Import Risk Analysis: Sable antelope from Zambia into South Africa

Report

Prepared for

Directorate of Animal Health
Department of Agriculture, Forestry and Fisheries
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South Africa

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Contents

Abbreviations and Acronyms

AGID	Agar gel immuno-diffusion assay
ALOP	Appropriate Level of Protection, also sometimes referred to as "acceptable level of risk"
CBPP	Contagious bovine pleuropneumonia
CFT	Complement Fixation Test
CVO	Chief Veterinary Officer
DAFF	Department of Agriculture, Forestry and Fisheries
DAH	Directorate: Animal Health, Department of Agriculture, Forestry and Fisheries
ELISA	Enzyme-linked immuno-assay
FAO	Food and Agricultural Organisation of the United Nations
FMD	Foot-and-mouth disease
OIE	World Organisation for Animal Health
PCP	Progressive control pathway for FMD
PCR	Polymerase chain reaction
PPR	Peste des petits ruminants
PVS	Performance of Veterinary Services
RBT	Rose Bengal Test
RT-PCR	Reverse transcriptase PCR
RVF	Rift Valley fever
SAT	South African Territories serotypes of FMD virus
SADC	Southern African Development Community
VS	Veterinary Services
WAHID	World Animal Health Information Database

Introduction

In 2009, the South African company Swanvest 234 (Pty) Ltd purchased approximately 150 sable antelope from the national wildlife authority in Zambia. Subsequently, Swanvest's application for an animal health permit for the importation was refused by the Department of Agriculture, Forestry and Fisheries (DAFF) on account of potential disease risks to South Africa from the importation. Negotiations continued and despite several previous risk analyses, the importation has still not been approved. The dispute has since resulted in court action in an attempt to force a resolution.

In February 2014, the North Gauteng High Court in Pretoria, where the case is being heard, made an order that DAFF (among other things) "…*complete a Risk Analysis as prescribed by the OIE Code*…". This risk analysis has been prepared in response to that order.

Scope

The scope of this risk analysis specifically relates to the importation of Sable antelope from Zambia, and in particular to the import application for a consignment of Sable currently in isolation near Lusaka, Zambia and owned by Swanvest 234 Pty Ltd. This group of sable has been maintained in isolation in Zambia for more than five years, an important factor that has been taken into account in this analysis where appropriate and which might not be applicable for other shipments.

Because of the nature of the risk analysis process, the process for setting import policy and the consideration of potential for future similar applications, this analysis is undertaken primarily as a generic analysis for estimating and managing the risk associated with importation of sable antelope imported from Zambia into South Africa. This process is important to allow setting of policy for future imports. However, during the analysis, issues of relevance to the specific shipment currently under consideration are identified and discussed.

Methods

Assumptions in relation to the current shipment

Approximately 150 sable were originally purchased in 2009 and were captured from Kafue National Park in Zambia. During this period they have reportedly been kept isolated from other wildlife species and domestic livestock and no additional animals have been introduced, although this information is unverified. Presumed natural increase during the period has resulted in the herd now approaching 500 animals in total. The degree of supervision during this isolation period is uncertain, as is any involvement or official supervision by the Zambian veterinary authorities.

An important consideration for this risk analysis is that while the sable are reported to have been in "isolation" for 5 years or more, this is not the same as being in a quarantine station. A quarantine station requires official control and includes a high level of management of biosecurity risks associated with both direct and indirect contact with potential infection sources outside of the quarantine station (OIE, 2014h). In contrast, isolation is undefined by

the OIE and has no requirement for official supervision or for management of biosecurity risks, other than by an undefined separation from other animals.

Soon after capture (2009-2010) the sable were reported to be submitted to a variety of disease testing as summarised below (G. R. Thomson, 2010; D. Keet, 2014):

- Foot-and-mouth disease – 160 animals all negative (SAT 1,2,3 only) in September 2009 and 150 animals all negative (SAT 1,2,3 only) in October 2009.
- Trypanosomes and theileriosis – 150 tested, no parasites observed on blood smears but 21 positive for trypanosomes on PCR (not further identified).
- Brucellosis – 150 animals tested, 1 positive by Rose Bengal test and C-ELISA, subsequently euthanased and negative on complement fixation test at slaughter.
- Tuberculosis – two occasions but details not provided.
- CBPP – a negative test by CFT, no details provided.

In addition, a number of animals that died were necropsied and tissues submitted for a variety of testing with no diseases of trade significance detected.

No evidence has been provided of supervision of testing by State veterinary services in Zambia.

OIE Code chapter on import risk analysis

The Terrestrial Animal Health Code (the *Code*) provides recommendations and principles for conducting transparent, objective and defensible risk analyses for international trade (OIE, 2014i). These recommendations and principles were applied for this risk analysis, with a brief summary of the guidelines and details of how these were implemented for this analysis described in the following sections.

