Contagious bovine pleuropneumonia in Botswana: experience with control, eradication, prevention and surveillance

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Summary

Botswana experienced an outbreak of contagious bovine pleuropneumonia (CBPP) in February 1995 after 56 years of freedom from the disease. The outbreak was confined to the north-western region of the country in the Ngamiland District. CBPP was eradicated by applying the stamping-out policy that was implemented in April 1996 and resulted in the slaughter of 320 000 cattle. The Botswana government compensated farmers, offering them different compensation options. By the end of 1997, the restocking exercise introduced 70 000 cattle into Ngamiland. Botswana was declared CBPP-free by the World Organisation of Animal Health in 1998. Prevention strategies, which included border control, quarantine and animal movement controls, were implemented to reduce the risk of reintroduction of the disease as CBPP is still present in neighbouring countries. Serological surveillance and abattoir inspections are conducted in high-risk areas.

Keywords

Botswana, CFT, Complement fixation test, CBPP, Contagious bovine pleuropneumonia, Control, Eradication, Surveillance, PCR, Polymerase chain reaction, Prevention.

Pleuropolmonite contagiosa bovina in Botswana: controllo, eradicazione, prevenzione e sorveglianza

Riassunto

Nel febbraio 1995, in Botswana, a distanza di 56 anni dall'eradicazione della malattia, è stato registrato un focolaio di pleuropolmonite contagiosa bovina (PPCB) nel distretto di Ngamiland, territorio a nord-ovest del paese. La malattia è stata eradicata nell'aprile 1996, adottando la politica dell'abbattimento totale, con il sacrificio di 320.000 capi di bestiame. Il governo ha compensato i proprietari offrendo diverse opzioni di risarcimento. Alla fine del 1997, nel Ngamiland, sono stati reintrodotti 70.000 capi di bestiame. Nel 1998 l'Organizzazione mondiale della sanità animale (OIE) ha dichiarato il Botswana indenne da PPCB. Per ridurre il rischio di una nuova insorgenza della malattia, vista la presenza della PPCB nei paesi confinanti, sono state attuate strategie di prevenzione come: verifica delle frontiere, controllo della movimentazione animale, isolamento forzato (quarantena). Nelle aree ad alto rischio sono state condotte ispezioni dei mattatoi con misure di sorveglianza sierologica.

Parole chiave

Botswana, CFT, Controllo, Eradicazione, PCR, Pleuropolmonite bovina contagiosa (PPCB), Prevenzione, Reazione a catena della polimerasi, Sorveglianza, Test di fissazione del complemento.

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Introduction

Contagious bovine pleuropneumonia (CBPP) caused by *Mycoplasma mycoides* subsp. *mycoides* small colony (*Mmm*SC), is one of the most serious transboundary diseases of cattle in Africa and is characterised by pneumonia and serofibrinous pleurisy. In Africa, the disease causes significant economic losses and, according to some authors, these losses exceed those incurred by any other disease, including rinderpest (3). Botswana had remained free from CBPP since the disease was eradicated from the Chobe Sub-District in 1939 (6). Freedom from CBPP and other cattle diseases, such as rinderpest and foot and mouth disease (FMD), has helped to make Botswana one of the few countries in Africa that exports meat to the international markets, including those of the European Union.

However, in 1995 an outbreak of CBPP occurred in Ngamiland District (Fig. 1) (1). The outbreak was probably linked to the return of peace in Namibia in 1990. During the Namibia struggle for independence, cordon fences between Namibia and Botswana, together with military patrols, prevented pastoral movement and cattle theft. The withdrawal of military patrols and damage to the cordon fences by wildlife, enabled people with strong intercultural links to move across the border.

Since the disease had been reported in Namibia in 1989, it seemed likely that Botswana cattle taken for grazing into the CBPP-endemic zone of Namibia had introduced the infection that resulted in the outbreak. Illegal movements of cattle from Namibia into Kaepe in Botswana in search of better pastures occurred around June 1994. Cattle mortalities from a respiratory disease started in September 1994. The mortalities were exacerbated during the official vaccination campaign for blackquarter, anthrax and botulism which took place in February 1995. These mortalities were reported in the Xaudum Valley which is an area adjacent to the Kavango District of Namibia where CBPP was present (7). Approximately 200 cattle were reported dead and 74 were sick. Farmers had started to treat animals with tetracycline and potassium permanganate which could have led to the development of a chronic and carrier state.

