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An epidemiological investigation of the African horsesickness outbreak in the Western Cape Province of South Africa in 2004 and its relevance to the current equine export protocol

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ABSTRACT

African Horsesickness (AHS) is a controlled disease in South Africa. The country is divided into an infected area and a control area. An outbreak of AHS in the control area can result in a ban of exports for at least 2 years. A retrospective epidemiological study was carried out on data collected during the 2004 AHS outbreak in the surveillance zone of the AHS control area in the Western Cape Province. The objective of this study was to describe the 2004 outbreak and compare it with the 1999 AHS outbreak in the same area. As part of the investigation, a questionnaire survey was conducted in the 30 km radius surrounding the index case. Spatial, temporal and population patterns for the outbreak are described. The investigation found that the outbreak occurred before any significant rainfall and that the main AHS vector (*Culicoides imicola*) was present in abundance during the outbreak. Furthermore, 63 % of cases occurred at temperatures ≤15 °C, the Eerste River Valley was a high risk area, only 17 % of owners used vector protection as a control measure and 70 % of horses in the outbreak area were protected by means of vaccination at the start of the outbreak. The study revealed that the current AHS control measures do not function optimally because of the high percentage of vaccinated horses in the surveillance zone, which results in insufficient sentinel animals and the consequent failure of the early warning system. Alternative options for control that allow continued export are discussed in the paper.

Key words: African horsesickness, *Culicoides*, compartmentalisation, horse exports, outbreak, surveillance zone.

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INTRODUCTION

African horsesickness (AHS) is a controlled disease in South Africa. For the purpose of control, the country is divided into 2 areas, an infected and a control area. The latter is situated in the Western Cape Province and is further divided into 3 zones, the protection, surveillance and free zone.

In order to retain South Africa's export status, strict movement control is implemented between these zones. Movement of horses into and within the control area requires, amongst others, that horses moving from the infected to the control area or from the protection zone to the surveillance or free zones have to been fully vaccinated against AHS within the past 12 months and at least 60 days prior to the movement. Annual vaccination for AHS is compulsory for all horses in the protection zone to create a barrier, while the surveillance zone is meant to act as an early warning or sentinel system for the free zone and horses in this area may only be vaccinated against AHS with written permission from the Boland State Veterinary Office. An outbreak in these areas can result in a ban on exports for at least 2 years.

From 2001 until 2003 a total of 487 horses (149 Thoroughbreds, 111 Arabians and 52 other) were exported from the free zone to different countries (including the United Arab Emirates, European Union, Singapore, Malaysia, Mauritius, Hong Kong and Bahrain)[2]. The exact income from these exports is unknown but is estimated to be at least R60 million annually (P Gibson, Racing South Africa, pers. comm., 2006).

Recent outbreaks of AHS have only been recorded in 1967 and in 1990 in the Cape Peninsula prior to the classification of AHS as a controlled disease in 1994[1,3]. Neither of these 2 outbreaks was completely documented. The 1st recorded outbreak in the surveillance zone after 1994 was the 1999 outbreak, during which 32 horses died from 21 March to 17 May 1999. In addition, a total of 20 suspect cases were reported outside the surveillance zone in the Beaufort West State Veterinary Area in 1996, 2000 and 2002. This area is part of the infected zone (together with the rest of the country) and outbreaks here do not influence the export of horses.

No information on previous outbreaks in the control area of the Western Cape Province has been published in the scientific literature, hence the 2004 outbreak provided an ideal opportunity to record the epidemiology of AHS and investigate the risk factors pertaining to the Western Cape epidemic[8].

MATERIALS AND METHODS

A retrospective study was carried out using data accumulated during the 2004 AHS outbreak with the object of describing this outbreak and comparing it with available information on the 1999 outbreak. The data were examined using a disease outbreak investigation approach as described by Thrusfield[9].

For the purpose of this study, a case was defined as a horse showing typical symptoms of AHS and from which virus could be isolated. Spleen and lung tissue as well as lymph nodes were sent to the Onderstepoort Veterinary Institute for virus isolation and typing. These 2 procedures were carried out according to specifications described in the 5th edition of the World Animal Health Organisation's (OIE) *Manual of diagnostic tests and vaccines for terrestrial animals*[7].

