THE DEVELOPMENT OF AN INTEGRATED WILDLIFE DISEASE SURVEILLANCE AND MONITORING SYSTEM FOR THE DISEASE MANAGEMENT IN FREE RANGING WILDLIFE IN THE GREATER KRUGER NATIONAL PARK.

by

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ABSTRACT

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The study was conducted in the Greater Kruger National Park Complex (GKNP), which consists of the Kruger National Park (KNP) and adjacent private game reserves and focuses primarily on the following objectives:

- To monitor and evaluate the standard of the existing disease surveillance programmes for the following diseases, Foot and Mouth, Anthrax, Tuberculosis, Brucellosis and Rabies, within the Kruger National Park and adjacent private game reserves by evaluating the level of competency and knowledge in field rangers, field guides and trails rangers with regard to these specific diseases.

It can be stated that important differences exist between disease surveillance techniques used for domestic animals and those used for wildlife (Bengis, R.G., Kock, R.A., & Fischer, J., 2002). According to Morner, T., Obendorf, D.L., Artios, M., & Woodford, M.H., 2002, it is more difficult to monitor diseases in wildlife than in domestic animals because wild animals are not constrained by boundaries and can roam over large

distances. For significant diseases in wildlife, an active surveillance programme may be the preferred approach with the aim to collect a certain number of samples from a target population (live or dead animals) to determine the point prevalence of certain pathogens. Active veterinary participation is essential in protected area management, with emphasis on training of technicians, rangers and field biologists with regard to specific diseases and their clinical signs, surveillance and sampling techniques, data collection, and reporting.

For the purpose of this study, data collection was conducted by means of a questionnaire drawn up according to the related critical points as described in the Dufour grid (Dufour, 1998).

The results of this study clearly showed a need to address certain important aspects regarding a wildlife disease programme within the GKNP. A more efficient wildlife disease surveillance programme, which included more specific and “hands-on” trained staff, would definitely ensure a better early warning system which would detect new or emerging disease outbreaks.

Keywords: Greater Kruger National Park, Kruger National Park,
Private Game Reserves, wildlife diseases surveillance programmes, Foot-and-Mouth, Anthrax, Tuberculosis, Brucellosis, Rabies, veterinary participation, training of technicians, rangers, field biologists, questionnaire.

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- preparation of the questionnaire,
- level 1 " Wildlife Disease Surveillance" training program,
- pamphlets and posters
- translation of certain aspects into Shangaan, the most popular language in the Greater Kruger National Park.

Me. Angelique Snoeren, a final year B Sc student from the Netherland.
She was responsible for the electronic training material and the pamphlets and posters in English.

Mr. Emmanuel Munyamella, a general assistant working for veterinary services in Skukuza and also a second year student enrolled for the National Diploma in Animal Health.
He was responsible for translation of important aspects into Shangaan which include almost all the pamphlets and training material. He also helped illiterate field rangers with the fill of the questionnaires.

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LIST OF ABBREVIATIONS.

AWHN	AUTRALIAN WILDLIFE HEALTH NETWORK
BTB	BOVINE TUBERCULOSIS
FAO	FOOD AND AGRICULTURE ORGANIZATION
FAS	FEDERATION OF AMERICA SCIENTISTS
FGASA	FIELD GUIDE ASSOCIATION OF SOUTH AFRICA
FMD	FOOD-AND-MOUTH DISEASE
GKNP	GREATER KRUGER NATIONAL PARK
GLTFCA	GREATER LIMPOPO TRANSFRONTIER CONCERVATION AREA
ILIAD	INTERNATIONAL LOOKOUT FOR INFECTIOUS ANIMAL DISEASES
KNP	KRUGER NATIONAL PARK
OIE	INTERNATIONAL ANIMAL HEALTH ORGANIZATION
SAGR	RéSEAU NATIONAL DE SURVEILLANCE DE L'éTAT SANITAIRE DE LA FAUNE SAUVAGE
SANPARKS	SOUTH AFRICAN NATIONAL PARKS
SAT	SOUTH AFRICAN TERRITORIES
TFCA	TRANSFRONTIER CONCERVATION AREA
UK	UNITED KINGDOM
UNESCO	UNITED NATIONS EDUCATIONAL SCIENTIFIC AND CULTURAL ORGANIZATION
USDA	UINTED STATES DEPARTMENT OF AGRICULTURE
VLA	VETERINARY LABORATORIES AGENCY

CHAPTER 1.

LITERATURE STUDY

1.1 INTRODUCTION.

Wildlife diseases are of growing concern worldwide because they threaten not only wildlife populations, but also domestic animals and human health (Vallet, 2008; Wentworth, 2008). According to Karesh (2008), wild animals are more susceptible to new diseases than domesticated animals and are good indicators of emerging disease outbreaks. The clinical signs of disease in wildlife are not as readily observed as in domestic animals, and the "hands-on" collection of specimens is more difficult. These factors make the detection and response to disease outbreaks much slower to implement in wildlife (Vallat, 2008). The Australian wildlife management society states that the response to threats to wildlife is largely undeveloped despite the apparent increasing incidence of disease in wildlife and threats to humans from diseases originating in wildlife (AWHN, 2005). The Australian scientific journal estimates that about 70 percent of the world's new and emerging human diseases of the past 50 years have originated in wild animals.

Successful wildlife disease prevention and control depends on information on the morbidity and mortality of domestic animals and wildlife (Akhtar, S., & White, F. 2003). According to Vallat (2008), wildlife often acts as sentinel for animal diseases thus allowing for effective management and control of the diseases in domestic animals. Surveillance and monitoring of wildlife mortality and morbidity has been recognized as a crucial aspect not only of wildlife conservation projects, but also of disease surveillance schemes for domestic animals and humans (Morner, T., Obendorf, D.L., Artios, M., & Woodford, M.H. 2002).The importance of disease surveillance programmes is the detection of diseases present and the further assessment of risks involved as well as the prevalence of disease and patterns of new and emerging conditions. Such programmes for commercial animals exist in most developed countries and can be seen as early warning systems. In developing countries, however, a different scenario exists with poor or non-existent surveillance programmes, leading to a lack of high quality information for disease management (Akhtar *et al.*, 2003). Surveillance is a continuous and systematic process of collection, consolidation, analysis, interpretation and dissemination of relevant information on the occurrence of health problems (Akhtar *et al.*, 2003; Nussar, S.M., Clark, W.R., Otis, D.L., & Ling, H. 2008). Surveillance and monitoring programmes are, therefore, the first step towards providing an appropriate level of

understanding of the health status of wildlife populations. It is most important that disease management programmes include a continuous monitoring process, so that the effectiveness of techniques can be measured and new methods introduced if current methods are ineffective. Programmes should be sufficiently flexible to change with evolving circumstances as the programme proceeds, and several methods may need to be applied either simultaneously or sequentially during a programme (Morner *et al.,* 2002; Doherr, 2003). Effective disease surveillance is a prerequisite for participation in the international trade in livestock and its products: it is, therefore, imperative to have effective emergency preparedness programmes and successful disease eradication programmes. All too frequently, national and international programmes have no quantative measure of their surveillance activities, and the absence of passive reports is often taken to mean the absence of disease, and no further inquiry is undertaken (Akhtar *et al.,* 2003).

With diminishing natural habitats and increasing numbers of threatened species worldwide, the capability to investigate wildlife diseases has become an essential component in the management of free-ranging wildlife. Defining the diseases, which have an impact on threatened wildlife, is now considered integral to conservation and rehabilitation programmes for remnant wildlife populations (Morner *et al.,* 2002). Wildlife disease surveillance must not be overlooked. Wildlife may provide a reservoir of infection for some diseases but may also act as a sensitive indicator of diseases that are not clinically apparent in adjacent livestock populations. Close co-operation is required between veterinary and wildlife authorities. As direct examination of wildlife by capture techniques or slaughter is expensive and often difficult to organize, where possible sera and other diagnostic specimens should be collected when such wildlife surveys are carried out. It should be emphasized that the emergency disease information system needs to be a two-way process, with adequate feedback from national veterinary headquarters to the field and laboratory veterinary staff that originally collected and processed the information (Geering, W.A., Roeder, P.L., & Obi, T.U. 2006).

Apart from the direct economic, public health and trade implications of the presence of diseases in wildlife, overt disease outbreaks and mass mortality in wildlife could be important indicators of ecological disturbance, introduction of new animal species, introduction of new diseases, climatic or habitat change, or local pollution (Morner *et al.,* 2002).

According to Salman (2003), surveillance and monitoring programmes are implemented for specific purposes with the data generated from these programmes being used to document the health status of populations and to trigger reaction. It is, thus, essential that the data delivered by animal disease surveillance systems be of adequate quality to satisfy the demands of trading partners or other data users. Quality assurance and evaluation methods, therefore, need to be applied to every animal monitoring and surveillance system.

Surveillance data can also be used to calculate the incidence and prevalence of events, to categorize disease distribution, to guide investigations into the occurrence of epidemic and endemic disease, and to contribute essential information for the design and evaluation of effective disease prevention and control programmes (Akhtar *et al.,* 2003).

A fully integrated surveillance and monitoring programme will enable managers, role players and scientists to use relevant information for management decisions. It is very important that management programmes include a continuous monitoring process, so that the effectiveness of techniques can be measured, and new methods can be introduced if current methods are ineffective (Wobeser, 2002).

Countries, provinces, wildlife parks or sanctuaries that conduct disease surveillance of their wild animal populations are more likely to understand the epizootiology of specific infectious diseases and zoonotic infections within their territorial borders and are, therefore, better prepared to protect wildlife, domestic animals and human populations (Morner *et al.,* 2002). According to Morner (2002), the presence or absence of animal infections in the wild cannot be declared unless sampling has been carried out and the results subjected to the appropriate statistical analysis.

Surveillance systems require the formation of networks of people, the free-flow of information, and the support of well-designed procedures for disease prevention activities, control measures and epidemiological investigations with constant attention to maintenance and quality improvement functioning at different levels (Akhtar *et al.,* 2003).

According to the World Organisation for Animal Health (OIE), Terrestrial Animal Health Code (2006), animal health surveillance is an essential component necessary to detect diseases, to monitor disease trends, to control endemic and exotic diseases, and to support claims of freedom from disease (OIE 2006).

1.2 DISEASE SURVEILLANCE PROGRAMMES IN THE WORLD.

New threats to the environment from diseases, pests and weeds are a regular occurrence throughout the world and are rising due to freer international trade and human movement. There are several examples of programmes for controlling and monitoring diseases in various parts of the world:

1.2.1 Europe.

In Europe, fox rabies is an historic example of an attempt to routinely collect specimens for diagnosis and to obtain further information for health and agricultural administrations. As rabies spread across continental Europe, it became clear that international co-operation and a surveillance programme were necessary to keep rabies-free countries informed of the proximity of the threat to their borders (Blancou, J., Aubert, M.F.A., & Artois, M. 1991*;* Morner *et al.*, 2002).

Among the earliest surveillance programmes for wildlife diseases were the programmes established in the early 1930s in Denmark and in the 1940s in Sweden. These programmes were based on the examination of dead animals submitted to national veterinary laboratories. The programme in Sweden revealed the problems of mercury poisoning of wildlife in the early 1950s, which discovery resulted in a well-established health-monitoring programme for wildlife in Sweden (Morner *et al.*, 2002).

Other health monitoring programmes based on examining wildlife are in action today in other European countries. Some are based on the collection of *ad hoc* sampling and routine diagnostics carried out in various institutions and laboratories (Leighton, 1994; Briones, 2000; Morner *et al.*, 2002).

The veterinary surveillance programme in the United Kingdom is a package of activities that will put the Veterinary Surveillance Strategy into practice over the next ten years. Surveillance reports will inform the international community of the disease status of animals in the UK. This information is also used as part of the certification required for international trade of animals and animal products (Scudamore, 2003).

In France, the SAGIR Network (*Réseau national de surveillance de l'état sanitaire de la faune sauvage*), the national network for the surveillance of the health status of wildlife, is an example of

an official organization that collects data from wildlife autopsies performed at different laboratories across the country (Morner *et al.*, 2002).

1.2.2 United States of America and Canada.

The International Lookout for Infectious Animal Diseases (ILIAD) was established to transform a concept developed by the Federation of America Scientists' (FAS) animal disease surveillance project into an operational test programme. This concept calls for pro-active, *in situ* surveillance, using appropriate forms of new technology for outbreak reporting, associated diagnostics and clinical activities in remote farming communities and wildlife reserves (Federation of American Scientists, *Infectious animal and zoonotic disease surveillance,* 2006).

The goal of the National Wildlife Disease Surveillance and Emergency Response Program of the United States of America is the proper development and implementation of a nationwide system to survey for wildlife diseases and to respond to a variety of emergencies including natural disasters and disease outbreaks. The system, which is managed by the Wildlife Services unit of the United States Department of Agriculture's Animal and Plant Health Inspection Service, is designed to provide assistance to Federal, State and Tribal agencies with wildlife disease threats (USDA, *Animal Health monitoring and surveillance, National Animal Health surveillance system,* 2006).

In North America, several regional co-operative studies on wildlife diseases are operating, e.g. Southeastern Cooperative Wildlife Disease Study in Athens, Georgia and the Wildlife Health Research Centre in Madison, Wisconsin, as well as the Canadian Cooperative Wildlife Health Centre in Saskatoon, Saskatchewan (Morner *et al.*, 2002).

The 2006 Colorado Avian Disease Surveillance Protocol coordinates avian disease surveillance in Colorado that has been identified as a critical function for federal, state and local agencies responsible for monitoring and protecting veterinary and human health (*Colorado Avian disease surveillance protocol, 2006).*

1.2.3 Australia.

The Australian wildlife health network comprises a network of government and private stakeholders across Australia. The core business activity is collaboration with key stakeholders to coordinate wildlife health surveillance and information systems across Australia into a national

database. Furthermore, it aims to identify wildlife health surveillance and research needs and priorities (Australian wildlife health network, 2005).

1.2.4 Africa.

The major constraints to mixed game and livestock ranching in many parts of Africa are vector-borne diseases with wild animals being blamed as the source of infection. One example is Lake Mburo National Park in Uganda that is surrounded by cattle ranches. Historically, wild animals in this area have been living together with pastoralist herds for over four centuries. The park is faced with two major problems, namely incursions of pastoralist herds into the park during the dry periods in search of water and pasture, and numerous wild animals living on the neighbouring ranches (Baranga, 1996). A preliminary study was done to evaluate the feasibility of a disease surveillance programme in mixed livestock and game areas around Lake Mburo National Park. This study also involved a questionnaire and regular visits to the ranches with information given regarding the importance of different diseases in the area (Ocaido, M., & Siefert, L. 1996).

The Greater Limpopo Transfrontier Conservation Area (GLTFCA) is the flagship of the Transfrontier conservation areas that are currently being established in Southern Africa, a concept that will hopefully progress to other parts of the world in the future. The GLTFCA will, eventually, incorporate the Kruger National Park in South Africa, the Limpopo, Bahnin and Zinhave National Parks in Mozambique, and be joined to the Gonarhazou National Park in Zimbabwe through the Sengwe Corridor. One of the major challenges in establishing the Transfrontier conservation areas is the presence of significant wildlife and domestic animal disease in one or more of the participating countries. The movements of diseased animals or vectors across international borders through the conservation areas may result in changes of the international trade status of participating countries with disastrous financial implications for such countries.

The following animal health priorities have been identified by the Veterinary sub-committee of the Greater Limpopo Transfrontier Park Conservation Committee:

- Determine the current bovine tuberculosis and brucellosis status of cattle in the Limpopo National Park, Sengwe Corridor, and communal farmlands to the west of the Kruger National Park fence.
- Determine the rate of northward spread of bovine tuberculosis in buffalo in the Kruger National Park and enhance surveillance to detect “cross over” into other species.

- Determine which topotypes of foot and mouth disease are circulating in the Ghonarezhou buffalo population
- Determine the current status and rate of southward spread of tsetse flies in Ghonarezhou National Park and adjoining areas of Mozambique
- Control rabies and canine distemper in domestic dogs bordering the TFCA.

1.3 OBJECTIVES OF A DISEASE SURVEILLANCE PROGRAMME.

It is important to define the objectives of the animal disease surveillance and monitoring system and to make sure that the objectives are fully understood by all the partners at all levels (Jebara, 2004).

According to the Veterinary Laboratories Agency (2006), wildlife diseases can be significant because:

- Wildlife can be reservoirs of zoonotic disease.
- Wildlife can be reservoirs of disease of domesticated stock.
- Exotic pathogens may be introduced to the country by migrating wildlife.
- New and emerging diseases may first appear in wildlife species.
- Wildlife disease may be a sensitive indicator of underlying environmental pollution.
- Wildlife disease incidents, with mass mortality, may be of concern to the public.
- Wildlife diseases may be of conservation importance, threatening endangered populations.

Disease surveillance should be an integral and key component of all government veterinary services. Such surveillance is important for early warning of diseases, planning and monitoring of disease control programs, provision of sound animal health advice to farmers, certification of export livestock and livestock products and international reporting and proof of freedom from diseases (Geering *et al.,* 2006).

An important principle in quality assurance of surveillance is to ensure that data providers receive feedback relating to the inputs they provide. Ideally, this would be in the form of useful information, which they can apply. In this way, there would be an incentive for providers to improve on shortcomings in data input, because such remedial action would result in improved quality of outputs of interest to them. Quality assurance, thus, includes an important element of education and communication. Veterinary education needs to include training in epidemiology and

surveillance techniques. There is an urgent need to develop skills and provide practical field experience for indigenous wildlife biologists/ecologists, veterinarians and social scientists in conservation biology, wildlife management, disease surveillance and community-based natural resource management (Bourn, D., & Blench, R. 1999). Communication between the different groups needs to be a two-way process.

1.4 WILDLIFE DISEASE SURVEILLANCE.

It can be stated that important differences exist between disease surveillance techniques used for domestic animals and those used for wildlife (Bengis, R.G., Kock, R.A., & Fischer, J., 2002). According to Morner *et al* (2002), it is more difficult to monitor diseases in wildlife than in domestic animals because wild animals are not constrained by boundaries and can roam over large distances. Disease surveillance within domestic farming areas is less complicated, needs less people, is less costly and is much more "hands-on" than in wildlife parks and reserves.

Many developed countries have developed and implemented properly designed surveillance systems for domestic animals which will enable them to analyze data and to recognize potential risk factors associated with diseases and sub-optimal productivity. These countries have disease prevention measures and control strategies in place for their unique circumstances (Morner *et al.*, 2002).

Samples can easily be obtained from abattoirs, clinics and veterinary hospitals, holding facilities, sanctuaries, from herds and flocks during routine inspections, during serological surveys and active surveillance. Diagnostic tests are also available for the majority of diseases found in domestic animals without major additional costs involved (Bengis *et al.*, 2002).

According to Bengis *et al* (2002), wildlife disease surveillance on the other hand is less structured, "hands-on" opportunities are less frequent, and therefore, it is essential to maximize information gained from the limited availability of carcasses or captured animals. It is much more difficult to monitor diseases in wildlife populations than in domestic animals.

It is, however, widely recognized that countries that do conduct disease surveillance of their wild animal populations are more likely to understand the epizootiology of specific infectious diseases and zoonotic infections within their territorial borders and are, therefore, better prepared to protect wildlife, domestic animals and humans (Morner *et al.*, 2002).

Wildlife parks, reserves and game farms exist in many developing African countries and frequently pastoral communities and wildlife share vast areas, where local communities and their livestock still form an integral part of the ecosystem. In these cases, the livestock frequently serve as sentinels for disease events that affect wildlife.

In other fenced conservation areas, such as the Kruger National Park (KNP), no commercial or communal farming enterprises are allowed, and active and passive disease surveillance must be carried out by conservation and veterinary staff. All morbidity or mortality events must be investigated, and all "hands-on" opportunities should be fully utilized. Investigating and sampling for diseases in wildlife should, thus, be performed whenever possible.

It is also important not to assume that tests that have been developed for domestic livestock are equally sensitive or specific in their wildlife counterparts. Many of the current tests still need to be validated in wildlife (Bengis *et al.,* 2002).

1.5 METHODS OF SURVEILLANCE.

Disease surveillance in wildlife is generally less well structured than in livestock because free-ranging wildlife populations are not visited and visualized on a regular basis, frequently do not have owners, and are not easily manipulated for "hands-on" examination or specimen collection (Bengis *et al.,* 2002).

Consequently, it is essential to initiate active investigation of any reports of abnormal clinical signs, mortalities or sustained increase in vulture activity in a given geographical area and to make use of all opportunities to do a veterinary examination of animals captured for any reason at all, including translocation, clinical assistance, fitting radio transmitters, or removal of problem animals, as well as veterinary supervision at all wild animal holding facilities and game sales (Bengis *et al.,* 2002).

Active veterinary participation in protected area management should emphasise the training of technicians, rangers and field biologists with regard to specific diseases and their clinical signs. In addition, protocols for surveillance and sampling techniques, data collection, reporting and decision making should be supplied, Field diagnostic manuals are most useful if they are prepared in a simple, practical and highly illustrated format, whereby they can always be carried in a vehicle

and can be available for quick reference at the site of a disease event. The manual should cover essential information on the etiological agent, host species, epidemiology, clinical signs, gross pathology, differential diagnosis and collection of diagnostic specimens for each of the known diseases (Geering *et al.,* 2006).

1.6 APPROACHES TO SURVEILLANCE.

The following approaches can be useful in a surveillance program:

1.6.1 Active and passive surveillance.

According to Bengis *et al* (2002), the difference between an active and a passive approach towards surveillance is that an active approach means initiating procedures to obtain samples from targeted animals in the field, in animal holding facilities and during capture operations, while a passive approach to surveillance means no specific programmes or procedures have been initiated and surveillance takes place on an *ad hoc* basis, when morbidity or mortality events that are reported by staff or visitors to the Park are investigated.

For significant diseases in wildlife, an active surveillance programme may be the preferred approach with the aim to collect a certain number of samples from a target population (live or dead animals) to determine the point prevalence of certain pathogens. The FAO states that active disease surveillance requires purposeful and comprehensive searching for evidence of disease in animal populations as active surveillance.

Passive surveillance, on the other hand, is unplanned, and its response is driven by reports from veterinary field staff, rangers, researchers and the public. Abattoirs and livestock markets may also play an important role in providing information for passive disease surveillance (Geering *et al.*, 2006). According to Morner *et al* (2002), once an infectious pathogen has been identified, serological surveys supported by accurate species-specific test are the most commonly used means to actively assess the extent of an infection within select free-ranging populations.

1.6.2 Notifiable disease reporting.

According to Akhtar *et al* (2002), veterinary health agencies have the authority to designate certain diseases as notifiable by law, and this approach has traditionally been used for important infectious diseases. All relevant veterinary health workers, farmers and animal slaughters houses are, by law, obliged to report any notifiable diseases to the veterinary authorities for investigation purposes.

1.6.3 Laboratory-based surveillance.

Using diagnostic laboratories as the basis for surveillance can be effective since their information yields a high level of specificity. This information can be obtained from various samples sent to these laboratories (Akhtar, S., & White, F. 2003).

1.6.4 Volunteers

The participation of field staff, e.g. field rangers, field guides and trails rangers doing routine patrols, can be utilized to the advantage of a wildlife disease surveillance programme.

1.7 SHORTFALLS WITHIN DISEASE SURVEILLANCE PROGRAMMES.

In many developing countries, it is unlikely that many veterinarians or other animal health workers in either the public or private sector will have had first-hand experience with trans-boundary or other emergency animal diseases, as these diseases may never have previously occurred in the country or may be exotic to the region. This deficiency needs to be rectified by a systematic training programme for all those who, in their professional capacity, may be the first to come into contact with an incursion or outbreak of such a disease. Because a disease could strike in any part of the country and because of staff turnover, training programmes should be both comprehensive and regular. This training must extend to staff in the remotest parts of the country. In most cases, it is sufficient for trainees to be familiar with the basic clinical, pathological and epidemiological features of high risk diseases and to know what to do if they suspect one of these diseases (Geering *et al.*, 2006).

Active veterinary participation is essential in protected area management, with emphasis on training of technicians, rangers and field biologists with regard to specific diseases and their clinical signs, surveillance and sampling techniques, data collection, and reporting.

An important weakness in the current approach to surveillance is that the activities of this diverse range of contributors, users and beneficiaries are poorly integrated. The aim in delivering this strategic goal is to draw together all these parties as a functional network of surveillance partners and collaborators (Scudamore, J.M., & Harris, D.M. 2002).

1.8 CRITERIA FOR INCLUSION OF SPECIFIC DISEASES WITHIN A SURVEILLANCE PROGRAMME.

It is not possible to include all diseases into surveillance and monitoring programmes and, therefore, only a few of the OIE-listed diseases are usually under active or passive surveillance. The following elements should be taken into account when setting the priorities for diseases:

- Impact of the disease on both human and animal health.
- Availability of cost-effective prevention and control measures as well as possible resource considerations.
- Diseases which farmers and veterinarians consider important in their particular areas (Akhtar *et al.,* 2003).

Every country and conservation area, however, have certain priorities of their own for inclusion of diseases into their surveillance program. It is appropriate that those diseases be considered which may seriously affect wildlife populations directly or may undermine wildlife management efforts (Bengis, R.G., Kock, R.A., Thomson, G.R., & Bigalke, R.D. 2004).

According to Akhtar *et al* (2003), in general the criteria for inclusion of diseases in surveillance systems have been based on their potential to affect public health, for instance zoonotic diseases and diseases that affects production as well as international trade.

1.8.1 Notifiable Diseases.

Notifiable disease means a disease listed by the veterinary administration, and that, as soon as detected or suspected, must be brought to the attention of the Veterinary Authority, in accordance with national regulations (OIE, Terrestrial Animal Health Code, 2006).

1.8.2 Zoonoses

Zoonoses are infectious diseases that can be transmitted between animals and humans (Bengis *et al.,* 2004). Zoonoses also refer to any disease agent that moves into humans from an animal source (Brown, 2004).

Wildlife can be an important source of infectious diseases to both domestic animals and humans. According to Vallat (2008), approximately 60% of existing human pathogens and over 75% of those that have appeared during the past two decades can be traced back to animals. Many of them have a proven link with wildlife. The Canadian Science Issue (2006), states that many wildlife diseases infect agricultural animals and cost Canada and other agricultural economies billions of dollars. With expanding human populations, recreational interests, and changes in our ecosystem

and wildlife habitat, there is a greater interface between wildlife, livestock and humans; yet, there also seems to be a lack of knowledge about diseases in wildlife populations and often a lack of disease prevention and management strategies for wildlife (Williams, E.S., Yuill, T., Artois, M., Fischer, J., & Haigh, S.A. 2002; Bengis *et al.,* 2004).

According to Karesh (2008), it would be cheaper to build warning systems and undertake disease surveillance in places like the Congo Basin than building expensive machines to control an outbreak.

The spectrum of infectious diseases affecting wildlife today is greater than at any time during the last century. Brown states that the expansion of the human population and their movement between continents has resulted in pathogens and vectors expanding their geographic range and finding novel niches and hosts with pathogenic results. Wildlife translocation, in which humans move wildlife from one geographical site to another, is a common conservation tool but also a practice that has facilitated the translocation of animal diseases as well as the transmission and spread of zoonoses (Brown, 2004).

Bovine tuberculosis in the Kruger National Park, the spread of distemper in wild dogs and lions of the Serengeti, and toxoplasmosis in seals off the coast of California all represent emerging diseases in which the pathogen has shifted from domestic animals to wildlife with devastating results (Bengis *et al.,* 2004).

Wildlife may also provide a ‘zoonotic pool’ from which previously unknown pathogens may emerge. Wildlife populations can be the reservoir for pathogens that threaten domestic animal and human health, and wildlife diseases may pose a substantial threat to the conservation of global diversity (Morner *et al.,* 2002).

The mingling of animals, both domestic and wildlife, animal products, and people has created a microbial milieu that not only favors the emergence of zoonoses, but suggests that this era of emerging and re-emerging zoonoses will likely continue unabated (King, 2004).

1.9 IMPORTANT DISEASES FOR SURVEILLANCE IN AFRICA, WITH SPECIFIC REFERENCE TO THE GKNP.

1.9.1 Foot and Mouth Disease. (FMD)

Foot and Mouth disease is a most contagious and usually acute affliction of cloven-hoofed animals caused by a virus of the family *Picornaviridae*. The susceptibility of different species to infection and their ability to transmit it is highly variable (Bastos, 1998; Thomson, G.R., & Bastos, A.D.S. 2004).

In cloven-hoofed livestock, the disease is usually characterized by high morbidity, low mortality and the development of vesicles and erosions in the mucosa of the mouth and skin of the interdigital spaces and coronary bands (Vosloo, W., Knowles, N.J., & Thomson, G.R. 1992; Anderson, E.C., Foggin, C., Atkinson, M., Sorenson, K.J., Madekurozva, J., & Nqoindi, J. 1993).

Countries in sub-Saharan Africa face another problem that is unique in the context of FMD: the African buffalo (*Syncerus caffer*) is a maintenance host for the South African Territories (SAT) types of FMD virus, and large herds of infected buffalo are present in many countries of the subcontinent, particularly in eastern and southern Africa (Thomson, G.R., & Bastos, A.D.S. 2004). This widespread presence of the virus complicates control or eradication of the infection. FMD has occurred regularly in most southern African countries since 1931, and the cost of control has undoubtedly eclipsed that of any other viral disease from that time (Bengis *et al.*, 2004).

1.9.1.1 Impact of Foot-and-Mouth Disease.

A remarkable feature of FMD disease is that, although the pathogenesis of the disease varies little from one geographic region to another, the impact of the disease differs considerably in different parts of the world, depending on their agricultural export status. In the developed world, it is the most feared of all animal diseases. The reason is the devastating economic consequences it may have. Most recently, the consequences were illustrated during the 2001 United Kingdom outbreak where, within three months, over three million animals were destroyed, the cost to the tourist industry was 5.2 billion pounds and it caused considerable human misery (Howard, S.C., & Donnelly, C.A. 2000; Scudamore, J.M., & Harris, D.M. 2002; Thomson, G.R., & Bastos, A.D.S. 2004).

Conversely, in many pastoral communities in sub-Saharan Africa where the disease is prevalent and well recognized by livestock owners they often – although not always – ascribe little importance to it, except during periods where animal draught power is needed for plowing (Thomson, G.R., & Bastos, A.D.S. 2004).

A general observation has been that wherever in the world FMD has been eradicated from livestock, it has also generally disappeared from wildlife. In all parts of the world, with the exception of sub-Saharan Africa, FMD in free-ranging or captive wildlife appears to have been an extension of the disease in livestock (Bruckner, G.K., Vosloo, W., Du Plessis, B.J.A., Kloeck, P.E.L.G., Connoway, L., Ekron, M.D., Weaver, D.B., Dickason, C.J., Schreuder, F.J., Marais, T., & Mogajane, M.E. 2002; Thomson, G.R., & Bastos, A.D.S. 2004).

The only locality in which overt FMD has been reported regularly in wildlife over the last 60 years is the Kruger National Park (KNP) in South Africa, where there have been 31 recorded outbreaks in impala since 1938, of which 23 outbreaks were detected after routine surveillance was introduced in the KNP in the mid-1960s (Vosloo *et al.,* 1992; Bastos, A.D.S., Boshoff, C.I., Keet, D.F., Bengis, R.G., & Thomson, G.R. 2000). In the KNP, FMD in impala *(Aepyceros melampus)* appears to occur generally in localities where high densities of this species occur and mix with the viral maintenance host, namely the African Buffalo (Thomson *et al.,* 2004).

1.9.2 Anthrax

Anthrax is an infectious disease of domestic and wild animals and humans, caused by the bacterium *Bacillus anthracis* (De Vos, V., & Turnbull, P.C.B. 2004)

According to de Vos (2004), anthrax is characterized in most species of animals by the development of a rapidly fatal septicemia that results in sudden death. A bloody discharge from the body openings of the dead animal will alert the animal health worker to be on the lookout for anthrax.

Anthrax, which is indigenous to Africa, appears to be the first disease of humans and animals shown to be caused by a microorganism (Anon, 1986; Wilson, G.S., & Miles, A.S. 1966; De Vos, V., & Turnbull, P.C.B. 2004).

