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A retrospective study of a Porcine Reproductive and Respiratory Syndrome outbreak in South Africa in 2004

A dissertation submitted to the Faculty of Veterinary Science of the University of Pretoria in partial fulfilment of the requirements for the degree of MMedVet(suill)

C. M. Oosthuizen

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A Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) outbreak occurred for the first time in the Western Cape, South Africa during 2004. The economic impact of this disease on the pork industry is enormous and a decision was made to eradicate the disease. The spread of the disease was successfully prevented and controlled by the local veterinary authorities.

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AUTHOR	Oosthuizen, Cornelia Maria
Email	marie@pigandpoultry.co.za
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ABSTRACT

Porcine Reproductive and Respiratory Syndrome (PRRS) is a controlled disease in South Africa. This disease is caused by an Arterivirus and occurs commonly in Europe (European serotype) and in the United States of America (American serotype); therefore PRRS is not a trade sensitive disease. However, the disease has severe economic implications for the producer and the local pork industry and the decision was made by the Department of Agriculture, Fisheries and Forestry in association with the South African Pork Producers' Organization (SAPPO) to eradicate the disease when the first outbreak occurred in 2004 in the Western Cape.

Severe disease leading to acute mortalities and almost 100% mortality and morbidity rate in a few pig units in the Jacobsdal area (Kuilsrivier district) in the Cape Town peninsula, alarmed local veterinary consultants during the autumn of 2004. A first diagnosis of *Salmonella choleraesuis* was confirmed at the Provincial Veterinary Laboratory in Stellenbosch. Antibiotic treatment did not resolve the clinical picture. Sows still aborted and died and young pigs still died from acute respiratory distress. The syndrome was similar to "blue ear disease" because of severe cyanosis visible on the extremities of affected pigs. The first suspected diagnosis of Porcine Reproductive and Respiratory Syndrome virus (PRRSV) was made on post mortem examination on 10 June 2004 and was confirmed on 17 June 2004 with positive ELISA (Idexx Herdchek PRRSV Ab test kit 2XR) results.

A stamping out procedure immediately followed through slaughtering of all affected pigs showing clinical signs of PRRSV infection. Pigs in close proximity with possible contact and infection risk were also slaughtered. The movement of pigs was only allowed under Red Cross permit and all pig auctions were stopped. A local and countrywide serological survey was implemented immediately. The results of this survey luckily showed that the outbreak was limited to a few districts in the Western Cape. The probable source of infection is suspected to be uncooked swill originating from the Cape Town Harbour or the Cape Town International Airport, which was fed to pigs. The PRRSV responsible for the outbreak was confirmed on 5 July 2004 as the American serotype by RT-PCR test done at Lelystad, Netherlands. The National Department of Agriculture (NDA)* agreed to compensate pig owners for slaughtered pigs. This decision was further made possible by funding from SAPPO to protect the rest of the commercial pig herd in South Africa to ensure food safety and security. A total of 32 pig units were affected by PRRS of which only one was a commercial unit. All affected pigs were slaughtered by the end of August 2004. Units were cleaned and disinfected by the staffs of the Boland and Swartland State veterinary departments with approved disinfectants which is effective against PRRSV. Cleaned units had to stay empty of pigs for at least 8 weeks after disinfection was completed. Restocking was only allowed from known PRRS-free pig suppliers and regular monitoring was implemented of all previously infected sites and units in high risk areas. On-going serological monitoring revealed no more positive cases since May 2005.

It seems that the stamping out procedure and a temporary ban on movement and auctions of live pigs played a primary role in eradication of the PRRSV outbreak in South Africa in 2004.

* The name of the NDA has been changed to the National Department of Agriculture, Forestry and Fisheries (DAFF) in 2009, but because the NDA was the applicable name when the PRRS outbreak occurred, NDA will be used in this document.

Table of contents

SUMMARY

Porcine Reproductive and Respiratory Syndrome (PRRS) is a controlled disease in South Africa. This disease is caused by an Arterivirus and occurs commonly in Europe (European serotype) and in the United States of America (American serotype); therefore PRRS is not a trade sensitive disease. However, the disease has severe economic implications for the producer and the local pork industry and the decision was made by the Department of Agriculture, Fisheries and Forestry in association with the South African Pork Producers' Organization (SAPPO) to eradicate the disease when a first outbreak occurred in 2004 in the Western Cape.

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outside Klapmuts – taking the total amount of pigs implicated up to 8592! This time many more pigs were involved compared to the first round of infection! There was one positive thing: the sites involved were far less which made the chance of successful eradication a bit better. The only problem was to convince the DAFF that eradication could still be possible! There were no funds available from DAFF for 2005 and eradication with compensation was no option! SAPPO however managed to convince Minister Kobus Dowry (Minister of Agriculture in the Western Cape) that time is of the essence because winter is approaching which means it will be cold and wet soon – making circumstances ideal for the PRRSV to survive and spread much easier. If eradication ever had a chance of being successful, this was the time to protect the national pig herd by eliminating the positive foci. By April 2005 he agreed to control measures being implemented in the affected districts (Philippi, Wellington, Tierfontein outside Malmesbury, Paardeberg, and Cape Metropolis) once again: full quarantine of positive sites with no movement and auctions of live pigs and slaughtering of positive animals. A full survey and registration with a "seek and slaughter" policy with regard to positive PRRS animals was implemented immediately (with a time limit on compensation to encourage owners of positive pigs to slaughter their animals). Concurrently there was a broad national survey to once again confirm the belief that PRRS was still confined to the Western Cape. Restocking of the emerging farmers with PRRS negative stock was also combined with an upliftment and education programme which formed part of the motivation for new statutory levies for the pig industry. The last positive pigs in Mbekweni were slaughtered on the 18th of April 2005.

It seems that the stamping out procedure and a temporary ban on movement and auctions of live pigs played a primary role in eradication of the PRRSV outbreak in South Africa in 2004.

The disease pattern for the 2004 outbreak can be classified as an epidemic pattern. This type of epidemic pattern can be suspected with a disease outbreak in a naive population.

The temporal pattern revealed that most abortions occurred in the beginning of the outbreak, but this might also be because animals were slaughtered and not left to follow the normal course of the disease.

The analysis of the spatial pattern during the 2004 outbreak suggested the informal settlements around Cape Town as a high-risk area for the outbreak of PRRS and other diseases which can be transmitted via swill feeding to pigs.

The possible source of the infection was most likely swill which originated from the Cape Town harbour or Cape Town International airport which was fed in an uncooked state to pigs.

PRRSV outbreaks in South Africa can cause substantial financial loss to the pork industry and the controlling authorities.

2. LITERATURE REVIEW

2.1 Porcine Reproductive and Respiratory Syndrome (PRRS)

Porcine reproductive and respiratory syndrome (PRRS) is an infectious viral disease of swine that is easily transmitted through direct contact to susceptible pigs and vertically to foetuses. PRRS is considered the most economically important viral disease of intensive swine farms in Europe and North America. It is characterized by reproductive failure in sows and respiratory distress in piglets and fattening pigs, which, combined with its potential for rapid spread, can cause significant production and economic losses. PRRS, also known as Mystery Swine Disease, Blue Ear Disease, Porcine Endemic Abortion and Respiratory Syndrome (PEARS) and Swine Infertility Respiratory Syndrome (SIRS), is not known to be a zoonosis. The PRRS virus (PRRSV) is an enveloped positive-stranded RNA virus, classified in the order Nidovirales, family Arteriviridae, and genus Arterivirus. Two major serotypes of the virus are currently described: the European and the American types. This classification is significant in that vaccines made for one serotype will not completely protect against the other [(1)].

A swineherd has to be suspected of PRRSV infection if clinical signs like reproductive failure characterized by late-term abortions, increased numbers of stillborn, mummified and weak piglets and increased pre-weaning mortality appear within the herd. However, a diagnosis based on clinical signs only, is difficult to achieve due to variation of signs between herds. Furthermore, no gross lesions specific to PRRSV infections have been demonstrated in infected pigs at necropsy, and by histological examination interstitial pneumonia is the only consistent lesion observed. Therefore, a definitive diagnosis requires detection of PRRSV in infected animals or detection of antibodies in foetal fluid or in precolostral blood of stillborn and weak born piglets. Detection of antibodies in sera originating from farms with a previously known seronegative status is another indication of an acute infection with PRRSV. Besides virological methods, serology represents a powerful tool for the detection of PRRSV in a pig population. Several methods have been described for the detection of antibodies to PRRSV: Enzyme-linked immunosorbent assay (ELISA), Immunoperoxidase monolayer assay (IPMA), Serum Neutralization test (SNT) amongst others. PRRSV can be demonstrated by the isolation of virus using cell cultures, by direct detection of viral antigen in tissue sections or by the detection of virus-specific RNA[(2)].

Veterinarians commonly assess the status of a swineherd using serological testing. In the case of PRRS, a serum sample can be used to detect the presence of the actual PRRS virus by polymerase chain reaction (PCR) testing or it can be used to detect antibodies produced in an immune response after PRRSV exposure by using ELISA. Often, ELISA and PCR testing are utilized simultaneously to determine/confirm the PRRS status of an animal [(17)].

To guarantee the safety of semen for artificial insemination, very rapid, sensitive and reliable tests for virus detection are crucial. Conventional methods for virus detection in semen, like virus isolation, are: (a) not very sensitive; (b) time-consuming; (c) very expensive, and (d) the application of the virus isolation technique is markedly reduced for semen due to cell toxicity. Furthermore, boar semen can only be stored temporarily, and consequently a rapid test is a pre-requisite to guarantee the safety of boar semen prior to use. The PCR technique as a diagnostic method is generally known as a very sensitive, specific, and rapid tool for the detection of, e.g. viral genomic sequences. It has been shown that even matrices such as boar semen can be used in PCR-based

tests. After the CSF outbreak in The Netherlands in 1997, it was decided to develop rapid and reliable assays for the detection of list-A diseases such as CSF, FMD and other economically important diseases [12].

GEOGRAPHICAL DISTRIBUTION

PRRS was first detected in North America in 1987 and in Europe in 1990 and has since then been recorded in most major pig-producing areas throughout the world.

Only Argentina, Australia, Cuba, Finland, New Caledonia, New Zealand, Norway, Sweden and Switzerland are reportedly free from PRRSV infection [13]. The most recent outbreaks have occurred in China, Chinese Taipei, Costa Rica, Croatia, French Polynesia, Honduras, Hong Kong, Japan, Korea, Netherlands, Romania, Russia, Spain, Thailand, Vietnam, United Kingdom (2009) and Czech Republic, Denmark, Hungary, Ireland, Laos, Latvia (2010) [23].

STATUS	COUNTRIES REPORTING (2009 up to August 2010)
Infection present (With no clinical disease)	Bolivia, Bosnia, Czech Republic, Herzegovina, Cyprus, Mexico, Slovenia, Ukraine, Ireland and Latvia
Infection present (With clinical disease)	China, Chinese Taipei, Costa Rica, Croatia, French Polynesia, Honduras, Hong Kong, Japan, Korea, Netherlands, Romania, Vietnam, United Kingdom, Russia, Spain, Thailand, Vietnam, United Kingdom
(Disease present with No quantitative data)	Canada, Denmark, Dominican Republic, Hungary, Philippines, United States of America

Table 1 Status of PRRS in affected countries (Source: OIE Home page, WAHID 2010)

Clinical signs: The pig, both domestic and feral, is the only species known to be naturally susceptible to PRRS. The incubation period is between 4 to 8 days experimentally, but can range from 3 to 37 days in natural outbreaks.

The clinical presentation and clinical signs of PRRS vary greatly between herds. In general, PRRS is characterized by reproductive failure of sows and respiratory distress of piglets and growing pigs. The characteristics of the reproductive failure are infertility, late foetal mummification, abortions, agalactia, stillbirths, and weak piglets that usually die shortly after birth due to respiratory disease

and secondary bacterial infections, such as *Salmonella enterica (S. choleraesuis* previously*), Haemophilus parasuis, Streptococcus suis* and *Mycoplasma hyopneumoniae*. In young piglets, high mortality rates will occur and at the peak of an outbreak losses from death may reach 60-70 %, with 30-50 % losses more common. The disease in weaned and fattening pigs is characterized by anorexia, lethargy, cutaneous hyperaemia, dyspnoea, rough hair coats, failure to thrive and an increase in mortality from secondary infections. Mortality rates are also elevated in the post-weaning period, varying between 4 -20 %. Decreases in post-weaning weight gain of up to 65 % have been reported. Older pigs may show mild respiratory signs, which may also be complicated by secondary infections. Finishing pigs, boars, gilts and sows are often found to have sub-clinical infection.