The actions taken to eradicate the disease and to prevent its reintroduction into Botswana are described below.

Action taken to face the outbreak

Disease diagnosis

The disease outbreak was confirmed in February 1995 by the three following regional laboratories:

- the Onderstepoort Veterinary Institute (South Africa)
- the Central Veterinary Laboratory (Namibia)
- the Botswana Vaccine Institute (BVI).

Mycoplasma mycoides subspecies *mycoides* small colony (*Mmm*SC) was isolated from lung tissues and pleural fluid and detected by polymerase chain reaction (PCR), serum samples tested by complement fixation test (CFT) were also reported positive.

Disease control

To control the disease, zoning, with the creation of physical barriers and enforcing cattle movement standstill were implemented; all clinically affected cattle in the infected area were slaughtered to reduce infection pressure and intensive surveillance was undertaken.

The affected area (Fig. 2) was divided into an infected area (2a), a surveillance area (2b) and a disease-free area (2c); initially picketing manned by veterinary officials placed at strategic points to stop cattle movement was established. Picketing was later replaced by permanent cordon fences.

In the infected area, 13 000 apparently healthy animals were vaccinated using the T_1SR vaccine produced by the BVI. In the surveillance area, 12 000 animals were similarly treated and all immunised animals were appropriately branded to identify their area of appurtenance.

Despite the measures taken, the disease spread rapidly and in June 1995 CBPP was clinically detected in the surveillance area (2b) and later in the disease-free area (2c).

The Botswana government sought assistance from the Food and Agriculture Organization (FAO) to reinforce disease surveillance and a field laboratory to perform screening tests was established. The FAO funded the testing of 3 000 to 5 000 serum samples per week by the *Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale'* in Teramo and, in

