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NATIONAL DEPARTMENT OF
AGRICULTURE



NATIONAL DIRECTORATE
VETERINARY SERVICES

SUBMISSION TO THE
FOOT AND MOUTH DISEASE
& OTHER EPIZOOTICS COMMISSION
OF THE OIE FOR THE RE-INSTATEMENT OF A
FOOT AND MOUTH DISEASE FREE ZONE
WITHOUT VACCINATION

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1. EXECUTIVE SUMMARY IN SUPPORT OF THE REQUEST OF SOUTH AFRICA FOR THE RE-INSTatement OF A FREE ZONE FOR FOOT AND MOUTH DISEASE WITHOUT VACCINATION

1.1. SHORT HISTORY OF FOOT AND MOUTH DISEASE (FMD) IN SOUTH AFRICA

Hutcheon made the first official record of foot-and-mouth disease ('klouwsiekte' or also known then as tongue or hoof sickness) in South Africa in 1892, when an outbreak occurred in Griqualand West¹. The scourge was, however well known to several farmers and, according to information obtained from other older inhabitants, it had been prevalent in South Africa for many years before this outbreak was reported. In the two following years mild epizootics occurred in different parts of the country, but the disease never assumed serious proportions, and no further outbreaks were reported after 1895.¹

In April 1903 foot-and-mouth disease reappeared in South Africa. This was caused by shipments of cattle from Argentine to the Cape Peninsula. Fortunately the disease was confined to two places only, namely a farm where the imported cattle were kept and a local dairy that harboured a runaway heifer from the Argentine shipment. Both areas were immediately placed under strict quarantine and premises were thoroughly disinfected. At the end of July the same year, there was no further evidence of the disease, and the quarantine restrictions were raised.¹

After the Rinderpest pandemic, foot-and-mouth disease disappeared from the region until April 1931, when it occurred in Zimbabwe. The reappearance of the disease was a source of great consternation at the time as the ability of buffalo to provide a reservoir of infection was unknown and many people believed that the infection had been re-introduced by imported animals or animal products, although no evidence for this could be found.¹ In South Africa only the SAT1, 2 & 3 serotypes have ever been diagnosed prior to the introduction of Type O in September 2000 (kwaZulu-Natal).

Foot-and-mouth disease has occurred regularly in most southern African countries since 1931, during which, time and cost of control has undoubtedly eclipsed that of other viral diseases.¹

Foot and mouth disease (FMD) is a controlled disease in South Africa. It is endemic in the Kruger National Park (KNP) where the African buffalo (*Syncerus caffer*) act as the main carrier of the disease. They maintain the 3 SAT serotypes.

¹ INFECTIOUS DISEASES OF LIVESTOCK, VOLUME 2, Edited by, J.A.W. Coetzer, G.R. Thomson, R.C. Tustin, pages 825-852.

The area adjacent to the KNP constitutes the FMD control zone consisting of buffer and surveillance zones between the endemically infected KNP and the FMD free zone. As no outbreaks of FMD had occurred in the FMD free zone since 1957 and no vaccination was practiced in this area, South Africa applied to the International Committee of the OIE in 1995 to be allocated FMD free zoned status without vaccination. The International Committee of the OIE subsequently during its meeting in May 1996, zoned South Africa free from FMD without vaccination. The areas excluded from the zone are the endemically infected KNP and the FMD control zones along the KNP and along the areas bordering Swaziland, Mozambique, Zimbabwe and Botswana.

The last outbreak of FMD, prior to 2000, in the free – zone was in 1957 and the last outbreak within the FMD control zone adjacent to the KNP, was in 1983.

1.2. FOOT AND MOUTH DISEASE CONTROL POLICY IN SOUTH AFRICA

Prior to the first outbreak of the disease in the free zone in September 2000, the only FMD control zones were the endemically infected KNP, a buffer zone including the adjacent game reserves and a FMD surveillance zone stretching from the Ingwavuma area in northern KwaZulu-Natal bordering southern Mozambique all along the borders of Swaziland, the KNP, Zimbabwe and Botswana (see Fig.1). These areas are identified in terms of clear natural geographical borders, fenced roads and are excluded from the FMD free zone without vaccination. Vaccination is carried out twice a year in the buffer zone along the southern and western boundaries of the KNP (trivalent SAT 1, 2 & 3 vaccines). Stringent movement restrictions are enforced to ensure that no vaccinated animals move into the free zone unless for direct slaughter in accordance with the *Code*.

Foot and mouth disease is a controlled disease in accordance with the Animal Diseases Act 35/1984. The Regulations promulgated in terms of the Act lay down the detailed requirements for disease control and measures to be taken in the event of an outbreak and to prevent the introduction of the disease through imports of animals and animal products.

The *Veterinary Administration* as outlined in the *Code*, controls all Regulatory matters for disease control and also has legal precedence over the veterinary administrations of provincial veterinary authorities for disease control purposes.

Surveillance activities within the FMD control zone are carried out by para-veterinary personnel (animal health technicians) under the control of a state veterinarian. The frequency of inspection of cloven-hoofed livestock in the FMD control zones varies from 7 – 14 days (7 days in the buffer zone and 14 days in the surveillance zone). Sero-surveillance is done to determine the immune status of animals within the buffer zone. Serum samples are submitted for testing prior to the translocation of animals and game from the surveillance zone.

Active and passive surveillance is carried out on an ongoing basis within the KNP and adjoining reserves to monitor the incidence of the disease in wildlife – specifically African buffalo and impala.

In the free areas, surveillance for disease is done on an ongoing basis together with other disease control interventions (e.g. TB testing, etc.)

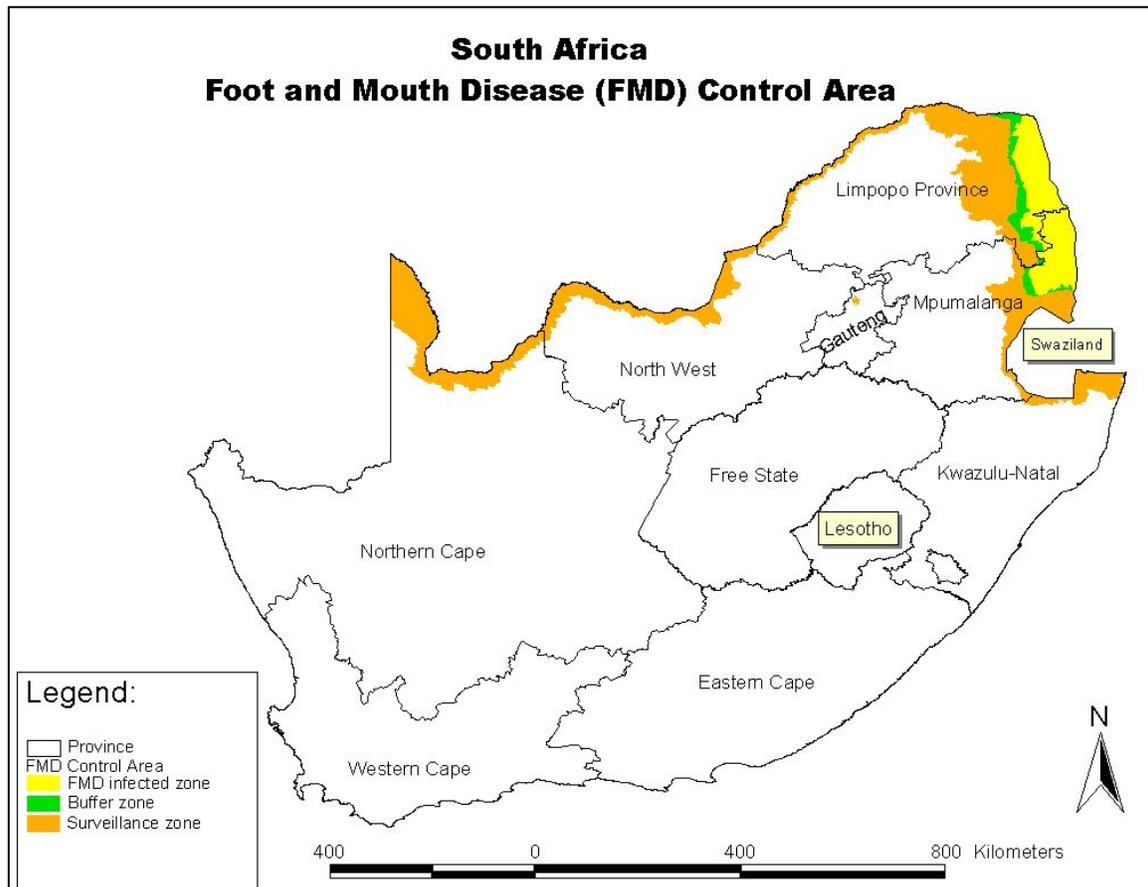


FIG 1: Map indicating the FMD control areas of South Africa

1.3. SUMMARY OF THE FOOT AND MOUTH DISEASE OUTBREAKS IN 2000/2001

South Africa lost its FMD-free zoned status without vaccination after an outbreak of FMD serotype O was diagnosed on 14 September 2000 in a piggery in the district of Camperdown in KwaZulu-Natal (Fig.2). It was the first time ever that serotype O was diagnosed in South Africa. This virus was presumably introduced with galley waste from a ship docked at Durban harbour. The disease was confined to a small area of 15 km radius within the Camperdown district. Stamping out was immediately instituted in accordance with Article 2.1.1.6 of the Code. When the disease spread to a 3rd focus bordering the communal grazing area, limited vaccination was applied. The disease was effectively brought under control with no further clinical cases after 5 November 2000. The Camperdown district remains a controlled zone for foot and mouth disease until declared free by the OIE.

On 29 November 2000 an outbreak of the disease was diagnosed in a feedlot in the district of Middelburg in Mpumalanga Province (Fig.2). The feedlot is within the FMD free zone. The virus type responsible was SAT1 and partial sequencing of the VP1 gene indicated that the virus causing the outbreak was related to buffalo isolates previously obtained from the south of the KNP. Emergency vaccination was immediately applied at the feedlot in accordance with Article 2.1.1.6 of the Code with subsequent slaughtering of all vaccinated cattle. The disease was only diagnosed in cattle in the feedlot. The almost 52 000 pigs in a separate holding in the feedlot never contracted the disease in the presence of strict bio-security measures. The pigs were vaccinated once only. All porkers were slaughtered for the local market under strict veterinary control by the end of July 2001.

Trace-back actions following the outbreak in the feedlot led to the origin of the disease which was caused by buffalo/cattle contact in the Lowveld area of Nkomazi, bordering the southern KNP (Fig.2). This area is part of the FMD control zone. Stray buffalo movements were observed outside the KNP after devastating floods in the first quarter of 2000, with subsequent severe damage to the southern and western KNP fence. Suspect lesions were detected and infection was later confirmed by the presence of antibodies to the non-structural proteins at the Thabankulu dip tank. The whole area was immediately quarantined and vaccinated. Vaccination was repeated after 3 weeks. No animals were culled. No further clinical cases were observed and all emergency restrictions applied during the outbreak were lifted on 31 March 2001. This entire area is within the FMD control zone accepted by the OIE and falls outside the FMD disease-free zone.

On the 1st of February 2001, FMD lesions were detected in cattle at a dipping tank in the Mhala district, within the foot and mouth disease control zone of Limpopo Province bordering the KNP (Fig.2). Contact between stray buffalo and cattle, following damage to the KNP fence after the floods, was the most likely cause of the outbreak. This was confirmed when nucleotide sequencing of a part of the VP1 gene indicated that the virus causing the outbreak was related to buffalo isolates previously obtained from the adjacent areas of the KNP. In this case the SAT2 FMD virus was diagnosed as the causative virus. The same

control strategy applied in Nkomazi was followed, with quarantine, vaccinations, strict movement control and surveillance. The emergency restrictions applied during the outbreak were lifted at the end of August 2001. The entire area falls within the foot and mouth disease control zone.

In summary, there were two minor outbreaks in the area previously recognized by OIE as disease free zone without vaccination (Camperdown and Middelburg feedlot). The two outbreaks in the Nkomazi and Mhala districts were in the FMD control zone and did not endanger the previously disease-free status.

1.4. RATIONALE FOR REQUEST OF SOUTH AFRICA FOR THE RE- INSTATEMENT OF A FMD FREE ZONE WHERE VACCINATION IS NOT PRACTISED

South Africa requests the Foot and Mouth Disease and other Epizootics Commission to consider the re-instatement of the previously recognised status of a FMD free zone where vaccination is not practised. The rationale for the request is the following:

- 1.4.1. The serotype O outbreak in Camperdown was well contained with no infection detected after 5 November 2000. All livestock on infected farms were stamped-out. Limited ring vaccinations were carried out once only with a saponin/alhydrogel adjuvant vaccine in negative herds on the periphery adjacent to the communal area. A total of 61% of the vaccinated animals were serologically evaluated between March 2001 and December 2001 and were found to be serologically negative.
- 1.4.2. The second outbreak in the feedlot at Middelburg, was controlled on the principle of emergency vaccination and stamping out (controlled slaughter) in accordance with Article 2.1.1.6 of the Code. The infection only occurred in the cattle in the feedlot. All the cattle and sheep were slaughtered under strict veterinary control. The disease never spread to the piggery on the farm. Pigs were vaccinated once as a precautionary measure. All porkers were slaughtered by the end of July 2001. Feedlot cattle were slaughtered by 19 March 2001 and vaccinated commercial cattle held adjacent to the feedlot by 5 December 2001.
- 1.4.3. The outbreaks in Nkomazi and Mhala were both in the FMD control zone adjacent to the Kruger National Park, which are not included in the free zone without vaccination.
- 1.4.4. National serological survey conducted on 634 randomly selected farms were negative for serotypes O, SAT-1 and SAT-2.
- 1.4.5. A selected serological survey on high-risk properties in perceived high-risk areas at the time of the outbreaks proved negative for the serotype prevalent for that area. During the period from the time of outbreak to 3 months post infection more than 3 million livestock were inspected clinically, serology samples taken of 34,435 animals of which all were negative.

1.4.6. The piggery was not infected at any stage, as indicated by serological results produced using the liquid phase blocking ELISA prior to vaccination and the 3ABC ELISA post vaccination. Porkers (44 000) were slaughtered and utilised locally. It is important for the Commission to note that should there have been active infection present within the piggery, it would have manifested very visibly and quickly within such a close-contact environment between the sows and porkers. At the end of May 2002 there will be only 2419 vaccinated sows left. Sows were vaccinated only once with the oil adjuvant vaccine and since there is no evidence of a carrier state in pigs, it does not pose a risk to keep these pigs. Furthermore 92% of vaccinated culled sows are already sero-negative..

1.5. FORMAL REQUEST FOR CONSIDERATION

The Foot and Mouth Disease and other Epizootics Commission is requested to consider the rationale and other evidence substantiated in the report for the reinstatement of the previously recognised FMD free zone where vaccination is not practiced, with immediate effect.

MAPS OF FMD OUTBREAKS IN SOUTH AFRICA: 2000 AND 2001

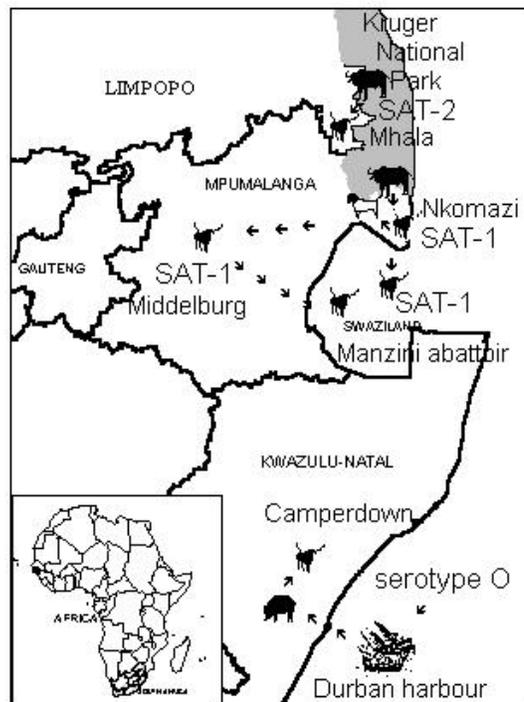
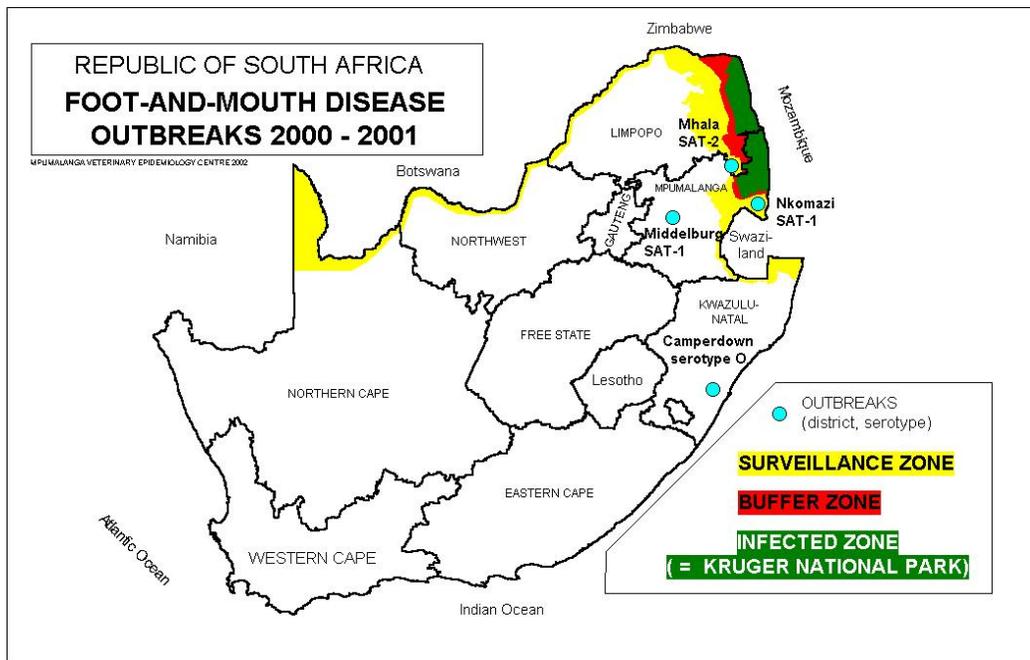


FIG 2: Maps indicating the regions in South Africa affected by the FMD outbreaks during 2000 – 2001. --> Denotes spread of the infection

government maintained and financed dipping tanks and are inspected at regular intervals by the local technical staff. Of the 2.3 million cattle in the Province 61 % are owned by the communal farmers, as are 25% of the sheep and 95% of the goats.

The province of KZN is divided into 51 administrative districts. The FMD outbreak was confined to one only.

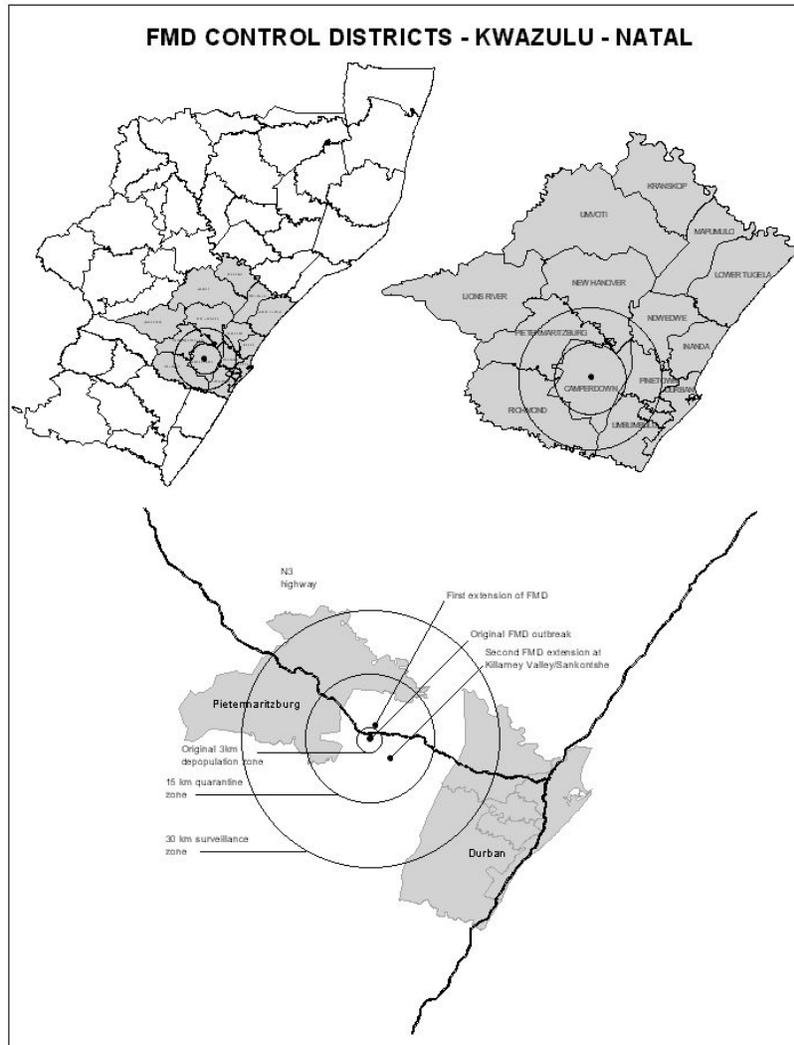


FIG.4: Map showing FMD control districts, as well as the location of the outbreak in Kwazulu - Natal

FIG.4: Map showing FMD control districts, as well as location of outbreak

A total of 16 districts were declared FMD control areas during the operation. For disease control purposes, the province of KZN is divided into 13 state veterinary areas each headed by a state veterinarian supported by trained animal health technicians. A total of 108 technicians are employed. There are also 124 fence guards responsible for the fences and movement control in the FMD surveillance zone along the Mozambique border.

The province has two veterinary laboratories, the main provincial laboratory

situated in Pietermaritzburg and a smaller laboratory situated in the north of the province at Vryheid. The Exotic Diseases Division, Onderstepoort Veterinary Institute performs all diagnostic tests for foot and mouth disease. The laboratory at Pietermaritzburg was responsible for the recording, packing and submission of the specimens during and after the disease outbreak as well as the correlation and reporting of results.