Antibodies generally confer limited protection, and serum titres for PRRS-infected finishing pigs often decline with advancing pig age. Infected pigs can remain viraemic and infectious for very variable periods. When the virus is cleared from the blood, it can remain in lymphoid tissues for up to 150 days after exposure [(1)].

Diagnosis and differential diagnosis: The detection of antibodies to PRRSV can be done using a wide range of serological tests: commercial or in-house enzyme linked immunosorbent assays (ELISA) are widely used. The immunoperoxidase monolayer assay and the indirect immunofluorescence assay can also be used [(2, 5)], but were not used in South Africa during the outbreak. The ELISA is the most common and widely used antibody application. ELISAs are designed for detecting and quantitating substances such as peptides, proteins, antibodies, hormones, drugs of abuse and their metabolites. A number of different assay formats are being used dependent on the system being investigated. The simplest format involves coating of antigen onto micro titre plates, followed by incubation with a specific antibody. The binding antibody or an appropriate secondary antibody is conjugated to an enzyme that typically catalyses formation of a coloured product. Colour formation is monitored spectophotometrically and related to concentration of antibody by calibration to a standard curve. ELISAs are typically performed in 96, 384 and even 1536-well plates and are easily robotised and adapted to high throughput screening [(11, 15)].

The commercially available indirect ELISA (IDEXX) is an easy, quick and reliable test to diagnose PRRSV infection in swine herds, and it readily detects antibodies against both the European and American types of PRRSV. However, for individual animal certification and for the detection of maternal serum antibodies against PRRSV, a more sensitive test is still needed [(8)]. Immunofluorescence (IF) is widely used for the rapid diagnosis of virus infections by the detection of virus antigen in clinical specimens, as well as the detection of virus-specific IgG, IgA or IgM antibody. The technique makes use of a fluorescein-labelled antibody to stain specimens containing specific virus antigens, so that the stained cells fluoresce under UV illumination. In the case of direct IF, the specimen is probed directly with a specific labelled antibody against a particular virus antigen. In the case of indirect IF, the specimen is first probed with a non-labelled specific antibody, followed by a labelled antibody against the first antibody. Direct or indirect IF can be used for the detection of virus antigen, whereas indirect IF is virtually always used for the detection of antibody. Indirect IF possess the advantage of an extra amplification step for the signal, however, it requires an extra step in comparison to direct IF. IF is highly dependent on the quality of the specimen. One of the criticisms of IF is that it is labour intensive and requires highly skilled staff for the reading of the specimen [(18)]. The IFA test may be used as a confirmatory test when a false-positive ELISA result is

suspected or *vice-versa*. The immunoperoxidase monolayer assay (IPMA) is similar to the IFA test. The anti-species secondary antibody is labelled with peroxidase, which leads to brown staining by a substrate that can be evaluated using a light microscope, rather than fluorescent labels as with the IFA, resulting in fewer false positive results.

The number of sera needed to identify an infected herd depends on the seroprevalence. Shortly after an acute outbreak, the prevalence of seropositive animals in infected herds is high. This situation makes it possible to identify infected herds by testing a small number of sera. When a herd with unknown status must be examined, it is advisable to examine more samples from a sow herd than from a finishing herd, because seroprevalence in sow herds is usually lower compared to seroprevalence in finishing herds.

Virological diagnosis of PRRS is difficult. Isolation of the virus can be done on porcine macrophages, ascetic fluids or tissue cultures from organs such as lung, tonsil, lymph node and spleen. PRRS virus isolation is preferably done using porcine alveolar macrophages (PAM) or one of the two continuous cell lines CL 2621 or Marc-145 but in general the use of macrophages constitutes the most sensitive system for virus isolation [7, 18]. PAM should be harvested from pigs, preferably specific pathogen free (SPF), younger than 6-8 weeks of age. Since different batches of macrophages are not equally susceptible to the virus, each batch has to be tested before use. This makes PRRSV isolation a rather laborious process. The identification of virus isolates is done by immunostaining using specific antisera. With regard to antigenic variation polyclonal antisera should be used in combination with monoclonal antibodies [2]. For laboratory confirmation, immunohistochemistry or reverse-transcription PCR (RT-PCR) is used. Immunohistochemistry is the localization of antigens in tissue sections by the use of labelled antibody as specific reagents through antigen-antibody interactions that are visualized by a marker such as fluorescent dye, enzyme, radioactive element or colloidal gold. Immunocytochemistry differs from immunohistochemistry in that the former is performed on samples of intact cells that have had most, if not all, of their surrounding extracellular matrix removed. This includes cells grown within a culture, deposited from suspension, or taken from a smear. In contrast, immunohistochemical samples are sections of tissue (biology), where each cell is surrounded by tissue architecture and other cells normally found in the intact tissue. Immunocytochemistry is a technique used to assess the presence of a specific protein or antigen in cells (cultured cells, cell suspensions) by use of a specific antibody, which binds to it, thereby allowing visualization and examination under a microscope. It is a valuable tool for the determination of cellular contents from individual cells. Samples that can be analysed include blood smears, aspirates, swabs, cultured cells, cell suspensions.

Antibodies are an important tool for demonstrating both the presence and the sub cellular localization of an antigen. Cell staining is a very versatile technique and, if the antigen is highly localized, can detect as few as a thousand antigen molecules in a cell. In some circumstances, cell staining may also be used to determine the approximate concentration of an antigen, especially by an image analyser.

Immunohistochemical detection of PRRSV in frozen sections or formalin-fixed tissues by the use of immunogold, silver staining, or immunoperoxidase staining has been described as a useful technique for diagnosis, but apparently it seems mostly to be used for research purposes [2].

PCR allows the *in vitro* amplification of specific target DNA sequences by a factor of 10^6 and is thus an extremely sensitive technique. It is based on enzymatic reactions involving the use of synthetic oligonucleotides flanking the target nucleic sequence of interest. Repeated cycles (usually 25 to 40) of denaturation of the template DNA (at 94°C), annealing of primers to their complementary sequences (50°C), and primer extension (70°C) result in the exponential production of the specific target fragment. Advantages of PCR include extremely high sensitivity (may detect down to one viral genome per sample volume), easy to set up and fast turnaround time. Disadvantages include that it is extremely liable to contamination, it requires a high degree of operator skill, it is not easy to quantitate results and a positive result may be difficult to interpret [(18)]. Reverse transcription-polymerase chain reaction (RT-PCR) is another tool for the detection of PRRSV. By means of strain-specific primers, RT-PCR can differentiate American strains from European strains. It appears that the method still has to be optimized to become more sensitive than isolation in PAM cultures. However, for the detection of PRRSV in samples with reduced virus infectivity and for the examination of semen samples, which may be toxic for PAM cultures, the RT-PCR may constitute a valuable tool [(2)].

Reproductive signs need to be differentiated from leptospirosis, porcine parvovirus infection, porcine enterovirus infection, haemagglutinating encephalomyelitis, African Swine Fever and Classical Swine Fever. For the respiratory and post-weaning form of the disease, differential diagnosis is needed for enzootic pneumonia, proliferative and necrotizing pneumonia, *Haemophilus parasuis* infection, haemagglutinating encephalomyelitis virus, porcine respiratory coronavirus infection, as well as post weaning multi-systemic wasting syndrome.

Transmission of the virus: The virus is shed in saliva (up to 6 weeks), urine (up to 2 weeks), semen (up to 6 weeks) and mammary gland secretions. Transmission can be by inhalation, ingestion (including ingestion of infected meat), coitus, trans-placental, artificial insemination (also from vaccinated boars), pig bites and needles and other inanimate objects (equipment, instruments, and clothing) or substances (water, feed). PRRSV is highly infectious and easily transmitted through direct contact among pen mates. Aerosol transmission is difficult (but possible), although it has been experimentally shown. PRRSV is unstable outside the pH 5.5-6.5 range. Low concentration of detergents and solvents such as chloroform and ether rapidly inactivate PRRSV. The virus survives in water for up to 11 days, but drying quickly inactivates it. As a result, the virus does not survive in the environment or on fomites under dry conditions.

PRRSV can be isolated from fresh muscle and lymphoid tissues up to 24 hours after slaughter (it can even be isolated from muscle that has been frozen at -20°C for one month). Nevertheless, the virus titres decrease with cooling, hardening and freezing, although PRRSV can survive several weeks at 4°C in bone marrow. Cooking, curing and rendering are sufficient to inactivate PRRSV in meat, minimizing the risk of spread in this way. The real threat occurs when unprocessed infected meat is fed to susceptible pigs (swill feeding).

The most likely path of entry into a farm or country is asymptomatically infected pigs, via semen and swill feeding [(1, 6, 10)].

2.2 Prevention and control of PRRS

The key elements of PRRS control and eradication programs are early disease detection and rapid laboratory confirmation; quick identification of the infected farms and control of the infection through different stamping out strategies. Control options will depend on pig density, the degree of multi-site structure of farms, the movement of pigs, and whether infected pig meat is processed by cooking. Because PRRS is transmitted by direct contact, control measures are advisable although not critical at slaughter plants and meat processing plants [(1)].

Vaccination is part of the routine programme in North America and Europe. There are modified live vaccines and inactivated vaccines available in different parts of the world. The financial implication of vaccination and worse, no vaccination is a huge part of the cost of successful production in countries which are endemically infected with PRRSV.

2.3 Objectives of the study

The 2004 outbreak was of great concern considering that PRRS has never occurred before in South Africa. The huge economic impact of this disease on the pig production industry and the effect on the supply of affordable and safe pork to the consumer cannot be over emphasized. The only way to ensure consistent pork production to all levels of the market in South Africa was to eradicate this disease as soon as possible. No information on previous outbreaks in any region of South Africa has been published within the scientific literature, therefore the 2004 outbreak provided an ideal opportunity to record the epidemiology of PRRS and investigate the risk factors associated with the epidemic in the Western Cape. Identifying risk factors will promote rapid control and limit spread in possible future outbreaks and hopefully fully prevent any future outbreaks of PRRS in South Africa.

3 MATERIALS AND METHODS

3.1 Disease outbreak investigation

3.1.1 Case definition

For the purpose of this study, a case was defined as a pig with clinical signs of PRRS and positive serology (Idexx PRRS ELISA – indirect antibody test kit) or a pig with positive serology alone (the only available and practical test in RSA).

3.1.2 Verifying the diagnosis

For each suspect case, the diagnosis was verified by serological test (ELISA) which was conducted at the ARC – Onderstepoort Veterinary Institute (OVI) or the Provincial Veterinary Laboratory (PVL) Stellenbosch. Blood was collected in serum tubes for ELISA testing. The positive ELISA results were confirmed by sending serum (for ELISA and Reverse RT-PCR), white blood cell fractions (RT-PCR) and lung tissue (RT-PCR) to ID-Lelystad, Lelystad in the Netherlands of the first few cases. The virus was confirmed as the US-type of the PRRSV by RT-PCR of the lung tissue, by ID-Lelystad.

3.1.3 Determining the magnitude of the problem

A serological survey was conducted on all affected units (showing typical clinical signs and/or dead pigs) initially, but was quickly followed by a broad serological survey of the Western Cape and the rest of the country.

3.1.4 Determining the temporal pattern

The number of cases per day was recorded for the duration of the outbreak from 15 June 2004 to 30 March 2005.

3.1.5 Determining the spatial pattern

ArcView 8.3 was used for GIS manipulation of the data. Coordinates of the affected properties (obtained by the Animal Health Technicians visiting the farms) were recorded in an Excel spread sheet (Microsoft Office 2010) for easy reference. All the overlays used were obtained from the Elsenburg GIS database and included:

- boundaries of the Western Cape Province
- towns of the Western Cape Province
- major rivers of the Western Cape Province
- major roads of the Western Cape Province
- major mountains of the Western Cape Province

3.2 Population at risk

3.2.1 Phase 1

Initially in mid-June 2004 the population at risk was defined as all pigs in the Philippi area (Mitchell's Plain district) and Jacobsdal area (Kuilsriver district) in the Cape Town metropolis where the first cases appeared. All identified high risk properties were placed under quarantine and a serological survey of these properties were conducted after purchasing adequate stock of ELISA test kits. Western Cape animal health technicians were directed to conduct on-site inspections of pig holdings in close proximity of the outbreak farm and to complete questionnaires focussing on abnormal mortalities, illness and abortions. A database of all major pig producers in the Western Cape was drawn up on the 18th of June 2004 to define the possible broader pig population at risk.