During the 2004 outbreak, a questionnaire survey was conducted in the 30 km radius surrounding the index case. This radius was decided upon based on the previous AHS outbreak in the surveillance zone in 1999, which spread 17 km from

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Table 1: **Host factors and date of death of horses that died of AHS in the Stellenbosch area of the Western Cape Province of South Africa in 2004.**

Case no.	Age	Breed	Sex*	Vaccination history	Date of death
1	1.5 y	Percheron	F	Unvaccinated	31 Jan 2004
2	3.5 y	Percheron	F	Unvaccinated	21 Feb 2004
3	2.5 y	Percheron	F	Unvaccinated	22 Feb 2004
4	2.5 y	Percheron	F	Unvaccinated	22 Feb 2004
5	4.5 y	Percheron	F	Unvaccinated	24 Feb 2004
6	24 y	Pony	M	Unvaccinated	24 Feb 2004
7	8 m	SA Saddler	M	Unvaccinated	26 Feb 2004
8	26 y	Pony crossbred	M	Unvaccinated	28 Feb 2004
9	14 y	Thoroughbred	F	Vaccinated	9 Mar 2004
10	5 y	Apaloosa-cross	F	Unvaccinated	13 Mar 2004
11	4 y	SA Saddler	M	Unvaccinated	17 Mar 2004
12	8 m	SA Saddler	F	Unvaccinated	17 Mar 2004
13	8 y	Thoroughbred	F	Vaccinated	18 Mar 2004
14	4 y	Boerperd	M	Unvaccinated	22 Mar 2004
15	6 m	Thoroughbred	M	Unvaccinated	24 Mar 2004
16	12 y	Thoroughbred	M	Unvaccinated	28 Mar 2004

*F = female; M = male.

the index case by natural means (i.e. not involving horse movement) (P Koen, Deputy Director Animal Health: Western Cape Province, pers. comm., 2004).

The aim of the questionnaire was to ascertain the following:

- to obtain an accurate, up to date equine census;
- to determine the vaccination status (and thus degree of protection) of horses in the region;
- to document clinical evidence of disease or unexplained deaths of horses;
- to obtain information on suspicious recent movement of horses.

All equine deaths in this 30 km radius were recorded and where possible post mortem examinations were performed at the Provincial Veterinary Laboratory in Stellenbosch.

The temporal pattern was determined by recording the number of cases per day for the duration of the outbreak from 31 January to 28 March 2004. Corresponding information for the 1999 outbreak was obtained from filed situation reports. Climate and geographical data for the relevant areas and time periods during both the outbreaks was obtained from the Agricultural Research Council at Nietvoorbij in Stellenbosch in order to describe the spatial pattern. The population pattern for the 2004 outbreak was determined by recording the host factors (age, breed, sex), history and relevant clinical data for the 16 horses that died of AHS[8].

The data were recorded and analysed in a spreadsheet (Excel, Microsoft Office 2000). ArcView 8.3 was used for GIS manipulation of the data.

RESULTS

Sixteen horses died in a 10-week period from 31 January 2004 to 28 March 2004. Virus was isolated from all these cases and AHS virus serotype 1 was identified as the sole cause of the outbreak.

Epidemiological findings

Table 1 shows the host factors of the horses that died of AHS during the 2004 outbreak.

Figs 1 and 2 illustrate the cumulative case series during the 2004 and 1999 outbreaks, respectively.

Figs 3 and 4 summarise the climatic variables (average weekly maximum and minimum temperature and the total weekly rainfall) of the affected geographical region in conjunction with the number of cases that occurred during the 2004 and 1999 outbreak periods, respectively. No data were available for the week 25–31 March 2004 due to malfunction of the weather station.

Most of the affected properties during the 2004 outbreak were situated in the Eerste River Valley in the Stellenbosch district with the exception of 1 case that was diagnosed in the Malmesbury and 1 in the Durbanville district. A similar situation prevailed during the 1999 outbreak where the infection was initially detected in and subsequently spread along the Eerste River Valley[8]. All of these areas are classified as part of the surveillance zone for AHS. Figs 5 and 6 illustrate the geographical distribution of the cases during the 2004 and 1999 outbreaks, in relation to the free and surveillance zones.

Questionnaire survey

Table 2 shows the information obtained through the questionnaires.

