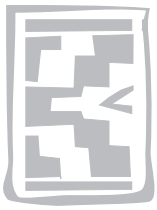


RESEARCH COMMUNICATION

Some observations on the sero-prevalence of heartwater and tick infestation in Zambian goats

B. AHMADU[1]*, C.E.A. LOVELACE[1], K.L. SAMUI[1] and S. MAHAN[2]

ABSTRACT

AHMADU, B., LOVELACE, C.E.A., SAMUI, K.L. & MAHAN, S. 2004. Some observations on the sero-prevalence of heartwater and tick infestation in Zambian goats. *Onderstepoort Journal of Veterinary Research*, 71:161–164

A survey was carried out to define the distribution of heartwater in goats that originated from six districts in communal grazing semi-arid areas of Zambia. A total of 181 samples (40.1 %) out of 451 serum samples from adult goats were positive for *Ehrlichia ruminantium* antibodies after screening using indirect MAP-1B antigen ELISA technique with statistically significant differences ($P < 0.01$) between the six districts. Out of 1 036 adult goats examined for tick infestation, 105 were infested by ticks, with *Amblyomma* species being the most dominant tick encountered. *Amblyomma variegatum*, which is the vector for heartwater transmission in Zambia constituted 42.4 % of the tick species, identified. The overall tick infestation rate was 10 % while the tick:goat ratio was 2.1:1. *Amblyomma variegatum* appears to be widespread throughout the study area, as are antibodies to *E. ruminantium*.

Keywords: *Amblyomma variegatum, Ehrlichia ruminantium*, goats, heartwater, Zambia

INTRODUCTION

Heartwater poses a serious threat to the Zambian livestock where about 2.7 million cattle and 800 000 small ruminants are estimated to be at risk from the disease (UF/USAID/SADC Heartwater Reference Laboratory, Harare, Zimbabwe 1999). The disease is frequently fatal in susceptible animals with mortalities of up to 90 % in sheep and goats (Carlos, Mahan & Barbet 1999). The disease has been recognised as a major obstacle to upgrading local breeds of livestock with more productive susceptible exotic breeds and has been identified to be one of the major constraints to goat rearing in Zambia (Mangani 1997).

In order to reduce the losses caused by heartwater, it is important to detect its presence in an area and to monitor its spread. This is essential for developing an understanding of the epidemiology of the disease and for devising effective control measures. The present study was conceived with the main objective of establishing the sero-prevalence and distribution of heartwater and its vector in local Zambian goats for which no published data are presently available.

MATERIALS AND METHODS

The study was conducted in Zambia and the goats utilised came from the drought and flood-prone valleys of Gwembe and Lumsemfwa, the central and

[1] Department of Disease Control, School of Veterinary Medicine, University of Zambia, P.O. Box 32379, Lusaka, Zambia

[2] University of Florida/USAID/SADC Heartwater Reference Laboratory, CY 551, Causeway, Harare, Zimbabwe

* Present address: Department of Animal Health and Production, P.O. Box 17, Jwaneng, Botswana

