Summary of foot-and-mouth disease outbreaks reported in and around the Kruger National Park, South Africa, between 1970 and 2009

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ABSTRACT

Information with regard to foot-and-mouth disease (FMD) outbreaks that occurred in the Kruger National Park (KNP) and adjacent areas of South Africa between 1970 and 2009 was collected from reports and files of various government departments and collated into one report. The collected data were summarised in a table and assessed for patterns. Fifty-one FMD outbreaks occurred during this period in the target area, of which 16 were SAT 1, 31 were SAT 2, 4 were SAT 3 and 3 were not serotyped. No pattern could be discerned although SAT 1 outbreaks occurred more frequently in the summer months while more SAT 2 outbreaks occurred in winter.

Keywords: foot-and-mouth disease, Kruger National Park, Limpopo Province, outbreak reporting, South Africa.

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INTRODUCTION

Foot-and-mouth disease (FMD) is economically important because it is trade sensitive and lack of efficient control can lead to trade embargos on potentially contaminated products. In the declared infected FMD zones of Mpumalanga and Limpopo provinces, which include the Kruger National Park (KNP), 3 serotypes of FMD are present, namely SAT 1, SAT 2 and SAT 3. The African buffalo (*Syncerus caffer*) in the KNP and many of the adjacent private nature reserves on the western borders of the KNP are carriers of all 3 serotypes of FMD virus[2,4–6,8]. It is assumed that buffalo are the source of FMD outbreaks in impala (*Aepyceros melampus*) within the KNP and adjacent nature reserves and in cattle in farming areas bordering the KNP complex[7,10].

In the 1970s the KNP was separated from adjacent farms by a game-proof fence that was maintained regularly. Wildlife density was controlled at lower numbers than currently. Cattle and small stock numbers were larger than at present and they grazed close to the KNP fence. No domestic animals were preventively vaccinated against FMD. During the 1980s private game farming next to the KNP became popular and domestic stock numbers were greatly reduced. Fences between the KNP and these adjacent private reserves were taken down. South Africa also started using bi-annual preventive vaccination against all 3 SAT serotypes in domestic stock. Since the late 1990s wildlife numbers started to increase in the KNP, putting increased pressure on the KNP fences. In 1996 the greater part of South Africa was granted the status of an FMD-free zone without vaccination by the World Organisation for Animal Health (Office International des Epizooties – OIE). This implies that FMD outbreaks within the FMD-infected or buffer zone are not an obstacle to trade or trade agreements as long as these outbreaks are controlled and eliminated within a reasonable time and do not spill over into the free zone. The FMD buffer zone is situated between the FMD-infected zone and the FMD-free zone and forms part of the FMD control area. Cattle within the FMD buffer zone close to the FMD-infected zone are bi-annually vaccinated against FMD.

A large number of FMD outbreaks occurred between 1970 and 2006 in the provinces of Limpopo (formerly Northern Transvaal) and Mpumalanga (formerly Eastern Transvaal) as well as in the KNP. These outbreaks were reported in single, weekly, monthly and annual reports by various offices and governments in these described areas (Appendix 1). There are more than 80 reports in different files and documents in different offices and their safe storage in perpetuity is in question. The aim of this article is to summarise all available information in one report to ensure that it is preserved and available to support epidemiological research on FMD.

MATERIALS AND METHODS

All of the reports consulted are listed in Appendix 1. Annual reports of the Assistant Director Eastern and North Eastern Transvaal (1970–1993), Director Northern Province (Limpopo province) (1994–2006) and FMD outbreak reports relating to the same areas were studied and all relevant information relating to FMD outbreaks from 1970 to 2006 was collated and summarised (Table 1). Information collected included the date of confirmation of the outbreak (by the isolation and serotyping of the specific SAT virus), the SAT serotype and the farms or areas affected in each outbreak, with dates if available. The current local municipality of the property/farm/dip tank area affected is given in order to indicate the geographical distribution of the outbreaks. The species affected and the duration of the outbreak/time it took to control the disease was recorded. The control activities usually continued for 2–3 months after the last clinical case was seen in order to ensure that the outbreak was over and to comply with international disease control standards.