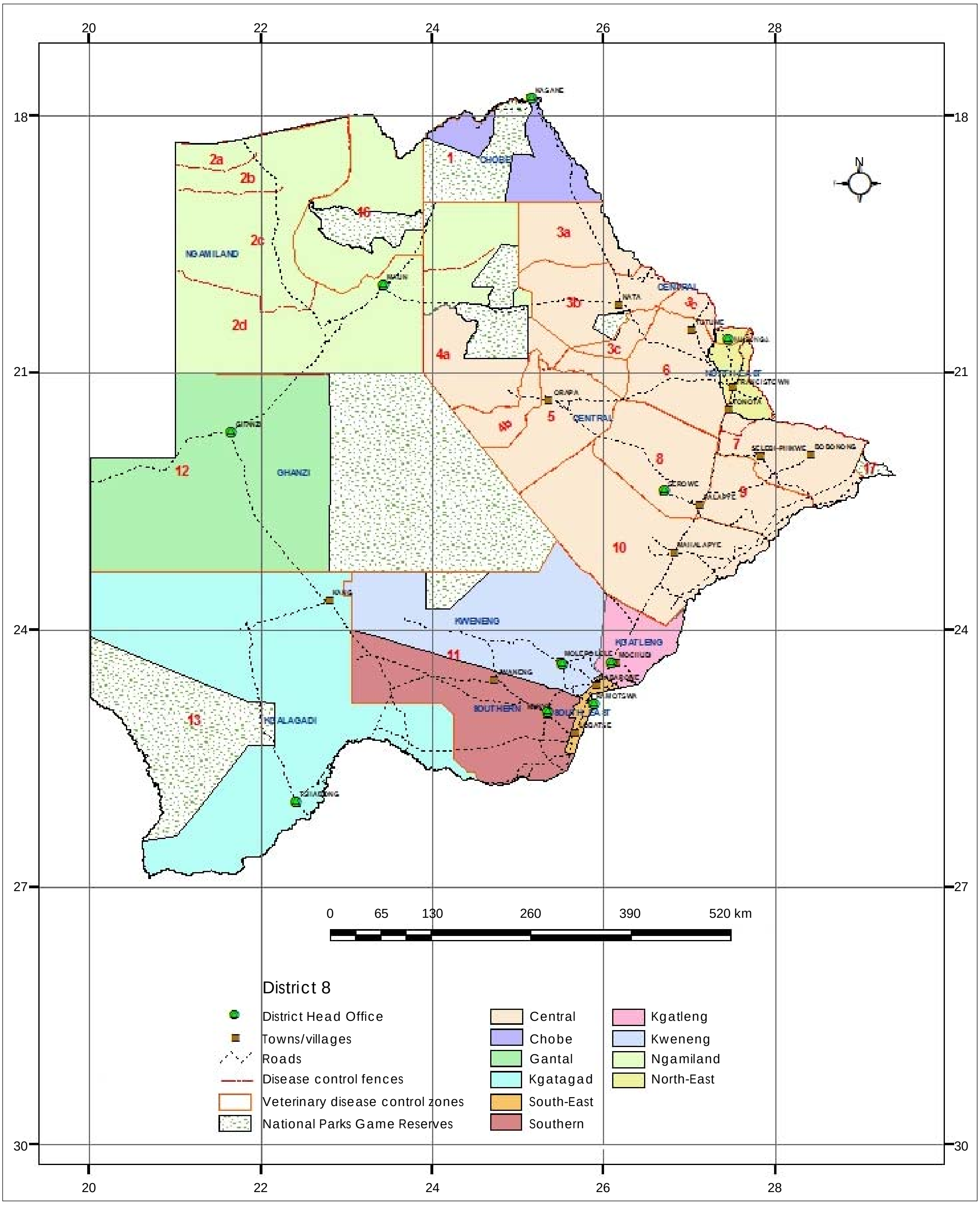

Figure 1
Veterinary districts of Botswana

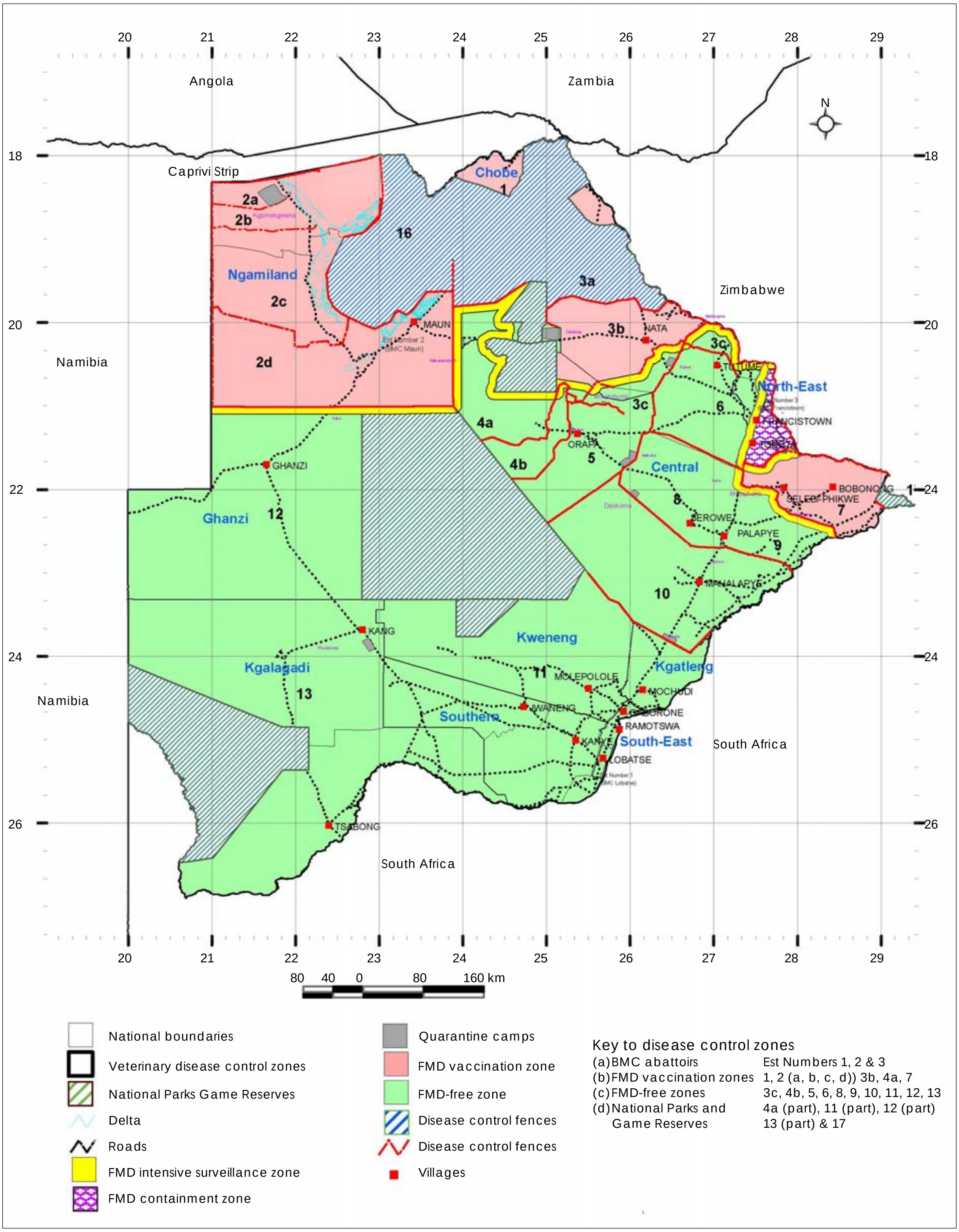

Figure 2
Veterinary disease control zones in Botswana

December 1995, assisted Botswana through the Emergency Preparedness and Contingency Planning (EMPRES) (4) by providing the expertise of an epidemiologist who was made available for three months to assist in the monitoring of progress of the control/ radication campaign.

In March 1996, the entire Ngamiland District was declared infected. A different strategy was then adopted. Vaccination was stopped and depopulation of the Ngamiland District implemented. This resulted in the slaughter of 320 000 cattle, carcasses were buried and aerial surveillance of Ngamiland was conducted to locate any animals that might still be left in the district.

Farmers were compensated for their losses, with three compensation options offered as follows:

- the first option was 100% cash compensation
- the second was 70% cash and 30% replacement of animals
- the third was 30% cash and 70% replacement of animals.

The replacement animals originated from CBPP-free areas in Botswana or neighbouring countries. The government also assisted the affected farmers by ploughing their fields for crops, feeding the aged, infants and infirm, providing donkeys for draught power and labour intensive public work projects were created (5).