DISCUSSION

The outbreak during 1999, with a mortality of 32 horses and an enforced 2-year ban on exports by the European Union, resulted in a substantial loss in foreign income for the racing industry in South Africa and breeding animals for local

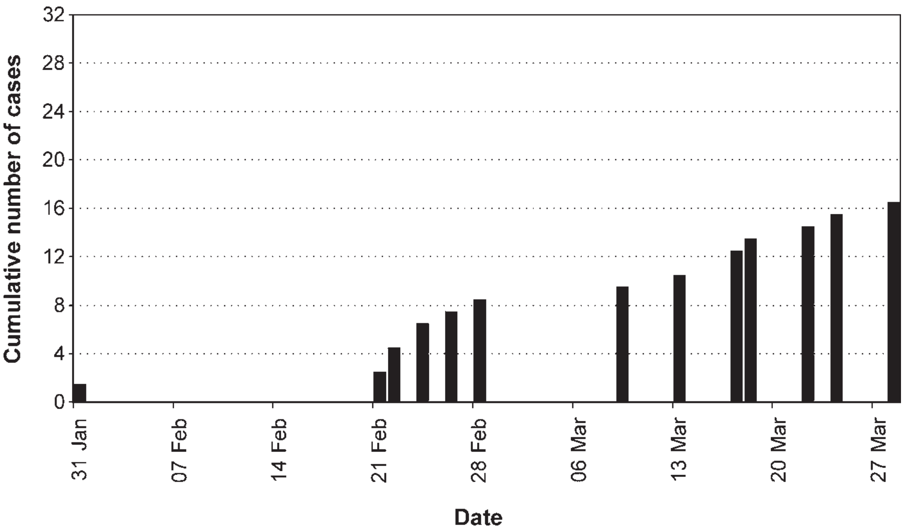

Fig. 1: **Cumulative case series of AHS during the 2004 outbreak in the Western Cape Province**.

owners. The 2004 outbreak resulted in several race meetings and numerous large shows being cancelled as all horse movement ceased completely and consequently 5000 casual workers were out of work. In addition, exports were placed under embargo and the whole export industry came to an immediate standstill, which represented a loss estimated to be at least 30 million rand in foreign exchange during the 24 months following the outbreak (P Gibson, Racing South Africa, pers. comm., 2006).

The disease pattern for both the 2004 and 1999 outbreaks can be classified as sporadic epidemics. This type of epidemic pattern is to be expected in a vector borne disease and it is typical of a disease situation where some of the animals are immune. The high prevalence of vaccinated (immune) horses was confirmed in the results of the questionnaire survey for the 2004 outbreak. Although there is no specific information available on the immune status of the horses prior to the 1999 outbreak, it would be expected that a significant number of animals would also have been vaccinated in order to be able to compete in equestrian events in compliance with the AHS movement control protocol instituted in 1997. In addition, during the 1999 outbreak, all the horses within approximately 30 km radius of the infected cases were vaccinated to limit the number of deaths. The higher number of cases and the initial steep increase in the cumulative case series (Fig. 2) during the 1999 outbreak suggests, however, that fewer animals were immune prior to the 1999 outbreak compared with the 2004 outbreak. It can also be assumed that the severity of the 1999 outbreak left the owners concerned for the welfare of their horses and some continued to vaccinate their horses regularly.

The immediate disease control actions taken during the 2004 outbreak, especially the rapid vaccination campaign, the recommendation to use insecticides and to stable horses where possible, along with the strict movement controls, ensured that only 16 horses died in the Stellenbosch district where the main focus of the disease was situated. Two other isolated deaths occurred outside this area but were linked to the primary outbreak as they were all confirmed as the same serotype of the AHS virus (serotype 1) and occurred along the prevailing wind direction. The number of deaths is low when compared with Gauteng, where 75 deaths were recorded between February and March 2004.

