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The Distribution of Bovine Trypanosomosis in Zimbabwe and an Evaluation of the Value of an Anti-trypanosomal Antibody Detection ELISA as a Tool for Monitoring the Effectiveness of Tsetse Control Operations

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ABSTRACT

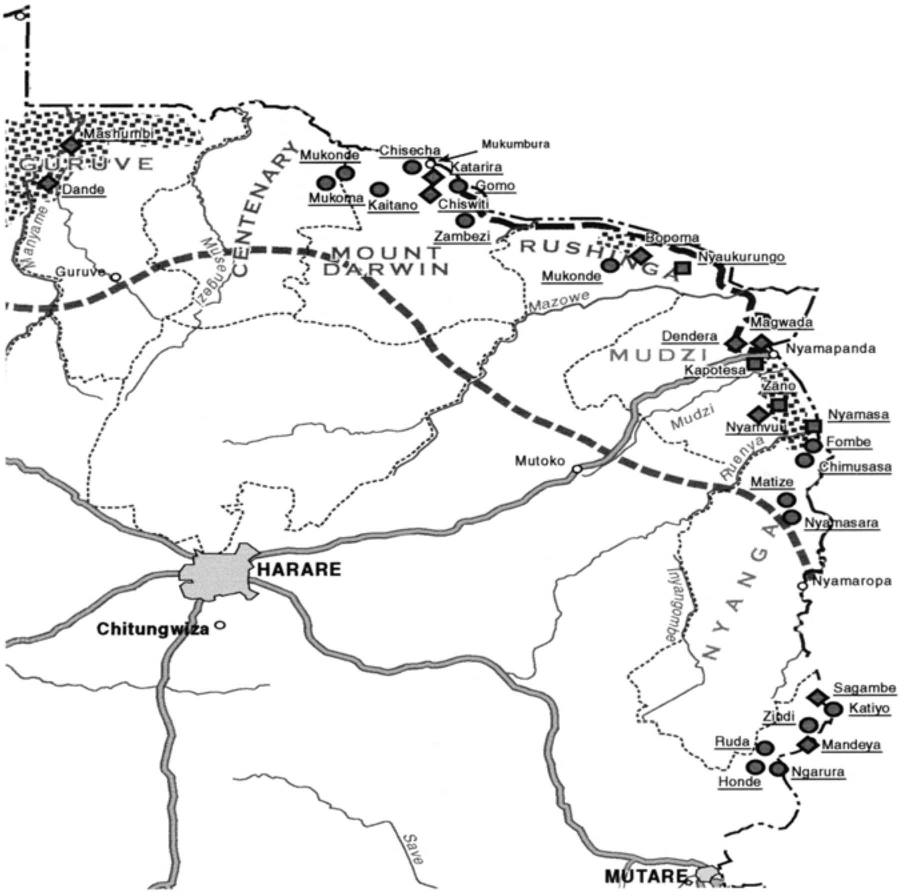
Tsetse have been cleared from large areas of Zimbabwe during the past 65 years. In most areas, they are prevented from re-invading cleared areas by barriers of odour-baited, insecticide-treated targets. A trypanosomosis survey was conducted to determine the effectiveness of such barriers against re-invasion and to confirm the absence of tsetse in areas where they had previously been eradicated. Parasitological diagnostic methods and an anti-trypanosomal antibody detection enzyme-linked immunosorbent assay (antibody ELISA) were used. The prevalence of trypanosomal infections in the tsetse-cleared areas was generally low. However, the prevalence of anti-trypanosomal antibodies was unexpectedly high in some areas. This high proportion of cattle with antibodies could, in most cases, be explained by recent or historic information on the distribution and density of tsetse. The results from the survey demonstrated the value of anti-trypanosomal antibody detection as an additional sensitive tool for monitoring the effectiveness of tsetse control operations.

Keywords: antibodies, cattle, control, diagnosis, ELISA, epidemiology, prevalence, surveillance trypanosomosis

Abbreviations: ELISA, enzyme-linked immunosorbent assay; PCV, packed cell volume; TTCB, Tsetse and Trypanosomiasis Control Branch; RTTCP, Regional Tsetse and Trypanosomosis Control Programme