The export of pigs and pig products were stopped by the Director of Veterinary Services, Dr. Gideon Bruckner on the 21st of June 2004. On 25 June 2004 the quarantined farms in the Western Cape included 86 herds (6869 pigs). The total pig population in the Western Cape existed of 250 pig herds including 37 500 pigs.

3.2.2 Phase 2

By the 28th of June 2004 the quarantined districts with movement restrictions included the Cape Metropolis and the surrounding magisterial districts of Stellenbosch, Paarl and Malmesbury.

Movement was only allowed by means of a Red Cross permit*(see page 38) and then only for slaughter at a registered abattoir. All pig auctions were also disallowed. On-site inspections continued concentrating on the Cape Flats area.

By 12 July 2004 293 properties were visited (11 397 pigs) and inspected. The total number of positive farms at that stage was 10 farms. On 13 July a notice to all provincial directors and deputy directors of the national DAFF, Skukuza and SAPPO was sent by the senior manager: Animal Health DAFF that a targeted survey for PRRS had to be conducted in all provinces as soon as possible to determine the incidence and possible spread of the disease in the country. Piggeries where swill feeding was practiced had to be targeted (10 blood samples from post-weaner pigs and any sows recently aborted to be collected from each piggery).

The survey in the outbreak areas was completed on 23 July 2004. The total number of pigs surveyed included 30 272 pigs on 464 farms.

3.2.3 Phase 3

By 2 August 2004 three units (outside the previous risk areas) in Atlantis, Piketberg and Vredenburg respectively were also positive for PRRSV. This extended the population at risk also to Malmesbury district.

The countrywide serological survey was also finished on 2 August. All 47 503 samples tested from 368 farms, had negative PRRS results. The conclusion was made that the disease was confined to the Western Cape only. The so-called final stages of attempting to eradicate PRRS from the Western Cape, was reached by the end of August 2004. This included buying and slaughtering all remaining pigs of farms which tested serologically positive. This process was mediated by a memorandum of agreement between the Western Cape Provincial Government (in its Department of Agriculture) and the Seller (owners of serologically positive pigs).

3.2.4 Phase 4

There were unfortunately once again positive PRRS serology results on a previously slaughtered and re-stocked farm in the Philippi area by the beginning of December 2004. It seemed that the pigs arrived on the farm PRRS positive since they were healthy with no signs of disease. The pigs were sourced from 3 locations within the previously controlled areas and one location in Grabouw which was not previously in a controlled area. PRRS positive source farms in Mbekweni (Paarl district) were quarantined once again. A census of pigs in Mbekweni was organized by SAPPO and was finished on 11 February 2005. A total of 1262 pigs of 98 owners were all considered to be PRRS +ve due to the close proximity of surrounding pigs. At this stage there were 6 sites regarded as positive – implicating about 2400 pigs. SAPPO requested the implementation of controlled movement once again in the affected districts. At this stage the DAFF did not implement any of the controlled movement measures as was applied in 2004. Affected sites were quarantined only. This was not due to unwillingness from the local veterinary authorities, but mainly due to lack of enough manpower and support of national structures – which requested a risk analysis of the situation before eradication was considered. SAPPO encouraged farmers to slaughter pigs on affected sites in Klapmuts, Tierfontein (Malmesbury), Rondebosch and Durbanville – which reduced the number of affected sites to 4 with approximately 1592 pigs. Sites were still quarantined.

On the 14th of March 2005 the number of positive sites implicated once again increased to 5 when a big commercial unit at Klapmuts tested serologically positive for PRRSV infection. This pushed the total pigs involved up to 8592! By 17 March the Director Animal Health agreed to movement control and requested a state controlled vaccination program of all positive animals. The vaccine suggested was a modified live PRRS vaccine which delivers cross protection against heterologous and homologous challenge. Since there were no PRRS vaccines registered in South Africa, an application for importation of PRRS vaccine was delivered to the Registrar and DAFF. Only positive farms would be vaccinated (6 infected localities, 120 owners, about 8000 pigs).

On 21 March 2005 the districts which were affected by movement control included the area southwest of the Hottentots Holland, Du Toitskloof and Limietberg Mountains and then south of the Berg River from Gouda across to Veldrif. The ban on sale of live pigs at auctions included auctioneers at Klipheuwel, Klapmuts, Gouda, Clanwilliam and Worcester. An intensive serological survey and census continued particularly in and around infected areas. To date 425 samples were tested of 71 farms – representing 18 300 animals. All commercial farms had to be tested again at the abattoirs. At that stage no incentive would be paid to positive farms, but farmers were encouraged to slaughter at abattoirs as soon as possible. There was some resistance to this approach by informal farmers due to lower slaughter prices and risk of condemnation (compared to informal slaughter). By 4 April 2005 the State Veterinarian Boland addressed a letter to the acting Senior Manager: Animal Health (NDA) stating the 6 confirmed PRRS positive localities (5 small farmers, 1 commercial unit – total of 8000 pigs) as Philippi, Klapmuts, Mfuleni, Mbekweni, Tierfontein and Paardeberg. The strategy so far was to quarantine positive farms with movement restriction in the surrounding areas (Red Cross permit). On 5 April SAPPO had a meeting with the Minister of Agriculture and agreed to carry the cost of culling the commercial unit – R 7 million and requested the cost for culling the small farms from NDA. The intensive serological survey and census continued to identify additional positive farms as soon as possible and place them under quarantine.

3.2.5 Phase 5

The mountain ranges in the north east starting at Gordon's Bay and stretching along the Hottentots Holland, Du Toitskloof and Limiet mountains to Gouda and then following the Berg River in the north to Veldrif were the boundaries of the last permit controlled area effective from the 7th of April 2005.

3.3 Serological survey and census

A serological survey was originally done only at affected and high risk properties in Mitchells Plain and Kuilsriver at the end of June 2004. This was extended to the Western Cape Province and the whole country. The survey in the area was completed by end of July and included 464 farms with 30 272 pigs. The countrywide serological survey confirmed that the outbreak was confined to the Western Cape. A total of 47 503 samples was tested from 368 farms. 120 samples were taken monthly for routine monitoring in each area after the first part of the outbreak and eradication was completed. An intensive serological survey and census was conducted in Mbekweni when the second focus of infection was identified in early December 2004. The survey in the affected areas continued with special attention to infected areas. Up to the end of March 2005, 425 blood samples of 71 farms in these areas were tested – this represented 18 300 pigs. By beginning of April 2005 a survey with "seek and slaughter" policy with regards to PRRS positive pigs was implemented. A

concurrent broad national survey confirmed that the disease has not spread over the mountains of the Western Cape.

3.3.1 Objectives

The aim of the serological surveys and census was to ascertain the following:

- to determine the serological status and thus infection levels of PRRSV infection
- to discover clinical evidence of disease or unexplained deaths of pigs
- to obtain an accurate, up to date porcine census

3.3.2 Information gathered

- The spread of PRRSV infection could be determined from the results of the serological survey
- Forward and backward tracing of movement of possibly infected pigs was made possible
- The total susceptible population of pigs in the Western Cape could be determined

3.4 Questionnaire survey

A PRRS specific questionnaire survey was conducted in affected areas. Questions included: owner's details, GPS location, number of pigs, clinical signs associated with PRRS during the previous 3 months, dates of occurrence, number of pigs affected, feed, movement of pigs during the previous 3 months, number of pigs involved.

3.5 Handling of data an analysis

As part of the disease outbreak investigation, the host factors in some cases, clinical signs, some serological results, summaries of discussions and meetings, veterinary quarantine notices, press releases were recorded and filed and written up in situation reports that was updated as new information became available. The State Veterinarian Boland also kept all other relevant information with regard to the PRRS outbreak in the 14/2/9/33 PRRS 2004 file.

4. RESULTS

4.1 Clinical presentation of cases

The first cases manifested with massive abortion storms in sows followed by acute deaths. Later on in the disease sows first went off their feed before aborting and dying, prolonging the time to death by a day or two. There were increased stillbirths and mummies in the farrowing houses. This was usually associated with blue discoloration of the extremities i.e. ears, snout, legs, abdomen, tail (hence the layman's term "blue ear disease"). Growing pigs showed discoloration of the extremities, swollen eyes, coughing and diarrhoea. With the "second" part of the outbreak, the first signs in the commercial unit appeared as litters with large numbers of post natal deaths followed by poor performers; sows going off feed and then abortions. Numerous sows went off their feed and whole litters were dying. The first signs in the farrowing house were that suckling piglets showed poor

growth (weak with diarrhoea) and mortality increased. Initially a feed problem was suspected: several sows did not have milk and their appetite declined. Pre-weaning performance continued to decline and deaths increased. PM's revealed severe secondary *E.coli* infections of the intestine.

4.2 Confirmation of the diagnosis

4.2.1 Serological findings

32 farms showed positive ELISA results during the June – August 2004 part of the outbreak. There were 6 positive sites during the December 2004 – April 2005 part of the outbreak. The Mbekweni location was considered as a single site during the second outbreak because of the close proximity of > 1000 pigs in the informal settlement outside Wellington. The HerdChek PRRS Antibody Test Kit of Idexx Laboratories was used for ELISA testing of serum.

4.2.2 Post mortem findings

Post mortems of various cases were done at the Provincial Veterinary Laboratory in Stellenbosch by Dr Jakob Stroebel and private veterinary consultants during May and June 2004. The first tentative diagnosis of PRRS on macroscopic lesions were made on the 10th of June 2004 on pigs from Sandown Piggery (Ghisolfo).The most outspoken macroscopic lesion was an uncomplicated interstitial pneumonia mainly in young pigs (pre-weaning and post-weaning). This was often associated with cyanotic ears ("blue ear"). Sows did not show the respiratory lesions primarily; they presented mainly with abortions. Sandown Piggery had good management and biosecurity systems in place and secondary infections were minimal.

4.2.3 Virus typing

Virus typing by RT-PCR from ELISA positive cases identified PRRSV US-serotype as the only cause of the 2004 outbreak.

4.3 Population at risk

Summary of data obtained from PRRS-specific questionnaire survey and other surveys during the PRRS outbreak in the Western Cape Province in 2004

Total number of properties visited with the survey in WC	535
Total number of pigs represented in WC survey	48 572
Total number of listed pig herds in WC	250
Total number of pigs in listed herds in WC	37 500
Total number of samples submitted to PVL	5915
Total number of samples tested at PVL	4707
Total number of samples tested positive at PVL	412

Total number of farms in countrywide survey	368
Total number of samples tested in countrywide serological survey	47 504

4.3.1 Questionnaire survey

A PRRS specific questionnaire survey was used to plot 535 farms. 7 of these locations were removed because of incorrect or lacking GPS information.