The main vector of the AHS virus (*Culicoides imicola*) was present in abundance during the 2004 outbreak[10]. These

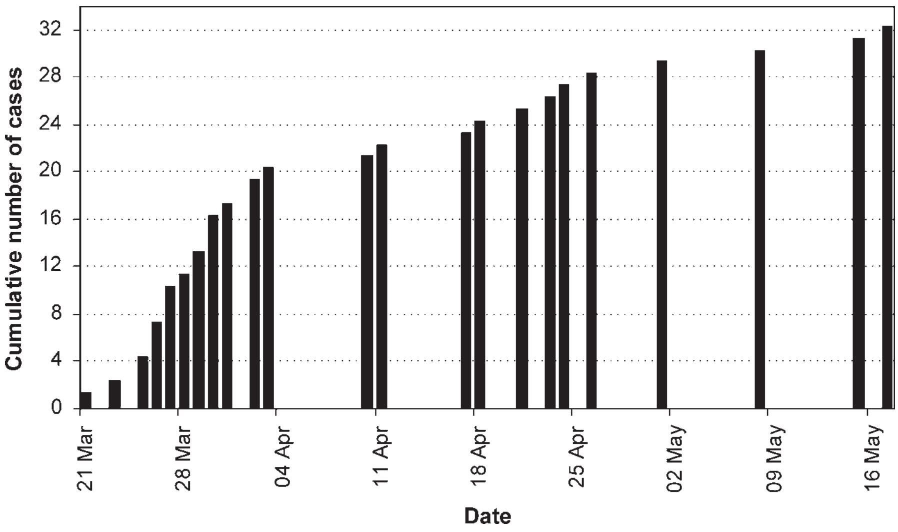

Fig. 2: **Cumulative case series of AHS during the 1999 outbreak in the Western Cape Province.**

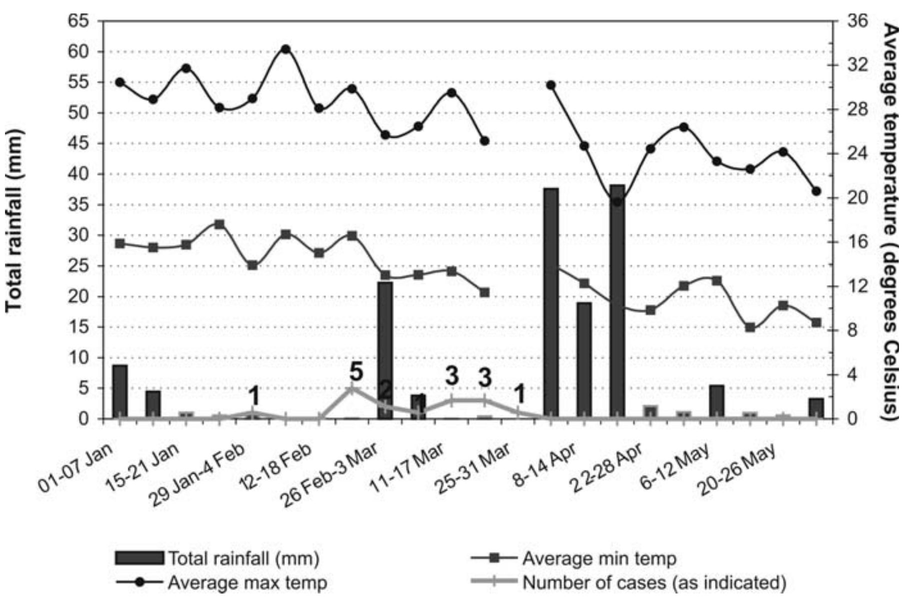

Fig. 3: **Average temperatures, total rainfall and case distribution during the 2004 AHS outbreak in the Western Cape Province.**

