The distribution of ixodid ticks (Acari: Ixodidae) in central Ethiopia

S. MEKONNEN[1], I. HUSSEIN[2] and B. BEDANE[3]

ABSTRACT

MEKONNEN, S., HUSSEIN, I. & BEDANE, B. 2001 The distribution of ixodid ticks (Acari: Ixodidae) in central Ethiopia. *Onderstepoort Journal of Veterinary Research*, 68:243–251

Ixodid ticks were collected from domestic animals, mainly cattle, in 11 administrative zones covering 84 districts in central Ethiopia over a period of 2 years (July 1996 to June 1998). Nineteen tick species were identified. Four of these belonged to the genus *Amblyomma*, one to *Boophilus*, two to *Haemaphysalis*, three to *Hyalomma* and nine to *Rhipicephalus*. *Amblyomma variegatum* and *Rhipicephalus evertsi evertsi* were present in all 11 administrative zones and, with the exception of Afar, *Boophilus decoloratus* was present in nearly every district in which collections were made. These three species constituted more than 50 % of all ticks collected. *Amblyomma cohaerens* and *Rhipicephalus bergeoni* were common in the west of the survey region and *Rhipicephalus pulchellus* in the east. Except for *B. decoloratus*, of which more females than males were collected, the numbers of male ticks recovered were equal to or exceeded those of females.

Mortality in crossbred dairy cattle caused by heartwater (*Cowdria ruminantium* infection) was reported during the survey period. An integrated approach to tick control is suggested.

Keywords: *Amblyomma variegatum, Boophilus decoloratus, Cowdria ruminantium*, dairy cattle, Ethiopia, tick control, tick distribution

INTRODUCTION

Cattle play a significant role in the socio-economic life of the people of Ethiopia. Hides and skins are important components of the agricultural sector in generating foreign export earnings, and animals provide draught power for cultivating the agricultural holdings of many peasants. Because of the growing nutritional demands of an increasing human population exotic breeds have been introduced to improve milk production. The number of dairy farms using crossbred stock is increasing and there are an estimated 100 000 *Bos taurus/Bos indicus* crosses in the country. These animals are concentrated mainly in the central regions, but small dairy farms are also scattered elsewhere. All these cattle are potentially at risk to the deleterious effects of ticks and tick-borne diseases (TBDs).

Ixodid ticks are responsible for a diversity of livestock health problems. In addition to transmitting certain protozoal, rickettsial and viral diseases, they damage skins causing hides to be downgraded, and heavy infestations may reduce milk production and increase susceptibility to other diseases (De Castro 1997). The conventional approach to tick control in Ethiopia over the past decades has been the application of acaricides. However, there is no effective legislation

[1] National Animal Health Research Center, P.O. Box 4, Sebeta, Ethiopia

Present address: Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort, 0110 South Africa

[2] National Animal Health Research Center, P.O. Box 4, Sebeta, Ethiopia

[3] RDP Livestock Services, B.V., P.O. Box 5507, Addis Ababa, Ethiopia

Accepted for publication 10 July 2001—Editor

for the importation and marketing of these compounds or for monitoring their use and this has contributed to their widespread indiscriminate application (Shiferaw, Girma, Jober, Haile Mariam & Zerbini 1997).

The species composition and geographic distribution of ticks in Ethiopia has been recorded by several authors (Pavesi 1883, cited by De Castro 1994; Neumann 1902; Bergeon & Balis 1974; Morel 1980; Pegram, Hoogstraal & Wassef 1981; Gebre-Ab 1983; De Castro 1994; Mekonnen 1998). The purpose of this survey was to determine these parameters for the economically important ticks of livestock in the central region of the country and to suggest possible control strategies based on the findings.

MATERIALS AND METHODS

The survey lasted from July 1996 to June 1998 and the study area encompassed 84 districts in 11 administrative zones in central Ethiopia (Fig.1).

Tick collection sites at high, medium and low altitudes were identified in collaboration with the zone and district veterinarians. Ticks collected by the collecting team prior to the commencement of the study have been included in the results. Cattle were the target animals and, on one occasion only, at each locality all stages of development were collected from these animals by means of forceps and placed in screw-cap bottles pre-filled with 68 % methanol. Ticks taken from animals other than cattle during the study period were put in separate bottles and have also been included in the survey. Date and place of collection and host species were recorded. The ticks were transported to the National Animal Health Research Center at Sebeta and identified using taxonomic criteria described by various authors (Hoogstraal 1956; Kaiser 1987; Matthysse & Colbo 1987).