INTRODUCTION

Tsetse control has a long history in Zimbabwe. During the past 65 years, large portions of land have been cleared of tsetse through the concerted efforts of Zimbabwe's Tsetse and Trypanosomiasis Control Branch (TTCB). Between 1986 and 1998, for example, approximately 20 400 km^2 were cleared of the fly using a variety of control methods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GURUVE
Dande
Manyame
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CENTENARY
Musengezi
Mukonde
Mukoma
Kaitano
Chisecha
Mukumbura
Katarira
Gomo
Chiswiti
Zambezi
MOUNT DARWIN
RUSHINGA
Bopoma
Nyaukurungo
Mukonde
Mazowe
Dendera
Magwada
Nyamapanda
MUDZI
Kapotesa
Zano
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Nyamasa
Nyamvuu
Fombe
Ruenya
Chimusasa
Mutoko
Matize
Nyamasara
HARARE
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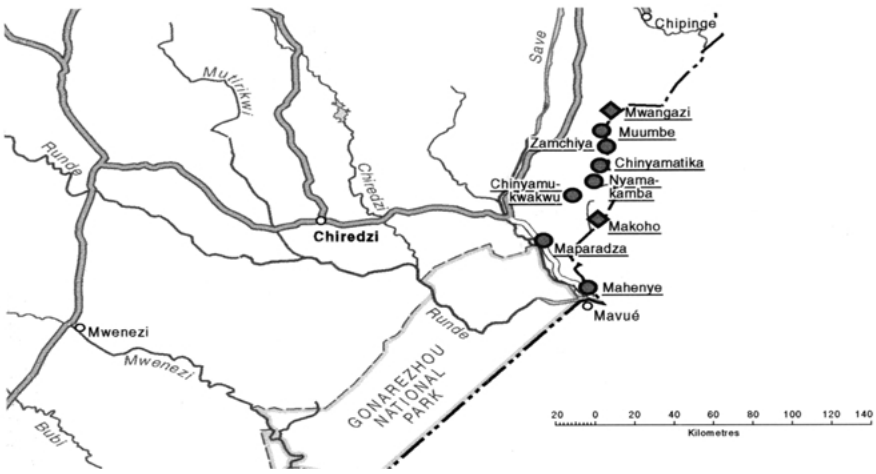
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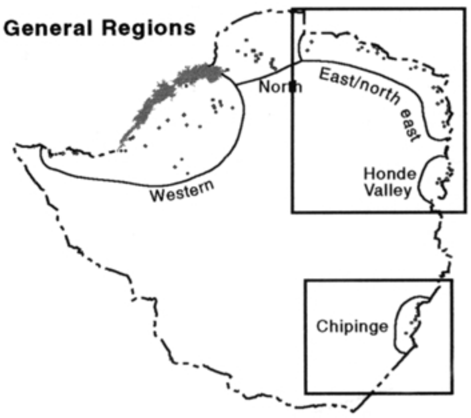
(Lovemore, 1999). In the northern and north-eastern regions, barriers of odour-baited insecticide-treated targets (Hargrove, 1993), sometimes supported by insecticide-treated cattle (Thompson *et al.*, 1991), have been put in place to prevent tsetse from re-invading cleared areas. In other areas, where the risk of re-invasion of tsetse is low, artificial barriers are absent. The effectiveness of these barriers or the absence of tsetse in areas not protected by barriers is monitored through tsetse and trypanosomosis surveillance. Such surveillance exercises are time consuming and expensive. Moreover, owing to the low sensitivity of the currently available tsetse and trypanosomosis surveillance methods (Paris *et al.*, 1982; Hargrove, 1980), low-density tsetse populations and areas where the prevalence of trypanosomosis is low are often missed and, hence, erroneously considered to be tsetse-free or disease-free. The recently improved anti-trypanosomal antibody detection enzyme-linked immunosorbent assay (antibody ELISA) (Hopkins *et al.*, 1998) is available for use as an additional tool for monitoring the effectiveness of tsetse control operations. The assay is reported to have a high diagnostic sensitivity and specificity in detecting anti-trypanosomal antibodies in cattle (Hopkins *et al.*, 1998). Moreover, the assay detects antibodies against current and past trypanosomal infections.

To determine the value of the antibody ELISA as an additional tool with which to monitor the effectiveness of tsetse control operations, a trypanosomosis survey was conducted along Zimbabwe's tsetse-front. The prevalence of anti-trypanosomal antibodies in cattle was determined at various sampling sites and compared with the parasitological prevalence of trypanosomal infections and current and historic data on the distribution and density of tsetse.