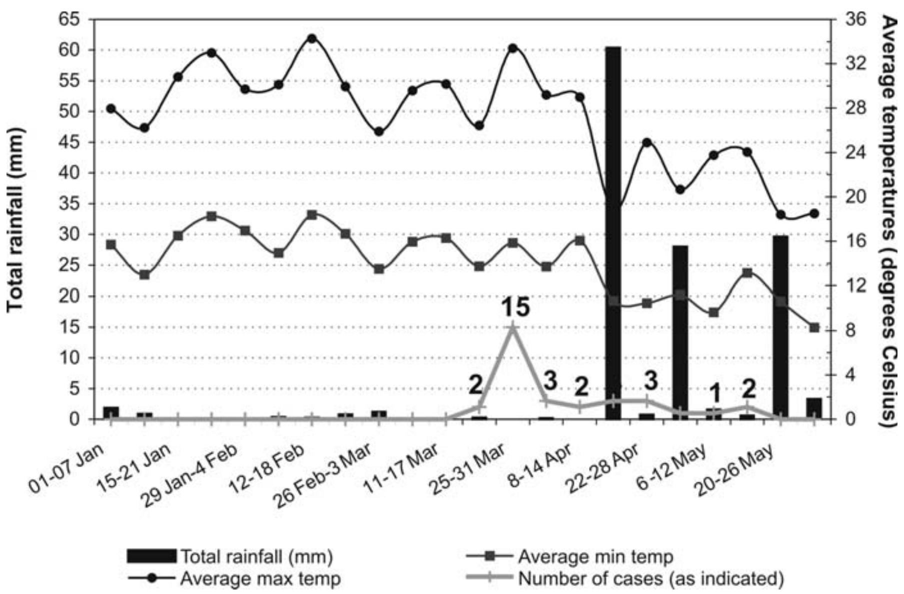

Fig. 4: **Average temperatures, total rainfall and case distribution during the 1999 AHS outbreak in the Western Cape Province.**

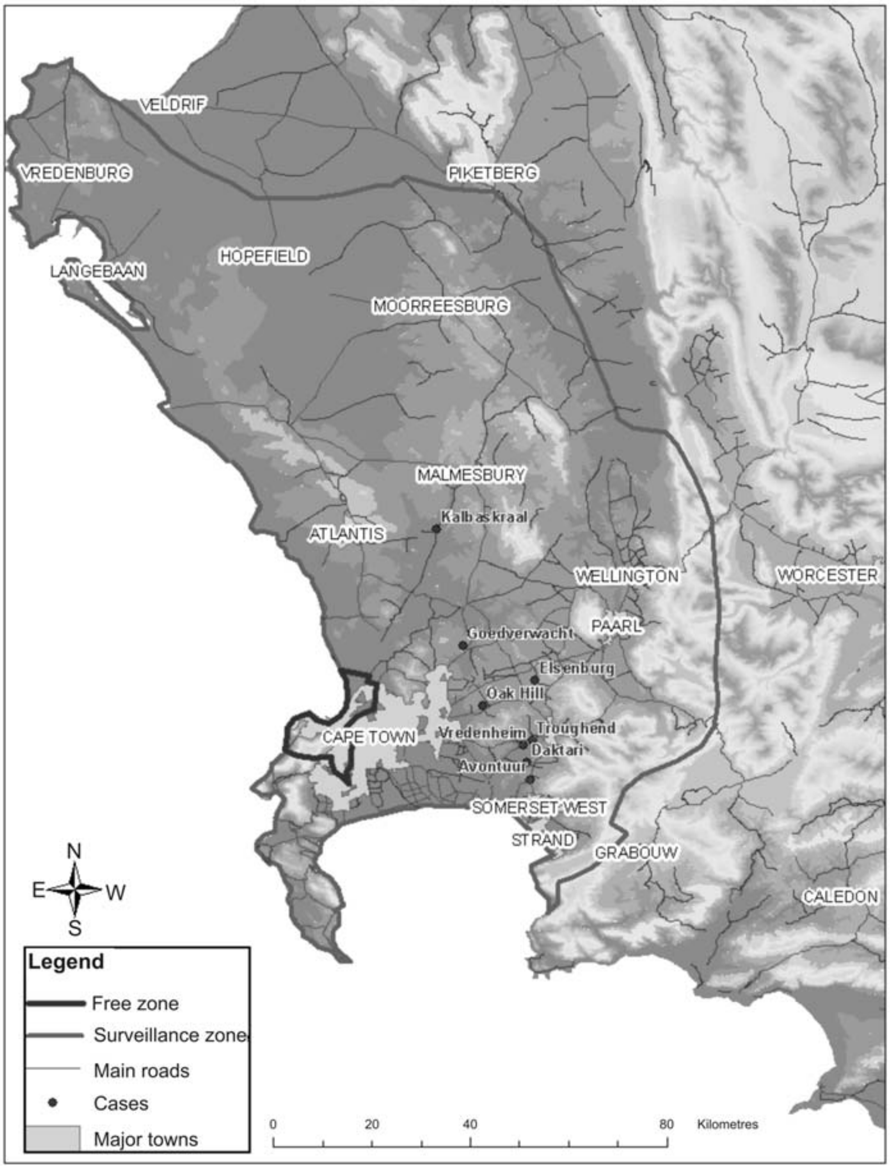

Fig. 5: **Geographical distribution of AHS cases in relation to the free and surveillance zones during the 2004 AHS outbreak in the Western Cape Province.**

