A historical perspective on the prevalence, distribution and influence of African Horse Sickness in Namibia

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Like the shifting Namib Desert sands, the historical record reveals and conceals the history of horses in southern Africa[1]

Abstract

African Horse Sickness (AHS) is a devastating, non-contagious, infectious, insect-borne disease of equids. AHS is endemic to sub-Saharan Africa. *Culicoides* midges (*Diptera: Ceratopogonidae*) act as vectors for the transmission of the causative agent, African Horse Sickness virus (AHSV). It is considered to be one of the most lethal horse diseases with mortality rates exceeding 80% in susceptible hosts. The AHS season is one of the most critical times for any horse owner in southern Africa. This dreadful disease has caused losses of great economic and emotional value for as long as horses have been on the African continent. The objective of this article is to assess the historical prevalence, distribution and influence of AHS in Namibia over the past approximately 200 years by discussing historical events that influenced the distribution of this disease. It was found that several major historical events played a role, since the introduction of horses to southern Africa with AHS influenced the outcomes of some of these events. The most important observations made during this investigation were the underreporting of AHS in Namibia, as well as the distribution across the districts. The importance of the effects of AHS on historical events is highlighted, with the limited movement of horses during the AHS seasons being an imperative historical precaution.

Keywords: African Horse Sickness (AHS); *Culicoides*; Namibia; Historical perspective; Socio-economic, military and environmental consequences.

1 SS Swart, *Riding high: Horses, humans and history in South Africa* (Johannesburg, Wits University Press, 2010), p. 1.

Introduction

African Horse Sickness (AHS) is a devastating, non-contagious, infectious, insect borne disease of equids caused by the African Horse Sickness virus (AHSV).[2] AHSV is usually transmitted by adult female *Culicoides* midges (Diptera: Ceratopogonidae) with *Culicoides imicola* and *Culicoides bolitinos* as identified vectors.[3] The disease has a seasonal occurrence influenced by environmental conditions that favour the breeding of *Culicoides* midges. AHS is endemic to sub-Saharan Africa with outbreaks particularly frequent and severe in South Africa[4] and Namibia.[5] It is considered to be one of the most lethal horse diseases with mortality rates exceeding 80% in susceptible hosts[6] and has accordingly been declared notifiable by the World Organisation for Animal Health. Despite early records of an outbreak of the disease in Yemen as far back as 1327, the virus appears to have originated in Africa and was first recognised as a distinct disease during the exploration of Africa. The first account of AHS in southern Africa was during the occupation of the Cape of Good Hope by the Dutch East India Company at the beginning of the 18th century.[7]

Horses are not native to Africa and were first introduced into southern Africa by Jan van Riebeeck and the Dutch settlers in 1652. Horses could not be introduced overland from northern Africa due to the physical barrier of the Sahara desert. The presence of AHS and trypanosomiasis presented a pathogenic hindrance.[8] Van Riebeeck requested horses from the Dutch East India Company on several occasions, believing that horses would prove invaluable for transportation. Their draught power would transform the physical environment and allow for the exploration of the hinterland.[9] Van Riebeeck considered horses to be his greatest and principal need and argued that horses would accelerate the settling process, making settlers independent from the local tribes. His request

2 JAW Coetzer & AJ Guthrie, "African Horse Sickness", JAW Coetzer & RC Tustin (eds.), *Infectious diseases of livestock*, 2 (Cape Town, Oxford University Press, 2004), pp. 1231-1246.

3 R Meiswinkel & M Baylis, "Morphological confirmation of the separate species status of *Culicoides* (*Avaritia*) *nudipalpis Delfinado*, 1961 and C. (A.) *imicola Kieffer*, 1913 (*Diptera: Ceratopogonidae*)", *Onderstepoort Journal of Veterinary Research,* 65(1), 1998, pp. 9-16.

4 M Baylis, R Meiswinkel & GJ Venter, "A preliminary attempt to use climate data and satellite imagery to models the abundance and distribution of *Culicoides imicola (Diptera: Ceratopogonidae)* in southern Africa", *Journal of the South African Veterinary Association*, 70(2), 1999, pp. 80-89.

5 HP Schneider, *Animal health and veterinary medicine in Namibia* (Windhoek, Agrivet, 1994), pp. 1-272.

6 PS Mellor & MP Wellby, "Effect of temperature on African Horse Sickness virus infection of and transmission by vector species of *Culicoides (Diptera: Ceratopogonidae)*. Equine Infectious Diseases VIII" (Paper, Proceedings of the Eighth International Conference, Dubai, March 1998), n.p.

7 PS Mellor, "African Horse Sickness: Transmission and epidemiology", *Veterinary Research,* 24(2), 1993, pp. 199-212.

8 R Law, "Horses, firearms, and political power in pre-colonial West Africa", *Past and Present,* (1)72, 1976, pp. 112-132; SS Swart, *Riding high...,* p. 18.

9 SS Swart, *Riding high...,* p. 21.

was granted, and by July 1655 Van Riebeeck had six Javanese ponies – the first horses to set their hooves on South African soil.[10] Despite several setbacks and the harsh environmental conditions, the horse stock increased and played an integral role in the transformation and colonisation of the African continent. Horses endowed their owners with enhanced military capabilities, hunting aptitude and transport capacity. They not only represented the grasping of power but also the performance of that power in key rituals of society.[11] Progress was ultimately carried on the horse's back.

Horses, being foreign to southern Africa, were faced with a multitude of diseases that showed the region to be one of the worst environments in the world for equids. It proved that an equine settlement was more difficult to establish than a human settlement.[12] Two of the most menacing livestock diseases that settlers and travellers had to face were African animal trypanosomiasis and AHS. According to Moulé (1896), quoted by Theiler, the first historical reference to a disease which can be regarded as AHS, was found in an Arabian document: "Le Kitâb El-Akouâ Wa El Chafiâh".[13] Another very early reference to the disease in Africa was made by Father Monclaro in his account of a journey to East Africa in 1569.[14] One of the first incidences of AHS was reported in the Cape Colony in 1719 when 1 700 horses died, more than 60% of the horse population.[15] The disease was soon found to be endemic to southern Africa and had a profound influence on the development of Africa.[16] Particularly severe outbreaks were recorded during the years 1780, 1801, 1839, 1845, 1862 and 1891. The outbreak of 1854-1855 was considered the most virulent. Mortalities amounted to nearly 70 000, comprising more than 40% of the horse population in the Cape at that time. AHS mortality had such a devastating effect that most travellers mentioned it in their notes and diaries. James Backhouse, a Quaker evangelist, wrote in 1838:[17]

> One of our horses exhibited symptoms of a fatal disease called in this Colony 'The Sickness'. His eyelids were swollen and the blood-vessels of his mouth and tongue were in a state of congestion. He appeared to be in perfect health

10 C Grobbelaar, *The Arabian horse and its influence in South Africa* (Cape Town, Protea Book House, 2007), p. 17.
11 SS Swart, *Riding high...,* p. 19.
12 SS Swart, *Riding high...,* p. 22.
13 L Moulé, *Histoire de la Médicine Vétérinaire* (Quoted by Theiler, 1896), p. 38.
14 MW Henning, *Animal diseases in South Africa: Being an account of the infectious diseases of domestic animals*, 3 (Pretoria, Onderstepoort Central News Agency, 1956), pp. 785-808.
15 HP Schneider, *Animal health and veterinary medicine ...,* n.p.; C Grobbelaar, *The Arabian horse ...,* p. 19.
16 MW Henning, *Animal diseases in South Africa* ..., pp. 785-808.
17 T Gutsche, *There was a man: The life and times of Sir Arnold Theiler, KCMG of Onderstepoort* (Cape Town, H Timmins, 1979), n.p.