RESULTS

Nineteen tick species were identified and, in descending order of abundance, the major species were *Boophilus decoloratus*, *Amblyomma variegatum*, *Amblyomma cohaerens*, *Rhipicephalus evertsi evertsi*, *Rhipicephalus pulchellus* and *Rhipicephalus praetexatus* (Table 1).

TABLE 1 Tick species recorded in order of numerical abundance in central Ethiopia

No.	Administrative zone	Tick species
1	East Shoa (13 districts)	*A. variegatum, R. pulchellus, R. praetextatus, B. decoloratus, R. evertsi evertsi, H. marginatum rufipes, R. simus, A. gemma, H. truncatum, R. sanguineus, A. cohaerens, H. dromedarii, H. aciculifer, A. lepidum, R. muhsamae*
2	West Shoa (14 districts)	*B. decoloratus, A. variegatum, R. evertsi evertsi, A. cohaerens, R. bergeoni, R. simus, H. truncatum, A. lepidum, R. sanguineus, R. pulchellus, R. lunulatus, H. marginatum rufipes, R. praetextatus, R. pravus*
3	North Shoa (14 districts)	*A. cohaerens, R. pulchellus, A. variegatum, B. decoloratus, H. truncatum, R. simus, R. evertsi evertsi, H. marginatum rufipes, A. gemma, A. lepidum, H. dromedarii*
4	North-West Shoa (11 districts)	*B. decoloratus, A. variegatum, R. evertsi evertsi, R. simus, H. marginatum rufipes, H. truncatum, A. lepidum, R. bergeoni, R. lunulatus*
5	Gurage (ten districts)	*A. cohaerens, B. decoloratus, R. evertsi evertsi, A. variegatum, H. truncatum, R. simus, H. marginatum rufipes*
6	Hadiya (four districts)	*B. decoloratus, A. cohaerens, A. variegatum, R. evertsi evertsi, R. simus*
7	Kembata-Alaba-Timbaro (five districts)	*B. decoloratus, A. variegatum, R. praetextatus, R. simus, A. cohaerens, H. truncatum, R. evertsi evertsi, R. muhsamae*
8	Arsi (four districts)	*B. decoloratus, A. variegatum, R. evertsi evertsi, R. lunulatus, R. simus, R. bergeoni, A. cohaerens, H. marginatum rufipes, R. praetextatus*
9	Zone 3 (Addis Ababa) (four districts)	*B. decoloratus, A. variegatum, R. evertsi evertsi, H. leachi*
10	Zone 6 (Addis Ababa) (two districts)	*B. decoloratus, A. variegatum, A. lepidum, R. evertsi evertsi, H. leachi, A. cohaerens, A. gemma, R. pulchellus*
11	Zone 3 (Afar Reg.) (three districts)	*R. praetextatus, H. dromedarii, R. evertsi evertsi, A. lepidum, A. variegatum, H. truncatum, H. marginatum rufipes, R. simus, R. pulchellus, A. gemma, R. sanguineus*