Cattle repopulation of Ngamiland commenced in April 1997. Purchased animals were held in quarantine, bled on arrival and tested for CBPP using the CFT, FMD using the enzyme-linked immunosorbent assay (ELISA) and brucellosis using the Rose Bengal plate test and CFT before release to farmers. By the end of 1997, approximately 70 000 cattle had been restocked in the district; the exercise was completed by March 1998.

Laboratory testing

Initially, to confirm the outbreak, post-mortem examination, *Mmm*SC isolation, PCR and serological testing were performed (Table I).

Once the outbreak had been confirmed, testing was restricted to serological assays in order to establish the extent of *Mmm*SC spread. The serum agglutination slide test (SAST) was used initially in the field but was later abandoned as the test was found to lack specificity. All serum samples were then tested using the CFT, in accordance with procedure recommended by the World Organisation for Animal Health (*Office International des Épizooties*: OIE). Over a period of three years (1995-1997), a total of 398 592 sera were assayed (Table II).

Disease prevention and surveillance strategies

Botswana followed the OIE pathway of countries not practising vaccination to be declared free from CBPP (8). The country was declared provisionally free from CBPP at the end of 1997 after intensive surveillance, prohibition of any form of treatment and absence of disease and then was declared free from infection in 1998.

The cost of managing and eradicating the 1995 CBPP outbreak has been estimated at Pula 360 million (US$97.5 million).