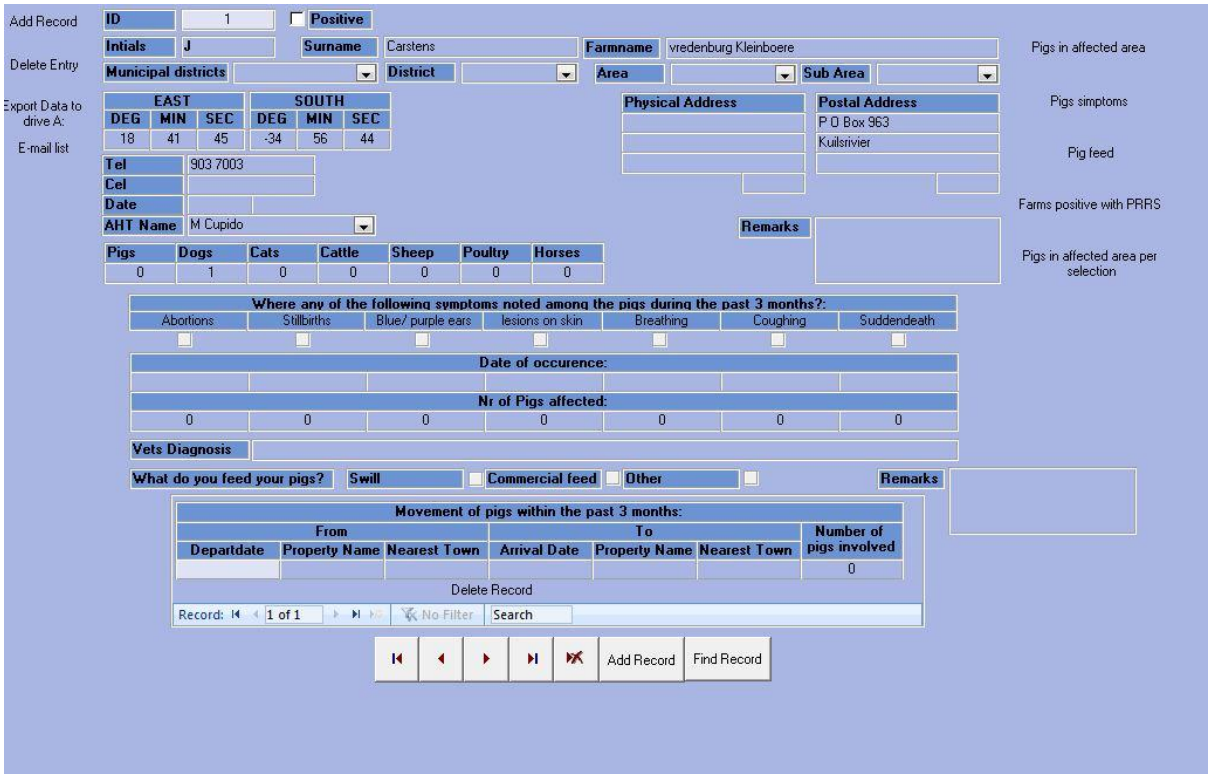

Table 2 Pig specific questionnaire survey

4.3.2 Integration of 3 different databases

Data was collected in the **Integrated Farm and Animal Information system (IFAS)** from January 2003 until June 2004. 115 farms were identified as pig-associated properties in the environment at risk for PRRSV infection with this census. Three GPS location readings were blatantly wrong and were removed from the data.

71 farms with pigs were also identified with the **African Horse sickness surveillance** done in June 2004 (total count of 34 400 pigs). 66 of these farms were used to populate the census of pig associated farms. There was some duplication of these farms with other databases (an effort was made to separate farms within 100m from each other: the IFAS database was used preferentially and specific points were then deleted from the AHS database for this evaluation).

The **Laboratory Information Management system (LIMS)** was used to evaluate PRRS serology sent to PVL Stellenbosch. 700 events were sampled on this database. This included a total of 5915

samples submitted of which 4707 were tested for PRRSV. 412 samples of these tested positive for PRRSV antibodies. 261 of the locations in this database had no GPS readings in the LIMS, but 147 were found by cross-referencing with other databases. 5 of these were removed because the full GPS address was lacking. A total of 585 farms with GPS readings noted in the LIMS could be plotted. Out of the 115 farms in the system with no GPS readings, there were 16 farms with positive PRRS titres which could not be plotted.

4.4 Temporal pattern

4.4.1 Disease pattern

As illustrated in Figure1, 2 and 3, the disease pattern for the 2004 outbreak can be classified as an epidemic pattern.

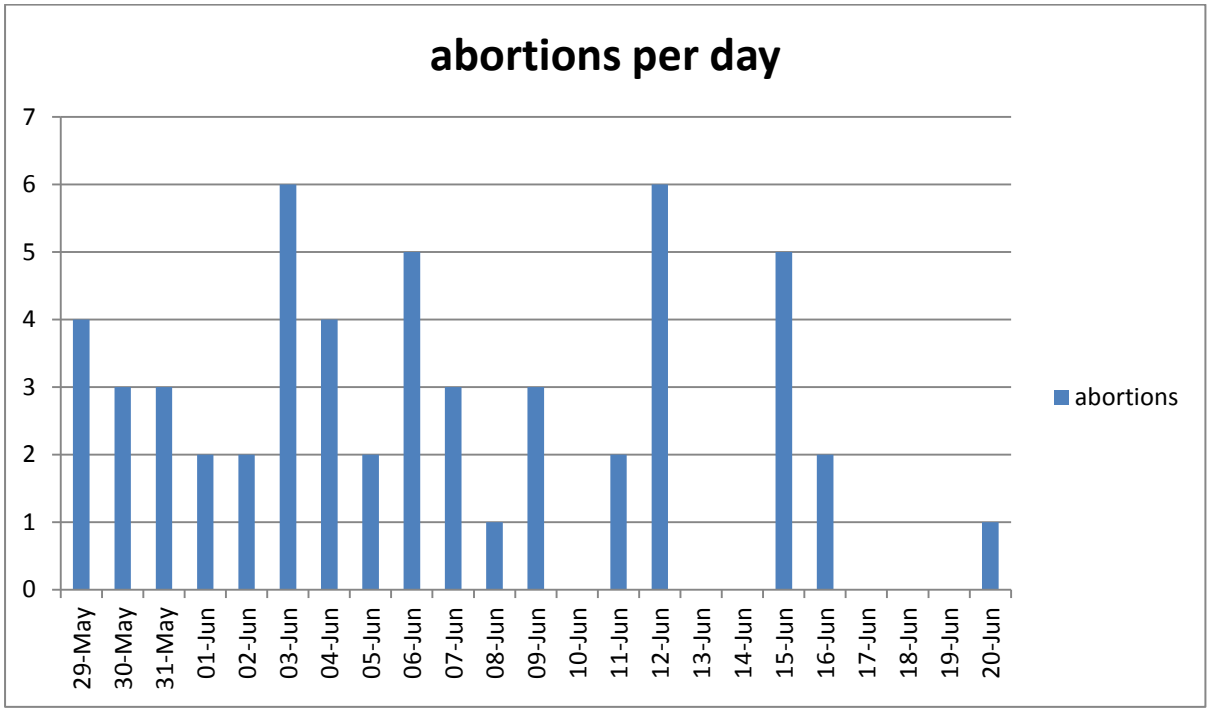

Figure 1 Timeline of abortions at Sandown Piggery (index case) during the 2004 PRRS outbreak in the Western Cape Province

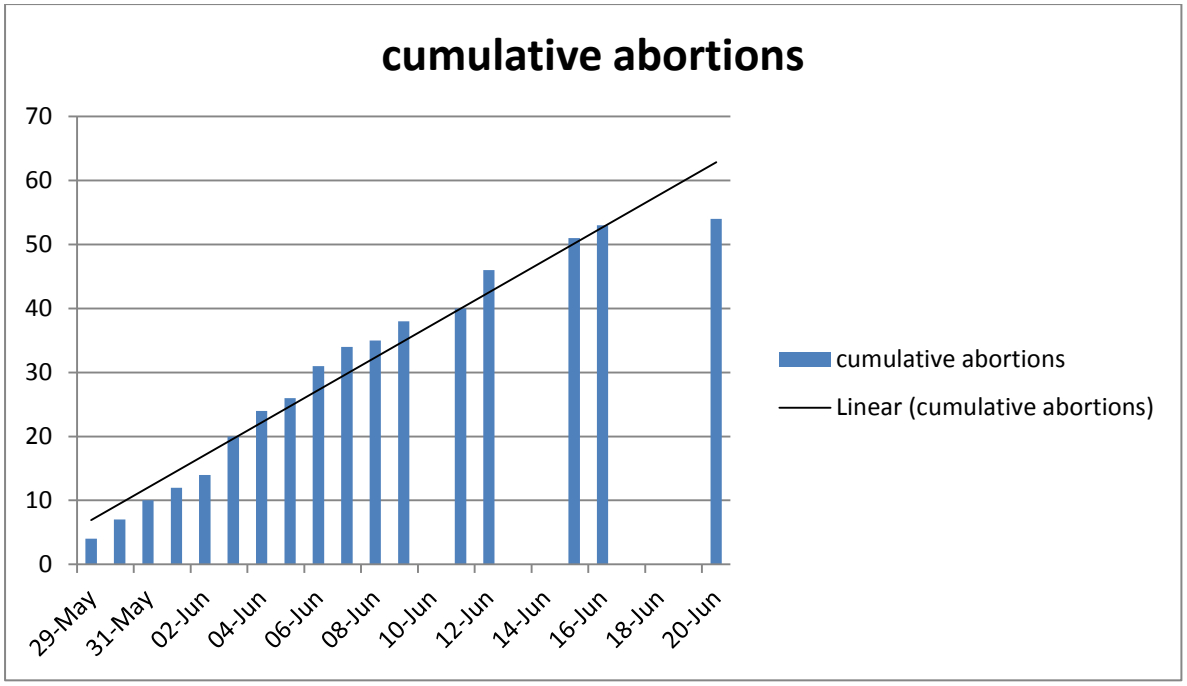

Figure 2 Cumulative numbers of abortions due to PRRS at Sandown Piggery during the 2004 outbreak in the Western Cape Province

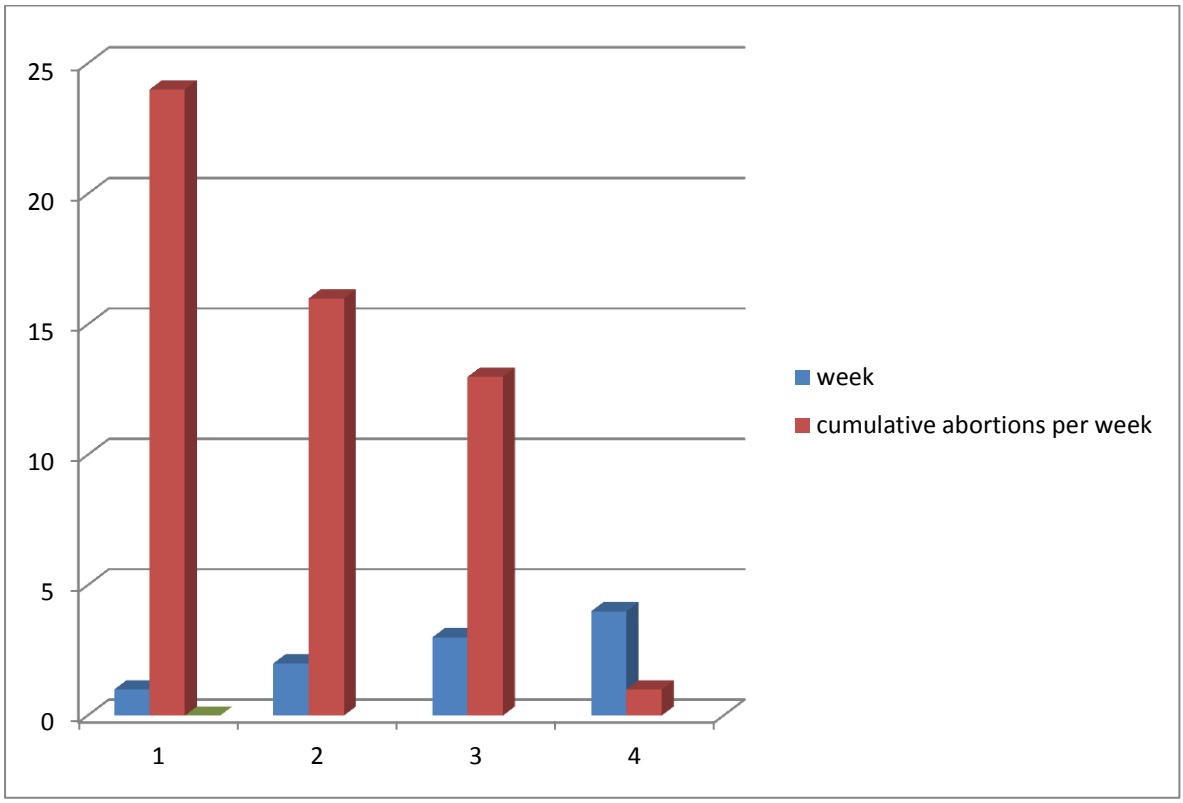

Figure 3 Decreasing weekly abortions after the first case of PRRS at Sandown Piggery during the 2004 outbreak in the Western Cape Province