2.1.2. CONTROL MEASURES PRIOR TO OUTBREAK

Within the Province, strict FMD control measures were confined to the surveillance zone along the Mozambique border.

The international border, of approximately 65 km in length, is controlled by the National Department of Agriculture and any illegal introduction of livestock is followed up with assistance from the Stock Theft Unit of the South African Police Service.

Approximately 20 km from the international border, a second control fence is maintained by the Provincial Department of Agriculture. The area between this fence and the international border is the FMD surveillance zone. Cloven-hoofed livestock within the surveillance zone are inspected at communal dip tanks on a 14-day cycle. Cloven-hoofed animals may only move out of the surveillance zone after quarantine and inspection in official quarantine camps. All movements into, within or out of the zone are controlled by veterinary permits.

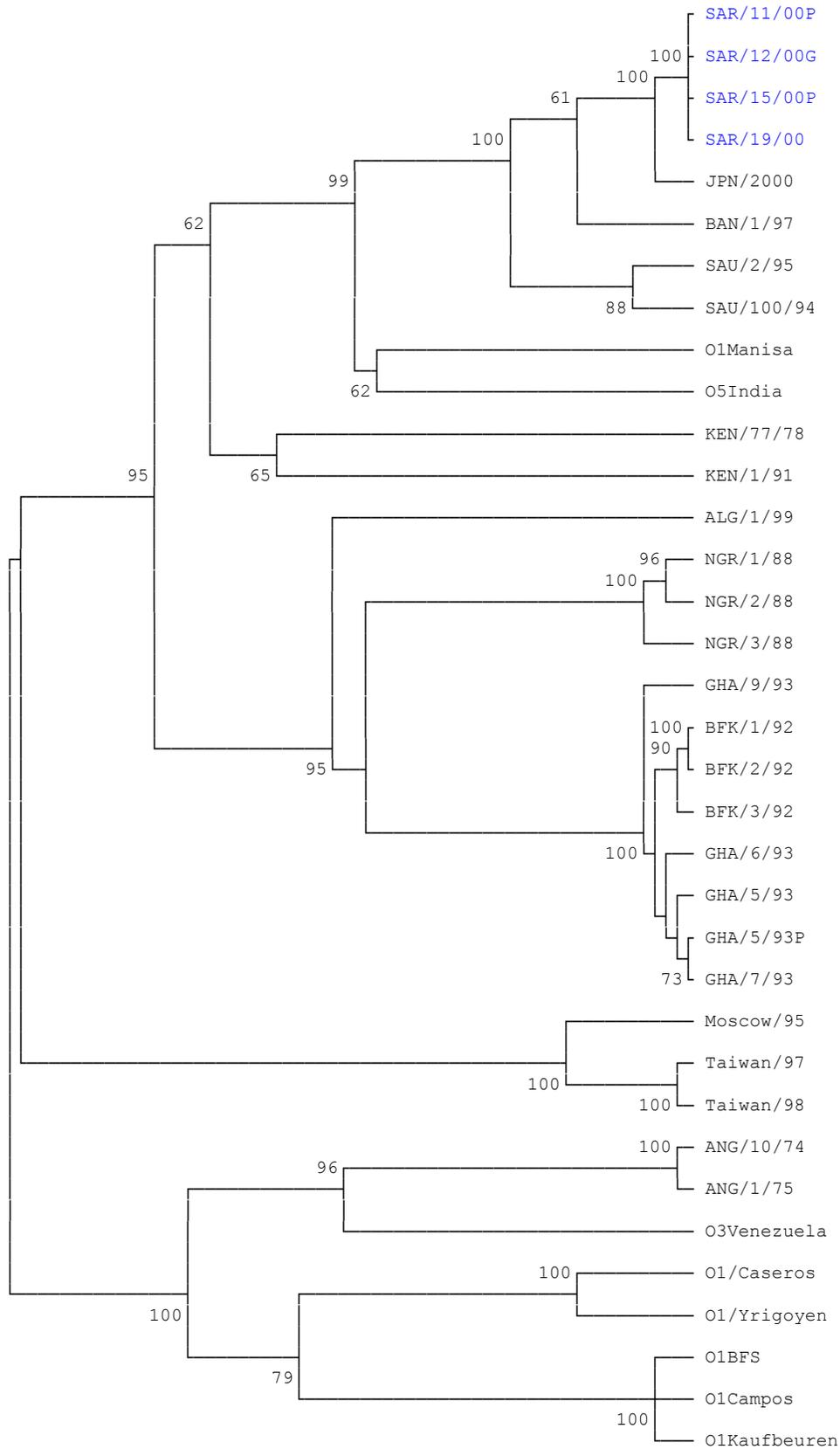
Products of cloven-hoofed animals are also subject to inspection before movement and veterinary permits are issued for movements out of the surveillance zone.

Within the rest of the province, FMD surveillance is combined with routine farm visits by officials, together with tuberculosis and brucellosis testing. Surveillance also takes place during the inspection of all livestock at sales and the ante mortem and post mortem inspections of all livestock slaughtered at abattoirs. The commercial farming areas are also well serviced by a network of more than 60 private veterinarians.

2.1.3. SYNOPSIS OF THE OUTBREAK OF FOOT AND MOUTH DISEASE

A private veterinarian investigated deaths in pigs on a farm in the Camperdown district and samples were submitted to a private pathologist. Vesicular lesions were detected and the local State Veterinarian was informed. Investigations commenced with immediate effect.

Samples taken from swill-fed pigs on Tifton Farm, Camperdown on 14 September 2000 were confirmed positive for the FMD virus at the Exotic Diseases Division, Onderstepoort Veterinary Institute, Pretoria on the 15 September 2000. This initial diagnosis was made by using the sandwich ELISA to detect viral antigen, the serotype O specific PCR to detect viral genomic material and virus isolation on primary pig kidney cells and the liquid phase blocking ELISA to detect antibodies.



Scale: each — is approximately equal to the distance of 1.79% Compiled by Dr RM Dwarka, 15/06/2001, OVI-EDD

Fig.5: UPGMA tree depicting VP1 gene relationships of O-type viruses. The South African outbreak strains are indicated in blue

Partial sequencing of the 3' end of the VP1 gene was used to determine the phylogenetic relationships between various isolates made during the outbreak. These sequences were also compared to other serotype O isolates to determine a possible origin of the exotic virus found in South Africa. The isolates taken from pigs, cattle and goats were all 100% homologous over the region sequenced and closely related to the Japan 2000 isolate. They fall into the Pan-Asian lineage, which suggests a possible origin in Asia (Fig. 5). This serotype has never been seen before in South Africa, whereas types SAT 1, 2 and 3 are endemic in the buffalo in the buffalo populations of the KNP.

It was suspected that the virus was brought into the country in swill derived from galley waste from shipping in Durban harbour, which was later fed to the pigs on Tifton Farm (labelled as "Original FMD outbreak" in Fig.4). An investigation was launched to ascertain the source of the virus but the country of origin and the ship involved could never be established.

2.1.3.1. Summary of outbreak

14 th Sept	-Samples taken from Tifton Farm Camperdown District (30° 31' 59.2" E : 29° 44' 52.8"S). Tifton Farm is labelled as "Original FMD outbreak" in Fig.4
15 th Sept	-Confirmed positive type O, FMD virus
16 th Sept	-Trace back of animal, human and vehicle movements started, all other properties visited by the farm staff and private veterinarian inspected and placed under quarantine
16 th Sept	-The FMD control centre was established/call up of staff/intensive surveillance begun/permit control started/culling of pigs on Tifton farm started
17 th Sept	-Culling and burial of 677 pigs, 5 sheep, 14 goats and 6 cattle on Tifton completed
18 th Sept	-Quarantine notices served on all farms within 3 km of Tifton -10 km quarantine zone established with prohibition of movement of all animal and animal products (Fig.4) -Roadblocks established with assistance of Security force personnel -Intensive surveillance on surrounding farms -Further 20 km surveillance zone identified with movement controls and surveillance (Fig.4)
20 th Sept	-Positive samples detected in one cow on Esparanza (neighbouring farm) during routine surveillance. (30° 32' 50.9" E 29° 44' 40.1 S) This farm is also part of the label "Original FMD outbreak" in Fig.4. A total of 5 clinical cases were seen during culling operation - Pigs on farm not infected but decision taken to destroy all animals on farm
22 nd Sept	- To ensure that no animals enter the export trade, a total of 16 magisterial districts were declared as a FMD control area (Fig.4). Movement control instituted with inspections before any movement of cloven-hoofed livestock or their products was allowed

29 th Sept	-All cattle and pigs on Esperanza slaughtered, farms disinfected and surrounded by razor wire (2381 pigs and 953 cattle). -3 km depopulation zone using natural barriers was identified around the two infected farms and depopulation started
1 st Oct	-Depopulation of 3 km zone completed
10 th Oct	-Positive FMD found on Thornhill farm (5 kms from original outbreak, geographical location: 29° 42' 54.4" S 30° 32' 50.9" E (Fig.4, labelled as "First extension of FMD")
11 th Oct	- All 19 livestock on Thornhill slaughtered -Sanitary cordon placed around infected zone by Security force personnel, including horse and foot patrols -Meetings held with traditional leaders in the surrounding communal areas
23 rd Oct	-Fence erected to limit cattle movement into infected area
30 th Oct	-Positive animals identified in Killarney valley (Fig.4) -Clinical cases identified in communal areas of Mophela/Sankontshe. These areas border directly onto the Killarney Valley farms
30 th Oct	-Increased culling area identified and culling operations commence
8 th Nov	-Completion of culling operations with 982 cattle, 1 102 pigs, 122 sheep and 814 goats being culled. During culling operations 37 animals seen with clinical symptoms
5 th Nov	-Last clinical case seen during culling operation at the Eston culling site
8 th Nov	On 8 November serological results obtained by using the liquid phase blocking ELISA indicated that there were possible serologically positive animals at a dipping tank in the Valley of a Thousand Hills outside the 30km restricted zone. This dip tank falls in a vast communal grazing area without fencing between properties and it was decided to stop the culling operation and start a ring vaccination campaign while waiting for confirmation of the results by virus neutralisation assay. The control measures were also immediately extended to include a larger area. The results obtained 3 days later indicated that the disease had not spread and the World Reference Laboratory at Pirbright later confirmed these results. The emergency control measures were subsequently decreased to the original restricted area but it was nevertheless decided to complete the limited vaccination programme in the district of Camperdown.
11 th Nov	-The diptank was revisited and a further 108 samples collected. These tested negative. For confirmation of these results all samples were submitted to the OIE World Reference Laboratory (Pirbright United Kingdom)
30 th Nov	-The final results were received from Pirbright confirming the negative status of this diptank area -The conclusion was that this diptank area was not infected. As it had been more than 30 days since the last positive case in the Killarney Valley area, the enlarged control area was

Dec 2000	reduced to the original 30 km radius -During December all properties in the 16 magisterial districts previously declared as the FMD control area, were visited and inspected and random serum samples taken
Nov. to Feb	-A total of 9 738 cattle, 1 219 sheep and 1 457 goats were vaccinated within the disease control zone of 15km within the Camperdown district. All vaccinated animals were branded with a "F" brand on the left neck or cheek at the time of vaccination
Feb 2001	-Vaccinations ceased and surveillance continues in control area

Due to the sensitivity of the public mainly as result of intensive press coverage of the outbreak, numerous reports of suspicious cases were reported to state veterinarians throughout the province. These were all followed up, with an inspection by an official and collection of samples if needed. All these cases proved to be negative.

2.1.3.2. Definition of area:

It was decided after the initial surveillance results from the surrounding farms that a 10 km quarantine zone with strict movement controls and surveillance would be established. This was later expanded to 15 kms after the disease was confirmed in the adjoining communal area. The quarantine zone was surrounded by a further 20 km surveillance zone, in which increased surveillance was carried out. Movement control was also enforced. A further 16 magisterial districts were proclaimed in the Government Gazette as a foot and mouth disease control area with movement control and a prohibition of exports from this area (see Fig.4, on page 13).

2.1.3.3. Animals at risk:

Out of the 2,45 million head of cloven-hoofed livestock in the province, 260,000 were regarded at risk, as they occurred in the Camperdown magisterial district and the 6 adjoining districts.

Since the 5th November 2000, no clinical cases or positive serum samples outside the vaccination zone have been detected.

2.1.3.4. Field Surveillance results

2.1.3.4.1. During Outbreak

A total of 367 168 physical inspections and 34 324 serological examinations were recorded during the period 16 September 2000 until end of January 2001 within the infected and surveillance zones and surrounding areas. Properties surrounding the infected zone were visited on a weekly basis; farms in the surveillance zone were visited on a 14-day cycle.

Game animals were also inspected by officials in the three game reserves bordering the infected area. A total of 189 serum samples were collected from game animals and all proved to be negative.

2.1.3.4.2. Ongoing surveillance in control area

From 1 February 2001, surveillance in the Camperdown magisterial district was carried out on a 14-day cycle within the 15 km quarantine zone and on a 28-day cycle within the surveillance zone. A total of 78 properties are in the quarantine zone and 98 in the surveillance zone. A total of 14 895 cloven hooved livestock are inspected on these properties every month. Random samples of animals are bled for serological testing. Up until February 2002, all results have proved negative.

2.1.3.4.3. Sero-surveillance results

Vaccination area

When the infection was confirmed on the periphery of the communal area, a limited ring vaccination strategy was implemented. This included all the farms in the quarantine zone, excluding the pig farms.

From a period 3 weeks post vaccination and up to 6 months later, vaccinated animals showing positive reactions to the blocking ELISA were subjected to the 3 ABC ELISA; all tested negative indicating that no active infection was present.

Number of animals bled and tested within vaccination area:

Farms	Cattle	Pigs	Sheep	Goats	Game
191	6,248	1,137	629	751	122

Surveillance in the free area (outside Camperdown Magisterial district)

All properties in the remaining 15 declared magisterial districts were visited, all animals inspected and a statistical sample submitted for serology with negative results.

From Sept 2000 until January 2002 the following serological samples from the free area were tested, all with negative results.

Farms	Cattle	Pigs	Sheep	Goats	Game
1,228	18 941	315	3018	3,409	64

2.1.4. CONTROL

2.1.4.1. During Outbreak

Initially the control measures were based on a stamping out policy, in which all cloven hooved animals were destroyed on the infected farm. This was extended to the adjoining farms using natural barriers to create a depopulated cloven-hooved area of approximately 3km around the initial infected farm. When infection was diagnosed on the periphery of the communal farming area, a decision was made to use a limited ring vaccination strategy and cease stamping out of animals.

2.1.4.1.1. Logistical support

As soon as the initial diagnosis was confirmed, an Operational Centre was established at Allerton Headquarters. The South African National Defence Force (SANDF) and the South African Police Services (SAPS) were informed and a Joint Operational Centre formed. A Joint Operational Committee (JOC) was established, involving all role players that met on a daily basis throughout the control campaign. The Road Traffic Inspectorate (RTI) and the provincial disaster management committee also formed part of the Joint Operational Centre. The SANDF, SAPS and RTI officials functioned at roadblocks, formed cordons for movement control purposes and assisted with the supply of the logistical equipment needed for the control operation i.e. tents, mobile showers, toilets, roadblock equipment, radio communications etc.

Veterinary staff from KwaZulu Natal arrived at Allerton within 24 hours of the diagnosis being made and immediately started with movement control and surveillance. At the height of the campaign more than 300 members of KwaZulu Natal personnel were involved.

Veterinary personnel were also drawn from other provinces to assist with inspections, surveillance and movement control and a total of 143 veterinary personnel from other provinces were involved in the control operations.

The SANDF committed up to 900 defence force members and the SAPS 70 members, who manned 23 roadblocks as well as performing other duties. The SANDF also provided aerial support, both fixed wing and helicopters.

Within 2 days of the outbreak a complete set of aerial photographs were taken and were made available for planning control operations. The Department of Agriculture seconded 80 extension officers to assist with extension and communication in communal areas. Quarantine camps were erected and all stray animals were impounded.

Daily press releases were prepared and numerous meetings with farmers in both commercial and communal areas were held.

2.1.4.1.2. Movement control:

Movement control of animals and animal products both into and out of the quarantine and surveillance zones was strictly enforced during these outbreaks and whereas, initially, there were only 9 roadblocks, the number rapidly increased to 23 with an average of 17 throughout the campaign.

A complete ban on the movement of animals, animal products and agricultural produce in the infected area was enforced.

Movement protocols were revised at regular intervals according to the latest disease surveillance results. A dedicated permit office, headed by a senior veterinarian, was established to control issue of all permits. All animals were inspected before the issuing of a permit.

Personnel were stationed at all abattoirs in the quarantine and surveillance zones and at other abattoirs in KwaZulu-Natal to control the arrival of animals, inspect all animals pre- and post slaughter and to ensure the correct documentation was present.

2.1.4.1.3. Slaughter-out

A total of 6 773 animals were culled over the entire period (see table below):

Place	Date	No. properties	Cattle	Pigs	Sheep	Goats	Total
Initial plus 3 km zone	30 Sept	14	213	3 374	42	37	3 666
Thornhill	10 Oct	1	15	0	0	4	19
Killarney Valley Commercial	3-6 Nov	23	432	914	146	182	1 674
Sankontshe	3-6 Nov	1	771	5	2	637	1 415
Total		39	1 431	4 293	190	860	6 774

All farms where animals were culled were sanitized twice with a 10-14 day interval, by a commercial contractor under official supervision

2.1.4.1.4. Vaccination:

A FMD type O saponin/alhydrogel vaccine (01 Manisa), imported by Intervet was used.

Over the period between November 2000 to February 2001, 9,738 cattle, 1,219 sheep and 1,457 goats were vaccinated. This was carried out on 138 commercial properties and at 10 sites on the periphery of the communal areas.

2.1.4.2. **Post Outbreak**

2.1.4.2.1. Sentinel animals:

No pig farms were vaccinated and these acted as sentinel animals. Two cattle farms within the vaccination zone were also left as sentinel herds.

Sentinel animals (cattle), placed on Tifton and Esperanza in December 2000 were still serologically negative 30 days later (8 January 2001) and by 2 February 2001, restocking had commenced.

2.1.4.2.2. Movement Control

After the deregulation of the 15 districts, a revised movement protocol was approved during July 2001 to lessen the movement restrictions in the previously controlled areas with the exception of Camperdown. In the Camperdown district strict movement control over vaccinated animals, surveillance and inspections remain in force.

Vaccinated animals are only allowed out of the Camperdown district directly to an approved abattoir under strict veterinary permit control. Vaccinated farms are inspected at 14-day intervals and all stockowners are obliged to keep strict records of all vaccinated animals.

2.1.4.2.3 *Serological surveillance in vaccinated area*

Between February and September 2001, 6171 animals were bled out of the original 12414 vaccinated (50%) and only 45 animals tested positive for antibodies to serotype O (0.7% of the animals tested). During November and December 2001 another 1543 animals were tested and no positive animals were found. These animals were vaccinated only once between November 2000 and January 2001 with the saponin/alhydrogel vaccine and the negative results are therefore not surprising and furthermore indicates that no infection was present at the time of the outbreak. Therefore, in excess of 99% of animals have lost their titres by end of December 2001.

2.2. TWO RELATED OUTBREAKS OF SAT 1 IN MPUMALANGA (MIDDELBURG AND NKOMAZI)

2.2.1. HISTORY OF FMD IN MPUMALANGA PROVINCE

The Mpumalanga Province of South Africa borders onto Mozambique in the east and Swaziland in the south. The KNP forms the northeastern area of the province. There are about 1 000 000 cattle, 1 100 000 sheep, 53 000 goats and 80 000 pigs in the province. The province is 80 000 km² in extent, of which 3000 km² (less than 4%) was affected by the 2000-2001 Nkomazi FMD outbreak.

FMD outbreaks were first recorded in livestock in Mpumalanga in 1937, and occurred sporadically every 1 to 7 years. The last FMD outbreak in Mpumalanga province, outside the endemically infected KNP, occurred in 1977 – an extensive outbreak in cattle in the communal grazing area of the Nsikazi district on the western boundary of the KNP, as well as an unrelated, limited outbreak amongst commercial cattle in the Nkomazi area on the southern boundary of the KNP.

After 1977, spread of the disease had been effectively prevented through movement control by fences and a permit system, as well as by vaccination of livestock in areas adjacent to the KNP. Since 1992 the vaccination area in the Nkomazi area was reduced systematically according to the risk of spread of the disease and the improvement and effectivity of veterinary and game fences, as illustrated in Fig.6.

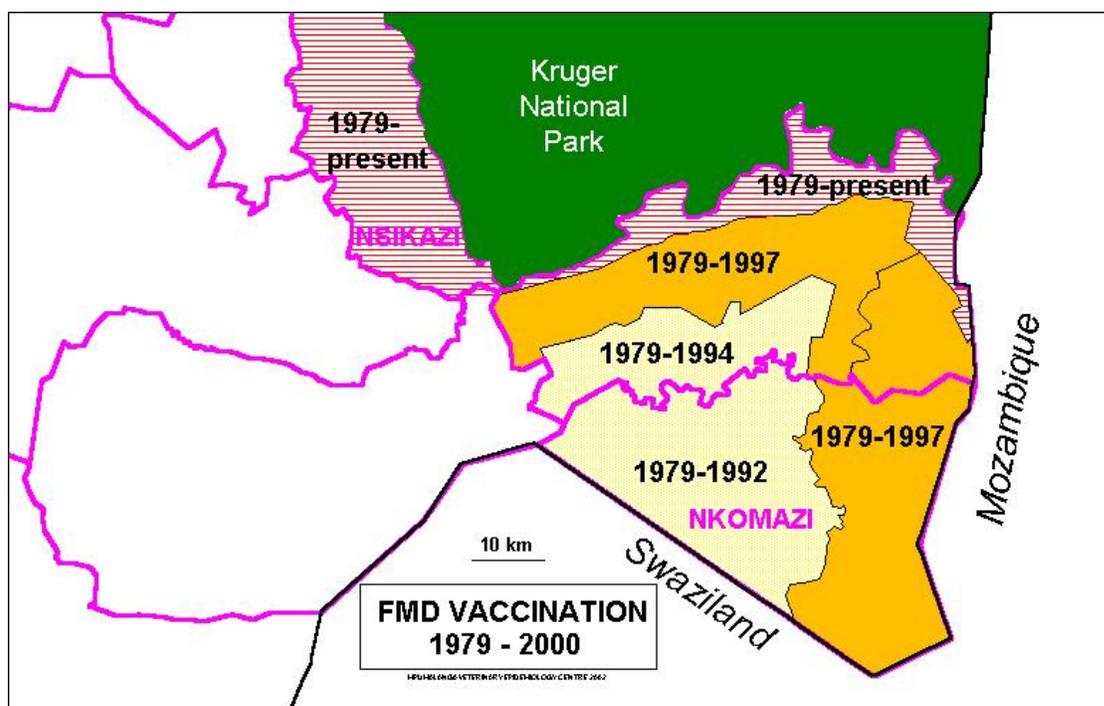


FIG 6: Map showing area of FMD vaccination in the Mpumalanga Province from 1979 to the present

2.2.2. CONTROL MEASURES IN PLACE BEFORE THE OUTBREAK

The routine control measures in place before the 2000 FMD outbreak consisted briefly of the following:

- The FMD control zone proclaimed in terms of the Animal Diseases Act (no. 35 of 1984) includes the infected zone, (the KNP), the buffer zone and a surveillance zone adjacent to the buffer zone (Fig. 7).
- **Veterinary fences** were erected along the western and southern boundaries of the KNP as well as around all other game reserves and game farms where infected African buffalo are kept.