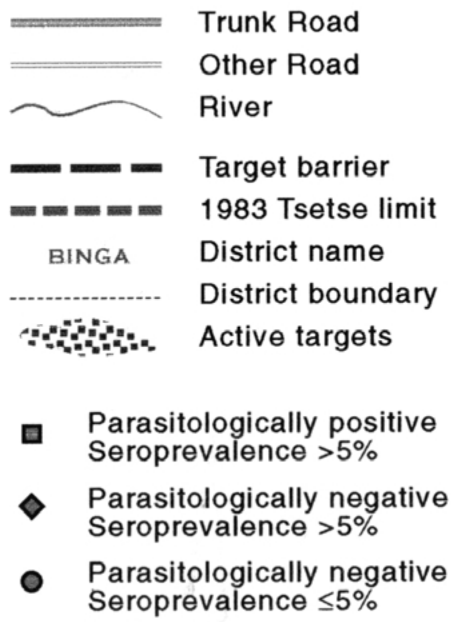


Figure 1 (opposite page). Location of sampling sites, tsetse control measures and survey areas in the Chipinge area, Honde Valley and eastern/north-eastern regions of Zimbabwe

MATERIALS AND METHODS

Sampling sites and sample selection

Between January 1998 and September 1999, 4580 adult cattle were examined at 77 sampling sites in the south-eastern, eastern/north-eastern, northern and western regions of Zimbabwe (Figures 1 and 2). Sampling was restricted to areas that were supposedly cleared of tsetse and were either adjacent to the tsetse invasion front or along barriers for preventing re-invasion.

A cross-sectional sampling method was applied. Sample sizes depended on the total cattle population at a particular sampling site but were calculated to provide 95% certainty of detecting at least one positive case at a prevalence of 5% (Cannon and Roe, 1982).

Survey areas

Chipinge area

Tsetse was eradicated from the south-eastern lowveld following large-scale ground spraying operations involving the governments of Mozambique, South Africa and Zimbabwe (then Rhodesia) and pushed to about 60 km east of the Zimbabwe border (Robertson *et al.*, 1972). Despite the absence of measures to contain the westerly advance of the fly front, no cases of bovine trypanosomosis have been diagnosed in the south-eastern lowveld since the spraying operation. In 1997, two tsetse flies were captured at Mavué (Figure 1) on the Zimbabwe/Mozambique border, immediately south of the Save River (RTTCP, 1999). Because of the threat of re-invasion of tsetse into Zimbabwe, intensive tsetse surveillance was initiated in 1998 in the Chipinge area. No tsetse were captured.

Honde valley

In the Honde Valley, bovine trypanosomosis was recorded as far back as 1959 (Thakersi, 1992). In 1992, a major outbreak of the disease occurred. This outbreak was attributed to the spread of *Glossina pallidipes*, *G. m. morsitans* and *G. austeni* from neighbouring Mozambique (Thakersi, 1992) and was controlled by dipping. Insecticidal treatment of cattle ceased at the end of 1996. Since then, little information is available on the tsetse and trypanosomosis situation in the Honde Valley, but no major outbreaks have been recorded.

Eastern/north-eastern border region

In this region, tsetse are confined to the international border with Mozambique. A barrier of odour-baited, insecticide-treated, targets is present in most of the border area (Figure 1).

Northern region

Between the eastern edge of Lake Kariba and the Manyame River, tsetse-cleared areas are protected from re-invasion of tsetse by target operations of varying widths (Lovemore, 1999) (Figure 2).