midges constituted 95 % of the midge population in 2004, while *C. imicola* constituted only 20 % of the midge population in 1986[6]. In 1996, during a study to determine the abundance of *Culicoides* species, *C. imicola* constituted only 11 % of the population in the Stellenbosch area[11]. The dramatic increase in the *C. imicola* population from 1996 to 1999 when *C. imicola* constituted 96 % of the population, and the persistence of the high numbers during 2004, may explain the occurrence of the 2 AHS outbreaks in the Western Cape Province during the past 5 years[10]. Although all the midge traps were placed in the surveillance zone, it is reasonable to assume that a similar situation will prevail in the free zone, since the location of the free zone was in fact based on a historical absence of the disease and not the vectors[4].

Table 2: **Results of questionnaire census of properties within a 30 km radius of the index case during the 2004 AHS outbreak in the Western Cape Province.**

Total number of properties visited	1616
Total number of properties with horses	603
Total number of equines	4484
Total number of horses (included in total number of equines)	4289
Total number of zebra (included in total number of equines)	44
Total number of donkeys or mules (included in total number of equines)	151
Total number of horses vaccinated within 12 months before the outbreak	2987
Total number of horses with AHS-related clinical symptoms during the preceding 2 months	16
Number of properties on which management practices to repel midges are used	75
Number of horses on properties with midge control	728

In both 2004 and 1999, the outbreaks occurred before any significant rainfall was recorded, proving that even during the dry season in the Stellenbosch area, there are sufficient numbers of *Culicoides* midges present to transmit disease. During the 2004 outbreak 63 % of the cases occurred when the recorded average minimum temperatures were below 15 °C. Previously, transmission had not been recorded at temperatures ≤15 °C, although it is known that virogenesis may still be possible at this low temperature[5]. This is of great concern since the results of the questionnaire survey indicate that on only 12 % of properties (75/603) with equines, some kind of method is used to prevent vector contact with the animals (including stabling). Hence only 17 % (728/4289) of horses in the investigated area were protected from vector contact during the initial stages of the outbreak. It is therefore recommended that an effort should be made to raise public awareness regarding the importance of vector control in the prevention of AHS infection.

On the other hand, 70 % of horses in this area of the surveillance zone were protected by means of vaccination at the start of the outbreak. Considering this high percentage of horses vaccinated, the ratio between the different methods of preventative control, vaccination *versus* stabling/vector control is 4:1. For the purpose of a surveillance zone, it would rather be expected that this ratio would be reversed, with significantly more animals being protected by means of vector control rather than vaccination. The resultant absence of sufficient numbers of sentinels inhibits the objective of the surveillance zone to serve as early warning system.

During the 1999 outbreak the disease could be detected fairly quickly since the horses in the vicinity of the index case were susceptible to disease. The surveillance zone thus fulfilled its function well. However, during the 2004 outbreak the index case could not be pinpointed and this impeded the ability to determine the source of infection. The disease only became apparent when it reached the fully susceptible horses at Elsenburg, which is an experimental farm of the Department of Agriculture in Stellenbosch where an unvaccinated Percheron herd is maintained. This is an indication that the surveillance zone is not as functional as it was 5 years earlier. An AHS virus, serotype 7, was isolated from a midge during the 2004 outbreak[10]. Genetic characterisation revealed that this virus was not a remnant of the 1999 outbreak but a new