The anthrax life cycle includes the ability of the bacterium to survive outside its host, to enter and successfully infect its host, and to multiply *in vivo* with fatal consequences for the host. Thereafter, sporulation and subsequent dissemination of the spores are dependent on the carcass being opened, and the bacteria being exposed to atmospheric oxygen (Turnbull, 1998*).*

In the Kruger National Park in South Africa, an intricate ecological pattern, with anthrax an integral part thereof, has also been identified (de Vos, 1998). This pattern suggests a symbiotic relationship which could only have taken place over a long evolutionary period. Anthrax appears to have evolved as a population control mechanism for certain preferred hosts, such as kudu. Because of practical difficulties encountered in vaccinating free-living wild animals, anthrax retains a continued place in the ecology of free-ranging wildlife in several regions of the world (De Vos *et al.*, 2004; Hugh-Jones, M.E., & de Vos, V. 2004).

1.9.2.1 Anthrax Surveillance.

Anthrax can be easily diagnosed using relatively low-tech diagnostics. All that is needed is a peripheral blood smear taken from the carcass. This method should be the basis for ongoing surveillance in conservation areas.

In addition, good surveillance procedures should provide a country with an indication of its high-risk anthrax areas. It is imperative that an early warning system be in place so that an outbreak can be identified at an early stage and combated before it can assume major epidemic proportions (Hugh-Jones, 1996). Hugh-Jones is of the opinion that veterinary authorities must regard anthrax more seriously and therefore improve surveillance.

1.9.3 Rabies

Rabies is a fatal disease in humans and all other warm-blooded vertebrates; it is caused by a virus which is present in the saliva in the latter stage of infection. The infection affects the brain causing behavioral changes, such as excitability, furious behavior, inability to swallow, salivation, convulsions, paralysis, coma and death (King, A.A., Meredith, C.D., & Thomson, G.R. 1993*;* Swanepoel, 2004). These behavioral changes may result in intra- and interspecies aggression, and the virus is generally transmitted by the bite of diseased animals, most commonly dogs and other mammals. Rabies surveillance and monitoring is poor in Africa. For instance, the 2081 confirmed cases of the disease in domestic and wild animals reported for the continent as a whole in 1988 constituted less than 5% of the total of the world (Foggin, C.M., & Swanepoel, R. 1979; Khomari, 1988).Virtually all African countries have the requisite veterinary and medical infrastructures, but many have been unable to devote adequate resources to monitoring and controlling rabies in the face of poverty, prolonged droughts, other diseases such as HIV, or armed conflict (Khomari, 1988; Hofmeyer, M., Bingham, J., Lane, E.P., Ide, A., & Nel, L. 2000).

In sub-Saharan Africa, where humans and other animals are more widely distributed than in northern Africa, there has been a greater tendency for epidemics of dog rabies to spread over large areas and for the disease to be observed in domestic herbivores and wild vertebrates (Blancou, 1988). This trend is most noticeable in the more developed countries of southernmost Africa, where the high proportions of cases recorded in wild animals must to some extent reflect more intensive monitoring of the disease, but where specific problems with sylvatic rabies are nevertheless encountered (Swanepoel *et al.,* 1993).

1.9.4 Bovine Tuberculosis (BTB).

Bovine Tuberculosis is caused by *Mycobacterium bovis*, and cattle are the maintenance host. Bovine tuberculosis generally has a chronic, variable, and often sub-clinical course (Thornburn, J.A., & Thomas, A.D. 1940; De Lisle, G.W., Mackintosh, C.G., & Bengis, R.G. 2001). It usually takes months or even years before clinical signs develop. In most infected cattle, the disease is not apparent, its presence only being detectable by the application of the tuberculin test. However, if clinical signs are manifested, their nature depends on the organ system or systems involved and the severity of the infection (De Lisle, G.W., Bengis, R.G., Schmitt, S.M., & O'Brien, D.J. 2002).

In recent years, it has become evident that infection with *M. bovis*, the cause of the infection in cattle, is common in a wide variety of wildlife in various parts of the world (Woodford, 1982; Cousins, D.V., Huchzermeyer, H.F.K.A., Griffin, J.F.T., Bruckner, G.K., Van Rensburg, I.B.J., & Kriek, N.P.J. 2004). According to De Lisle (2002), the infection in wildlife is important not only from the perspective of the value of some species of wildlife, some of which are endangered, but because of the role of wildlife in sustaining the infection. Continuing research has highlighted the significance of these wildlife reservoirs and their adverse effects on the efficacy of control measures that are currently in use in developed and developing countries (O'Reilly LM, & Daborn CJ. 1995*). M. bovis* infection has recently been diagnosed in African buffalo, which is considered to be a maintenance host as are various other species of wildlife in some game parks and commercial game ranches in South Africa (Keet, D.F., Kriek, N.P.J., Huchzermeyer, H., & Bengis, R.G. 1994; Bengis, R.G., Kriek, N.P.J., Keet, D.F., Raath, J.P., de Vos, V., & Huchzermeyer, H.F.A.K, 1996; Keet, D.F., Kriek, N.P.J., Bengis, R.G., & Michel, A.L. 2001; Cousins *et al.,* 2004).

1.9.5 Bovine Brucellosis

Bovine brucellosis is a highly contagious disease caused by *Brucella abortus*, an intracellular bacterium that can infect a wider range of mammals. Apart from causing characteristic mid- to long-term abortion and infertility in cows, Brucella abortus also occasionally causes orchitis and inflammation of the accessory sex glands in bulls (Godfroid, J., Bosman, P.P., Herr, S., & Bishop, G.C. 2004).

Furthermore, bovine brucellosis is a major zoonoses (Anon, 1986). In sub-Saharan Africa, brucellosis is prevalent in both humans and livestock. The surveillance and control of brucellosis in sub-Saharan Africa is rarely implemented outside southern Africa (McDermot, J.J., & Arimi, S.M. 2002). The rate of infection in humans is virtually unknown, and public awareness is extremely low. Hence, the impact of brucellosis in terms of public health and social importance is rarely correctly addressed (Godfroid *et al.,* 2004).

Other livestock, wild animal species and marine mammals, though of varying susceptibility, are sometimes infected (Godfroid, 2002). According to Davis (1990), brucella spp. infections have been documented worldwide in great variety of terrestrial wildlife species and marine mammals. For example, Brucella abortus or Brucella *suis* have been isolated in wild animal species, such as bison *(Bison bison),* elk/wapiti (*Cervus elaphus*), feral pigs (*Sus scrofa*), European wild boar (*Sus scrofa*), European. hares (*Lepus europaeus*), African buffalo (*Syncerus caffer*), Eland (*Taurotragus oryx*), and waterbuck (*Kobus ellipsiprymnis*) (Davis, 1990).

Brucella melitensis rarely occurs in wildlife but has been reported in Europe in chamois (*Rupicapra rupicapra*) and ibex (*Capra ibex*) in the Alps (Ferroglio, E., Tolari, F., Bollo, E., & Bassano, B. 1998; Garin-Bastui, B., Oudra, J., Richard, Y., & Gastellu, J. 1990), and sable antelope in South Africa (Madsen, M., & Anderson, E.C. 1995*).*

Wildlife brucellosis is a political issue; the livestock, hunting and gaming farming industries, and those involved in wildlife conservation and welfare, have conflicting interests (Corbel, 1997; Godfroid *et al.,* 2004). The development of the game farming industry has contributed to the re-emergence of brucellosis as being of international concern for both livestock and wildlife because of the lack of pre-movement screening, an increase in the density of possibly infected game species, the introduction of artificial feeding, and the movement of certain wildlife species (Godfroid, J., Bosman, P.P., Herr, S., & Bishop, G.C. 2004).

In South Africa, apart from African buffalo, several other species of wildlife – hippopotamus *(Hippopotamus amphibious)*, zebra *(Equus burchelli)*, eland (*Taurotragus oryx*), waterbuck (*Kobus ellipsiprymnis*), and impala (*Aepyceros melampus*) – have tested serologically positive for brucellosis (Gradwell, D.V., Schutte, A.P., van Niekerk, C.A.W.J., & Roux, D.J. 1977; Herr, S., & Marshall, C. 1981). These species are probably of minor importance in the epidemiology of bovine brucellosis in southern Africa because of their relatively infrequent contact with cattle (Gradwell *et al.*, 1977). There are few records of abortions due to brucellosis in wildlife in southern Africa, although Brucella biovar 1 has been isolated from the cotyledons of pregnant buffalo at slaughter. In addition, experimental infection of pregnant buffalo resulted in late-term abortions (Herr, S., & Marshall, C. 1981).

Serological surveys have revealed that up to 23% of African buffalo in Kruger National Park are serological positive for brucellosis. It was concluded that brucellosis may be a sustainable infection in African buffalo populations in southern Africa which can be a potential source of reinfection particularly for cattle (Madsen, M., & Anderson, E.C. 1995; Godfroid, 2002).

1.10 OBJECTIVES OF THIS STUDY.

In the light of the information available and the above discussions, it is apparent that no wildlife disease surveillance programme exists in South Africa and that such programmes are imperative in various natural areas in the country. This study focuses on the Greater Kruger National Park and has the following objectives:

- To monitor and evaluate the standard of the existing disease surveillance programmes for the following diseases, Foot and Mouth, Anthrax, Tuberculosis, Brucellosis and Rabies, within the Kruger National Park and adjacent private game reserves by evaluating the level of competency and knowledge in field rangers, field guides and trails rangers with regard to these specific diseases.
- To identify shortfalls within the current disease surveillance activities in the Greater Kruger National Park.
- To develop a surveillance system to optimize wildlife disease surveillance in the Greater Kruger National Park.

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CHAPTER 2

STUDY AREA

2.1. INTRODUCTION

The study was conducted in the Greater Kruger National Park Complex (GKNP), which consists of the Kruger National Park (KNP) and adjacent private game reserves (Figure 2.1).

The GKNP is located in the Lowveld of Mpumalanga and the Limpopo Provinces along the north-eastern boundary of South Africa, bordering Mozambique in the east and Zimbabwe in the north, with a total area of more than two million hectares. The Kruger National Park on its own is roughly the same size as Wales; it has an area of 18,989 square km and extends 350 km from north to south and 60 km from east to west. The park is part of the GKNP Kruger to Canyons Biosphere, an area designated by the United Nations Education and Scientific Organization (UNESCO) as an International Man and Biosphere Reserve (Du Toit, J.T., Rogers, K.H., & Biggs, H.C. 2003*).* No fences run between the KNP and these various private game reserves; thus the GKNP comprises almost 2, 5 million hectare of unspoiled natural habitat (Figure 2.1).

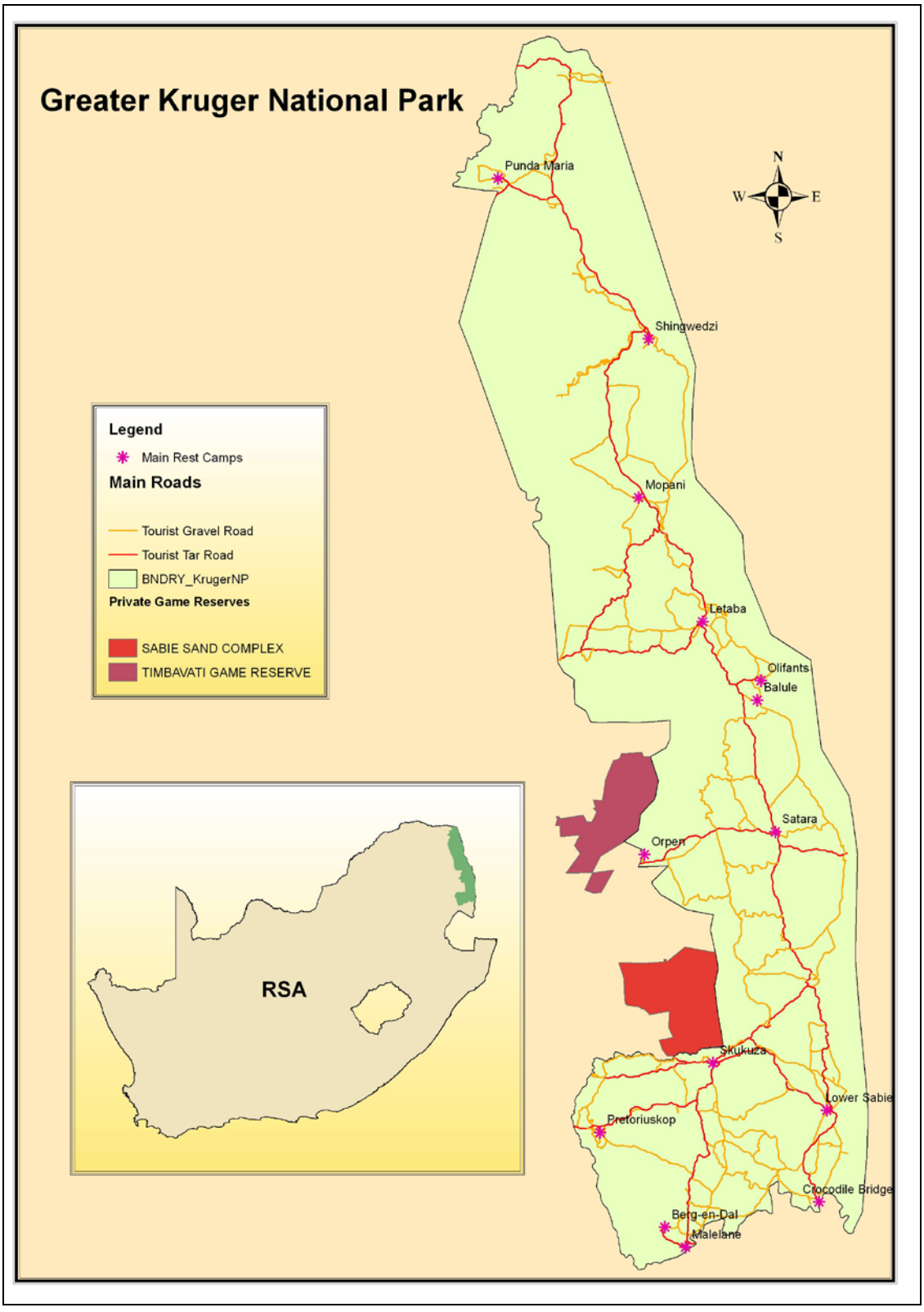


Figure 2.1. The Greater Kruger National Park, Timbavati and Sabi Sand Private Reserves. Map Produced by Mr. S v Dyk (Chief Animal Health Technician KNP).

2.2 HISTORY OF THE GREATER KRUGER NATIONAL PARK

2.2.1 Kruger National Park (KNP).

In 1884, Transvaal President Paul Kruger's government declared Africa's first nature reserve, Pongola, close to the border of Swaziland in what is now northern KwaZulu-Natal. As the land had already been hunted to extinction, this "gameless" game reserve was a curious project, bravely supported by a handful of courageous politicians and conservationists for fourteen years (Carruthers, 1995). These early conservation efforts were motivated by the need to protect some resources for later exploitation, rather than a desire for their outright protection on any sort of idealistic basis.

For many years, it had been apparent that wildlife, which formed a key part of the Boer Republic's economy, was dwindling. The Volksraad, the governing body of the ZAR, was empowered to declare areas of state land closed to hunters. The primary reason for the proclamation of this reserve was to allow wildlife the chance to breed so that it could later be shot (Carruthers, 2001). However, the act did lay the foundations for what is today a network of protected areas scattered across the continent. In 1896, the Rinderpest virus wiped out most of the region’s game and cattle. Aiming to preserve game animals for future hunters, the Transvaal Volksraad voted in favor of a small government game reserve.

One quarter of a million hectares of Lowveld land was set aside as a “Government Reserve” on 26 March 1898 (Figure 2.2). The fledgling reserve was given the name the Sabi Game Reserve which remains at the core of today's KNP (Kruger to Canyons, *History of the KNP*, 2008).

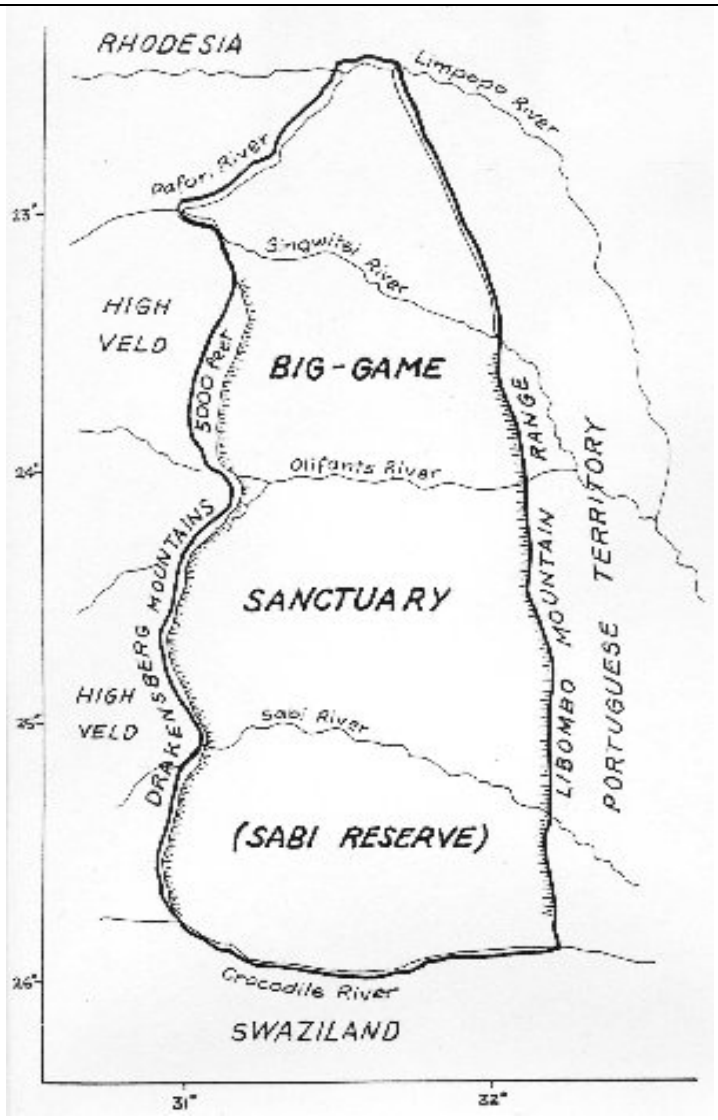


Figure: 2.2 Rendition of Abel Chapman's proposal for a big game sanctuary presented in London at the International Convention for the Preservation of Wild Animals, 1900. (Kruger to Canyons, History of the KNP, 2008).

In the style of traditional governance inherited from the British colonial system, two policemen were put in charge of the entire Reserve. However, the Boer War ensued, and any semblance of order broke down. After peace was negotiated in 1902, a former Intelligence Officer of the Sixth Inniskilling Dragoons, James Stevenson-Hamilton, was appointed as the Sabi's Reserve's first Warden. In 1903, Stevenson-Hamilton oversaw an extension of the Sabi Reserve twenty kilometers or so back towards the Drakensberg Escarpment. He was also put in charge of a new Reserve established that year, the Shingwedzi, comprising an additional half a million hectares of land to the north of the Sabie. At this time, he displayed an example of the foresight that earned him the local name of Skukuza - "he who sees far" or "he who sweeps clean" (Carruthers, 1995). He negotiated with the private landholders to lease the property between the two reserves in order to join them into a contiguous whole. In another, unpopular fit of prescience, he developed an uncompromising set of measures to curtail hunting in the newly expanded region and to punish its perpetrators (Kruger to Canyons, History of the KNP, 2008).

In 1914, Stevenson-Hamilton rejoined the British Army in France for the duration of World War I. During his absence, the Union government deliberated on the future of the reserves. Since hunting was no longer a mainstay of the economy, the justification for the game reserves had evaporated, and there was pressure to make the area available for farming. The reserves were expensive to maintain, generated no revenues, occupied land potentially useful for other purposes and harbored dangerous animals. Pressure mounted to have them de-proclaimed. The survival of the Sabi and Shingwedzi Reserves ultimately came down to an aesthetic, rather than economic, rationale. Upon his return to South Africa, Stevenson-Hamilton, impressed by the success of national parks in the United States of America, lobbied for more permanent protection for these parts of the Lowveld. He carried with him the South African public, who quickly became enamored with the idea (Kruger to Canyons, History of the KNP, 2008).

In 1926, today's current boundaries were settled with the expropriation from the Ba-Phalaborwa tribes of the areas between the Letaba and Olifants rivers (Figure 2.3). In 1926, as an act of reconciliation, the British administration officially renamed the reserve after Paul Kruger and declared it to be South Africa’s first national park. The Kruger National Park was formally promulgated in the same year (English, 1990; Pienaar, 1990).

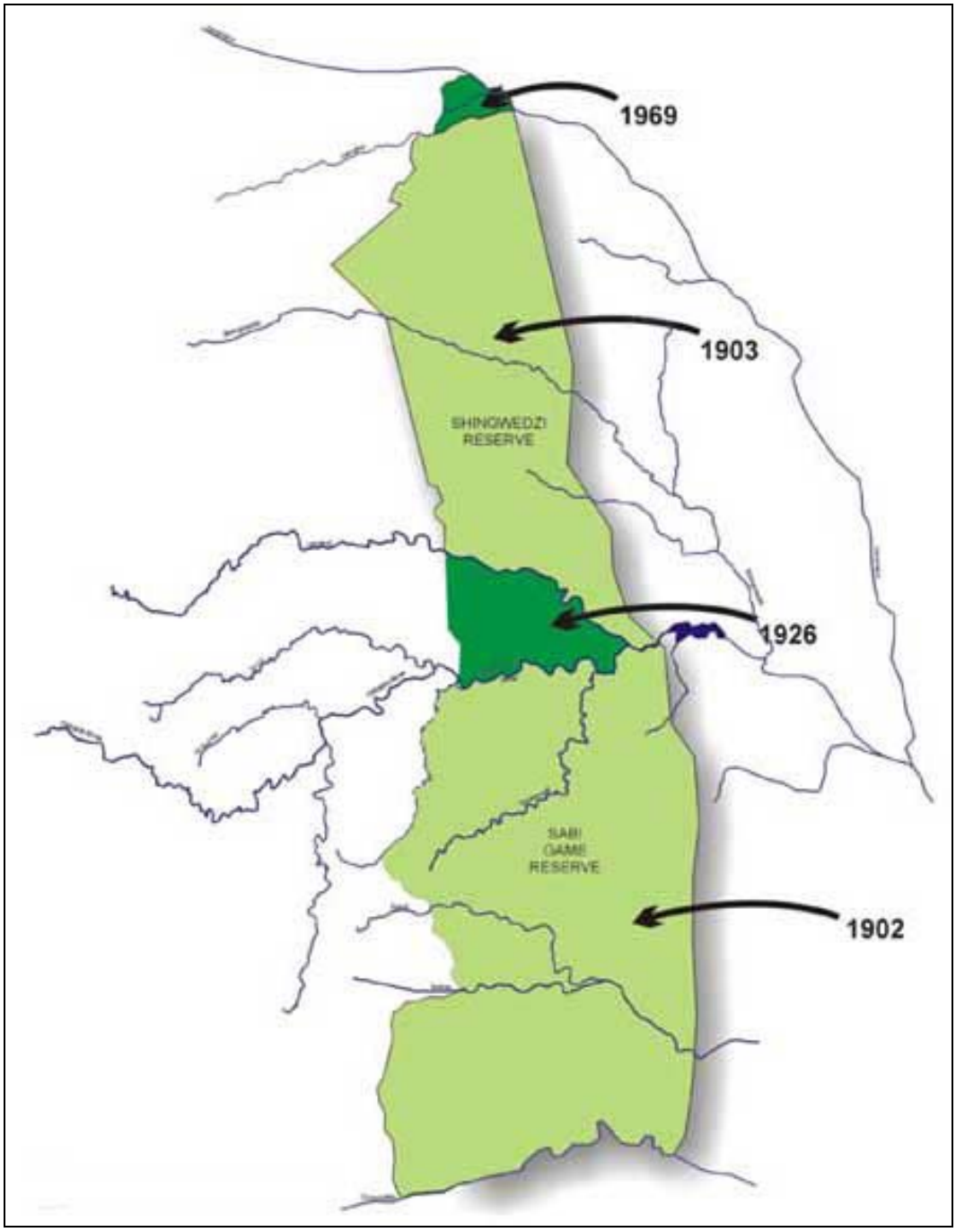


Figure: 2.3 The 1926 Addition to the Kruger is now the subject of a Land Claim by the Ba-Phalaborwa Tribe. (Kruger to Canyons, 2008)

In 1991, the CEO of the National Parks Board, Robbie Robinson, decided to begin with the removal of fences that separated the park's western border from numerous small, private game reserves and the KNP (Kruger National Park, Kruger Park History, 2008).

The KNP could have been established because of the presence of tsetse fly-transmitted trypanosomiasis and anopheline mosquito-transmitted malaria in the Lowveld region of South Africa in the latter half of the nineteenth century (Pienaar, 1980; Connor, 1994). Furthermore, the endemic presence of several major wildlife-associated diseases of livestock, including foot-and-mouth disease, theileriosis, malignant catarrhal fever, anthrax, African swine fever and African horse sickness, which still make this area unsuitable for livestock farming could have been a motivating factor for the establishment of the KNP (Bengis, R.G., Grant, R., & de Vos, V. 2003).A less auspicious introduction from foreign climates into Africa was that of rinderpest, a cattle plague. Because it is an extremely contagious airborne virus, it spreads rapidly. It first emerged in bovine stock introduced by Italian troops from the Asian sub-continent into Somaliland in 1889, and rapidly infected the entire continent by 1897. The disease was impeded only briefly by the Sahara desert and South Africa's erection of 1,600 km of barbed wire from Bechuanaland to the Cape-Natal coastline. Between 60% and 95% of all cattle died over this period, depending on the control measures employed by the different countries (Kruger to Canyons, Flora and Fauna, 2008).

Wildlife, no longer out-competed for resources by managed herds of cattle, increased rapidly in number. These animals carry trypanosomes (parasites) in their blood to which they have developed immunity. The colonists and their cattle of European origin had no immunity, and these parasites resulted in sleeping sickness (in humans) and Nagana in cattle (trypanosomiasis) which are still frequently fatal (Connor, 1994). The blood-sucking tsetse fly is the main vector that transmits the infection between hosts (Kruger to Canyons, Flora and Fauna, 2008).

The combination of the growth in tsetse flies' populations and the increase in the wild game population rendered large swathes of formerly inhabited Africa uninhabitable once again due to endemnicity of sleeping sickness and Nagana. Many such areas were declared game reserves early in the twentieth century as nature's equilibrium was shifted in favour of the wild game populations (Pienaar, 1980). South Africa's Kruger National Park was one of these, along with Hwange in Zimbabwe, Selous in Tanzania, the Okavango Delta in Botswana, and Luangwa and Kafue in Zambia (Kruger to Canyons, Flora and Fauna, 2008).

2.2.2 Timbavati Game Reserve.

The Timbavati Game Reserve (Figure 2.1) is located and linked to the western boundary of the Kruger National Park. In 1993, in recognition of the importance of the area, the fences between the

Kruger National Park and the Timbavati Game Reserve were removed to encourage natural species migration.

The Timbavati Association was formed in 1956 by a group of conservation-minded land owners who had witnessed the degradation of this once pristine wilderness area. Intensive land use had caused soil erosion and destruction of indigenous plant species. In addition, natural water sources had been routed by dams further impacting on the natural *status quo*. As a result, much of the wildlife common to this area was lost.

Today, a total of 50 privately owned farms, encompassing 53,392 hectares of land, have succeeded in restoring the habitat to its former glory with diverse and rare wildlife species making the Timbavati their home (History of the Timbavati Private Nature Reserve, 2007).

The Timbavati Game Reserve is one of a handful of nature reserves on the western boundary of the KNP that is now an integral part of the greater Kruger Park system. Collectively termed the Association of Private Nature Reserves, these wildlife-rich lands adjoin and are managed in cooperation with the Kruger National Park, forming a unique combination of public and private lands called “The GKNP”.

The Timbavati consists of at least 12 guest lodges which provide daily safari experiences to their guests which include a number of foreign visitors. The safaris are made possible by field or game guides operating from the different guest lodges. The guides possess either the National Diploma in Nature Conservation or the FGASA qualification

2.2.3 Sabi Sand Game Reserve.

The Sabi Sand Game Reserve (Figure 2.1) was formed in 1948 when fourteen farm owners, who where strong believers in preservation of wilderness, met at MalaMala Game Lodge to discuss the future of this precious piece of landscape. The Sabi Sand is an association of freehold landowners, many of whom manage commercially active photographic safari operations (History of the Sabi Sand Reserve, 2007).

Situated on the western boundary of KNP (Figure 2.1), the Sabi Sand Game Reserve is a 65 000 hectare wildlife sanctuary which shares a common 50 km unfenced eastern boundary with the Kruger National Park as part of the 2, 3 million hectare GKNP game preservation area. With no fences in this area, animals are allowed to roam unhindered through the enormous conservancy

with habitat types ranging from riverine thicket to open savannah. Two perennial rivers, the Sand River and the Sabie River, supply the game reserve with a valuable water source.

Sabi Sands comprises of the following smaller private game reserves: Singita, Djuma, Mala Mala, Londolozi, Lion Sands, Exeter, Sabi Sabi and Ulusaba (Sabi Sand Game Lodges, 2007).

In 1961 and as a result of the threat of foot and mouth disease and the continued hunting on adjacent private lands, fences were erected between the Sabi Sand Game Reserve and the KNP. The Sabi Sand Game Reserve also fenced their perimeter fence to the west to prevent the movement of game from the area. In 1993, however, after much discussion between the management of the KNP and Sabi Sand Game Reserve, the fences between the two reserves once again came down and animals migrated between the park and the private reserves to the west (History of the Sabi Sand Reserve, 2007).

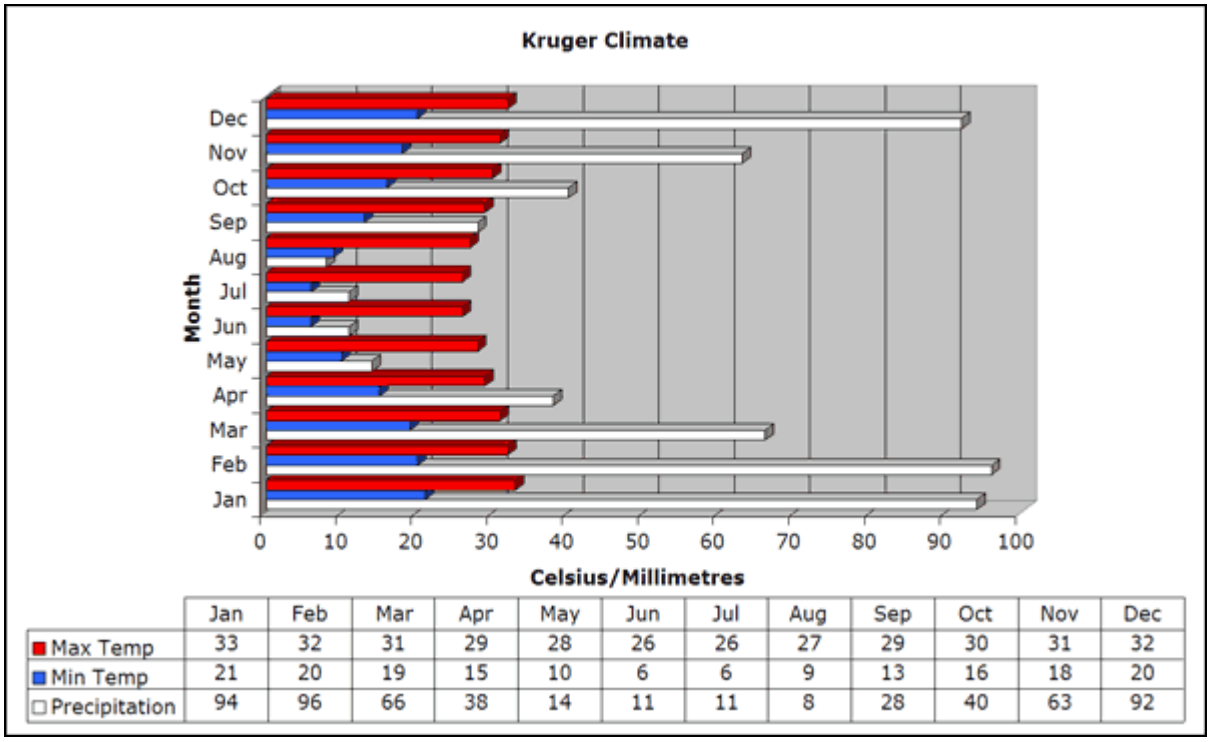
The main objective of the Sabi Sand Game Reserve's game management policy is to monitor the habitat and wildlife densities. The reserve has had to cope with threats, such as foot and mouth disease, bovine TB, uncontrolled fires, bush encroachment and overgrazing (History of the Sabi Sand Reserve, 2007).