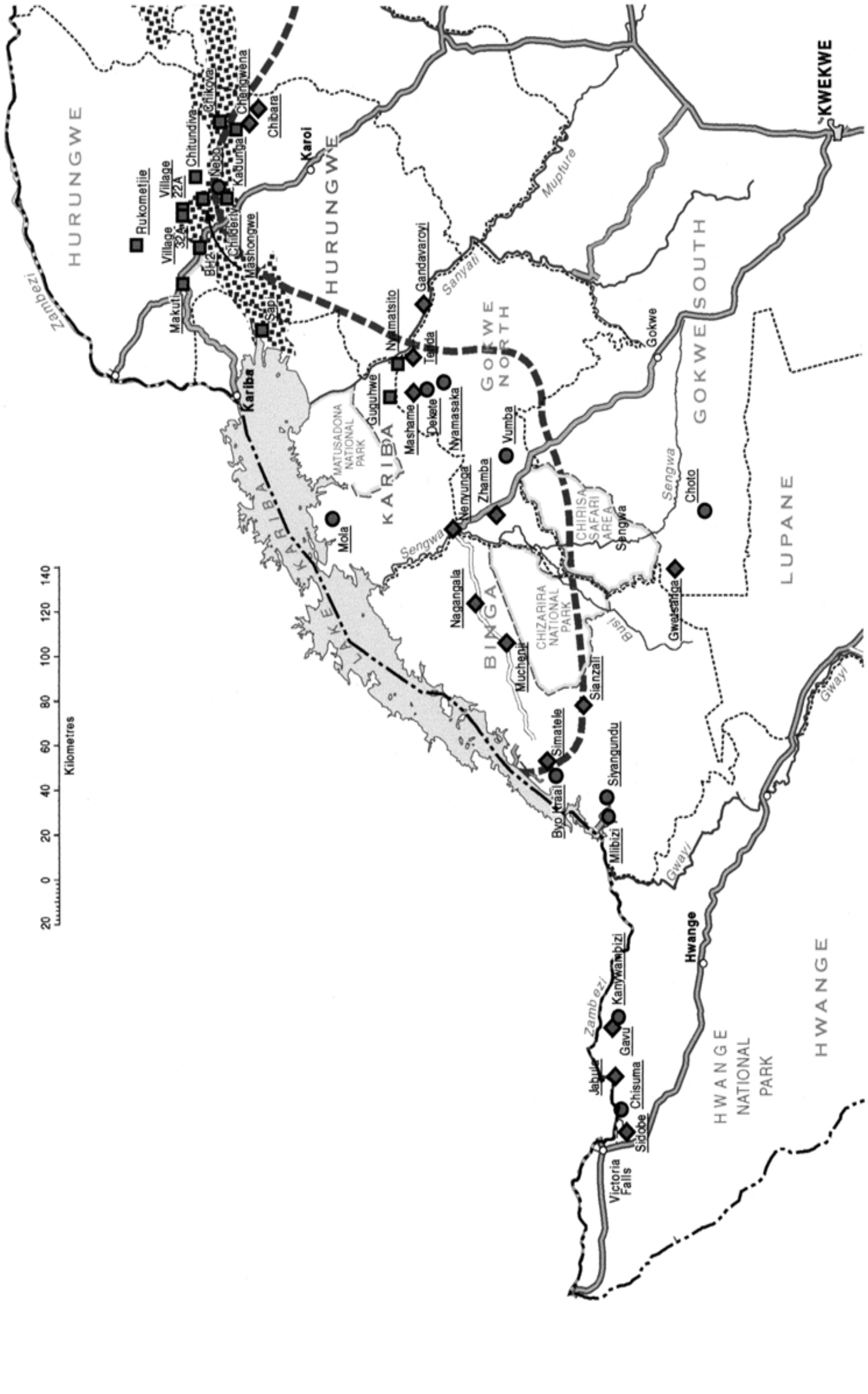
Western region

With the exception of the Matusadona National Park, large-scale aerial and ground spraying operations were conducted between 1982 and 1987, with the aim of clearing the western region of tsetse (Hursey and Allsopp, 1984; Allsopp and Hursey, 1986; Lovemore, 1990). Despite all these efforts, tsetse (*G. pallidipes*) were still being captured in parts of the region (Lovemore, 1990). As a result of these catches, tsetse control measures were initiated in areas surrounding the Chirisa Safari Area at the end of 1988. No tsetse have been caught in the area since December 1989 (RTTCP, 1989).

Tsetse disappeared from the banks of the Zambezi between Victoria Falls and the Gwayi River after the rinderpest outbreak at the end of the nineteenth century (Jack, 1914). However, an isolated outbreak of bovine trypanosomosis was reported in 1972 (Lovemore and Napier Bax, 1972). Since then, no bovine trypanosomosis has been reported from the area. However, surveys in Zambia have revealed a southerly advance from the tsetse (*G. m. centralis*) infestation centred on the Kafue National Park (RTTCP, 1991).

Diagnostic methods

The buffy coat and stained thick and stained thin smears were examined in the parasitological diagnostic tests (Paris *et al.*, 1982). Blood was collected from an ear vein into heparinized microhaematocrit centrifuge capillary tubes and onto glass slides, as thick and thin blood smears. The capillary tubes were sealed with 'Cristaseal' (Hawksley, Lancing, UK) and centrifuged immediately in a microhaematocrit centrifuge for 5 min at 7500*g*. After centrifugation, the packed cell volume (PCV) was determined. Animals with a PCV $\leqslant$24% were considered to be anaemic. The buffy coat and the uppermost layer of red blood cells in each specimen were extruded onto a microscope slide and examined under a phase-contrast microscope with a $\times 40$ objective lens for the presence of motile trypanosomes. Giemsa-stained thick and thin blood smears were examined under a $\times 100$ oil immersion objective lens.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Nebo
Childerley
Mashongwe
Makuti
Sapi
Karoi
Kariba
Gandavaroyi
Sanyati
Nyamatsito
Tenda
Guguhwe
Mashame
Dekete
Nyamasaka
GOKWE NORTH
Mupfure
Gokwe
GOKWE SOUTH
KWEKWE
MATUSADONA NATIONAL PARK
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From each of the animals sampled at the 77 sampling sites, the blood contained in one heparinized microhaematocrit centrifuge capillary tube was extruded onto a filter paper (Whatman no. 4, Whatman, Maidstone, Kent, UK). Eluates from the blood spots were then screened for the presence of trypanosomal antibodies using an indirect ELISA (Hopkins *et al.*, 1998). A rigorous system of quality assurance was adopted. The optical density (OD) in the ELISA of each sample tested was expressed as a percentage (percentage positivity) of a strong positive reference standard (Wright *et al.*, 1993). A cut-off of 28% positivity was used (Van den Bossche *et al.*, 2000).