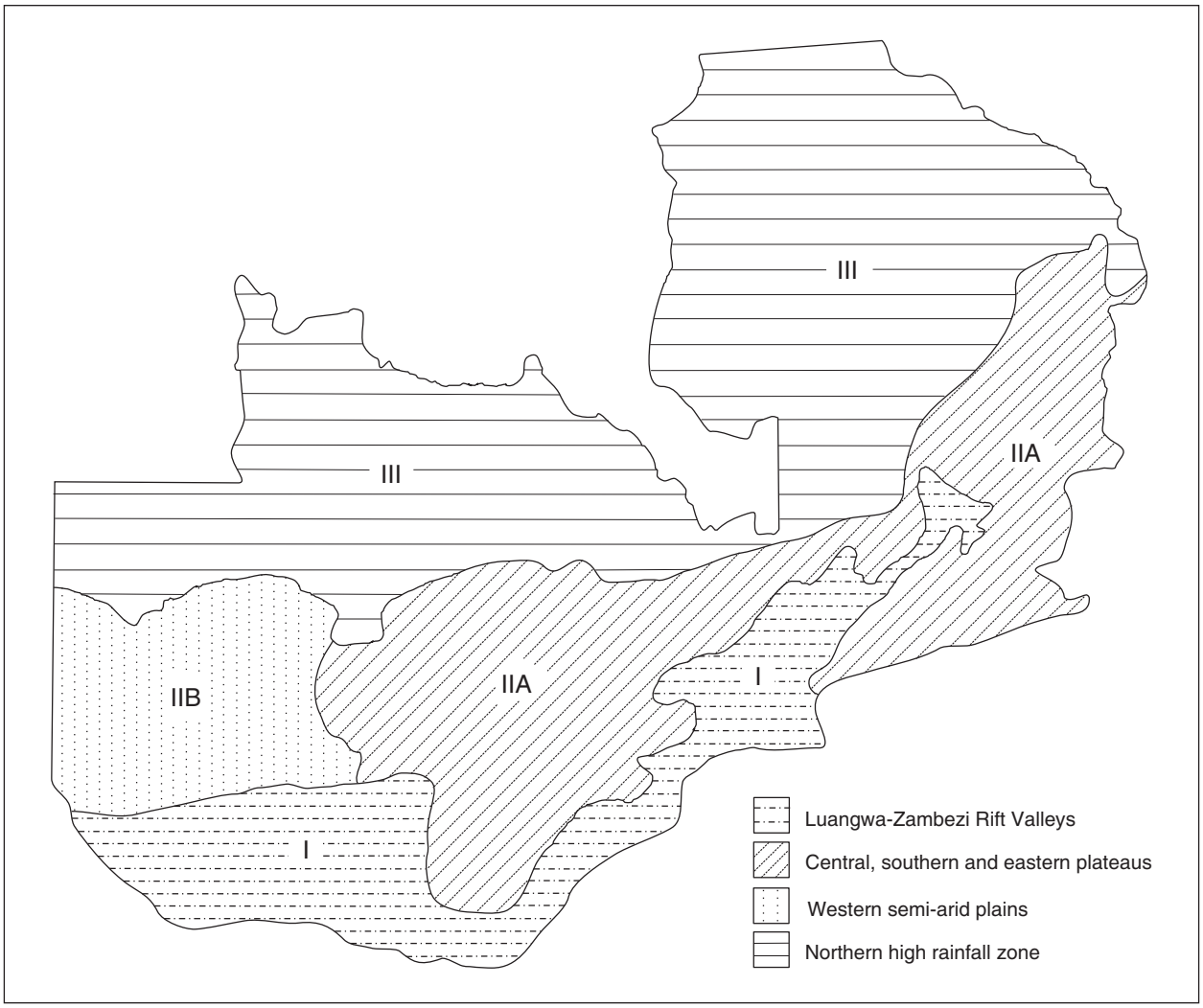
E-mail: bahmadu@gov.bw

Accepted for publication 12 March 2004—Editor

southern parts of the Luangwa valley as well as the southern parts of the Western Province of Zambia (16–18°S; 26–29°E). The region accounts for about 15 % of the land area and is characterised by low, unpredictable and poorly distributed rainfall (less than 800 mm average annual rainfall), a short growing period of 80–120 days due to low, and a wide range of physical and chemical soil properties which are limiting to crop production (Fig. 1). Most of the farmers are small-scale resource-poor farmers who cultivate crops such as maize, sunflower, and soybeans and keep mainly cattle, goats, sheep and pigs.

Goats brought from the study areas to the Lusaka goat market/abattoir were used for this study. The market/abattoir was visited at least four times every week during the rainy season to collect ticks and blood samples. All the goats examined at each occasion were physically examined to record whole body tick counts by species, sex and stage of engorgement using the guidelines provided by Soulsby (1986).