2.3. CLIMATE

The climate of the KNP is of subtropical nature with hot, humid summer days with temperatures often soaring to above 40 degrees C. KNP's rainy season is from September until May with mild dry winter seasons offering the best game viewing, when animals often converge on shrinking surface waterhole supplies (Kruger to Canyons , Climate of the KNP, 2008).

According to Figure 2.4, the hottest months of the year are usually December, January and February, and the highest monthly average was recorded in 1982: 41.1C. Day temperatures of above 35° in summer are a common phenomenon.

Maximum temperatures in midwinter average 23 degrees C, and the minimum average is 6 degrees C. Midsummer maximum temperatures average 30 degrees C with evening temperatures of 19 degrees C (Du Toit *et al.,* 2003).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Max Temp	33	32	31	29	28	26	26	27	29	30	31	32
Min Temp	21	20	19	15	10	6	6	9	13	16	18	20
Precipitation	94	96	66	38	14	11	11	8	28	40	63	92

Figure 2.4. Average annual temperatures of the Kruger National Park. (Kruger to Canyons, 2008).

The area's climate is related to the regional climate of the subcontinent as a whole in that it is influenced by anticyclonic systems moving rhythmically over southern Africa from west to east. During the summer months, the presence of anticyclonic conditions in the interior of southern Africa gives rise to extremely hot and dry conditions over the area which can persist for up to two weeks at a time (Kruger to Canyon, Climate of the KNP, 2008). These conditions are normally followed by the development of a low-pressure cell over the interior, resulting in an influx of hot, moist equatorial air from the north and northeast. Subsequently, thunderstorms as warm moist air is sucked down from weather systems normally associated with the Congo. The establishment of equatorial low-pressure troughs over the subcontinent often causes widespread and continuous rain over the Lowveld (Ogutu & Owen-Smith, 2003; Owen-Smith, 1998).

Like other semi-arid regions of the world, the Lowveld is exposed to great variations in the amount of rainfall received in any one year. The reason for the low rainfall in the Lowveld and its variability lie in the position of the region relative to the main weather-generating circulation systems (Figure 2.5). The long-term average rainfall for the whole park is 530 mm, and according to Figure 2.5, the average rainfall can vary between 400 in the north to 730 in the southwest of the park (Du Toit *et al.*, 2003).

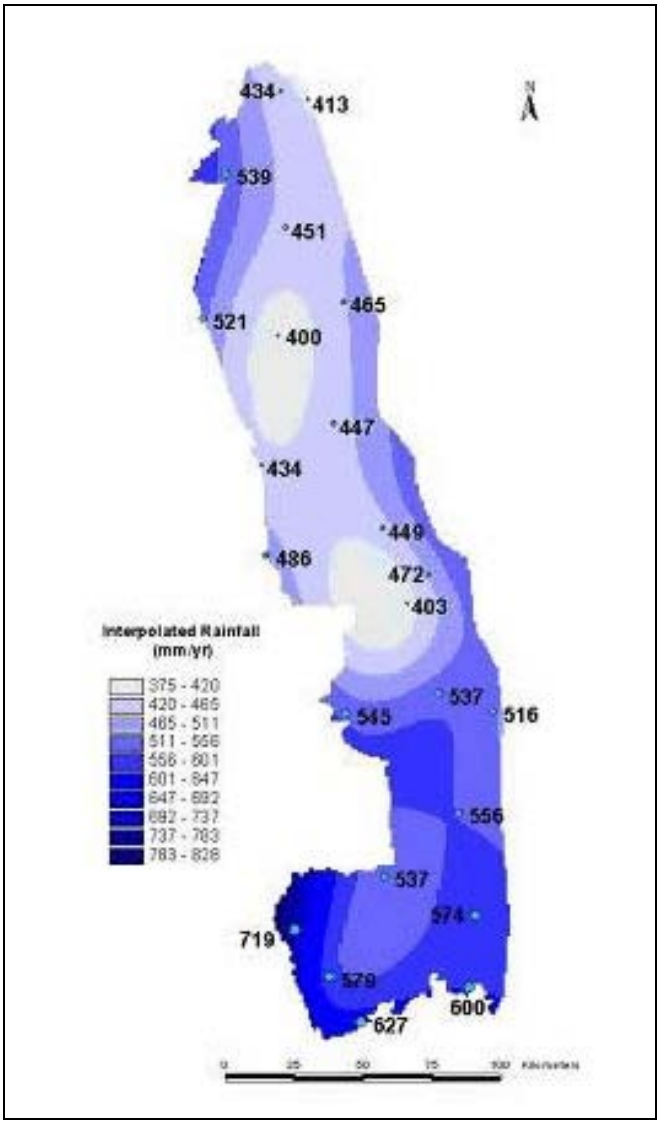


Figure2.5. Average annual rainfall of the KNP within the different zones. (SANParks, 2009).

Tropical cyclones occasionally enter the area in the late summer months. These storms originate in the equatorial areas of the Indian Ocean when the surface temperature of the sea rises above 27°C. The storms move slowly across the Mozambique Channel, gaining moisture as they proceed. The extremely high rainfall associated with tropical cyclones moving overland usually causes extensive flooding and destruction of roads and bridges.

Winter months are normally characterized by the presence of anticyclonic conditions over the interior of southern Africa which results in fine and mild conditions. These intermittently give way

to cooler, cloudy conditions when cold frontal systems of polar origin penetrate from the south (Kruger to Canyons, Climate of the KNP, 2008).

It is worth noting that the high temperatures during summer cause a high evaporation rate which reduces the effectiveness of the precipitation. Hail occurs on a regular basis, but at low frequencies. Mist in winter is common in the lower lying areas. Frost occurs as an exception in the lower lying areas of the KNP (Gertenbach, 1983).

Climate acts with geology as a critical determinant of the ecological potential of a landscape. The climate of the Lowveld follows a trend from wetter and cooler weather in the south and west to drier and hotter in the areas of the north and east. These trends cut across the diverse geological belts to provide a wide variety of habitats, accounting for the great variety in the vegetation and wildlife in the region (Du Toit *et al.*, 2003).

2.4. FAUNA AND FLORA

In Southern Africa, there are seven biomes, namely Fynbos, Savannah, Grassland, Nama-Karoo, Succulent Karoo, Desert and Forest. Each of these biomes is classified according to rainfall, dominant life forms and other structural characteristics (Gertenbach, 1983.). The Kruger to Canyons Biosphere Reserve is a showcase of three of these biomes. The escarpment consists of Grassland and Forest biomes, while the Lowveld region is characterized by the Savannah biome (Kruger to Canyons, Flora and Fauna of the KNP, 2008).

Like many areas of the world, sub-Saharan Africa has suffered significant habitat destruction, degradation and fragmentation. South Africa has lost at least 57% of its natural wildlife habitat through the activities of mankind (Primack, 1993).

Research suggests that only about 6% of South Africa is under official protection, falling somewhat short of the recommended International Conservation Union figure of 10%. However, the ANC Government has announced plans to increase the amount of protected land, so this figure is gradually increasing (Kruger to Canyons, Flora and Fauna of the KNP, 2008).

The UNESCO Man and Biosphere Program is based on the belief that conservation of these systems can have economic and ecological benefits to the local and national communities. The Kruger to Canyons Reserve consists of a diverse range of landscapes and ecosystems: four of the fifteen important types listed by the World Network of Biosphere Reserves exist here (UNESCO, Biosphere Reserves, 2008).

The region is positioned to contribute uniquely to the conservation of South Africa's landscapes because of the atypical interfaces between the ecosystems associated with the escarpment and the Savannah. The rapid change in the altitude of the land has created some unique niche habitats, each with its own endemic species. The extensive savannah ecosystem found within the Biosphere Reserve is not currently a threatened system and is probably one of the more resilient systems in the country. However, because of the size of the area that is protected (by the state and by private landowners), its value to conservation actually increases exponentially (Kruger to Canyons, Flora and Fauna of the KNP, 2008).

2.5. CHALLENGES FOR DISEASES SURVEILLANCE IN THE GKNP

Some historically alien agents to sub-Saharan Africa causing certain diseases such as canine distemper, brucellosis and tuberculosis could have significant direct impacts on the population

dynamics of certain wildlife species in the park. Indigenous African free-ranging mammals have little inherent genetic resistance to these foreign agents (Bengis, R.G., Kock, R.A., Thomson, G.R., & Bigalke, R.D. 2004). In addition, certain indigenous multi-species diseases, which are inherently fatal, such as anthrax and rabies, could impact on wildlife at a population level.

2.5.1. Foot and Mouth Disease

From an international trade point of view, Foot and Mouth Disease is probably the most important wildlife-maintained disease, and this disease currently presents the greatest constraint to access to lucrative markets for animal products produced in sub-Saharan Africa, especially from areas surrounding the national parks, including the KNP. The pivotal role played by the African buffalo as a sylvatic maintenance host was identified in the late 1960s. Strict management of the disease in national parks containing infected buffalo is essential, and the KNP is a good example. This park is fenced and buffer zones have been created along its borders; these measures together with vaccination of cattle and regular FMD surveillance and testing of animals in the buffer zones have been relatively effective in containing the disease in this the only endemically infected area in the country (Bengis *et al.*, 2004).

2.5.2. Anthrax

The northern sand and panveld areas of the KNP, in the vicinity of the Levubu and Limpopo drainages, are persistently infected with anthrax organisms. Anthrax spores of previous outbreaks, in the above-mentioned areas, persist in the soil and can be present for many years to come. Outside of this endemic areas, localized to extensive epidemics or outbreaks of Anthrax occur in the KNP ecosystem (Bengis *et al.*, 2003). An intricate ecological pattern, with anthrax as an integral part of it, has also been identified in the Kruger National Park which suggests that a dynamic host / pathogen relationship could have taken place over a long evolutionary period. Hence, anthrax can be considered to be part of a population regulatory mechanism for free-ranging wildlife, as is the situation in the KNP (De Vos, V., & Turnbull, P.C.B. 2004).

Anthrax outbreaks have been documented in wildlife populations in KNP at almost regular intervals since the 1950s. Anthrax outbreaks seem to follow the rain pattern within the park with outbreaks during dry cycles or dry seasons, resulting in numerous deaths of a number of wildlife species with kudu being the most common (De Vos, V., & Turnbull, P.C.B. 2004). Although a vaccine for anthrax is available, the use thereof, within natural free-ranging wildlife is not an easy workable option because of the logistical limitations on administering the vaccine in wildlife.

Without vaccinations, all susceptible wildlife will be at risk during an anthrax outbreak which might lead to thousands of dead animals. Proper surveillance of the park will ensure early detection of a new outbreak and the measures being implemented to minimize their effects on the wildlife population.

2.5.3. Bovine Tuberculosis

Bovine Tuberculosis, an alien bacterial disease, entered the KNP in the late 1950s through contact between buffalo and cattle on the southern boundary of the KNP. BTB is now slowly spreading north in the KNP at about 5 km per year with the long-term effects of Bovine Tuberculosis on animal populations difficult to predict (Bengis *et al.*, 2003). Bovine tuberculosis, caused by *Mycobacterium bovis*, is another foreign (exotic) and zoonotic animal disease introduced into the African buffalo population of the KNP and has now become endemic in the buffalo population of the KNP with spill-over of infection to other popular species, such as kudu, baboon, lion, leopard and bushbuck (De Vos, V., Bengis, R.G., Kriek, N.P.G., Michel, A., Keet, D.F., Raath, J.P., & Huchzermeyer, H.F.K.A. 2001). The long-term effects of tuberculosis on these species and the animal diversity of the park are still a debateable and, sometimes, controversial issue. Although it could be possible for some species to adapt to this foreign organism, other species would have more difficulty in adapting with disastrous long-term effects. Surveillance and research are currently the only options available, in the absence of an effective vaccine, to monitor the spread of tuberculosis within the wildlife population of KNP (De Vos *et al.*, 2001).

2.5.4. Rabies

The presence of canine distemper or rabies currently circulating in domestic or feral dogs at the interface could threaten wild carnivores, especially wild dogs, lions and bat-eared foxes in the near future (Alexander, K.A., & Appel, M.J.G. 1994; Hofmeyer, M., Bingham, J., Lane, E.P., Ide, A., & Nel, L. 2000). Numerous dogs infected with rabies have entered the northern and western part of the park over the last few years resulting in a possible infection of wild carnivores. Although rabies is an endemic disease in many areas of sub-Saharan Africa, it has never been able to establish itself in the KNP. However, regular positive cases in stray domestic dogs have been found within the KNP in the past four years, and only a single confirmed positive case was found in a jackal within the boundaries of the GKNP in 2006.

Rabies, as a zoonotic disease, poses a threat wherever it occurs. Awareness campaigns and surveillance in the KNP will not only ensure that visitors and staff members are aware of the

dangers involved with rabies but also identify possible positive cases at an early stage. Rabies is much more likely to spread rapidly through populations of social predators, such as wild dogs and lions, than in solitary predators, such as leopards. Abnormal behaviour is a more important clinical sign in wildlife than aggression: nocturnal animals could become active in daylight, and some animals could lose fear of humans and enter buildings (Swanepoel, 2004; King, A.A., Meredith, C.D., & Thomson, G.R. 1993).

2.5.5. Bovine Brucellosis

The current infection rate of Bovine Brucellosis within the African buffalo population in the KNP fluctuates between 14% and 23%. Apart from the zoonotic risk, brucellosis in wildlife might be a possible source of re-infection to domestic cattle. At the time of this study, the ecology of infection of brucellosis, especially in wildlife, is still poorly understood (Godfroid, 2004; Bengis, R.G., Kriek, N.P.J., Keet, D.F., Raath, J.P., de Vos, V., & Huchzermeyer, H.F.A.K. 1996). Although not as visible and fatal as anthrax or tuberculosis, the long-term effect of this disease on buffalo and other susceptible species could also be underestimated. As humans could be infected by brucellosis, the risk of infection through handling of infected wildlife carcasses could be minimized through awareness and surveillance programs.

2.5.6. Movement of animals

The presence of serious or “trade sensitive” livestock diseases maintained by wildlife remains a significant barrier to adjoining agricultural development. The boundary fences of the park require more intensive and regular monitoring because cattle, goats, dogs, and other species could cross these borders especially during the dry seasons. Communal farming enterprises alongside the fence are at risk from wildlife inside the park and *vice versa*, especially in places where the fence is broken, damaged or partly stolen, resulting in close contact between wildlife and domestic animals (Bengis *et al.,* 2004; de Vos *et al.,* 2001*).*

These uncontrolled movements of animals could result in traditional livestock diseases, for example tuberculosis, brucellosis and rabies entering wildlife, or indigenous wildlife infections, such as foot and mouth disease and theileriosis crossing over into livestock (Bengis *et al.,* 2003).

2.5.7. Hunting, culling and capture operations

Hunting, culling and capture operations in the private reserves should be utilised for monitoring purposes and to obtain specimens from wildlife.

2.5.8. Formation of the Trans-frontier Park

The newly formed Limpopo National Park in Mozambique and part of the Trans-frontier Park forms part of the eastern border of the KNP and sections of the fence have already been removed. This new Trans-frontier Park makes conservation and ecological sense, but from an animal health point of view, it would pose many challenges, particularly in the fields of disease surveillance and monitoring programmes, and disease management. The removal of fences poses a possible threat for existing and new or emerging diseases to enter the Kruger Park's animal population from these communal/ wildlife-farming areas in Mozambique. Surveillance and monitoring programmes and the collection of information for this area would need to be improved, upgraded and made more intensive (Bengis *et al.*, 2004).

2.6. CONSERVATION STAFF EMPLOYED IN THE PARK

At the time of this research, the Kruger National Park was divided into 22 ranger sections and 4 regional ranger sections as per figure 2.6.

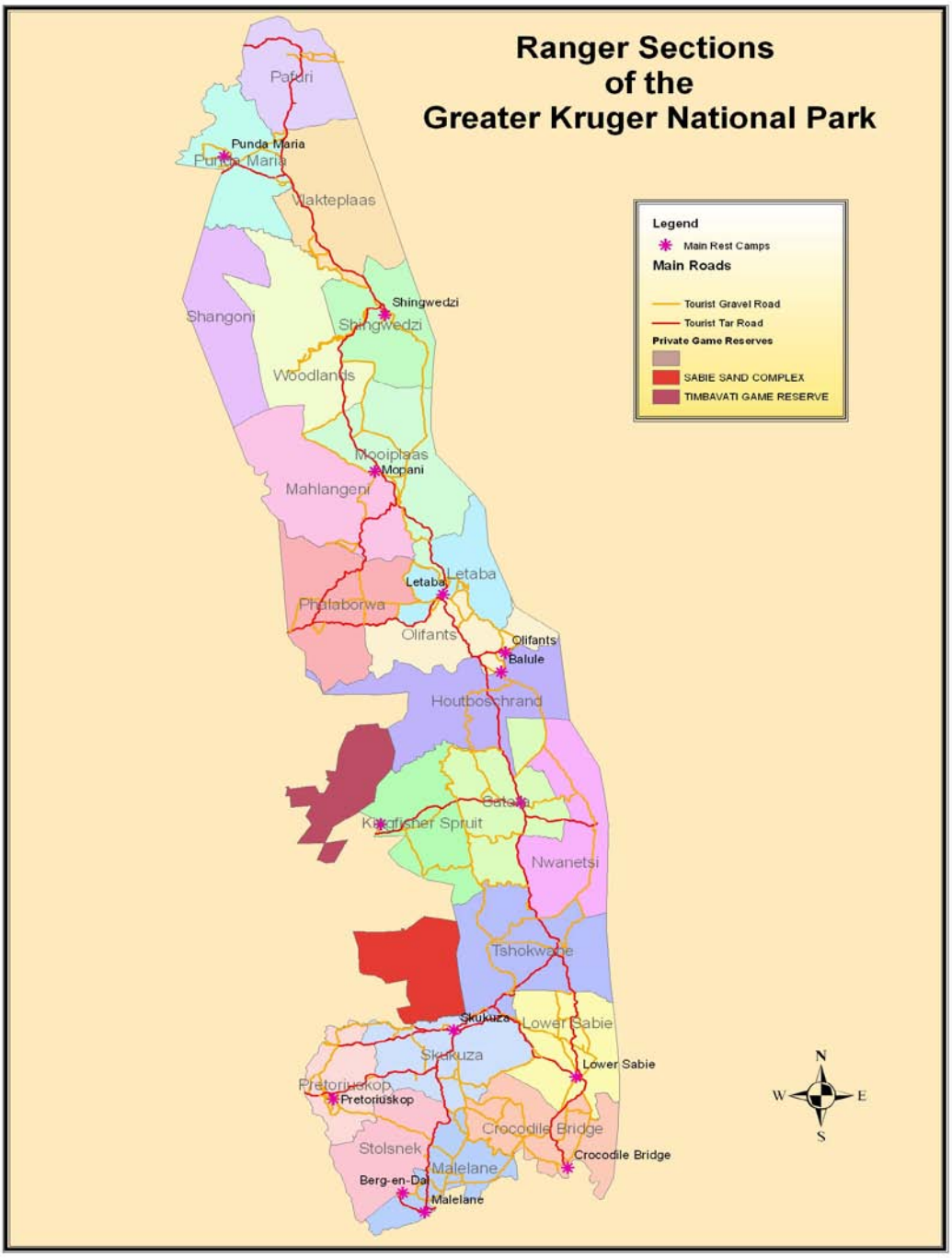


Figure 2.6: The 22 rangers sections of the Kruger National Park.
Map Produced by Mr. S v Dyk (Chief Animal Health Technician KNP).

The 22 sections were each managed by a section ranger assisted by between 8 to 15 field rangers and nature conservation students. The staff component could fluctuate between sections depending

on the size and locality as well as importance of the section. The administration or management offices of the different sections were mostly situated next to the main rest camps.

2.6.1 Section Rangers

The section rangers mostly had obtained the National Diploma in Nature Conservation with some having other related qualifications, such as a Field Guide diploma.

2.6.1.1 Job Description.

Management of a section in the Kruger National Park aimed at protecting the territorial integrity of the section in accordance with the National Parks Act, Kruger National Park Management plan, policies, principles and guidelines in place within the South African National Parks (SANParks) organization. Such management involved the planning and execution of a wide range of duties in different fields of conservation and associated functions as well as the management of the staff on the section. Duties included capturing and distributing data related to grass species, trees, animal species rainfall temperatures and dams in their sections.

The section rangers' tasks comprised mostly the application of law and order and discipline which coincided with the SANParks nature conservation policies regarding the management plan. They were responsible for the implementation of veldt burning and water provision policies as well as maintenance of respective installations. The section rangers would oversee all operations on their sections where animals were culled, caught or transferred while also monitoring the disease status by collecting and the analysis of carcasses and samples (SANParks, 2002).

A low degree of supervision existed because many section rangers were stationed at remote locations on their own. One of the requirements for section rangers was that they had to be able to act independently and make decisions.
Section rangers should be prepared and were on duty 24 hours a day. They had to act immediately in emergency and crisis situations regardless the time of the day. They worked under dangerous conditions on a daily basis.

2.6.1.2 Requirements for a section ranger:

Section rangers had to have at least a National Diploma in Nature Conservation or a higher relevant qualification as well as knowledge of the National Parks and Criminal Procedures Act and be registered as a peace officer. A sound knowledge of the disciplinary Code and Procedures was

required (SANParks, 2002). The section rangers had to be well equipped with soft skills, such as communication skills, interpersonal relationships, conflict management and self-image together with hard skills, such as the ability to use wide range of fire arms, be technically skilled as well as have business, computer and financial management skills.

2.6.2. Field Rangers

The field rangers did not need any formal post-school qualification but had to do in-service training and practical courses in different aspects of their job description. Practical courses included firearm drills and skills, anti-poaching training, identification of plants and trees, basic bush skills and basic wildlife disease training (SANParks, 2003).

2.6.2.1 Job description

These rangers had to support and assist the Section Rangers in protecting the integrity of the area in accordance with current legislation, Kruger National Park Management Plan, rules and guidelines through patrolling the section, gathering information, applying law and order and assisting with repairs to structures.

Major task headings:

Field rangers had to plan and undertake routine patrols by foot, bicycle or vehicle to gather information and report back on a daily basis. They took part in anti-poaching operations; participate in the extinguishing of all accidental fires and the burning of fire breaks and blocks. Field rangers frequently participated in game capture operations as well as in disease surveillance and monitoring and had to take blood smears of all carcasses encountered during patrols. They furthermore gathered information on all animal health-related aspects within their section.

The section rangers were the first line of supervision for the field rangers and supervised the field rangers' daily activities of routine inspections and any related training programmes. The field rangers, in turn, also had a hierarchical structure, with the more experienced field rangers having higher ranks (corporal / sergeant).

2.6.2.2 Requirements necessary for the job:

The field rangers had to have a minimum Grade 10 qualification with knowledge of South African National Parks legislation, Code of Conduct as well as Rules and Regulations (SANParks, 2003).

2.6.3. Field Guides

Several private concession lodges were operated within predefined areas in the KNP, and they employed their own field guides for tourist game drives or walks within the allocated area. Their responsibilities involved pick-ups, transfers, meeting and greeting guests, morning, afternoon and full-day safaris in the KNP as well as guided walks on the concession. These field guides either qualified with a National Diploma in Nature Conservation or obtained a Field Guide Association of South Africa (FGASA) qualification which allowed them to operate as field guides (Field Guide Association of South Africa, 2007).

2.6.4. Tour Operators

Private companies, using open safari vehicles for game drives, would enter the park on a daily basis with tourists. These tour operators or guides mostly obtained a FGASA qualification which enabled them to operate in this field (Field Guide Association of South Africa, 2008).

2.6.5. Trails Rangers

Within Kruger National Park, small camps, which made provision for a maximum of eight people, were managed by trails rangers. These trails rangers usually possessed a National Diploma in Nature Conservation and were responsible for entertaining guests on daily walks within their allocated area.

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CHAPTER 3

METHODS AND MATERIAL

3.1 INTRODUCTION

For the purpose of this study, data collection was conducted by means of a questionnaire drawn up according to the related critical points as described in the Dufour grid (Dufour, 1998). This specific method, which was modified to fit the needs and circumstances that existed in the study area, consisted of critical related points for the section rangers group combined into a grid and accumulated to a global score. The importance of critical points in relation to this study area was first used to determine the weight allocated to each critical point where after a further breakdown within each category was done.

The field rangers, together with the field guides and trail rangers, were evaluated according to a standard scoring system whereby each correct and or positive answer counted only one point. The total score for each ranger's section or group was calculated according to the following formula to obtain an average score per ranger's section or group.

(Number of correct answers x 100) * (Number of participants per section).

3.2 QUESTIONNAIRE

A questionnaire to collect the information required for the evaluation was developed by the researcher. The questionnaire included the main objectives of surveillance as stipulated in the grid and related to the study site of the Greater Kruger National Park. The questionnaire consisted of three different sections each related to a specific occupational class within the study area...

3.2.1. Section A: Field Rangers.

This section related specifically to the field rangers, the group responsible for patrolling the different sections within the park with the following important aspects included in their questionnaire on pages 4 – 10.

3.2.1.1. General information related to responsibility, qualifications, locality and veterinary experience.

The aim of this set of questions was to establish the level of qualifications of field rangers within the sections and to establish if any previous veterinary or veterinary-related experience existed. It was important to ascertain the field rangers' perspective of what they saw as their first responsibilities and if any veterinary-related work was included. Any veterinary-related experience could be of an advantage to the surveillance programme of the section or the park as a whole.

3.2.1.2. Training related issues – intervals and duration of sessions.

These questions aimed to establish if the field rangers had attended any veterinary or animal health-related workshops, practical demonstrations, practical training sessions or refreshment courses during their time working as field rangers. Through these questions one could establish:

- whether any annual training programme, relevant or not existed,
- the person responsible for the programme, and
- which topics were included in the training programme that could be of an advantage to a surveillance programme within the park The intervals and duration of the current training programme would give an indication of any shortfalls or not within the programme.

3.2.1.3. Communication – line and language of communications.

The aim was to establish the line of communication from ground level through to the veterinary office, and where possible, the main language of communication between field rangers and supervisors.

3.2.1.4. Disease reporting.

Reports sent in by field rangers were most important to ensure proper disease surveillance. The number of reports per annum could indicate awareness and/or knowledge of the field rangers and the level of knowledge in the rangers' sections. The report intervals for each of the five diseases included in this study as well as the risk they posed were important to humans, the economy, livestock and wildlife. Field rangers had to be able to differentiate between the different diseases and acknowledge the impact any of the diseases could have on the economy, humans or other animals.

3.2.1.5. Zoonotic aspects and knowledge regarding zoonotic diseases.

The aim of this specific question was to establish the ability of field rangers to differentiate between a zoonotic disease and diseases without a human risk as well as their ability to identify the different safety precautions when working with zoonotic diseases.

3.2.1.6. Surveillance objectives during routine field inspections or patrols.

This section was to establish the importance of wildlife disease surveillance as a component of daily field inspections for field rangers. It was important that field rangers were trained to locate a carcass or infected animal and be able to recognize and differentiate between abnormalities and conditions. The field rangers had to be able to recognize important vectors responsible for infections in wildlife and the different important steps to follow during the discovery of a carcass, infected or sick animal.

The ability of field rangers to collect and process the correct samples when locating a carcass and if they possessed the correct equipment that would enable them to perform mentioned animal health duties had to be established.

QUESTIONNAIRE: Wildlife Disease Surveillance

SECTION A: Field Rangers

Wildlife Disease Surveillance System.

Section A

1. General – Experience.

What is your work Title?

i) What is your highest Qualification?

Describe your responsibilities and primary objectives. (In not more than 30 words)

Where are you located?

Park	
Reserve	
Region	
Area	
Section	

ii.) Do you have any veterinary related background/experience? Y/N

If yes, please supply more details.

2. Training.

a.) Do you have an annual training program? Y/N

b.) Do you undergo any veterinary related training? Y/N

c.) Please specify the intervals between training sessions:

1-3 months		6-9 months		1-2 years	
3-6 months		9-12 months		2 years +	

d.) What is the average duration of training sessions?

0 -30 minutes		30 -60 minutes		60 minutes +	

e.) Who is responsible for the advanced training within your section?

Supervisor		Nature conservation personnel		Veterinary services personnel	

f.) Which of the following topics are included in the training?

Law Enforcement		Veterinary Public Health/Zoonoses	
Fire Management		Animal Diseases	
Veld condition monitoring		Surveillance and Sampling	
Problem animal control			

g.) Do you attend veterinary/animal health related?

Workshops	Yes	No	Practical training sessions	Yes	No
Practical demonstrations	Yes	No	Refreshment courses	Yes	No

3. Communications.

a.) Indicate your direct line of communications after discovering of an infected animal or suspicious carcass. Priorities 1-3. (1 = First and 3 = Last)

Supervisor	
Veterinary Wildlife Services	
SV Veterinary Services (Skukuza)	

b.) Indicate your language of communication between yourself and your Supervisor.

English		Venda		Any Other	
Shangaan		Sotho			
Zulu		Afrikaans			

4. Disease Reporting.

a.) How often do you send-in reports or specimens regarding the following diseases?

Foot-and-Mouth	More than 6 reports per year		Brucellosis	More than 6 reports per year	
	Less than 6 reports per year			Less than 6 reports per year	
	Not regular			Not regular	
	Don't know			Don't know	
Anthrax	More than 6 reports per year		Rabies	More than 6 reports per year	
	Less than 6 reports per year			Less than 6 reports per year	
	Not regular			Not regular	
	Don't know			Don't know	
Bovine Tuberculosis	More than 6 reports per year				
	Less than 6 reports per year.				
	Not regular				
	Don't know				

b.) Who will be at risk if we don't control or eradicate the following diseases?

Foot and Mouth	Economy		Humans		Livestock		Wildlife	
Anthrax	Economy		Humans		Livestock		Wildlife	
Bovine Tuberculosis	Economy		Humans		Livestock		Wildlife	
Brucellosis	Economy		Humans		Livestock		Wildlife	
Rabies	Economy		Human		Livestock		Wildlife	

5. Zoonoses.

a.) Are you aware that humans can be infected with certain diseases when handling infected animal carcasses? Such diseases are called zoonoses. Y/N

b.) Which of the following diseases would you classify as zoonotic?

Bovine Tuberculosis	Yes	No	Rabies	Yes	No
Anthrax	Yes	No	Foot and Mouth	Yes	No
Brucellosis	Yes	No			

c.) Do you take the necessary safety precautions to protect yourself against any possible infections when handling a suspected infected carcass? Y/N

d.) Which safety precautions do you know?

Not to open a suspected carcass	Yes	No
Wearing protective clothing	Yes	No

e.) Which protective clothing is part of your usual equipment?

Protective gloves	
Protective uniform	
Masks	

6. Surveillance.

a.) What are your primary objectives during routine inspections/patrols?
Please indicate from most important (5) to less important (1).

Illegal immigrants		Veld management	
Surveillance for clinically suspect animals		Problem animal control	
Fire control		Surveillance for infected carcasses	

b.) During field inspections and surveillance for clinically suspected cases, what are the most important aspects/signs/conditions, which will enable you to identify a suspicious infected animal or carcass?

	FMD	TB	Anthrax	Brucellosis	Rabies
Vulture activities					
Limping Impalas					
Emaciated predators or buffalo					
Buffalo with swollen knees					
Kudu with mumps					
Aggressive animals					

c.) Surveillance of susceptible wildlife populations requires proper awareness regarding the various visible abnormal conditions or situations within a population.
Will you be able to recognize these abnormal conditions or situations under the following headings; Conditions, Behavior and Social structures?

Conditions	Skin	
	Body	
	Lesions	
	Swellings	
	Movement	
Behavior	Aggressiveness	
	Tameness	
Social - Behavior		

d.) Surveillance of vectors (carriers of different diseases) in a wildlife population does need a certain level of competency, awareness and skills.
The following animals or insects are carriers of certain diseases, thus indirect vectors.
Which disease will you associate with which vector specie?

Diseases		**Vector**	
1. Swine Fever		Warthogs	
2. Anthrax		Vultures	
3.Rabies		Jackals	
4.Foot and Mouth		Buffalo	
5.Corridor		Blue Wildebeest	
6.Snotsiekte		Tsetse fly	
7.Nagana		Midges	
8.African Horse Sickness			

e.) To enable a person to do a field diagnosis an elementary screening process is needed beforehand.
Certain steps need to be followed to ensure a correct field diagnosis.
Are you able to follow these elementary steps?