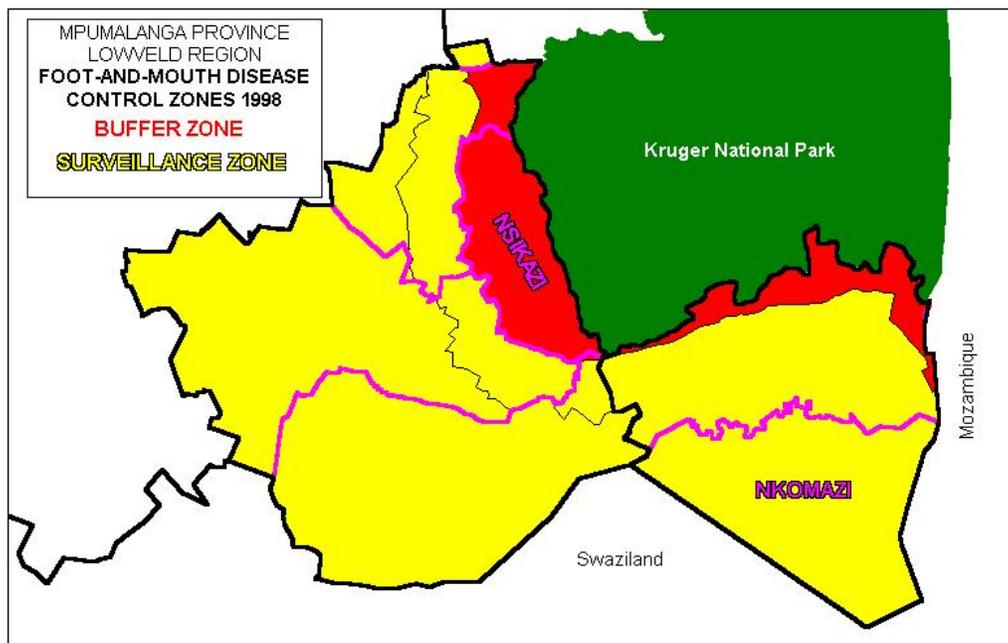


FIG.7: FMD controlled area of the Lowveld Region of Mpumalanga

- From 1979 to 1997, cattle, goats and sheep were **vaccinated** in the areas indicated in Figure 6 with a trivalent FMD vaccine, containing SAT-1, SAT-2 and SAT-3. Since 1998 only cattle in the buffer zone are vaccinated every six months (Fig. 7).
- Records of numbers and increases and decreases of all susceptible livestock in the control zone are by the owner. For this purpose **livestock registers** are kept by Veterinary Services, corresponding to stock cards or records kept by owners
- All increases and decreases and the reasons therefore are recorded during compulsory **livestock inspections** at the following intervals:

<i>Part of restricted area</i>	<i>Cattle</i>	<i>Goats, sheep and pigs</i>
Buffer zone	7 days	28 days
Surveillance zone	14 days	28 days

During the above livestock are inspected and counted by animal health technicians.

- A **permit system** regulates the movement of all cloven-hoofed animals and their products from, to and within the various areas, according to the 1998 FMD control measures
 - * Cattle from the buffer zone may only leave the area after being permanently identified by a "F" on the right side of the neck and after 14 days quarantine. These cattle may only be moved to the surveillance zone or for direct slaughter at an approved abattoir in the control zone.
 - * Cattle from the surveillance zone may only leave that area if unvaccinated and negative on serology or for direct slaughter.
 - * Cloven-hoofed game may only leave the buffer or surveillance zones after 14 days quarantine and a negative serological test.
 - * All products of cloven-hoofed animals from the buffer or surveillance zones are subject to permit control.

2.2.3. FOOT AND MOUTH DISEASE OUTBREAK: FEEDLOT IN MIDDELBURG (MPUMALANGA)

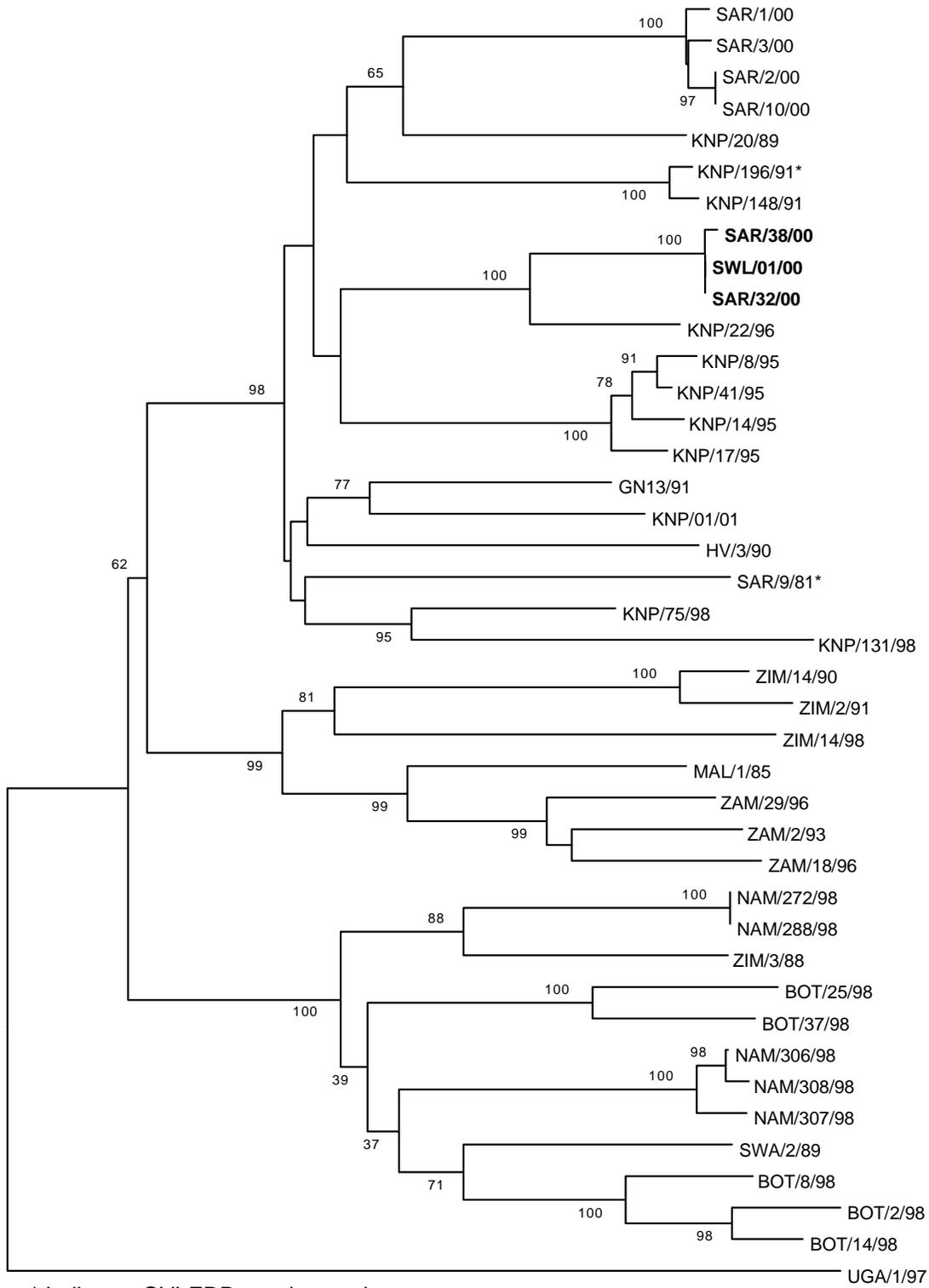
2.2.3.1. Background:

A suspicion of FMD infection was raised by Swaziland when cattle from a feedlot on the farm Arendsfontein 464JS (Geographical locus 25° 53' 41" S, 29° 34' 02" E) in the Middelburg district (Mpumalanga Province) belonging to Kanhym Estates, were sent to the abattoir in Manzini, Swaziland. These cattle were sent on Thursday, 23 November 2000 and suspicious lesions were found during routine meat inspection on Friday, 24 November 2000. Samples were taken from live animals showing symptoms by the Swaziland authorities and dispatched to the Exotic Diseases Division, Onderstepoort Veterinary Institute (EDD-OVI), where they arrived on the evening of 28 November 2000. On Wednesday, 29 November 2000 at 08h00 the Director of Veterinary Services in Mpumalanga was notified of the positive diagnosis, as was the National Director of Veterinary Services. An investigation was immediately conducted on the farm Arendsfontein, which was placed under quarantine and all movements were stopped. Clinical lesions were detected in 30 cattle. Samples were immediately dispatched to the EDD-OVI and confirmed positive for SAT1 FMD virus late on the night of 29 November 2000. Subsequent samples submitted on Thursday, 30 November 2000 also yielded positive results for SAT1 FMD virus.

The isolates obtained from the outbreak in Kanhym (SAR/32/00), as well as those from Nkomazi (SAR/40/00), were investigated to determine the possible source of infection in cattle. Partial nucleotide sequencing of the 3'end of the VP1 gene was determined and the phylogenetic relationships determined with other isolates from southern Africa (Fig. 8). The origin of all isolates included in Fig. 8 is indicated in Table 1. The comparisons indicated that the virus found in the abattoir in Swaziland (SWL/01/00) was 100% homologous over the region sequenced to the isolate found in the feedlot in Kanhym, indicating that the Swaziland incidence had originated from a feedlot in South Africa. An infection was found at Thabonkhulu and the virus was 100% homologous to the other isolate obtained from Kanhym (Fig. 8). This isolate was related to viruses previously isolated from buffalo in the south of the KNP indicated that buffalo was the most likely source of infection in the cattle.

TABLE 1: List of viruses included in the phylogenetic tree

ISOLATE	COUNTRY	LOCATION	SPECIES
BOT 2/98	Botswana	Nxaraga	Buffalo
BOT 8/98	Botswana	Nxaraga	Buffalo
BOT 14/98	Botswana	Nxaraga	Buffalo
BOT 25/98	Botswana	Vumbura	Buffalo
BOT 37/98	Botswana	Vumbura	Buffalo
MAL 1/85	Malawi	Kasungu National Park	Buffalo
SWA 2/89	Namibia	Caprivi	Buffalo
NAM 272/98	Namibia	Mahili National Park	Buffalo
NAM 288/98	Namibia	Mahili National Park	Buffalo
NAM 306/98	Namibia	Mahamgo National Park	Buffalo
NAM 307/98	Namibia	Mahamgo National Park	Buffalo
NAM 308/98	Namibia	Mahamgo National Park	Buffalo
KNP 20/89	South-Africa	Numbi Gate, Kruger National Park (KNP)	Buffalo
KNP 148/91	South-Africa	Skukuza area, KNP	Buffalo
KNP 196/91	South-Africa	Berg-en-dal area, KNP	Buffalo
KNP 8/95	South-Africa	Orpen area, KNP	Buffalo
KNP 14/95	South-Africa	Orpen area, KNP	Buffalo
KNP 17/95	South-Africa	Orpen area, KNP	Buffalo
KNP 41/95	South-Africa	Orpen area, KNP	Buffalo
KNP 75/98	South-Africa	Shingwedzi area, KNP	Buffalo
KNP 131/98	South-Africa	Orpen area, KNP	Impala
KNP 22/96	South-Africa	Lower Sabie, KNP	Buffalo
KNP 01/01	South-Africa	Shinwedzi area, KNP	Buffalo
SAR 9/81	South-Africa	Pafuri, KNP	Game
SAR1/00	South-Africa	Phalaborwa	Buffalo
SAR2/00	South-Africa	Phalaborwa	Buffalo
SAR3/00	South-Africa	Phalaborwa	Buffalo
SAR10/00	South-Africa	Phalaborwa	Bovine
SAR 32/00	South-Africa	Kanhym Estate, Mpumalanga	Bovine
SWL 01/00	Swaziland	Manzini	Bovine
UGA 1/97	Uganda	Hamukungu	Buffalo
ZAM 2/93	Zambia	Nanzhile Kafue National Park	Buffalo
ZAM 18/96	Zambia	Nanzhile Kafue National Park	Buffalo
ZAM 29/96	Zambia	Lochinvar National Park	Buffalo
HV 3/90	Zimbabwe	Hippo Valley National Park	Buffalo
GN 13/91	Zimbabwe	Gonarezou National Park	Buffalo
ZIM 3/88	Zimbabwe	Hwange National Park	Buffalo
ZIM 14/90	Zimbabwe	Bumi	Buffalo
ZIM 2/91	Zimbabwe	Bumi	Buffalo
ZIM 14/98	Zimbabwe	Lubangwa Island, Kariba	Buffalo



* Indicates OVI-FDD vaccine strains
 0.05

Compiled by Karin Boshoff, 01-08-2001

FIG.8: Neighbour-joining tree depicting VP1 gene relationships of SAT-1 viruses in southern Africa

The farm Arendsfontein (also known as Kanhym Estate) is a dedicated feedlot system for cattle (14 308) and pigs (48 376) with excellent record keeping. Both groupings are housed in separate fenced facilities. The fact that there is strict control and biosecurity implies that these facilities could be managed as quarantine facilities. There is no immediate physical or human contact between the two units. No clinical cases occurred in the piggery and serological samples taken during and throughout the operation were negative. Strict bio-sanitary control to prevent cross contamination between the feedlot and the pig unit was maintained around the clock. A disinfection point, spraying all vehicles entering the infected area as well as a control point at entry to the cattle feedlot and the piggery was instituted. The feedlot and main piggery on Kanhym were included in the infected zone (Fig 9). Other activities on the farm included a feedmill producing feed for pigs, a small feedlot for sheep (2 445), a herd of commercial cattle, manure for cultivation of gardens and crops; a small abattoir on the premises and a fleet of trucks leased commercially.

Kanhym Estates also has a National Pig Development Unit (NPD unit) consisting of \pm 5000 pigs about 5 kilometres from the feedlot. On the farm Driehoek, adjoining Arendsfontein, there is another small quarantine unit that had 24 pigs at the time of the outbreak.

The NPD unit and small quarantine unit mentioned in the previous paragraph had excellent bio-security measures in place and were excluded from the infected zone but included in the quarantine zone. The quarantine zone also included some commercial cattle farms, one fairly big dairy (EDE Farming), two small-scale dairies and two fairly big piggeries (ALZU \pm 7000 pigs and EDE Farming \pm 12000 pigs). EDE Farming also has a small cattle feedlot (\pm 350 cattle), commercial cattle (2200) and some sheep. Other farming activities in the quarantine zone consist mainly of crop production (maize and potatoes) (Fig.9).

Kanhym sources their cattle for the feedlot from Namibia (30-40%), Mpumalanga surrounding Kanhym (30-40%), Free State Province (5-10%) and Eastern Cape Province (5%). Very few animals are sourced from the Western- and Northern Cape Provinces. Kanhym makes use of 2 agents buying animals from farmers and speculators.

A business activity subsequently identified as high risk, and since the outbreak that has been abolished, is the system of contract or custom feeding, whereby Kanhym feedlot feeds animals of outside customers in the feedlot. These animals are sourced from different farmers and from any area of the country by private individuals who are mainly butchers and retailers in the meat trade. It was this weak link that precipitated the outbreak in Kanhym. Cattle were purchased in the Nkomasi surveillance zone and translocated directly to the feedlot.

Occasionally younger purchased animals are taken to a farm (Middelplaas) in the Ermelo district and fed on pastures until they are ready for the feedlot at Kanhym.

The situation at the piggery is somewhat different to that in the cattle feedlot. Breeding pigs for the piggery come from their own NPD unit about 5km away and from similar units at Magaliesberg, Bapsfontein and Heidelberg in Gauteng Province.

Kanhym's NPD piggery supplies various other piggeries with breeding stock (gilts, pregnant sows, boars and semen).

Immediately after confirmation of FMD, an infected area, quarantine zone and surveillance zone was identified (Fig. 9).

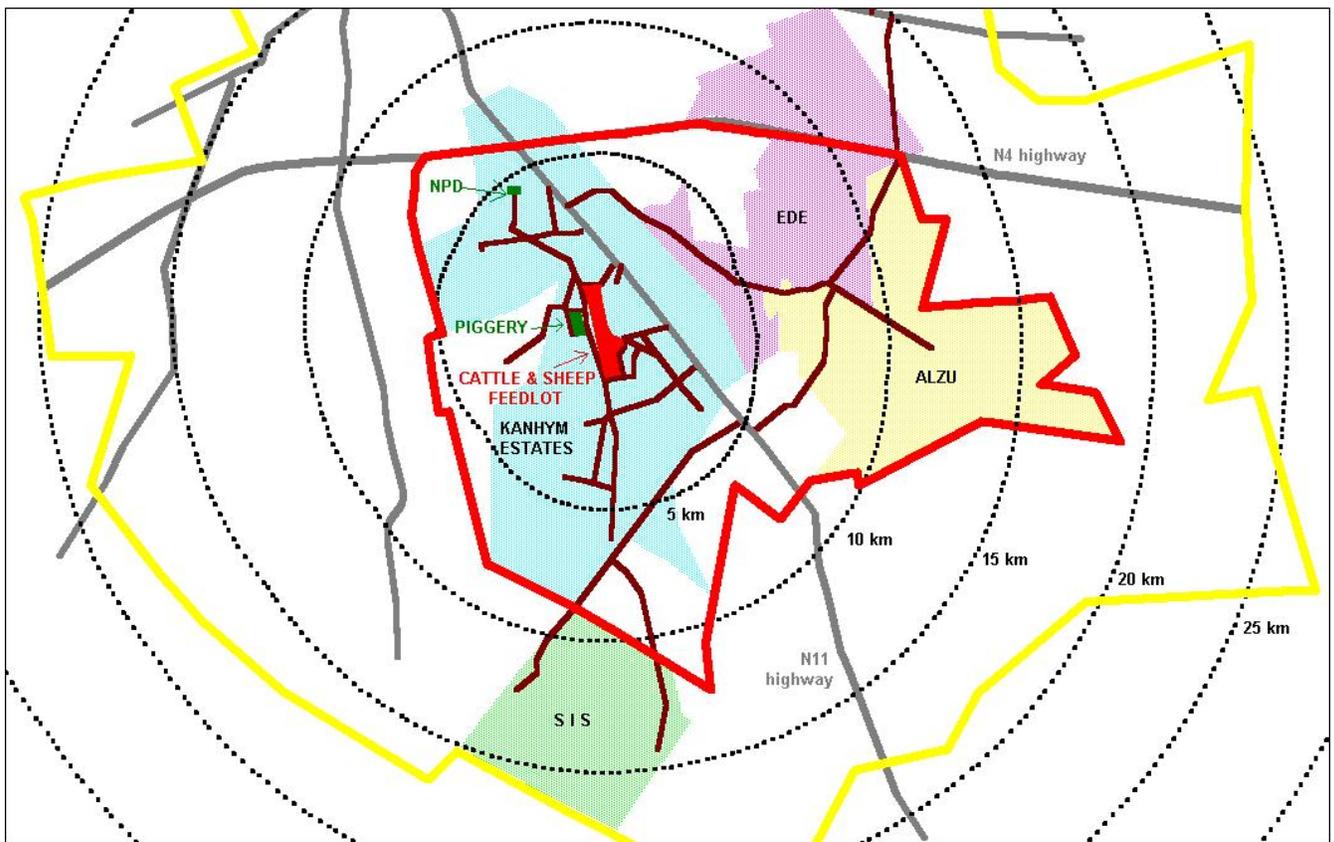


FIG.9: Map showing infected feedlot area (red) and quarantine zone (area within red line), and also the surveillance zone (yellow)

Stock census of the area under restriction:

INFECTED AREA (275 ha)

	CATTLE	SHEEP	PIGS	GOATS	GAME
CENSUS	14308	2445	48376	0	0

QUARANTINE AREA (31632 ha)

	CATTLE	SHEEP	PIGS	GOATS	GAME
CENSUS	30185	4373	25671	235	0

SURVEILLANCE AREA (96911 ha)

	CATTLE	SHEEP	PIGS	GOATS	GAME
CENSUS	22794	4916	350	402	671

TOTAL

	CATTLE	SHEEP	PIGS	GOATS	GAME
CENSUS	68426	11760	73988	637	671

2.2.3.2. Course and progress of the disease:

Following confirmation of FMD at Kanhym Estates (Arendfontein) on 29 November 2000, the following control measures were immediately instituted: emergency vaccination and subsequent slaughter. A Joint Operational Committee (JOC) similar to the process followed in KwaZulu-Natal was set up within 24 hours following the detection of the disease. The JOC consisted of management from provincial and national veterinary services, SANDF, SAPS, RTI, and representatives of organised and the informal farmer community. The last new clinical case in the feedlot was observed on 14 December 2000. On 15 January 2001 controlled slaughter commenced. By 19 March all the feedlot cattle and sheep were slaughtered. From 19 March to the end of March, disinfection was continued and finished. Sentinel cattle (200) were introduced in April. During April these sentinel animals were bled when entering the feedlot and twice while in the feedlot (14 days apart). All results were negative on the liquid phase blocking ELISA. They were inspected every second day. At the beginning of May quarantine was lifted on the feedlot and the piggery. In the first week of May Kanhym estates started to introduce new animals in the feedlot.