> last night when tied to the wagon wheel to secure him from Hyenas which are numerous here. This disease usually comes on suddenly and runs its course quickly ... He was bled without delay and dosed with Calomel and Tartarised Antimony ... He soon rose again and began to eat but quickly lay down and then struggled and died. His death took place about an hour after the symptoms of "The Sickness" were first noticed. Before night his carcass was nearly consumed by vultures and by the dogs of the Hottentots. Thus quickly a horse is finished in Africa.

In the reports of AHS to the Horse Guard War Office in England, the devastating effect of AHS was described in the narrative by Dr Scherzer:[18]

> During our residence in the Cape Colony (1857), severe depression existed among the agricultural inhabitants of the western and eastern districts, in consequence of an epidemic which, within two years, had carried off 64,850 horses of the value of 525,000 sterling. Many landowners, in consequence, entirely gave up rearing horses and turned their attention almost exclusively to the breeding of sheep.

The objective of this article is to assess the prevalence, distribution and influence of AHS in Namibia over the past approximate 200 years until 2011 and to discuss historical events that influenced the distribution of AHS in Namibia (The most relevant historical events from the first arrival of horses in southern Africa up to the 2011 and their influence on the distribution of AHS in Namibia are portrayed in a time line in the addendum of this article).

Research methodology

Although the research methodology of this study is encapsulated within the quantitative paradigm, the scope of this article further necessitated the use of a qualitative lens in order to contextualise historically the socio-economic and military influences of AHS in Namibia. A comprehensive literature review of primary and secondary sources on AHS was conducted first for the pre-colonial (1800-1883) and German colonial period (1884-1914). Namibia had several names in history; however, for the purpose of this article we will only use the name "Namibia" as a reference to the country, regardless of the political rule.

Primary historical data on AHS were gathered from the National Archives of Namibia (NAN) in Windhoek, as well as annual reports of AHS incidence

18 JA Nunn, "Interim report on investigations into the nature and prevention of the South African Horse Sickness", *The Veterinary Journal,* 26, 1888, pp. 38-49.

from the Directorate of Veterinary Services during the period of South African rule (1915-1987) and after independence (1990-2011). Data for the periods 1916-1934 and 1990-2011 were extracted from the annual published veterinary reports. Average annual AHS cases were calculated for each district of Namibia. District divisions of the state veterinary boundaries were used for the analysis. Historical AHS outbreak occurrence data as reported in the annual reports were analysed to determine differences in horse mortality due to AHS between districts, using Chi-Square contingency analysis. The problem with converting data to percentages or only averaging the data was that the sample size is ignored, which therefore distorted the results.[19] Chi-square contingency analysis allows the determination of an expected value of AHS outbreak occurrence relative to the national AHS incidence. Cramer's V test was also performed to support the Chi-Square results by adjusting the significance to factor out sample size. Horse census data as published in the annual agricultural and veterinary reports were used for the analyses. The 1929 census was used as an indication of horse numbers in the 1916-1934 period and the 2000 census for the 1990-2011 period. The number of horses per district is an indication of the introduction of horses to Namibia, and the growth in horse numbers per district in the two periods.

A dependent t-test and Wilcoxon matched-pair test were performed to determine statistically significant differences between the two periods (1916 - 1934 and 1990 - 2011) when AHS outbreaks occurred. Results are illustrated in GIS-based maps using ArcGIS 10.[20]

Very high resolution interpolated monthly precipitation data at a 1 km spatial resolution for a 50-year period (1950-2000)[21] were used as historical descriptive data to support the distribution of AHS outbreak occurrence in Namibia. Data from 1935-1987 were descriptive and therefore tagged as missing for the quantitative analysis. An excerpt of the descriptive data of the annual veterinary reports from 1971-1987 is presented in Image 5.

19 J Fowler & L Cohen, *Statistics for Ornithologists*, 2 (Tring, British Trust for Ornithology, 1996), pp. 68-74.

20 ESRI, ArcGIS Desktop: Releasev10. Redlands, CA: Environmental Systems Research Institute, 2011.

21 RJ Hijmans, SE Cameron, JL Parra, PG Jones & A Jarvis, "Very high resolution interpolated climate surfaces for global land areas", *International Journal of Climatology,* 25(15), 2005, pp. 1965-1978.

Pre-colonial (1800-1883) and colonial German rule (1884-1914)

The influx of the first horses into Namibia and the influence of AHS

The first inland expedition from the Cape to cross the Orange River into southern Namibia appears in the records of the hunting expedition of Jacobus Coetse Jansz in 1760. In his journals he describes how he was able to chase down and kill a giraffe with the use of his horse.[22] European hunters, traders, missionaries and scientists penetrated the interior of Namibia in increasing numbers at the beginning of the 19th century. With horses, greater freedom of movement was achieved and therefore greater trade networks could be established. Subsequent trading centres and the founding of mission stations resulted in more horses being imported from the Cape and Europe and distributed across southern Africa, with the first horses reaching central Namibia in 1820.[23] By 1870 horses started to reach the more northern parts of Namibia, where they were used by the Nama-speaking Topnaar and Swartbooi commandos in their raids on the surrounding pastoralists communities.[24] The people of the northern parts, unlike the semi-nomadic inhabitants in the central and southern parts (known as the Police Zone),[25] lived in fairly settled communities governed by strong centralised Kingdoms, that, due to their remoteness, escaped direct colonial rule until 1909.[26] It was not until 1915 that the northern parts became part of South Africa colonialism.[27]

The Oorlam traders also had a significant effect on the initial introduction of horses into Namibia. They were well known for their frequent possession of rifles, ox-wagons and horses.[28] Oorlam and Herero groups vied for grazing land and therefore trade between the two cultural groups was at a minimum. According to Dugard,[29] the possession of firearms and horses by the Nama (who were willing to pay 50 oxen for a horse)[30] and Oorlam groups in the

