Davis and Philpott,1980).

In this study infestation with *A. varigatum* had a significant ($p < 0.05$) influence on the prevalence of the disease where *A. varigatum* infested cattle were 6.2 times more likely to be infected with *D. congolensis* than non-infested ones .In comparable with this report a similar findings were previously reported by (Morrow *et.al*, 1989; Koney *et. al.*, 1996; Enquebaher *et. al*., 2003).

Skin lesions were reported to occur predominantly at the feeding site of *A. varigatum* (Plow Right, 1956; Macadam, 1962). However, no relationship between the location of the lesions and tick attachment. In agreement with this study, (Moges and Geremew, (2002); Moges and Degu,(1999); Enquebaher *et. al.*, 2003) have not found the lesions to be confined to the tick attachment sites. Instead it appears on the dorsal line where the ticks are not their (Bewket, 1987).

6. CONCLUSION AND RECOMMENDATIION

Dermatophilosis was found to be a disease of exotic and indigenous zebu cattle in mid lowland areas of North West Ethiopia. Infection was higher in exotic cattle than indigenous zebu cattle. Prevalence was also higher during wet periods than during the dry period. In cool high land areas there was no infection, thus its importance as a determinant to development of dairy cattle through cross breeding would not be hindered. Infection of animals with ticks was another predisposing factor of dermatophilosis.

To reduce the existing prevalence rate and alleviate the economic loss from bovine dermatophilosis, with respect to the nature of the disease the following points are recommended.

- Strategic tick control should be implemented based on seasonal tick population dynamics.
- The introduction of cross-bred animals for high production should be supported by the over all improved management system of the herd.
- Detailed economical analysis on dermatophilosis supported by socio-economic study should be carried out.
- Further study on the epidemiology of dermatophilosis at regional and national level, covering the whole year should be conducted.
- Affected animals should be detected and isolated from the herd at early stages for better response during treatment and thereby avoid spread of the disease.

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8. ANNEXES

Annex 1: Questionnaire

Dermatophilosis questionnaire survey

Date_____

Zone _____ Woredas _____ PA_____ Village_____

Agro ecological zone _____ Respondent Name_____ Age_____

Sex_____ Position _____ Interviewer's name _____

Sex_____ Position _____

1. Livestock owned: Cattle__ Sheep _____Goat _____Came l_____ Donkey____ Others_____
2. Breed of the cattle_____
3. Objective of cattle keeping: Dairy____ Draught _____Both _____Feed lot_____
4. Production system:
   - 4.1 Settled ____Nomadic _____Semi nomadic ____Trade_____
   - 4.2 Livestock only _____Mixed farming system (crop livestock) _____
5. Are you familiar with the disease dermatophilosis? yes_____ No_____
6. What is the local name? _____ __
7. Do you believe that the disease is important? yes_____ No____
8. What is its rank in comparison with other diseases and skin diseases around? In relation with other diseases _____in relation to other skin iseases_____
9. Seasonality of the disease: When does the disease most commonly revealed? Dry___ month _____wet _____month_____
10. Do you believe that dermatophilosis is a contagious disease? yes_____ No _____I don't know_____
11. Which of the following you believe is/are predisposing factor/s for dermatophilosis?
    Ticks_____poor nutrition_____wet weather _____biting flies_____
    feed_ _____thorny bushes _____poor management_____