Animal	Number of animals visually affected	
	Number of dead animals	
	Age of animals affected	
	Condition of animals affected	
	Behavior of live animal/s	
	Species involved	
Environment	Presence of predators	
	Time of the year (season)	
	Condition of field	
	Nearest water resource	
Lesions	Any visible lesions	
Precautions	Fluids from the body	

f.) Sampling can only take place after the screening process has been completed.
Certain procedures must be followed to ensure the safety of the worker involved and to ensure that the correct specimen (samples) are collected.
Are you aware of the following safety precautions and procedures?

Not to open a suspected Anthrax carcass		Don't utilize any meat from the carcass	
Always make use of protective clothing		Handle all samples in the correct manner	

g.) The collection, preservation and delivery of specimen will determine the quality of the results from these different samples collected.
Field workers need to be trained to collect the correct samples according to the field diagnosis made, to preserve the samples correctly and to ensure that the samples reach their destination in a good condition.
Are you capable of doing the following?

Preparing a blood smear		Opening a carcass for further investigation	
Taking a blood sample		Keeping specimen at low temperature to preserve them	
Collecting a skin sample			

h.) Do you have knowledge regarding the correct samples to test for which diseases? Y/N

i.) Can you differentiate between normal and abnormal tissue? Y/N

j.) Do you have the necessary equipment to perform the above mentioned duties? Y/N

k.) Are you able to fill a data form for specimens collected? Y/N

Table3.1: Field Rangers evaluation grid as per section.

	% Section		% Section
1. Experience.		ii. Wearing protective clothing	
a. Qualification		e. Protective clothing	
b. Vet related experience		i. Protective gloves	
2. Training.		ii. Protective uniform	
a. Annual training program		iii. Masks	
b. Vet related training		**6. Surveillance.**	
c. Intervals		a. Primary objectives	
d. Duration		i. Clinically suspect animals	
e. Responsible person		ii. Infected carcasses	
f. Topics included		b. Aspects, signs, conditions	
i. VPH/Zoonoses		i. Vulture activities	
ii. Animal diseases		ii. Limping Impalas	
iii. Surveillance and sampling		iii. Emaciated predators/buffalo	
g. Veterinary/Animal Health related		iv. Buffalo with swollen knees	
i. Workshops		v. Kudu with mumps	
ii. Practical demonstrations		vi. Aggressive animals	
iii. Practical training sessions		c. Recognition of abnormal conditions	
iv. Refreshment courses		i. Skin	
3. Communications.		ii. Body	
a. Line of communications		iii. Lesions	
i. Supervisor		iv. Swellings	
ii. Veterinary Wildlife Services		v. Movement	
iii. State Veterinary Services		vi. Aggressiveness	
b. Language of communications		vii. Tameness	
4. Disease reporting.		viii. Social behavior	
a. Report intervals		d. Disease vectors	
i. Foot and Mouth		8 mentioned diseases	
ii. Anthrax		e. Steps to do a field diagnosis	
iii. Bovine Tuberculosis		12 different steps	
iv. Brucellosis		f. Sampling – safety precautions	
v. Rabies		i. Not to open the carcass	
b. Risk if not controlled		ii. Protective clothing	
i. Foot and Mouth		iii. Not to utilize the meat	
ii. Anthrax		iv. Correct handling of the samples	
iii. Bovine Tuberculosis		g. Capabilities for correct sampling	
iv. Brucellosis		i. Preparing a blood smear	
5. Zoonoses.		ii. Taking a blood sample	
a. Aware of zoonoses		iii. Collecting a skin sample	
b. Zoonotic diseases		iv. Opening of a carcass – further investigation	
c. Safety precautions		v. Preservation of specimen	
d. Which safety precautions		h. Knowledge regarding the correct samples	
i. Not to open a carcass		i. Differentiate between normal and abnormal	
		j. Necessary equipment	
		k. Able to fill a data form	

3.3. Section B: Section Rangers

Section B dealt with the Section Rangers as the first line of direct supervision to the field rangers, and therefore, more questions regarding management, skills and responsibilities were included.

The questionnaire (pages 15 – 24) for Rangers consisted of two parts:

The first part of this section comprised the general section consisting of different questions related to financial, human resources, training and disease aspects. This information would not form part of the evaluation process for wildlife disease surveillance and would only be for information.

The second part comprised the critical points section which would be used to do the scoring of each section according to the defined Dufour grid for this section.

3.3.1 Part 1

3.3.1.1. Responsibilities.

Responsibilities of the rangers and location were covered in this section of questions.

3.3.1.2. Human Resources.

This group of questions involved human resources, their availability and the existence of an annual training programme as well as veterinary-related experience.

The aim was to establish the mobility of staff as well as availability of transport and accessibility of sections during different seasons and to establish the availability of funding for veterinary-related work.

The researcher had to find out whether the rangers had an awareness and knowledge regarding legislation pertaining to movement control of animals and animal products in the park.

A further aim was to establish the different ways of communications between the section rangers and field rangers as well as between the section rangers and their supervisors and between section rangers and the veterinary office and field staff.

3.3.1.3. Diseases.

The aim was to establish the knowledge of the different diseases within the rangers section, annual disease reports and the seasonal influence on these diseases as well as control procedures during an outbreak with the risk factors involved.

3.3.1.4. Veterinary Public Health.

The aim was to determine the veterinary public health aspects that could have an important influence on people handling an infected or dead animal.

3.3.2 Part 2

Critical Points

3.3.2.1. Objectives.

What were the main objectives of the section rangers' field staff during their day-to-day field inspections?

3.3.2.2. Surveillance.

Rangers had to be able to recognize important aspects and signs during surveillance as well as know what steps to follow during an outbreak.

They had to rate their field rangers' accuracy and precision towards surveillance and awareness during routine field patrols or inspections as well as the awareness training and co-ordination thereof.

Rangers had to rate the field rangers' ability to recognize abnormalities or conditions as well the associated vectors within the wildlife populations together with the ability of field rangers to recognize certain disease conditions and the safety precautions related to that.

3.3.2.3. Awareness.

The rangers had to be able to evaluate their field rangers' awareness during routine inspections while scoring them regarding ongoing awareness training for the field rangers. The existence of a properly co-ordinated surveillance or daily inspection programme had to be evaluated.

3.3.2.4. Conditions.

Section rangers had to have the ability to recognize certain important diseases caused by abnormalities and conditions as well as social behavior abnormalities in wildlife together with the ability to recognize certain vectors.

3.3.2.5. Techniques.

There was a need to determine the awareness of the field rangers towards safety precautions and possible infection from infected carcasses.

3.3.2.6. Data.

The ability of the field rangers to collect the correct samples and fill a data form for that specific disease as well knowledge regarding normal and abnormal tissue had to be established. Did the staff possess the correct equipment to collect the correct samples, and did they know the correct way in which to report a possible infected carcass or sick animal?

QUESTIONNAIRE: Wildlife Disease Surveillance
Section B: Section Rangers

1. Responsible person:

a.) Job Title of primary responsible person:
b.) Qualifications of primary responsible person:
c.) Describe your responsibilities and primary objectives (In not more than 30 words)
d.) Where are you located?

Park	
Reserve	
Region	
Area	
Section	

e.) Do you have any veterinary related background/experience? Y/N
If yes, please supply more details.

2. General Information:
i.) Human Resources:
a.) What is the total number of people in your section doing surveillance/inspections/patrols on a regular basis?
b.) Specify the qualification level of the above mentioned people:

Grade 6-8		M+2 (Certificate)	
Grade 8-12		M+3 (Diploma)	
M+1 (Certificate)			

c.) Do you have an annual training program for field staff? Y/N
d.) Do your field staff undergo regular advanced training? Y/N
e.) Please specify the intervals between training sessions:

1-3 months		9-12 months		6-9 months		2 years +	
3-6 months		1-2 years		6-9 months		2 years +	

f.) What is the average duration of training sessions?

0 -30 minutes		30 -60 minutes		60 minutes +	

g.) Who is responsible for the advanced training within your section?

Supervisor (Yourself)		Nature conservation personnel		Veterinary services personnel	

h.) Which of the following topics are included in the training?

Law Enforcement		Veterinary Public Health/Zoonoses	
Fire Management		Animal Diseases	
Veld condition monitoring		Surveillance methods and Sampling	
Problem animal control			

i.) How would you rate the above-mentioned training sessions regarding their inputs towards advanced training?

1= far less than required
2= less than required
3= adequate
4= better than required
5= exceeds requirements

j.) Do your field staff attend veterinary/animal health related?

Workshops	Yes	No	Practical training sessions	Yes	No
Practical demonstrations	Yes	No	Refreshment courses	Yes	No

k.) If yes, how often?

Every 1-3 Months		Once a year	
Every 6 Months		Not on a regular basis	

l.) Please estimate, on a scale from 1 to 5. (1= poor and 5=excellent)
Field staff's awareness to detect and report sick or injured animals.

1.	Ability to recognize a sick animal		3.	Competency to recognize a specific disease	
2.	Ability to do sampling of a dead animal		4.	Knowledge on zoonotic diseases	

ii.) Mobility.

a.) Indicate your most common means of transport during routine surveillance or patrol operations.

On foot		Motorcycle	
Bicycle		Vehicle	

b.) What percentage of roads in your section is?

Gravel		Tar		Fire breaks	

c.) Please indicate the accessibility of your area for surveillance purposes via the road network in your area:

	Apr - Sept	Oct - Mrt
Access less than 20%		
Access 20 – 40 %		
Access 40 – 80%		
Access more than 80%		

d.) Indicate the conditions of the road network in your area, on a scale of 1 to 5. (1 = Very poor and 5 = Excellent.)

iii.) Financial Resources.

a.) Do you experience budget restrictions on a regular basis? Y/N

b.) Is cost effective transport readily available for surveillance? Y/N

c.) Do you have revolving emergency funds for disease outbreaks? Y/N

iv.) Legislation

a.) Are you aware of the legislation pertaining to animal diseases? (Act 35 of 84) Y/N

b.) Are you aware of the notifiable diseases that have to be reported to the nearest state veterinarian? Y/N

c.) Are you aware that your section/area must comply with the mentioned animal disease act with regard to movement control permits? Y/N

d.) In what form may products of cloven hoofed animals be removed from the park?

Raw meat		Canned		Cooked		Processed hides	
Biltong		Raw hides		Cooked		Processed hides	

e.) Is it legal to move an undressed carcass of a cloven hoofed animal out of the park? Y/N

v.) Communications.

a.) Please indicate the different means of communication between yourself and the surveillance/patrol staff:

Standard telephone		Two way radio		e-mail	
Mobile cellular phone		fax		verbal	

b.) Please indicate the different means of communication between yourself and your supervisor:

Standard telephone		Two way radio		e-mail	
Mobile cellular phone		fax		verbal	

c.) Please indicate your communication intervals with your field staff:

Daily		Weekly		Monthly	

d.) Please indicate your communication intervals with your supervisor:

Daily		Weekly		Monthly	

e.) Indicate your direct line of communications after discovering of an infected or suspicious carcass: Priorities 1-3 (1= first -3= last)

Supervisor		Veterinary Wildlife Services		SV Veterinary Services Skukuza	

f.) How often do you communicate with veterinary services?

Weekly		Only in case of emergencies		Never	
Monthly		When necessary			

g.) Do you receive written reports concerning possible animal diseases from your field staff? Y/N

h.) Do you receive feedback after submission of samples to the veterinary section? Y/N

i.) How often do you interact with the Animal Health Technician Doing? (disease surveillance in your Section/area.)

During every visit		Never	
Not on a regular basis		Not aware of the visits	

j.) Indicate, on a scale of 1 – 5, how you rate the interaction between yourself and the veterinary section. (1 = very poor and 5 = excellent)

3. Disease Status.

a.) Presently, which of the following diseases are you aware of in your section?

Foot and Mouth Disease	Not Sure	Yes	No	Brucellosis	Not Sure	Yes	No
Anthrax	Not Sure	Yes	No	Rabies	Not Sure	Yes	No
Bovine Tuberculosis	Not Sure	Yes	No				

b.) How often do you get reports from your field staff regarding the following diseases?

Foot and Mouth Disease	More than 6 reports per year		Brucellosis	More than 6 reports per year	
	Less than 6 reports per year			Less than 6 reports per year	
	Not regular			Not regular	
	Don't know			Don't know	
Anthrax	More than 6 reports per year		Rabies	More than 6 reports per year	
	Less than 6 reports per year			Less than 6 reports per year	
	Not regular			Not regular	
	Don't know			Don't know	
Bovine Tuberculosis	More than 6 reports per year				
	Less than 6 reports per year				
	Not regular				
	Don't know				

c.) Do any of the following diseases have a seasonal occurrence in your section?

			Time of Year	
Foot and Mouth Disease	Yes	No	Dry	Wet
Anthrax	Yes	No	Dry	Wet
Bovine Tuberculosis	Yes	No	Dry	Wet
Brucellosis	Yes	No	Dry	Wet
Rabies	Yes	No	Dry	Wet

d.) Are you made aware of any new emerging diseases? Y/N

If answer is yes in previous question, please give details.

e.) Are you aware of the control procedures of the following diseases?

Foot and Mouth	Yes	No	Not Sure	Brucellosis	Yes	No	Not Sure
Anthrax	Yes	No	Not Sure	Rabies	Yes	No	Not sure
Bovine Tuberculosis	Yes	No	Not Sure	Brucellosis	Yes	No	Not Sure

f.) Who will be at risk if we don't control or eradicate the following diseases?

Foot and Mouth	Economy		Humans		Livestock		Wildlife	
Anthrax	Economy		Humans		Livestock		Wildlife	
Bovine Tuberculosis	Economy		Humans		Livestock		Wildlife	
Brucellosis	Economy		Humans		Livestock		Wildlife	
Rabies	Economy		Humans		Livestock		Wildlife	

4. Veterinary Public Health.

a.) Are you aware that humans can be infected when handling infected animal carcasses? Y/N
b.) Which of the following diseases would you classify as zoonotic?

Bovine Tuberculosis	Yes	No	Rabies	Yes	No
Anthrax	Yes	No	Foot and Mouth	Yes	No
Brucellosis	Yes	No			

c.) Does your field staff take the necessary safety precautions to protect themselves against any possible infections when handling a suspected infected carcass? Y/N

Part 2.

Critical Points.

1. Objectives (Aim).
a.) What are the primary objectives of your field staff during routine inspections? Please indicate from most important (5) to less important (1).

Tourist violations		Fire control	
Water Management		Surveillance for sick or infected animals or carcasses	
Law Enforcement		Problem animal control	

2. Surveillance.
a.) During field inspections and surveillance for clinically suspected cases, what are the most important aspects/signs/conditions, which will enable you to locate a suspicious infected animal or carcass?

	FMD	TB	Anthrax	Brucellosis	Rabies
Vulture activities					
Limping Impalas					
Emaciated Predators					
Emaciated Buffalo					
Kudu with mumps					
Aggressive animals					

b.) The regulations covering notifiable disease prescribe which important steps to be followed during the discovery of notifiable diseases. Which of the following steps would be the most important according to your knowledge?

Sampling of the infected carcass		
Reporting to the SV office		
Blood smear before sampling		

c.) The proportion of cases declared during an outbreak as well as during day-to-day field inspections is very important, it is therefore also important that this is done accurately and with precision. How would you rate your staff's ability in this regard? On a scale of 1-5 with (1 = poor and 5 = excellent) Describe accuracy and precision.

Accuracy		Precision	

d.) Surveillance for infected carcasses needs the ability to recognize unusual activities within the area. How would you rate your staff's ability to recognize, locate and report these suspicious infected carcasses?

On a scale of 1- 5. (1= poor and 5 = excellent)

Accuracy		Precision	

3. Awareness.

a.) *Awareness of field workers is vital in the success of any surveillance network.*
Without a high standard of awareness a high percentage of accuracy and precision of reporting will not be achieved.
On a scale of 1 to 5 (1= poor and 5 = excellent) **How would you rate your field staff's awareness?**

b.) Awareness training forms an integrated part of the field workers development.
Without proper ongoing awareness training the field worker will lack the necessary experience and ability of awareness to be able to detect infected cases.
On a scale of 1 to 5 (1= poor and 5 = excellent); **How would you rate your field staff's ongoing awareness training?**

c.) The maintenance of awareness training is the responsibility of the supervisor. As a supervisor you have to maintain a high level of awareness amongst your field staff.
On a scale of 1 to 5 (1= poor and 5 = excellent); **How would you rate yourself regarding initiative to maintain a high standard of awareness?**

d.) Awareness can be sustainable if evaluated on a regular basis. Do you evaluate?
the level of awareness of your field staff on a regular basis? Y/N

e.) The coordination of the surveillance network needs preplanning with inputs from all the participants involved. Do you coordinate the methods used by field staff? Y/N

f.) To enable field staff to do proper field patrol, enough time is necessary for each inspection period. Does your staff have enough time for each inspection period? Y/N

Please indicate the average hours/day.

Less than 4 hours		6 Hours/day	
4 Hours/day		8 Hours/day	

4. Conditions.

a.) Surveillance of susceptible wildlife populations need proper awareness regarding the different visible abnormalities or conditions within a population. Will you be able to recognize these abnormal conditions or situations under the following headings, Conditions, Behavior and Social Structures?

Conditions	Skin	
	Body	
	Lesions	
	Swellings	
	Movement	
Behavior	Aggressiveness	
	Tameness	
Social - Behavior		

b.)Surveillance of vectors (carriers of different diseases) in a wildlife population does need a certain level of competency, awareness and skills to be able to detect animals carrying these diseases towards susceptible populations. The following animals or insects are carriers of certain diseases and are thus direct or indirect vectors.

Which disease will you associate with which vector specie?

Diseases		**Vector**	**Number**	
1. Swine Fever		Warthogs		
2. Anthrax		Vultures		
3. Rabies		Jackals		
4. Foot and Mouth		Buffalo		
5. Corridor		Blue Wildebeest		
6. Snotsiekte		Tsetse fly		
7. Nagana		Midges		
8. African Horse Sickness				

5. Techniques used for field diagnosis.

(The following important information is needed for diagnosis and epidemiological studies.)

a.) To enable a person to do a field diagnosis an elementary screening process is needed beforehand. Certain information is needed to ensure a correct field diagnosis.

Is your field staff able to collect this information?

Animal	Number of animals visually affected		**Environment**	Presence of predators	
	Number of dead animals			Time of the year (season)	
	Age of animals affected			Condition of field	
	Condition of animals affected			Nearest water resource	
	Behavior of live animal/s				
	Species involved				
Lesions	Any visible lesions		**Precautions**	Fluids from the body	

b.) Sampling can only take place after the screening process has been completed. Certain procedures must be followed to ensure the safety of the worker involved and to ensure that the correct specimen (samples) are collected. **Is your field staff aware of the following safety precautions and procedures?**

Not to open a suspected Anthrax carcass		Don't utilize any meat from the carcass	
Always make use of protective clothing		Handle all samples in the correct manner	

6. **Collection and circulation of data.**

i.) Standardization of field observer's work during sampling. The collection, preservation and delivery of specimen will determine the quality of the results from these different samples collected. Field workers need to be trained to collect the correct samples according to the field diagnosis made, to preserve the samples correctly and to ensure that the samples reach their destination in a good condition.

Is your field staff capable of doing the following?

Preparing a blood smear		Opening a carcass for further investigation	
Taking a blood sample		Keeping specimen at low temperature to preserve them	
Collecting a skin sample			

Do you have knowledge regarding the correct samples to be taken to test for which diseases? Y/N
Can you differentiate between normal and abnormal tissue? Y/N
Do you have the necessary equipment to perform the above mentioned duties? Y/N
Are you able to fill a data form for specimens collected? Y/N

ii.) Quality and rapidity of data circulation.

The quality and rapidity of data received back from veterinary laboratories is very important to ensure that the correct measures are taken to prevent any further outbreaks and deaths of wildlife. It is also very important to ensure that samples are sending off to the laboratory as soon as possible with the correct information accompanying them. The correct procedure must also be followed to inform the nearest state veterinary office regarding the cases.

Do you adhere to the following steps to ensure quality data feedback?

Informing the SV Office regarding the outbreak/deaths		Follow up of results own initiative	
Quality info accompany the samples		Do you get regular feedback from SV regarding the results?	
Sending of samples or smears as soon as possible.			

Do you know which information should accompany samples that you send to the lab? Y/N

Do you know how to fill the appropriate forms? Y/N

Table 3.2: Evaluation grid for Section Rangers, as per section and according to Dufour.

Critical point	Criteria important for evaluation	Points	Weight	Max Score
1. Objectives (Aims)	Primary objectives of field staff	5	5	25
2. Surveillance				
Surveillance for clinically suspected cases	Important aspects/signs/conditions	5	12	60
Regulation covering notifiable disease	Notifiable diseases – steps to follow	2	12	24
Proportion of cases declared:				
Accuracy (if sample)	Staff's ability – cases in outbreak - accuracy	5	1	5
Precision (if sample)	Staff's ability – cases in outbreak - precision	5	1	5
Surveillance for infected carcasses:				
Accuracy	Staff's ability – infected carcasses - accuracy	5	1	5
Precision	Staff's ability – infected carcasses - precision	5	1	5
3. Awareness				
Awareness of field workers	Field staff's awareness	5	3	15
Awareness training	Field staff's ongoing awareness training	5	3	15
Maintenance of awareness	Rangers initiative maintaining high standard of awareness	5	4	20
Evaluation of level of awareness	Evaluation of awareness	3	4	12
Coordination of the network:				
Coordination methods	Co-ordination of surveillance methods of staff	3	3	9
Suitable provision of staff hours	Time for proper inspections/surveillance	3	3	9
4. Conditions.				
Surveillance of susceptible wildlife	Recognize abnormal conditions or situations	4	1	4
Surveillance of vectors	Disease and vector	8	3	24
5. Techniques.				
Screening for diagnosis in the field	Field staff able to collect info	6	3	18
Sampling	Field staff aware of the safety precautions	4	5	20
6. Data				
Standardization of field observers work	Field staff capable of doing the following actions	5	5	25
Quality and rapidity of data circulation	Knowledge regarding correct samples	5	5	25

3.4 Section C. Field Guide, Tour Guides and Trails Rangers.

The questionnaire, pages 25 – 29, specifically related to the following groups operating within the Kruger National Park:
Tour Guides, Field Guides and Trails Rangers.

3.4.1. General information.

Information related to responsibility, qualifications, locality and veterinary experience was required.

3.4.2. Communications.

The line of communications from the guides or rangers during their daily walks and/or drives was ascertained.

3.4.*3. Training.*

The aim was to establish whether an annual or regular training programme with veterinary-related matter existed as well as the intervals and duration thereof. Furthermore the researcher had to establish who was responsible for the training session and the topics included in the sessions.

3.4.4. Disease reporting.

The aim was to determine whether they reported any disease-related aspects, mortalities and conditions and their knowledge regarding the risk factors associated with specific diseases.

3.4.5. Zonooses.

The aim was to establish the awareness of the importance of zoonotic diseases and the ability to recognize specific zoonotic diseases.

3.4.6. Surveillance.

The aim was to establish whether surveillance formed part of the primary objectives during routine game drives or walks. The ability to recognize and report animals with disease-related symptoms, abnormal conditions or even abnormal behavior while being able to recognize vectors related to specific diseases had to be determined.

QUESTIONNAIRE: Wildlife Disease Surveillance

Section C: Tour Guides/Field Guides/Trails Rangers

1. Responsible person:

a.) What is your work Title?

b.) What is your highest Qualification?

c.) Describe your responsibilities and primary objectives (In not more than 30 words)

d.) Where are you located?

Park	
Reserve	
Region	
Area	
Section	

e.) Do you have any veterinary related background/experience? Y/N

If yes, please supply more details.

To establish the level of training, locality and previous veterinary experience of guides.

2. Communications.

Indicate your direct line of communications during routine tours/drives/walks with tourists.

Supervisor at Head office.		Other	
Veterinary Wildlife Services Skukuza		Nothing	
SV Veterinary Services (Skukuza)			

2. Training

a.) Do you have an annual training program? Y/N

b.) Do you undergo regular advanced veterinary related training? Y/N

c.) Please specify the intervals between training sessions:

1-3 months		6-9 months		1-2 years	
3-6 months		9-12 months		2 years +	

d.) What is the average duration of training sessions?

0 -30 minutes		30 -60 minutes		60 minutes +	

e.) Who is responsible for the advanced training within your section?

Supervisor		Nature conservation personnel		Veterinary services personnel	

f.) Which of the following topics are included in the training?

Law Enforcement		Veterinary Public Health/Zoonoses	
Fire Management		Animal Diseases	
Veld condition monitoring		Surveillance methods and Sampling	
Problem animal control			

g.) Do you attend veterinary/animal health related?

Workshops	Yes	No	Practical training sessions	Yes	No
Practical demonstrations	Yes	No	Refreshment courses	Yes	No

h.) Do you have a self-development program regarding animal diseases? Y/N

4. Disease Reporting.

b.) How often do you send-in reports or specimens regarding the following diseases?

Foot and Mouth	More than 6 reports per year		Brucellosis	More than 6 reports per year	
	Less than 6 reports per year			Less than 6 reports per year	
	Not regular			Not regular	
	Don't know			Don't know	
Anthrax	More than 6 reports per year		Rabies	More than 6 reports per year	
	Less than 6 reports per year			Less than 6 reports per year	
	Not regular			Not regular	
	Don't know			Don't know	
Bovine Tuberculosis	More than 6 reports per year				
	Less than 6 reports per year				
	Not regular				
	Don't know				

a.) *Who will be at risk if we don't control or eradicate the following diseases?*

Foot and Mouth	Economy		Humans		Livestock		Wildlife	
Anthrax	Economy		Humans		Livestock		Wildlife	
Bovine Tuberculosis	Economy		Humans		Livestock		Wildlife	
Brucellosis	Economy		Humans		Livestock		Wildlife	
Rabies	Economy		Humans		Livestock		Wildlife	

5. Zoonoses.

a.) Are you aware that humans can be infected when handling infected animal carcasses? Those diseases are called zoonoses. Y/N

b.) Which of the following diseases would you classify as zoonotic disease?

Bovine Tuberculosis	Yes	No	Rabies	Yes	No
Anthrax	Yes	No	Foot and Mouth	Yes	No
Brucellosis	Yes	No			

6. Surveillance.

a.) What are your primary objectives during routine game drives/ trails?

Inform tourists/guests regarding wildlife		Gathering info on wildlife movements	
Surveillance for suspect carcasses		Surveillance for clinically abnormal animals	

b.) During game drive/trails operations, what are the most important aspects/signs/conditions? Which will enable you to locate a sick animal or carcass?

	FMD	Tuberculosis	Anthrax	Brucella
Vulture activities				
Limping Impalas				
Emaciated Predators or Buffalos				
Buffalo with swollen knees				
Kudu with mumps				

c.) Surveillance of susceptible wildlife populations need proper awareness regarding the different visible abnormal conditions or situations within a population.
Will you be able to recognize these abnormal conditions or situations under the following headings: Conditions, Behavior and Social Structures?

Animal	Number of animals visually affected	
	Number of dead animals	
	Age of animals affected	
	Condition of animals affected	
	Behavior of live animal/s	
	Species involved	
Environment	Presence of predators	
	Time of the year (season)	
	Condition of field	
	Nearest water resource	
Lesions	Any visible lesions	
Precautions	Fluids from the body	

a.) Surveillance of vectors (carriers of different diseases) in a wildlife population does need a certain level of competency, awareness and skills to be able to detect animals carrying these diseases towards susceptible populations. The following animals or insects are carriers of certain diseases, thus indirect vectors. Which disease will you associate with which vector species?

Diseases		**Vector**	**Number**	
1. Swine Fever		Warthogs		
2. Anthrax		Vultures		
3. Rabies		Jackals		
4. Foot and Mouth		Buffalo		
5. Corridor		Blue Wildebeest		
6. Snotsiekte		Tsetse fly		
7. Nagana		Midges		
8. African Horse Sickness				

Table 3.3: Evaluation grid for Guides and Trails Rangers as per group.

	Total per Section	**Percentage per Section**
1. Communications.		
a. Veterinary Wildlife Services		
b. State Veterinary Services		
2. Training.		
a. Annual training program		
b. Vet related training		
c. Intervals		
d. Duration		
e. Responsible person		
f. Topics included		
g. Veterinary related sessions		
h. Self development program		
3. Disease reporting.		
a. Reports per annum		
b. Who is? at risk of diseases		
4. Zoonoses.		
a. Aware of zoonoses		
b. Zoonotic diseases		
5. Surveillance.		
a. Primary objectives		
b. Important aspects/signs/conditions		
c. Different visible abnormal conditions		
d. Diseases and Vectors		

3.5 Method of obtaining data

For the purpose of this study, training sessions were arranged with each section, reserve and tour-operator involved. The first stage of each training session was a brief explanation of the aim of this project and survey as well as the aim of completing a questionnaire. All attendees were presented with a questionnaire before the training session which they had to complete. People that were unable to read and/or write gained help from the assistants present which enabled them to take part in the survey.

The aim of this survey was to obtain a filled questionnaire beforehand from as many people and different occupational classes and groups present as possible.

The second stage of the session consisted of an electronic presentation on wildlife diseases and surveillance with the following aspects included in the trainings session.

- Zonooses
- Wildlife Disease Surveillance
- Foot and Mouth Disease
- Rabies
- Anthrax
- Bovine Tuberculosis
- Bovine Brucellosis
- How to make a blood smear
- Condition scoring system for wildlife.
- Reporting of possible infected cases.

Each of the above was followed by an open discussion or question slot with all questions recorded for future use and feedback.

3.6 Numbers allocated to different sections

For the purpose of this study, numbers instead of the section names were allocated to all rangers section within the Kruger National Park as well as the private reserves. The number system was implemented to ensure some privacy towards the participants in the project.

The numbers are indicated in Table 3.4.

Table 3.4: Numbers allocated to the different sections in KNP and Private Reserves.

Kruger National Park			
Section	**Number**	**Section**	**Number**
Crocodile Bridge	KR01	Olifants	KR12
Lower Sabie	KR02	Letaba	KR13
Skukuza	KR03	Phalaborwa	KR14
Malelane	KR04	Mhalangeni	KR15
Pretoriuskop	KR05	Mooiplaas	KR16
Stolznek	KR06	Shingwedzi	KR17
Tshokwane	KR07	Vlakteplaas	KR18
Satara	KR08	Woodlands	KR19
Nwanetsi	KR09	Shangoni	KR20
Kingfisher	KR10	Punda Maria	KR21
Houtboschrand	KR11	Pafuri	KR22
Private Reserves			
SabiSand	PR01		
Timbavati	PR03		

REFERENCES:

Dufour, B. 1998. Technical and economic evaluation method for use in improving infectious animal disease surveillance networks.

CHAPTER 4

RESULTS AND DISCUSSION: SECTION RANGERS AND RANGERS

4.1 INTRODUCTION.

At the time of the study, the Kruger National Park was divided into 21 sections of different sizes according to habitat and animal populations. In this chapter, the different sections of the Kruger National Park were evaluated as one entity together with the rangers of the private reserves performing predominantly the same functions as the section rangers of the KNP.

The rangers of the private reserves would play an important role in the control of diseases since a section or private reserve with a low staff capability towards surveillance could cause a disease outbreak in an important part of the park or reserve which would have a detrimental or devastating effect on the rest of the park should the disease spread.

4.1.1. Method of discussion.

The results obtained from the different section rangers within the KNP were discussed according to the critical points of the evaluation grid. These results were then compared against each section's per critical point, followed by a discussion and then a comparison as one unit of KNP. The results of the rangers from the two private reserves were discussed as one unit.

The figures presented in this chapter were the results obtained in the form of summaries.