22 M Goldbeck, T Greyling & R Swilling, *Wild horses in the Namib Desert: An equine biography* (Windhoek, Friends of the Wild Horses, 2011), p. 16.
23 HP Schneider, *Animal health and veterinary medicine ...,* n.p.
24 M Wallace & J Kinahan*, A history of Namibia. From the beginning to 1900* (Auckland Park, 2012), pp. 87, 103.
25 G Miescher, *Namibia's Red Line: The history of a veterinary and settlement border* (New York, Palgrave Macmillan, 2012), p. 44.
26 M Wallace & J Kinahan. *A history of Namibia*..., pp. 46, 99, 148-149, 199.
27 M Wallace & J Kinahan. *A history of Namibia*..., p. 208.
28 A Kienetz, "The key role of the Oorlam migrations in the early Europeanization of South-West Africa (Namibia)", *The International Journal of African Historical studies,* 10(4), 1977, pp. 553-572.
29 J Dugard, *The South West Africa/Namibia dispute: Documents and scholarly writings on the controversy between South Africa and the United Nations* (Berkeley, University of California Press, 1973), p. 12.
30 H Vedder, *South West Africa in the early times*, *Being the story of South West Africa up to the date of Maharero's* (London, Thomas Nelson Printers, 1960), p. 169.

southern areas, lead to the defeat of the Hereros in several battles, indicating that initially they did not possess horses. The Hereros' shortage of horses could have led to the lower number of horses before 1870 in the northern areas of Namibia where they settled.[31]

As the value of horses increased and as they were moved further into southern Africa, some tribesmen noted that certain areas were at all times disease-free. As early as 1843, Jonker Afrikaner, a captain of the Oorlam, was looking for AHS free areas in the vicinity of the Erongo Mountains. During the AHS season, horses would be sent to these areas for protection.[32]

These sanctuaries were well known to horse owners[33] and for some people AHS held an economic advantage. For example, in the 1840s Chief Tseib of the Hoachanas made a living by allowing horses from other tribes to graze on the known AHS-free Keetmanshoop area during the rainy season, demanding high prices for this privilege.[34] Another person who gained financial advantage from AHS during this time was the vice-captain of the "Red Nation" – a subgroup of the Namas – who provided the Rehoboth Basters with grazing in the Swartmodder area (since 1866 Keetmanshoop). However, he later demanded so much for this service that the Rehoboth Basters refused to send their horses. Many of their horses died and consequently had an impact on the distribution of horses in this area. [35]

As the influx and demand for horses gradually began to grow in Namibia at the onset of the diamond rush in the early 1900s, as well as the large influx of Cape horses during World War I,[36] an outbreak of endemic proportion was soon to follow when conditions were favourable for the increase in *Culicoides* populations. In 1890, for instance, close to a thousand horses died of AHS, which was almost 50% of the horse population of Namibia.[37] This corresponds with previous research findings that found a positive correlation between AHS cases and the number of horses.[38]

31 M Wallace & J Kinahan, *A history of Namibia*..., p. 110.
32 HP Schneider, *Animal health and veterinary medicine*..., n.p.
33 HP Schneider, *Animal health and veterinary medicine*..., n.p.
34 JA Nunn, "Interim report in investigations...", *The Veterinary Journal*, 26, 1888, pp. 38-49; HP Schneider, *Animal health and veterinary medicine*..., n.p.
35 GS Preller, *Voortrekkers van Suidwes*, pp. 16, 20.
36 M Goldbeck, T Greyling & R Swilling, *Wild horses in the Namib Desert* ..., p. 16.
37 HP Schneider, *Animal health and veterinary medicine*..., n.p.
38 D Liebenberg, SJ Piketh & H van Hamburg, "A web-based survey of horse owners' perceptions and network analysis of horse movements relating to African Horse Sickness distribution in Namibia and South Africa", *Acta Tropica*, 158, 2016, pp. 201-207.

The large influx of horses occurred mostly during wars when horses were considered a valuable asset. Not all of these horses were in a good condition on arrival. In this regard, Swart[39] postulates that due to the pressing need for horses during wartime, horses arrived dehydrated, malnourished and with their immune systems severely compromised, making them more susceptible to diseases such as AHS.

Epidemic outbreaks of AHS had direct effects on the outcomes of tribal wars, military operations, police patrolling and the colonisation of Namibia. In the case of the Hereros who were resisting German colonial rule, it was of major importance for them to obtain horses. In 1903, the year before their revolt against the Germans, they were willing to exchange their breeding cattle for horses. This even happened before the AHS season, leaving them at risk of losing horses during outbreaks.[40] One of the outcomes of the Herero-German war (1904-1907) was the promulgation of ordinances in 1907 in order to destroy the indigenous peoples' political, cultural and economic structure so as to prevent them from making an independent living, and thereby forcing them to work for white employers. One of these laws that would have had an influence on the transfer and movement of horses in Namibia and finally on the distribution of AHS patterns, was issued in September 1907. It stated that the Africans in the Police Zone were prohibited from owning land, cattle and horses without special permission.[41]

Any other military action was brought to an almost complete standstill during the AHS season. In 1894 Governor Leutwein of the Schutztruppe (German military) ordered that no military excursion would take place during the AHS season unless absolutely necessary.[42]

Another example of where AHS had a direct effect on military action was at the well-known Sterbeplatz outside of Windhoek. The Schutztruppe kept their horses on the farm Regenstein in the Auas Mountains during German colonial times (Image 1) as this area was believed to be free of AHS.[43] Thus Regenstein had considerable strategic importance for military mounted units. This was also recognised by the Nama leader, Hendrik Witbooi, who

39 SS Swart, *Riding high*..., pp. 108-110.
40 G Pool, *Die Herero-opstand, 1904-1907* (Kaapstad, Haum, 1979), pp. 58, 66.
41 M Wallace & J Kinahan, *A history of Namibia*..., p. 185; J Sarkin, *Germany's genocide of the Herero: Kaiser Wilhelm II, His General, His Settlers, His Soldiers* (Cape Town, UCT Press, 2011), pp. 86-87.
42 HP Schneider, *Animal health and veterinary medicine*..., n.p.
43 A Heywood & B Lau, *Three views in the past of Windhoek* (Windhoek, Namibisch-Deutsche Stiftung für kulturelle Zusammenarbeit, 1993), n.p.

effectively immobilised the Shutztruppe by seizing all of the remaining horses at Regenstein as well as the newly purchased horses en route to Regenstein.[44]

Image 1: Photo of the ruins of the Schutztruppe horse camp at Regenstein where horses were kept during the AHS season as a precaution against the disease (June, 2014)

Source: Photo taken by D Liebenberg, 16 June 2014.