12. Do you have tick control program? Yes _____No_____

12.1 Type: Manual _____chemical _____both_____

12.2 Interval_____

13. Does the tick control program have an effect on dermatophyllosis?

Yes_ _____No_____

14. What is your recommendation, if your animal is infected with the disease?

Cull/sell ____slaughter __modern treat _____herbal_ _____no response_____

15. What is in majority cases, the fate of an animal if once infected with dermatophilosis?

Spontaneous recovery ____cure and relapse _____progress from moderate to sever

and death _____

16. Effect of modern treatment on dermatophilosis? Effective _____moderate _____not effective _____I don't know_____

17. Cost of the treatment: expensive _____moderate _____cheep _____I don't know_____

18. Do you know herbal medicine against dermatophilosis? Yes _____No _____if yes the type _____

18.1 Its effect: effective _____moderate _____not effective_____

19. Feeding practice: communal feeding_____ enclosed grazing _____indoor feeding_____

20. Current feed condition: excess _____adequate _____below average_ _____critical

shortage_____

21 In which month of the year do you have shortage of feed? _____

22. Do you expect that there are associations between dermatophilosis and feed shortage?

Yes___ No_____

23. Do you expect that there is association between dermatophilosis and other concurrent?

Infections? Yes _____ No____

24. If yes with which disease? Demodex _____internal parasitism _____ trypanosomiasis _____others_____

25. Housing condition:

25.1 Roofed _____Not roofed_____

25.2 Fenced: Yes _____No_____

25.3 Adult and calves spend together: yes _____No_____

25.4 Contact to each other: yes _____No_____

25.5 Floor condition: soil _____concrete _____

26. Is there any thing that brings traumatic wound to the animals?

Yes _____ No_____

26.1 If yes: the type Ox pecker birds _____Concrete floor _____

Thorny and bush _____

27. Is there any biting flies in the area? yes ___No_____

27.1 If yes the local name_____

27.2 Months seen in abundance_____

27.3 Reason_____

28. Do you believe that there is relationship between high number of the biting Flies and incidence of dermatophilosis? Yes _____No _____

I do not know_____

29. Previous history of dermatophilosis out break in the village/tabia/farm?

Yes _____No _____I do not know _____year/month_____

30. Dominant nature/type of the available vegetation cover?

Woodland _____Grassland _____Mixed_____

Annex 2: Media used for isolation and identification of bacteria

1. Blood Agar Base (BBL®, Becton Dickinson, USA)

Composition (g/l): Heart muscle, infusion from (solids) 2.0; pancreatic digest of casein 13.0; Yeast extract 5.0; sodium chloride 5.0; agar 15.0

Preparation: Suspend 40.0g of the powder in 1 liter of distilled water. Mix thoroughly. Heat with frequent agitation and boil for 1 minute to completely dissolve the powder. Autoclave at 121^0C for 15 minutes. Cool the base to 45 to 50^0C and add 5% sterile defibrinated blood.

2. MacConkey Agar (Oxoid, Hampshire, England)

   Composition (g/l): Peptone 20.0; lactose 10.0; bile salts No.3 1.5 ; sodium chloride 5.0; neutral red 0.03; crystal violet 0.001; agar 15.0

   Preparation: Suspend 51.5g in 1 liter of distilled water. Bring to boil completely. Sterilize by autoclaving at 121^0C for 15 minutes.

Annex 3: Primary and secondary identification test

1. Gram's stain

   Procedure:

- Make a thin smear or film
- Allow the film to dry in air
- Fix the film by passing through the Bunsen flame several times
- Flood the slide with crystal violet for 30 to 60 seconds
- Pour of the stain and wash the remaining stain with iodine solution
- Wash off the iodine and shake the excess water from the slide
- Decolorize with acetone alcohol
- Counter stain with safranin for 30 to 60 seconds and wash with water

2. Catalase test

   Principle: The break down of hydrogen peroxide in to oxygen and water is mediated by the enzyme catalase.

   Procedure: A loopful of the bacterial growth is taken from the top of the colonies avoiding the blood agar medium. The bacterial cells are placed on a clean

microscope slide and a drop of 3% H_2O_2 is added. An effervescence of oxygen gas, within a few seconds, indicates a positive reaction.

3. Indole test

Principle: Indole positive bacteria possess an enzyme tryptophanase which converts tryptophan to indole.

Procedure: Stab inoculate SIM medium with test bacterium and incubate at 37 ^{0}C for 18 to 24 hours. Then add Kovac's reagent (0.2 ml) to tube and stand for 10 minutes.

Interpretation: The formation of dark red ring indicates positive reaction while in negative reaction a yellow ring is formed.

4. Methyl red (MR) test

Principle: It is a quantitative test for acid production, requiring positive organisms to produce strong acids (lactic, acetic, and formic)

Procedure: Inoculate MR-VP broth with pure culture of test organism and incubate at 37^{0}C for two days, then add 5 drops of MR solution in to the media.