FIG. 1 Map of Ethiopia and tick collection sites

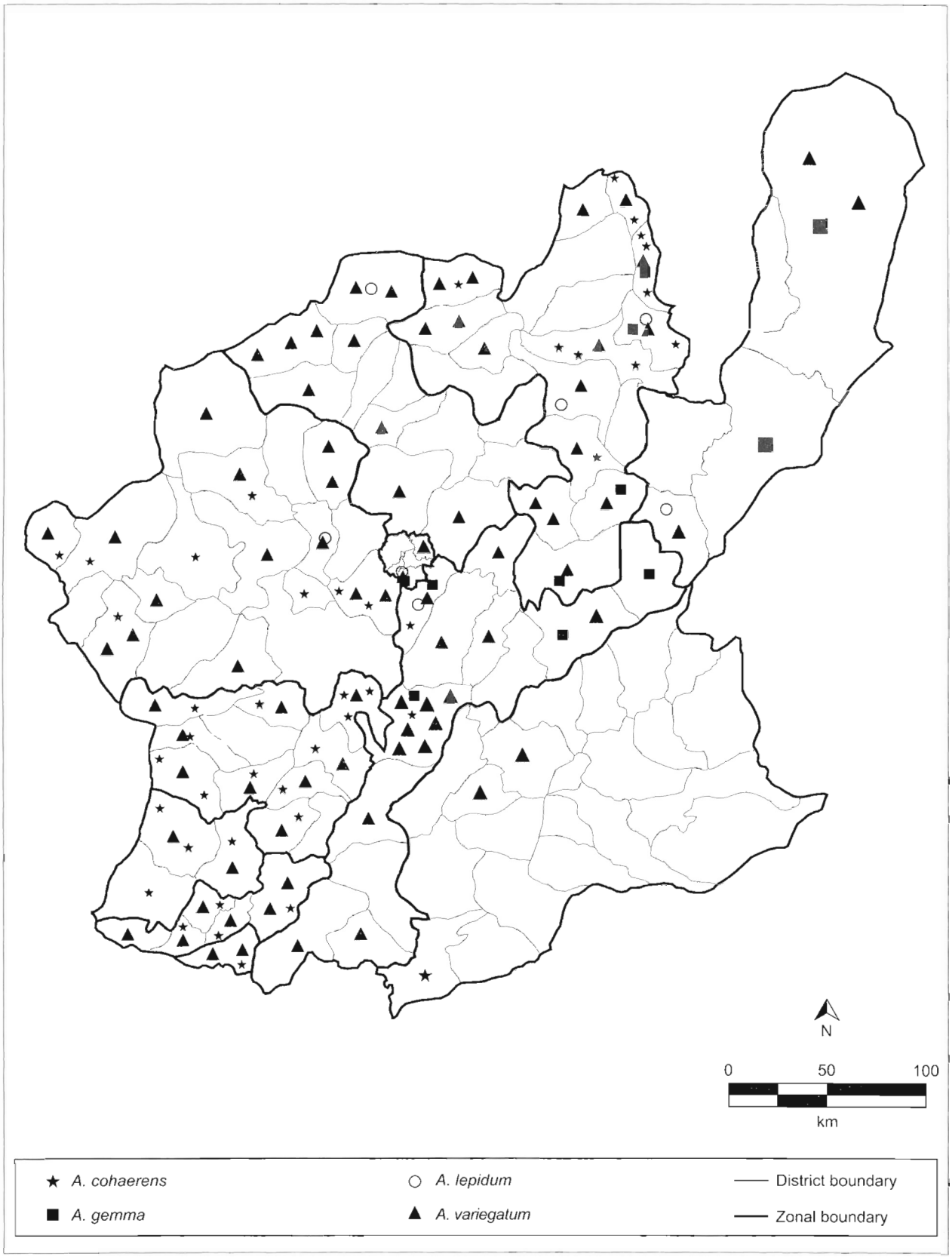

FIG. 2 Distribution of *Amblyomma* species

Each symbol represents 1–50 ticks

FIG. 3 Distribution of *Boophilus, Haemaphysalis* and *Hyalomma* species

Each symbol represents 1–50 ticks

FIG. 4 Distribution of *Rhipicephalus* species

Each symbol represents 1–50 ticks

The distribution of the various tick species in central Ethiopia is illustrated in Fig. 2–4. *Amblyomma variegatum* was widespread and was collected in all 11 administrative zones. *Amblyomma cohaerens* was common in the west and southwest of Addis Ababa and, although no *A. lepidum* was collected here, it was present in several districts north of the capital. *Amblyomma gemma* was present mainly in the northeast. With the exception of zone 3 (Afar), where no *B. decoloratus* were collected, this tick was present in nearly every district in which collections were made. *Haemaphysalis aciculifer* was found in East Shoa and *H. leachi* was collected from dogs in Addis Ababa. *Hyalomma dromedarii* was collected chiefly from camels, and it and *R. praetexatus* were abundant in the arid to semi-arid Afar region. *Hyalomma marginatum rufipes* was present mainly in the northern and northeastern administrative zones. *Rhipicephalus bergeoni* was collected in West and Northwest Shoa, *R. pulchellus* in the central and northeastern districts of the survey region, with a single collection in the west, while *R. evertsi evertsi* was present in all administrative zones surveyed.