The information collected was verified and rectified/adjusted with information from reports from various files of the Director Veterinary Services Limpopo Province, Annual Reports of the Director Veterinary Services available on the National Department of Agriculture's website and Annual Reports from the State Veterinarian Skukuza. It must be noted that self-governing states such as Venda and Gazankulu existed during the reporting period and an outbreak within these states was reported as a new outbreak even if it was a continuation of an existing outbreak from a bordering area. This is can be seen by comparing their reports with the Director of Veterinary Services reports, and in such cases the information from the different reports

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Table 1: **Summary of foot-and-mouth disease outbreaks between 1970 and 2009 in Limpopo, Mpumalanga Provinces and the Kruger National Park.***

Date confirmed	SAT serotype	Number of areas/ farms affected	Local municipalities affected	Species affected	Duration of outbreak in months‡	Reference (reports in Appendix 1, other sources)
24 Apr 70	2	Entire KNP	KNP	Impala	11 m	1, 26, 53
11 Feb 71	1	Entire KNP + 1	KNP; Nkomazi	Impala	17 m	1, 2, 53
Oct 73	1	Entire NKP	KNP	Impala	8 m	4, 29, 55
7 Nov 73	2	2	Bushbuckridge	Cattle	?	4, 29
29 Apr 74	1	5	Maruleng	Impala Cattle	?	5, 30, 49
14 Jun 74	2	7	Bushbuckridge; Maruleng; KNP	Cattle Sheep Goats Impala	?	5, 30, 49,56
Sep 74	2	3	KNP	Impala	Brief	5, 30, 56
Oct 74	1	Several	KNP	Impala	15 m	5, 30, 56
Dec 74	1; 2	Several	KNP	Impala	13 m	5, 30, 56
Jan 75	Unknown	Several	KNP	Impala	11 m	5, 6, 30, 56
29 Feb 75	1	1	Nkomazi	Cattle	?	5, 6, 30
14 Jun 77	2	5	Nkomazi	Cattle	5 m	23, 32, 43
14 Jun 1977	2	13	Mbom bela	Cattle	12 m	23, 32, 43
25 Jun 77	2	28	Phalaborwa; Giyani	Cattle	7 m	23, 32,43, 86
Oct 77	2	Several + 1	KNP; Bushbuckridge	Impala	11 m	23, 32, 43, 59, 86
21 Jul 78	2	2	KNP	Impala	6 m	7, 33, 60
10 Apr 79	2	5	Giyani; Thulamela	Cattle	4 m	8, 24
14 Jun 79	2	1	Bushbuckridge	Cattle	5 m	8, 50
19 Jun 79	2	23	Giyani; Makhado; Thulamela	Cattle	5 m	8
12 Jul 79	2	5	Maruleng	Cattle	3 m	8, 50
22 Nov 79	1	12	Mutale; Thulamela	Cattle	?	8
13 Dec 79	3	32	Giyani; Thulamela	Cattle	9 m	8
21 Jul 80	1	2	Thulamela	Cattle	4 m	9
Nov 80	Unknown	2	KNP	Impala	5 m	9, 62
2 Apr 81	2	2	Musina	Cattle	3 m	10, 51
Jun 81	1	2	KNP	Impala	6 m	10, 63
Oct 81	1	1	KNP	Various	8 m	10, 63
Aug 82	1	3	KNP; Maruleng; Bushbuckridge	Impala	5 m	11, 64
Feb 83	2	Several	KNP	Impala	5 m	11, 64
Apr 83	Unknown	1	KNP	Impala	4 m	12, 34, 65
6 Jul 83	2	1	Phalaborwa	Cattle	4 m	12, 34
Jul 83	2	2	KNP; Bushbuckridge	Impala	4 m	12, 34, 65
21 Nov 85	2	1	KNP	Impala	5 m	14, 67
26 Sep 88	2	4	KNP; Bushbuckridge	Impala	11 m	16, 70
Jul 92	2	Several	KNP	Impala	6 m	20, 74
Sep 93	2	1	KNP	Impala	4 m	21, 75
Dec 93	2	1	KNP	Impala	2 m	75
Sep 95	2	Several	KNP; Nkomazi	Impala	17 m	36, 77
May 98	1	3	Maruleng; KNP; Bushbuckridge	Impala	9 m	37, 79
Dec 99	2	1	KNP	Impala	7 m	80
1 Sep 00	1	1	Phalaborwa	Buffalo	1 m	38
24 Nov 00	1	1	Middelburg	Cattle	5 m	38,39
15 12 00	1	61	Nkomazi	Cattle	4 m	38, 39
1 Feb 01	2	30	Bushbuckridge	Cattle	7 m	39, 44
9 Jan 02	3	1	Phalaborwa	Buffalo	2 m	40
Mar 02	2	2	Maruleng; KNP	Impala	9 m	40, 83
Jul 02	1	1	Nkomazi	Buffalo	2 m	41
Jan 03	2	2	Maruleng; KNP	Impala	7 m	41, 83
08 Aug 03	2	3	Mutale	Cattle	4 m	41
26 Jun 04	2	38	Phalaborwa; Giyani	Cattle	8 m	46
Aug 04	2	1	Maruleng	Buffalo	12 m	42
1 Aug 06	3	2	Thulamela	Cattle	4 m	45
May 08	3	1	KNP (Pafuri)	Impala	7 m	Dr R. Bengis
5 Dec 08	2	1	Maruleng	Buffalo	1 week	OIE WAHID†
6 Sep 09	1	4	Mbombela	Cattle, goats, pigs	8 m	OIE WAHID