A total 451 blood samples from randomly selected adult goats were considered a representative sample for this investigation. Serum was prepared and frozen, and transported in tubes packed in ice to the University of Florida/USAID/SADC Heartwater Reference Laboratory based at the Central Veterinary Research and Diagnostic Laboratory in Harare, Zimbabwe for analysis. An indirect MAP-1B antigen ELISA was used to screen for circulating antibodies in the goats as an indication of previous or current infection with heartwater. The procedure for the indirect MAP-1B ELISA has been described by Semu, Peter, Mukwedeya, Barbet, Jongejan & Mahan (2001).



Author, please provide legend

FIG. 1 The study area showing the Luangwa Valley

RESULTS AND DISCUSSION

Of the 1 036 goats examined for tick infestation, only 105 were infested with a total of 224 ticks. The mean number of ticks per goat was 2.1. The species and developmental stages of these ticks are presented in Table 1 and their distribution on the goats in Table 2.

Out of the 451 serum samples tested, 181 were positive for MAP-1B (heartwater) antibodies while 270 were negative (Table 3). Analysis of the data using the Chi-square test revealed that there were statistically significant differences ($P < 0.01$) between the districts in the number of positive samples.

The main species of ticks identified were *Amblyomma variegatum, Boophilus decoloratus, Hyalomma truncatum* and *Rhipicephalus appendiculatus.* The predominance of *A. variegatum* species over the others is quite significant as it has been previously identified as the most important vector of heartwater parasitising domestic animals in Zambia (Mwase, Pegram & Varma 1991).

The infestation rate of 10 % and the mean number of 2.1 ticks per goat recorded in this survey appeared to be low considering the fact that the survey was carried out in the later part of the rainy season. This is the period when the seasonal tick dynamics are reportedly high in Zambia and the tick

TABLE 1 The numbers and developmental stages of ticks identified and counted from goats from all the study sites

Tick genus	Larvae	Nymphs	Adult males	Adult females[a]	Total identified	Percentage of the total number counted
Amblyomma	50	0	26	19 (6)	95	42.4
Boophilus	0	0	12	15 (3)	27	12.1
Hyalomma	0	3	46	26 (9)	75	33.4
Rhipicephalus	0	2	11	14 (6)	27	12.1
Total	50	5	95	74 (24)	224	100
Percent	22.3	2.2	42.4	33		100

[a] = Number of engorged females in parentheses

TABLE 2 The numbers of tick collected from various attachment sites of all the goats in the study areas

Attachment site	No. of ticks identified	No. of goats infested	Mean no. of ticks/goat
Interdigital space	53	12	4.4
Ear pinnae	47	35	1.3
Anus area	40	7	5.7
Scrotal area	36	23	1.6
Axillae	18	12	1.5
Base of horns	17	10	1.7
Groin	13	6	2.2
Total	224	105	2.2

TABLE 3 MAP-1B indirect ELISA analysis of goat sera for heartwater

Origin of goats	Sample size	No. positive (%)	No. negative (%)
Batoka	48	37 (77)	11 (23)
Chirundu	67	20 (30)	47 (70)
Choma	41	21 (51)	20 (49)
Monze	79	40 (51)	39 (49)
Siavonga	120	26 (22)	94 (78)
Sinazongwe	96	37 (39)	59 (61)
Total	451	181 (40)	270 (60)

(%) = Numbers in parenthesis are percentages of the total number of goats examined

challenge is high with all animals (Pegram, Perry, Musisi & Mwanaumo 1986).

The sero-prevalence of 40.1 % recorded in this study supports the conclusion that heartwater is present in the indigenous goats. This conclusion is further supported by the epidemiological data from the Zambian veterinary authorities, which indicates that the study area is being encroached by heartwater with sporadic outbreaks recorded over the years (Mangani 1997). The reliability of the MAP-1B ELISA technique is somewhat limited by the detection of antibodies to cross-reacting agents. However, at present there is no information available for such cross-reactions in goats in the study area and hence the contribution of false positive reactions in these data is difficult to assess.