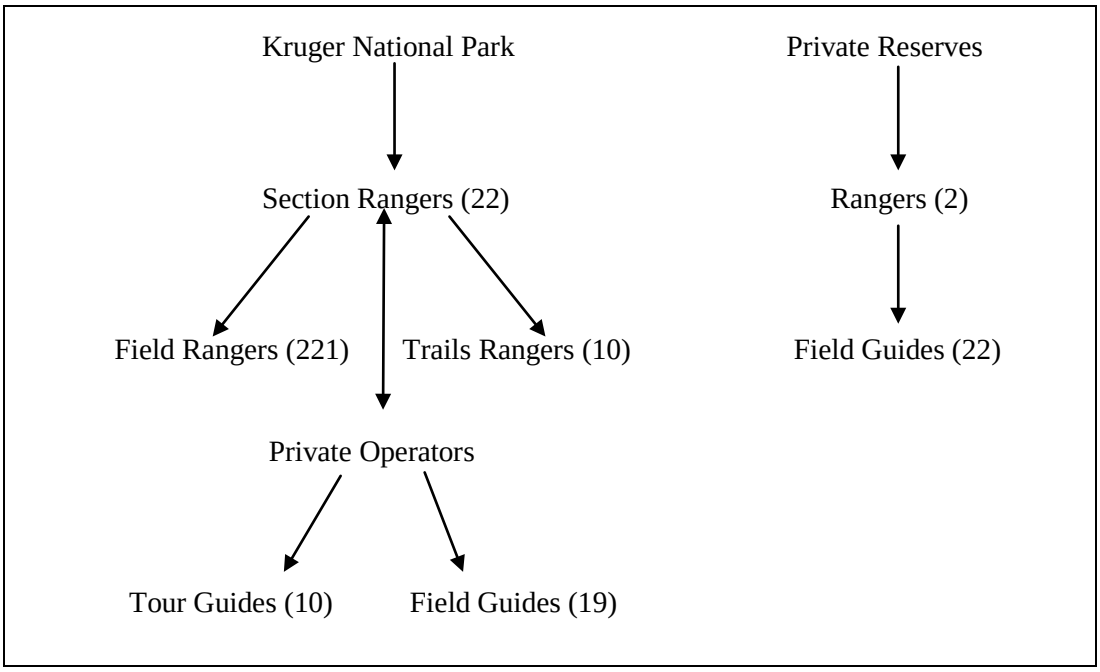
The aim was to measure the results of section rangers and rangers from private reserves, and to compare results within sections and between groups. The following percentage scoring system was used to evaluate and compare the results of the different categories:

- Above 70%: a score or an average score of above 70% was deemed as good and the person or section considered capable of working and fulfilling the tasks according to the specific job description.
- Between 50 -70%: a score or an average score of between 50 – 70% was deemed as average and the person or section would be capable of fulfilling their job description.
- Below 50%: a score or an average lower than 50% was deemed as poor and the person or section would be not capable of fulfilling tasks according to the job description.

4.1.2 Questionnaires obtained.

As indicated in Table 4.1, the following groups participated in the study with the number of possible participants listed next to them:

Table 4.1: *Relation between the groups and possible number of participants per group that participated in the study.*



The 22 section rangers of KNP were responsible for all activities within their respective section with field rangers doing daily patrols. Trail rangers within the sections reported any abnormalities to the responsible section ranger. Private operators, (field guides and tour guides)

doing daily vehicle safaris and walks within the KNP were also responsible for reporting any abnormalities to the local section ranger of the area.

The private reserves used rangers were responsible for a specific reserve and all activities related to nature conservation and wildlife management of the area. Within these reserves, field guides were responsible for tourist safaris either by means of vehicle or foot patrols and reported directly to the rangers of the reserves.

The percentage of completed questionnaires obtained varied between 63% and 100% and are indicated in Table 4.2.

Table 4.2: *Filled questionnaires obtained from all the different participating groups.*

Organization	Group	Filled	Possible	%
Kruger National Park	Section Rangers	22	22	100
	Field Rangers	221	235	94
	Trails Rangers	10	15	67
Private Concessions	Field Guides	10	14	71
Timbavati Nature Reserve	Ranger	1	1	100
	Field Guides	10	16	63
Sabi Sand Game Reserve	Ranger	1	1	100
	Field Guides	12	18	67
Private Operators	Guides	19	27	70
Total		306	349	88

The researcher was personally involved with the participants during the sessions to ensure a high percentage of involvement from the different groups participating. This initiative led to the high percentage (88%) filled questionnaires obtained during the study and could be indicative of the support for the programme from the groups.

The total number of filled questionnaires obtained from the three main groups is indicated in table 4.3.

Table 4.3: *Total number of filled questionnaires obtained per relevant group.*

Group	Number	Possible	%
Rangers/Section Rangers	24	24	100
Field Rangers	221	235	94
Guides/Field Guides/ Trails Rangers	61	90	68

According to table 4.3, all rangers from KNP (100%) as well as from the two private reserves completed the questionnaire. Ninety-four per cent of the field rangers and 68% of field guides and trails rangers working in the study area took part in the survey.

4.2. KNP SECTION RANGERS

4.2.1 Critical Points

4.2.1.1 Aims:

This question established whether disease surveillance formed an integral part of the section rangers' routine daily tasks and the importance thereof within their total work sphere. The section rangers had to allocate points to each objective, as stipulated from their job description in the question, from most important to less important. This allocation gave an indication on the importance of veterinary-related disease surveillance, according to them within their work programme.

Only surveillance for sick or infected animals or carcasses was included in this question.
The allocation of the maximum of 5 points towards the importance of veterinary-related disease surveillance was an indication of high importance thereof to them and their sections.

Results and discussion:

Only eight section rangers (36%) obtained an average score above 70% and thus rated surveillance for wildlife diseases as important as any other non veterinary task on the job description, while 11 section rangers obtained between 50 – 70% for rating surveillance important but less important than other tasks on the job description. Only three section rangers who scored below 40% rated surveillance for wildlife diseases as not important at all.

Nineteen (19) section rangers or 86% of section rangers within Kruger National Park met the job description of a section ranger by including wildlife disease surveillance for carcasses and sick animals and reporting thereof in their daily tasks with three section rangers or 14% of KNP section rangers not recognizing the importance of wildlife disease surveillance in their sections. The results are indicated in Figure 4.1.

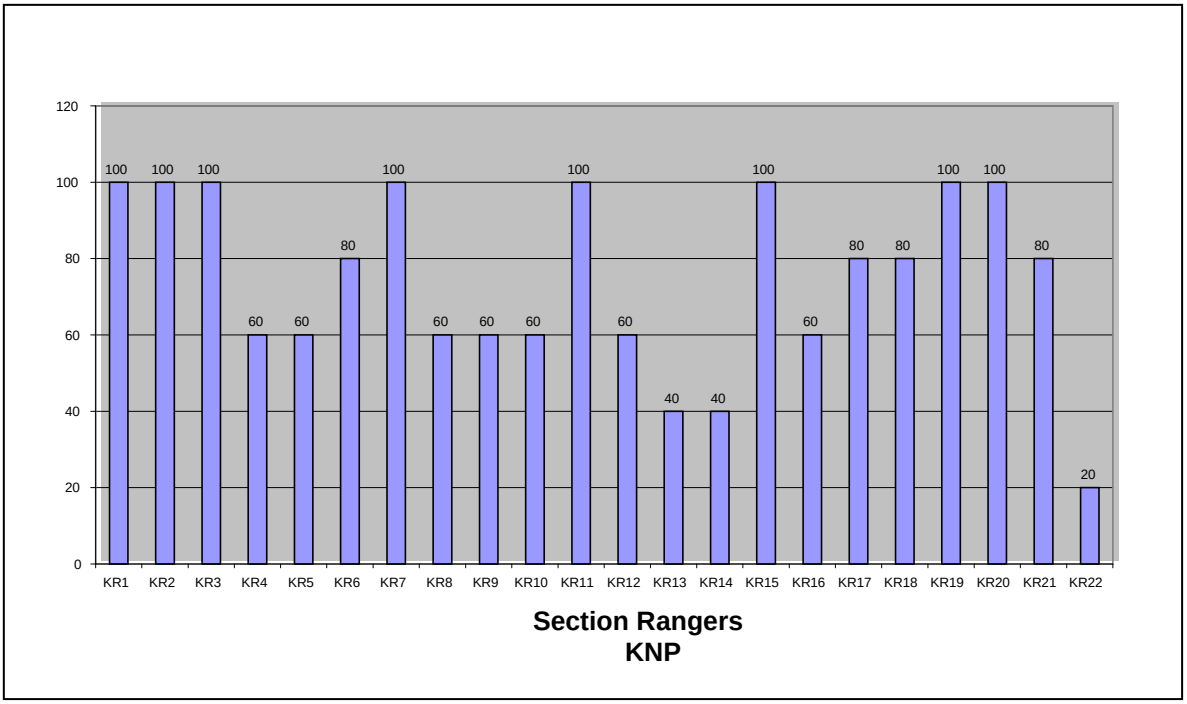


Figure 4.1: *Importance of surveillance for wildlife diseases as part of section ranger's daily tasks.*

4.2.1.2 Surveillance:

The rangers had to be able to recognize conditions and associate them with a specific disease.

An increase in vulture activities could be an indication of an Anthrax outbreak while a limping impala could be the associated with Foot and Mouth disease. One would clearly associate an emaciated predator or buffalo and a kudu with mumps-like swelling with Bovine Tuberculosis infection.

It was also important that the correct steps were followed during the process of discovering a possible infected animal or carcass and that no carcass be sampled or even opened before a blood smear had been taken and the case reported to the relevant person or office.

Results and discussions:

According to figure 4.2, the 12 sections (55%) with scores above 70% revealed that these rangers had the ability to recognize abnormalities, make a blood smear and correctly report the case to the state veterinary office. The eight sections (36%) with a score of less than 70% but

above 50% could have the necessary skills to recognize, assess and report all abnormalities successfully. Only two sections (9%) scoring below 50% were not capable of recognizing or reporting any abnormalities in the correct manner.

The results are indicated in Figure 4.2.

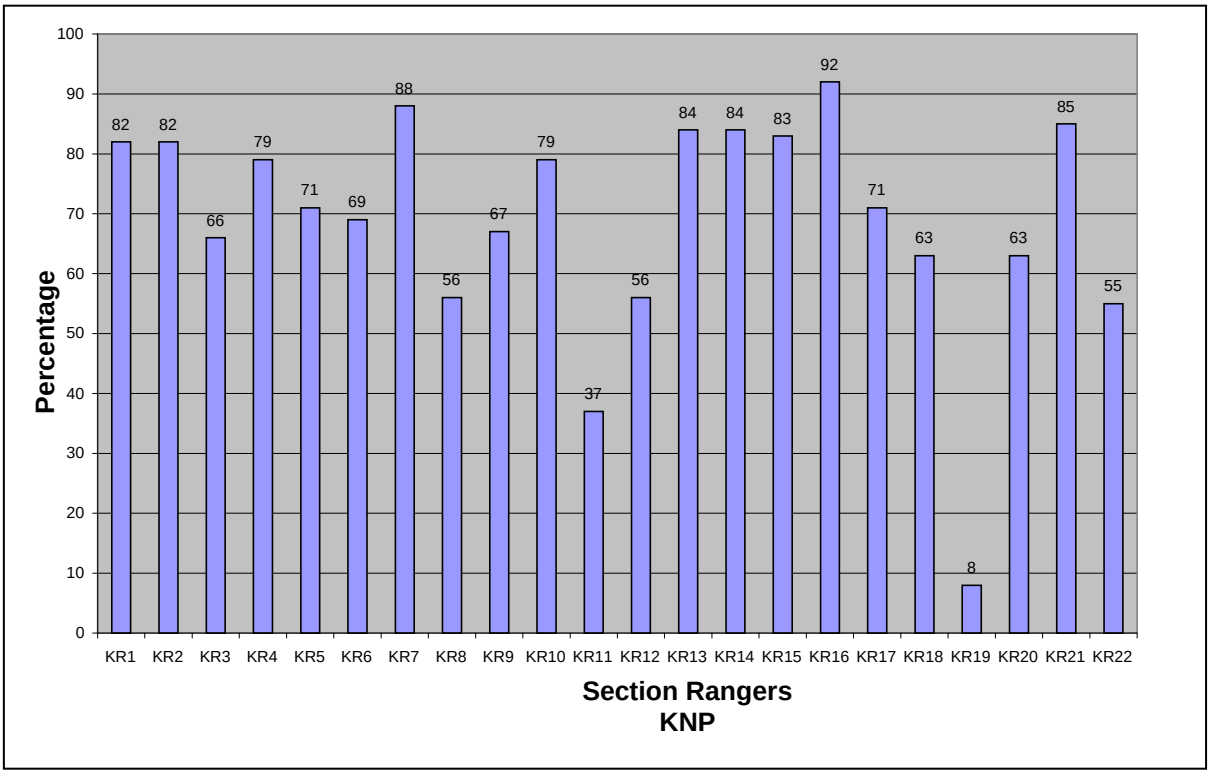


Figure 4.2: *Importance of recognizing conditions related or associated to wildlife diseases.*

4.2.1.3 Awareness.

The aim was to examine the section rangers' perception towards their field staff's awareness during routine inspections.

Section rangers had to ensure at all times that their field staff was properly trained and aware of the symptoms and conditions to look for. They had to be able to give proper feedback reports on these conditions. The section rangers also had to commit themselves to the ongoing training of their field staff. This question was specifically directed at the rangers and their personal input in the field rangers' ongoing training to ensure a high standard of awareness among their staff. They, therefore, had rate themselves on personal maintenance of ongoing awareness training of their staff.

The rangers had to maintain a high standard of awareness amongst their field rangers at all times through weekly information sessions and feedback on diseases and the results of previous reports submitted. Such information sessions were essential for maintaining awareness among staff and for monitoring competency. The monitoring could be done through ongoing feedback, short information sessions or quarterly training programmes. The rangers' sections would not be able to function without a properly co-ordinated surveillance or inspection programme. Field rangers in the KNP had to work according to an ongoing programme which should include, for example, time spent on field patrols or surveillance as such programmes would ensure the best coverage of their specific sections. Because of the size of certain sections, it would not be productive to do patrols for less than six hours per day. Unless enough time were spent per day on patrol, the surveillance would not be efficient and of a high standard.

Results and discussions.

According to Figure 4.3, seven sections (32%) of the section rangers had a proper ongoing awareness training programme that would enable them to recognize abnormalities. There were, however, sections (45%) that scored between 50 – 70% that could have an ongoing awareness training programme as well as the evaluation thereof that would not be capable of fulfilling its purpose.. According to Figure 4.3, five sections that scored less than 50% and were not capable, needed a more intensive ongoing awareness training programme which would enable them to perform better during routine inspection or patrols.

The results are indicated in Figure 4.3.

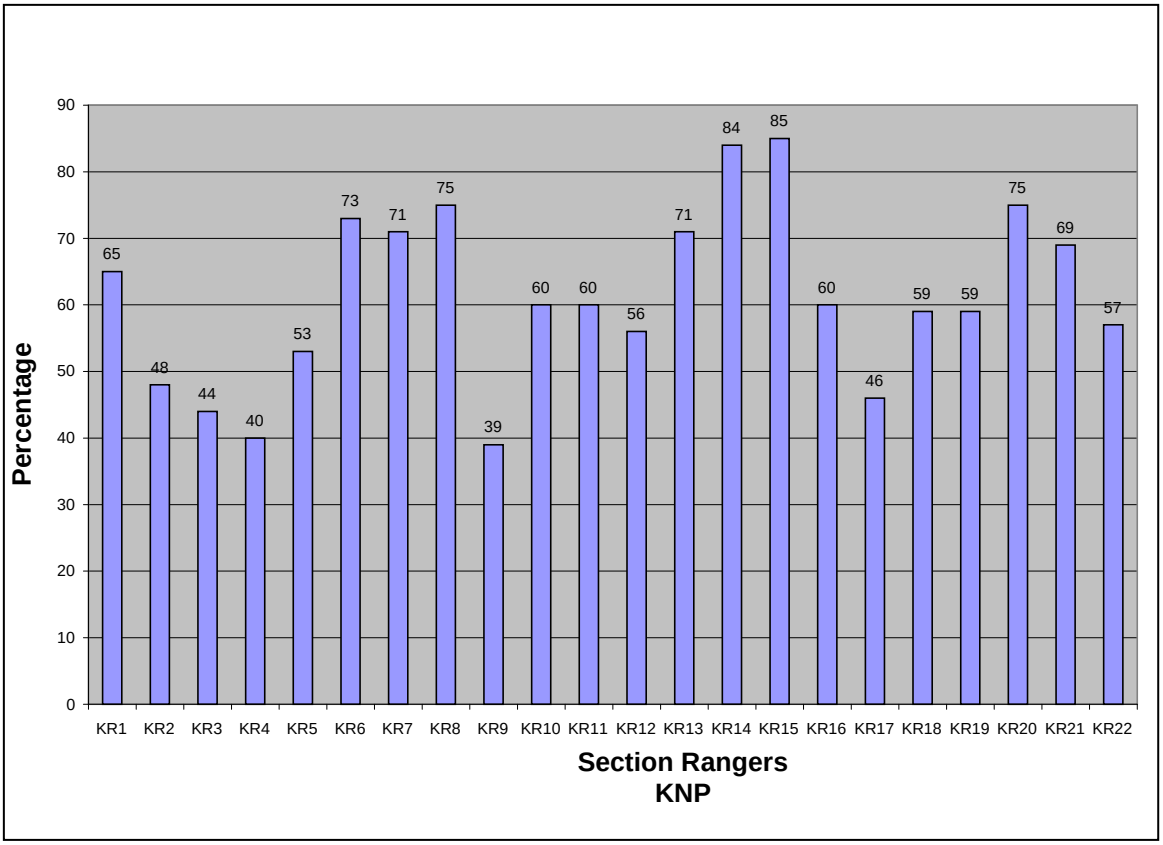


Figure 4.3: *Importance of the maintenance of a high standard of awareness amongst field staff.*

4.2.1.4 Conditions:

Section rangers had to be capable of recognizing certain abnormalities and conditions associated to the animals' condition and behavior as well as the social behavior of wildlife. Skin or external conditions could be an indication of an abnormality or infection, for instance mumps-like swellings in kudu, limping impalas and emaciated lions and buffalo. Sick or infected animals could show a change in behavior, e.g. wild animals that suddenly become tame, as a symptom of Rabies. Abnormal social behavior could cause an animal that normally forms part of a social group to distance itself from the group, e.g. Bovine Tuberculosis infection in lions.

The ability of section rangers to recognize certain vectors and the associated disease was vital in recognizing any abnormal condition. Knowledge of the vector of a certain disease which could be an indicator of the outbreak of a disease was most important.

Results and discussion.

According to Figure 4.4, a total of nine section rangers (41%) who scored above 70% were capable and had enough knowledge of abnormal conditions and vectors and the ability to recognize diseases through vectors present. Two sections rangers (9%) who scored above 50% but less than 70% could be capable of properly recognizing abnormal conditions and the reporting thereof. The other 11 sections rangers (50%) who obtained a score below 50% (below 50%) were not capable and would not be able to recognize abnormal conditions and vectors related to specific conditions. This inability could potentially have a major negative impact on future disease outbreaks in the park.

The results are indicated in Figure 4.4.

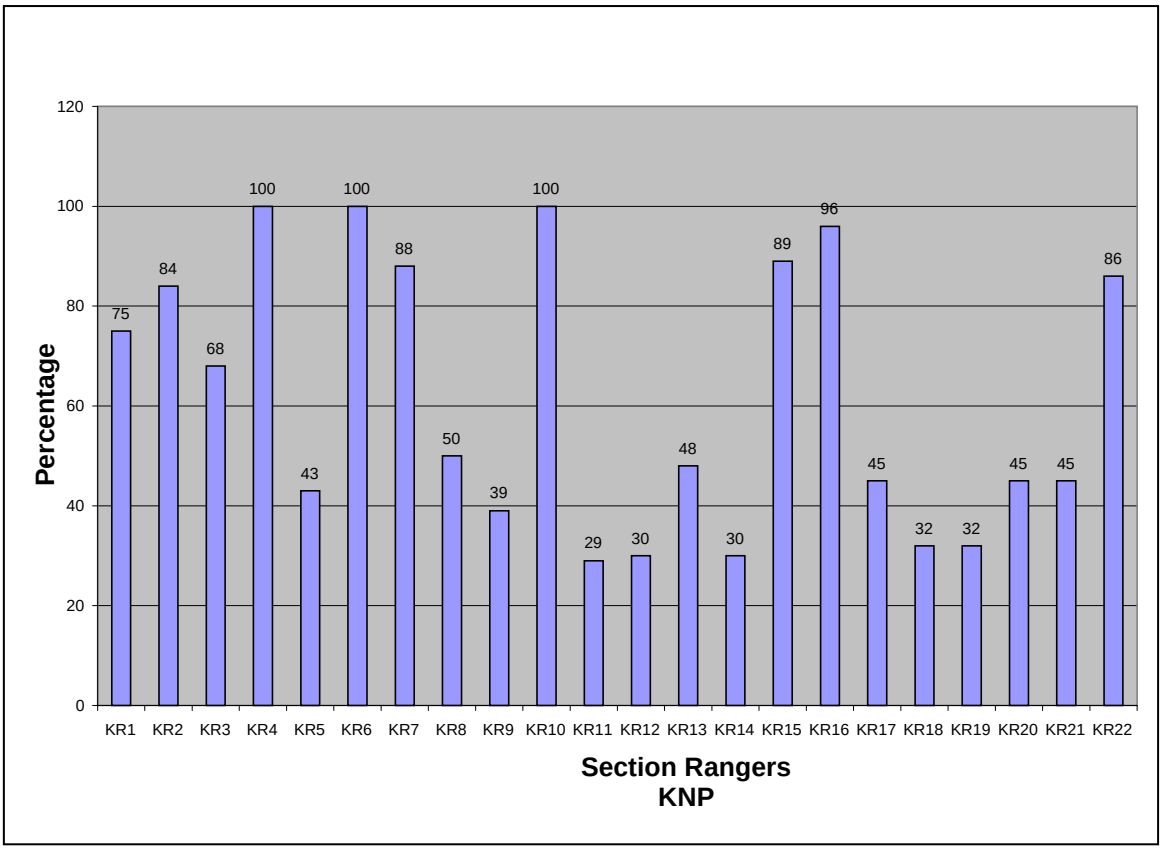


Figure 4.4: *Importance of knowledge regarding the recognition of abnormalities and conditions in the diseases surveillance program.*

4.2.1.5 Techniques.

The question referred to the ability of the section rangers' field staff to conduct a screening process for a basic field diagnosis. There should be a high priority of awareness of safety and infection which would ensure correct sampling and prevent zoonotic disease transmission.

Results and discussion.

According to Figure 4.5, a total of 14 sections (63%) scored above 70% and would be capable of doing a basic elimination process and would be aware of the safety precautions required for sampling a possibly infected animal or carcass. However, five sections (23%) that scored between 50 – 70% could be capable, and three sections (14%) that scored below 50% were not capable of recognizing infectious diseases and were not aware of specific precautions when handling infected material which could pose a threat to humans.

The results are indicated in Figure 4.5.

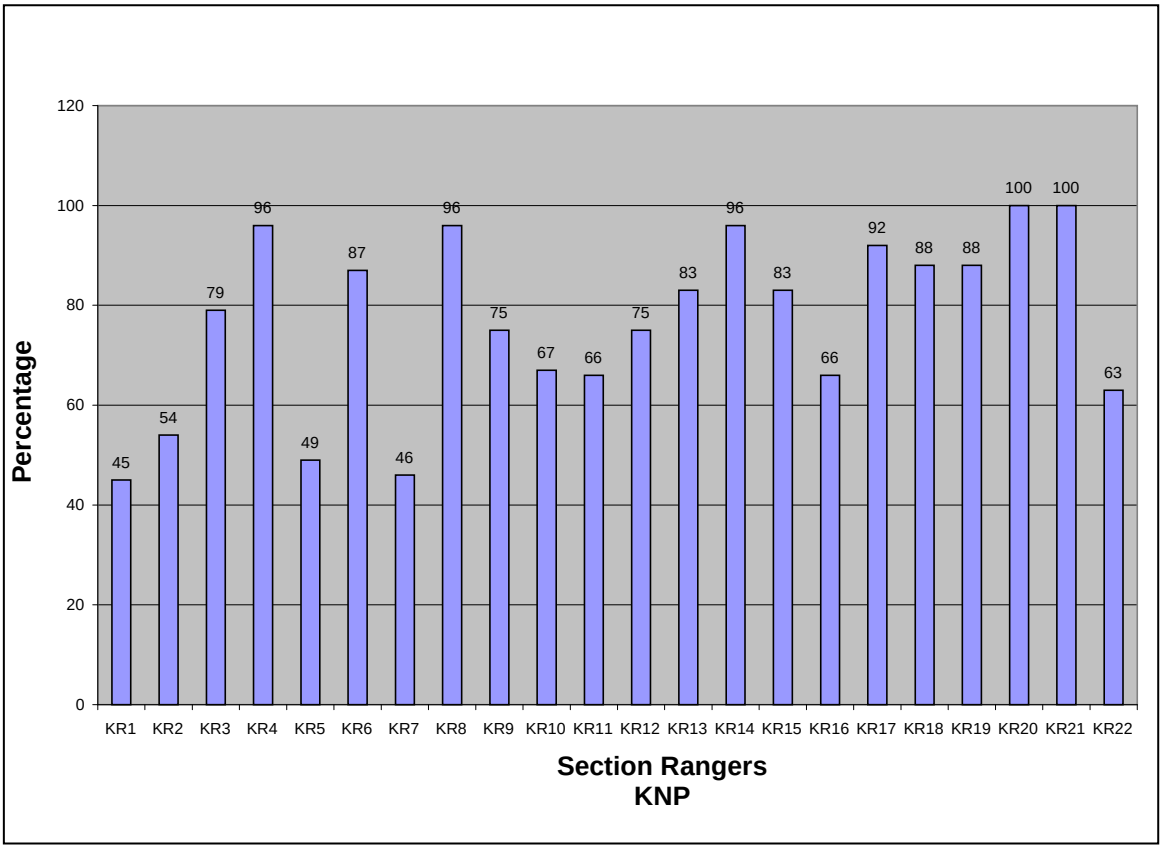


Figure 4.5: *Importance of field staff's ability (Techniques) to do a basic field diagnosis.*

4.2.1.6 Data:

The section rangers had to be aware, at all times, of the capabilities of their field staff with sampling, handling and the preservation of samples taken.It was imperative to be able to differentiate between normal and abnormal tissue during the investigation of a carcass while the need for the correct equipment could not be over emphasized. The rangers also had to be capable of completing a basic data sheet and of teaching staff the correct method to do it.

Results and discussion:

According to Figure 4.6, ten sections (45%) that scored above 70% had the correct equipment and the capability of collecting the correct specimens as well as the knowledge to supply the correct data to the state veterinary office.

Nine sections (41%) that scored above 50% but below 70% could have the correct equipment or knowledge to do a proper specimen collection and submit a proper report. Three sections (14%) scored below 50% and were not capable of performing these tasks at all.

The results are indicated in Figure 4.6.

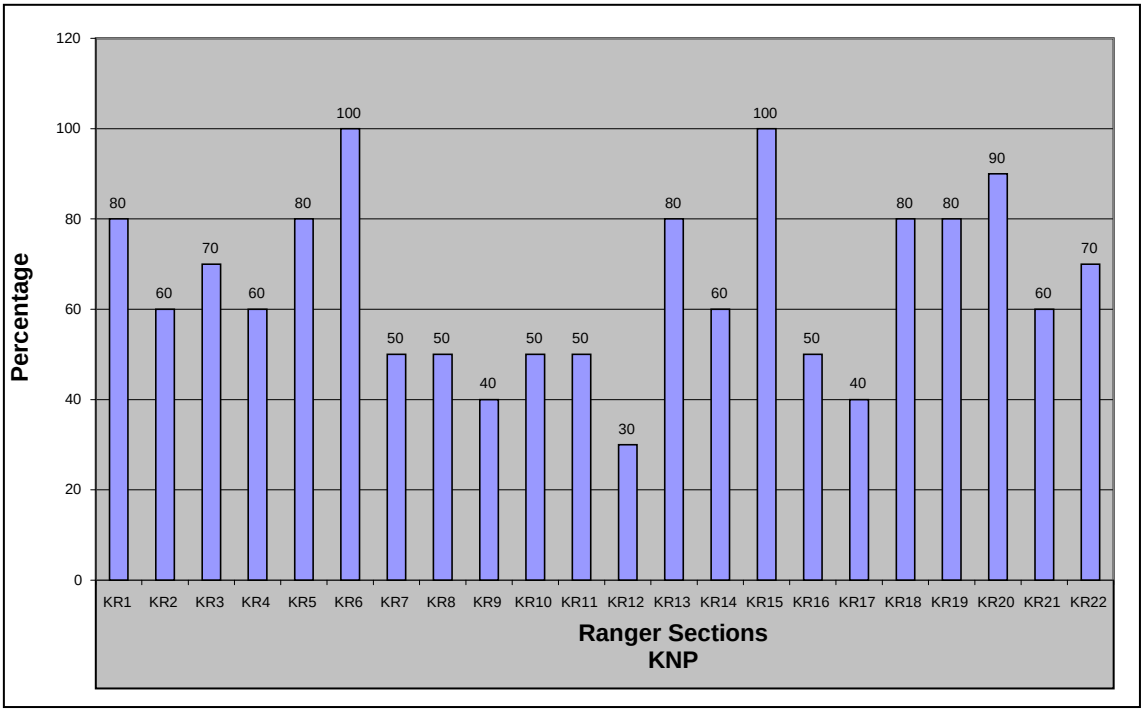


Figure 4.6: *Importance of field staff's ability towards correct sampling and data.*

4.2.2 Average scores per section obtained for KNP section rangers group

According to the combined average score for all critical point categories, as illustrated in Figure 4.7, only nine sections (41%) scored above 70% overall. Thus only 41% would be capable of conducting a proper wildlife disease surveillance while the other 13 sections (59%) could have various shortfalls in this regard which would need to be addressed in future.
The results are indicated in Figure 4.7.

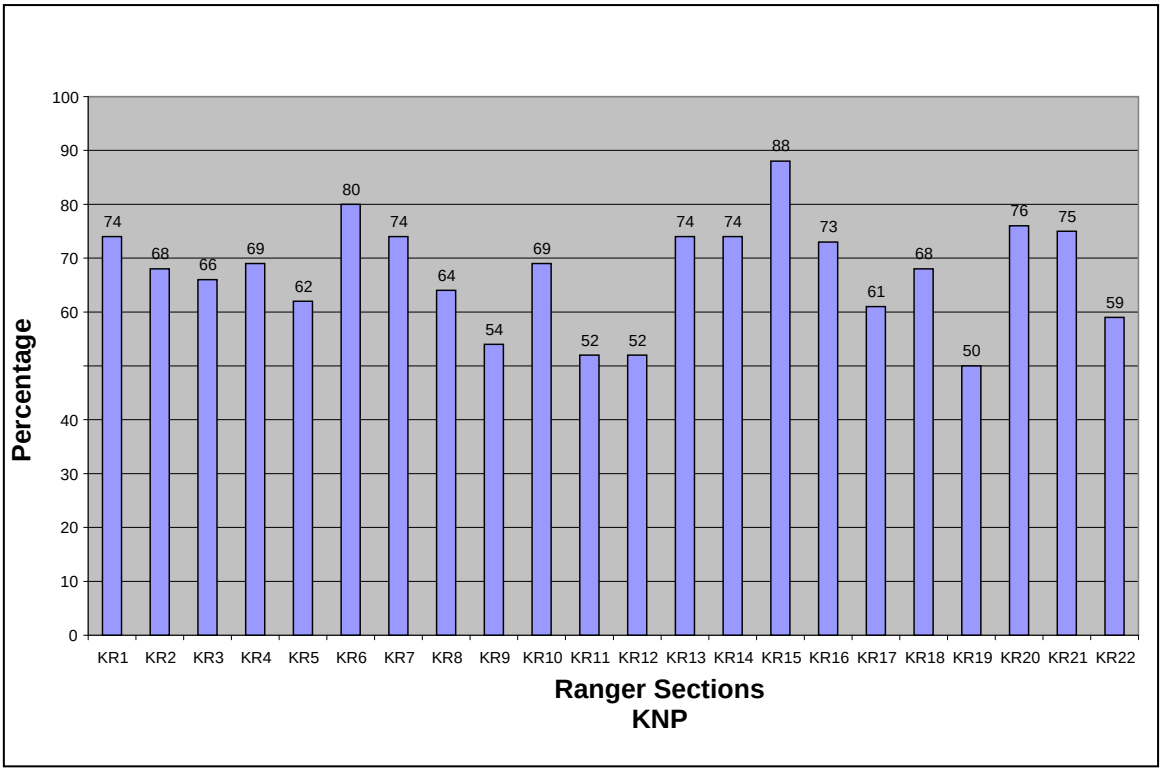


Figure 4.7: *Average score for all categories for the section rangers of KNP.*

4.2.3 Average scores obtained per critical point for the KNP section rangers group

4.2.3.1 Aim:

According to Figure 4.8, the average score of 75% which was relatively higher than the desirable 70% was a good indication that most section rangers of Kruger acknowledged and adhered to their job descriptions regarding wildlife disease surveillance and the reporting thereof.