*A comprehensive database is available from the author.

†http://www.oie.int/wahis/public.php

‡This includes the period of observation and/or control activities.

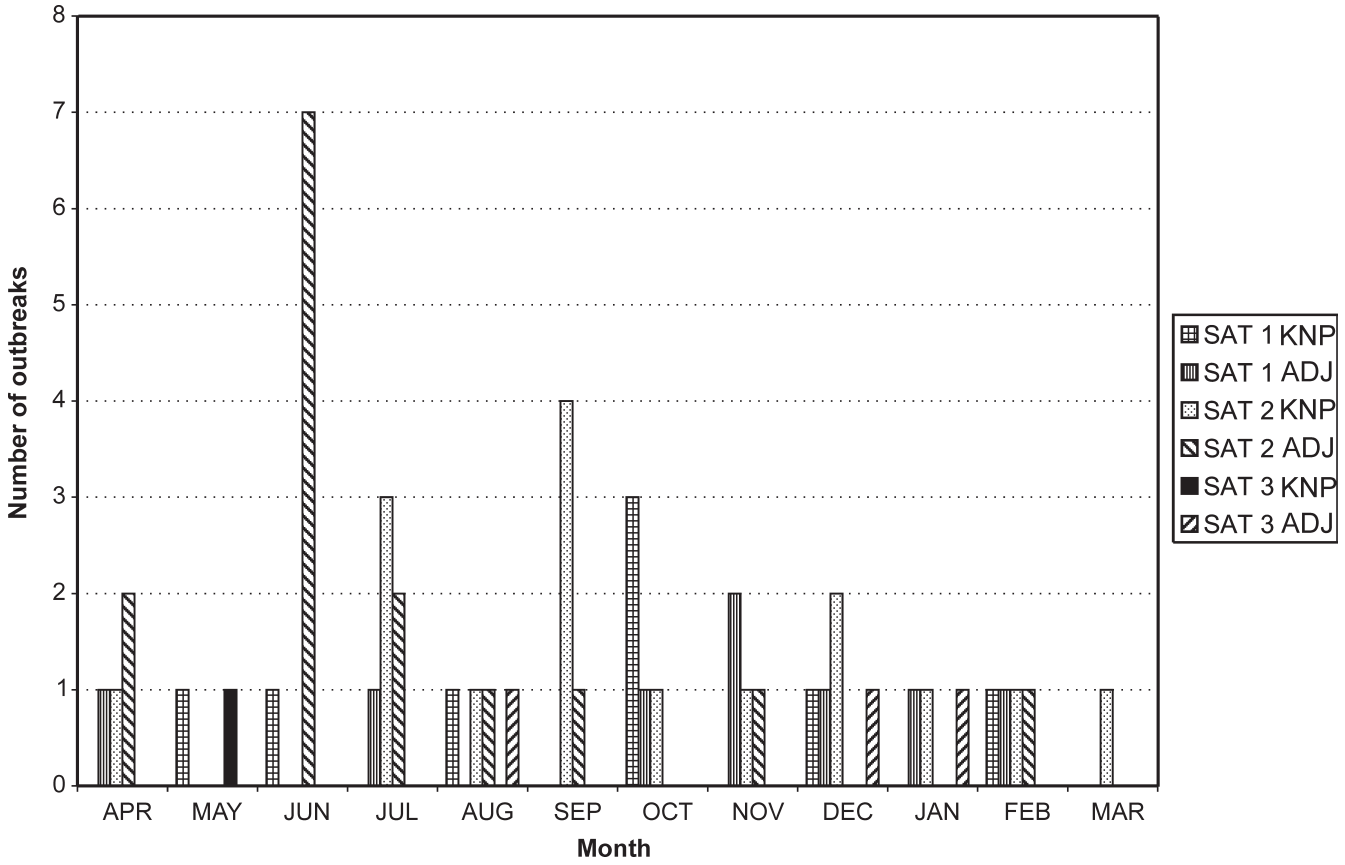

Fig. 1: **Seasonal distribution of the FMD outbreaks for which the SAT serotype was confirmed. KNP = Kruger National Park; ADJ = areas adjacent to the KNP** (private nature reserves or farming areas)