Table I
Results of diagnostic tests to confirm the contagious bovine pleuropneumonia outbreak in 1995

Test	Sample	No. of samples tested	No. positive	No. negative
Post mortem	Carcasses	20	15	5
Isolation of *Mmm*SC	Lung, pleural fluid	20	8	12
Complement fixation tes	Serum	20	13 (titre ranged from 1:10 to 1:1 280)	7
Polymerase chain reaction	Lung, pleural fluid	8	8	0

MmmSC *Mycoplasma mycoides* subspecies *mycoides* small colony

Table II
Serum samples tested during contagious bovine pleuropneumonia outbreak

Year	No. of samples tested	No. of samples positive (%)
1995	74 183	182 (0.25%)
1996	253 972	326 (0.13%)
1997 (restocking cattle)	70 437	1 (0.0014%)

To avoid the reintroduction of infection through the movement of cattle from neighbouring countries, an intensive surveillance programme to ensure early detection of disease has been implemented. Surveillance is performed in the high-risk areas of Chobe that has a cattle population of 12 000 head and Shakawe, in the Ngamiland District, with 33 000 head.

Prevention strategies

Prevention strategies adopted by the veterinary authorities includes border controls, livestock movement controls and import quarantine.

Border control

A double cordon fence prevents the movement of cattle from Namibia's Caprivi Strip into Shakawe in the Ngamiland District.

From the Caprivi Strip and Zambia into Kasane, cattle movement is prevented by the Chobe River, which is perennial.

Import quarantine policy

Cattle from CBPP-free countries are allowed into the country only when they meet conditions stipulated in the import permit issued by the veterinary authorities. The imported animals are tested for CBPP, FMD and brucellosis as they enter the country and they are observed for clinical signs of disease on the farms.

Movement controls

The country is divided by cordon fences (Fig. 2) into disease control areas called 'veterinary zones'. Movement of cattle between zones is allowed under permit, at specified gates where animals are inspected by veterinary staff and issued with the movement permits. Animals are not allowed to move from FMD- and CBPP-high-risk areas into the rest of the country.

Disease surveillance

Disease surveillance is performed in CBPP high-risk areas. The objective of this policy is to detect CBPP as early as possible should the disease enter the country. Clinical, serological and abattoir surveillance and public awareness are in force.

Awareness

The awareness of farmers and of the public is ensured by staff of the Department of Veterinary Services during public gatherings, mainly in the high-risk areas of Chobe (Zone 1) and Ngamiland (Zone 2). The public is familiarised with the signs of CBPP and members are informed on how to report a suspect case. Farmers are also made aware of the importance of not allowing their cattle to graze or mix with cattle from neighbouring countries.

Clinical surveillance

All cattle in the high-risk areas that show respiratory signs are investigated for CBPP.

In the event of the occurrence of a suspect case, the Director of Veterinary Services is notified and a specialist team is despatched to investigate. The team comprises a pathologist, a bacteriologist and an epidemiologist.

The animals are clinically examined, affected animals are sacrificed and post-mortem examination is performed to detect CBPP lesions. Samples are collected for *Mmm*SC isolation, PCR and histopathology.

The herd is sampled for detection of antibodies using the CFT.

Animal movement controls are enforced until the case has proved to be negative for CBPP.

Abattoir surveillance

In high-risk areas, lungs from all slaughtered cattle are inspected for pneumonic lesions using forms used to record findings to assist in the identificatioin of CBPP lesions. In these areas, cattle are mainly slaughtered at slaughter slabs. Lungs from animals slaughtered at abattoirs in the country outside the high-risk areas are also inspected for CBPP lesions.

Trained livestock officers who follow a written schedule, perform the inspections. Lungs with suspicious lesions are sent to the National Veterinary Laboratory (NVL) in Sebele, Gaborone, for testing.

Serological surveillance

A statistically significant number of blood samples are collected from cattle once a year during FMD vaccination campaigns (Fig. 3), but schedules may change depending on risk levels. The aim of serological surveillance is to detect the presence of CBPP at a prevalence of 1% and at a confidence level of 95%.

A team from the NVL is involved in ensuring proper collection, documentation, storage and the transportation of samples to the laboratory.