4.2.3.2 Surveillance:

The average score, as indicated in Figure 4.8, obtained for surveillance (69%) was just below 70%. This score indicated that a sound knowledge and understanding of disease surveillance existed among the section rangers of KNP.

4.2.3.3 Awareness:

According to Figure 4.8, the section rangers obtained an average score of 59% for awareness which seemed to be relatively lower than what was required. This shortfall could have a negative impact in the event of a disease outbreak. The possibility of staff missing important clinical signs could result in a late or insufficient recognition of an outbreak causing more deaths or sick animals.

4.2.3.4 Conditions:

According to Figure 4.8, the section rangers obtained an average score of 62% for the category conditions, and although one could assume that it was not too low, it could impact on their ability to recognize certain conditions related to specific diseases. The ability of section rangers had to be addressed as this could result in major diseases or conditions being unidentified.

4.2.3.5 Techniques:

According to Figure 4.8, the section rangers obtained an average score of 77% for the category of techniques. They possessed enough knowledge of techniques on how to handle a carcass or infected animal and the thereof.

4.2.3.6 Data:

The ability to complete a data sheet and to submit an accurate report or give feedback to the state veterinary office should be deemed vital. This ability was the last, but most important step, towards ensuring good wildlife disease surveillance. According to Figure 4.8, they obtained an average score of 61% for this particularly important aspect which could also have a negative impact in the KNP if outbreaks or individual cases were not reported correctly or in the correct manner.

The results are indicated in Figure 4.8.

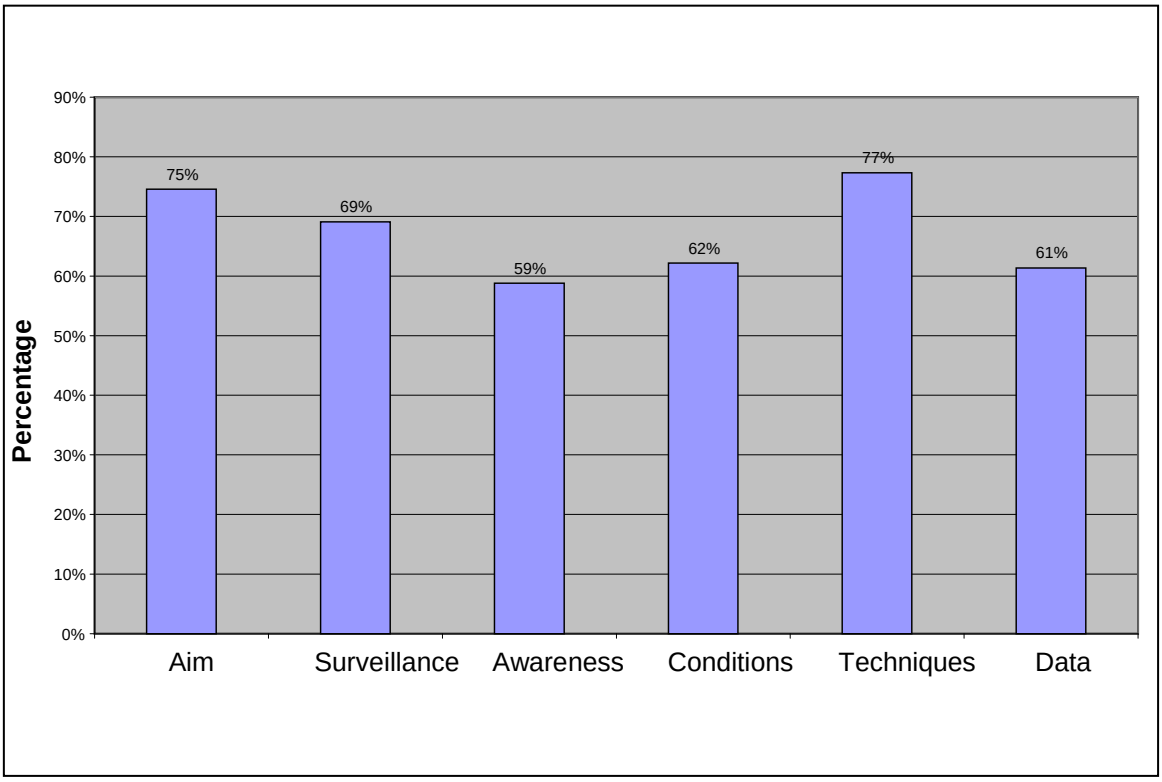


Figure 4.8: *Average scores for the KNP section rangers per critical point.*

4.3 PRIVATE RESERVE - RANGERS

4.3.1 Aim.

According to Figure 4.9, the private rangers obtained 30% for this category, and consequently, they did not have the same priorities as the section rangers in the KNP. They could function

according to different job descriptions which would exclude or under-emphasize the importance of wildlife disease surveillance and reporting.

4.3.2 Surveillance.

Although the score in this area is 67% as reflected in Figure 4.9, it was not sufficient to ensure a proper functional disease surveillance program. They would most probably be capable of conducting an adequate wildlife disease surveillance.

4.3.3 Awareness.

According to Figure 4.9, the rangers from private reserves obtained a low 41% in the category of awareness and were not capable in the awareness category.

The low average obtained for awareness clearly demonstrated the need for a regular awareness training programme which would enable the rangers from the private reserves to be more aware of wildlife diseases and the other aspects related to that.

4.3.4 Conditions.

According to Figure 4.9, they obtained a score of 77% in the category for recognizing certain diseases conditions or abnormalities.

This result indicated that they were capable of recognizing certain abnormalities and disease conditions in wildlife.

4.3.5 Techniques.

According to Figure 4.9, they scored 76% which rendered them capable of doing blood smears and collecting other specimens from possibly infected animals or carcasses.

4.3.6 Data. (45%)

The rangers from private reserves obtained a very low score of only 45% in the category for data as reflected in Figure 4.9.

This area needed to be addressed as this was still part of the surveillance programme that could not be neglected. Without this last step being done, no proper diagnoses, follow up operations or investigations would be possible. The ways and means of reporting possible infected animals or carcasses could easily be addressed through an ongoing awareness training programme.

The results are indicated in Figure 4.9.

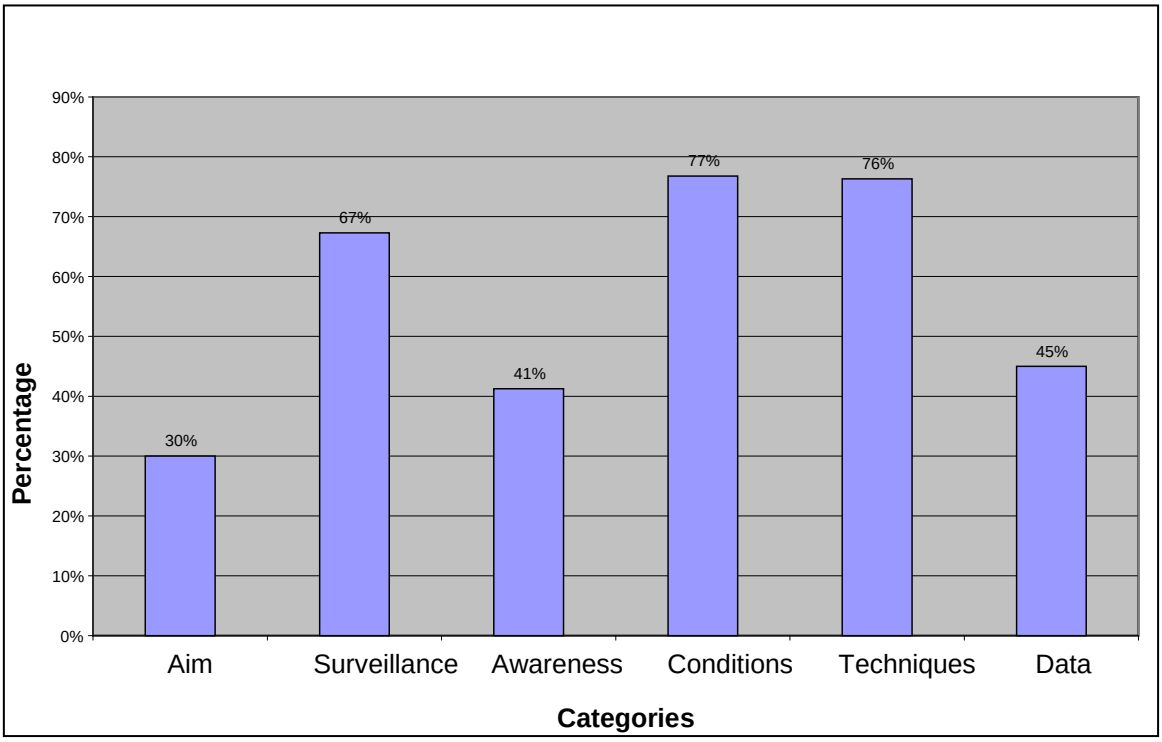


Figure 4.9: *Average score, per critical point, obtained by the rangers of the Private Nature Reserves.*

4.4 COMPARISON BETWEEN THE SECTION RANGERS FROM KNP AND THE RANGERS FROM THE PRIVATE RESERVES

4.4.1 Aim.

The section rangers of Kruger were working according to a well-defined job description which clearly emphasized the importance of wildlife disease actions. According to the results of the survey, KNP rangers acknowledged the importance of wildlife diseases surveillance as an integral part of their daily routine. Although they obtained an average score of 78% (Figure 4.8) for this category, only eight sections rated the importance thereof as 5/5 with a worrying three sections not rating the importance of wildlife disease as being significant.

No definite job description for rangers appointed within the private reserves was available except for a welcoming and briefing letter which did not mention any responsibility towards wildlife diseases at all. This lack of a job description could have an influence on the performance of these rangers towards wildlife disease surveillance as a whole. Rangers not able to do any awareness training would lack the knowledge themselves to recognize and report any suspicious, sick or abnormal animal. The fact that no definite job description existed could be the reason for the low score of 30% (Figure 4.9) obtained by the private reserves.

4.4.2 Surveillance.

According to the section rangers of KNP, it seems as though their field rangers possessed more than enough ability to locate infected carcasses during an outbreak and even in the absence of a defined outbreak. That ability was reflected in the results where 55% of the responders have scored above 70% in this category (Figure 4.2).

The rangers from private reserves were also optimistic (69%) regarding their field staff's ability to locate infected carcasses during or before an outbreak (Figure 4.9).

4.4.3 Awareness

According to the section rangers of KNP, they rated their field staff's awareness at an almost acceptable rate of 67% (Figure 4.10) with the unfortunate situation that the section rangers did not ensure an ongoing awareness training programme for field staff which would add more value towards their capabilities in this regard.

According to Figure 4.10, the section rangers of KNP maintained a relatively high standard of awareness (61%); yet, at the same time they did not evaluate (39%) their field staff's awareness on a regular basis which would ensure once again a much higher standard of awareness.

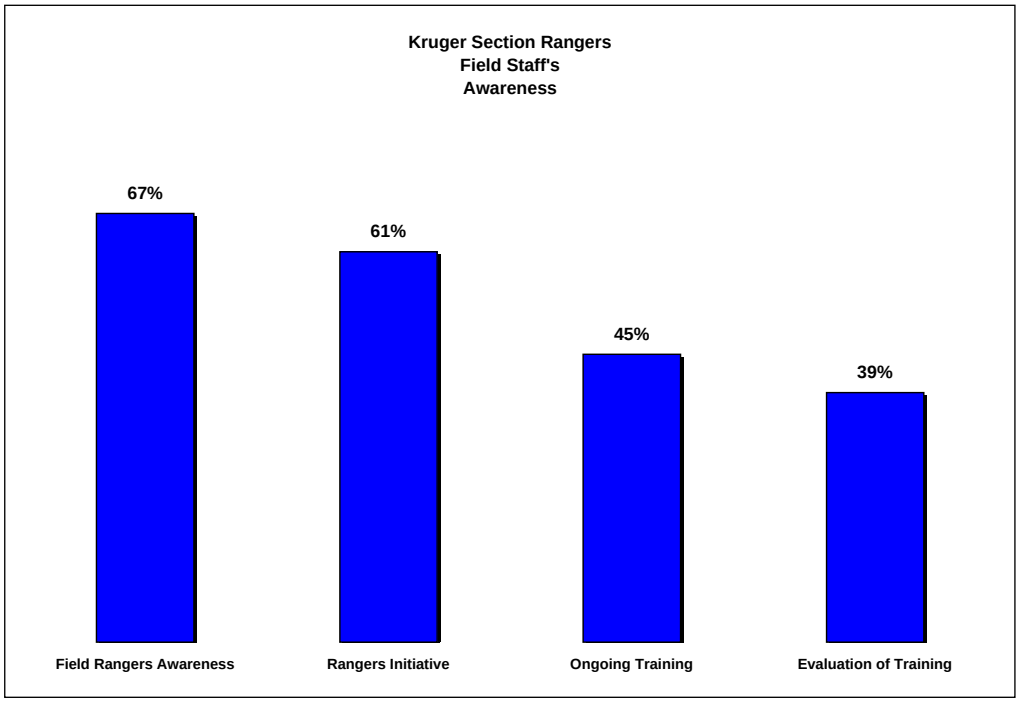


Figure 4.10: *Importance of an ongoing awareness training and evaluation program for wildlife disease surveillance.*

It seemed as if the situation with rangers from private reserves differed dramatically from section rangers in Kruger. According to Figure 4.11, the rating of their field staff's awareness in private reserves, as indicated by their rangers, was not acceptable at a very low 33%. The rangers' ongoing awareness training was also at a low 33% while the maintenance thereof was not much better at 38%. Evaluation of training, according to the rangers, did not exist.

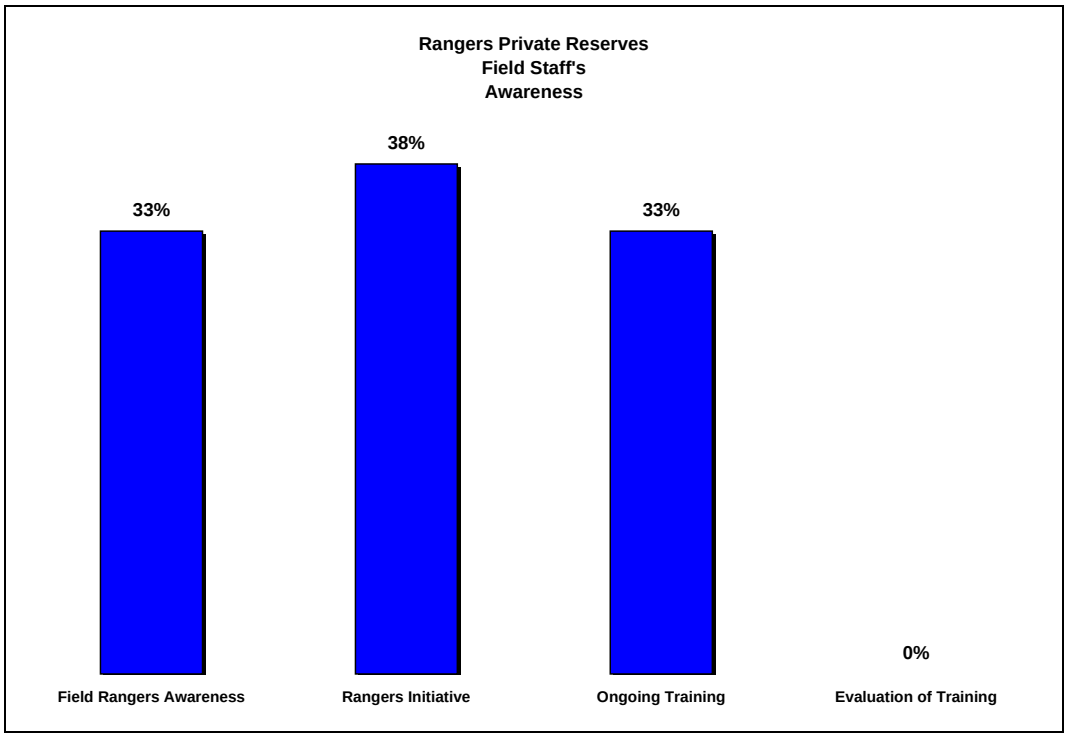


Figure 4.11: *Importance of an ongoing awareness program for field staff in private reserves.*

4.4.4 Conditions.

Section rangers would only be able to recognize certain abnormalities and conditions associated to the animals' condition and behavior if they possessed the knowledge and experience in this field. The section rangers from KNP indicated, according to Figure 4.8, that 62% of them were equipped with enough knowledge and experience to adhere to this. They also did reasonably well by indicating diseases with the specific vector species responsible for causing the disease.

According to Figure 4.9, the private reserve rangers did extremely well when 77% of them were able to recognize abnormal conditions or situations, although they could not maintain the same standard with the indication of diseases and vector species responsible for the diseases.

4.4.5 Techniques (Sampling).

The section rangers of the KNP indicated that, according to them, their field staff had the ability to collect information as well as to maintain the safety precautions thereof in table 4.1.

Table 4.4: *Average scores of sub categories within the main category techniques - for the Section Rangers of the KNP.*

5. Techniques.		**%**
i.	Field staff able to collect info	81
ii.	Field staff aware of the safety precautions	76

The section rangers indicated, in the subcategory of techniques, that 81% of their field staff was more than capable of doing a field diagnosis by means of a basic screening process while on patrol (Table 4.4). They also indicated that their field staff was aware of the safety precautions to be taken when handling infected carcasses or material (76%) (Table 4.4).

The rangers of the private reserves indicated that, according to them, their field staff had the ability to collect information as well as to maintain the safety precautions thereof in table 4.5.

Table 4.5: *Average scores of sub categories within the main category techniques - for the Rangers of the Private Reserves.*

5. Techniques.		**%**
i.	Field staff able to collect info	50
ii.	Field staff aware of the safety precautions	60

Rangers from the private reserves, however, had their doubts about the ability of the field staff to do a basis field diagnosis (50%) as well as their knowledge about the safety aspects involved when working with possible infected material (60%) (Table 4.5).

4.4.6 Data

According to Figure 4.12, the section rangers of KNP indicated that they had enough knowledge about the reporting process for samples to the relevant veterinary office (82%). However, they had their doubts about the capabilities of their field staff to differentiate between normal and abnormal tissue. They also doubted their ability to perform the correct procedure which would enable them to obtain a sample or blood smear (45%).

The rangers from private reserves indicated a lack of capability from their side on the reporting process (30%) even though their field staff might be able to perform or obtain a field sample (52%).

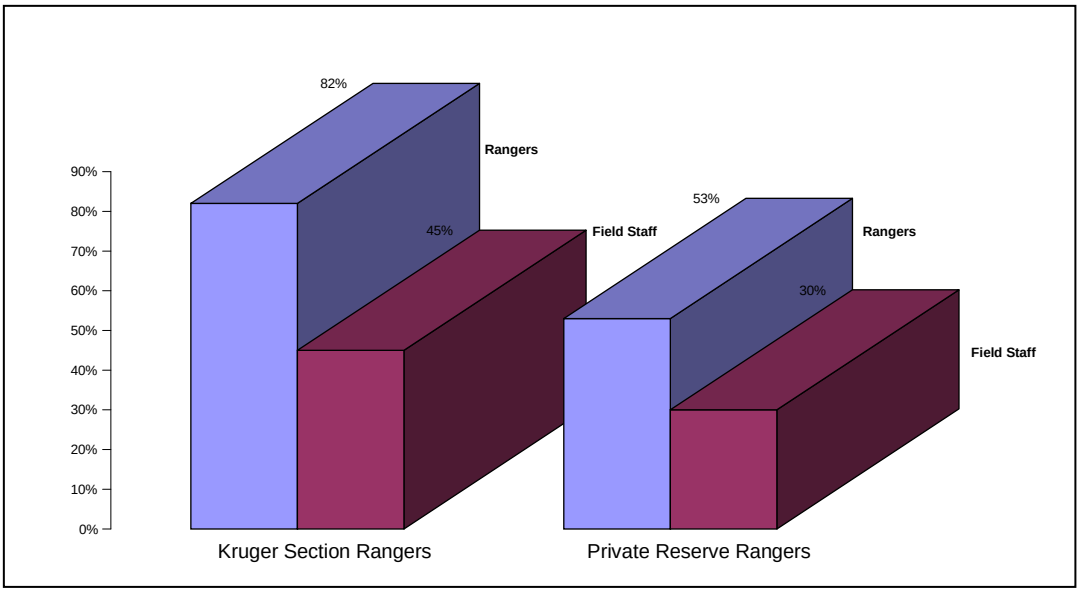


Figure 4.12: *The ability of rangers and field staff to collect the correct samples.*

CHAPTER 5

RESULTS AND DISCUSSION: FIELD RANGERS

5.1 INTRODUCTION

The field rangers of Kruger National Park could be deemed as the largest and most important group involved in wildlife disease surveillance as they patrol the almost 2 million hectares of Kruger on a daily basis. Most of their patrols were done on foot or by bicycle which brought them much closer to the environment with a greater possibility of involvement and "hands-on" situation regarding disease surveillance.

The field rangers were working according to a defined job description which stipulated specific veterinary-related tasks as follows:

- They had to take blood smears of all carcasses encountering during patrols.
- They had to follow in all disease control measures.
- They had to look for visible signs, e.g. Mange.

Field rangers needed to be more active, more aware, better trained and equipped than any of the other groups involved. They also had to be utilized to their full potential and to the advantage of the Greater Kruger National Park.

Field rangers were the first line of defense within the total wildlife disease surveillance plan of the Kruger National Park as they were the staff members who patrolled the park on foot or by bicycle on a daily basis. As they were the more experienced people regarding bush skills, this advantage had to be utilized to maximize the effectiveness of the surveillance programme in the park. Field rangers were trained to recognize abnormal or unnatural conditions in the bush environment and were, therefore, the most important link in the surveillance chain. The reason for the lowering of the percentage scoring system was that, in most cases, field rangers had obtained a maximum qualification of Grade 10 and even lower. In addition people with a post-school qualification were not usually employed as field rangers.

To be able to measure the results of field rangers and to compare results within sections, the following percentage scoring system for field rangers was used to compare the results of the sections as well as within the different categories:

- Above 60% – a score or an average score of above 60%: The persons or sections were capable of working and fulfilling the tasks according to the specific job description.
- Between 40 -60%- Average: The persons or sections could be capable of fulfilling their description.
- Below 40% - Insufficient: The field rangers were not capable of fulfilling tasks according to their job description.

5.2. FIELD RANGERS RESULTS

5.2.1. Experience:

This question referred specifically to the veterinary-related experience of field rangers, such as specific experience obtained from working with veterinary staff, attending any veterinary-related courses or demonstrations or during outbreaks by means of collecting of specimens or data.

Results and discussion:

According to Figure 5.1, only four sections (18%) indicated that they had previous knowledge or attendance of any veterinary-related training or courses while one section (4, 5%) indicated some veterinary-related experience in the past. The majority of sections namely 17 or 77% of the sections in Kruger indicated that they had almost no veterinary experience, with five sections (23%) indicating no experience at all.

The results are indicated in Figure 5.1.

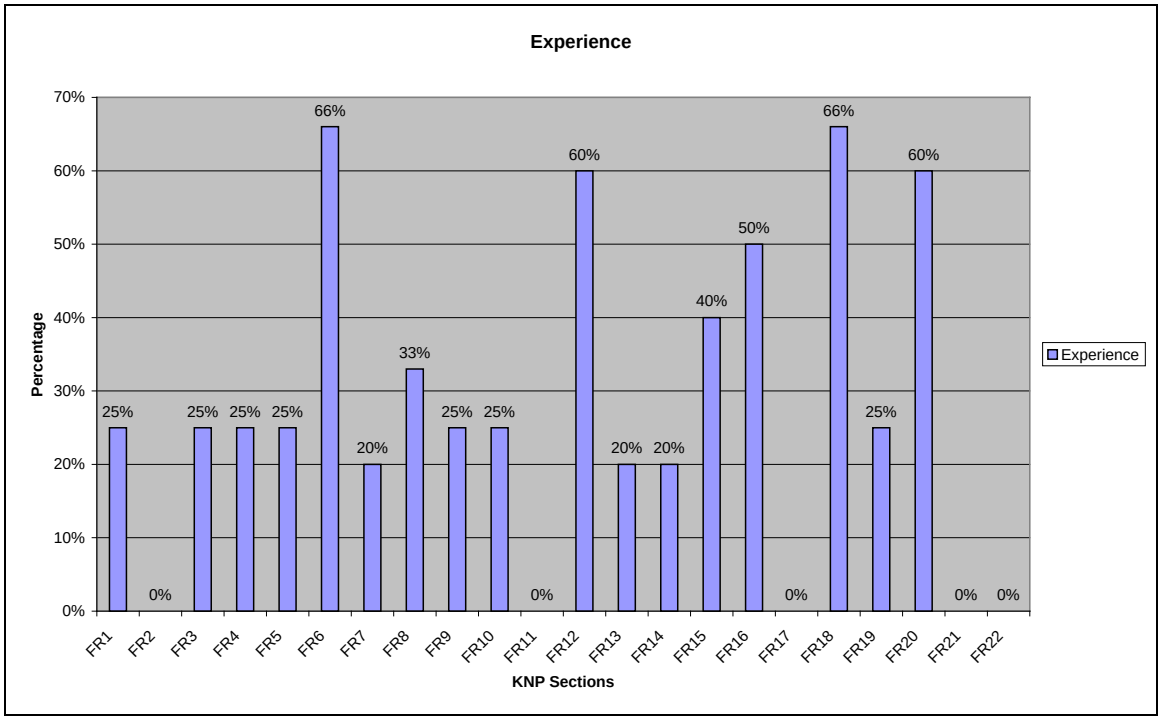


Figure 5.1: *Importance of veterinary related experience for field rangers.*

5.2.2. Training.

Training has become one of the most important aspects within the working environment today. Training has a positive influence on the functionality and productivity of the worker. People with no ongoing training programme would not be able to progress within their working environment and would eventually become frustrated and negative towards their work. Veterinary-related training could include formal training, workshops, practical training sessions or even refresher courses within or during time of employment with the national park.

Results and discussion:

According to Figure 5.2, the average scores obtained for training were the most concerning factor pertaining to the field rangers results as these scores could impact on their responsibility for and capability of disease surveillance.

Only two sections (9%) indicated that they had previously received any veterinary-related training.. According to the above result one could assume that an important part of the field rangers' work outfit, namely ongoing veterinary-related training, had been neglected in the past. The results are indicated in Figure 5.2.

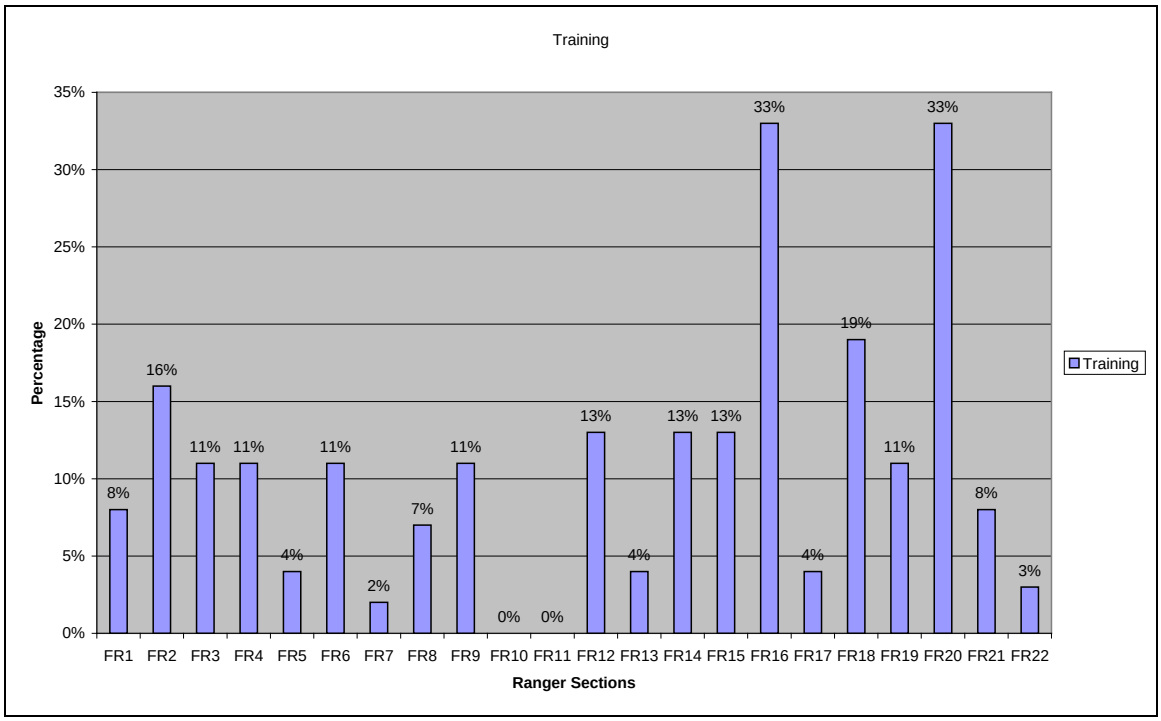


Figure 5.2: *Importance of veterinary-related training for field rangers.*

5.2.3. Disease Reporting

It was important to establish the total number of reports as well as the report intervals from field rangers per annum as these results could be an indication of the awareness of the different ranger sections. The results could be an indication of knowledge of the different diseases.

Results and discussion:

According to Figure 5.3, only three sections (14%) were able to obtain a score better than 40% which indicated a significant shortfall in specific disease reporting aspects with 17 sections (77%) scoring well below the 40%. The outcome meant that the situation would have to be

addressed urgently. It was a matter for concern that most of the field rangers were unable to meet the basic requirements of the job description of a field ranger.

The results are indicated in Figure 5.3.

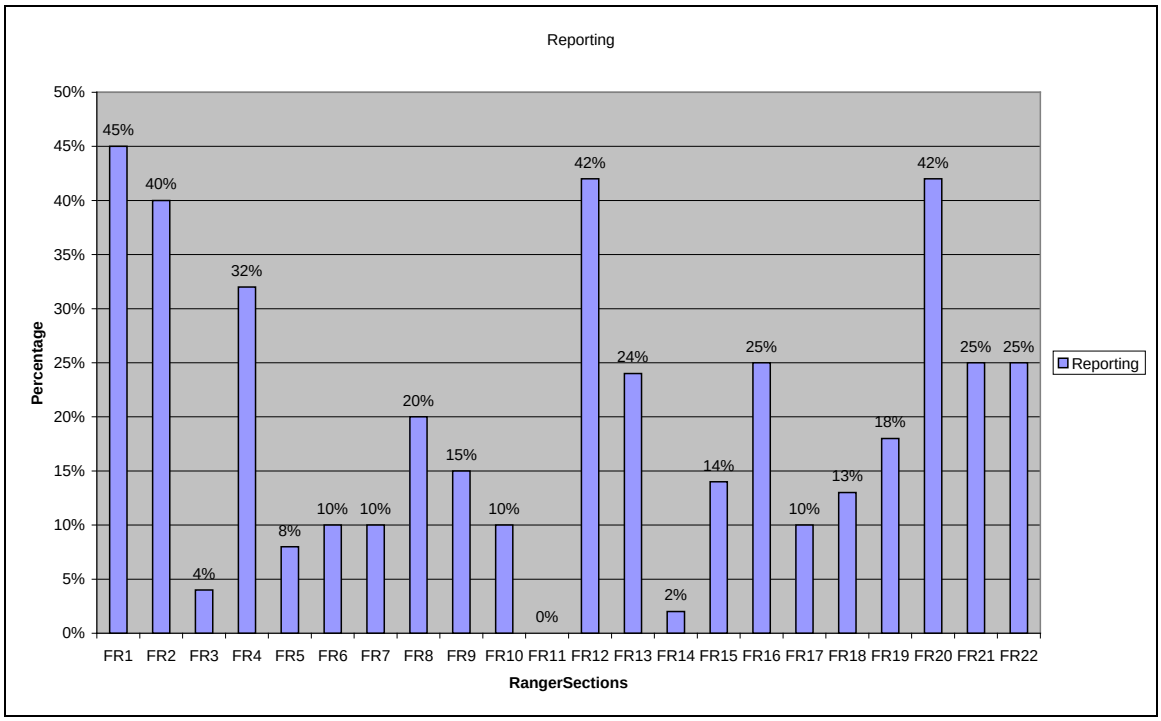


Figure 5.3: *Importance of a functional reporting system.*

5.2.4. Zoonoses

The awareness of field rangers of the importance and dangers of zoonotic diseases which could have a major impact on human lives was of major importance. Field rangers had to be aware of the dangers of infection when handling an infected carcass or animal and the necessary safety precautions to prevent infection.