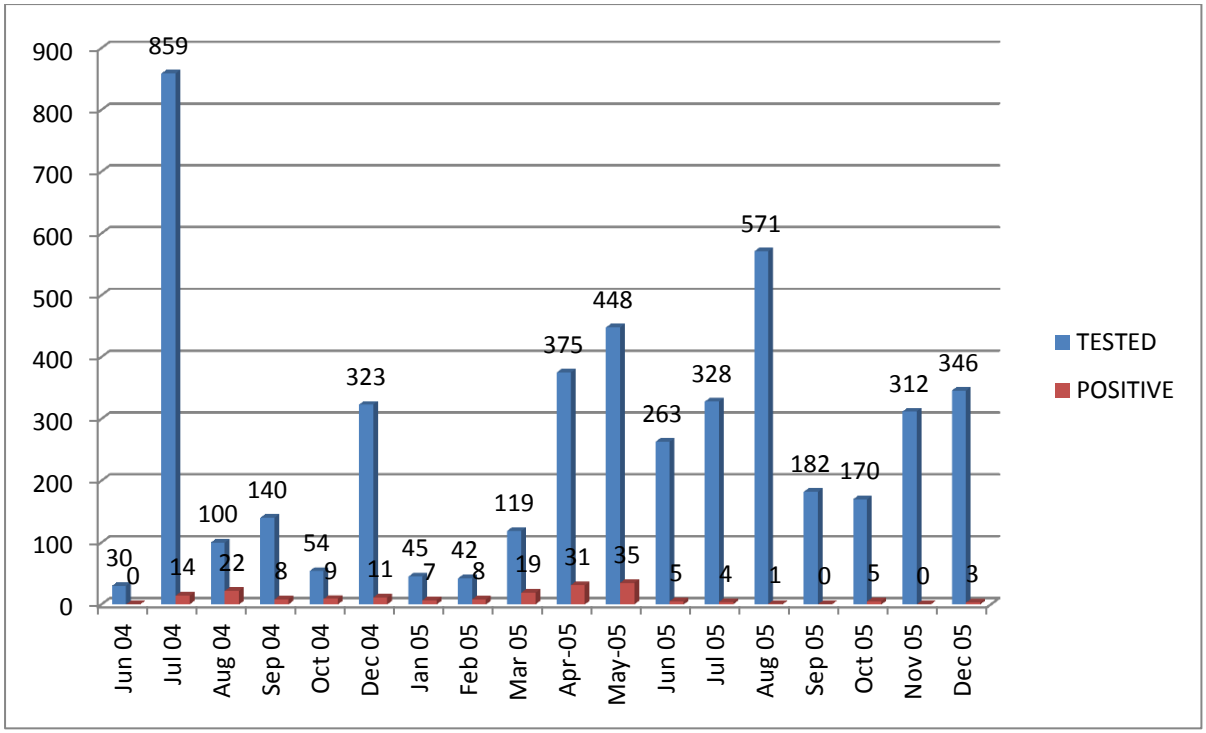

Figure 4 A summary of the total number of tested and positive serum samples during the period June 2004 through December 2005

4.5 Population pattern

4.5.1 Identification of host factors (age, breed, nutrition) of cases

The data obtained from the PRRS specific questionnaire survey during 2004 was unfortunately incomplete and very few questionnaires contained data indicating specific types of feeding (6 out of 181 questionnaires), age or breed. The reason for this is not clear. An epidemiologic evaluation of specific host factors could not be done due to lack of information. Therefore no conclusion regarding the high infection risk for PRRSV associated with feeding swill to pigs, could be made from this data.

4.6 Spatial pattern

4.6.1 Geographical distribution in relation to pig density and topography

Figures 5 – 11 illustrate the geographical distribution of the cases during the 2004/2005 outbreak. The maps also illustrate where the cases occurred in relation to the possible source(s) of infection, index case(s) and the boundaries of the controlled movement zone.

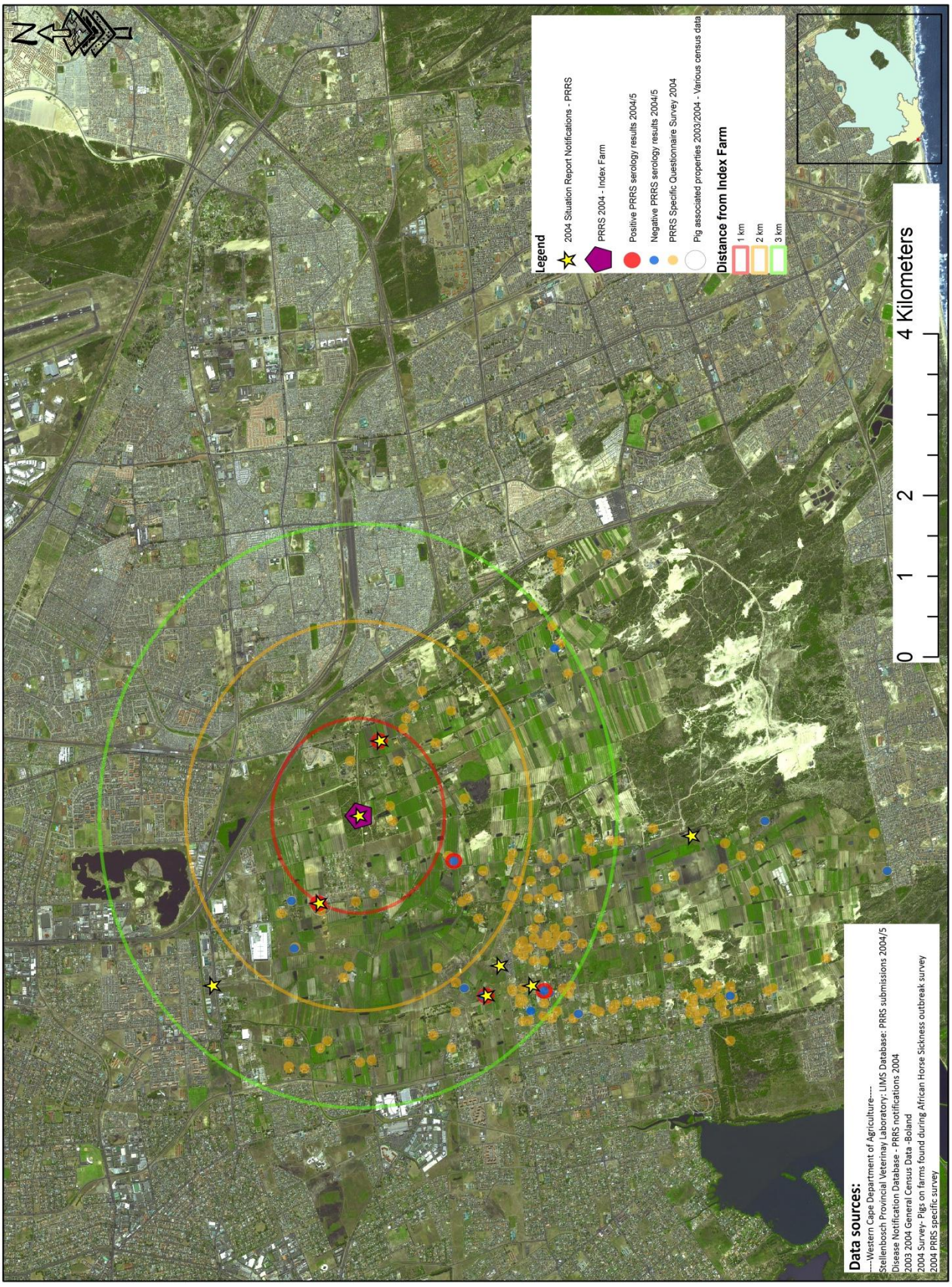

Figure 5. An aerial view of Philippi near Cape Town indicating Pine Acres (one of the possible index cases).

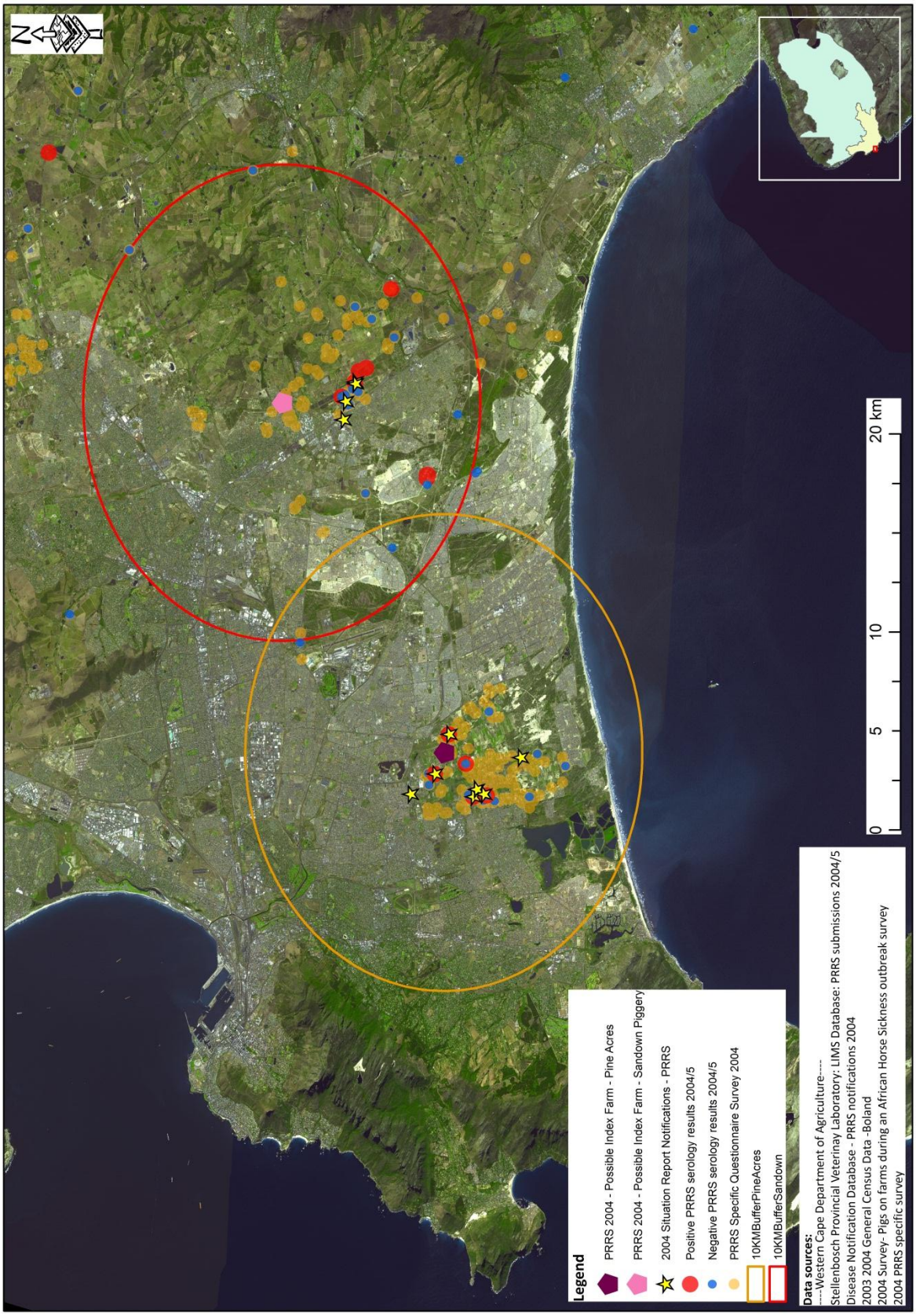

Figure 6. Pine Acres in Philippi and Sandown Piggery in Kuilsriver visible on an aerial view of the Cape Town metropolis. The Cape Town harbour and Cape Town International airport are also visible.