RESULTS

Chipinge area

No trypanosomal infections were detected in any of the cattle from nine sampling sites in the Chipinge area (Table I and Figure 1). However, anti-trypanosomal antibodies were present in cattle sampled at each site, although the average proportion of cattle with such antibodies at each sampling site was low (4.8% ± 0.9%). The average percentage positivity of the seropositive samples was 34.0% ± 1.1%. The average PCV of the seropositive animals did not differ significantly from that of the seronegative animals (28.1% ± 0.9% and 28.6% ± 0.9% for the seropositive and seronegative animals, respectively, $p > 0.05$).

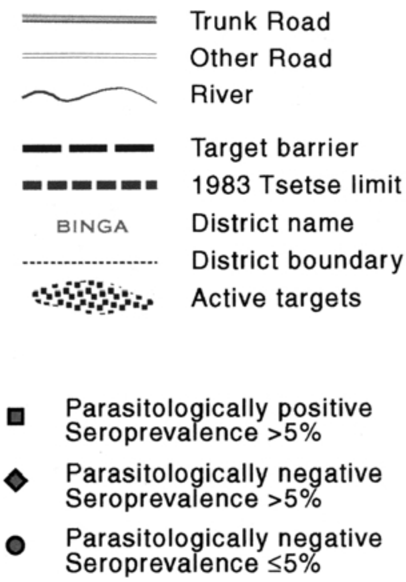

Figure 2 (opposite page). Location of sampling sites, tsetse control measures and survey areas in the northern and western regions of Zimbabwe

TABLE I
Number of herds and animals sampled, herd average PCV, herd average proportion of anaemic animals and average serological and parasitological prevalences of trypanosomosis in each of the survey areas in Zimbabwe

Area or region (District)	Number sampled		Average (±SE) PCV (%)	Average (±SE) proportion with PCV ≤24% (%)	Average (±SE) prevalence (%)	
	Herds	Animals			Parasitological	Serological
Chipinge	9	540	28.3 ± 0.5	12.2 ± 1.7	0	4.8 ± 0.9
Honde	7	363	27.1 ± 1.5	28.0 ± 4.0	0	2.5 ± 1.2
East/north-eastern region						
Nyanga	5	508	29.5 ± 0.5	9.9 ± 5.5	2.6	8.4 ± 7.6
Mudzi	4	292	27.9 ± 0.4	26.1 ± 9.8	2.8 ± 1.8	20.7 ± 2.5
Rushinga	3	184	32.8 ± 0.5	1.1 ± 1.1	1.0 ± 1.0	13.4 ± 8.5
Mount Darwin	6	365	32.0 ± 0.6	0.3 ± 0.3	0	7.3 ± 4.2
Centenary	2	125	31.3 ± 1.4	2.3 ± 2.3	0	0
Guruve	2	120	31.4 ± 4.1	5.8 ± 4.1	0	21.6 ± 5.9
Northern						
Hurungwe	13	620	27.7 ± 1.0	42.6 ± 7.0	13.4 ± 3.6	23.8 ± 5.0
Kariba	1	22	31.4	0	4.5	6.2
Western						
Gokwe north	9	544	28.7 ± 0.5	25.4 ± 4.6	0.2	9.0 ± 3.2
Kariba	2	56	30.5 ± 2.9	37.0 ± 37.0	5.8 ± 5.8	13.5 ± 13.5
Binga	7	420	31.2 ± 0.4	5.6 ± 1.7	0	8.6 ± 3.3
Gokwe south	2	120	32.2	5.5	0	20.8 ± 15.8
Hwange	5	301	31.1 ± 0.4	7.2 ± 2.1	0	12.9 ± 5.8

Honde valley

No trypanosomal infections were detected in the Honde Valley (Table I). Only two herds had a prevalence of cattle with anti-trypanosomal antibodies of more than 5% (Mandeya 7.1% and Sagambe 5.6%) (Figure 1). The average PCV of the seropositive animals did not differ significantly from that of the seronegative animals (26.0% ± 1.2% and 26.8% ± 0.3% for the seropositive and seronegative animals, respectively, $p > 0.05$).