Interpretation: Production of red colour indicates a positive result and yellow colour negative in methyl red test.

5. Voges-Proskauer (VP) test

Principle: Some organisms produce acetoin as the chief end product of glucose metabolism and form less quantity of mixed acids.

Procedure: Inoculate MR-VP broth with pure culture of the test organism and incubate at 37^{0}C for 2 days. Then aliquot 1 ml of broth to a clean test tube and add 0.6 ml of 5 % α-naphthol followed by 0.2 ml of 40 % KOH. Shake the tube gently

to expose the medium to atmospheric oxygen and allow the tube to remain undisturbed for 10 to 15 miutes.

Interpretation: A pink colour indicates a positive reaction.

6. Urease test

Principle: Urease is an enzyme possessed by many species of microorganism that can hydrolyze urea with the formation of ammonia (alkaline).

Procedure: The surface of the agar slant is streaked with the test organism and incubated at 37^0C for 18 to 24 hours.

Interpretation: Organisms that hydrolyze urea rapidly may produce positive reaction with in 1 or 2 hours. Red (pink) colour through out medium indicates positive reaction.

Annex 4: Distribution of samples in different breed, sex, age and localities for wet season

Kebele	Cattle Population		Cattle inspected								Scr.	Tick	severity		
	Breed		Breed												
	Local	Cross	Local				Cross								
			Female		Male		Female		Male						
			Y	A	Y	A	Y	A	Y	A			L	M	S
Dishet Abaragi	5250	41	132	77	97	57	3	6	2	4	18	14	13	2	3
Sebatamit	4746	17	91	107	50	59	-	4	-	2	25	17	18	5	2
Yigoma	3718	95	84	126	40	61	10	8	4	3	22	16	11	2	9
Bahir Dar	2818	1930	56	94	23	37	10	48	8	6	33	8	25	2	6
Woramit	8144	46	110	168	48	73	10	3	3	4	17	13	12	2	3
Subtotal	24676	2129	473	572	258	287	33	69	17	19	115	68	79	13	23
Fagi	3602	2530	33	61	42	78	23	56	26	60	4	-	4	-	-
Angolela	3443	3114	23	60	33	88	57	47	54	45	-	-	-	-	-
Wushawushign	2521	1251	21	42	27	54	15	26	12	28	-	-	-	-	-
Bakelo	1561	1294	10	24	14	34	18	29	14	23	1	-	-	1	-
Debre Berhan	-	7240	9	35	7	29	77	307	27	60	7	-	6	-	1
Subtotal	11127	15429	96	222	123	283	190	465	133	216	12	-	10	1	1
Total	35803	17558	569	794	381	570	223	534	150	235	127	68	89	14	24

Annex 5: Distribution of samples in different breed, sex, age and localities for dry season

Kebele	Breed								Scr.	Tick	Severity		
	Local				Cross								
	Female		Male		Female		Male						
	Y	A	Y	A	Y	A	Y	A			L	M	S
Dishet Abaragi	164	115	50	34	6	4	3	2	7	4	7	-	-
Sebatamit	110	113	41	43	2	3	-	-	8	6	8	-	-
Yigoma	113	131	31	36	8	12	2	3	4	1	4	-	-
Bahir Dar	39	103	18	50	15	50	3	4	8	2	8	-	-
Woramit	109	219	24	47	4	12	2	3	5	4	5	-	-
Subtotal	535	681	164	210	35	81	10	12	32	17	32	-	-
Fagi	45	59	47	63	20	49	30	66	2	-	2	-	-
Angolela	38	56	45	65	56	59	50	38	-	-	-	-	-
Wushawushign	30	29	25	60	16	20	18	27	-	-	-	-	-
Bakelo	14	36	12	20	16	31	17	20	-	-	-	-	-
Debre Berhan	10	38	8	24	90	286	17	78	3	-	3	-	-
Subtotal	137	218	137	232	198	445	132	229	5	-	5	-	-
Total	672	899	301	442	233	526	142	241	37	17	37	-	-

Y= Young, A= Adult, L= Light, M= Moderate, S= Severe

Annex 6: Prevalence of dermatophilosis in percent with different risk factors for mid and highlands