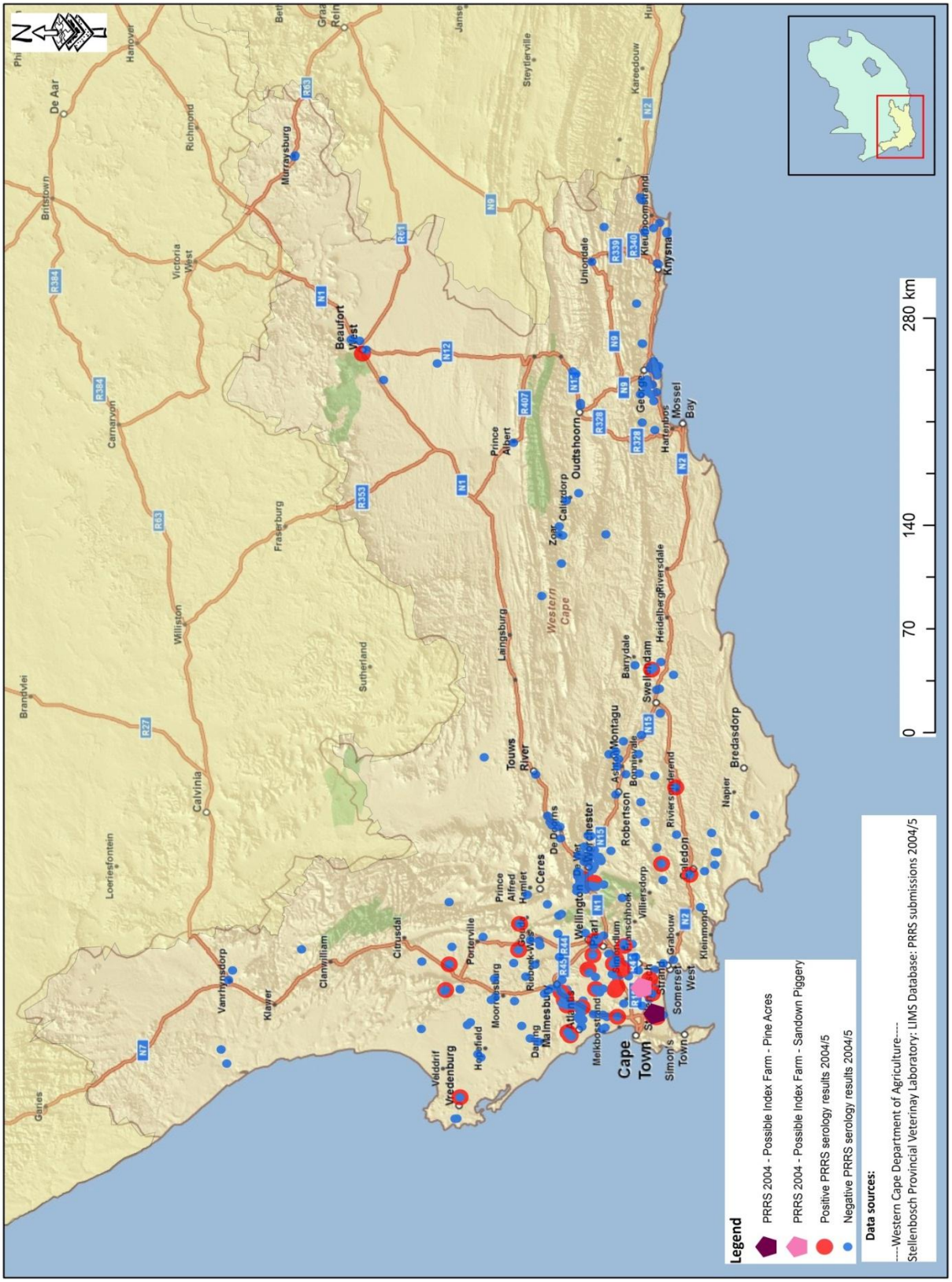

Figure 7. The Western Cape Province with the main roads and mountains in relation to the PRRS serological survey indicated.

Figure 8. The Cape Town metropolis and surrounding areas with roads and index cases indicated.

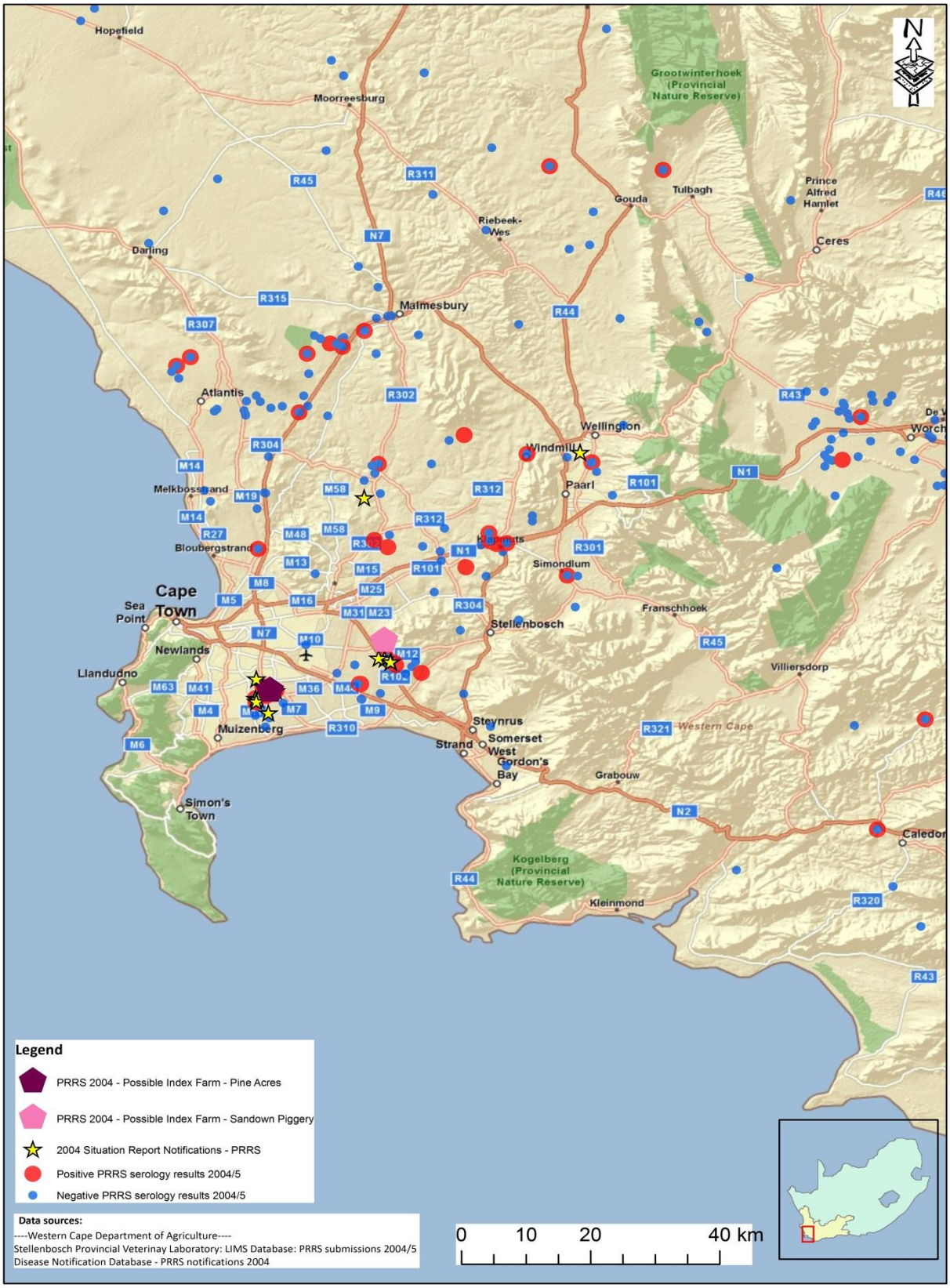

Figure 9. The spread of PRRS in the Western Cape Province is visible on this map.

Figure 10. The controlled movement area which was in place with the PRRS outbreak during 2004 and 2005 is indicated on this map.

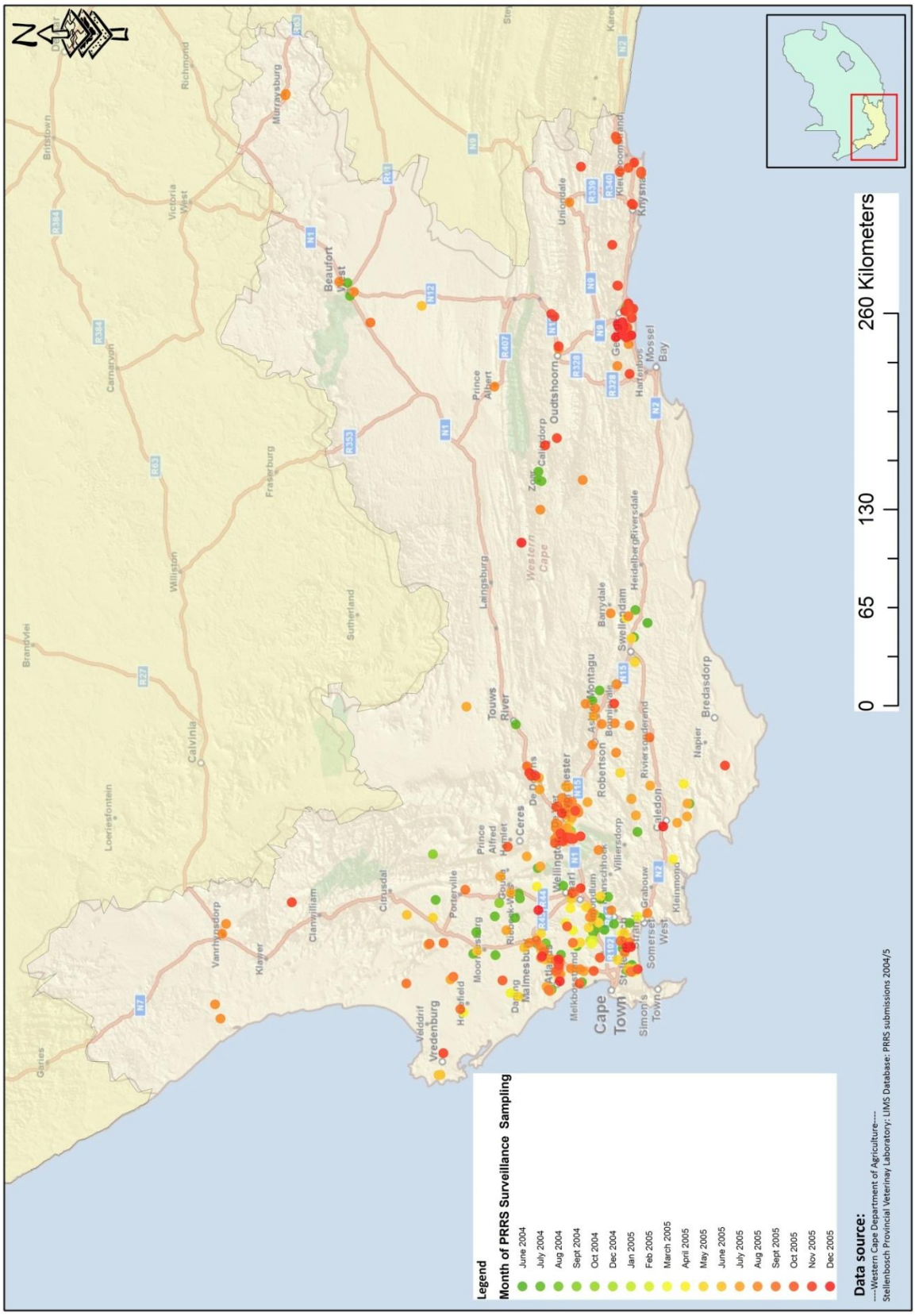

Figure 11. The area in which the PRRS surveillance serum sampling was conducted from June 2004 until December 2005 is indicated.

5. DISCUSSION

5.1 Case definition

A case was defined as a pig or unit showing signs of PRRSV infection and/or with positive PRRS serology. However, farms or units in close proximity with a high risk of becoming infected were also slaughtered and compensated to limit the possible spread of disease.

5.2 Pathology

The macroscopic lesions of PRRSV infection are not specific and no pathognomonic lesions are visible on a post mortem examination. The probable first cases of PRRSV infection were not diagnosed as such, because severe mortalities (close to 100%) and abortions were attributed to confirmed *Salmonella choleraesuis* and/or *Pasteurella multocida* infections on farms with poor housing and management circumstances. When these farms were tested later for PRRSV infection they were positive. The result of this is that the first confirmed index case of the PRRS outbreak (Sandown Piggery) might not be the true index case of the outbreak. A logical other possible index case might be the farm Pine Acres which had severe mortalities and abortions already from the beginning of April 2004. Because PRRS had not previously been diagnosed in South Africa and was regarded as an "exotic disease", the non-specific post mortems obscured by secondary infections did not immediately point in that direction and there was no reason to doubt the first diagnosis of *S. choleraesuis* – which can also cause high mortalities and abortions in septicaemic and toxaemic conditions resulting in "blue-eared" pigs.