Eastern/north-eastern region

Trypanosomal infections (25 *T. congolense* and 13 *T. vivax*) were detected in cattle from four sampling sites, most of them located in Mudzi District or adjacent to the target barrier (Table I and Figure 1).

Anti-trypanosomal antibodies were most prevalent in cattle sampled in Mudzi and Guruve Districts. With the exception of cattle sampled at Nyaukurungo (Rushinga District) and Chiswiti (Mount Darwin District), anti-trypanosomal antibodies were scarce in cattle sampled elsewhere in the region (Figure 1). The average PCV of the seropositive animals differed significantly from that of the seronegative animals (27.2% ± 0.2% and 29.8% ± 0.2% for the seropositive and seronegative animals, respectively, $p < 0.001$).

Northern region

Trypanosomosis was diagnosed in 93 animals from 11 sampling sites, most of them located within or to the north of the active target operations (Figure 2). Trypanosomal infections were mainly due to *T. congolense* (50.3%) and *T. vivax* (40.8%).

The prevalence of anti-trypanosomal antibodies was high in all areas (Table I). It was, however, substantially higher in cattle sampled at sites to the north of the target operations (34.5% ± 7.2%) compared to cattle sampled within (13.5% ± 7.6%) or south (12.4% ± 1.5%) of these operations.

Western region

Trypanosomal infections (four, all *T. congolense*) were detected in cattle sampled at two sampling sites. They were both located south of the tsetse-infected Matusadona National Park (Figure 2).

The prevalence of cattle with anti-trypanosomal antibodies was relatively high at sampling sites located along the Sanyati River (Tenda 11.7% and Gandavaroyi 8.3%), in the vicinity of the Chizarira National Park (Mucheni 11.7%, Nagangala 26.7% and Zhamba 30.0%) and in the Chirisa Safari Area (Gwetsanga 36.7%) and along the border with Zambia in the vicinity of Victoria Falls (Gavu 13.3%, Jabula 31.5% and Sidobe 10.0%) (Figure 2).

DISCUSSION

Distribution and prevalence of bovine trypanosomosis

Chipinge and Honde areas

Whereas no trypanosomal infections were diagnosed using parasitological diagnostic methods, a low prevalence of anti-trypanosomal antibodies was detected in cattle at all sampling sites. However, since the anti-trypanosomal antibody detection ELISA is not 100% specific, a proportion of these antibody-positive animals may be due to false positive reactions or non-specific cross-reactions. A study investigating the possibility of non-specific cross-reactions with *Trypanosoma theileri*, *Anaplasma marginale* or *Babesia bigemina* showed that the presence of these parasites did not result in non-specific cross-reactions (P. Van den Bossche, personal observation, 1999). False positive reactions are, therefore, the most likely explanation for the very low prevalence of cattle with anti-trypanosomal antibodies at most of the sampling sites. The proportion of false positive reactions is likely to increase with a decreasing prevalence of infection and will thus be higher in areas where the disease is absent (Thrusfield, 1986). Depending on its cause, the problem may be reduced by repeated testing of the same specimen. However, because of the higher prevalence of anti-trypanosomal antibodies in cattle sampled at Makoho, Mwangazi, Sagambe and Mandeya, tsetse challenge cannot be excluded. The observed antibody levels could be a result either of undetected current trypanosomal infections or of persistent antibodies after an infection has been cured. However, if some of the seropositive animals were infected with trypanosomes, their average PCV would be expected to be lower than the average PCV of the seronegative animals (Murray and Dexter, 1988). This was not the case. Therefore, the results suggest that, if present at all, any challenge is low and probably irregular. The possible origin of such a challenge is difficult to determine. Despite the potential for mechanical transmission in African animal trypanosomosis, many reports of mechanical transmission have subsequently been discounted by the discovery of low-density tsetse populations. Moreover, several field transmission experiments, including a trial conducted in south-east Zimbabwe (Boyt *et al*., 1970), have failed to demonstrate unequivocally mechanical transmission of *T. congolense* (Wells, 1972). Challenge by tsetse may occur when animals stray into tsetse-infested parts of Mozambique. Although tsetse challenge within the areas cannot be totally excluded, a 12-month intensive surveillance exercise in the Chipinge area did not detect tsetse (J. Chihiya, personal communication, 1999).