In case of a severe outbreak of AHS, the Mounted Police was also at times instructed to stop patrolling the affected areas. Their lack of visibility may have negatively influenced the effective enforcement of law and order in these areas.[45]

Horses that were lucky enough to recover from AHS were known as salted horses and believed to be immune to future attacks from the dreadful disease. These horses were marked with a slip in the ear and were traded at high prices.[46]

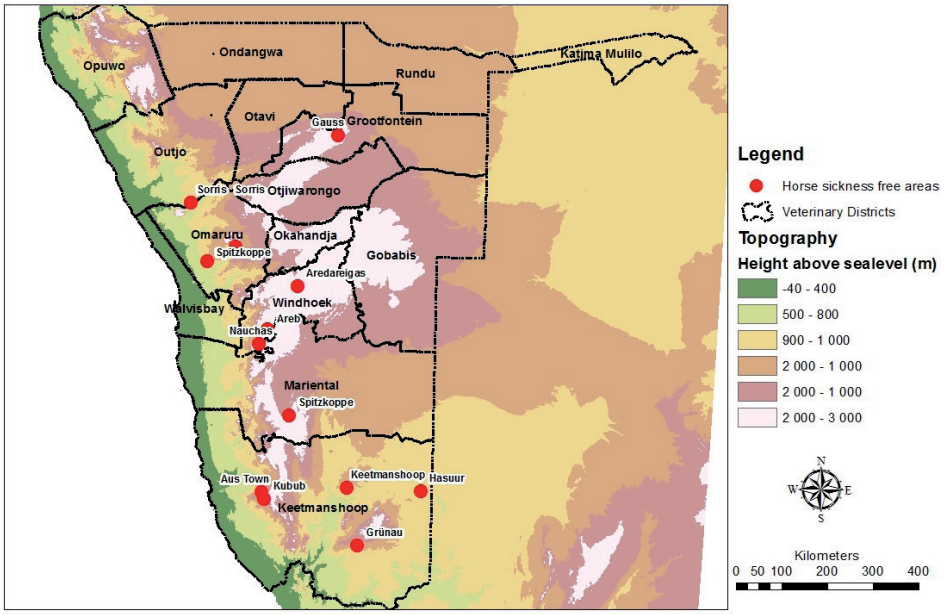
Apart from the afore-mentioned Keetmanshoop that was considered an AHS-free area, there were also other such areas in Namibia during pre-colonial times (See Image 2):

44 A Heywood & B Lau, *Three views in the past of Windhoek*, n.p.

45 Compare Cape Town Archives Repository (CTAR), R 86, Horse Sickness in the Cape mounted Police: Letter, The Cape Mounted Police Commissioner/Director of Agricultural Department, 3 April 1907.

46 WHH Walters, *The German official account of the war* ..., p. 8; N Stassen, *Die Dorslandtrek, 1874-1881* (Pretoria, Protea Boekhuis, 2015), p. 206; HP Schneider, *Animal health and veterinary medicine* ..., n.p.

Image 2: The topography of Namibia, showing the veterinary districts and areas which were believed to be AHS-free during the pre-colonial period



Source: HP Schneider, *Animal health and veterinary medicine ...,* n.p.

It is notable that the AHS free areas were not allocated to a certain district, as shown on the pre-colonial map above, but were located at a certain height above sea level. The reason for this was probably because the change in climatic parameters at higher elevations was not favourable to midge activity. At higher elevations, increased wind speed is experienced, thus inhibiting the flying ability of the midges[47] and resulting in lower biting rates.

Dealing with AHS

In dealing with this disease, horse owners had to construct a body of local knowledge from various healing traditions. Settlers learned from indigenous herdsman about using smoky fires to discourage flies.[48] Travellers also noted that the Khoikhoi would relocate their cattle if they manifested illness and implemented the same guidelines against AHS.[49] The only useful ways of

47 RF Sellers, "Weather, host and vector – their interplay in the spread of insect-borne animal virus diseases", *Journal of Hygiene*, 85(1), 1980, pp. 65-102.

48 Compare Anon., "Documentation Services, South African Defence Force, The South African Army Veterinary Services", *Journal of the South African Veterinary Association*, 49(4), 1978, p. 300.

49 SS Swart, *Riding high...,* p. 23.

preventing AHS proved to be moving the horses to higher ground and stabling during dawn and dusk.[50] New settlers established themselves in places where horses could survive. This desire to reach Horse Sickness free zones determined the range of the settlement.[51] Epidemics of AHS resulted in major transportation impairments[52] and losses were also very disruptive to agriculture, mining and military operations.[53]

Initially, AHS was confused with diseases like anthrax, human malaria and biliary fever.[54] The first scientific research on AHS was carried out by Alexander Edington (1892) who was appointed the first government bacteriologist of the Cape Colony. With his research he established AHS as a separate disease. His research unfortunately lost credibility when he announced that AHS was caused by a fungus, which he failed to prove.[55] The filterability of the AHS virus was demonstrated in 1900 by M'Fadyean in London, proving the viral nature of the agent.[56] M'Fadyean's findings were independently confirmed by Theiler,[57] Nocard[58] and Sieber,[59] concluding that the disease was caused by a virus.[60] Sir Arnold Theiler is considered the founder of veterinary research in South Africa, with a variety of ground-breaking experiments on AHS. He found that some horses and mules were immune to experimental infection and he stated on several occasions that he was unable to produce fatal symptoms in donkeys. He was also the first to show in 1907 that dogs were susceptible to AHS and realised that AHS was not contagious.[61]

50 HP Schneider, *Animal health and veterinary medicine ...,* n.p. SS Swart, *Riding high...,* p. 24.
51 SS Swart, *Riding high...,* p. 24.
52 BJ Erasmus, "African Horse Sickness", *Onderstepoort Journal of Veterinary Research,* 76, 2009, p. 97.
53 MW Henning, *Animal diseases in South Africa* ..., pp. 785-808; JAW Coetzer & AJ Guthrie, "African Horse Sickness", JAW Coetzer & RC Tustin (eds.), *Infectious diseases of livestock*, pp. 1231-1246.
54 MW Henning, *Animal diseases in South Africa* ..., pp. 785-808.
55 DW Verwoerd, "History of *orbivirus* research in South Africa", *Journal of the South African Veterinary Association*, 83(1), 2012, pp. 1-6.
56 MW Henning, *Animal diseases in South Africa* ..., pp. 785-808; DW Verwoerd, "History of *orbivirus* research ...", *Journal of the South African Veterinary Association*, 83(1), 2012, pp. 1-6.
57 A Theiler, "Die Südafrikanischen Pferdesterbe", *Deuts Tierarztl Wschr*, 9, 1901, pp. 201-203, 221-226, 233-237, 241.
58 E Nocard, "La horsesickness ou 'Maladie des Chevaux' de l'Afrique du Sud', *Bulletin de la Société Centrale de Médecine Vétérinaire,* 55, 1901, p. 37.
59 H Sieber, "Experimentelle Untersuchungen über die Pferdesterbe", *Zschr. für Infektionskrkh. der Haustiere*, 10, 1911, pp. 81-119.
60 MW Henning, *Animal diseases in South Africa* ..., pp. 785-808.
61 MW Henning, *Animal diseases in South Africa* ..., pp. 785-808; JJO Koekemoer, "Molecular applications of the African horsesickness virus genome segment 2 in diagnostics and epidemiology" (PhD, Potchefstroom, NWU, 2004), n.p.