2.2.3.2.1. Sequence of events during outbreak:

DATE	Event
23 November 2000	70 Cattle exported from Arendsfontein to Manzini abattoir in Swaziland
24 November 2000	Matsapha (Swaziland) - suspicious vesicular lesions on ante mortem inspection
28 November 2000	Tissue samples submitted from Matsapha abattoir to the OVI
29 November 2000	<ul style="list-style-type: none"> • Matsapha samples SAT 1 positive • Arendsfontein feedlot and surrounding farms under quarantine • Inspections and sero-surveillance commenced
1-3 December 2000	First vaccination of feedlot cattle using a trivalent SAT 1, SAT 2 and SAT 3 vaccine
1 December to 31 January 2001	<ul style="list-style-type: none"> • Feedlot and piggery = inspections 2x/day, sero-surveillance 1 x per week • Rest of quarantine zone = inspections 2 x per week, sero-surveillance 1 x per week • Surveillance zone = inspections once a week, sero-surveillance 1 x per 2 weeks
4 December 2000	Vaccination of feedlot sheep and commercial cattle on surrounding farms
4 December 2000	4 road blocks instituted at entry and exit points
8, 9 December 2000	Pigs in piggery vaccinated with monovalent SAT 1 vaccine with oil adjuvant
14 December 2000	Last new clinical case seen in feedlot
18-20 December 2000	Second vaccination of feedlot cattle
12 January 2001	Road blocks lifted
15 January 2001	Controlled slaughter of feedlot cattle and sheep started
1 February 2001 to 19 March 2001	<ul style="list-style-type: none"> • Feedlot and piggery = inspections 3 x per week, sero-surveillance, every 2 weeks in pigs • Rest of quarantine zone = inspections every 2nd week, sero-surveillance, once a month before slaughtering in the feedlot
19 March 2001	Controlled slaughter of feedlot cattle completed
19-30 March 2001	Disinfection of feedlot done
30 March	Vaccinated commercial breeding cattle released to grazing
2 April 2001	<ul style="list-style-type: none"> • 200 sentinel cattle introduced to feedlot pens • Sero-surveillance (200)

April 2001	Inspections 2 x per week
19 April 2001	Sero-surveillance 200 sentinel cattle
30 April 2001	Sero-surveillance 200 sentinel cattle
2 May 2001	Movement restrictions lifted on feedlot
May to date	Regular inspections and sero-surveillance

2.2.3.3. Epidemiological investigations

2.2.3.3.1. Backward and forward tracing:

Follow-up and trace-back actions carried out immediately revealed no spread of the infection from the feedlot.

Forward tracing:

Cattle:

The fact that very good records are kept and that the majority of animals are slaughtered directly, facilitated forward tracing. Some 731 calves (groups of 76, 326 and 299) were moved from Kanhym to Middelplaas in the Ermelo district before the outbreak. The calves are reared there until they are ready to go to the feedlot. Blood samples were collected on 3 December 2000. On 6 December 2000 the results were received - all samples were negative. Blood samples of these cattle were again taken on 28 December, and all results were negative.

Pigs:

The disease was kept out of the piggery through stringent control and biosecurity measures. The majority of pigs are slaughtered. The selling of breeding stock was followed up and all serological and clinical results were negative. Kanhym Estates also rented facilities on a farm outside Middelburg in the outbreak surveillance zone. This farm was visited immediately and animals were inspected and sero surveillance was done. All samples tested negative.

Back tracing:

Cattle:

After sequencing of the virus it was obvious that efforts had to be concentrated on animals that came from the Lowveld area in the Mpumalanga Province. The virus was similar to other viruses of African buffalo occurring in the southern part of the KNP.

During the early months of 2000 severe floods washed away sections of the southern fence of the Kruger National Park resulting in contact between buffalo and cattle. Inspections and surveillance in the area south of the KNP were intensified.

Since the Kanhym agents source mainly from areas other than the Lowveld, it was clear that all efforts had to be concentrated on the custom feeders and who source throughout the entire country and in one particular case an individual who sourced cattle from the Nkomazi district. Detailed records were available from the feedlot and the state veterinary offices within the area. All areas where possible movement to and from occurred or were recorded, were included in the back-tracing exercise.

Pigs:

The piggery sources only from Kanhym's own farms, which are not in FMD control zone. The pigs had not contracted the disease, and back tracing in the pigs was uncomplicated. Serological testing was done, and all results were negative.

Normal stringent biosecurity at the piggery and the feedlot facilitated tracing of other activities.

Other activities:

Trucks:

All trucks entering and leaving the premises were disinfected routinely. The practice of commercial leasing of trucks were stopped.

Manure:

The transport of manure from Kanhym with trucks to and from the Lowveld was also considered. The movements that were investigated proved not to have caused any problems. Movement of manure from the feedlot was stopped.

Abattoir (Kanhym):

The abattoir at Kanhym Estate was closed for the duration of the operation. Carcasses already in the fridges were deboned and the meat consumed on the estate. The pig carcasses, skins, offal, bones and everything else were disposed of by incineration on the premises under official supervision.

Feed:

Livestock feed was produced on site, at the estate. The distribution of dairy meal and pig feed was stopped. Only chicken feed was marketed under strict control and security.

People:

Strict control over people (movement and disinfection) was enforced to prevent spread of the disease from the cattle feedlot and between cattle. Very strict

control and 24 hour security ensured that no unauthorised people or vehicles entered the piggery.

2.2.3.3.2. Movement control:

General:

Following the confirmation of FMD at Kanhym feedlot, movement control was immediately implemented. Movement restriction notices were served on Kanhym Estates (infected area) and owners in the quarantine zone. The notices were further supported by a movement protocol explaining detail.

A cordon sanitaire was placed within a 10km radius on surrounding farms with movement control on animals and animal products, backed by intensive sero-surveillance and physical daily inspections. Quarantine notices were served on all surrounding farms (28 owners) and all livestock were inspected and subjected to sero-surveillance as well as the following three large farms (Fig.9):

- The SIS feedlot falls outside the quarantine area and has strict access control and disinfection of people and vehicles.
All 25 000 cattle were inspected daily (including 3 000 ranch cattle). All inspections and sero-surveillance done daily, were negative.
- ALZU Farm (in quarantine zone) - 6 000 pigs were inspected daily and bled for sero-surveillance on a regular basis. All results were negative.
- EDE Farm (in quarantine zone) - 2200 cattle, 12 000 pigs and 200 sheep were inspected daily and bled for sero-surveillance. Results were negative and no suspicious symptoms were noted.
- These activities continued daily from 29 November 2000 to 15 January 2001.

In Kanhym feedlot animals showing clinical symptoms were located mainly in the southern part of the feedlot. This was the area allocated to custom feeders and the source of infection. A small number of cattle in pens in the middle were also affected. After the first round of vaccination all animals in pens showing clinical symptoms were moved to the southern section of the feedlot. A section between these clinically affected animals and the other animals was left empty. These pens were disinfected with lime and a fence was erected with one entrance gate. Dedicated personnel performed duties in the two sections.

Four roadblocks were set up to monitor any movements out of and through the area with the assistance of security officials (South African Police Services, South African National Defense Force and Traffic Control). A further two roadblocks were set up on gravel roads at the main entrance to Kanhym and the entrance to the piggery.

December 2000 up to 14 January 2001:

Movement protocols were carefully considered and revised when necessary for movements within and out of the infected area and quarantine zone based on the disease situation and serological results. Control measures at the feedlot included strict movement control of animals, disinfection, showering in and out and separate, dedicated work teams for the different areas within the feedlot.

The following movements were authorised after vaccination and the clinical endpoint of the disease in the feedlot.

- ***Movements out of or within the infected farm:***

Controlled slaughter of pigs and all other movements took place under strict veterinary control. Pigs were slaughtered at dedicated abattoirs and on dedicated days under strict veterinary control and abattoirs were disinfected thoroughly afterwards. The following conditions were set and adhered to: porkers were clinically inspected and loaded in sealed limed vehicles. Vehicles were accompanied by veterinary officials to the dedicated abattoir. The pH of carcasses had to drop below 6 within 24 hours and all carcasses were deboned. A further waiting period of 3 weeks for slaughtered carcasses were enforced pending the serological results of samples collected on the slaughter line and on the farm. Bones and offal were destroyed under strict control. Meat was used for local consumption only.

- ***Movements out of the quarantine zone (excluding the infected farm):***

Controlled slaughter of pigs from ALZU and EDE piggeries were allowed under the following conditions: Animals were inspected and bled before movement to the abattoir, pH of carcasses had to drop below 6 within 24 hours; heads and feet had to be destroyed and meat was utilised locally. Meat was only released after 8 days after ensuring that inspections and sero-surveillance samples from these farm and Kanhym were negative.

All movements of cloven-hoofed animals and animal products of cloven-hoofed animals from within the quarantine and infected areas, took place under strict veterinary control.

Movements into the quarantine zone (excluding infected farm) and surveillance zones were done under veterinary control.

Control measures as from 15 January 2001:

Controlled slaughter of the feedlot cattle (14308) and sheep (2445) commenced on the 15th of January 2001. Since all the cattle were vaccinated, a 3ABC ELISA

test had to be performed on representative samples of animals in the respective pens. An epidemiologist of the University of Pretoria determined statistically significant sample sizes.

Results of the 3ABC ELISA, as well as clinical signs, were used to determine whether pens were previously infected or not. Infected pens were subjected to dedicated slaughter sessions. Meat was deboned and heads, feet, bones and offal were incinerated, buried or cycled through by-product plants.

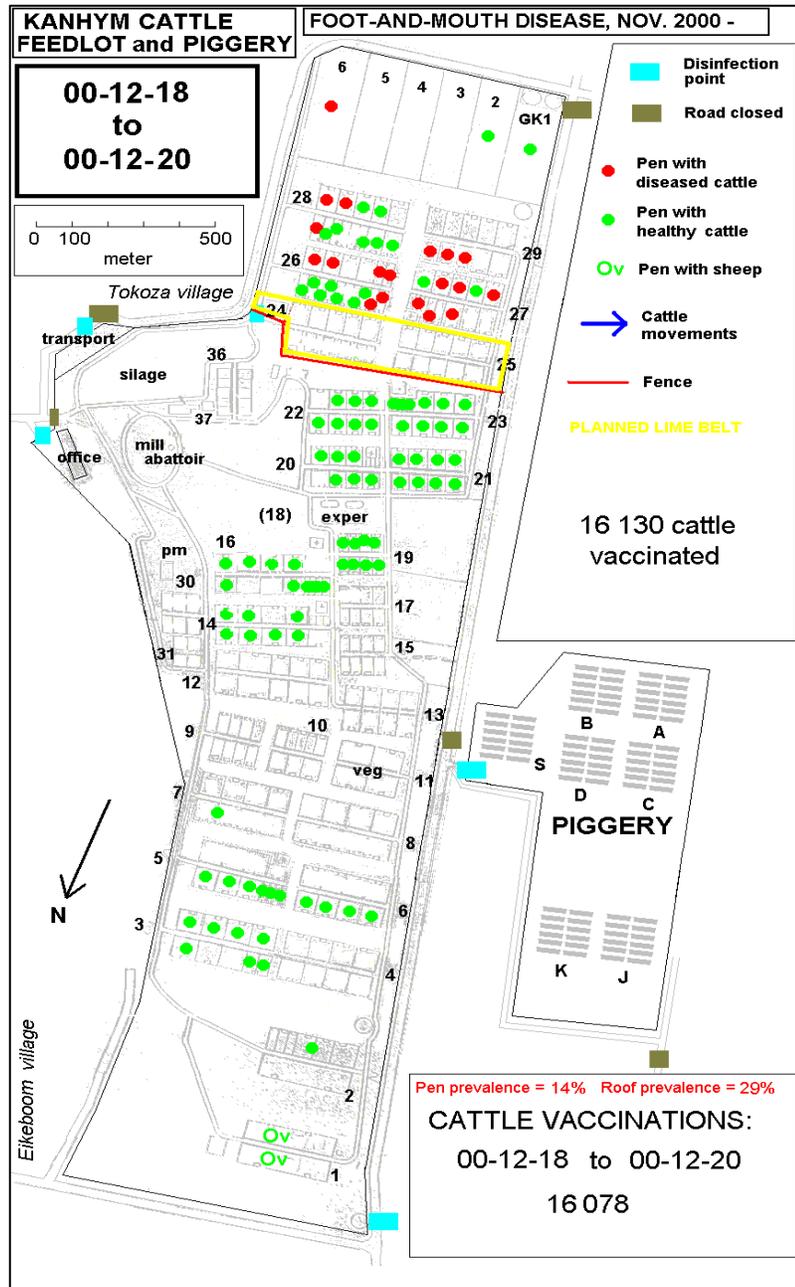


FIG.10: Map of Kanhyam feedlot, indicating location of cattle, sheep and pigs, as well as the cattle pens where clinical infection was detected (red)

Controlled slaughter of the cattle took place at selected abattoirs under veterinary control.

On 19 March 2001 (8 weeks later) all the feedlot cattle were slaughtered. By the end of March the whole feedlot was disinfected. All movements of cattle took place under veterinary control (permits and sealing of trucks).

2.2.3.3.3. Vaccination:

It was decided to implement emergency vaccination in accordance with Article 2.1.1.6 of the *Code* to minimize virus excretion, instead of immediate stamping out, because it was felt that destroying all these animals would pose a greater risk of virus dissemination. The strict control measures in place at the feedlot and the secure infrastructure met those of a quarantine facility and it strengthened the decision. The strategy was considered to hold the least risk of the piggery becoming infected. Moreover, 450 assistants worked on a share-profit scheme and total destruction of more than 69 000 livestock would have led to an unacceptable disease risk.

All cattle in the feedlot were vaccinated twice (1-3 December 2000 and 18-20 December 2000) with a trivalent SAT 1,2 and 3 vaccine, produced at the EDD-OVI (see below). The commercial breeding cattle (1200) on the grazing were vaccinated on 4 and 5 December while they were still on the grazing to ensure that they developed sufficient immunity. Only after the second vaccination were they moved into the northern part of the feedlot, furthest away from the southern infected part, where clinical FMD occurred. By moving the commercial breeding cattle into a section of the feedlot, a 5 km animal-free zone was created around the infected farm.

The vaccinated F branded commercial cattle were released to grazing on Kanhym at the end of March 2001 and were kept in 2 separate groups away from the feedlot and the piggery. Inspections are done once a week and all animals were bled once a month. Slaughtering of the vaccinated commercial cattle was completed by 5 December 2001.

Sheep in the feedlot (2 445) were vaccinated once with the trivalent vaccine (4 December 2000). In order to protect the piggery, pigs in the piggery (48 376) were vaccinated once with an inactivated monovalent SAT 1 vaccine produced by EDD-OVI. The vaccination began on 8 December 2000 and was completed on 9 December 2000.

To determine the efficacy of the vaccines used, certain cattle in the feedlot were identified and bled regularly (days 3, 5 and 8 post vaccination) and tested on the liquid phase blocking ELISA. The same was done with the pigs and a further 5

vaccinated pigs were taken to EDD-OVI and challenged. None of these pigs contracted the disease while control animals developed symptoms.

The vaccine used during the outbreak was a formalin and binary ethyleneimine inactivated vaccine against FMD, produced at the EDD-OVI according to the processes described in the OIE Manual of Standards for Diagnostic Tests and Vaccines. FMD viruses were propagated on baby hamster kidney (BHK) cells in monolayer, inactivated and subsequently purified and concentrated. The resulting antigens were stored at ultra-low temperature until formulation of the final virus. The vaccine used in cattle, sheep and goats was made in an aluminum-saponin adjuvant (ALSA). The vaccine used in pigs was made in double oil emulsion adjuvant (ISA 206). The vaccine strains are all viruses isolated from buffalo in the Kruger National Park, except for one SAT 2 isolate, that was isolated from western Zimbabwe, but has a broad antigenic coverage. The vaccine contained 2 SAT 1, 2 SAT 2 and 1 SAT 3 strains. The vaccine prepared for pigs contained only two SAT 1 strains.

All vaccinated feedlot cattle were slaughtered by 19 March 2001 in accordance with Article 2.1.1.6 of the Code.

By the end of July 2001 all vaccinated porkers were slaughtered.

Vaccinated breeding stock (sows and boars) on hand at the end of May 2001 was 4 747. Taking normal replacement policies into account, the estimation of vaccinated breeders left in the herd is as follows:

June 2001	-	95 %
June 2002	-	55 %
June 2003	-	30 %
June 2004	-	5 %

The piggery was not infected at any stage, as indicated by serological results produced using the liquid phase blocking ELISA prior to vaccination and the 3ABC ELISA post vaccination. Meat from these culled sows are utilised locally after slaughtering at 2 dedicated abattoirs. The pigs were only vaccinated once with the oil adjuvant vaccine. As there is no evidence of a carrier state in pigs, it does not pose a risk to keep these pigs. There is an embargo on the movement of live vaccinated pigs from the farm accept for direct slaughter.

The outbreak in the feedlot was restricted to the cattle feedlot and dealt with in accordance with the requirements of Article 2.1.1.6 of the Code i.e. emergency vaccination with slaughter of all cattle and sheep in the feedlot completed on 19 March and the commercial herds of uninfected vaccinated cattle by 5 December 2001. All calves born to these cattle were also slaughtered.

2.2.3.3.4. Surveillance:

Before the outbreak:

Normal disease surveillance was done by veterinary staff, namely collecting census data, testing for tuberculosis and contagious abortion, and visiting livestock auctions and abattoirs and using these activities to inspect for FMD.

During the outbreak:

Inspections in the feedlot and piggery were done on a twice daily basis and sero-surveillance once a week. In the rest of the quarantine zone inspections were done twice a week and once a week in the surveillance zone. These inspections were done *up to 12 January 2001*.

The last clinical case was seen on 14 December 2000 and it was decided that controlled slaughter of the feedlot cattle would start from 15 January 2001.

The surveillance program was subsequently adjusted to the following:

From **15 January up to 31 January 2001** inspections were done once a day in the infected area (feedlot and piggery) and once a week in the quarantine zone. Sero-surveillance was done once a week on cattle that were to be slaughtered from the feedlot and once a week in the piggery. In the quarantine zone, sero surveillance was done once a week.

From **1 February 2001 up to 19 March 2001** inspections in the feedlot changed to 3 times a week. Sero surveillance in cattle continued to be done before controlled slaughter, while sero surveillance in the piggery was done every 2 weeks. In the quarantine zone inspections were done every second week and sero surveillance once a month up to the end of April 2001.

By 19 March 2001 all the feedlot cattle were slaughtered. Disinfection was completed by the end of March 2001, after which 200 sentinel cattle were introduced to the feedlot. These animals were all bled before entering the feedlot and again after 14 and 28 days. Inspections were done twice a week. From 19-31 March inspections in the piggery were still done three times a week and sero-surveillance every 2 weeks. From 1 April until the end of July 2001 inspections were done once a month.

At the end of March movement restrictions were lifted in the quarantine zone (except for the feedlot).

On 2 May 2001 quarantine was lifted in the quarantine zone. Marketing restrictions remain in force for vaccinated sows and boars in the previously infected zone and they may not be slaughtered at export abattoirs.

Summary of surveillance done during the period:

A total of 1 708 943 cattle, 128 163 sheep and 3 570 363 pig inspections were performed up to the end of July 2001.

TABLE 2: Inspections and surveillance performed in the various areas between 29 November 2000 and 31 July 2001

INFECTED AREA (275 ha)

	CATTLE	SHEEP	PIGS	GOATS	GAME
Census	16031	2445	48376	0	0
No. of Inspections Performed	648153	61690	1819751	0	0
No. of Rounds of Inspections	69	22	56	0	0
No. of Animals Mouthed	15519	92	126	0	0
No. of Serum Samples Submitted	25666	129	1200	0	0
No. of Vesicular Samples Submitted	1	0	1	0	0
No. of Tissue Samples Submitted	14	1	1	0	0
No. of Vaccinations Performed	32062	2445	48376	0	0
No. of Visits to Property	115				
No. of Herds	1				
No. of Farms	1				
No. of Farm Portions	1				

QUARANTINE AREA (31632 ha)

	CATTLE	SHEEP	PIGS	GOATS	GAME
Census	30185	4373	25670	235	98
No. of Inspections Performed	581979	50431	1748801	432	0
No. of Rounds of Inspections	23	16	71	8	0
No. of Animals Mouthed	4810	203	219	9	0
No. of Serum Samples Submitted	2382	1194	898	70	0
No. of Vesicular Samples Submitted	1	0	0	0	0
No. of Tissue Samples Submitted	5	0	3	0	0
No. of Vaccinations Performed	0	0	0	0	0
No. of Visits to Property	402				
No. of Herds	77				
No. of Farms	28				
No. of Farm Portions	136				

TABLE 2 (cont.)**SURVEILLANCE AREA (96911 ha)**

	CATTLE	SHEEP	PIGS	GOATS	GAME
Census	22794	4916	350	402	671
No. of Inspections Performed	478811	16042	1811	586	0
No. of Rounds of Inspections	20	4	4	4	0
No. of Animals Mouthed	4810	203	219	9	0
No. of Serum Samples Submitted	1579	152	2	86	0
No. of Vesicular Samples Submitted	0	0	0	0	0
No. of Tissue Samples Submitted	5	0	0	0	0
No. of Vaccinations Performed	0	0	0	0	0
No. of Visits to Property	445				
No. of Herds	118				
No. of Farms	101				
No. of Farm Portions	473				

DISEASE-FREE AREA

	CATTLE	SHEEP	PIGS	GOATS	GAME
Census	626	9	38	16	0
No. of Inspections Performed	498	7	34	2	0
No. of Rounds of Inspections	1	1	1	1	0
No. of Animals Mouthed	2	0	0	0	0
No. of Serum Samples Submitted	4	0	25	0	0
No. of Vesicular Samples Submitted	0	0	0	0	0
No. of Tissue Samples Submitted	0	0	0	0	0
No. of Vaccinations Performed	0	0	0	0	0
No. of Visits to Property	13				
No. of Herds	0				
No. of Farms					
No. of Farm Portions					

TABLE 3: Summary of activities in all areas from 29 November 2000 to 31 July 2001

TOTAL

	CATTLE	SHEEP	PIGS	GOATS	GAME	ALL
Census	69052	11769	74025	653	769	156268
No. of Inspections Performed	1709441	128170	3570397	1020	0	5409028
No. of Rounds of Inspections	113	43	132	13	0	250
No. of Animals Mouthed	25141	498	564	18	0	26221
No. of Serum Samples Submitted	5228	1475	2125	136	0	8964
No. of Vesicular Samples Submitted	2	0	1	0	0	3
No. of Tissue Samples Submitted	24	1	4	0	0	29
No. of Vaccinations Performed	32062	2445	48376	0	0	82883
No. of Visits to Property	975					
No. of Herds	196					
No. of Farms	130					
No. of Farm Portions	610					

2.2.3.4. Summary Of The Outbreak In The Feedlot In Accordance With Article 2.1.1.6 Of The Code

The outbreak in the feedlot was restricted to the cattle in the feedlot and dealt with in accordance with the requirements of Article 2.1.1.6 of the *Code* i.e. emergency vaccination with slaughter of all cattle in the feedlot completed by 19 March 2001. The vaccinated F branded commercial cattle and calves were slaughtered by 5 December 2001.