Eastern/north-eastern region

Along the eastern/north-eastern border with Mozambique, tsetse challenge is highest in Mudzi, in the southern part of Rushinga and in Gururve Districts (Figure 1). Despite the presence of a 10 km-wide target barrier in Mudzi District, several trypanosomal infections were diagnosed and high proportions of the animals had anti-trypanosomal antibodies. This challenge is attributed to the high invasion pressure of tsetse (*G. m. morsitans* and *G. pallidipes*) along this part of the Zimbabwe/Mozambique border (Warnes *et al.*, 1999). Since entomological and disease prevalence data indicate that targets are able to cope with this invasion pressure (Warnes *et al.*, 1999), most of the challenge probably occurs when cattle graze close to the tsetse invasion front along the international border.

In the areas to the south and north of Mudzi District, the parasitological prevalence of trypanosomosis and the prevalence of cattle with anti-trypanosomal antibodies was low. These results suggest that a trypanosomosis challenge is almost non-existent and that the control measures in place are effectively restricting tsetse invasion from neighbouring Mozambique. Exceptions are the relatively high prevalence of anti-trypanosomal antibodies in cattle sampled at Katarira and Chiswiti (Mount Darwin District) and at Dande and Mashumbi (Gururve District) and the presence of a trypanosomal infection and anti-trypanosomal antibodies in cattle sampled at Nyaukurongo (Rushinga District). The anti-trypanosomal antibody levels detected in cattle sampled at Katarira and Chiswiti could be due to a residual tsetse focus. In 1996, tsetse flies (*G. m. morsitans*) were captured near Mukumbura (Figure 1) (Davison, 1996). A detailed assessment of the situation is required however. The origin of the trypanosomal infection detected at Nyaukurongo is not clear. It could be attributed to the movement of cattle into tsetse-infested habitat in Mozambique or to re-invasion by tsetse. Again, more detailed investigations are required. Since Mashumbi is located close to the tsetse invasion front (Figure 1), the high prevalence of cattle with anti-trypanosomal antibodies is not surprising. Challenge still occurs at Dande but at a much lower rate than at Mashumbi.

Northern region

Not surprisingly, the prevalence of cattle with trypanosomal infections and anti-trypanosomal antibodies was high in animals sampled north of the target-protected area (Hurungwe District). *T. congolense* and *T. vivax* were the dominant trypanosome species detected. *T. congolense* is the most prevalent trypanosome species in cattle in southern Africa (Van den Bossche *et al.*, 2000). The high proportion of *T. vivax* infections detected in the northern region is, therefore, unusual. Since *T. vivax* has a short developmental cycle in the tsetse fly (Davies, 1977), a higher proportion of *T. vivax* is expected in younger age-groups of tsetse. Hence, *T. vivax* infections are likely to dominate in areas where the proportion of young tsetse flies is high because of high mortality rates. Such high mortality rates certainly occur within or along the target barrier.

Immediately south of the target barrier, only one trypanosomal infection was detected, in an animal sampled at Kadunga (Figure 2). However, the proportion of cattle with anti-trypanosomal antibodies suggests some challenge at all other sampling sites located south of the barrier. This finding can be explained by a challenge to the cattle by tsetse when moving into the barrier. The presence of tsetse south of the barrier cannot, however, be excluded.

Western region

The trypanosomal infections in cattle sampled south of the tsetse-infested Matusadona National Park and along the Sanyati River are consistent with the fact that tsetse are present, at low densities, south of the target barrier surrounding the National Park and along the Sanyati River (TTCB, 1991).

According to our survey results, bovine trypanosomosis was absent from most areas sampled along the southern shoreline of Lake Kariba. However, trypanosomal antibodies were prevalent in cattle sampled at sites surrounding the Chizarira National Park and the Chirisa Safari Area. This suggests that, despite the efforts made to clear these areas of tsetse (Lovemore, 1990), challenge still occurs. Intensive tsetse surveys are required to elucidate the current tsetse situation.

A high proportion of cattle with anti-trypanosomal antibodies was detected along the Zambezi River in the western part of the country. The most likely explanation for this is the southerly advance of the *G. m. centralis* fly-belt in Zambia (Lovemore, 1989). Indeed, bovine trypanosomosis was detected in cattle sampled on the other side of the Zambezi River immediately north of Jabula (RTTCP, 1991). Constant monitoring is necessary in this area.

