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THE INCIDENCE OF *COXIELLA BURNETII* ANTIBODIES IN CATTLE IN THE TRANSVAAL

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ABSTRACT

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With the use of the complement fixation test, 8 900 cattle were tested for antibodies to *Coxiella burnetii*. These were randomly selected from 178 different farms in 37 districts in the Transvaal. The percentage of cattle in the sample with positive antibody titres was equal to 7,78 %, with a standard error of 0,28 %. Because of the large size of the sample, asymptotic normality can be relied upon and the population confidence interval calculated. This was found to be > or = 0,07 and < or = 0,085 at a 99 % confidence level. Hence we are 99 % confident that between 7 % and 8,5 % of the cattle in the Transvaal had antibodies to *Coxiella burnetii* during the period March 1985 to July 1986.

The proportion of cattle with *C. burnetii* antibodies was also estimated for each of the 37 districts tested. Every district tested had some evidence of *C. burnetii*. The percentage of positive titres ranged from less than 1 %–30 % per district. This suggests that *C. burnetii* is probably an endemic disease of the cattle population of the Transvaal. A higher proportion of cattle had antibody titres in the central and south-eastern parts of the Transvaal. This distribution may be linked to the distribution of *Boophilus* species ticks which occur in the same areas of the Transvaal.

INTRODUCTION

Descriptive epidemiological studies of *Coxiella burnetii* (*C. burnetii*) have been carried out in various countries of the world with the use of the complement fixation test (CFT) (Polydorou, 1985; Roth & Bauer, 1986; Woernle & Muller, 1986). These have led to a greater understanding of the disease and the necessary control measures pertinent to that country. In South Africa, it is known that *C. burnetii* infection does exist in the animal population [unpublished data, Veterinary Research Institute (VRI), Onderstepoort, RSA, 1981–1985], but there is almost complete lack of scientific information on its incidence and distribution. A serological survey of cattle in the Transvaal was therefore conducted in order to address this lack of information.

MATERIALS AND METHODS

Sampling procedure

A sample size of 8 900 cattle was obtained from the Transvaal cattle population in the following manner: the Transvaal was divided up according to the 63 magisterial districts in accordance with the Division of Veterinary Services' livestock census, March 1985. At the end of the test period of 16 months (beginning in March 1985) samples had been randomly obtained from a total of 37 districts (Table 1). The samples selected were from bovine sera sent to the VRI for routine brucellosis serology. From each district an average of 244 cattle (with a standard error of 15) were tested for antibodies to *C. burnetii*. It was decided that not more than 50 cattle from any one farm in a district should be tested, and a record of the origin of each sample was kept. An average of 4,8 farms were tested per district, a total of 178 farms being investigated. The 50 cattle selected from each farm in a district were randomly selected (using random number tables) from submitted sample sizes, ranging from 50–550 cattle, with a submitted sample size mean of 154 cattle per farm. Samples were thus selected only from farms with submitted sample sizes greater than 50. The districts in which these farms occurred were then recorded until a maximum of 7 farms for that district had been obtained. The order in which the districts were selected was thus dependent on how the samples were submitted. The selection of districts was therefore also done randomly to a degree.

Test procedure

Using random samples as far as practically possible, each serum sample was tested for antibodies to *C. burnetii*, using the complement fixation test as described by Herr, Huchzermeyer, Te Brugge, Williamson, Roos & Schiele (1985). Titres greater than 1/16 were regarded as positive and recorded. A negative and positive control supplied with the commercial antigen were used when testing each batch of sera.

TABLE 1 The number of cattle per Transvaal district sampled together with the number that had antibodies to *C. burnetii*, expressed as a percentage