The piggery was not infected at any stage, as indicated by serological results produced using the liquid phase blocking ELISA prior to vaccination and the 3ABC ELISA post vaccination. Porkers (44 000) were slaughtered and utilised locally. At the end of May 2002 there will be only 2419 vaccinated sows left. Sows were vaccinated only once with the oil adjuvant vaccine and since there is no evidence of a carrier state in pigs, it does not pose a risk to keep these pigs. Furthermore 92% of vaccinated culled sows are already sero-negative.

An updated status report on the feedlot is reflected in Appendix 1

2.2.4. NKOMAZI FOOT-AND-MOUTH DISEASE (FMD) OUTBREAK

2.2.4.1. Sequence of events

The veterinary fence along the western and southern boundary of the KNP was erected in the 1960's to prevent contact between endemically infected (SAT-1, SAT-2 and SAT-3) African buffalo in the KNP and cattle in adjacent farming areas in order to prevent FMD, Corridor and other disease outbreaks in cattle.

Due to aging and deterioration of this fence, upgrading to a 2,4 m high-electrified 20 strand game fence commenced in 1998. In Mpumalanga this upgrading was about 70% completed by 7 February 2000, when a devastating 1 in 100 years flood damaged most of the fence along the southern boundary of the KNP severely. As soon as the dry season set in, the damage to the fence allowed buffalo to stray out of the KNP. The incidence of stray buffalo in the 3rd quarter of 2000 increased significantly as reflected in Fig.11.

Despite major efforts to control the straying of infected buffalo by chasing back herds using helicopters or destroying buffalo, contact between buffalo and cattle did occur. In some instances it was observed, reported and recorded, while in other cases it was suspected. However, no disease was detected in contact cattle herds during official inspections or reported by owners. No sero-surveillance was done in the area shortly before the outbreak, due to the fact that the whole of the Nkomazi area had been subject to compulsory vaccination. Earlier serological tests revealed that some vaccinated cattle tested positive as long as 5 years after their last vaccination. Furthermore the 3ABC EIISA test was not available until mid December 2000.

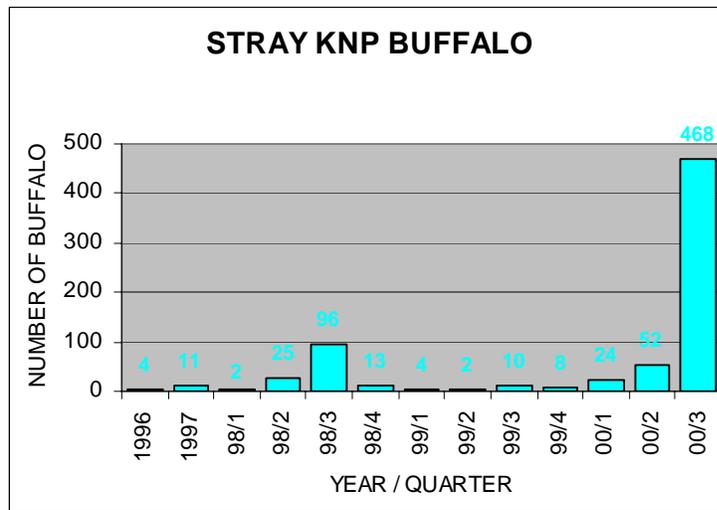


FIG.11: Graph showing incidence of stray KNP African buffalo (*Syncerus caffer*)

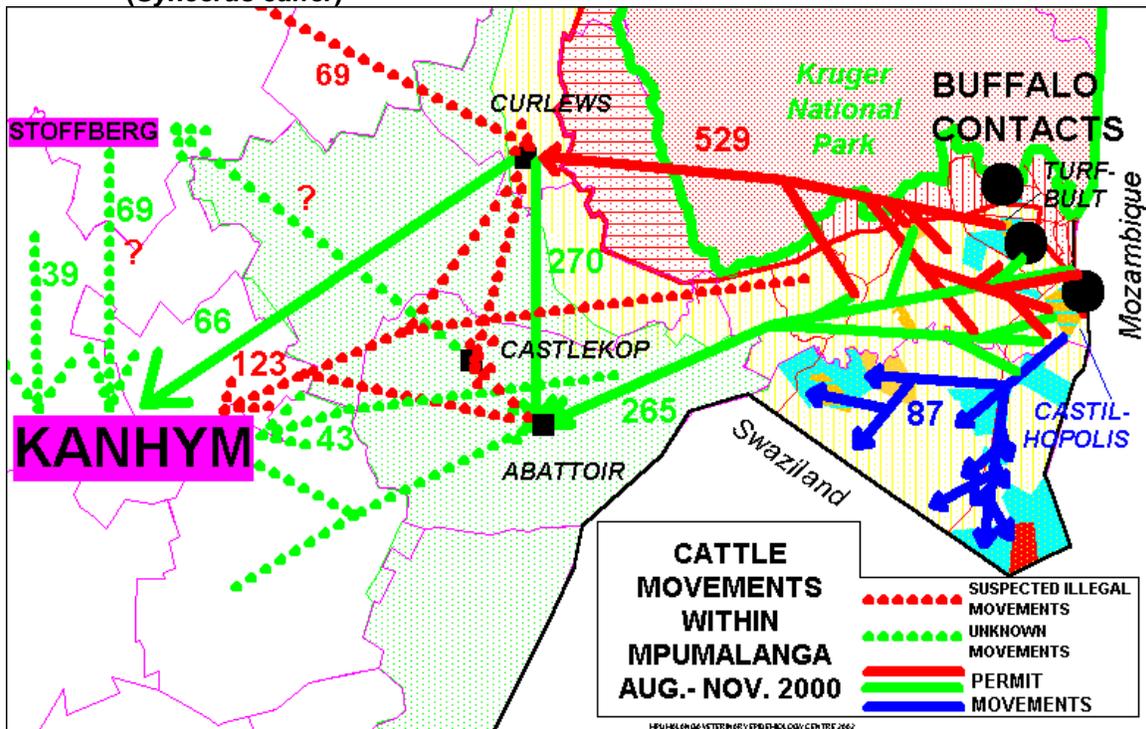


FIG.12: Map showing Lowveld FMD control zones and suspected cattle movements that resulted in the outbreak at the feedlot at Kanhyam

Following the diagnosis of FMD (SAT-1) in the Middelburg district on 29 November 2000, backward tracing and virus sequencing indicated the Nkomazi State Veterinary (SV) area as possible and probable source of the infection. All movements from the Nkomazi and Nelspruit SV areas, from where cattle had moved earlier to the Middelburg district according to the movement control measures, were stopped. A Joint Operational Committee (JOC) similar to the

outbreaks in KwaZulu-Natal and Middelburg was set up within 24 hours. The routine surveillance actions were intensified and strengthened by collection of serum specimens. Three roadblocks were instituted to control movements from the Nkomazi SV area.

On 15 December 2000 the first results of the newly imported 3ABC ELISA indicated the possibility of FMD infection in cattle on 4 farms. There was however, no clinical evidence of disease. On the same day epithelium specimens from cattle with suspicious fresh lesions were taken at Thambokhulu communal diptank and confirmed tested positive. The SAT-1 virus isolated at this dip tank was closely related to the Kanhym virus and to other viruses isolated previously from buffalo in the south of the KNP (Fig. 8). Subsequently serological evidence of previous infection was obtained on 5 more farms and at 12 communal diptanks, all in the Nkomazi SV area, while clinical signs were recorded in cattle on 4 farms and 2 communal diptanks.

The entire Nkomazi SV area was declared an **infected zone, quarantine zone** and **vaccination zone** for the control campaign. A **surveillance zone** was declared comprising of the Nsikazi red line and adjacent areas, as well as the Phabeni, Nsikazi and Crocodile catchment areas in the Kruger National Park, so as to enclose the quarantine zone. The campaign control zones and the situation at the end of December 2000 are shown in Fig.12.

It is important for the Commission to understand that the Nkomazi state veterinary area is a very isolated and restricted area between the southern borders of the KNP, Mozambique and Swaziland. It comprises of a commercial farming area with 7542 cattle and communal farming area of 55610 cattle.

There is only one port of entry into and out of the area along a national highway at the N2 Nkomazi tollgate. The Drakensberg and Lebombo mountains are the southern, western and eastern borders and the Crocodile river to the north are extremely effective natural barriers between this entire area and the rest of South Africa.

Communal cattle are almost exclusively utilised within the area for consumption and ceremonial purposes while commercial cattle are marketed to abattoirs and feedlots only. The following statistics confirm that between August and November 2000, 254 movement permits were issued for internal movements within the communal area and only one permit of 2 cattle out of Mpumalanga Province. Fourteen (14) permits were issued for movement to the adjacent communal farming area. Movements of commercial cattle out of the surveillance area consisted of 24 movements directly to abattoirs and 23 movements to feedlots, a few of which were subsequently proven to be illegal. It is assumed that the outbreak in Middelburg was the result of one of these movements. All the movements to feedlots were carried out by one entrepreneur.

2.2.4.2. Diagnostic procedures

Collection of serological specimens commenced on 4 December 2000 and was done on all farms and diptanks in the Nkomazi and Nelspruit SV areas where susceptible livestock were kept, as well as in impala in the adjacent parts of the KNP in an attempt to detect any possible viral activity in the area. Epithelial tissue specimens were collected in all cases where suspicious lesions were detected during inspections and mouth examinations.

All tests were done at the Exotic Diseases Division of the Onderstepoort Veterinary Institute in Pretoria. Serum samples were tested using the liquid phase blocking ELISA. Positive sera were then tested using the 3ABC ELISA. Tissue samples were tested by using typing ELISA, PCR and virus isolation.

The Thambokhulu communal diptank area was the only locality where virus was isolated during the outbreak (red area in the extreme south of the infected zone in Fig.12).

2.2.4.3. Surveillance

The numbers of susceptible livestock at risk, and the numbers of inspections, mouthings and serum and tissue sample collections performed in the various control zones in the different species during the campaign period of December 2000 to March 2001 are shown in Table 4.

TABLE 4: Activities performed in the State Veterinary Areas during the FMD campaign period of December 2000 to March 2001

CATTLE

SV AREA	SECTOR	ZONE	NUMBER OF DIPTANKS / FARMS	TOTAL CATTLE	CATTLE INSPECTIONS	CATTLE MOUTHINGS	SERUM SAMPLES COLLECTED	TISSUE SAMPLES COLLECTED	INFECTED DIPTANKS / FARMS
NELSPRUIT	COMMERCIAL	R	288	18088	23610				0/288 (0%)
NELSPRUIT	COMMERCIAL	S	63	4331	16312	1798	873	4	1/63 (2%)
NELSPRUIT	COMMUNAL	S	32	20435	181210	2341	1909	14	3/31 (10%)
NKOMAZI	COMMERCIAL	I	61	7542	33188	3486	2807	23	18/61 (30%)
NKOMAZI	COMMUNAL	I	39	55610	460484	2198	3673	10	43/47 (91%)
TOTAL			483	106006	714804	9823	9262	51	

SMALL STOCK

SMALL STOCK			SHEEP				GOATS			
SV AREA	SECTOR	ZONE	TOTAL	INSPECTIONS	MOUTHED	SERUM SAMPLES	TOTAL	INSPECTIONS	MOUTHED	SERUM SAMPLES
NELSPRUIT	COMMERCIAL	R	1247	1223			872	139		
NELSPRUIT	COMMERCIAL	S	250	660	17	25	398	1304	36	67
NELSPRUIT	COMMUNAL	S	7	13		7	3214	2466	892	1096
NKOMAZI	COMMERCIAL	I	442	1204	11	21	351	1508	4	40
NKOMAZI	COMMUNAL	I	122	388	26	30	10865	12985	59	1591
TOTAL			2068	3488	54	83	15700	18402	991	2794

PIGS

SV AREA	SECTOR	ZONE	TOTAL	INSPECTIONS	MOUTHED	SERUM SAMPLES
NELSPRUIT	COMMERCIAL	R	4281	4628		
NELSPRUIT	COMMERCIAL	S	1494	9723	15	72
NELSPRUIT	COMMUNAL	S	923	958	4	3
NKOMAZI	COMMERCIAL	I	103	274	0	23
NKOMAZI	COMMUNAL	I	785	451	7	24
TOTAL			7586	16034	26	122

GAME

GAME		IMPALA	
SV AREA	SECTOR	INSPECTIONS	SERUM SAMPLES
NELSPRUIT	COMMERCIAL		
NELSPRUIT	COMMUNAL		
NKOMAZI	COMMERCIAL	4	4
NKOMAZI	COMMUNAL		
SKUKUZA	KNP	50	50
TOTAL		54	54

I = Infected zone

S = Surveillance zone

R = Rest of restricted area (not in campaign zones)

Clinical and serological surveillance was continued in cattle, goats, sheep and pigs on all farms and at all communal diptanks as well as some impala (*Aepyceros melampus*) in the infected and surveillance zones. Results revealed serological evidence of infection in cattle on 6 more farms and at 19 more communal diptanks, as well as in goats at 4 communal diptanks, all in the infected zone. In summary, clinical or serological evidence of infection has been found at 43 out of 47 diptank sections and 18 out of 61 farms in the infected zone.

The situation on 31 March 2001 with regard to spread of the infection is illustrated in Fig.13.

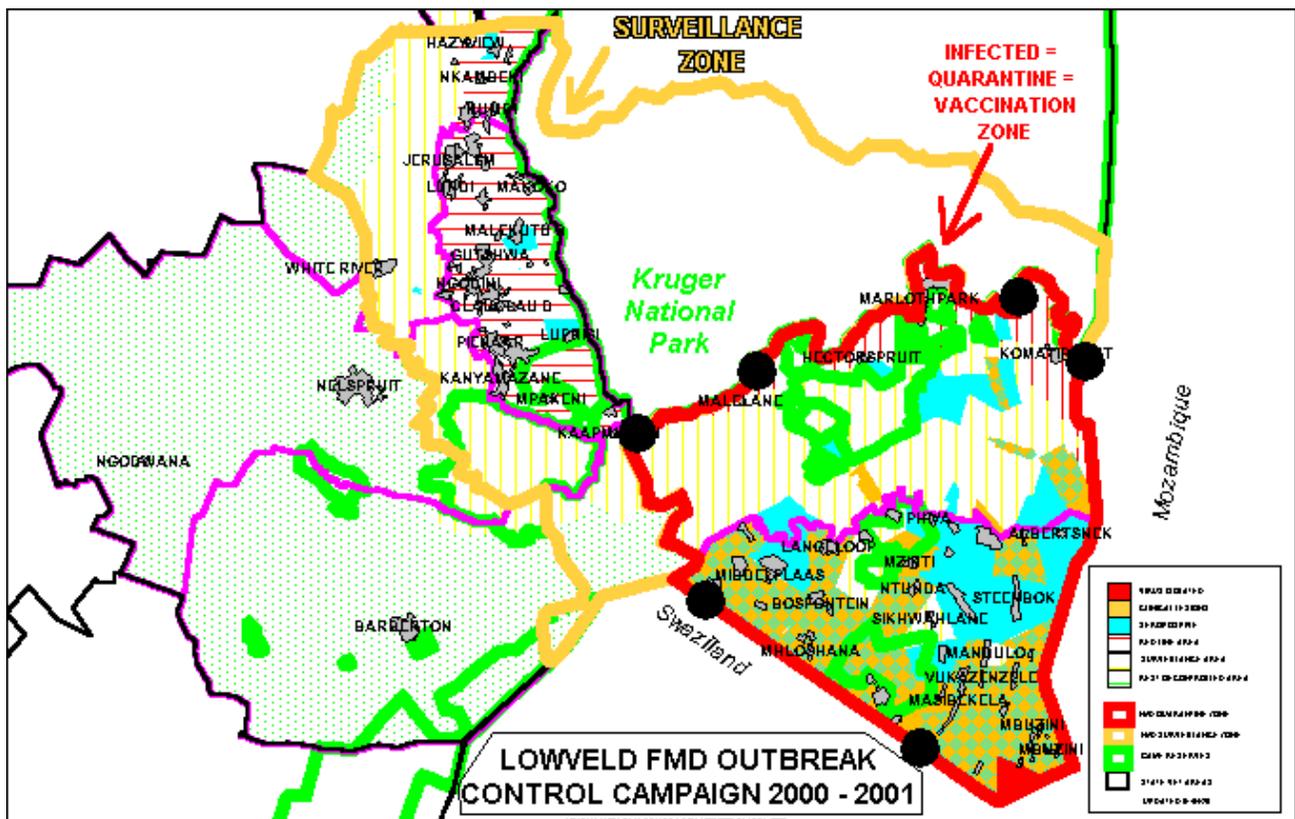


Fig.13: Lowveld FMD campaign as it was on 31 March 2001, showing situation with regard to spread of infection

Up to the end of March 2001, 714 804 cattle inspections, 18 402 goat inspections, 3 488 sheep inspections and 16 034 pig inspections have been done as part of the campaign. 9 823 cattle, 991 goats, 54 sheep and 26 pig mouthings were done, while 9 262 serum samples were collected from cattle, 2 794 from goats, 83 from sheep, 122 from pigs and 54 from impala. 51 tissue samples were collected from cattle, but virus could only be isolated from the Thambokhulu communal diptank samples.

2.2.4.4. Control Of The Outbreak

2.2.4.4.1. During the outbreak

Stamping out was not considered as a control option, because:

- the outbreak occurred in the FMD control zone area which had not been part of South Africa's FMD free zone;
- vaccination would not affect the status of a future FMD free zone of South Africa;
- the geographical distribution and the socio-political implications of the outbreak rendered stamping out an impractical control option.
- History of previous vaccinations and immune status.

Movement control and vaccination were the main aspects of the control strategy of the outbreak.

Movement control

On 29 November 2000 all movements and issuing of movement permits for movements from the FMD control zone in Mpumalanga were stopped. From 2 December 2000, roadblocks were put up at all hitherto uncontrolled public exits from the infected zone, to prevent cloven-hoofed animals and products from leaving the zone.

A movement protocol was compiled with effect from 18 December 2000 to rule the movement of live cloven-hoofed livestock and game, as well as products of cloven-hoofed animals from, into and within the infected zone. This protocol was amended several times as the disease situation evolved.

Information pamphlets on movement restrictions were distributed and extension was done at all butcheries in the infected zone and the 3 border posts on the Mozambican and Swaziland borders.

As from 5 March 2001, controlled direct slaughter of cattle at approved abattoirs was allowed. The heads, feet and offal either being moved back to the infected zone or destroyed under official supervision.

The last roadblock was lifted on 31 March 2001.

TABLE 5: Summary of products seized, movement permits issued and animals and products permitted to move into the Nkomazi area, as well as traffic flow through the Nkomazi Plaza roadblock. Also cattle slaughtered from the quarantine zone

MOVEMENT CONTROL	DEC.2000	JAN. 2001	FEB.2001	MAR.2001	TOTAL
ROADBLOCKS	3	3	1	1	3
MEAT SEIZED (kg)	224.3	121.17	731.5	5732	6808.97
MILK SEIZED (litres)	34	26.5	2	150	212.5
PERMITS ISSUED	444	326	15	0	785
MEAT PERMITTED THROUGH (kg)	14085	933	42	920	15980
SHEEP PERMITTED IN	23	1	0	0	24
GOATS PERMITTED IN		1	0	0	1
CATTLE PERMITTED IN	1	5	0	0	6
TRAFFIC FLOW	184088	165618	87028	81377	518111
CATTLE SLAUGHTERED		32	27	198	257

Vaccination

Immediately after the disease was diagnosed on 15 December 2000, a massive cattle, goat and sheep vaccination campaign was launched in the infected zone. Despite the holidays and festive season, cattle vaccination coverage of 78% had been achieved by 31 December 2000. Cattle were vaccinated twice with a trivalent (SAT-1, SAT-2 and SAT-3). Vaccination coverage in cattle was 89% and 83%, and goats and sheep 74% and 63% respectively.

All vaccinations in the quarantine zone were suspended on 31 March 2001, except for cattle in the routinely vaccinated buffer zone, as well as an additional vaccination area (see section on vaccination after the outbreak in 2.2.4.2.2)

82% of the cattle in the Nsikazi buffer zone were vaccinated from February to April 2001, 6 weeks earlier than what was planned for the routine vaccination program in that area, following the Bushbuckridge outbreak, to decrease the risk of infection spreading to Nsikazi from the north.

Vaccine reaction in the infected area was assessed serologically in cattle. The liquid phase blocking ELISA was used and 73% of samples tested positive, indicating a good level of herd immunity.