Monitoring of the effectiveness of tsetse control operations

The effectiveness of tsetse control operations is usually assessed by establishing their impact on the density of the tsetse population. Once tsetse have been cleared, continuous monitoring is required to confirm the absence of the fly should the area be exposed to tsetse invasion. Monitoring can be either direct or indirect. Direct monitoring involves establishing the presence or absence of tsetse. However, interpretation of the results is difficult when no tsetse are caught. The absence of tsetse catches in, for example, traps or along fly-round transects does not necessarily mean the total absence of the fly (Hargrove, 1980). Therefore, indirect indicators of their presence, such as the parasitological prevalence or incidence of bovine trypanosomosis, usually supplements information on the abundance of tsetse. However, interpreting results is again difficult when no trypanosomal infections are detected. Indeed, because of the low sensitivity of the methods of detection (Paris *et al.*, 1982), the apparent absence of trypanosomal infections does not necessarily mean the absence of the disease. The low sensitivity of the tsetse sampling methods and of methods for the parasitological diagnosis of trypanosomosis can be compensated for by surveillance. However, surveillance is time consuming, labour intensive and, therefore, frequently beyond the financial means of tsetse control departments. Moreover, whereas surveillance may be used to declare a specific area tsetse-free, it is practically impossible to continue such intensive surveillance to monitor the vector-free status of the whole tsetse-cleared area, particularly in large-scale tsetse control operations.

There is clearly a need for a simple and inexpensive but sensitive method for quickly assessing the efficacy of control measures. According to the results obtained from the present survey conducted in Zimbabwe, the ELISA for detecting anti-trypanosomal antibodies may be such a method. The antibody ELISA can, however, only be used for monitoring areas where cattle are present and does not indicate where or when a challenge occurred. In some cases it may, therefore, be useful to introduce seronegative sentinel cattle and monitor their serological status.

The results described in this paper have improved the knowledge of the bovine trypanosomosis situation in Zimbabwe. More importantly, the survey results have made it possible for the Tsetse and Trypanosomiasis Control Branch to focus routine surveillance using traditional parasitological diagnostic methods and tsetse capturing tools. This does not imply that the antibody-ELISA should replace surveillance methods. It should rather be considered as an additional tool for monitoring bovine trypanosomosis.

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Résumé – La mouche tsé-tsé a été éliminée de vastes zones du Zimbabwe au cours de 65 dernières années. Dans la plupart des zones, la prévention d'une réinfestation des lieux nettoyés se fait au moyen d'écrans d'appâts odoriférants imprégnés d'insecticides. Une étude sur le trypanosome a été menée en vue de déterminer l'efficacité de ces barrières contre la réinfestation et de confirmer l'absence de la mouche tsé-tsé dans des zones d'où elle avait précédemment été éliminée. A cet effet, on a utilisé des méthodes de diagnostic parasitologique et de détection des anticorps anti-trypanosome par des essais enzymatiques immunoabsorbent (anticorps ELISA). La prévalence de trypanosomiases dans les zones d'où la mouche tsé-tsé avait éliminée était en général faible. Toutefois, la prévalence d'anticorps anti-trypanosome était beaucoup plus élevée dans certaines zones. Cette forte proportion de bétail présentant des anticorps pouvait, dans la plupart des cas, s'expliquer par l'information récente ou historique de la distribution et de la densité des mouches tsé-tsé. Les résultats de cette étude ont démontré la valeur de la détection d'anticorps anti-trypanomose comme outil supplémentaire sensible pour surveiller l'efficacité des opérations de lutte contre la mouche tsé-tsé.

Distribución de la tripanosomiasis bovina en Zimbabwe y evaluación del valor de la detección de anticuerpos antitripanosómicos mediante Elisa como instrumento para supervisar la infectividad de las operaciones de control de la tsetsé

Resumen – La tsetsé ha estado desapareciendo de grandes áreas de Zimbabwe en los últimos 65 años. En la mayoría de las áreas, se les impide que vuelvan a invadir áreas despejadas mediante barreras de blancos con olor de cebo y tratados con insecticidas. Se realizó un estudio de la tripasonomiasis a fin de determinar la eficacia de tales barreras contra la reinvasión y confirmar la ausencia de la tsetsé en áreas de donde había sido previamente erradicada. Se utilizaron métodos de diagnóstico parasitológico y un método inmunoenzimático de determinación de anticuerpos antitripanosómicos (ELISA). La prevalencia de infecciones tripanosómicas en las zonas despejadas de tsetsé fue generalmente baja. Sin embargo, la prevalencia de anticuerpos antitripanosómicos fue inesperadamente alta en ciertas áreas. Esta alta proporción de bovinos con anticuerpos podía explicarse, en la mayoría de los casos, por información reciente o histórica sobre la distribución y densidad de la tsetsé. Los resultados del estudio demostraron el valor de la detección de anticuerpos antitripanosómicos como instrumento sensible adicional para observar la eficacia de las operaciones de control de la tsetsé.