District	n	x	%	Std. error (%)
Heidelberg	250	1	0,4	0,4
Wakkerstroom	150	1	0,7	0,7
Lydenburg	300	3	1,0	0,6
Pelgrimsrus	100	1	1,0	1,0
Volksrust	200	2	1,0	0,7
Pretoria	350	8	2,3	0,8
Standerton	300	8	2,7	0,9
Pietersburg	250	7	2,8	1,0
Nigel	300	9	3,0	1,0
Swartruggens	100	3	3,0	1,7
Thabazimbe	300	10	3,3	1,0
Randfontein	200	7	3,5	1,3
Koster	300	12	4,0	1,1
Barberton	200	8	4,0	1,4
Watervalboven	50	2	4,0	2,8
Krugersdorp	300	14	4,7	1,2
Brits	150	8	5,3	1,8
Rustenburg	200	12	6,0	2,0
Marico	350	22	6,3	1,3
Witbank	300	21	7,0	1,5
Ermelo	350	25	7,1	1,4
Balfour	150	13	8,6	2,2
Vereeniging	100	9	9,0	2,9
Bronkhorstspruit	350	33	9,4	1,6
Nelspruit	250	24	9,6	1,9
Middelburg	300	29	9,7	1,7
Carolina	100	10	10,0	3,0
Frankfort	250	26	10,4	1,9
Warmbad	350	38	10,9	1,7
Belfast	300	32	11,0	1,8
Delmas	300	38	12,7	1,9
Letaba	350	50	14,3	1,9
Witrivier	150	23	15,3	2,9
Vrede	300	49	16,3	2,0
Cullinan	350	62	17,7	2,0
Bethal	100	19	19,0	3,9
Westonaria	200	53	26,5	3,1

n = the number of cattle tested
x = the number of cattle positive
% = the estimated proportion of cattle positive expressed as a percentage

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Statistical methods

Assuming that we have a random sample and because we have a large sample size, it was possible to calculate the population confidence interval for a proportion (p), as we can rely on asymptotic normality. The formula used to obtain an estimate of the 100 $(1-\alpha)$ % confidence interval for p is given by Steffens (1985). The same estimator was used to estimate the proportion of samples positive for each district tested, and the standard error for each estimate was then calculated as above. To allow for easier interpretation of the results, they were arranged according to rank order (Table 1). The median was then calculated and the districts grouped according to those areas with a prevalence of less than or equal to the median and those areas with a prevalence greater than the median (Fig. 1).

RESULTS

A total of 8 900 cattle were tested, 692 of which had antibodies to *C. burnetii*. The overall proportion of cattle in the survey with antibodies was 0,0778. The standard error of this estimate was 0,0028. Using the 99 % confidence level for z, the approximate proportion of the Transvaal cattle population with antibodies is estimated to be between 0,07 and 0,085 (i.e. 7 to 8,5 %).

The percentage of cattle with positive antibody titres in each of the 37 districts tested, together with their standard errors, is given in Table 1. These percentages range from 0,7 %–26,5 %. The area distribution of *C. burnetii* in the Transvaal is shown in Fig. 1. The central and south eastern Transvaal are shown to be areas where the prevalence of *C. burnetii* is greater than the median and the western Transvaal to be an area where the prevalence of *C. burnetii* is less than the median.

DISCUSSION AND CONCLUSION

The results show that between 7 % and 8,5 % of the cattle in the Transvaal had antibodies to *C. burnetii* (using the 1 % level of significance) and that these positive animals are widely distributed throughout the Transvaal, as cattle were found to be positive in every district tested. It is therefore highly likely that an endemic situation is present in the Transvaal, with the disease being maintained at a low level within the cattle population. Because of this low incidence, the threat of transmission to humans becomes small and the need for a rigorous control programme by means of vaccination becomes less important. It is felt, however, that the incidence can be lowered further by making farmers aware that *C. burnetii* is widespread in the Transvaal and that improved management practices, such as the careful handling and destruction of afterbirths, the pasteurization of milk and a greater control of tick carriers, can bring this about.

An interesting finding (Fig. 1) is that the areas where the prevalence of *C. burnetii* is above the median tend to lie predominantly in the central and south-eastern Transvaal, while the areas with a prevalence below the median lie more in the western Transvaal. Although the reasons for this are probably multifactorial, it is interesting to note that the distribution of the blue tick *Boophilus decoloratus* in a dry year such as 1985 (Howell, Walker & Nevill, 1978) is very similar to that of *C. burnetii*. In addition, the spot distribution of *Boophilus microplus* seems to coincide with highest prevalence areas, such as Belfast, Witrivier, Cullinan, Carolina and Warmbad. It would seem, therefore that *Boophilus* ticks could possibly play a role in the transmission and maintenance of *C. burnetii* amongst the cattle population of the Transvaal. On the other hand, the yellow dog tick, *Haemaphysalis leachi*, which is a recognized carrier of Q fever in this country, has a distribution which may coincide even more closely with *C. burnetii* (Howell *et al.*, 1978). The link, if any, between *Haemaphysalis* distribution and *C. burnetii* in cattle is puzzling, as these ticks are seldom associated with cattle, but are found primarily on carnivores.