TABLE 6: summary of vaccinations done from December 2000 to March 2001

CATTLE					FIRST ROUND		SECOND ROUND	
SV AREA	SECTOR	ZONE	NUMBER OF DIPTANKS / FARMS	TOTAL CATTLE	CATTLE VACCINATED	% CATTLE VACCINATED	CATTLE VACCINATED	% CATTLE VACCINATED
NELSPRUIT	COMMERCIAL	S	63	4331	(1) 242			
NELSPRUIT	COMMUNAL	S	32	20435	(2) 1171		(2) 16763	82%
NKOMAZI	COMMERCIAL	I	61	7542	6876	91%	6456	86%
NKOMAZI	COMMUNAL	I	39	55610	49498	89%	46125	83%
TOTAL			483	106006	56616	89%	52581	83%

SMALL STOCK			SHEEP			GOATS		
SV AREA	SECTOR	ZONE	TOTAL	VACCINATIONS	% SHEEP VACCINATED	TOTAL	VACCINATIONS	% GOATS VACCINATED
NKOMAZI	COMMERCIAL	I	442	244	55% *	351	90	26% *
NKOMAZI	COMMUNAL	I	122	112	92%	10865	8235	76%
TOTAL			2068	356	63%	15700	8325	74%

PIGS

SV AREA	SECTOR	ZONE	TOTAL	VACCINATIONS
NELSPRUIT	COMMERCIAL	S	1494	(3) 289
TOTAL			7586	289

I = Infected zone
S = Surveillance zone

(1) = Moved to infected zone after vaccination
(2) = Part of routine vaccination campaign
(3) = High risk herd, destined for eventual slaughter

* A number of isolated stud herds were left unvaccinated (sentinels).

Extension

Communication with and extension to animal owners to improve awareness and gain disease information received attention throughout the campaign. 14 Joint and 16 Veterinary Operational Committee meetings were held during the campaign of four months. Two meetings were held in Malelane with farmers from the Nkomazi SV area during December 2000.

On 4 January 2001 a meeting with stockowner committees in the Nkomazi district was held, to encourage owners to bring their livestock for the second round of vaccination, to keep the morale high, to explain the importance of the disease and to answer queries. More than 100 cattle owners attended as representatives of all the communal diptank areas.

On a Nsikazi district Animal Health Forum meeting on 25 January 2001, attended by representatives from all the communal diptank areas, the FMD situation was discussed.

On 18 February 2001 a meeting was held at Magogeni in the infected area, where about 250 farmers were informed on the progress with the campaign and thanked for their co-operation during the campaign with regard to vaccinations and inspections.

2.2.4.4.2. After the outbreak

The Nkomazi FMD outbreak control campaign practically ended on 31 March 2001, but being in a permanent restricted area, actions such as movement control, inspections and routine vaccinations continues as a matter of routine indefinitely beyond March 2001.

Control of vaccinated animals

Movement of vaccinated animals from the infected zone (Nkomazi SV area) is subject to the movement protocol of 28 May 2001 and only allowed for slaughter.

Movement of vaccinated cattle from the Nsikazi district are subject to the 1998 FMD control measures (see 2 above).

All cattle, goats, sheep and pigs in the FMD restricted areas are still being regularly inspected and their numbers, increases, decreases and movements monitored as explained in 2 above.

Vaccination

All vaccinations in the infected zone were suspended on 31 March 2001, except for cattle in the buffer zone, as well as an additional vaccination area, which was demarcated according to the risk of contact between infected stray buffalo and cattle, pending completion of construction of the veterinary fence. All cattle in the buffer zone were vaccinated again in June and October 2001 and all cattle in the additional vaccination area in July and November 2001. The situation will be re-evaluated with regard to future vaccination. Vaccinations in the buffer zone as from June 2001 is shown in Fig.14.

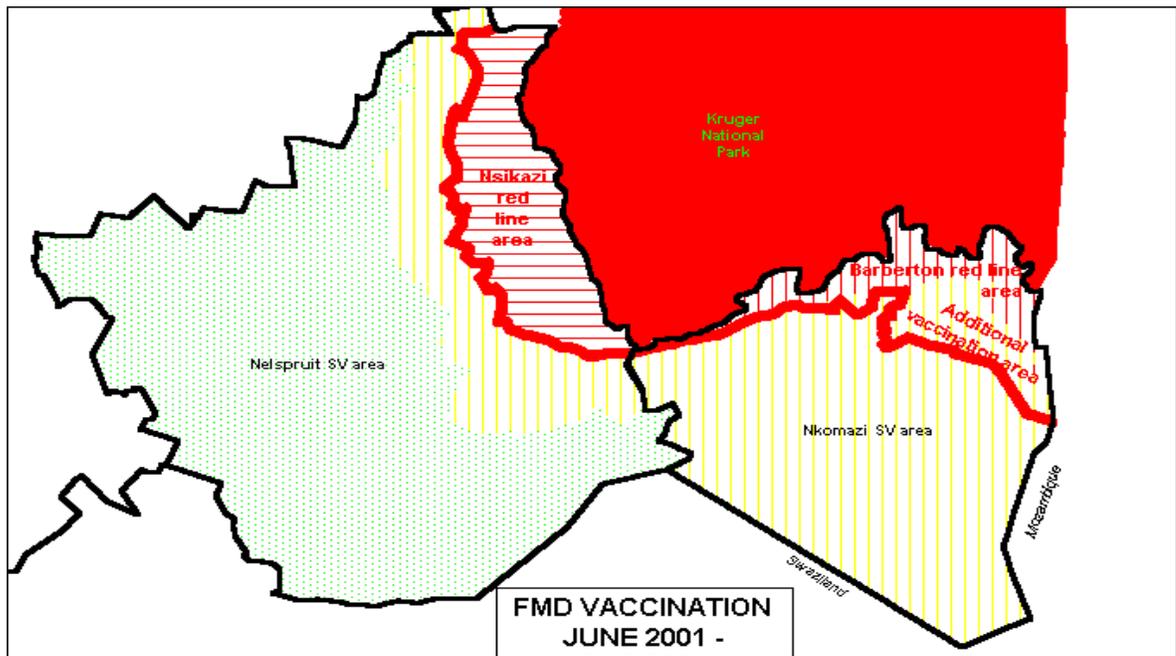


FIG.14: FMD vaccination situation in Lowveld area as from June 2001

Cattle in the Nsikazi buffer zone were vaccinated during June 2001, and again in October 2001, and from then on every six months in April and October.

Fences

The replacement of the flood-damaged sections of the veterinary fence along the southern boundary of the KNP is complete. A 2,4 m twenty strand electrified fence along the southern and southwestern borders of the KNP is presently a significant barrier to manage buffalo/cattle contact.

Analysis of the incidence of stray buffalo following the upgrading of this fence confirms that the risk of spread of FMD by stray buffalo has decreased considerably since upgrading and replacement has been completed.

Extension

Extension to communities in the FMD restricted areas and beyond is continuously done by veterinary officials. These activities include articles in the printed news media, presentations at farmers' days and meetings, exhibitions at agricultural shows as well as individual communications.

Regulations

The FMD regulations have been amended as a result of the Nkomazi FMD outbreak. Movements of unvaccinated livestock in the surveillance zone will be preceded by clinical inspection, quarantine and serology prior to movement. Vaccinated animals will only be permitted out of the control zone for direct slaughter according to the *Code*.

2.2.4.5. Summary of the impact of the outbreak on the previous FMD free zone of South Africa

The outbreak in the Nkomazi area was within the FMD control zone outside the FMD free zone approved by the OIE. The outbreak therefore would not have any affect on the free status should no outbreaks have occurred in the previous free zone (Camperdown, KwaZulu-Natal) and the feedlot at Middelburg.

2.3. OUTBREAK OF SAT 2 IN LIMPOPO PROVINCE (BUSHBUCKRIDGE, FEBRUARY 2001)

2.3.1. HISTORY OF FOOT AND MOUTH DISEASE IN THE LIMPOPO PROVINCE

The eastern side of the Province borders the KNP and private nature reserves where FMD-infected African buffalo are kept.

The last outbreak in cattle in Limpopo Province was in 1983, close to Phalaborwa, in a single small dairy herd in the buffer zone of the FMD control zone.

2.3.2. CONTROL MEASURES IN PLACE BEFORE THE OUTBREAK

The eastern side of the province consists of a FMD buffer zone adjacent to the KNP and a surveillance zone adjacent to the buffer zone. This buffer zone was decreased in size in 1995. The buffer and surveillance zone constitutes the FMD control area, excluded from the FMD free zone as recognized by the OIE. The control zone is separated from the free zone by clearly defined geographical borders.

FMD control measures in this area of the Limpopo Province are very similar to those for the Nkomazi FMD control zone with the exception that in certain areas a fully manned and controlled cattle fence demarcates the buffer zone from the surveillance zone.

The Bushbuckridge area (Mhala district), where the outbreak occurred, is also a closed community and very few animals move out of this specific area. With follow-up investigations on movements in the area, the following were reported:

From June 2000 to Oct 2000	65 permits with 228 animal movement internally
From Nov 2000 to Jan 2001	41 permits with 147 animal movement internally

Only one movement out of the area occurred and that was in October 2000, when eight cattle went for direct slaughter at Gaza beef at Giyani, which is in the FMD control zone.

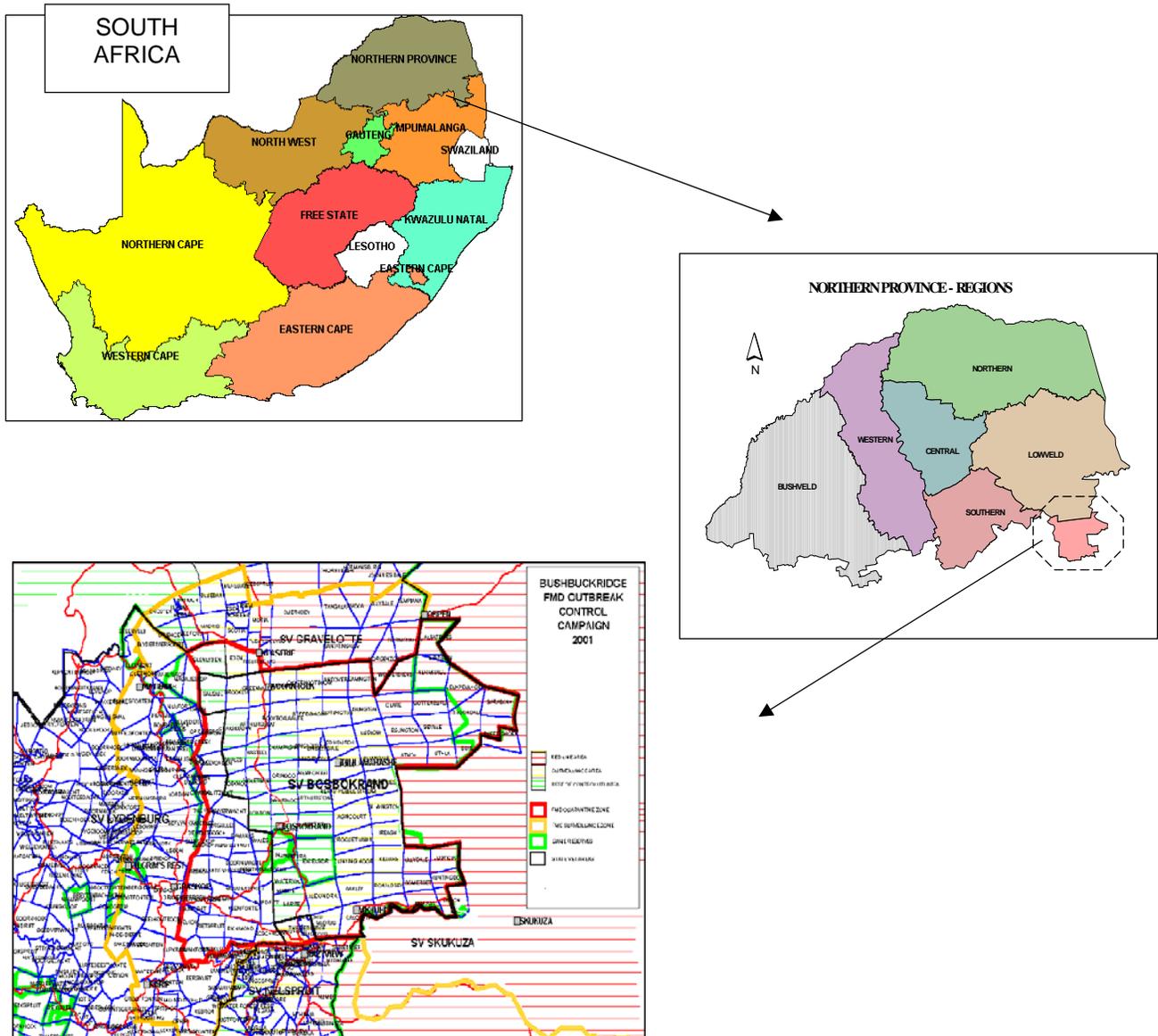


FIG 15: Map showing location of Limpopo Province and location of Bushbuckridge FMD outbreak

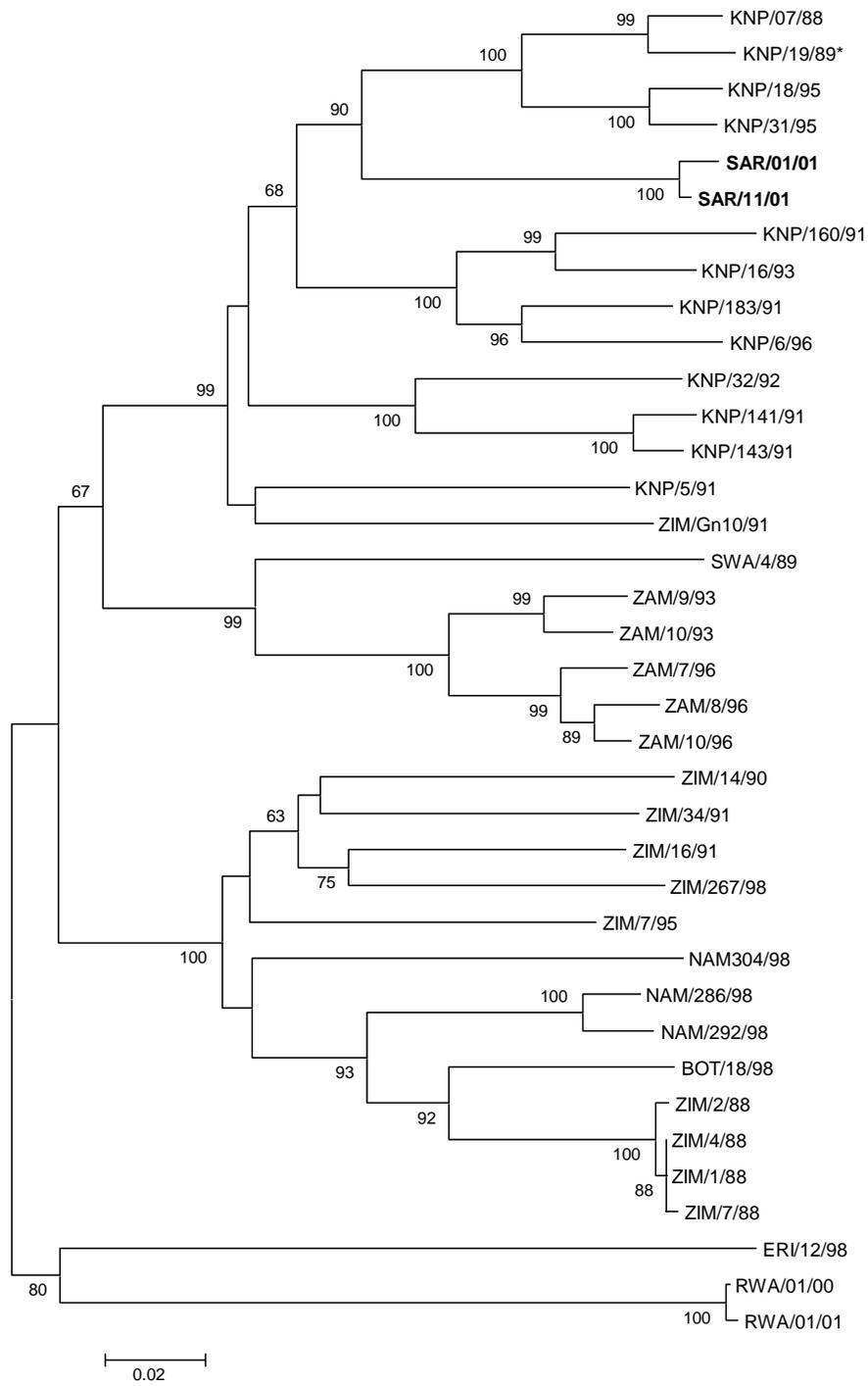
Vaccination

A trivalent Foot and Mouth Disease vaccine (SAT 1, SAT 2, SAT 3), provided by the EDD-OVI is used in the buffer zone and is administered to cattle every six months.

2.3.3. THE BUSHBUCKRIDGE FMD OUTBREAK

The disease was clinically diagnosed in cattle on 1 February 2001 on the farm Orinoco in the Mhala district. Samples were examined by the EDD-OVI, where the diagnosis was confirmed on the same day. Virus identification was firstly based on positive PCR tests and virus typing using the sandwich ELISA, nucleotide sequencing confirmed the serotyping to be a SAT 2 FMD virus, which relates very closely to the virus that occurs in buffalo in the Orpen area of the KNP. The Orpen area is the area inside the KNP adjacent to Bushbuckridge. Due to the damage to the KNP fence as a result of the floods in the first quarter of 2000, buffalo escaped from the KNP resulting in contact between cattle and buffalo in the adjacent communal farming area.

The nucleotide sequences of the 3'end of the VP1 gene of the initial as well as the last isolates obtained from the Mhala district were determined and compared with other isolates from southern Africa to determine the possible source of infection. The origin of all the isolates included in this comparison is indicated in Table 7. The two isolates (SAR/01/01, initial isolate and SAR/11/01, final isolate) differed by approximately 1.5% from each other, possibly indicating the selective pressure on the virus circulating in vaccinated animals (Fig. 16). Both isolates are related to buffalo isolates previously isolated from the Orpen area (KNP/19/89; KNP/18/95; KNP/31/95), which is very close to the district where the outbreak occurred. These groupings are supported by high bootstrap values, indicating that it is statistically significant. This indicated the possible role that buffalo had played in the transmission of the disease.



* Indicates OVI-EDD vaccine strains

Compiled by Karin Boshoff, 01-08-200

FIG 16: Neighbour-joining tree depicting VP1 gene relationships of SAT-2 viruses in southern Africa.

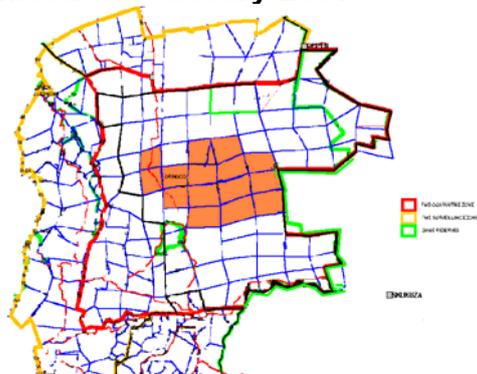
TABLE 7: List of viruses included in the phylogenetic tree

ISOLATE	COUNTRY	LOCATION	SPECIES
BOT 18/98	Botswana	Nxaraga	Buffalo
ERI 12/98	Eritrea	-	-
SWA 4/89	Namibia	Sigwe Village, East Caprivi	Bovine
NAM 286/98	Namibia	Mouma Game Reserve	Buffalo
NAM 292/98	Namibia	Mouma Game Reserve	Buffalo
NAM 304/98	Namibia	Mahango Game Reserve	Buffalo
RWA 01/00	Rwanda	Gishwati district	Buffalo
RWA 01/01	Rwanda	-	Bovine
KNP 07/88	South Africa	Lower Sabie area, Kruger National Park (KNP)	Buffalo
KNP 19/89	South Africa	Orpen area, KNP	Buffalo
KNP 5/91	South Africa	3 km SE Satara, KNP	Buffalo
KNP 141/91	South Africa	Phalaborwa gate area, KNP	Buffalo
KNP 143/91	South Africa	Phalaborwa gate area, KNP	Buffalo
KNP 160/91	South Africa	Orpen area, KNP	Buffalo
KNP 183/91	South Africa	Lower Sabie area, KNP	Buffalo
KNP 32/92	South Africa	Shingwedzi area, KNP	Buffalo
KNP 16/93	South Africa	Capricorn, KNP	Buffalo
KNP 18/95	South Africa	Orpen area, KNP	Buffalo
KNP 31/95	South Africa	Orpen area, KNP	Buffalo
KNP 6/96	South Africa	Crocodile bridge area, KNP	Buffalo
SAR 01/01	South Africa	Orinoco dip tank, Northern Province	Bovine
SAR 11/01	South Africa	Thulamashe, Northern Province	Bovine
ZAM 9/93	Zambia	Nanzhila, Kafue National Park	Buffalo
ZAM 10/93	Zambia	Nanzhila, Kafue National Park	Buffalo
ZAM 7/96	Zambia	Mulanga	Buffalo
ZAM 8/96	Zambia	Mulanga	Buffalo
ZAM 10/96	Zambia	Mulanga	Buffalo
ZIM 1/88	Zimbabwe	Hwange National Park	Buffalo
ZIM 2/88	Zimbabwe	Hwange National Park	Buffalo
ZIM 4/88	Zimbabwe	Hwange National Park	Buffalo
ZIM 7/88	Zimbabwe	Hwange National Park	Buffalo
ZIM 14/90	Zimbabwe	Doma safari area	Buffalo
ZIM/Gn 10/91	Zimbabwe	Gonarezhou National Park	Buffalo
ZIM 16/91	Zimbabwe	Matusadona National Park	Buffalo
ZIM 34/91	Zimbabwe	Urungwe National Park	Buffalo
ZIM 7/95	Zimbabwe	Sengwa	Buffalo
ZIM 267/98	Zimbabwe	Chizarira	Buffalo

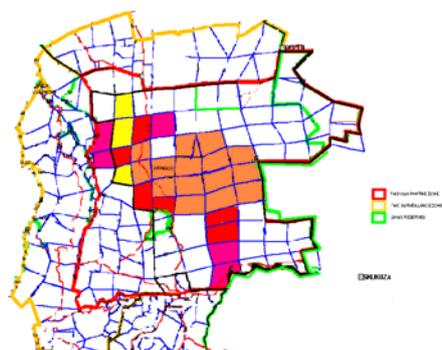
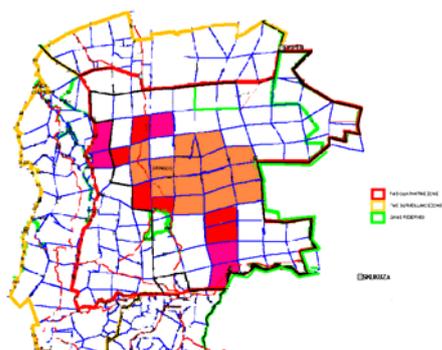
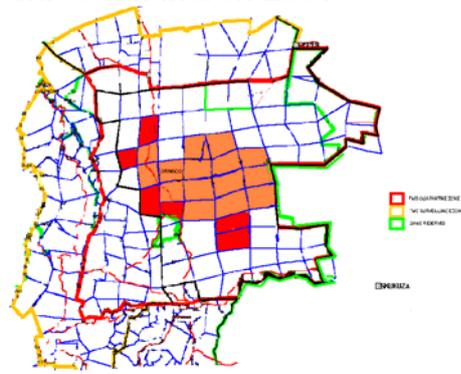
2.3.3.1. Evolvement of the disease and disease control

Evolvement of disease is reflected in Figure 17.