was pooled. The information was compared with published data[1,8,9] and again adjusted where discrepancies or differences occurred.

FMD outbreak data collected between 1970 and 2009 (Table 1) were compared in order to determine any patterns. The different serotypes were tabulated against the year of occurrence and against the months of a calendar year. In both comparisons a distinction was made between an outbreak within the KNP and an outbreak outside the KNP to determine any spread between the 2 areas.

For the sake of completeness 2 FMD outbreaks reported to OIE between 2007 and 2009 from the target area and 1 from the KNP have been included.

RESULTS

The data collected are summarised in Table 1 according to the month and year of the FMD outbreak. Fifty-four outbreaks occurred during this period in the target area.

Sixteen FMD outbreaks were SAT 1, of which 8 occurred in the KNP in impala and 8 outside the KNP, mainly in cattle. Thirty-one SAT 2 outbreaks occurred of which 16 were within the KNP in impala and 15 outside the KNP, mainly in domestic stock; 1 was detected in a buffalo breeding project. Only 4 SAT 3 outbreaks occurred, 3 outside the KNP, 2 in cattle and 1 in a buffalo breeding project, and 1 in impala in the KNP. In 3 outbreaks the serotype could not be determined.

Comparing the different serotypes to the month in which they were confirmed (Fig. 1), it appears that SAT 1 occurred more frequently in summer (October to March) and SAT 2 in winter (April to September). Six SAT 1 outbreaks occurred during winter months and 10 outbreaks during summer months. Twenty-one SAT 2 outbreaks occurred in winter months and ten outbreaks during summer months, but one of the latter was in a buffalo breeding project. Too few SAT 3 outbreaks occurred to reveal any seasonal pattern.

DISCUSSION

The main aim of this paper is to summarise field data for recent FMD outbreaks into a single document that will be widely available. For many of the outbreaks recorded within the KNP during the study period it was not determined with certainty whether they were new outbreaks or a continuation of a previous outbreak that had remained undetected for some time or had spread to a different area without being detected. In a previous study[8] certain outbreaks were clustered together as 1 outbreak and others were regarded as separate outbreaks. In the present study each outbreak was recorded as a separate outbreak as reported in the different governmental reports but the possible clustering of these different outbreaks is discussed. However, the complexity of a FMD outbreak in a large nature reserve like the KNP where it is difficult to monitor disease outbreaks efficiently, especially when the disease presents in a subclinical form that is not easily detected, makes accurate clustering difficult. This study used the information and opinions obtained from the various reports, but genetic characterisation of the viruses involved would be needed to confirm the clusters. However, the reports reflect the fact that FMD outbreaks did occur and that veterinary intervention was required to monitor and control them.

Most of the outbreaks were clearly separate outbreaks, but some may have been a continuation of an existing outbreak. In several cases possibly linked outbreaks occurred both in the KNP and outside it and for some of the SAT 1 outbreaks genetic characterisation of the viruses has confirmed that they were probably continuous[9].

SAT 2 outbreaks that occurred in impala in KNP in December 1974 may have been a continuation of the outbreaks in Bushbuckridge, Maruleng and KNP in June 1974 in cattle and impala.

SAT 1 outbreaks in October and December 1974 in impala in KNP may have been

the same outbreak and could also have been the source of the February 1975 outbreak in 19 cattle in the Nkomazi area. A molecular genetic study of SAT 1 viruses obtained from impala near Skukuza in September 1974 and from cattle in February 1975 supports a common source of infection[9].

The 2 SAT 2 outbreaks in June 1977 which occurred in the Nkomazi and Mbombela areas could have been one outbreak because of their relative proximity and population linkages.

SAT 2 outbreaks that occurred in June 1977 in Phalaborwa, August 1977 in Giyani and September 1977 in Letaba were reported separately because the localities were under the jurisdiction of 3 different authorities, but in fact represented a single outbreak.