Polymerase chain reaction

Nasal swabs are collected at random during FMD vaccination campaigns (Fig. 4).

Histopathology

Histopathological testing of lungs commenced in 2004. Tissues are collected from lungs showing suspect lesions in the course of abattoir surveillance (Fig. 5). The test is complementary to *Mmm*SC isolation and is utilised when samples have to travel long

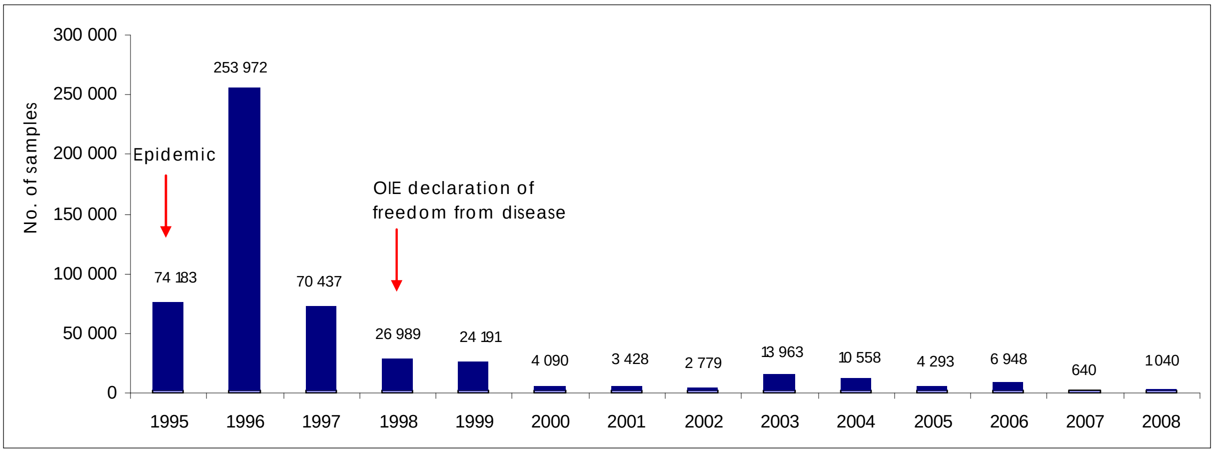

Figure 3
Number of serum samples tested using the complement fixation test, 1995-2008

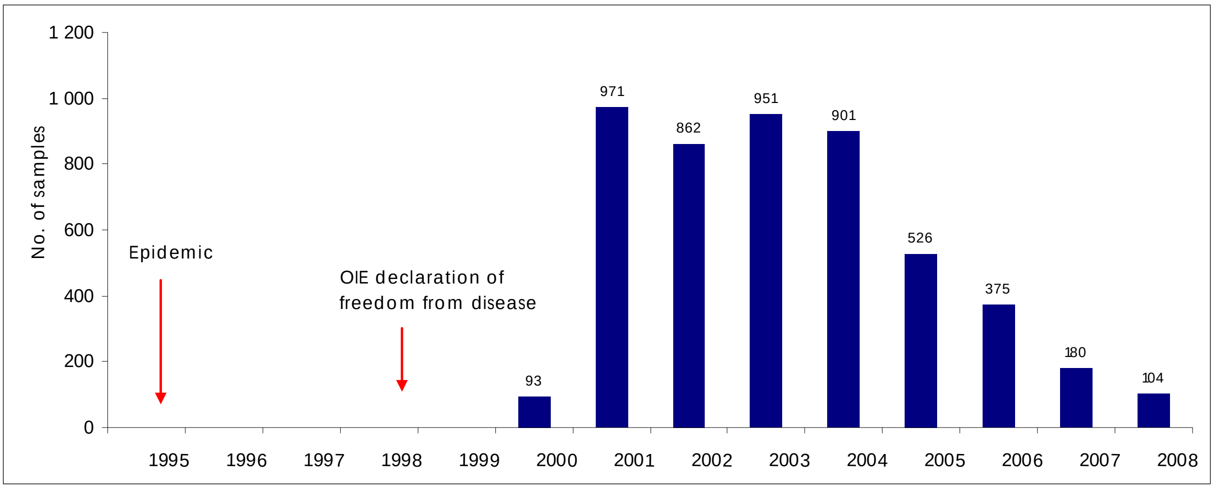

Figure 4
Number of nasal swab samples tested by polymerase chain reaction, 1995-2008