Results and discussion:

According to Figure 5.4, the field rangers from eight sections (36%) scored above 60% and were capable of recognizing and protecting themselves from potentially dangerous material that could prove fatal or could seriously infect a human. The rest of the sections, namely 14 sections (64%), seemed to neglect the importance of safety precaution.

The results are indicated in Figure 5.4.

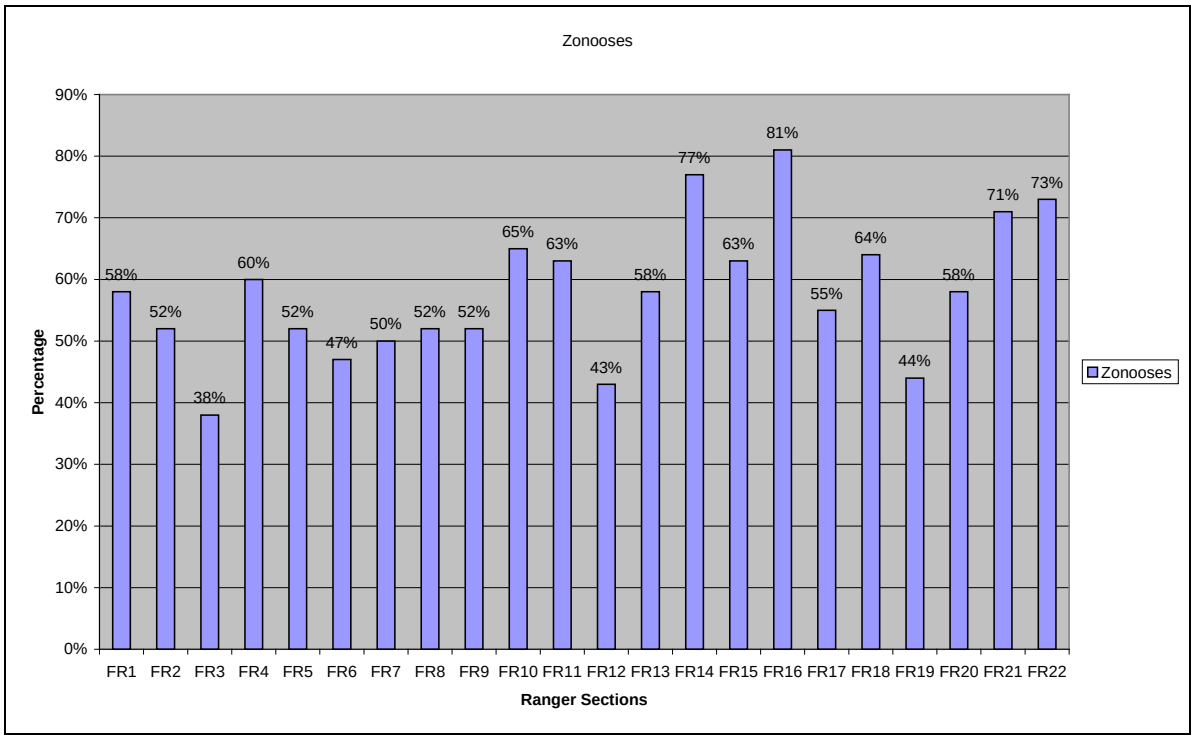


Figure 5.4: *Importance of knowledge regarding zoonotic aspects and safety precautions.*

5.2.5. Surveillance

Field rangers should have the ability to recognize certain aspects, activities or symptoms and relate them to a specific disease as well as the ability to recognize sick or infected animals by observing various visible conditions, behavior and social behaviors. Field rangers should be able to report certain aspects, conditions or environmental factors that could influence or impact on disease outbreaks. These observations should be reported as accurately as possible during their report-back to their supervisors.

They should have the ability and knowledge to take the correct samples. It was imperative to know the difference between normal and abnormal tissue during investigation of a carcass. After completion of all the above, the field rangers should be able to complete the basic data form supplied with the glass microscope slides.

Results and discussion:

According to Figure 5.5, only two sections (9%) scored above 60% while 18 sections (82%) scored above 40% and only two sections (9%) scored below 40%. It seemed that most of the field rangers had the ability to do proper surveillance with only two sections having above average knowledge in this regard. Two sections (9%) that scored below 40% did not have enough knowledge about the above important aspect which could influence future disease outbreaks if not rectified in the near future.

The results are indicated in Figure 5.5.

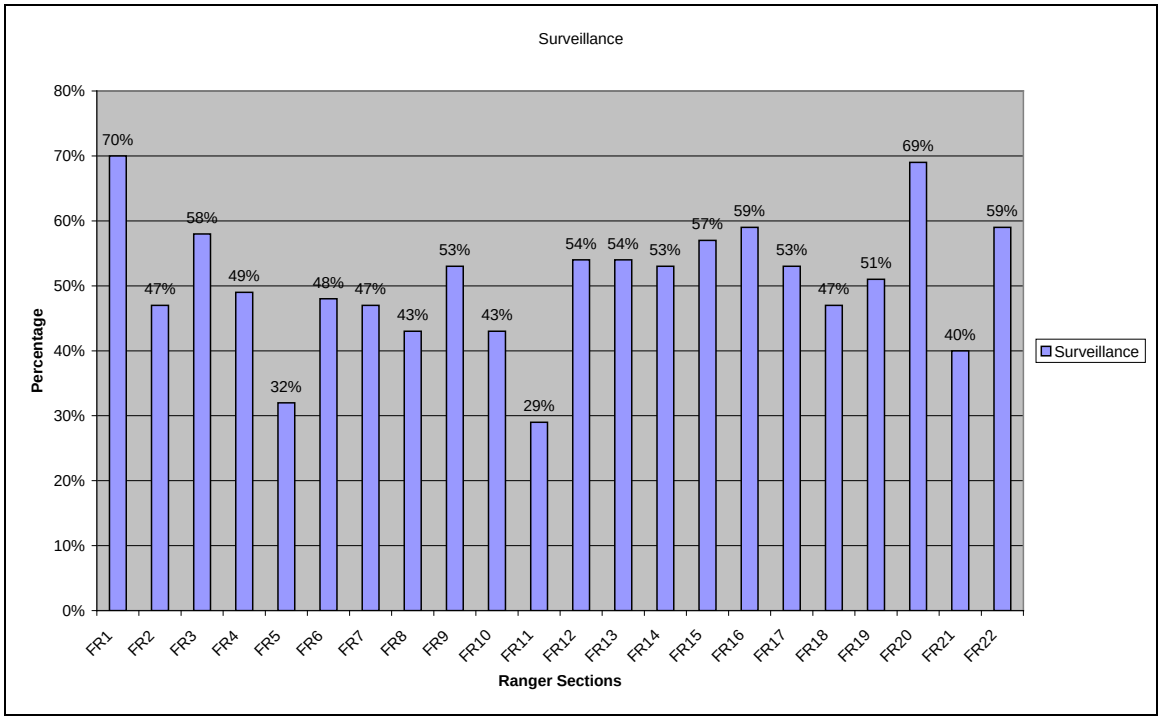


Figure 5.5: *Importance of surveillance aspects and correct sampling methods.*

5.3 DISCUSSION OF SUB-CATEGORIES FOR FIELD RANGERS

5.3.1. Experience

According to Table 5.1, the veterinary-related experience for field rangers in the KNP was very low.

		%
1. Experience.		
a. Qualification		-
b. Veterinary related experience		23

Table 5.1: *Percentage field rangers with veterinary-related experience.*

Field rangers could only obtain veterinary experience by working with veterinary-related aspects or either by attending veterinary training sessions. According to Table 5.1, 23% of the field rangers indicated that they had previous veterinary-related experience, meaning that 77% of the field rangers in the KNP did not have any previous veterinary experience.

5.3.2. Training

In Table 5.2, the results of the different scores of the sub-categories within the training category are indicated.

Table 5.2: *Average scores for KNP field rangers in the category – Training.*

2. Training.		%
a. Annual training program		53
b. Vet related training		2
c. Intervals		-
d. Duration		-
e. Responsible person		-
f. Topics included		-
i. VPH/Zoonoses		4
ii. Animal diseases		12
iii. Surveillance and sampling		8
g. Veterinary/Animal Health related		
i. Workshops		4
ii. Practical demonstrations		5
iii. Practical training sessions		1
iv. Refreshment courses		2

Training and, in this study specifically, veterinary-related training had become one of the most important aspects within the working environment and would definitely influence the functionality and productivity of the worker.

The job description of a field ranger clearly stated veterinary involvement as part of the routine daily tasks. Without the necessary veterinary training, no field rangers would be equipped to fulfill their tasks and could be responsible for not reacting or reporting when needed to. The field rangers (53%) indicated an annual training programme which could include different aspects of their job description, while only 2% of the participants indicated any veterinary-related topics included in the mentioned training (Table 5.2).

5.3.3. Communications

Communications from field rangers should always be directly to their section rangers, and all relevant communications from other levels had to be via the section rangers to the field rangers.

5.3.4. Reporting

The results of the average scores for the different sub-categories of reporting are indicated in Table 5.3.

Table 5.3: *Average scores for KNP field rangers obtained in the category – Disease Reporting.*

4. Disease reporting.		%
a. Report intervals		
i. Foot and Mouth		26
ii. Anthrax		23
iii. Bovine Tuberculosis		25
iv. Brucellosis		16
v. Rabies		13
b. Risk if not controlled		
i. Foot and Mouth		23
ii. Anthrax		23
iii. Bovine Tuberculosis		26
iv. Brucellosis		9
v. Rabies		20

Disease reporting entailed many different aspects, for instance report intervals for the five diseases as well as the risk factors involved.

According to table 5.3, the field rangers indicated a very low percentage (not regular) of reporting with an even lower percentage of being able to identify the risk factors involved.
As indicated in Table 5.3, only 20% of the participants were able to identify the dangers of rabies. All the other diseases scored a fraction better.

Without a good, functional training programme and relevant experience, no high standard of reporting and recognition of diseases would be possible.

The relationship between the three important aspects of diseases surveillance, namely, training, experience and reporting, are illustrated in Figure 5.6 and the importance thereof could not be overemphasized

Figure 5.6 clearly indicates that the low percentage of veterinary training (91%) and experience (77%) as the only reason for the very low reporting situation. Without a proper training programme and adequate experience, no high standard or quantity of reporting possible would be possible.

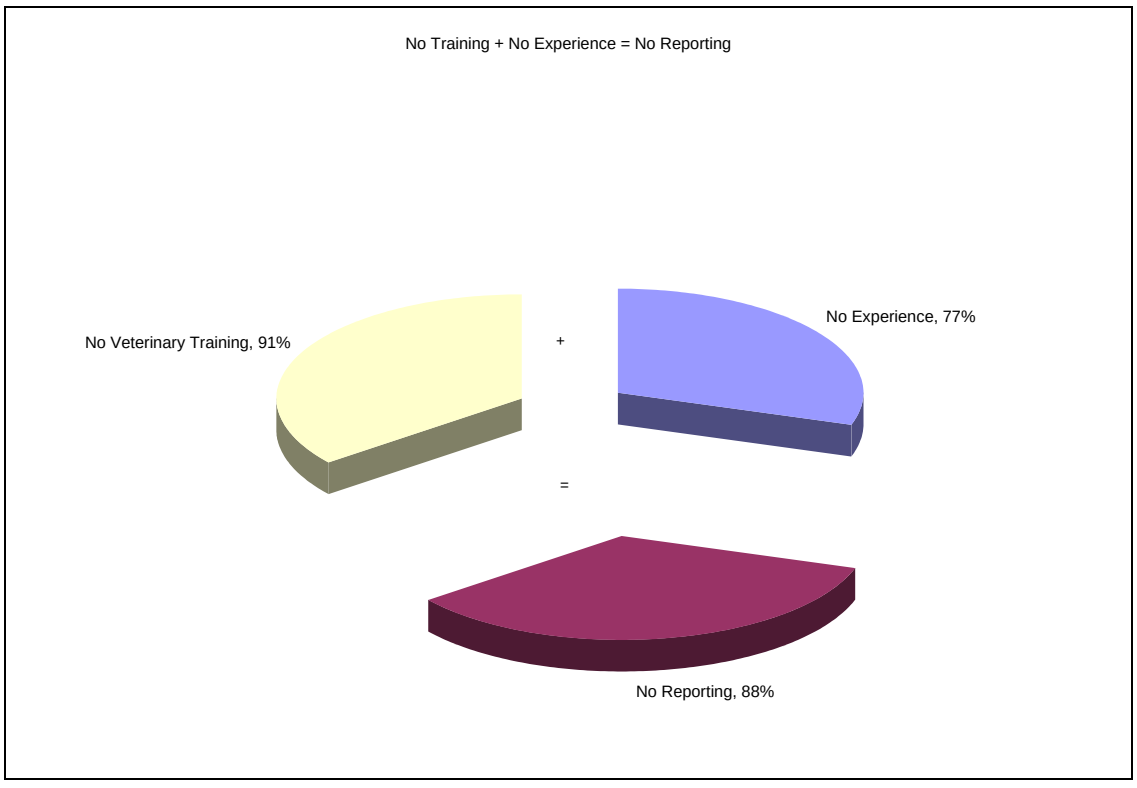


Figure 5.6*: Relationship between veterinary training, experience and reporting.*

5.3.5. Zoonoses

The importance of zoonotic diseases was to be aware of the dangers of certain diseases for humans and animals and to be able to recognize certain important zoonotic diseases which formed part of the environment in which the rangers worked.

Field rangers had to be aware of what safety precautions to take when handling infected carcasses or animals. It was imperative that field rangers or any persons working with suspicious or infected carcasses to be aware that they were not allowed to open such a carcass, especially when they suspected anthrax. It was also essential to wear protective clothing during the process of field sampling or carcass investigations.

Television and radio as a medium has had a major positive influence regarding veterinary public health aspects, such as safe meat and hygiene, thus contributing towards the high awareness among the people in South Africa of zoonotic aspects and the dangers thereof. This aspect might have contributed towards the high score of 84% of field rangers indicating their awareness of zoonoses.

According to Figure 5.7, 84% of the field rangers indicated their awareness of zoonoses and only 49% were able to name or recognize any of the four zoonotic diseases. Safety precautions formed an important part of the prevention of the dangers of zoonotic diseases and should be seen as important as the knowledge of the disease itself. Although 87% of the participants indicated their awareness of the safety precautions, only 45% of them knew that the opening of a possible infected carcass was forbidden.

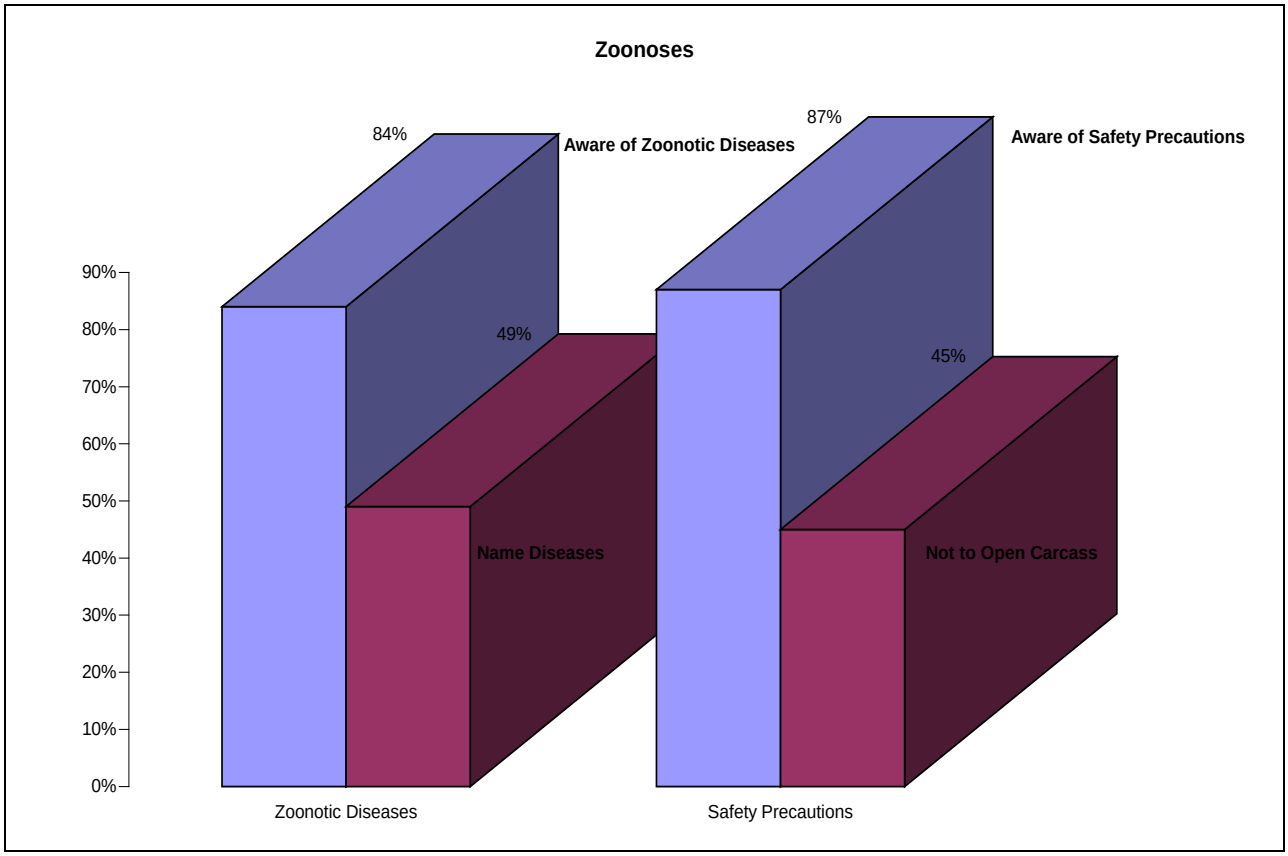


Figure 5.7: *Importance of zoonotic diseases and safety precautions to be taken.*

5.3.6. Surveillance

Surveillance included primary objectives, signs and conditions and the obtaining and reporting of a sample from a carcass, and the findings of the survey are indicated in table 5.4.

Table 5.4: *Average scores for KNP field rangers obtained in the category – Surveillance.*

6. Surveillance.		%
a. Primary objectives		
i. Clinically suspect animals		60
ii. Infected carcasses		63
b. Aspects, signs, conditions		
i. Vulture activities		28
ii. Limping Impalas		50
iii. Emaciated predators/buffalo		47
iv. Buffalo with swollen knees		14
v. Kudu with mumps		10
vi. Aggressive animals		52
c. Recognition of abnormal conditions		
i. Skin		85
ii. Body		71
iii. Lesions		49
iv. Swellings		77
v. Movement		80
vi. Aggressiveness		80
vii. Tameness		54
viii. Social behavior		40
d. Disease vectors		
8 mentioned diseases		17
e. Steps to do a field diagnosis		
12 different steps		74
f. Sampling – safety precautions		
i. Not to open the carcass		78
ii. Protective clothing		94
iii. Not to utilize the meat		88
iv. Correct handling of the samples		78
g. Capabilities for correct sampling		
i. Preparing a blood smear		75
ii. Taking a blood sample		59
iii. Collecting a skin sample		24
iv. Opening of a carcass – further investigation		22
v. Preservation of specimen		18
h. Knowledge regarding the correct samples		10
i. Differentiate between normal and abnormal		16
j. Necessary equipment		13
k. Able to fill a data form		37

Field rangers had to have the ability to recognize certain aspects, activities or symptoms and relate them to a specific disease. Furthermore, the ability to recognize sick or infected animals by various visible indicators, behavior and social behaviors was essential.

Field rangers should be able to report certain aspects, conditions or environmental factors that could influence or impact on disease outbreaks. These aspects should be reported as accurately as possible during their report-back to their supervisors. They should have the ability and knowledge to take the correct samples. It was also important to know the difference between normal and abnormal tissue during investigation of a carcass. After completion of all the above, the field rangers had to be able to complete the basic data form which was supplied together with the requisite glass slides.

Only two sections (9%) had sufficient knowledge of surveillance, while 82% of the sections were at risk and might not identify a disease outbreak or condition in time.
The field rangers' ability to recognize and associate specific animal diseases with conditions was not of a very high standard.

Knowledge on and differentiation between normal and abnormal tissue (16%) as well as the correct equipment (13%) and completion of the data form (37%) were below the acceptable score (Table 5.4).

CHAPTER 6.

RESULTS AND DISCUSSION: FIELD GUIDES AND TRAILS RANGERS.

6.1. INTRODUCTION.

The private operating companies and concessions within the park employed field guides trained to entertain guests on daily vehicle or foot excursions. These guides could become valuable tools in the bigger surveillance plan if trained correctly and were acknowledged as such assets.

The group of field guides and trails rangers had more job-related or specific post-school qualifications which were requisite to be employed as a guide. Questionnaires were obtained from trails rangers working in the park as guides operating from small bush camps and from guides on private reserves working for private operating companies and who more responsible for entertaining tourists than observing the health of game on game drives.

To be able to measure the results of all field guides and to compare results within sections and between groups the following percentage scoring system was used to evaluate the results of the different categories:

- Above 70% – a score or an average score of above 70% was considered as good and the groups capable of working and fulfilling the tasks according to the specific job description.
- Between 50 -70% - a score or an average score of between 50 – 70% was deemed as average and the groups could be capable of fulfilling their job descriptions.
- Below 50% - a score or an average lower than 50% was considered as poor and the groups not capable of fulfilling tasks according to their job descriptions.

6.2. FIELD GUIDES – CONCESSION AREAS

The concession areas located within the boundaries of the Kruger National Park had different types of agreements with the park, but all used field guides to entertain their guests on drives or day walks.

Results and discussion

6.2.1. Communications.

According to Figure 6.1, only 2% of participants acknowledged the existence of communications between the field guides from the concession areas and the veterinary section. One could safely assume that communications between these groups were basically non-existent.

The field guides from the concession areas had to adhere to prescripts referring to working conditions for concessions within the KNP in that they had to report to the section rangers of KNP responsible for the area.

6.2.2. Training.

According to Figure 6.1, the concessions areas obtained an average score of 11% for veterinary-related training. Although some participants indicated that annual training did take place within the company, they pointed out that the training did not include any veterinary-related training or topics. All participants indicated that no self-development programmes were available.

6.2.3. Reporting.

The average of 27% obtained for the reporting, according to Figure 6.1, was also well below the average needed to be competent. Such competency included the knowledge to be able to recognize abnormalities and conditions as well as the impact or risks these could have on either humans or animals.

6.2.4. Zoonoses.

According to Figure 6.1, the guides were more than capable as 72% were able to recognize the importance of zoonotic diseases and the role these diseases played.

6.2.5. Surveillance.

According to Figure 6.1, they scored an average of 53% in the surveillance category and could be capable of doing surveillance. The participants also indicated that they did not deem surveillance for diseases as important as other aspects of their routine day-to-day drives.

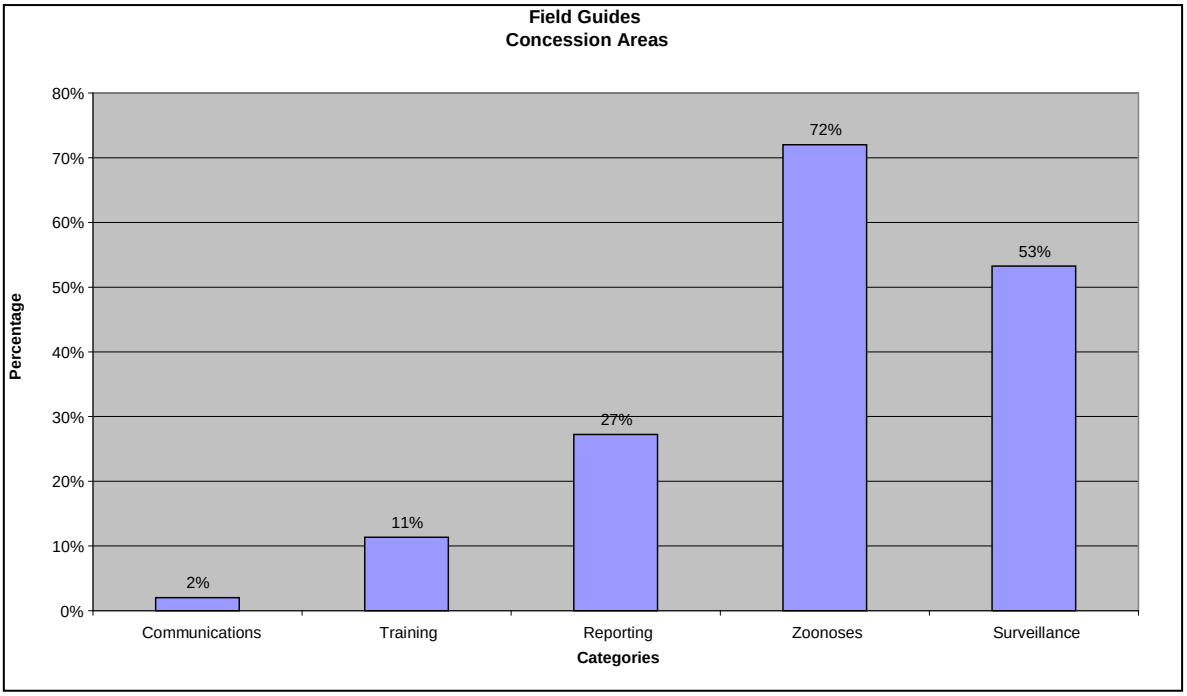


Figure 6.1: *Categories as per questionnaire for field guides in the concession areas.*

6.3. FIELD GUIDES – PRIVATE RESERVES

Private reserves that formed part of the Greater Kruger National Park employed mostly nature conservation qualified field guides to entertain their guests on day drives and walks within their allocated boundaries.

Results and discussion

6.3.1. Communications.

It seemed that the reason for the low score of 0% could be that all guides from the private reserves were obliged to report any suspicious cases or carcasses to their local game rangers who, in turn, would report the cases to the veterinary section.

6.3.2. Training.

Figure 6.2 indicated an average score of 12% for veterinary training which was well below the 70% needed and would require urgent attention from role players involved.

Some participants indicated that annual training did exist within the company; however, such training did not include any veterinary-related training or topics. In addition, all the participants indicated that no self-development programmes were available.

6.3.3. Reporting.

In the category for disease reporting, the group scored an average of 17% which was once again far below the standard needed to do be able to do proper disease reporting. This category included the knowledge to be able to recognize abnormalities and conditions as well as the impact or risks these could have on humans or animals (Figure 6.2).

6.3.4. Zoonoses.

According to Figure 6.2, the field guides obtained an average score of 65% for their ability or knowledge of zoonotic aspects and would, in most cases, be able to recognize zoonotic diseases and aspects related to that.

6.3.5. Surveillance.

The score of 53% in the surveillance category was below the ideal score of 70% for this specific category. The participants also indicated that they did not consider the surveillance for diseases as important as other aspects of their routine day-to-day drives (Figure 6.2).

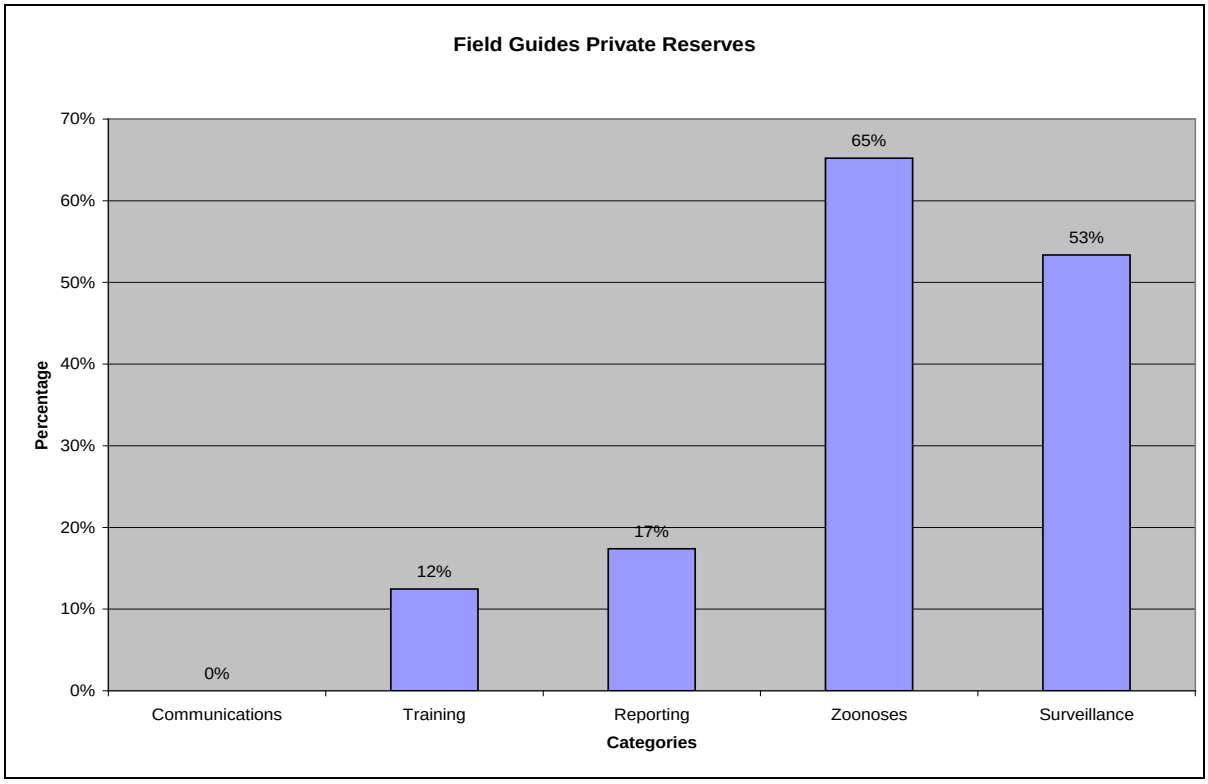


Figure 6.2: *Categories as per questionnaire for field guides from Private Nature Reserves.*

6.4. FIELD GUIDES – PRIVATE OPERATORS

Private operators transported tourists or guests from outside the park into the park for game drives on an almost daily basis. They employed mostly guides who had obtained at least a qualification from the Field Guide Association of South Africa (FEGASA) or any other related qualification.

Results and discussion

6.4.1. Communications.

According to Figure 6.3, only 5% of the participants indicated that a certain level of communication between the field guides, working as private operators, and the veterinary office existed. The situation, however, was below the accepted level of 70% and would have to be rectified as this group could make a huge contribution towards wildlife disease surveillance in the KNP.

6.4.2. Training.

The average score of only 7% indicated that almost no veterinary-related training existed within this group. These findings were similar to the other field guide groups with almost no formal or annual training programmes which included any veterinary-related aspects (Figure 6.3).

6.4.3. Reporting.

According to Figure 6.3, the participants scored 18% which was well below the average of between 50 -70% needed to be able to do proper disease reporting.

6.4.4. Zoonoses.

With a score of 67%, it was possible for these guides to recognize certain dangers pertaining to zoonotic diseases.

6.4.5. Surveillance.

With an average score of 30% in the surveillance category, the data indicated that participants had an inadequate capability to do proper wildlife disease surveillance. The participants also indicated that they did not regard the surveillance for diseases as important as other aspects of their routine day-to-day drives (Figure 6.3).