Adult *A. variegatum* preferred the udder, scrotum, axillae and groin regions as attachment sites, and damage to teats and udders was observed when infestations were severe. *Boophilus decoloratus* was collected mostly from the neck and dewlap but was also present on the rest of the body. Adult *R. evertsi eversi* showed a strong predilection for the patch of smooth skin under the tail as well as for the peri-anal and vulval areas. *Rhipicephalus simus* was collected mostly from the tail brush of cattle and from the legs and tail tips of sheep.

At genus level the male to female ratio was *Amblyomma* 4:1, *Boophilus* 1:3, *Hyalomma* 3:1 and *Rhipicephalus* 1:1.

During the 2-year survey 33 crossbred cattle (11 calves, ten heifers, 11 cows and one bull) died from heartwater (*Cowdria ruminantium* infection) on five commercial dairy farms, on which there were 756 of these animals.

DISCUSSION

In two earlier tick surveys covering a large portion of the country, 37 and 33 ixodid tick species or subspecies were identified, respectively (Bergeon & Balis 1974; Pegram *et al.* 1981). *Rhipicephalus pulchellus*, *A. variegatum* and *A. cohaerens*, in that order, were present in the largest numbers in the one (Bergeon & Balis 1974), and *A. variegatum*, *R. pulchellus* and *A. cohaerens* in the other (Pegram *et al.* 1981). In a subsequent survey conducted in western Ethiopia, 19 ixodid tick species were identified and *A. cohaerens* was the most numerous of these (De Castro 1994). The widespread distribution of *A. variegatum* in Ethiopia was confirmed in all these surveys. Despite the fact that very few *B. decoloratus* were collected in the survey conducted by Bergeon & Balis (1974), later collections and the present survey indicate that it is both abundant and widespread in the moister regions (Pegram *et al.* 1981; De Castro 1994).

Economically, the most important tick species infesting cattle in Ethiopia are *A. variegatum* and *B. decoloratus* (Mekonnen 1996), and particularly heavy infestations of *A. variegatum* have been encountered in Shoa Province (Pegram *et al.* 1981), the region in which most collections were made in the present survey. These two species constituted more than 40% of the total collections made in the present survey and both were widespread.

Amblyomma variegatum is the major vector of *C. ruminantium* to large and small domestic ruminants in Ethiopia. Apart from disease transmission, adult ticks attach in clusters and can cause considerable tissue damage leading to secondary bacterial infection. Infestation with *A. variegatum* also has a direct causal relationship with severe clinical dermatophilosis caused by *Dermatophilus congolensis* (Morrow, Arnot, Heron, Koney & Walker 1993; Koney, Walker, Heron, Morrow & Ambrose 1994; Walker 1996).

Amblyomma cohaerens, *A. gemma* and *A. lepidum* can also transmit *C. ruminantium*, but are less important vectors than *A. variegatum* (Petney, Horak & Rechav 1987). The distribution of *A. cohaerens* in the west and southwest of the survey region agrees with that in an earlier survey (Pegram *et al.* 1981) and complements the distribution pattern determined for this species in western Ethiopia (De Castro 1994). The largest numbers of adult *A. variegatum* and *A. cohaerens* generally attach to cattle between March and June, before the start and during the early part of the rainy season in Ethiopia (Pegram *et al.* 1981; De Castro 1994).

Boophilus decoloratus can transmit *Babesia bigemina* to cattle, and severe tick infestations can lead to tick worry, anorexia and anaemia. Larger numbers are generally present from spring to autumn than during the cooler months. Prevention of tick damage by both *A. variegatum* and *B. decoloratus* can be achieved if strategic tick control is implemented just before and during the warmer, moister months of the year.

In the present survey, *R. evertsi eversti* had the most widespread distribution of all species collected. In an earlier survey, large numbers of *R. evertsi evertsi* and *R. pulchellus* were collected from cattle, sheep and goats and some from domestic equids, while large numbers of the latter tick were also collected from camels (Pegram *et al.* 1981). In contrast to that survey, both *A. gemma* and *R. pulchellus* were found west of the Rift Valley. It has, however, previously

been suggested that "at the northern end of the Valley in Ethiopia, camel caravans passing from the east coast to western Ethiopia and the Sudan could easily carry numerous *R. pulchellus* west of the Valley", and it is also believed that there is considerable seasonal movement of Maasai cattle across the Rift Valley (Pegram *et al.* 1981). Either or both of these possibilities could account for the collection of these species west of the Valley in the present survey.