Pigs from Pine Acres (Mohr) which presented with *Salmonella choleraesuis* (typed by OVI on 8 May 2004) before a diagnosis of PRRS was confirmed at OVI (26 June 2004) showed severe button ulcers in the GIT and lesions associated with severe septicaemia. This farm had no biosecurity measures in place, fed swill to the pigs and had very poor management and nutritional systems. All affected pigs died acutely with an almost 100% morbidity. The acute mortality of 10 sows which presented on the 4th of April 2004 at Pine Acres (and possibly also the pigs dying during March 2004 according to the case history) might also have been caused by PRRSV, but because of (secondary?) *S. choleraesuis* infection which was confirmed first on post mortem examination and culture, the diagnosis of PRRS was only confirmed after blood samples were sent to OVI on the 24th of June 2004 with 9/10 PRRSV positive results on the 26th of June 2004.

5.3 Epidemic pattern

5.3.1 Temporal pattern

As Figure 1, 2, 3 and 4 illustrated, the disease pattern for the 2004 outbreak can be classified as an epidemic pattern. This type of epidemic pattern is to be expected in a total naive population where none of the animals are immune. The high number of cases and the initial steep increase in the cumulative case series (see figure 2) during the 2004 outbreak on the index case farm, confirms this. The slow-down in cumulative abortions at Sandown Piggery might be due to the fact that the mortality rate was very high and that pigs were slaughtered as soon as possible to limit spread of the

disease. Because mortality rate was extremely high in all cases, total daily mortalities were not recorded.

In figure 4 the positive sample results after the final eradication attempt during April and May 2005 were false positive results and were negative with re-testing. This graph shows that the biggest number of farms was sampled immediately after the first confirmation of PRRSV infection in June 2004. The 323 samples tested during December 2004 with the second part of the outbreak, can be ascribed to the higher density of pigs in Mbekweni compared to Philippi where the outbreak originally started in June 2004. On-going surveillance after PRRS was supposedly eradicated in May 2005 includes specific monitoring in high risk areas e.g. Mbekweni, Emfuleni and Jakobsdal of 3x20 serum samples and in each area nationally (according to recommendation from NDA). Animal Health technicians in the Western Cape Province also sample any property where they find informal pig farming. Because good prices were paid when owners were compensated after slaughtering their pigs in the 2004 outbreak, it is still a good incentive up to now for pig owners to notify the local state veterinarian and animal health technicians when their pigs are showing signs of disease or dying. This was also shown in September 2005 when pigs were confirmed PRRSV positive in Dunoon (next to the N7 close to Vissershok). These pigs were immediately culled. The pigs in this location were previously not known to exist and were therefore not sampled during the surveillance shortly after the 2004 outbreak.

5.3.2 Spatial pattern

Figures 5 - 11 illustrates the geographical location of cases in the 2004 outbreak. During both "peaks" of the outbreak almost all affected properties were situated in informal settlements in rural areas - still within the Cape Town metropolis or within a 100 km radius from Cape Town. Pigs were kept on properties with almost no permanent structures for pig housing, mostly fed swill from restaurants, bakeries and other not-specified sources. Biosecurity and health management were in most cases very low on the priority list – if listed at all and not in all cases due to ignorance, but in most cases due to financial restraints. These findings identify feeding of uncooked swill from unknown origin to pigs as a high risk for the outbreak of PRRS and it will be beneficial to target these areas during routine surveillance.

During the 2004 outbreak the infection spread mainly with direct contact between pigs and movement of people and vehicles between properties. The disease spread from the metropolis in a northerly direction to Vredenburg and Piketberg and in a north easterly direction to Mbekweni outside Wellington. The common factors in many cases were pigs bought at auctions and trading of live pigs directly between owners and properties.

See **Figure 5** for the geographical distribution of the cases around Pine Acres during the 2004 outbreak. There were 181 properties/owners with a total of 894 pigs within the Philippi area only. There is an average of below 5 pigs per owner underlining the nature of (subsistence) pig units in very close proximity of each other in this area. The properties were all located within a radius of 6km from Pine Acres between and on agricultural holdings producing vegetables. This small area is surrounded by Vanguard drive on the eastern side, Lansdowne Road on the northern side and Strandfontein Road M17 on the western side. It is clear from the photo that the southern side borders a very sandy area which is fairly close to the sea. The location of the Cape Town International Airport is visible in a north east direction from Pine Acres.

Figure 6 illustrates both possible index cases: Pine Acres on the south western location and Sandown Piggery more to the eastern side. The location of the Cape Town Harbour is visible in a north westerly direction from Pine Acres more or less 15 km in a straight line but obviously not so directly accessible through the city area (which is the only way due to the mountainous areas, the sea and Table Mountain in the west and North West directions). The Cape Town International Airport is visible almost in the middle of a straight line between Pine Acres and Sandown Piggery. The harbour and the airport are both sources of swill from incoming international ships and aeroplanes. According to the Animal Diseases Act 35 of 1984 infective material (swill) must be boiled for 60 minutes or otherwise treated to destroy infection before being fed to pigs and it is illegal to feed infectious food from the harbour or airport to pigs. Although the control measures to prevent disease entering the country via this route are in place, it is very difficult to police and because there is a substantial part of non-commercial pig production present in the surrounding areas of Cape Town and other districts, it will be very difficult to stop swill feeding in this portion of the food production chain. As long as the market for swill feeding stays, the extremely high risk of disease entering South Africa via this route will not be prevented; also because there is money to make from this. There is not enough evidence to prove that swill originating from the harbour or the airport was the definite source of the PRRS virus which was responsible for the outbreak in South Africa in 2004, but it remains one of the most probable sources of infection.

Figure 7 shows the state veterinarian districts in which PRRS specific serum sampling was done: Vredendal (Clanwilliam, Citrusdal, Vredendal, Van Rhynsdorp), Malmesbury (Piketberg, Vredenburg, Hopefield, Moorreesburg, Malmesbury, Tulbagh, Ceres), Boland (Wellington, Paarl, Stellenbosch, Cape Peninsula), Swellendam (Caledon, Swellendam, Worcester, Touwsriver), George and Beaufort West. The most positive cases occurred in the Malmesbury and Boland districts. The two possible index cases are marked in relation to the rest of the sampled cases. It is clear that the most positive samples were centred around the index case(s). This was also the high risk areas where most of the sampling was done. The positive results marked at Caledon, Riviersonderend, Swellendam and Beaufort West might have been false positive reactions (and re-tested as negative) because they were not described in the State veterinarian Boland file 14/2/9/33 PRRS 2004.

Figure 8 and 9: The pig associated properties identified with various databases as described, are visible on map 8. A question that might arise is why all these properties in proximity of the index case(s) known to be at risk of infection with PRRS were not sampled for the PRRS serology survey. Pigs from the plotted properties which were not sampled were culled (bought by the NDA and slaughtered without being tested to remove the susceptible high risk population as quickly as possible). It is also clear from this map that the PRRS specific questionnaire survey was focussed around positive PRRS cases. A likely link between positive cases in different foci without any other obvious links is probably pigs bought at central auctions and also the contact from “same type” farmers often looking for pigs to sell or buy at known possible sources in different areas or districts.

The connection between Sandown Piggery (probable secondary index case but confirmed PRRSV infection first) and Pine Acres (probable primary index case) was narrowed down to contact from Mr Ivan Cloete (from Philippi) looking for feed to buy at Sundown Piggery (feeding commercial feed) on the 19th of May 2004 (the first deaths occurred at Sandown Piggery on the 29th of May 2004). The 2004 situation report notifications to the OIE are plotted in some cases (not all cases were notified

to the OIE – e.g. Sandown Piggery was the first farm to be confirmed with PRRSV infection, but was not officially notified by the NDA although the notification was sent through from the state veterinarian Boland).

Figure 10: The permit-controlled movement area that was in place during the final eradication attempt in April 2005 is indicated on the map. An expanded permit control was announced in a press release on the 7th of April 2005 to cover the area from the mountain ranges in the south starting at Gordon's Bay and stretching along the Hottentots Holland, Du Toitskloof and Limiet mountains to Gouda and then following the Berg River in the North to Veldrif.

Figure 11 shows the timeline of PRRS surveillance sampling in the Western Cape Province. It is not possible to comment on the time spread of the PRRS outbreak because it was only the levels of antibodies present in pigs that were tested – it does not give specific indication of the time of exposure to the virus and is also dependent on the time the serum samples were submitted to the laboratory. The map does show that the first sampling was focussed around the index and other positive cases in the Malmesbury and Boland districts. The early sampling in Montagu, Touwsriver, Swellendam, Calitzdorp and Beaufort West was as part of surveillance to determine the possible spread of PRRS in the Western Cape Province. The later sampling during 2005 is surveillance follow-up sampling.

5.4 Control measures instituted

On the 20th of May 2004 a veterinary quarantine notice was served on the farm in Philippi with epidemic abortions and mortalities due to *S. choleraesuis*. This was followed by a visit from the Disaster Management team who informed the Environmental health officers and the Public health department because of the zoonotic risk to humans. An outbreak response meeting was held on the 24th of May. A veterinary quarantine notice was served to Sandown Piggery in Kuilsriver after a tentative diagnosis of PRRSV infection was made on post mortem examination on the 10th of June – this was confirmed with ELISA on the 17th of June. A notification of an animal disease outbreak was immediately sent to the national Department of Agriculture for notification to the OIE. This involved about 2500 animals at that stage – on the one confirmed PRRS positive farm. An outbreak response meeting was also held on the 18th of June and import data was obtained from NDA on the importation of live pigs and pig semen into RSA during the past 12 months. A database of all major pig producers in the Western Cape was drawn up and the high risk properties were placed under quarantine immediately. A serological survey was also done on the high risk properties. A press release was made by die Western Cape MEC for Agriculture and the National Minister of Agriculture informing the public about the disease outbreak. On the 21st of June the Western Cape animal health officials had a planning meeting directing the technicians to conduct on-site inspections of pig holdings in close proximity of the outbreak farm and to complete questionnaires focussing on abnormal mortalities, illness and abortions.

A restriction on movement of all live pigs was placed in the Cape Metropolis and surrounding magisterial districts of Stellenbosch, Paarl and Malmesbury and the Western Cape MEC for Agriculture issued another one of many press releases on 28 June 2004. This press release stipulated the movement restrictions and all pig auctions were also disallowed with immediate effect. The

Provincial Disaster Management System was activated with the 1st Combined Operations Meeting being held to police the live pig movements in the restricted areas. Veterinary Quarantine notices were given to all possible infected farms until confirmation was received or excluded.

Disaster Management team meetings were held to keep the Provincial and Municipal traffic authorities informed on the progress and disease status. Only pigs with Red Cross permits issued by the State Veterinarian Boland or Malmesbury were allowed to move straight to a registered abattoir.

The results of the countrywide serological survey was known to be negative for PRRSV by the 2nd of August 2004 and the decision that the eradication of PRRS in the Western Cape was the best option was underlined by this information. By the end of August there were no more positive serology results found in the Western Cape.

Apart from the Press Releases, situation reports were also compiled on a regular base to keep the relevant authorities, SAPPO and private veterinarians informed of the evolution of the outbreak, progress with disease control measures and the status of the quarantine restrictions.

It seemed as if PRRS could be eradicated from the Western Cape Province successfully.

Regular monthly serological surveillance was continued in the Western Cape after the last positive cases in August 2004, and it was during these routine samplings when positive results were unfortunately found once again in the beginning of December 2004. Positive farms were once again quarantined. A meeting was held with the Western Cape Pork Producers which was also attended by small farmer representatives on the 12th of January 2005 regarding the importance of extreme biosecurity, a traceability system, and the discouragement and control of swill feeding. Census and survey figures continually updated the current infected and susceptible populations.

Permit movement control was implemented once again. PRRS positive localities were limited to 6 involving around 8000 pigs. The “Cape Baconer” PRRS Update newsletter and the PRRS Hotline managed by SAPPO kept the people on the ground informed with applicable FAQs and answers.