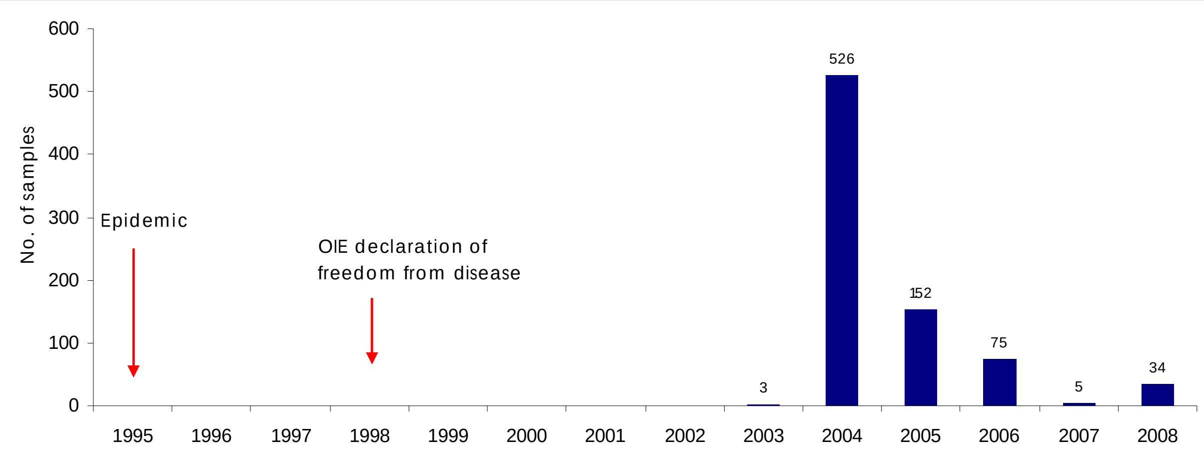

Figure 5
Number of lung samples tested by histology, 1995-2008

distances and preservation of mycoplasmas may be compromised.

Conclusions

Despite the fact that CBPP was present in northern Namibia (6, 7) and Botswana was a country at risk, prevention and surveillance strategies in place along border areas prior to 1995 were inadequate.

The 1995 CBPP outbreak was a lesson learnt at the high cost of US$97.5 million.

The outbreak of CBPP occurred in a remote location where roads were poor and therefore access to the area difficult. Consequently, the erection of cordon fences was slower than expected. Personnel were overstretched and resources were limited which lead to limited depths of epidemiological investigation.

When the outbreak occurred, the NVL did not have the diagnostic capacity required to control and eradicate CBPP and it was necessary to seek the support of laboratories in neighbouring and overseas countries and that of the FAO. This situation resulted in delays in obtaining results and also in decision-making, which allowed the infection to spread.

The 1995 CBPP outbreak led to an improvement in laboratory diagnostic capabilities, laboratory personnel was carefully trained and a specialist diagnostic team established.

The prompt and drastic action taken by the Botswana authorities resulted in the OIE declaring Botswana provisionally free from CBPP at the end of 1997 after intensive surveillance and prohibition of any form of treatment. In 1998, the country was again declared free from infection. The ongoing surveillance strategies should assist the country to control CBPP before the disease reaches epidemic proportions if it ever re-enters Botswana.

Cattle play a vital role in the socio-economic and cultural lives of the people in the Ngamiland District. These people depend heavily on cattle for their day-to-day needs, such as milk, meat, transport, draught power, weddings and funerals. The government had established a multi-sectoral reference group which coordinated the implementation of the relief programme for the people of Ngamiland so as to reduce social and economic disruption caused by the eradication policy (5). A study undertaken in 2000 indicated that the eradication of CBPP in Ngamiland posed a serious threat to food and nutrition security in the area and contributed to a significant increase in malnutrition rates in children below five years of age compared to the rest of the country (2).

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