In comparison to reports in neighbouring Zimbabwe where a sero-prevalence in excess of 90% (Mahan, Semu, Peter & Jongejan 1998) was established in goats from heartwater endemic areas, the 40.1 % established in the present study appeared to be substantially lower. The difference could be attributed to the fact the species of the vector tick are different for the two countries. The main vector in Zambia, *A. variegatum*, is less infectious and aggressive in host seeking than the widely spread main vector of the disease in Zimbabwe, *Amblyomma hebraeum* (Mahan, Peter, Semu, Simbi, Norval & Barbet 1995). *Amblyomma variegatum* is considered to be of secondary importance in the transmission of heartwater in Zimbabwe (Mahan *et al*. 1995).

There is a correlation between the sero-prevalence of heartwater and the presence of *A. variegatum* in the study area. Given that the tick infestation rate is already low and the apparent existence of enzootic stability would imply that any attempt to control the vectors could cause a situation of enzootic instability, which may bring about severe losses. The distribution of heartwater and the susceptibility of Zambian ruminants and wildlife to *E. ruminantium* needs to be re-assessed in order to formulate control measures and to limit the risk of keeping livestock in heartwater endemic areas.

ACKNOWLEDGEMENTS

The authors thank the University of Florida/USAID/ SADC Heartwater Reference Laboratory in Harare, Zimbabwe for helping to carry out the serology in their laboratory, and the farmers and members of the Small Livestock Association for the assistance during sample collection from goats in the Association's market.

REFERENCES

CARLOS R.S., MAHAN, S., & BARBET A.F. 1999. The map 1 gene of *Cowdria ruminantium* is a member of a multigene family containing both conserved and variable genes. *Biochemical and Biophysical Research Communications*, 257: 300–305.

MANGANI, M.P.C. 1997. Heartwater in Zambia, in *Proceedings of the SADC Heartwater Workshop, organised by the UF/ USAID/SADC Heartwater Reference Laboratory, Harare, Zimbabwe SADC Heartwater Research Project, April 2–4, 1997, Botswana*: 81–84.

MAHAN, S., PETER, T.F., SEMU, S.M., SIMBI, B.H., NORVAL, R.A.I. & BARBET, A.F 1995. Laboratory reared *Amblyoma hebraeum* and *A. variegatum* differ in their susceptibility to infection with *Cowdria ruminantium. Epidemiology and Infection*, 115:345–353.

MAHAN, S., SEMU, S.M., PETER, T.F & JONGEJAN, F. 1998. Evaluation of the MAP-1B ELISA for cowdriosis with field sera from livestock in Zimbabwe. *Tropical Veterinary Medicine*, 849:259–261.

MWASE, E.T., PEGRAM, R.G. & VARMA, M.G.R. 1991. The development and survival of *Amblyoma variegatum* Fabricius (*Acari: Ixodidae*) under quasi-natural conditions in Zambia. Academia, in *Modern Acarology*, Vol. 1, edited by F. Dusbabek & V. Bukva. The Hague: Prague and SPB Academic Publishing.

PEGRAM, R.G., PERRY, B.D., MUSISI, F.L. & MWANAUMO, B. 1986. Ecology and phenology of ticks in Zambia: Seasonal dynamics on cattle. *Experimental and Applied Acarology*, 2:25–45.

SOULSBY, E.J.L., 1986. *Helminths, arthropods and protozoa of domesticated animals*, 7th ed. London: Bailliere Tindall.

SEMU, S.M., PETER, T.F., MUKWEDEYA, D., BARBET, A.F., JONGEJAN, F. & MAHAN, S.M. 2001. Antibody responses to MAP-1B and other *Cowdria ruminantium* antigens are down-regulated in cattle challenged with tick-transmitted heartwater. *Clinical and Diagnostic Laboratory Immunology*, 8:388–396.

UF/USAID/SADC/Heartwater Project, Harare, Zimbabwe 1999. *Research report on distribution of small ruminants at risk from heartwater in SADC region*.