SAT 2 outbreaks during April and June 1979 in the Giyani and Thulamela areas probably also represent a single outbreak.

On 3 occasions the SAT serotype could not be confirmed, namely in January 1975, in November 1980 and in April 1983, all in impala within the KNP. Their relationship to other outbreaks can therefore not be determined.

A FMD outbreak started in impala in the KNP during February 1971 and both cattle and impala outside the KNP were infected with the same serotype during August 1971. The identity of the viruses isolated from the 2 outbreaks has been confirmed[9]. The 9 cattle were together with impala in a game camp and both species became infected. It is not known which species was infected 1st. It is generally accepted that FMD transmission occurs as a result of close contact between FMD sick or carrier animals and susceptible hosts[7]. Both impala and cattle would have been susceptible. At that time cattle were not preventively vaccinated against FMD. The source could have been infected impala or even buffalo that were shedding virus, but the available reports give no indication that attempts were made to investigate the possible source of infection.

The SAT 2 outbreak during June 1974 was 1st diagnosed in cattle and later in impala in the Sabie Sabie and Manyeleti Nature Reserves. This may have been the same virus that spread into the KNP and was confirmed in impala during September 1974.

The SAT 2 outbreak that was confirmed during October 1977 in impala within the KNP spread and infected cattle bordering the KNP during February 1978.

During the early 1980s the fences between the KNP and adjacent private nature reserves were removed and several FMD outbreaks occurred (August 1982, July 1983, September 1988, November 1995, May 1998, March 2002 and January 2003) that started in one area and spread to the other, but no domestic livestock were infected.

These data indicate that there has been no major or economically threatening FMD outbreak since 1970 that occurred within the KNP and spread to domestic livestock outside the KNP, and apparently no spread at all from outbreaks within the KNP to domestic livestock since 1977. The economically threatening FMD outbreaks in domestic livestock since 1970 occurred apparently unrelated to any known outbreaks within the KNP. The maintenance and spread of the 3 serotypes in the buffalo population is a continuous process within the KNP complex and in all recent outbreaks were caused by serotypes found in buffalo within the KNP according to the relevant reports. This indicates that although there were no clinical outbreaks within the KNP those particular serotypes did escape from the KNP and infect cattle within the neighbouring FMD buffer zone.

The 5 outbreaks in buffalo since 2000 that are included in Table 1 were in buffalo breeding projects in the FMD-infected zone, where calves were taken away from their FMD-infected mothers and raised in isolation to protect them from FMD infection. Once the calves tested negative for FMD they were moved to an isolation unit in the FMD buffer zone and underwent a series of further tests to ensure that they were negative for FMD. These 5 outbreaks were therefore 'artificial' outbreaks because they originated from infected herds within the FMD-infected zone. They were included in this study to see how their serotypes fitted into the bigger picture and for completeness.

No patterns were identified for the occurrence of outbreaks caused by the different serotypes inside and outside the KNP over the study period of 37 years. It seems that a certain serotype sometimes predominates for a time, for example all the outbreaks reported between July 1983 and September 1995 were caused by SAT 2, which also predominated between June 1977 and July 1979, while all 3 serotypes caused outbreaks from 1998–2006. The 2008 and 2009 outbreaks in domestic livestock were caused by SAT 2 and SAT 1, respectively, while the 2008 outbreak in impala in the KNP was caused by SAT 3.

It can be seen from Table 1 that from 1970 to 1983 both cattle and impala were implicated in outbreaks, while no outbreaks were seen in cattle from 1984 until 2000. There could be many reasons for this but it is likely that the bi-annual preventative FMD vaccination carried out by veterinary services from the early 1980s was an important factor. The increase in elephant and buffalo density in the KNP and the increased pressure on the KNP fence and subsequent spillover of especially buffalo from the KNP into farming areas in the 2000s could explain the increase in FMD outbreaks during the last few years.

This study supports previous findings that monitoring FMD outbreaks in impala is important because they can serve as a source of infection for other species including domestic livestock[3,9,10]. During this research it became clear that reliable recording of FMD (or any other disease) outbreaks is absolutely essential and that reporting and record keeping should be encouraged and improved. Proper safekeeping of data is essential.

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Appendix 1: **Reports from which the information was obtained.**

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2 ASSISTANT DIRECTOR VETERINARY SERVICES 1972 *Annual Report Eastern Transvaal 1971/72*
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