The first examinations in respect of animal diseases in Namibia and especially AHS were undertaken by Dr Sander, a retired naval medical officer with a veterinary background, who mistook AHS for anthrax.[62] The foundation of veterinary research in Namibia was established by Dr Rickmann, who considered AHS related to human malaria.[63] He arrived in Namibia in June 1895 as the first veterinarian. At that time, AHS was one of the most prevalent and important animal diseases. In response to the devastating effects of this disease, the Imperial Bacteriological Institute Gammams was established. The Institute was responsible for the research on the epidemiology of AHS.[64]

During German colonial rule (1884-1914), the Schutztruppe employed a large number of veterinarians; by 1914 each district in Namibia had its own veterinary officer. However, during World War I the veterinary structure crumbled as most veterinarians were called up for military service. Under South African administration the Chief Veterinary Officer was assisted by five veterinarians stationed at Gammams, Gobabis, Keetmanshoop, Omaruru and Windhoek. In the following decades there was a steady increase in the number of veterinary officers in most districts. However, the Eastern Caprivi remained under the South-West African (Namibian) Administration Veterinary Division from 1929 to 1945, after which it was transferred to South Africa.[65]

Because AHS was a disease that impaired the daily routine of horse users, many individuals[66] were involved in trying to find a cure. Alexander's discovery in 1930 that AHSV could be attenuated, represented a significant breakthrough in AHS vaccinology. These neurotropic vaccines were used to immunise horses successfully for decades. Over time, reports of encephalitogenic properties of the vaccine increased. Efforts to improve the safety of the vaccine led to the development of cell culture-attenuated vaccines by Erasmus in 1964.[67]

62 HP Schneider, "The history of veterinary medicine in Namibia", *Journal of the South African Veterinary Association,* 83(1), 2012, pp. 1-11.

63 MW Henning, *Animal diseases in South Africa* ..., pp. 785-808.

64 HP Schneider, "The history of veterinary medicine in Namibia", *Journal of the South African Veterinary Association,* 83(1), 2012, pp. 1-11.

65 For in-depth explanation of veterinary services in Namibia, see HP Schneider, "The history of veterinary medicine in Namibia", *Journal of the South African Veterinary Association,* 83(1), 2012, pp. 1-11.

66 For an in-depth explanation of early experimental treatment, see MW Henning, *Animal diseases in South Africa…,* pp. 802-806; SJE van den Bergh, "The Story of a disease: A social history of African Horse Sickness c.1850-1920" (MA, Stellenbosch University, 2009), pp. 107-114; AA van Dijk, *African Horse Sickness vaccine development* (Paper, Equine Infectious Diseases VIII, Proceedings of the Eight International Conference, Dubai, 23-26 March 1998), pp. 261-262.

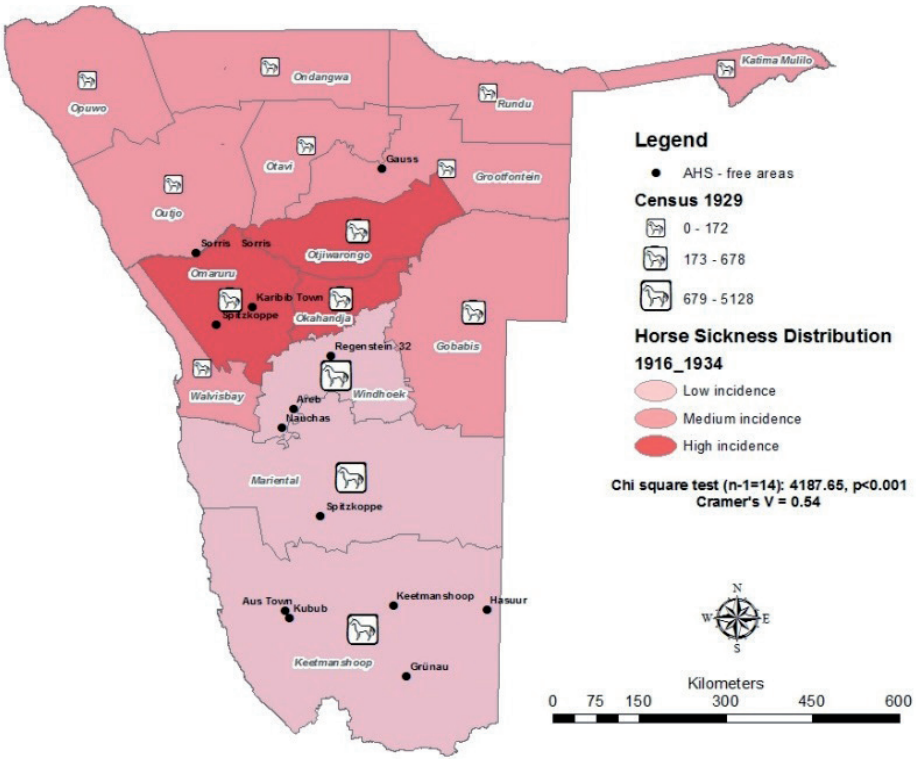
67 AA van Dijk, *African Horse Sickness vaccine development* (Paper, Equine Infectious Diseases VIII, Proceedings of the Eight International Conference, Dubai, 23-26 March 1998), pp. 261-262.

Research on AHS and the development of an effective vaccine were driven by the need for horses; as this need declined with the introduction of automobiles, new technology and increased political stability, research on the topic also declined. The last update on vaccine development was in 1990, which is also the current registered and commercially available vaccine. A chronological order of vaccine development is shown in the Addendum.

Colonial South African rule and independence

The historical prevalence and distribution of AHS in Namibia for the period 1916-1934 is illustrated in Image 3. These 18 years partly cover colonial South Africa rule (1915-1987) and the coming of independence in 1990, up to 2011.

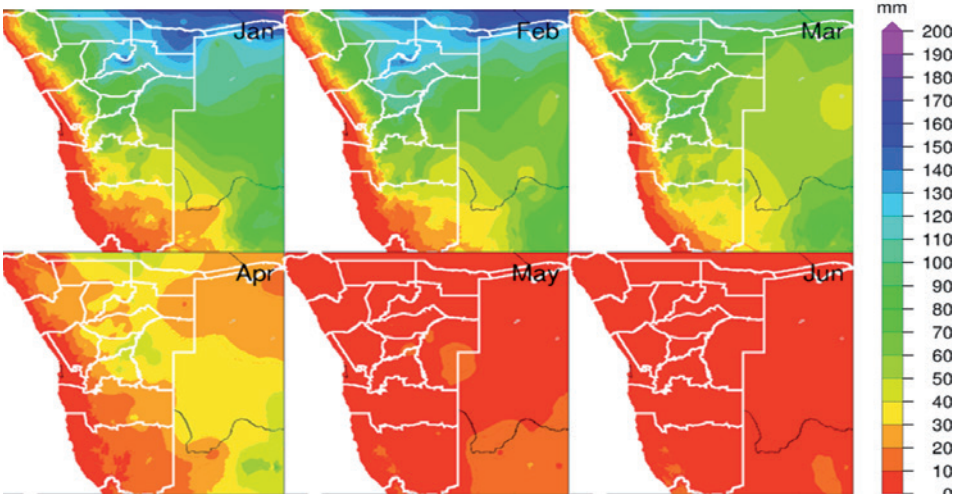
Image 3: Distribution map of AHS in Namibia for 1916-1934 indicating low, medium and high incidence districts. Districts believed to be free of AHS during the pre-colonial and colonial (German rule) periods are also indicated. The census further indicates the number of horses per district in 1929



Sources: Directorate of Veterinary Services; Ministry of Agriculture, Water and Forestry, Namibia: Annual reports 1916-1934.