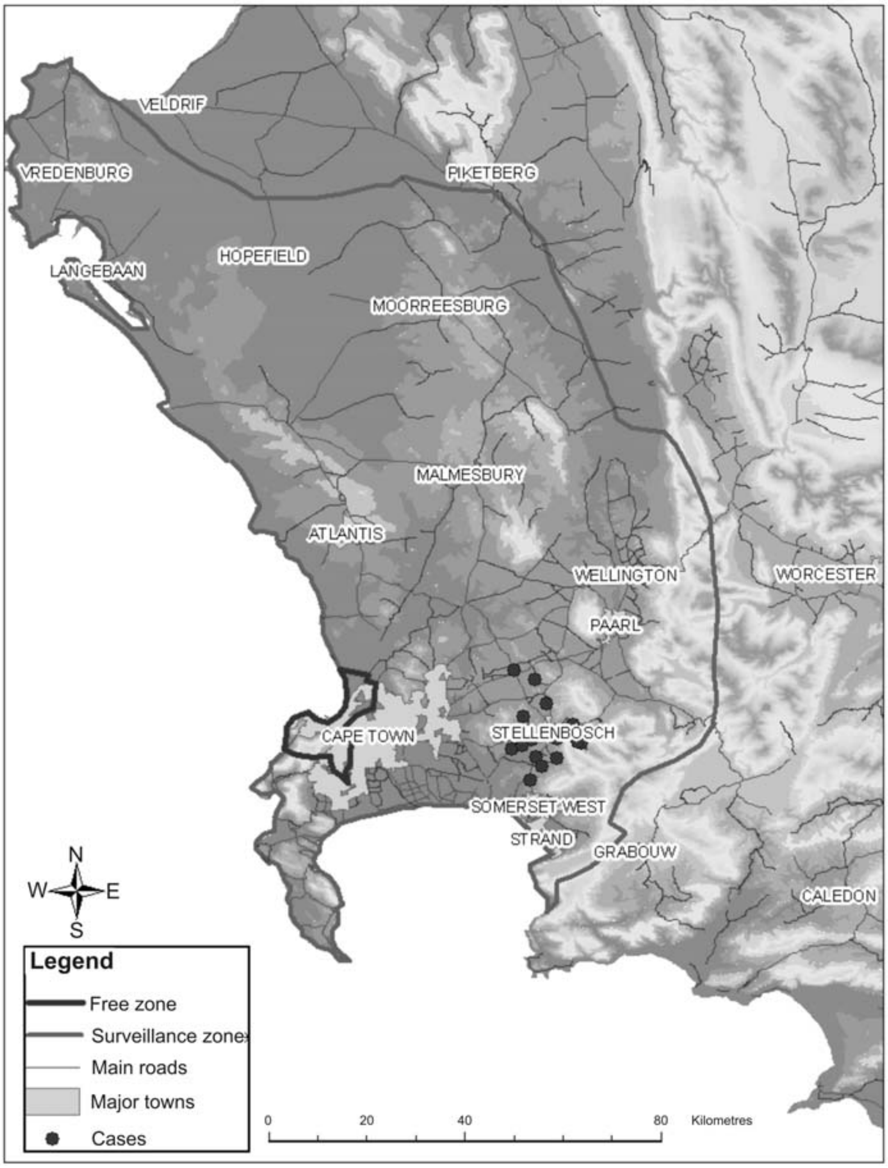

Fig. 6: **Geographical distribution of AHS cases in relation to the free and surveillance zones during the 1999 AHS outbreak in Western Cape Province.**

introduction from the endemic area of the country where serotype 7 was circulating during the same season in 2004. Therefore, 2 incursions of AHS must have taken place during 2004 even though only 1 outbreak was detected, casting even further doubt on the effectiveness of the surveillance zone[10]. The strict movement controls under the current AHS protocol results in a high percentage of vaccinated horses. This was compounded in 2004 by the vaccination of horses in the 30 km radius surrounding the epicenter as well as in the 10 km radius surrounding the Kalbaskraal focus. At the end of this operation, an estimated 94 % of horses in the mentioned areas had been vaccinated, thus further impairing the main function of the surveillance zone.

In order to improve this undesirable effect it is proposed that the AHS control policy needs to be reviewed. An option would be to decrease the size of the surveillance zone in order to enable Veterinary Services to improve disease surveillance and control in this zone. Since both the 2004 and 1999 outbreaks were primarily focussed in the Eerste River Valley, this valley should be considered a high-risk area in the surveillance zone and should be targeted during routine surveillance. Accompanying the decreased size of the surveillance zone, should be less strict controls of movement between the protection and surveillance zone, which are both areas of low risk, allowing movement without vaccination, but under permit issued by the local State Veterinarian for traceability purposes. Presently horse owners have to vaccinate their horses in order to move between the protection and surveillance zone. Since most equestrian events in the area are held in these 2 zones, a high percentage of horses in the surveillance zone are vaccinated in order to be able to compete.