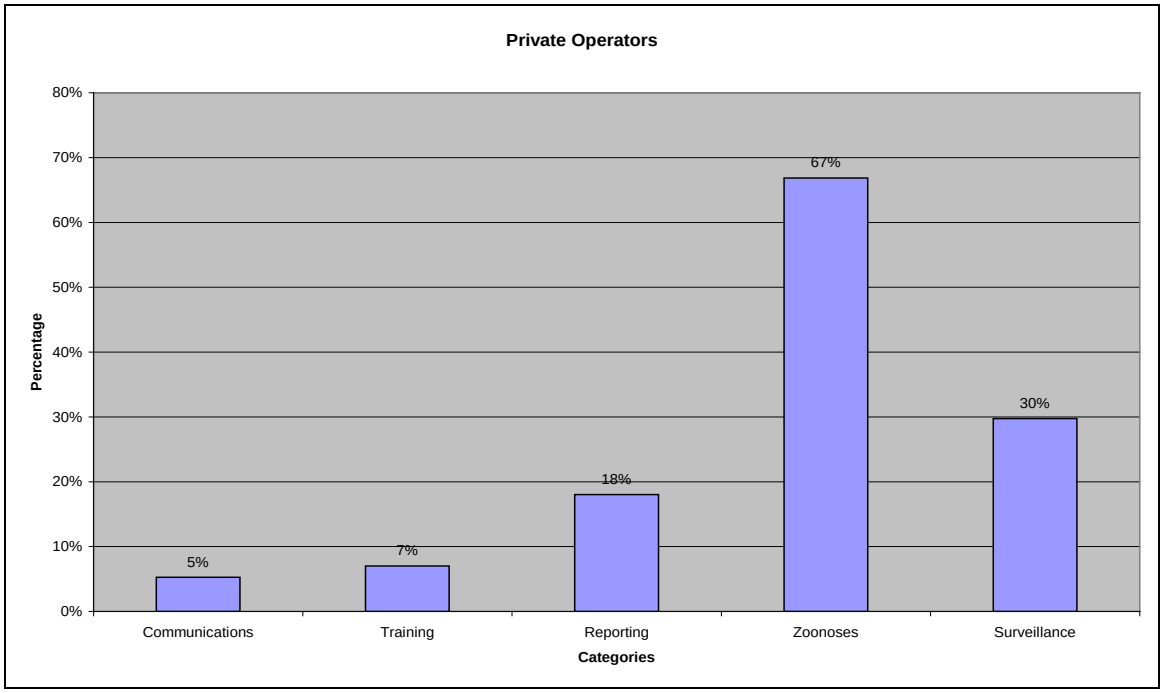


Figure 6.3: *Categories as per questionnaire for Private Field Guides.*

6.5. TRAIL RANGERS

Trail rangers who were mostly nature conservation qualified people, were employed by the KNP to work as trail rangers within the park at specific small rustic bush camps where they catered for and entertained the guests on day walks.

Results and discussion

6.5.1. Communications.

It seemed that the reason for the low score of 0% could be because the trail rangers from KNP were obliged to report any suspicious cases or carcasses to the section rangers in the area, who, in turn, would report the cases to the veterinary section (Figure 6.4).

6.5.2. Training.

According to Figure 6.4, the trail rangers achieved an average of 23% for veterinary-related training aspects which was well below an accepted average of at least 50%.

Although some participants indicated that an annual training programme was available in the park, it did not include any veterinary-related training or topics.

6.5.3. Reporting.

The score of 53%, (Figure 6.4), indicated that this group did have the capability of recognizing abnormalities and how to report them.

6.5.4. Zoonoses.

According to Figure 4.18, the group scored 78%, for this category which demonstrated the capability of recognizing certain dangers pertaining to zoonotic diseases.

6.5.5. Surveillance.

The participants regarded the surveillance aspect, in which they obtained an average of 68%, as an important part of their daily functions, demonstrating that they could be capable of doing good surveillance due to the theoretical training they received as part of their studies.

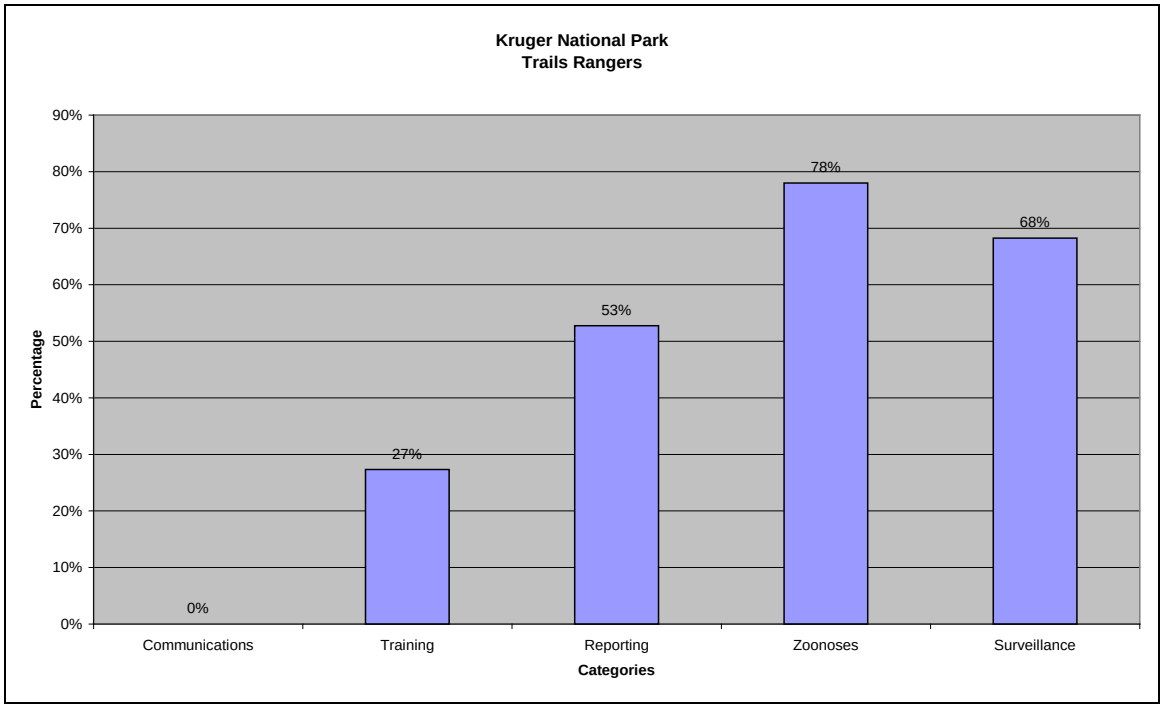


Figure 6.4: *Categories as per questionnaire for KNP trails rangers*.

6.6. COMPARISON BETWEEN FIELD GUIDES AND TRAIL RANGERS

6.6.1. Communications.

Most of the groups indicated (Figure 6.5) that they had no prior communications with the State Veterinary office in Skukuza, while some of the participants from the private tour operators did acknowledge prior communications with the Veterinary Wildlife Services of KNP.

Without a proper communications system between the veterinary sections and the groups operating in the park, no surveillance system would be able to function properly.

Although some of the groups were required to communicate through their respective rangers or section rangers, these groups had to be aware that communications and reporting of possible infected animals or carcasses was of vital importance since their reports would enable the veterinary section to locate a disease outbreak early (Figure 6.5).

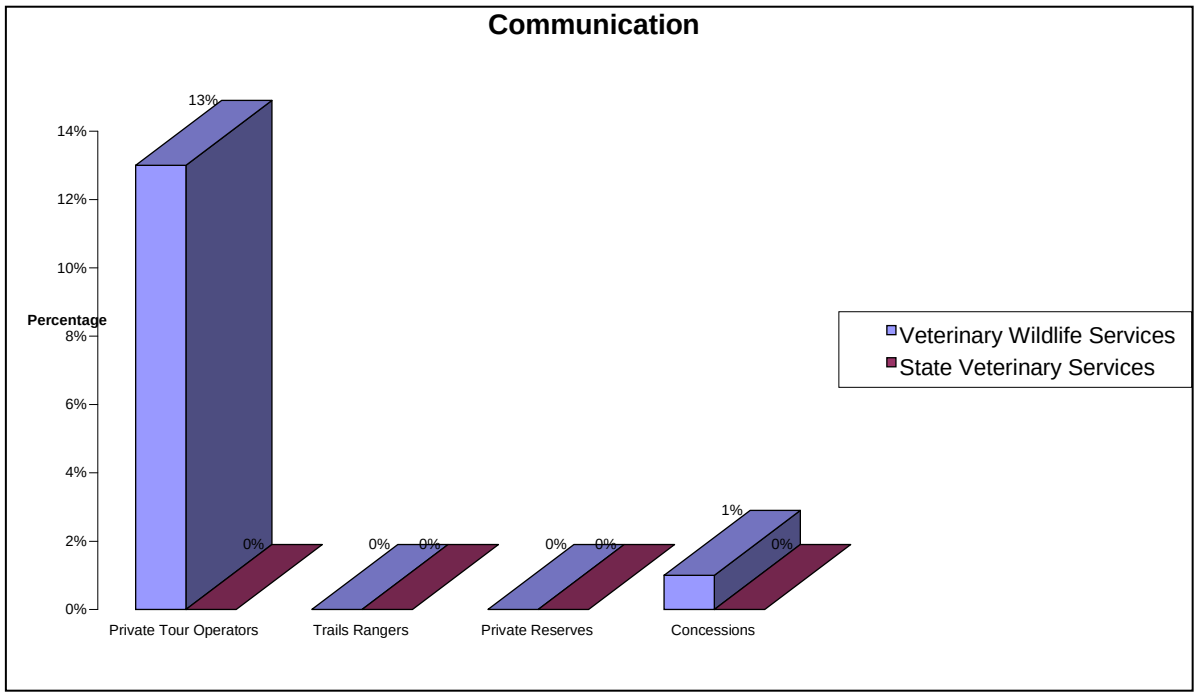


Figure 6.5: *A comparison of communications between groups towards the Veterinary divisions.*

6.6.2. Training.

According to Figure 6.6, all the groups indicated some form of annual training. However, training was almost non-existent for three of participating groups, Nonetheless, 40% of the trail rangers indicated involvement in an annual training programme. As can be seen in Figure 6.6, these annual training programmes did not include any relevant veterinary aspects..

Without proper veterinary-related training, these groups would not be able to participate in any active diseases surveillance program within the GKNP.

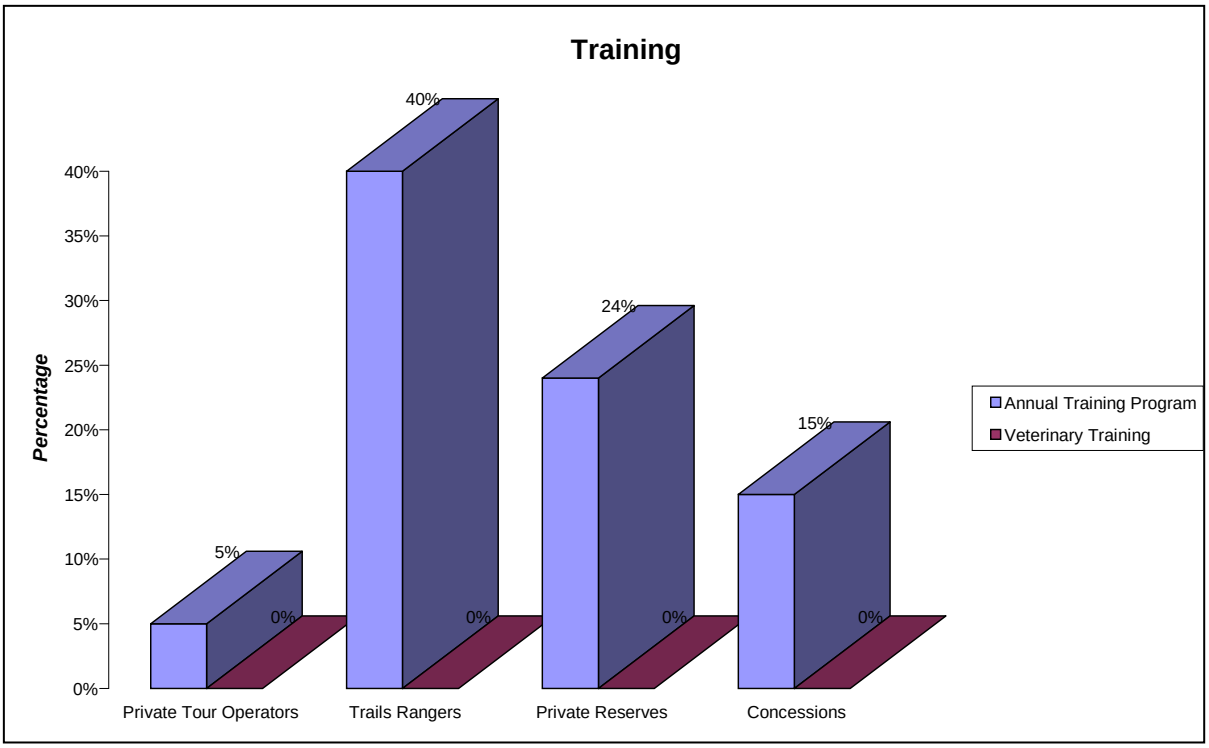


Figure 6.6: *Average scores for field guides and trails rangers regarding the annual training program which include veterinary related training.*

6.6.3. Reporting.

Table 6.1 indicates the average score per group in the category reporting for the number of reports sent to a veterinary section in KNP.

Table 6.1: *Average percentage of disease reports send to the veterinary sections in KNP, as well as the risk involved for a specific disease.*

Group	**Reports/annum**	**Who at risk**
Private Tour Operators	6%	22%
Trails Rangers	70%	47%
Private Reserves	4%	14%
Concessions	16%	5%

The reasons for reporting any abnormal, sick or dead animal are to prevent further spread towards humans, livestock, and wildlife or to prevent economic loss to the country.

Although a few participants indicated that they sent some reports per annum, they did not do well in identifying the reasons for doing so because they were unable to identify the risks involved. According to Table 6.1, the trail rangers indicated (70%) that they did send reports on a regular basis to the veterinary sections; however, only 47% of the participants were able to identify the risks or reasons for doing so.

Table 6.1 clearly indicates that the other groups did not take part in any surveillance programme prior to this study. These groups were also not able to identify the reasons for reporting specific diseases.

6.6.4. Zoonoses.

According to Figure 6.7, the field guides from the private reserves (59%), the trail rangers (90%) working in KNP and the field guides (79%) from private concessions did well in the sub-category "Aware of zoonoses". In the sub-category for recognition of zoonotic diseases only the trails rangers (60%) and the field guides (55%) from the concessions did reasonably well.

It was important to know the impact that a zoonotic disease could have on a human or animal. Furthermore, it was not good enough to know about the dangers of zoonotic diseases without the ability to recognize or know the specific disease involved.

Most of the groups did very well in acknowledging that they were aware of the dangers of certain diseases, but two groups, namely the concessions and private reserves, were unable to identify the most important zoonotic diseases present in KNP.

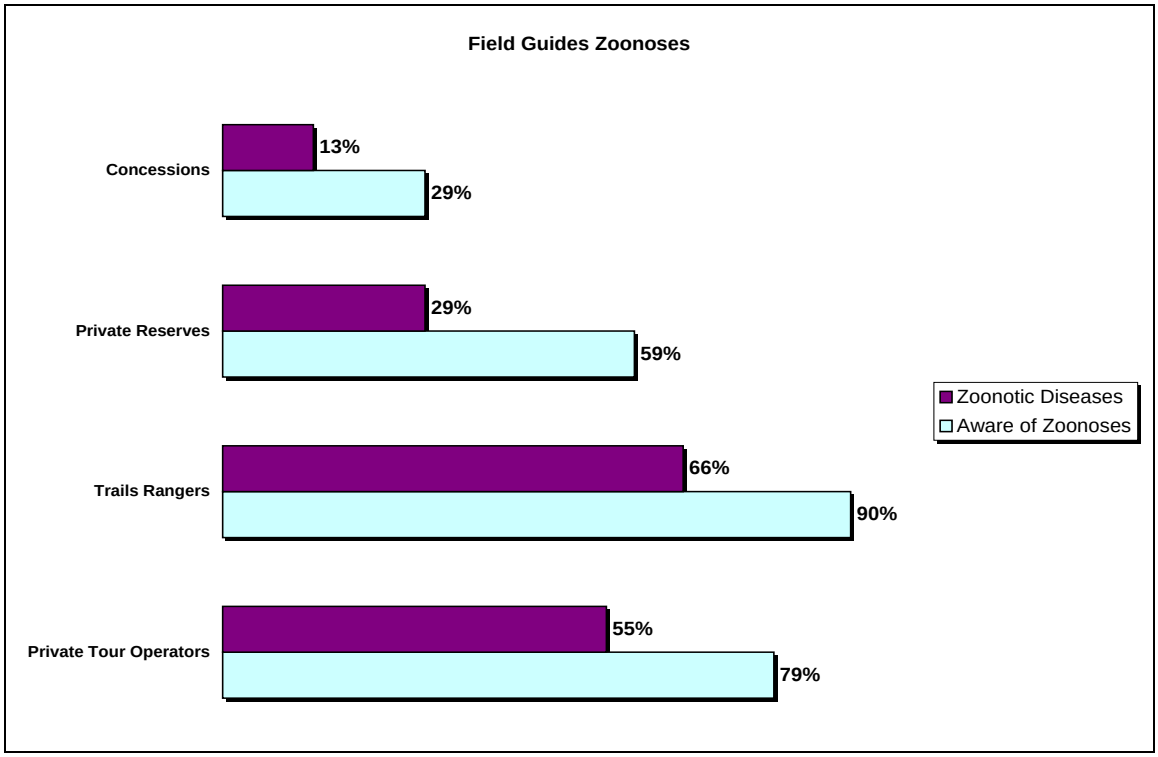


Figure 6.7: *Average percentage for field guides and trails rangers in the sub-categories zoonotic diseases and aware of zoonoses.*

6.6.5. Surveillance.

Surveillance included the primary objectives, important aspects and signs as well as different visible conditions and association of diseases with specific vector species during daily walks or drives in KNP. Surveillance could be deemed as one package with different aspects included in the package.

Taking into consideration the above and according to Figure 6.8, only the trail rangers, as a group, seemed to do well in this regard. Nonetheless, they should address the shortfall in important signs and conditions (44%). The other groups were not capable and should undergo more intensive training programmes in surveillance aspects which would ensure more capable surveillance members on the ground.

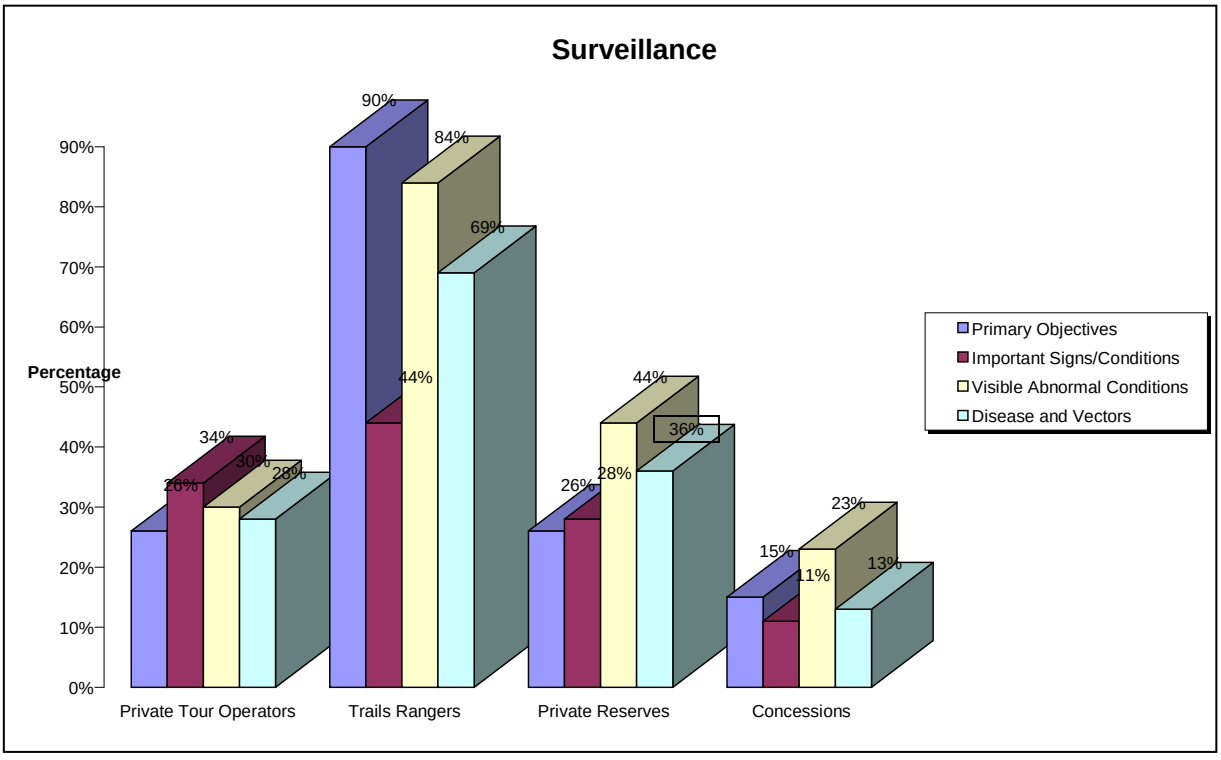


Figure 6.8: *A comparison of the sub-categories of surveillance for al the field guide groups.*

6.7. DISCUSSION.

6.7.1. Communications.

It was crucial that communications between the different groups and the veterinary sections in Kruger be upgraded. However, the low score for communication could be because the incidents were reported to section rangers. It would, therefore, be necessary to explore this communication chain

6.7.2. Training.

Except for the trail rangers, no other group did very well in this category. Therefore, the inclusion of veterinary aspects in annual training programmes should be addressed as a matter of urgency.

6.7.3. Reporting.

Aspects of reporting also required attention to ensure that as many cases as possible were reported to the veterinary sections.

6.7.4. Zoonoses.

Almost all the groups did well in this category which included the safety aspects when handling infected material.

6.7.5. Surveillance.

Except for the trail rangers, all the other groups would need to be more aware about surveillance aspects.

The results are indicated in Figure 6.9.

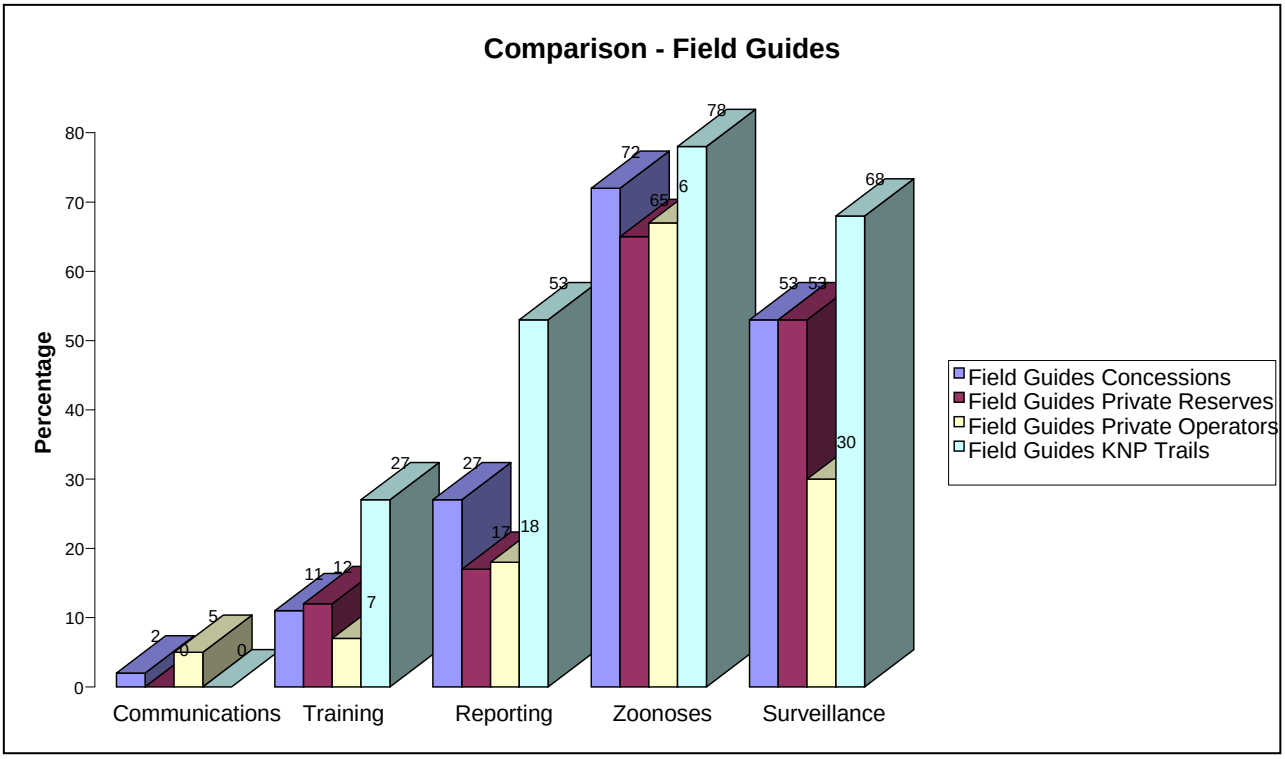


Figure 6.9: *Comparison between different field guide groups for all relevant categories.*

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS.

7.1 INTRODUCTION

The results of this study clearly showed a need to address certain important aspects regarding a wildlife disease programme within the GKNP. All role players and staff should be equipped with more knowledge and practical experience to enable them to participate in a functional wildlife disease surveillance programme. A more efficient wildlife disease surveillance programme, which included more specific and "hands-on" trained staff would definitely ensure a better early warning system which would detect new or emerging disease outbreaks. Such a programme should be aligned with management programmes to contain or eradicate any possible dangerous disease outbreaks which could either have an economic or zoonotic consequence for other wildlife species, livestock or humans.

7.2 SHORTFALLS TO BE ADDRESSED

7.2.1 Training

There was an urgent need for an annual training programme to be conducted with for the appropriate personnel. Such a programme should include considerable veterinary-related aspects as such knowledge is vital. This training programme should be co-ordinated and overseen by the veterinary departments of SANParks and the office of the State Veterinarian. There should be follow-up sessions at least twice per annum.

The training sessions for field rangers specifically should be integrated with well-organized practical training sessions and regular evaluation sessions. The reason for the more practical training of field rangers was because of their relative lower tertiary qualifications. The need also existed to train at least two people, field rangers, per section towards a higher level qualification to enable them to assist in emergency cases when more veterinary experience was

needed or when samples had to be collected in the absence of available trained veterinary field staff.

Ranger sections should be given the opportunity to qualify annually for some incentive or award based on their knowledge, both practical and theoretical, on wildlife diseases and the others relevant matters.

Other groups with higher education qualifications, who participated in the study, also had to be re-trained. In addition, sections or reserves should be visited at least twice per annum because of the relatively high turnover in personnel from certain sections and within certain of the field-guide groups.

The Field Guide Association of South Africa should introduce more veterinary wildlife disease-related aspects within their FEGASA qualification which would enable their guides to be better prepared for the recognition of certain wildlife diseases as well as being able to share more accurate information with their guests on the various aspects of wildlife diseases.

The concern, however, was for the students doing day and night drives as well as walks in the KNP. The reason for this concern was that these groups did not attend any of the training sessions nor completed the questionnaire. These groups fulfilled an important function in the KNP and could be an essential link in the surveillance programme as well as play a major role in the bigger wildlife disease surveillance group. Their recognition of disease aspects and lack of reporting these conditions to the veterinary office could result in a new disease outbreak or condition going by unnoticed. Their co-operation and support would be needed in the programme, and they should be part of the bi-annual training programme and evaluation.

7.2.2 Surveillance

All role players should be positive about wildlife disease surveillance, the important role they could play, and the detrimental effect that an outbreak could have on wildlife populations, livestock or humans.

The rangers of the GKNP should participate in the programme and commit themselves towards the success thereof. They should enforce daily or regular feedback from their field staff after patrols as well as emphasize the importance of submitting blood smears to the veterinary office without delay.

Rangers should ensure that their field staff have the equipment to collect blood smears with them at all times and that they submit these blood smears with the first available transport and not on a six-monthly or annual basis. It was important to submit blood smears of a suspected anthrax carcass immediately to either confirm the disease or not, as such a finding would activate the veterinary offices to react accordingly.

An actual and practical example was the situation at the time of the study on rabies in the KNP: Stray dogs had entered the Park through the fences. The outbreak of rabies, at the time of the study, alongside the borders of the GKNP rendered it essential for all parties involved to have been be aware the problem, to know what to do and how to handle a suspected positive animal or carcass. Rangers should, at all times, report suspected cases of stray dogs within the park without delay and not just discards of the carcass. All suspected cases should be handled as if positive, especially when a human had been bitten or in the case of human contact with a suspected positive animal. Staff and even visitors to the park view stray dogs within the park as possible pets and try to rescue them by picking them up without being aware of the consequences thereof. This aspect could be addressed by implementing proper wildlife disease surveillance and monitoring programmes within the GKNP which would not only sensitize staff and visitors but also make them aware of the consequences and deadly effects of certain diseases.

Although the job descriptions of section rangers and field rangers in the KNP made provision for wildlife disease surveillance as part of their daily work schedule, the private reserves needed to address the shortfall within their job descriptions for their field guides and rangers as both could and should play a major role in the GKNP wildlife disease surveillance programme.

7.2.3 Zoonotic aspects

It was important to ensure the safety of all staff working with possibly infected carcasses or material. The veterinary office supplying the smear glasses to the different sections should ensure that they supplied additional basic equipment, such as protective gloves. In cases of more dangerous material or carcasses, employers should ensure that the staff was equipped with protective clothing and masks.

Staff should know the safest but most efficient way for collecting samples or preparing blood smears. This knowledge was most important and all staff involved in collecting samples or smears should be aware of the safety precautions involved.

7.2.4 Communications and Reports

Without a proper functioning communication system, no functional wildlife disease surveillance programme would be able to operate effectively..

Section rangers in the KNP should report suspected cases or any abnormalities without delay to the veterinary office. Rangers in the private reserves should be more aware of their roles when reporting or communicating to the veterinary office. It seemed that cases reported by the trails rangers, field guides or concessions disappeared *en route* to the veterinary office. Consequently, a more direct channel of reporting important or urgent cases should be established.

The handling of reports should be a pivotal entity of the wildlife disease surveillance unit for all members and interested parties involved. These reports could be compiled into a monthly or quarterly wildlife disease surveillance magazine or newsletter for the GKNP.

7.3 DEVELOPMENT OF A DISEASES SURVEILLANCE SYSTEM

In addition to the identification of shortfalls discussed above, the following measures should be considered when developing and implementing a disease surveillance programme:

7.3.1 Information sessions for visitors and administrative staff of the KNP

Information sessions on wildlife diseases and the impact they could have on animals and humans for visitors during peak or high season times in all relevant rest camps and even at private lodges within the private reserves was essential. These information sessions could include brochures, short electronic shows on different diseases aspects, posters at rest camps and lodges and even static exhibition. They should expand to the administrative staff working in the park or reserve as they could play a crucial role in the surveillance program. Information programme should include permanent exhibitions at the different ranger sections and camps as a reminder for staff members to be aware at al times.

7.3.2 Reporting

A report book at every rest camp or lodge would be practical so that visitors report any abnormal, sick animal or carcass they had seen. These reports could then be investigated by staff from either the veterinary offices or from a surveillance unit that could be established specifically to follow up on any reports.

The provision of an emergency 0800DISEASE telephone line for the GKNP, operating on a 24 hour basis, should be investigated and, if possible, implemented. Such a line could be used by visitors, staff and other relevant partners to report suspicious cases immediately.

Apart from having a wildlife disease surveillance unit operating in the GKNP, it would be essential to have a dedicated office for wildlife disease surveillance from where all planning, operations, programmes, training, training material, information brochures and practical training sessions could be co-ordinated. All incoming reports could be scrutinized and sifted centrally and, where necessary, be referred to the relevant person or veterinary section for investigation.

The handling of reports should be a central entity of the wildlife disease surveillance unit for all members and interested parties involved. These reports could be compiled into a monthly or quarterly wildlife disease surveillance magazine or newsletter for the GKNP.

7.3.3 Training

All new staff members employed in the GKNP should undergo at least a level 1 training session in wildlife diseases surveillance aspects. The compilation of a pocket-sized field guide with explanatory photographs in different languages and easy to understand text should be essential for all field staff.

Training material, shows, posters and brochures should be printed in the most common language in the GKNP, namely Shangaan, to capture the attention and interest of the local inhabitants. These brochures could form part of the normal hand-outs to visitors at the entrance gates.

7.4. CONCLUSION

The researcher would like to see the process of disease surveillance in the GKNP as a procedure linked to **Time.** If no drastic improvement or adjustments were made to the process in operation as at the time of the study, it would be a matter of **Time** before an outbreak with devastating consequences occurred with immense monetary implications or loss of human life or both.

The researcher would suggest that a process, called the "TIMER" process be followed.

T	-	TRAINING	(everybody trainable)
I	-	INFORMATION	(as wide as possible)
M	-	MONITOR	(data and the process)
E	-	EVALUATE	(on a regular basis)
R	-	REPORT	(always give feedback on reports)

The objectives of the study had been met as it was able to evaluate various important aspects related to surveillance from 88% of the possible participants in the study area through a questionnaire. Numerous shortfalls within the current surveillance programme of the GKNP were identified and discussed together with proposals for the rectification of the situation as it

existed at the time of the study, and for the implementation of a proper wildlife disease surveillance programme for the GKNP.

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