Except for of a single collection from Sudan (Walker, Keirans & Horak 2000), the distribution of *R. bergeoni* is confined to Ethiopia and then chiefly to the western regions (De Castro 1994; Walker *et al.* 2000). It has been collected mainly in highland forest regions with an annual rainfall varying between 1 200 and 2 600 mm (De Castro 1994; Walker *et al.* 2000). The present collection localities lie within these parameters.

The *R. simus* group of ticks comprises three species, namely *R. muhsamae*, *R. praetextatus* and *R. simus* (Pegram, Walker, Clifford & Keirans 1987). It has been proposed that *R. muhsamae* is a western African tick occurring across the continent from Senegal to western and central Ethiopia in the east, and that *R. praetextatus* is present in northeast Africa from Egypt to Tanzania, while *R. simus* occurs across central and southern Africa south of 6° S (Walker *et al.* 2000). The authors of this proposal concede that, although these species have been precisely defined, it remains difficult to identify them individually purely on morphological grounds because the differences between them at all stages of development are slight (Walker *et al.* 2000). The present survey was conducted prior to these authors' observations and the ticks identified as *R. simus* should probably be designated *R. praetextatus*.

With the exception of *B. decoloratus*, of which the greater size of engorging females makes them easier to collect than the very small males of this species, more, or equal numbers, of male than female ticks of all genera were collected. This finding agrees with previous observations in Ethiopia (Pegram *et al.* 1981) and reflects both the greater ease with which engorging females are removed by self-grooming and the tendency for males to remain attached to hosts for longer periods than females.

Acaricide application is still the main method of tick control in Ethiopia. Arsenicals and chlorinated hydrocarbons have been banned because of the threat to human health and the emergence of acaricide resistant tick populations (Regassa & De Castro 1993). Currently organophosphates are the most widely used chemicals although evidence of resistance is emerging. Amidines and pyrethroids have recently been introduced, while plants that have acaricidal properties are widely used for tick control in the rural areas (Mekonnen 1998).

The basic aim of controlling ticks is to preserve and/or enhance enzootic stability to tick-borne diseases, limit damage done by ticks *per se* and prevent or reduce the rate of development of acaricide resistance. Ticks should be managed at an economically acceptable level by a combination of techniques (De Castro 1997), and this requires familiarity with the tick species present and an understanding of their seasonal intensities of infestation within a particular agro-ecological zone (Tatchell 1992). Because there is no single method that adequately controls the complex problem of ticks and TBDs (Tatchell 1992), a combination of available techniques to produce an integrated system of tick management is necessary. This encompasses the selection of highly productive tick resistant cattle (De Castro & Newson 1993), threshold acaricide treatment by farmers, appropriate livestock management and incorporation of traditional practices or remedies that appear to be of value.

ACKNOWLEDGEMENTS

The authors are most grateful to Dr Nigist Mekonnen, Mr Abebe Mekonnen and Mr Ejigu Zeben for their valuable assistance in the field and the laboratory. We thank Professor I.G. Horak and Drs J.J. de Castro and Sintayehu Abditcho for their comments on the manuscript. This survey was conducted as one of the projects funded by the Ethiopian Agricultural Research Organization (EARO) and the results are published with the permission of the National Animal Health Research Center, Sebeta.

REFERENCES

BERGEON, P. & BALIS, J. 1974. Contribution à l'étude de la répartition des tiques en Éthiopie (enquête effectuée de 1965 à 1969). *Revue d'Elevage et Médecine Vétérinaire des Pays Tropicaux*, 27:285–299.

DE CASTRO, J.J. 1994. Tick survey. *A survey of the tick species in Western Ethiopia*; AG: DP/ETH/83/023. Technical report. FAO, Rome.

DE CASTRO, J.J. 1997. Sustainable tick and tickborne disease control in livestock improvement in developing countries. *Veterinary Parasitology*, 71:77–97.

DE CASTRO, J.J. & NEWSON, R.M. 1993. Host resistance in cattle tick control. *Parasitology Today*, 9:13–17.

GEBRE-AB, F. 1983. Notes on tick species and tick-borne diseases of domestic animals in Ethiopia. Addis Ababa: Faculty of Veterinary Medicine, Addis Ababa University.