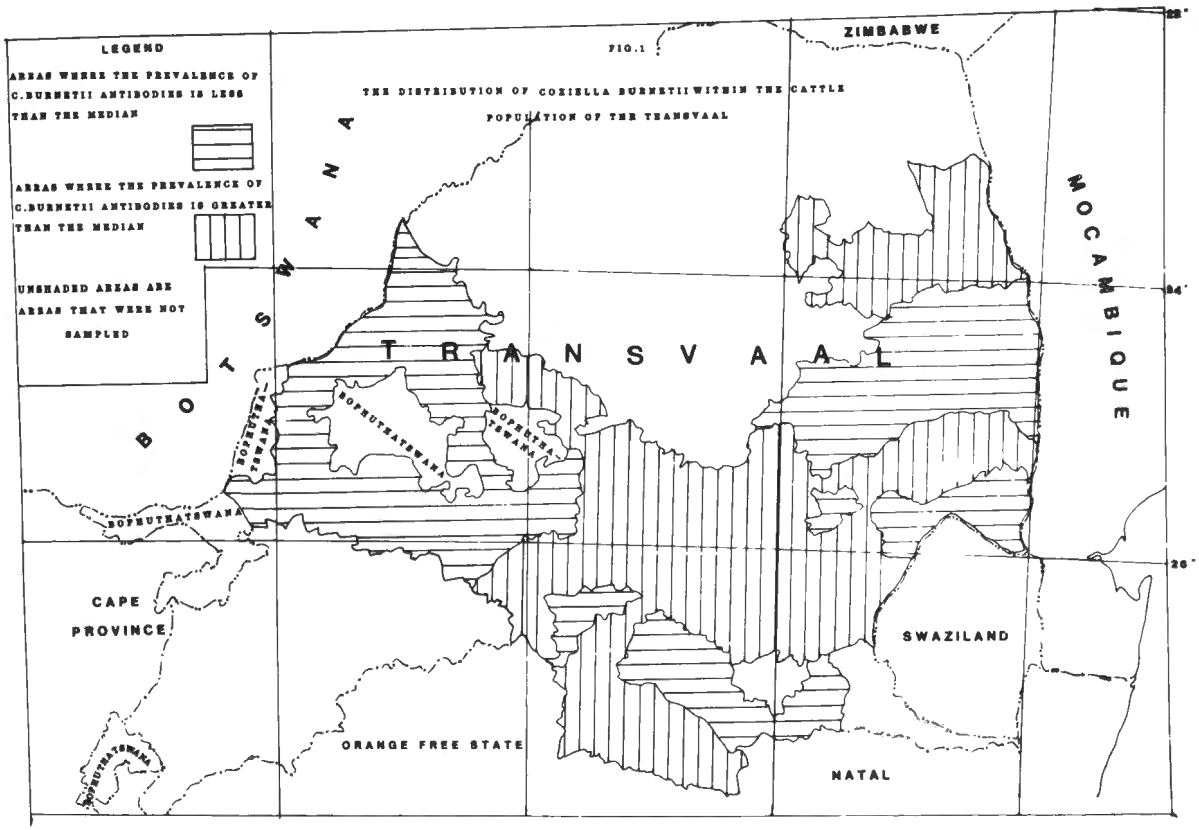

FIG. 1. The distribution of *Coxiella burnetii* in the cattle population of the Transvaal

From this study it becomes apparent that the epidemiology of Q fever in the Transvaal requires considerably more investigation, now that it is known to be widespread, so that some of the most fundamental questions about how this interesting organism behaves in our country may be answered.

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