By relaxing these measures, fewer horses in the surveillance zone will have to be vaccinated and the resulting presence of more sentinels will increase Veterinary Services' ability for early detection of disease. The relaxing of movement controls in these 2 zones will not constitute a higher risk, since the measures for movement of horses from the infected zone to the combined control area will remain as it is. The suggested measures of decreasing the surveillance zone and relaxing movement controls in the low risk areas, while increasing surveillance, will thus result in a decreased risk to export since an outbreak will be detected early and will be less likely to threaten the integrity of the free zone or compartment. In addition, the financial burden on local competitors in equestrian events will decrease significantly and these events will once again gain popularity.

The movement restrictions on horses in the AHS control zone affects all interest groups involved in the horse industry. An alternative option therefore needs to be investigated to facilitate exports while at the same time not inhibiting the needs of other non-export interest groups in the equestrian society. Any alternative option may, however, require a change in the international standards for the trade in horses recommended by the World Organisation for Animal Health and will therefore have to be negotiated with both the OIE and the European Commission.

Both compartmentalisation (where a compartment is defined as a vector-proof and bio-secure unit) and seasonal exports (where exports will only be allowed during the winter months) are alternatives to the current export protocol. From the results of this study, it appears that compartmentalisation is the better option, since the analysis of the climate data suggested that midge activity might still be sufficient to transmit disease during winter. It will thus be very difficult to determine specific time-intervals when export can be deemed safe, although, it should be kept in mind that seasonal freedom is already an approved concept in the European Union and from a political point of view it will be easier to negotiate this concept rather than compartmentalisation. The existing vector-proof export quarantine station at Kenilworth offers excellent bio-security and will be an ideal compartment for export purposes.

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REFERENCES

1. Bosman P, Brückner G K, Faul A 1995 African horse sickness surveillance systems and regionalisation/zoning: the case of South Africa. *Revue Scientific et Technique de l'Office International des Epizooties* 14: 645–653
2. Dunn J 2003 Minutes of a meeting of the South African Horse Import and Export Council, held at The Jockey Club, Turffontein Racecourse, Turffontein, Jahannesburg, 14 October.
3. Du Plessis D H, Van Wyngaardt W, Gerdes G H, Opperman E 1991 Laboratory confirmation of African horsesickness in the Western Cape: Application of a F(ab)2-based indirect ELISA. *Onderstepoort Journal of Veterinary Research* 58: 1–3
4. Lord C C, Venter G J, Mellor P S, Paweska J T, Woolhouse M E J 2002 Transmission patterns of African horse sickness and equine encephalosis viruses in South African donkeys. *Epidemiology and Infection* 128: 265–275
5. Mellor P S, Rawlings P, Baylis M, Welby M D 1998 Effect of temperature on African horse sickness virus infection in *Culicoides*. *Archives of Virology* 14: 155–163
6. Neville E M, Venter G J, Edwardes M, Pajor I T P, Meiswinkel R, Van Gas J H 1998 *Culicoides* species associated with livestock in the Stellenbosch area of the Western Cape Province, Republic of South Africa (Diptera: Ceratopogonidae). *Onderstepoort Journal of Veterinary Research* 55: 101–106
7. OIE 2005 Manual of diagnostic tests and vaccines for terrestrial animals online, 4th edn. Online: http://www.oie.int/eng/normes/mmanual/ A_00034.htm Accessed June 6, 2005
8. Sinclair M 2006 The epidemiology of an African horse sickness outbreak in the Western Cape Province of South Africa in 2004. MSc thesis, University of Pretoria
9. Thrusfield M 2005 Describing disease occurrence. In Thrusfield M (ed.) *Veterinary epidemiology* (3rd edn). Blackwell Science, Oxford: 46–74
10. Venter G J, Koekemoer J J O, Paweska J T 2006 Investigation on outbreaks of African horse sickness in the surveillance zone of South Africa. *Revue Scientific et Technique de l'Office International des Épizooties* 25(3). (In press)
11. Venter G J, Neville E M, van der Linde T C 1997 Seasonal abundance and parity of stock-associated *Culicoides* species (Diptera: Ceratopogonidae) in different climatic regions in southern Africa in relation to their viral vector potential. *Onderstepoort Journal of Veterinary Research* 64: 259–271