HOOGSTRAAL, H. 1956. *African Ixodoidea. I. Ticks of the Sudan (with special reference to Equatoria Province and with preliminary reviews of the genera* Boophilus, Margaropus *and* Hyalomma). Washington DC: Department of Navy, Bureau of Medicine and Surgery.

KAISER, M.N. 1987. *Report on tick taxonomy and biology.* AG: DP Eth/83/023 Tick survey. Consultant report. Rome: FAO.

KONEY, E.B.M., WALKER, A.R., HERON, I.D., MORROW, A.N. & AMBROSE, N.C. 1994. Seasonal prevalence of ticks and

their association with dermatophilosis in cattle on the Accra plains of Ghana. *Revue d'Elevage et Médecine Vétérinaire des Pays Tropicaux*, 47:163–167.

MATTHYSSE, J.H. & COLBO, M.H. 1987. *The Ixodid ticks of Uganda*. Maryland, USA: Entomological Society of America.

MEKONNEN, S. 1996. Epidemiology of ticks and tick-borne diseases in Ethiopia: future research needs and priorities, in *Epidemiology of ticks and tick-borne diseases in eastern, central and southern Africa*, edited by A.D. Irvin, T.J. McDermott, & B.D. Perry. ILRI, Nairobi (Kenya): 17–29.

MEKONNEN, S. 1998. Ticks, tick-borne diseases and control strategies in Ethiopia, in *Proceedings of the Second International Conference on Tick-borne Pathogen at the Host-vector Interface: A Global Perspective,* edited by L. Coons & M. Rothschild. 28 August to 1 September 1995, Kruger National Park, South Africa.

MOREL, P.C. 1980. *Study on Ethiopian ticks (Acarida, Ixodida)*. Maisons-Alfort, Paris: Institut d'Elevage et de Médicine Vétérinaire des Pays Tropicaux.

MORROW, A.N., ARNOT, J.L., HERON, I.D., KONEY, E.B.M. & WALKER, A.R. 1993. The effect of tick control on the prevalence of dermatophilosis on indigenous cattle in Ghana. *Revue d'Elevage et Médecine Vétérinaire des Pays Tropicaux*, 46:317–322.

NEUMANN, L.G. 1902. Note sur une collection d'ectoparasites recueillis en Abyssine par M. le Baron C. von Erlander. *Archives Parasitologiques*, 6:293–294.

PEGRAM, R.G., HOOGSTRAAL, H. & WASSEF, H.Y. 1981. Ticks (Acari: Ixodoidea) of Ethiopia. I. Distribution, ecology and host relationship of species infesting livestock. *Bulletin of Entomological Research*, 71:339–359.

PEGRAM, R.G., WALKER, JANE B., CLIFFORD, C.M. & KEIRANS, J.E. 1987. Comparison of populations of the *Rhipicephalus simus* group: *R. simus*, *R. praetextatus*, and *R. muhsamae* (Acari: Ixodidae). *Journal of Medical Entomology*, 24: 666–682.

PETNEY, T.N., HORAK, I.G. & RECHAV, Y. 1987. The ecology of the African vectors of heartwater, with particular reference to *Amblyomma hebraeum* and *Amblyomma variegatum*. *Onderstepoort Journal of Veterinary Research*, 54:381–395.

REGASSA, A. & DE CASTRO, J.J. 1993.Tick resistance to acaricides in western Ethiopia. *Tropical Animal Health and Production*, 25:69–74.

SHIFERAW, Y., GIRMA, A., JOBER, Y., HAILE MARIAM, M. & ZERBINI, E. 1997. Bioassay of acaricide resistance on three common cattle tick species around Holeta area, in *Proceedings of the 5th National Conference of the Ethiopian Society of Animal Production, Addis Ababa*: 146–156.

TATCHELL, R.J. 1992. Ecology in relation to integrated tick management. *Insect Science Application*, 13:551–561.

WALKER, A.R. 1996. *Amblyomma* tick feeding in relation to host health. *Tropical Animal Health and Production*, 28:26s–28s.

WALKER, J.B., KEIRANS, J.E. & HORAK, I.G. 2000. *The Genus* Rhipicephalus *(Acari, Ixodidae): a Guide to the Brown Ticks of the World*. Cambridge, UK: Cambridge University Press.