From the map above it is clear that low incidence districts were confined to the southern part of the country, with medium incidence in the northern districts and high incidence restricted to the central districts of Namibia. AHS free areas are also indicated on the map, with most of the areas located in the southern districts and at higher altitudes. According to the Chi-square analysis and Cramer's V test, there was a significant statistical difference ($p<0.001$) in the occurrence of AHS between the districts. Although AHS incidence and prevalence could not be linked to a single parameter, the only available historical data were climate data.[68] These included monthly precipitation and temperature data. Comparing the precipitation of the 50 years (1950-2000) with the occurrence of AHS outbreaks, the occurrence of the latter corresponded with areas with high precipitation in central Namibia, as seen in Image 4 below:

Image 4: Fifty-year (1950-2000) average monthly precipitation (mm) from January to June super-imposed over veterinary districts across Namibia



Source: RJ Hijmans, SE Cameron, JL Parra, PG Jones & A Jarvis, "Very high resolution interpolated climate surfaces ...", *International Journal of Climatology,* 25(15), 2005, pp. 1965-1978.

Higher precipitation contributes to more favourable conditions for vector breeding, thereby indirectly increasing the likelihood of the occurrence of AHS outbreaks.[69] *Culicoides imicola* occurs in areas with annual precipitation

68 RJ Hijmans, SE Cameron, JL Parra, PG Jones & A Jarvis, "Very high resolution interpolated climate surfaces ...", *International Journal of Climatology,* 25(15), 2005, pp. 1965-1978.

69 R Meiswinkel, "The 1996 outbreak of African Horse Sickness in South Africa – the entomological perspective", *Archive of Virology,* 14, 1998, pp. 63-77.

of between 300 and 700 mm.[70] In previous studies in Namibia conducted by Becker, Venter, Labuschagne, Greyling and Van Hamburg,[71] *C. imicola* was collected across a rainfall gradient from east to west in the Windhoek district with an average annual precipitation of between 150 mm in the west and 350 mm in the eastern area of the district. The southern districts of the country are extremely dry with precipitation ranging between 0 and 60 mm, which could account for the low incidence of AHS in these districts.

A socio-economic reason for the high incidence of AHS can in all probability be attributed to the attitude of some farmers, who during the 1930s had not yet realised the desirability of immunising their horses during the months when the disease was at its lowest prevalence. A possible reason for their tardiness to vaccinate their horses can be ascribed to the farmer's inclination to first wait and see in order to judge if it was a serious outbreak before being willing to apply to the senior veterinary surgeon and spend £2 per horse for the serum to have their horses inoculated at their own risk.[72] Horse owners could also not have full use of their horses after receiving their first AHS vaccine as these horses had to refrain from intensive exercising during the six-week vaccination period.[73]

In instances where vaccination did occur, it was not guaranteed that every horse would survive after contracting the sickness. During March 1933, Mr Bohme from the farm Otavifontein, for example, reported to the government veterinary officer in Grootfontein that he had lost 66% of his horses due to Horse Sickness, despite the fact that they had been immunised.[74] Experiences like these could possibly also have served as a reason why some horse owners were at times reluctant to follow the advice of veterinary staff.[75]

Due to the low incidence of AHS in the south and the greater number of horses that was available, one would have expected it to have a positive impact on the general breeding of horses. Although this might be the case, it

70 R Meiswinkel & M Baylis, "Morphological confirmation of the separate species status ...", *Onderstepoort Journal of Veterinary Research,* 65*,* 1998, pp. 9-16.

71 E Becker, GJ Venter, K Labuschagne, T Greyling & H van Hamburg, "The effect of anthropogenic activity on the occurrence of *Culicoides* species in the South-Western Khomas Region, Namibia", *Veterinaria Italiana,* 49(3), 2013, pp. 277-284.

72 DVS Annual report of the senior veterinary surgeon, Windhoek, 29 September and 4 February 1930 and 23 December 1932.

73 "African Horse Sickness Trust, Information booklet, 2012/2013" (available at http://www.africanhorsesickness.co.za/Docu ments/doc_19.pdf).

74 G4 13/14: Letter, Bohme/Maybin, 1 March 1933.

75 "Documentation Services, South African Defence Force, The South African Army Veterinary services", *Journal of the South African Veterinary Association*, 49(4), 1978, p. 300.

does not necessarily guarantee the breeding of a good quality horse; especially those horses suitable for police and military operations. In this regard, the government veterinarian at Keetmanshoop reported in 1929:[76]

> With regard to the breeding of horses, the percentage of horses which come to the military and police standard is getting smaller each year. This condition of the industry today is due to the rapid spread of mechanical transport and the low market value of the horse. I may suggest that the government should offer a better price, above the average of the market, for those horses which are especially fit for the purposes of the police.

In the central parts of Namibia, a high incidence of AHS was experienced with the number of horses in these districts ranging between 173 and 678. A possible reason contributing to the increased number of AHS incidents was the absence of an effective breeding programme and the weakened immunity of the horses due to harsh conditions.[77] To this effect, the senior veterinary officer at Omaruru reported on 15 December 1933:

> ... Horse-sickness has considerably increased, especially in the Kalkfeld area and in the Herero reserve. Generally the practices of breeding used here are very primitive and unsatisfactory. The Hereros are very keen for horses but he has no understanding of any progressive breeding policy ...

The northern parts of the country were classified as medium incidence, although favourable conditions do occur in these districts. Because the number of horses in these districts are low (ranging from 0 to 172), the distribution and occurrence of AHS might not have been well documented.

The data following the period 1935-1989 were descriptive and considered as missing for s analysis, while for the period 1971-1987 an excerpt from the descriptive data of the annual veterinary reports is presented in the table in Image 5 below:

Image 5: Descriptive information on the occurrence and distribution of AHS outbreaks in Namibia for 1971-1987

Year	Description	Other comments
1971-1972	More cases than usual - which can be linked to a history of not vaccinating.	
1972-1973	A few cases were seen in the Gobabis and Omaruru districts.	

76 8/A Annual report of the Government Veterinary at Keetmanshoop, 1929.
77 C Grobbelaar, *The Arabian horse ...,* p. 18.