A letter by the State Veterinarian Boland to Minister Kobus Dowry underlining the importance of the upcoming winter and its effect on survival of the PRRSV in the Western Cape and the possible negative effects on the control of the disease and the meeting of SAPPO with the Minister of Agriculture on the 5th of April 2005 offering to carry the cost of culling the commercial unit involved in the outbreak, seemed to have tipped the scale in favour of a second eradication and compensation process. The cost factor partly solved, together with the concurrent broad national survey to confirm the belief that the disease has not spread over the mountains to the rest of the country, led to the press release made by the acting Minister of Agriculture in the Western Cape, that PRRS would once again be controlled in the Philippi, Wellington, Tierfontein and Paardeberg areas by an extensive eradication campaign in an attempt to contain and eliminate the disease before it could spread. The whole area of the Cape Metropolis was included in the controlled area with quarantine, movement on Red Cross permit only, and a ban on the sale of life pigs.

5.5 General considerations

The immediate disease control actions taken during the 2004 PRRS outbreak by stamping out all positive and possibly exposed pigs and especially the strict movement controls and restriction of

auction sales of life pigs, played a big role in the successful eradication of PRRS from the Western Cape in the 2004 outbreak.

The impact of the outbreak in the Western Cape on the commercial pork industry was huge – even with only 2 commercial units being affected. The effect it had on small farmers cannot be measured, but it was probably even bigger.

The efficacy of using untrained and usually under paid personnel in charge of roadblocks to monitor movement restrictions and movement with or without red cross permits was in some cases doubtful. There were numerous rumours of individuals being caught more than once without the necessary permits. In some cases the further transport of pigs were not disallowed even when the necessary documentation could not be provided. Personnel manning the road blocks were not always motivated and probably did not understand the importance of movement restrictions in the control of a potentially severely disabling disease for the pork industry. Training specific to PRRS and its transmission and spread could possibly have helped in this situation.

In our world where natural emergencies are real threats, it is essential to have a responsive plan of action – and this is where the police and the army can support animal health and disease outbreak situations. Weather, natural disasters, accidents, chemical and disease outbreaks, can create emergency situations where quick decision making and action are essential for various reasons. The Army or Police can often best “officially” assist during an emergency. They can structure a standard method to make co-informed decisions on future actions. A system can be designed to include Army active duty, reservists, civilian employees, contractors, etc.

We know that decisions we take on diseases during an outbreak in the morning have a real world impact in the afternoon. The PRRS outbreak led to various inquiries, including one on what are the lessons that needed to be learned out of the 2004 PRRS outbreak that could apply next time to try and ensure we never have that sort of situation again.

It is important to concentrate on contingency planning. Things like ensuring that we regularly review our plan, (we exercise frequently) and that we have all communication systems properly in place.
In an outbreak you need to be able to identify the right people to move from one part of the country to another if necessary. There must be a single version of instructions that everyone in future would be able to follow. It makes no difference whether they’re doing it in Kwazulu Natal or they’re doing it in Eastern Cape Province, they should be doing the same job. The key things are communication, communication, communication, absolutely.
In the height of a major crisis there must be a structure for the day. Every day follows the pattern and there must be a number of key people (including the veterinary authorities, private veterinarians, pork producers’ representative, etc.) who need to talk to each other at different points during the day. There is only one ultimate test, regrettably, that’s the next outbreak. The contingency plan must be reviewed regularly and there must be continuous talking to colleagues from other organisations and making sure that relationships are built so that when there is an emergency one can call on relationships that have been built.

The support received from the South African Pork Producers’ Organization was irreplaceable in the success of the eradication of PRRS from the Western Cape Province and the whole country. Without their financial support and perseverance in making the right decisions for the whole industry, this

concerted effort would have been much more difficult and the end results far more difficult to obtain.

Training and upliftment of emerging farmers is extremely important especially with regard to the risks associated with feeding swill to pigs. This must be an on-going operation in all levels of food production in all levels of society.

The following routes of introduction of the PRRS virus into the country were postulated:

- Feeding of galley waste originating from Cape Town or Simons Town harbours. No direct links were found, but plenty of rumours.
- Feeding of restaurant waste from these harbours. This restaurant waste could be contaminated by galley waste.
- Live pig(s) smuggled in through the harbours.
- Pig carcasses smuggled in from the harbours.
- Infected imported pig meat or meat offcuts fed to pigs via restaurant/butcheries, etc. Imports from February 2004 until June 2005 were from Brazil, Canada, Belgium, France, Denmark, Republic of Ireland and the United Kingdom. PRRS occurs in all of these countries.
- Feeding of sweepings contaminated by galley waste from Cape Town harbour.
- Imported semen (legally or illegally).
- Imported live pigs (legally or illegally).

6. CONCLUSION

Illegal feeding of uncooked swill originating from countries where PRRS is prevalent remains one of the biggest threats for PRRSV introduction into South Africa.

Susceptible populations of pigs in informal settlements have access to swill originating from international harbours and airports not only in the Western Cape, but also in Gauteng, Kwazulu-Natal and the Eastern Cape provinces.

The ability to control an outbreak successfully is directly dependent on rapid detection and response from the authorities and pig industry (commercial and rural) both.

Due to fairly large numbers of rural pigs (with poor housing conditions, poor nutrition, and no health management) the rapid detection of a disease outbreak is compromised. Training with regards to these and other aspects of safe, sound and wholesome pork production is extremely important.

The institution of strict control measures (movement control) soon after the initial cases were diagnosed in the outbreak, successfully limited the spread of the disease.

A very big part of the successful eradication of PRRS in the Western Cape was the absolute dedication and commitment of the people in the day to day face of the outbreak (state veterinarians of Boland and Malmesbury and their animal health technicians). Without their positive attitude the timeous eradication of PRRS would not have been possible.

7. RECOMMENDATIONS

The movement restrictions on pigs and the questionnaire survey, serology surveillance within the controlled area in the Western Cape place an additional burden on all interest groups involved in the pork industry. It is therefore recommended that options be investigated to facilitate more manpower at very short notice in outbreak situations like these, assisting with indicated actions in cooperation with the State veterinarian(s) and their animal health technicians.

It is extremely important that a complete survey is done as soon as possible and that all target animals (even those with no suspect clinical signs or no history of disease) in a situation like this is examined and sampled personally by the officials involved. In the PRRS outbreak situation the second part of the outbreak (starting November 2004 up to May 2005) could have been prevented if susceptible pigs in Mbekweni (which was noted in the survey but not sampled for ELISA testing) formed part of the serological survey. Another important issue regarding the questionnaire survey was the incompleteness of data obtained, for e.g. only 24 out of 181 survey questionnaires specified the type of feed given to the pigs on the properties. Many other questions regarding host factors amongst others were not completed, which made a proper epidemiological study of the outbreak impossible. Full conclusions about specific epidemiological factors also could have played an important role in prevention and better control of possible future outbreaks.

A disease outbreak with a so-called exotic disease like PRRS cannot be effectively controlled without the financial support of the NDA, because there are still a lot of pig owners out there who feed their pigs swill, who will probably never vaccinate their pigs (fostering a susceptible population) and who cannot afford to kill or slaughter their pigs without compensation.

Quick, informed decisions regarding the disease situation by the NDA from the powers that might be, are crucial to limit spread and to accommodate speedy, successful eradication or control of a potentially devastating disease for the local industry (even if it is not a trade-sensitive disease). This will ensure the availability of affordable port to all segments of the market in South Africa.

The decision to vaccinate against an “exotic” disease with a modified live vaccine, while there is still a chance of eradicating the (localized) disease, must be thought through carefully by all the parties involved. The consequences of a decision like this have an enormous economic impact on the whole industry. The huge immediate cost of a disease outbreak (with compensation) to the NDA must not diminish the importance of the long term effects on the pork producing industry. Similarly the pressure from the pharmaceutical industry (who is very willing to help) with available PRRS vaccines registered in other parts of the world must never influence the decision made for or against the introduction of a new modified live vaccine into our country.

Eradication attempts can never be successful in the long term if the support and cooperation of the producers’ organization does not form part of the whole process. The producers’ organization must form part of decisions regarding industry; also in cases like this with PRRS where a very small part of the national industry could have played the leading role in the introduction of a very erosive disease into South Africa.

Training and upliftment of emerging farmers with relation to the risks associated especially with swill feeding and poor quality of stock, but also regarding all other aspects of successful pig keeping is

vital in the prevention of future disease outbreaks. This effort must be supported by all role players to have the best chance of being successful.

* A **red cross permit** is a permit issued by the State veterinarian only under certain specified conditions of transport, e.g. only for slaughter at a specified abattoir, or only for transport between two specific disease free locations. This permit is issued in duplicate with the original copy going to the owner of the animals and a copy of the permit staying at the State Veterinarian's office for tracking purposes in disease outbreak situations. Animal movement is only allowed when a red cross permit can be presented to investigating or controlling authorities in movement restriction situations. Trucks transporting pigs were sealed by the veterinary authorities at the start point and this seal was only broken at the end point again. Actual pigs transported were correlated with the information indicated on the red cross permit. The name "red cross" permit comes from the physical appearance of the official document – with red lines diagonally from left to right and from right to left forming a cross over the whole page.

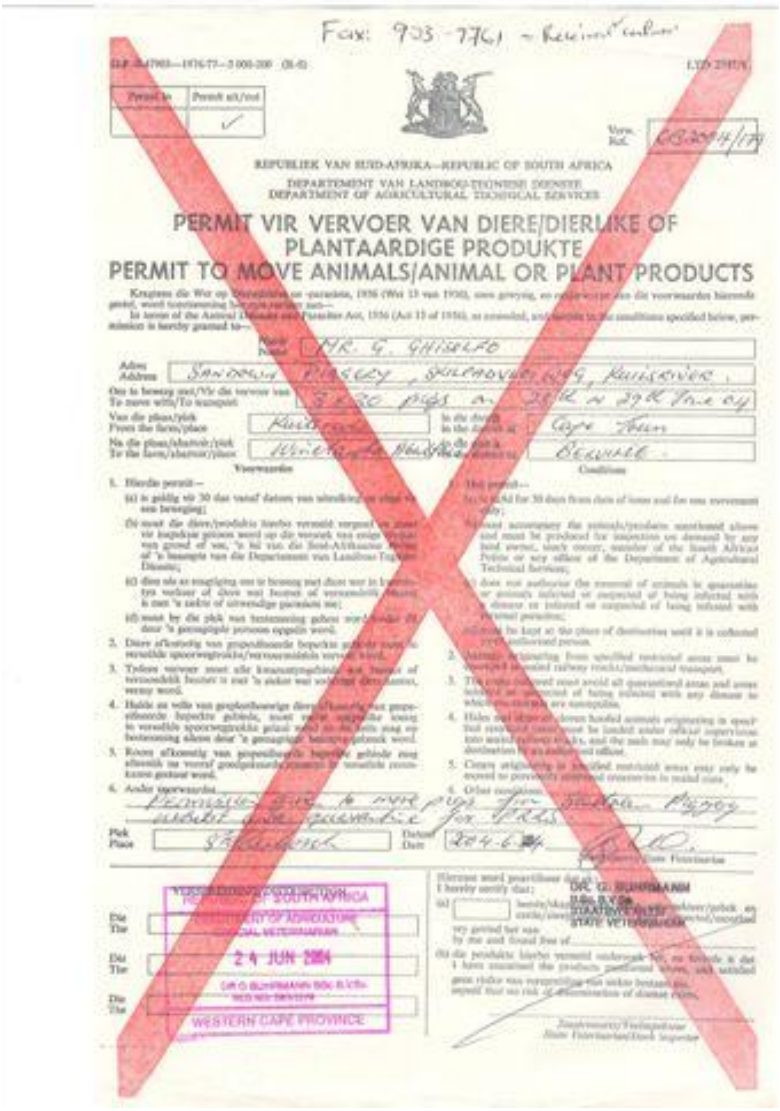
REPUBLIEK VAN SUID-AFRIKA—REPUBLIC OF SOUTH AFRICA
DEPARTEMENT VAN LANDBOU-TEGNIESE DIENSTE
DEPARTMENT OF AGRICULTURAL TECHNICAL SERVICES
PERMIT VIR VERVOER VAN DIERE/DIERLIKE OF PLANTAARDIGE PRODUKTE
PERMIT TO MOVE ANIMALS/ANIMAL OR PLANT PRODUCTS
WESTERN CAPE PROVINCE

Figure 12 An example of a red cross permit

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List of tables and figures

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