Infection February 2001



Infection March 2001



Infection April 2001

Infection May 2001

FIG.17: Evolvement of FMD infection in the Bushbuckridge area from February to May 2001

The date of return to routine control measures in the infected zone was 31 August 2001.

2.3.3.2. Details of diagnostic procedures

The infected zone was divided into 23 wards all functioning on a seven-day inspection cycle. Within the first two weeks in February, random sampling of all dip tank area and farms (119) in the infected zone was done. A total of 2 858 serum samples were taken and tested on the liquid phase blocking ELISA (results discussed under the heading serology). At the same time tissue samples were taken wherever lesions were found.

A total of 119 tissue samples were taken during the outbreak on 29 farms. The results are as follows:

Virus isolation: pig kidney cell culture	Direct typing ELISA	PCR
21 positive on 13 farms	27 positive on 13 farms	40 positive on 19 farms

2.3.3.3. Surveillance

Surveillance was done in the infected zone and in a 10-kilometer surveillance zone around the infected zone, excluding the Kruger National Park.

ANIMALS AT RISK:

Type of zone	Properties	Cattle	Small stock	Pigs
Infected zone	119	80 995	43 061	1 115
Surveillance zone	45	9 034	2 098	1 245
Total	164	90 029	45 159	2 360

2.3.3.3.1. Inspections.

Infected zone:

The zone was divided into 23 wards all functioning on a seven-day inspection cycle. From 5 February 2001 to 13 July 2001, the following inspections were done:

Visual inspections on cattle	1 173 148
Visual inspection of mouth of cattle (mouthing)	195 087
Cattle found with lesions	1 507
Blood samples taken for serology: cattle	5 769
Visual inspection of small stock	53 912
Visual inspection of mouth of small stock	2 833
Small stock found with lesions	0
Blood samples taken for serology: small stock	1 727
Visual inspection of pigs	1 234
Pigs found with lesions	0

Surveillance zone:

The following inspections were done in the surveillance zone:

Visual inspections on cattle	61 325
Visual inspection of mouth of cattle (mouthing)	3 274
Cattle found with lesions	0
Blood samples taken for serology cattle	500
Visual inspection of small stock	3 076
Small stock found with lesions	0
Blood samples taken for serology small stock	0

Visual inspection of pigs	6 183
Pigs found with lesions	0
Game visual inspections	1 418

Surveillance in the rest of the FMD control zone and in the FMD free zone of the Limpopo Province.

Foot and Mouth Disease inspections were intensified and all veterinary officials and farmers were alerted. The normal inspection cycle of once a week in the buffer zone and once every two weeks in the surveillance zone were maintained. Inspections at stock sales and at abattoirs were intensified. Veterinarians and animal health technicians investigated several alarms and samples were submitted to the laboratory when suspect clinical signs occurred, all with negative results for FMD.

2.3.3.3.2. Vaccination

Ten farms were randomly chosen and monitored serologically after the first and second round of vaccination. After analysing the serological response of the cattle to the first vaccination, it was found that 4 weeks after the primary vaccination there was an increase of 19.1% in the number of animals with a blocking ELISA titre of 1.6-2.0 and an increase of 8.3% in the number of animals with titres above 2.0. After the second vaccination, 86.8% of the samples tested above 1.6 and 63.7% tested above 2.0. This shows that the two rounds of vaccination stimulated a sufficient level of immunity.

Surveillance zone.

In the surveillance zone around the infected zone, serologically representative samples from cattle were taken and tested negative on the liquid phase blocking ELISA, confirming that the infection did not spread out of the infected zone.

2.3.3.4. Control Measures During And After The Outbreak

2.3.3.4.1. Control during the outbreak

The entire Bushbuckridge area was placed under quarantine and no movements of cloven-hoofed animals were allowed. Seven roadblocks on roads leaving the area were operational within five days. These roadblocks were manned by Veterinary officials, Defense Force members, SA Police Services and Traffic officials. No animals or animal products were allowed to leave the infected area. Fourteen confiscations of animal products, three of animal manure and twelve of fresh grass took place at these roadblocks. No animals were taken out. Movements for products for own consumption were allowed into and through the area controlled on a closely monitored permit system.

As was the case with the Nkomazi outbreak in Mpumalanga, control of the disease was based on a vaccination policy. On 5 February 2001, vaccinations started and within two weeks 88.7% of all cattle were vaccinated. A second round of vaccinations were initiated four weeks later and two weeks thereafter 84%

vaccination coverage was achieved. Follow-up serology proved that this strategy was effective.

Up to 13 July 2001 a total of 233 032 cattle and 29 025 small stock were vaccinated in the area. A total of 1 234 473 cattle; 56 988 small stock and 7 417 pig inspections were performed. A total of 195 087 cattle and 2 833 small stock were mouthed.

2.3.3.4.2. Control post infection

Movement control with veterinary movement permits are enforced. Internal movements of animals are allowed with a veterinary movement permit. Cloven-hoofed animals from non-infected farms are allowed to be sent for direct slaughtering to approved abattoirs after inspection, mousing and an official veterinary movement permit has been issued.

The area is a closed community and there are no requests to move animals from the area. Several requests to bring animals into the area were received and allowed. The entire Bushbuckridge area was vaccinated for a third time during July 2001 with a 95% success rate.

2.3.3.4.3. Control after the area is declared free from the disease

Movement control for animals and products are with veterinary movement permits and cloven-hoofed animals are only allowed out of the area for direct slaughtering within the FMD control zone areas within Limpopo Province or Mpumalanga Province.

Weekly inspections of all animals are performed and weekly stock totals are controlled via stock registers and owner's stock cards. This will continue for at least another three years. FMD vaccination of cattle in the entire area was repeated during November 2001 and in March 2002. Thereafter an evaluation of the area and the situation will be done and only the buffer zone will be vaccinated twice a year as in the past.

The strict control measures enforced during the outbreak were relieved on 30 August and reverted back to the routine control measures. Game and nature reserve fences have already been repaired and more effort is presently directed towards inspection and maintenance of fences. Early warning systems to alert veterinary and environmental officials about the presence of stray and roaming buffalo within the farming communities were re-activated or established via dip tank and livestock committees.

2.3.3.5. Conclusion

The affected area is in a FMD control zone and the communities are familiar with the disease. The disease did not spread to the FMD free zone and as such did not have an effect on the status of the free zone. The area will remain excluded from the FMD free zone.

3. SURVEILLANCE AND PUBLIC AWARENESS IN OTHER PROVINCES (FMD FREE ZONE WITHOUT VACCINATION)

3.1 INTRODUCTION

The outbreaks of foot and mouth disease in the previous FMD free zone without vaccination (Camperdown, KwaZulu-Natal and Kanhym feedlot, Middelburg, Mpumalanga) resulted in intensive follow-up and surveillance activities in all the remaining provinces of South Africa. The disease fortunately never spread from these two small foci of infection to other areas within South Africa. There was however, as could be expected, an increased sensitivity throughout the country due to extensive press and media coverage. All suspicious cases were immediately investigated, all of which proved to be negative.

The intensified surveillance activities were conducted over and above the requirements imposed on the import of animal and animal products as normal risk mitigation procedures to prevent the introduction of the disease.

The activities conducted in all the other unaffected provinces are summarized below:

- Provincial, joint operational co-ordination committees including members of the SANDF, SAPS, RTI, Emergency Services and Organized Agriculture were set up in each province. In addition each organization was briefed on the disease implications nationally and internationally.
- Inspection at all ports of entry and exit (air, water and road) were stepped up and where required, embargoes put in place.
- Inspections were conducted at all livestock auctions and sale pens, abattoirs, feedlots, dairies, piggeries and agricultural shows. Serum samples were randomly collected and tested. All were negative.
- All livestock and animal product movements out of the FMD controlled areas were immediately followed up and all movements into and out of the infected and quarantine zones of camperdown and Middelburg were immediately inspected.
- Awareness and extension was stepped up considerably by means of pamphlets, videos and presentations. The national media (television, radio and press) were spectacular in their response and generous news coverage was broadcast daily, reaching the remotest corners of the country.
- Strategic roadblocks set up in surrounding provinces and random roadblocks throughout the country, monitored all livestock and animal product movements and ensured compliance with movement protocols issued by the affected provinces and national co-ordinating body.

- Key industries, including taxidermists, tanneries and hides and skin establishments were targeted for regular inspections and monitoring.
- Key role players in agriculture were kept informed on a daily basis.
- Gauteng Provincial Veterinary Services played a cardinal role in assisting with the logistics of controlled slaughter of livestock from the infected farm and in the quarantine area. 22,763 pigs, 7801 cattle and 2016 sheep were slaughtered at dedicated abattoirs on dedicated slaughter days under extremely strict bio-security control measures. A percentage of animals slaughtered were bled for sero surveillance, held back for 8-14 days and all the carcasses' pH were checked before release. Abattoirs utilized had to comply with the strict deboning and incineration protocols drawn up by veterinary authorities.
- Prior to the KZN outbreak, there were only a few veterinarians and technicians with first hand experience of FMD campaigns. 168 officials from unaffected provinces obtained first hand experience of FMD in KZN and Mpumalanga. Following the outbreaks in KZN, Mpumalanga and Limpopo Province , South Africa can now call on 800 veterinary officials who have actively worked with FMD, many of whom can identify the disease with confidence. These trained officials have been conducting clinical examinations and sero surveillance from the time of the outbreak to date. No cases have been reported.

3.2 CLINICAL INSPECTIONS AND SERO SURVEILLANCE IN HIGH RISK AREAS (SURVEILLANCE AND FREE ZONE) AROUND FMD FOCI OF INFECTION FROM THE TIME OF OUTBREAK UP TO 3 MONTHS POST INFECTION.

AREA	LIVESTOCK INSPECTED	SEROLOGY TAKEN	SEROLOGY NEGATIVE
Camperdown	44,685	23,496	23,496
Middelburg	2,879,434	6392	6392
Nkomazi	242,250	4047	4047
Mhala	72,002	500	500
Total	3,238,371	34,435	34,435

3.3 NATIONAL SEROLOGICAL SURVEY

To demonstrate that the FMD virus did not spread to the free zone from the affected areas, a national serological survey was conducted in December 2001 to January 2002.

3.3.1 REPORT ON PROCEDURE FOLLOWED TO FIND AREAS TO SAMPLE FOR THE FMD SURVEY

Craig von Hagen (Computer Foundation) and Dr Celia Dickason (National Department of Agriculture: Directorate Veterinary Services)

Farms and Settlements polygons were used as the sampling units. The farm land parcel information is obtained from the Surveyor General and the settlements database was supplied by the Department of Water Affairs and Forestry. In areas where farms and settlements overlapped, the settlements were taken to be the sampling units. This was done because there is more uncertainty with regards to animal numbers and movements in these areas and these areas must also be deemed foot-and-mouth disease (FMD) free.

In all there were over 300 000 farm subdivision and settlement polygons throughout the country. From a logistical and sampling point of view this sample size is too big to be considered practical so the area was stratified to minimise the amount of sampling units and to minimise the variance of the sample. To do this it was decided to exclude areas where there is little (or no) chance of finding cattle (according to veterinary experts).

Sampling units inside or touching an urban area, a mining area, or permanent agricultural areas were excluded from the units available for sampling. Waterbodies and wetlands were extracted from the sampling units. The process of excluding these areas was done in using ArcView GIS. Urban areas, agriculture, mining, waterbodies and wetlands were obtained from the National Landcover database. These areas are derived from 1995 and 1996 LANDSAT satellite imagery. Definitions of these classes can be found in Thompson M, 1996: A standard landcover classification scheme for remote sensing applications in South Africa. South African Journal of Science, Vol. 92, pp 34-43. The ideal would have been to use reliable cattle numbers and cattle distribution information, but this information is only available for the Gauteng province. All other information regarding cattle numbers and cattle distributions is based on the experience of local veterinary technicians and it is therefore subjective.

The sampling units numbered 83 816 for farms and 23 204 for settlements after these areas were eliminated and the farm subdivision polygons were grouped by farm.

The sampling units were then stratified according to low risk and high risk areas. Risk was defined as areas where, if there was an FMD outbreak, how quickly would it be able to spread through the cattle population. The areas of low and high risk were defined with inputs from National and Provincial-level veterinarians. The criteria (as given by veterinary experts) used to define low and high risk were based on the following:

- proximity of areas to a previous FMD outbreak,
- proximity to FMD control area,
- areas of high cattle density (based on the experience of local experts), and
- communal areas where FMD infected cattle could have been transported to.

These areas can be seen in the following map (red areas are high risk and blue areas are low risk).

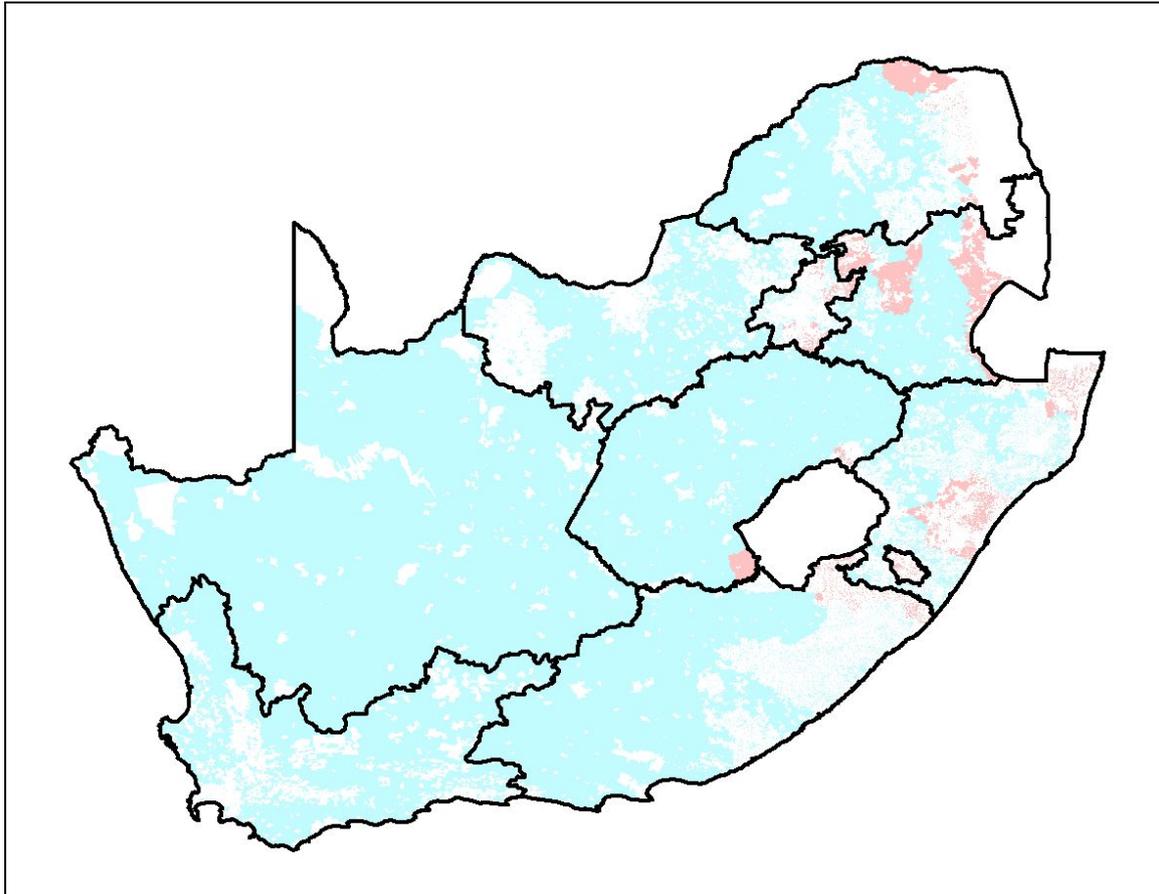


Figure 1. High and low risk areas for FMD outbreak.

In the end it was decided not to use the high and low risk areas as a stratification criteria but to break the sampling units down per province instead. The breakdown of sampling units is as follows:

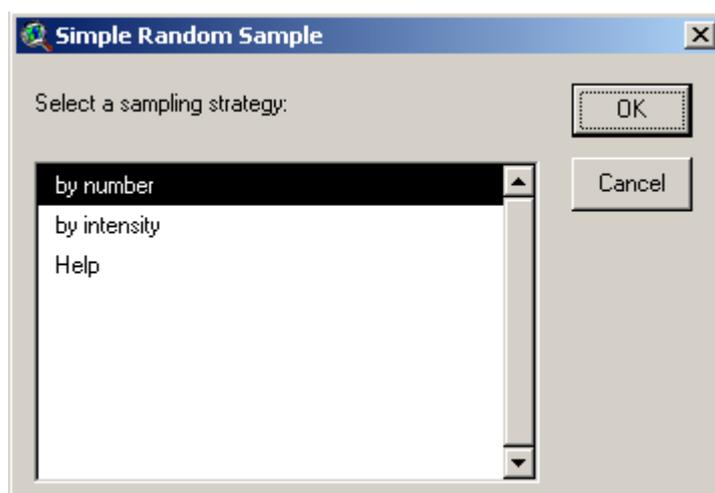
- Eastern Cape = 22 593
- Free State = 29 011
- Gauteng = 2 514
- KwaZulu/Natal = 17 677
- Northern Cape = 7 179
- Northern Province = 7 434
- North West = 6 920
- Mpumalanga = 4 295
- Western Cape = 9 395

It was decided by veterinary experts to sample 62 land parcels per province.

The land parcels were selected randomly per province in ArcView GIS using an extension developed for ArcView GIS by Dr William Huber from Quantitative Decisions. The extension is called Simple Random Sampling and it generates statistical sampling designs with the push of a button in ArcView GIS. It specialises in producing simple random samples of features in polygon themes.

Simple Random Sample computes random sets of points within polygons in two ways. It can (1) choose points independently and uniformly within the selected features of a theme or (2) choose points independently within features with a sampling intensity proportional to feature area. In the first mode, "by number", you are creating a simple random sample of the union of all selected features. It is the nature of randomness that some of the features may receive no samples while others may receive far more than their "fair share." In the second mode, "by intensity", you can guarantee that each feature has approximately the "right" number of samples.

The first option was chosen and it was run on all the land parcels available for selection per province. Once the extension is loaded the Sample option from the menu bar is clicked and the procedure for random selection is as follows:



1. Choose the sampling strategy, in this case by number.



2. Enter the number of samples you would like to take.

Output is in the form of an ArcView shapefile. The output points receive sequential identifiers only. ArcView GIS makes it simple to add attributes from the original features by performing a spatial join. (This is done by opening the feature table for the polygon theme, activating its [shape] field, opening the feature table for the sample point theme, activating its [shape] field, then pressing the "Join" button). This spatial join then assigns the information of the land parcel that the point falls in i.e. the farm name and number.

X and Y co-ordinates in decimal degrees and Degrees Minutes Seconds were then calculated for each selected land parcels using ArcView GIS. These co-ordinates are the centroid of the selected polygon and they are used in the field to locate the land parcels. To aid location, the 1:50 000-map sheet that the land parcels fall in was also given. A database with the selected land parcels name and co-ordinates was then sent to Dr Celia Dickason for distribution to each of the provinces. The database was an Access database and the fields were defined as described in the diagram below.

Field Name	Data Type	Description
village_desc	Text	Description of village from DWAF database (if not a farm)
village_code	Text	Code for village from DWAF database (if not a farm)
fmd_risk	Text	Risk from input from Veterinary experts
prov	Text	Province
farm_no_farm_name	Text	Farm number and farm name (if not a village)
x_wgs84_dd	Number	X coordinate of polygon centroid in decimal degrees - wgs84 spheroid
y_wgs84_dd	Number	Y coordinate of polygon centroid in decimal degrees - wgs84 spheroid
dms_east_x	Text	X coordinate (East) in Degrees Minutes Seconds
dms_south_y	Text	Y coordinate (South) in Degrees Minutes Seconds
sh_name	Text	1:50 000 sheet name
sh_no	Text	1:50 000 sheet number

3.3.2 EPIDEMIOLOGY REPORT ON THE RESULTS OF THE NATIONAL FMD SURVEY CARRIED OUT IN 2002

INTRODUCTION

Veterinary Services conducted a national survey of the cattle population in all provinces of South Africa during December 2001 to February 2002. The survey was based on the sampling strategy recommended by Professor B. Gummow. Details of the sampling frame used for the survey and the assumptions made can be obtained from this report. The summarised serological results of the completed survey (Table 1) were made available to Professor Gummow for further evaluation. The diagnostic tests were carried out by the Centre for Exotic Diseases, Onderstepoort.

METHOD

The results of the survey were analysed in Excel using the methods described in the book Veterinary Epidemiology (Thrusfield M. 1995, Blackwell Science Ltd.), for the detection of disease in populations.