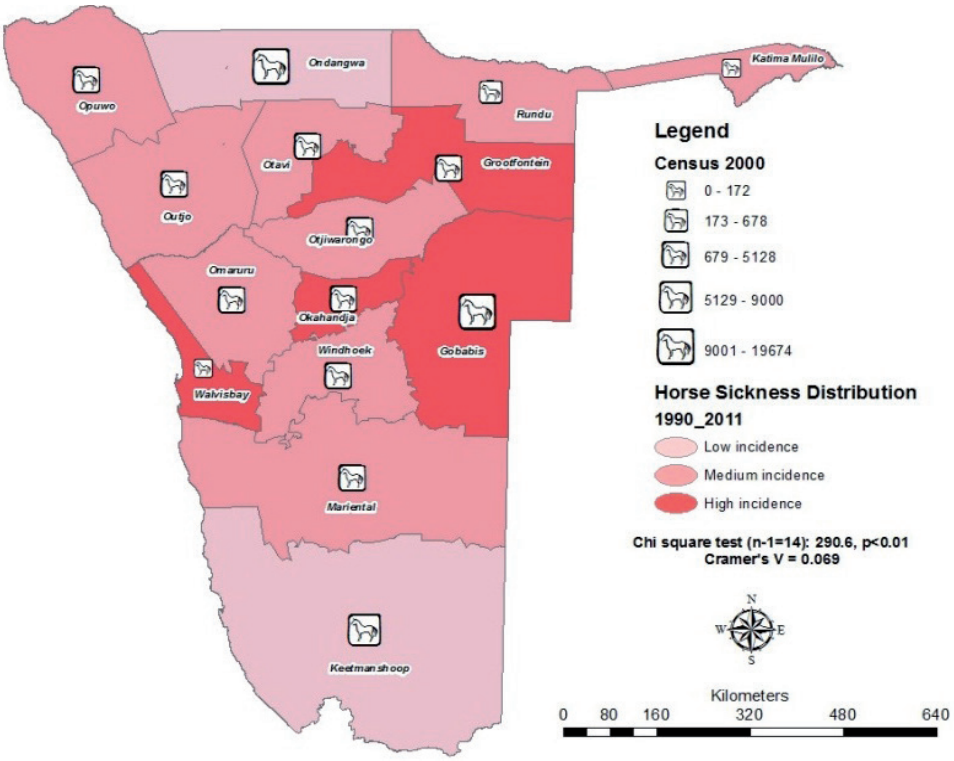
1973-1974	Due to the favourable conditions for vectors of the virus, losses reached massive proportions across Namibia.	Losses were also recorded in animals that were vaccinated due to the outbreak of serotype 4.
1974-1975	No deaths were reported during this year.	
1975-1976	Due to the good rains, the disease was wide-spread across Namibia.	Both Dikkop and Dunkop cases were diagnosed. There was an increase in demand for the vaccine.
1976-1977	A few cases occurred throughout the country. In Grootfontein district a few adult horses died.	The following virus types were isolated: Type 1, 5 and 9. The vaccine was used fairly extensively.
1977-1978	AHS was severe during this year with deaths occurring even in vaccinated horses. The increase can be ascribed to the good rains and thus the increase in vectors of the disease.	Cases reported on single farms in the following districts: Keetmanshoop, 36; Mariental, 30; Okahandja, 30.
1979-1980	A few cases of Dikkop were reported in the following districts: Gobabis, Keetmanshoop, Namaland, Okahandja and Omaruru.	
1983	Farmers in general made use of the vaccine. Cases were diagnosed in Mariental (3) and Omaruru (1).	
1984	A few cases were reported in the eastern districts of the country: Mariental, Grootfontein, Gobabis	
1985	Rarely diagnosed – three outbreaks: two in Windhoek and one in Grootfontein.	
1987	Five outbreaks were reported in the Keetmanshoop, Outjo and Omaruru districts as well as in the Kavango.	One outbreak in the Bondelswarts Reservation in the Karasburg area involved 110 donkeys of which only 10 survived. Although the symptoms and post-mortal lesions resembled those of Horse Sickness, the diagnosis could never be confirmed. Vaccination of horses was practised on a wide scale, especially in the commercial areas.

Source: Directorate of Veterinary Services; Ministry of Agriculture, Water and Forestry, Namibia: Annual reports 1971-1987.

During 1971-1987 horse owners became increasingly aware of the necessity to immunise their horses with the AHS culture-attenuated vaccine developed by Dr Erasmus in 1964. Reports further state the relationship between good rains and favourable conditions leading to an increase in vector numbers, resulting in severe outbreaks in 1973/74 and 1977/78.

The AHS distribution pattern for the period 1990-2011 is shown in Image 6, indicating a more scattered pattern, compared to the 1916-1934 period in Image 3.

Image 6: Distribution map of AHS in Namibia in 1990-2011, indicating low, medium and high incidence districts. The census indicates number of horses per district in 2000



Source: Directorate of Veterinary Services; Ministry of Agriculture, Water and Forestry, Namibia: Annual reports 1990-2011.

From Image 6 it is shown that horse numbers had doubled since 1934 and areas that were previously identified as low incidence districts now moved into a higher category. There was a positive correlation between the number of horses and AHS cases ($R^2 = 0.508$). According to the Chi-square analysis there was a statistically significant difference ($p<0.01$) between the various districts. However, with the Cramer's V test, which adjusts the Chi-square significance to factor out sample size, there was no significant difference ($p = 0.069$) between the districts. In relation to the precipitation distribution map (Image 4), precipitation did not visually correspond with the occurrence of AHS for the period 1990-2011 to the same degree as for the 1916-1934

period. This could be due to several societal reasons, with underreporting and the use of a vaccine being the principal suspected causes. It is worth noting that AHS in general had a significant economic impact on Namibia during this time as the country became increasingly involved as an exporter of pedigree horses.[78]

The Walvis Bay district changed from a low AHS incidence in the 1916-1934 period to a high incidence in the 1990-2011 period with no significant increase in horse numbers. This seems rather strange as this district is mostly desert with little rainfall. However, the movement of horses could have had an effect, as discussed by Liebenberg, Piketh and Van Hamburg.[79]

In the northern areas, the Ondangwa district changed from a medium incidence in the 1916-1934 period to a low incidence in the 1990-2011 period. However, in contrast to the Walvis Bay district, the horse population increased significantly. This could have been due to the trade restriction on horses in the district that was implemented in 1906 by Governor von Lindequist.[80] It is doubtful that this is a true representation of the history of AHS incidence in the district. This could again be attributed to underreporting or vaccination because favourable temperatures and precipitation ranges do exist in these areas to sustain *Culicoides* spp (See the table in Image 7). This needs to be researched further.