Altitude	Season		Local						Cross						Total		
			Female		Male		Wet	Dry	Female		Male		Wet	Dry			
			Y	A	Y	A			Y	A	Y	A			Wet	Dry	F + M
Mid	Wet	Y	0.85		0.39		0.68		3.00		23.50		0.10		1.30		
		A		0.70		2.80	1.40			7.20		5.30	6.80		1.90		
		F		0.77						5.90							1.22
		M				1.70						1.40					2.41
	Dry	Y	0.19		0.00			0.14	0.00		10.00			2.20		0.27	
		A		0.15		0.95		0.34		3.70		0.00		3.20		0.61	
		F		0.16					2.60								0.38
		M				0.53						4.50					0.76
	Sub total		0.50	0.40	0.24	2.00	0.66		0.15	0.53	18.50	3.20	5.40		1.04		
			0.44			1.20				4.10		10.30					1.04
High	Wet	Y	0.00		0.00		0.00		0.00		0.00		0.00		0.00		
		A		0.00		0.35	0.20			0.00		0.00	0.00		0.08		
		F	0.00							0.00							0.00
		M				0.25						0.00					0.13
	Dry	Y	0.00		0.00			0.00	0.00		0.00			0.00		0.00	
		A		0.00		0.00		0.00		0.00		0.00		0.00		0.00	
		F	0.00							0.00							0.00
		M				0.00						0.00					0.00
	Sub total		0.00	0.00	0.00	0.19	0.07		0.00	0.00	0.00	0.00	0.00		0.03		
			0.00			0.13				0.00		0.00					0.03
TOTAL			0.40	0.30	0.15	1.10	0.48		0.22	0.75	1.70	0.13	0.66		0.54		
			0.34			0.70				0.59		0.78					0.54

Y = young, A = adult, F = female, M = male

9. CURRICULUM VITAE

A. Biographical Data:

Name	Meseret Admassu
Date of birth	July, 1956
Place of birth	Bahir Dar, West Gojjam
Marital status	Married
Nationality	Ethiopian
Profession	Veterinarian
Occupation	Research officer in regional laboratory, Bahir Dar Laboratory

B. Educational background

1965-1969	Atsesertse Dingle Melek Seged Bahir Dar Elementary School
1970-1977	Atsesertse Dingle Melek Seged Secondary school,Bahir Dar Achievement: Ethiopian School leaving Certificate Examination
978-1979	Debrezeit Asistant Veterinary Institute, Debrezeit Achievement: Diploma in veterinary medicine

1987-1994	University/Under graduate program Faculty of Veterinary Medicine, Stavropol, USSR Achievement: Doctor of Veterinary Medicine, DVM Degree
2001 (2 Month)	Postgraduate Training Freie Universität Berlin, Faculty of Veterinary Medicine, Berlin, Germany Achievement: Certificate on Postgraduate Training in Veterinary Microbiology
2003/04-2004/05	Postgraduate study Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia Achievement: MSc in Tropical Veterinary Epidemiology

C. Work Experience

1980- 1981	Awraja Veterinary Officer Bechena (East Gojjam)
1982-1986	Awraja veterinary officer Bahir Dar(West Gojjam)
1995-1996	Wereda Veterinary Officer Bure (West Gojjam)
Sep.,1997-Sep., 2003	Senior research officer, Bahir Dar regional veterinary laboratory

D. Research out put/Technical paper

a. Prevalence of bovine mastitis in five administrative zones of Amhara National Regional State (Research paper, 2002).
b. Status of dermatophilosis in urban and periurban indiginious and cross-bred cattle of Bahir Dar and Debrebrihan towns (Msc thesis,2005)

E. Membership

Member of the Ethiopian Veterinary Association

F. Language

Amharic	Mother Tongue
English	Writing and speaking

10. DECLARATION

The thesis my original work, has not been presented for a degree in any other university and that all sources of material used for the thesis have been duly acknowledged.

Name _____

Signature _____

Date of submission _____

This thesis has been submitted for examination with my approval as University advisor.

Dr. Ademe Zerihun (Assisstant Professor)

_____