RESULTS

Table 1 Results of the FMD Survey, South Africa, 2002

Province	Total no. of land parcels in sampling frame	Number of farms (land parcels) sampled	Total number of animals bled	Species	Max % Pos at 95% confidence	Max % Pos at 99% confidence
KwaZulu Natal	17 963	79	1 604	Bovine	3.72	5.66
Gauteng	2 414	63	921	Bovine	4.62	6.99
Northern Province	7 434	78	1 489	Bovine	3.76	5.72
North West Province	6 920	64	1 209	Bovine	4.57	6.93
Western Cape	9 315	62	788	Bovine	4.71	7.15
Freestate	29 011	63	1 107	Bovine	4.64	7.04
Mpumalanga	4 295	63	1 115	Bovine	4.36	7.02

Province	Total no. of land parcels in sampling frame	Number of farms (land parcels) sampled	Total number of animals bled	Species	Max % Pos at 95% confidence	Max % Pos at 99% confidence
Eastern Cape	22 543	77	1 385	Bovine	3.81	5.8
Northern Cape	7 175	63	786	Bovine and Ovine	4.64	7.03
Total	107 070	612	10 404			

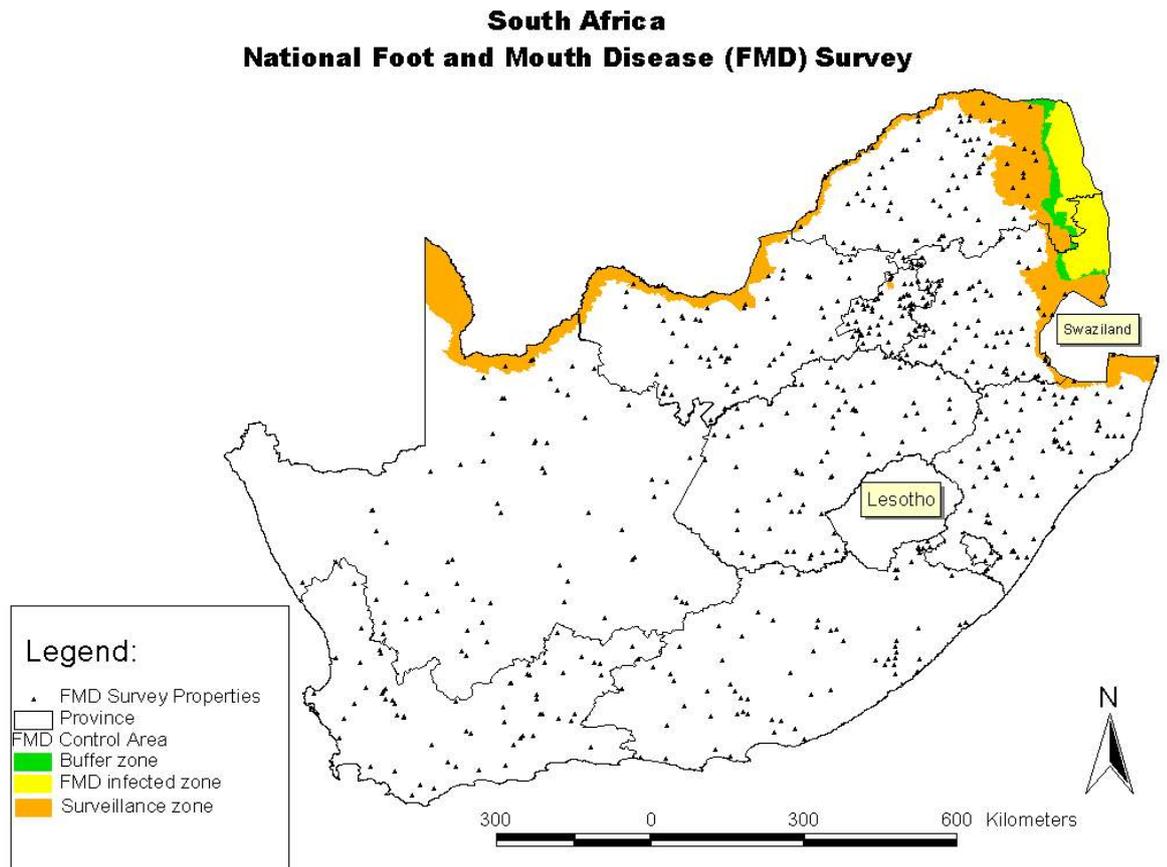
DISCUSSION AND CONCLUSION

A total of 107070 land parcels were included in the sampling frame. The land parcels were stratified according to province. From each province a predetermined number of land parcels were randomly selected and surveyed by State Veterinarians (Table 1), using systematic random sampling to obtain the required number of animals on each farm. The animal numbers were based on the sampling strategy document. No animals bled in the survey were found to be positive on the serological tests carried out by the Centre of Exotic Diseases. Therefore, no land parcels surveyed were positive for FMD. Having established that all land parcels surveyed were serologically negative for FMD it was possible to work out the extent to which FMD could still potentially be present in the population given this result. Table 1 shows the maximum percentage of land parcels that could potentially have FMD given the sample size used in the survey. Since the formula used assumes the diagnostic test to be 100 % sensitive and specific, the results err on the conservative side.

For example, one can be 95 % confident that Kwazulu-Natal will have less than 3.72 % of land parcels positive if FMD is present. There may in fact be no land parcels with FMD in Kwazulu-Natal, but because it was not possible to test every land parcel or animal in the province one can only conclude with confidence that the prevalence of infected land parcels (“farms”) with FMD in Kwazulu-Natal lies somewhere in the range 0 to 3.72 %, but no more than 3.72 %. The same interpretation applies to the other provinces listed in Table 1. A 99 % confidence level is also shown.

From a national perspective, it is possible to say with 95 % confidence that no province exceeds the 5 % land parcel prevalence level. Thus the objective of the survey was met.

Given the magnitude of the survey and taking into account other mitigating control factors (discussed elsewhere) and the nature of the disease, it can therefore, be argued that the results of the survey provide a reasonable measure of confidence for assuming that the risk of FMD in South Africa (excluding the designated infected zone) is negligible



3.3.3 REPORT FROM THE EXOTIC DISEASES DIVISION, ONDERSTEPSPOORT VETERINARY INSTITUTE ON THE COUNTRYWIDE SEROLOGICAL SURVEY TO PROVE FREEDOM FROM FOOT AND MOUTH DISEASE

Compiled by W. Vosloo and B. Botha

INTRODUCTION:

The serological testing for the above-mentioned serological survey has been performed at the Exotic Diseases Division (EDD), Onderstepoort Veterinary Institute (OVI). At this facility the liquid phase blocking ELISA is performed as described by Hamblin et al. (1986) and the OIE Manual of Standards for Diagnostic Tests and Vaccines. It is usually performed by making 4 serial dilutions of each serum sample in duplicate (1/20, 1/40, 1/80, 1/160) and this test is called a screening ELISA in-house. Any serum that gives a positive result on the screening ELISA is retested on the titration, where the serum is serially diluted to a final dilution of 1/1280. According to the OIE Manual of Standards for Diagnostic Tests and Vaccines, if the titre 1/40 is positive, the serum should be retested on the virus neutralization test (VNT). Therefore, any sera that give positive readings at 1/40 (borderline positive) on the full titration is then tested on the SNT.

In order for the EDD to handle large numbers of sera over a short period of time, it was decided to alter the ELISA to a "spot" ELISA where each serum was tested in duplicate at a dilution of 1/40 only, and if the result was positive, it would be retested on the screening ELISA.

RESULTS:

Validation of "spot" ELISA

An in-house validation exercise was performed to ensure that no false negative results were obtained using the "spot" ELISA. A total number of 539 sera were first tested on both the spot and screening tests and it was found that the spot test didn't give any false negatives, but indeed false positives (Table 1). The SAT-2 ELISA presented with the most false positives on the spot test (111), while the SAT-1 ELISA presented with 11 false positives and the serotype O with none.

Table 1 Comparison of results obtained using the "spot" ELISA and "screening ELISA on a total of 539 sera.

SAT-1		SAT-2		Serotype O	
<i>Spot ELISA</i>	<i>Screening ELISA</i>	<i>Spot ELISA</i>	<i>Screening ELISA</i>	<i>Spot ELISA</i>	<i>Screening ELISA</i>
11	0	111	81	0	0

Country survey:

The number of samples submitted to the EDD as part of the survey is indicated in Table 2. The number of dip tanks visited in each province and well as the number of animals sampled at each dip tank, is also indicated. Although the survey was designed to include only bovine, in certain areas of the country the farming system includes mainly sheep and ovine samples were submitted from those regions. In the Camperdown region in KwaZulu-Natal (KZN), where the serotype O outbreak was recorded, samples were normally tested only for antibodies to serotype O. To ensure that the region is free from SAT-1 and SAT-2, 298 bovine, 58 caprine and 24 ovine samples were tested for antibodies to these two serotypes as well (see Table 2).

Table 2. Summary of the number of sera tested at the EDD for the national survey

Province	Number of farms sampled *	Total number of samples submitted*	Number of dip tanks visited	Total number of samples submitted from dip tanks	Species
KwaZulu Natal	79	1 604	30	729	Bov
KZN Camperdown	19	380	4	72	298 bov, 58 cap, 24 ov
Gauteng	63	921	0	0	Bov
Northern Province	79	1 508	18	378	Bov
North West	64	1 209	3	60	Bov
Western Cape	62	788	0	0	Bov
Freestate	63	1 107	0	0	Bov
Mpumalanga	65	1 138	6	110	Bov
Eastern Cape	77	1 385	20	341	Bov
Northern Cape	63	786	0	0	249 ov, 537 bov
Total	634	10 826	81	1 690	

* Including dip tanks

After the validation exercise, all sera were first tested on the "spot" ELISA and from there on the screening ELISA, and if needed the titration ELISA and SNT. A number of false positives occurred when tested for antibodies to SAT-2 and 51 sera gave low positive titers on the titration ELSIA. A total of 44 had titres between 1.6 and 1.9, while only 8 had titres of 2.0 and higher (2 animals had titres of 2.4), but all were negative on the SNT. This has also been observed for sera obtained from giraffe,

and for that reason, the EDD routinely tests giraffe sera using the SNT (J.J. Esterhuysen, personal communication).

Table 3. Summary of the results obtained using the spot ELISA, screening ELISA and serum neutralization test

	Number pos on spot ELISA	Number pos on screening ELISA	Number pos on titration ELISA	Number pos on SNT
SAT-1	49	0	-	-
SAT-2	113	83	51	0
Serotype O	0	-	-	-

Other serological results from the EDD not related to the survey:

Export and other surveillance reports:

The last clinical case in the country occurred on the 30 May 2001 in the Bushbuckridge area. The EDD examined their records of work performed for private individuals for export purposes since June 2001 until February 2002 in the FMD free zone of South Africa (see Table 4). A number of samples were submitted individually by state veterinarians who had to give permission for movement out of their areas. These results are also summarized in Table 3. The number of exports has decreased significantly due to the loss of FMD-free status, therefore the number of tests for this time period is lower than usual. A total number of 711 animals were tested for antibodies to SAT-1, SAT-2 and SAT-3 and found to be negative to FMD virus. A further 1 434 sera were tested for antibodies to the 3 endemic serotypes as well as serotype O, and were also negative.

Table 4. Serological tests performed for exports and surveillance between June 2001 and February 2002

Province	NUMBER AND SPECIES TESTED
Gauteng	534 bovine*
KwaZulu-Natal	43 bovine [#]
Limpopo	11 sable*
Freestate	162 bovine*
North West Province	3 rhinoceros*
Eastern Cape	1 314 Bovine ⁺ , 120 Caprine ⁺ , 1 Ovine*
Total	2 188

* sera tested against SAT1-3

- # sera tested against O
- + sera tested against SAT1-3 and O

Reports on testing during buffalo movement:

The National Directorate of Veterinary Services has decreed that all buffalo in South Africa must be serologically tested for antibodies to FMD when they are translocated. There is furthermore a number of breeding facilities where buffalo calves are bred and tested on a regular basis for possible FMD infection. Some facilities are situated inside the FMD control zone, but they have not been included in Table 5. Only facilities in the free zone are shown. Since June 2001 until February 2002, 707 buffalo have been tested for antibodies to SAT-1, SAT-2 and SAT-3 and all found to be serologically negative. A total of 116 buffalo were translocated from the Hluhluwe Game Reserve, the only other game reserve in South Africa that have a large number of free ranging buffalo outside the control zone. They were all serologically negative.

Table 5. Buffalo tested between June 2001 and February 2002 in the FMD-free zone according to regulations on the movement of buffalo. All sera were tested against SAT1-3.

PROVINCE	NUMBER OF BUFFALO TESTED
Gauteng	2
KwaZulu-Natal	116
Limpopo	187
Mpumalanga	150
Western Cape	50
Freestate	66
North West Province	25
Eastern Cape	8
Northern Cape	103
Total	707

Results from an independent pig survey:

A large-scale survey in pigs was also performed as part of an annual survey driven by the Pig Industry of South Africa to determine the disease status in the country for various diseases. This survey was used to determine the FMD status as well as other diseases. Pigs were samples at various abattoirs in the country. All pig sera were tested for antibodies to SAT-1, SAT-2, SAT-3 and serotype O (see Table 6).

Table 6. Summary of the number of pig samples submitted for an independent survey to determine the status of various disease, including FMD.

Province	Number of farms sampled	Total number of samples submitted
KwaZulu Natal	13	150
Gauteng	41	365
Northern Province	9	135
North West Province	15	96
Western Cape	23	294
Freestate	10	143
Mpumalanga	7	85
Eastern Cape	12	100
Total	130	1 368

SUMMARY:

Between June 2001 and February 2002 a total number of 15 089 animals were tested for the presence of antibodies to FMD in the FMD disease free zone of South Africa. This included different species such as bovine, ovine, caprine, porcine, buffalo, rhinoceros and sable. None of these animals had antibodies to FMD. False positives were observed against SAT-2 using the liquid phase blocking ELISA, but were resolved using the SNT.

REFERENCES

Hamblin C, Barnett IT, Hedger RS. A new enzyme-linked immunosorbent assay (ELISA) for the detection of antibodies against foot-and-mouth disease virus. I. Development and method of ELISA. J Immunol Methods. 1986 Oct 23;93(1):115-21.
 OIE QUESTIONNAIRE: FMD FREE ZONE WHERE VACCINATION IS NOT PRACTISED

4. OIE QUESTIONNAIRE: FMD FREE ZONE WHERE VACCINATION IS NOT PRACTISED

5.4 FMD FREE ZONE WHERE VACCINATION IS NOT PRACTISED

I. RESUME OF REPORT

Resumé of Report of Country which applies for status, under Chapter 2.1.1 of the *International Animal Health Code*, as having an FMD free zone where vaccination is not practised, in an FMD free country where vaccination is practised or in a country of which parts are still infected.

1. Regular and prompt animal disease reporting

(Describe here the national system and to who you provide international disease reporting)

South Africa has a National Animal Disease Database, which has been in place since 1987. State Veterinarians throughout South Africa send monthly reports of controlled animal disease outbreaks to their Provincial Directors of Veterinary Services, who then send these reports to the National Directorate where this information is entered into a database and monthly reports are compiled. Monthly reports on controlled (all OIE List A and certain OIE List B) animal diseases are sent to the OIE in Paris and also to all SADC countries and trading partners internationally. Emergency reporting also takes place whenever there is an outbreak or suspected outbreak of: Foot and mouth disease; African swine fever; Rift Valley fever; any disease that has already been eradicated in South Africa; and any disease that has never previously been diagnosed in South Africa. Emergency reports are also sent if there are any abnormal outbreaks of African horse sickness, Anthrax and Newcastle disease. These emergency reports are sent from the State Veterinarian directly to the National Director Veterinary Services and the OIE is then notified immediately via an SR1 form, as are all SADC countries and international trading partners.

2. No FMD outbreak in zone in past two years

(State date of last outbreak and refer to FMD eradication section)

The last outbreak of FMD in the free zone where stamping-out and limited ring vaccination was applied was 14 September 2000 (KwaZulu-Natal Province) and on 29 November 2000 on the farm, "Arendfontein" (Kanhym feedlot) where emergency vaccination and slaughter was applied.

3. No vaccination in zone in past 12 months

(State here whether vaccination in the zone is prohibited, since what date, and briefly describe how this is enforced.)

No vaccination is practised in the FMD – free zone. The last vaccination executed in the Camperdown district was on the 26th January 2001 while the last vaccination in the feedlot at “Arendsfontein” in the Middelburg district of Mpumalanga Province was 20 December 2000.

In the Camperdown district where limited ring vaccination was applied together with stamping-out, 6171 animals were bled between February 2001 and September 2001 out of the original 12414 vaccinated (50%) and only 45 animals tested positive for antibodies to serotype O (0.7% of the animals tested). During November and December 2001 another 1543 animals were tested and no positive animals were found. These animals were vaccinated only once between November 2000 and January 2001 with the saponin/alhydrogel vaccine and the negative results are therefore not surprising and furthermore indicates that no infection was present at the time of the outbreak. Therefore, in excess of 99% of animals have lost their titres by end of December 2001.

At the Kanhym feedlot emergency vaccination and subsequent slaughter of all the vaccinated cattle, sheep and more that 44 000 porkers were completed by: 5 December 2001 in cattle, 28 February 2001 in sheep and 31 July 2001 in porkers.

FMD vaccine is produced under licence by the OIED only after authorisation by the National Director of Veterinary Services. FMD vaccine remains under strict state control.

4. No entry of vaccinated animals into zone since cessation of vaccination

(State date of prohibition of entry of vaccinated animals, and refer to method of enforcement under section on FMD prevention.)

The prohibition of vaccinated animals into the free zone from the FMD controlled area has remained in force since may 1996.

Vaccinated livestock in Camperdown are all sero negative and vaccinated cattle, sheep and pigs from “Arendsfontein” (Middelburg) have all been slaughtered under veterinary supervision.

5. Free and surveillance zone boundaries

(Concise geographic description of free zone and surveillance zones. Annex map with dimensions which includes both zones.)

The free zone is the area previously approved by the International Committee of the OIE as a free zone in May 1996.

6. Free zone

A. Surveillance

(Briefly describe system, refer to section on FMD surveillance in the free zone)

See initial FMD submission by SA and see report.

A national serological survey to prove FMD free status in the free zone was conducted in December 2001.

The country has in excess of 800 veterinary officials experienced in the diagnosis and management of FMD who are responsible for clinical inspections and sero surveillance. In addition there are thousands of farmers and agriculturalists with experience and awareness.

A national survey will be conducted annually in the free zone.

B. Regulatory measures

(Briefly describe measures, refer to section on FMD prevention in the free zone)

There has been no change in the regulatory measures on FMD prevention in the free zone.

7. Surveillance zone

A. Surveillance

(Briefly describe system, refer to section on FMD surveillance in the surveillance zone.)

The main aim of control in the surveillance area is to prevent previously vaccinated animals entering the FMD free zone of South Africa.

This is done by 7 –14 day interval inspections, balanced livestock registers and F branding vaccinated cattle. Vaccinated cattle are slaughtered within the FMD control area and in exceptional cases at abattoirs in the free zone in accordance with the *Code*.

No vaccinated animals are slaughtered at export abattoirs.

B.Regulatory measures

(Briefly describe measures, refer to section on FMD prevention in the surveillance zone.)

In addition to the above a 2.4 meter 20 strand electrified fence has been erected around the Kruger National Park which will drastically reduce buffalo / cattle contact and any further FMD outbreaks.

Prior to the most recent outbreak unvaccinated cattle leaving the surveillance zone were quarantined and inspected prior to translocation with movement

permits since the outbreak. Cattle will now in addition have to be negative on serology while in quarantine.

A total prohibition on the acceptance of animals from disease control areas at any feedlot in South Africa has been instituted.

There has been no other changes in the FMD Regulatory measures in the free zone.

NOTE: ANNEXES FOR THE FOLLOWING SECTIONS WHICH ARE NOT IN ONE OF THE THREE OFFICIAL OIE LANGUAGES SHOULD HAVE A BRIEF SUMMARY IN ONE OF THESE LANGUAGES.

APPENDIX 1

KANHYM FEEDLOT STATUS REPORT 2002-04-15

DATE OF OUTBREAK 29 NOVEMBER 2000	NO OF LIVESTOCK	VACCINATED	LAST ANIMAL SLAUGHTERED BY	QUARANTINE LIFTED	COMMENTS
Feedlot Cattle	14334 (2866)	1-3 December 2000 (1 st) 16-18 December 2000 (2 nd)	15 January - 19 March 2001	2 May 2001 (After repeat disinfection and liming)	200 sentinel calves introduced on 30 March, bled 3 times and all negative
Feedlot Sheep	2471	3 December 2000 (1 st) 18 December 2000 (1 st)	15 January - 23 February	2 May 2001	
Feedlot Pigs: Porkers	44104	8-9 December 2000 (1 st)	30 June 2001	30 June 2001	
Feedlot Pigs: Sows	4616	8-9 December 2000 (2 nd)	Ongoing 1757/4616	Controlled slaughter	Will continue until 2004
Commercial Cattle	1022	5 December 2000 (1 st) 20 December 2000 (2 nd) all F branded	5 December 2001 (cows and calves)	5 December 2001	
NPD Pig Unit	4865	Unvaccinated	N/A	31 March	Unaffected

APPENDIX 2

KANHYM ESTATES: SURVEILLANCE STATUS JANUARY-JUNE 2001

SURVEILLANCE AREA						QUARANTINE AREA					INFECTED AREA
Month	Inspection Frequency	Cattle	Sheep	Pigs	Animals bled	Inspection Frequency	Cattle	Sheep	Pigs	Animals bled	
Jan	2X / week	12371	7493	66649	417	Daily	20179	2471	54,000	846	276
Feb	Every 2 weeks	8779	4456	1104	1351	Daily	14533	2471	54,000	1266	6171
March	Every 2 weeks	2163	2124	50613	307	Daily	4915		48,242	490	2014
April	Every 2 weeks	2416	2005	6032	312		6032			814	639
May	Every 2 weeks	1210	1130	5039	185		2788			461	305
June	Every 2 weeks	2653	1219	7840	0		3557			38	0
Total					2572					3915	9405