Image 7: Results of the dependent t-test and Wilcoxon matched-pair test between the two periods (1916-1934 and 1990-2011) for the occurrence of AHS outbreaks in Namibia, indicating the mean AHS occurrence, standard deviation and p-values

			p-value	
Time period	**Mean AHS occurrence**	**Standard Deviation**	**Dependent t-test**	**Wilcoxon**
1916 - 1934	0.075	0.144	0.1436	0.2489
1990 - 2011	0.0098	0.020		

Sources: Directorate of Veterinary Services; Ministry of Agriculture, Water and Forestry, Namibia: Annual reports 1990-2011.

78 M Scacchia, R Lelli, A Peccio, T Di Mattia, R Mbulu, A Hager, R Monaco, G Savini & A Pini, "African Horse Sickness: A description of outbreaks in Namibia", *Veterinaria Italiana*, 45(2), 2009, p. 266.

79 D Liebenberg, SJ Piketh & H van Hamburg, "A web-based survey of horse owners' perceptions and network analysis of horse movements relating to African Horse Sickness distribution in Namibia and South Africa", *Acta Tropica*, 158, 2016, pp. 201-207.

80 G Miescher, *Namibia's Red Line: The history of a veterinary and settlement border* (New York, Palgrave Macmillan, 2012), p. 81.

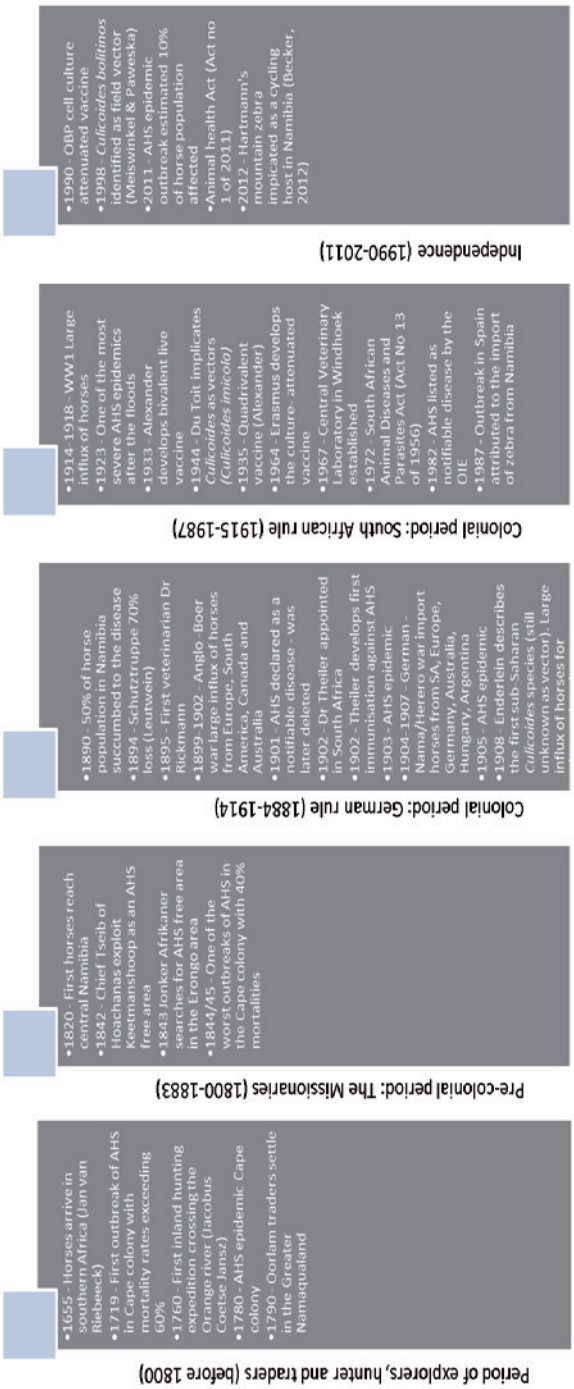
The results of the dependent t-test and the Wilcoxon matched-pair test is shown in the table as in Image 8. According to the dependent t-test ($p>0.14$) and the Wilcoxon matched pair test ($p> 0.24$), there was no significant difference in the occurrence of AHS outbreaks between the two periods. However, underreporting and societal influences must also be taken into consideration. Therefore, when compared based on the visual representations of the occurrence of AHS outbreaks in Images 3 and 6, a distinct difference can be perceived in the pattern of distribution of AHS between the two periods.

Conclusion

AHS outbreaks have been largely underreported and underestimated in Namibia. The full impact thereof on the social and economic life of the horse owner, military operations and the horse industry in general is yet to be assessed. The influences of horses and the role of AHS on the history of Namibia are sometimes hidden in soldiers' reports and missionaries' diaries. AHS and the harsh conditions of Namibia were mentioned in several letters as reasons why enemies could not be pursued.

However, results from this research indicate a difference in the distribution of AHS in past (Image 3) and more recent (Image 6) periods, but there is no statistically significant difference. The visually informed differences in the distribution pattern (Images 3 and 6) can be due to several reasons, e.g. the numbers of horses present in the different districts; environmental factors such as altitudes and climate patterns; the use of vaccinations; and the increase in the movement of horses over long distances. It is concluded from these results that the central districts of Namibia contained the highest incidence with lower incidence in the southern districts. One of the most important perspectives gathered from this historical assessment of AHS, was that even during times of war, horse movements were suspended during the rainy season. Furthermore, the results show to what great extent the prevalence and distribution of AHS impacted directly on the socio-economic conditions of the inhabitants and horse owners of Namibia and the manner in which it influenced the outcomes of several military events. One can only wonder whether the outcome of battles would have been different had AHS not occurred in southern Africa.

Image 8: Timeline depicting the most relevant historical events of AHS and its influence on the distribution in Namibia



Sources: Henning,[81] Schneider,[82] Grobbelaar,[83] Vandenberg,[84] Swart,[85] Goldbeck, Greyling and Swilling,[86] Schneider,[87] Becker,[88] Verwoerd.[89]

81 MW Henning, *Animal diseases in South Africa* ..., pp. 785-808.

82 HP Schneider, *Animal health and veterinary medicine* ..., n.p.

83 C Grobbelaar, *The Arabian horse* ..., n.p.

84 SJE Vandenberg, "The story of a disease: A social history of African Horse Sickness c.1850-1920" (MA, Stellenbosch University, 2009), n.p.

85 SS Swart, *Riding high*..., n.p.

86 M Goldbeck, T Greyling & R Swilling, *Wild horses in the Namib Desert* ..., n.p.

87 HP Schneider, "The history of veterinary medicine ... ", *Journal of the South African Veterinary Association*, 83(1), 2012, pp. 1-11.

88 E Becker, "The occurrence of African Horse Sickness in Hartmann's mountain zebra and its *Culicoides* vector in the south-western Khomas Region, Namibia" (MSc, Potchefstroom, NWU, 2012), n.p.

89 DW Verwoerd, "History of *orbivirus* research ... ", *Journal of the South African Veterinary Association*, 83(1), 2012, pp. 1-6.