Evaluation of Veterinary Services for Zambia

The evaluation of the Veterinary Services of the exporting country, including surveillance and control programmes and implementation of zoning and compartmentalisation systems form a critical part of the hazard identification process. In particular such an assessment can inform assessments of the likelihood of particular hazards being present in the population from which the imported animals are sourced or exposure from other sources prior to export. The OIE provides guidelines and support for the independent evaluation of a Member country's veterinary services and publishes completed evaluations on their website, along with a Gap Analysis (OIE, 2014r; OIE, 2014q). Published PVS reports and Gap Analyses can then be used by country's wishing to assess an exporting country's disease surveillance and control capabilities and capacity.

The PVS and Gap analysis reports for Zambia were unavailable, so for this analysis the veterinary services of Zambia were evaluated through the following means:

1. A specific questionnaire (based on the PVS tool) relating to general evaluation of veterinary services as well as occurrence and knowledge of specific diseases, submitted to the Zambian Chief Veterinary Officer and
2. A more detailed questionnaire specifically relating to foot-and-mouth disease also submitted to the Zambian Chief Veterinary Officer.

Hazard identification

Hazard identification involves identifying the pathogenic agents which could potentially produce adverse consequences associated with the importation of a commodity. Hazards must be appropriate to the species being imported, be present (or possibly present) in the exporting country and either not present in the importing country, or a notifiable disease and/or subject to control or eradication in that country. If the disease is present in the importing country risk management measures should not be more trade restrictive than those applied within the country. Where an importing country decides to permit the importation using the appropriate sanitary standards recommended in the *Code* there is no need for a risk assessment.

A list of potential hazards were initially identified from previous reports as well as by stakeholders through the risk communication process. This list was then further refined by consideration of:

- Relevance to Sable antelope
- Presence or likely presence in Zambia
- Presence/absence in South Africa
- Whether or not it is a notifiable disease or subject to control or eradication in South Africa
- Whether or not the OIE code provides an acceptable sanitary standard for the movement

Only diseases that met the criteria for a Hazard and where the sanitary measures recommended in the *Code* were not considered acceptable were considered further.

Risk assessment

Risk assessment for each of the hazards followed the four steps of entry assessment, exposure assessment, consequence assessment and risk estimation, described in the *Code*. Entry and exposure assessments were undertaken initially for unrestricted risk, in the absence of any proposed risk mitigation measures. Where the resulting risk exceeded the defined acceptable level, further risk management options were evaluated to determine the most appropriate risk management option(s). The assessment was undertaken on a qualitative basis, as described in more detail below. Likelihood and consequence assessments were undertaken in consultation with DAH staff to determine appropriate scores.

Entry Assessment

The entry assessment describes, for each hazard, the potential pathways by which the hazard might be introduced into the importing country and the likelihood of this occurring. For each hazard, potential pathways of entry were identified and the likelihood of entry of the hazard by the pathway(s) assessed on a qualitative scale, adapted from and similar to that used by the

Australian Government, as set out in Table 1 (Biosecurity Australia, (2009); Department of Agriculture, Fisheries and Forestry, (2012)). This approach is also similar to that presented by Dufour et al. (2011), but with fewer levels.

Factors considered in arriving at an appropriate entry likelihood score for each hazard include:

- host factors, including but not limited to species, size of consignment, location, management, previous testing history and other relevant information
- agent factors, including but not limited to species, occurrence of varying strains, sub species and topotypes, epidemiology of the agent and other relevant factors
- country of origin factors, in particular available information on disease occurrence (or lack thereof) and evaluation of veterinary services in the country of origin.

Table 1. Qualitative scale used for likelihood assessments

Likelihood estimate	Interpretation	Chance of occurrence
High	The event would be very likely to occur	>1/5
Moderate	The event would be moderately likely to occur	<1/5
Low	The event would be unlikely to occur	<1/100
Very low	The event would be very unlikely to occur	<1/10,000
Negligible	The event would almost certainly not occur	<1/100,000

Exposure Assessment

The exposure assessment describes, for each hazard, the potential pathways by which animals or humans in the importing country might be exposed to the hazard and the likelihood of this occurring. For each hazard, potential pathways of exposure were identified and the likelihood of exposure to the hazard via the pathway(s) assessed on the same qualitative scale as used for entry assessment (Table 1).

Factors considered in arriving at an appropriate exposure likelihood score for each hazard include:

- host factors, including but not limited to species, size of consignment, intended destination in South Africa, potential for onward movement and dispersal and other relevant information
- agent factors, including epidemiology and transmission potential under South African conditions
- country factors, in particular presence of vectors and suitable ecosystems for the hazard.

Consequence Assessment

The consequence assessment describes, for each hazard, the relationship between a specific exposure and adverse animal or human health or environmental consequences of that exposure. Consequences include both direct effects (production losses, deaths, public health effects) and indirect (control, surveillance, compensation, trade losses end environmental

impact) and are usually estimated in socio-economic terms and may be qualitative (descriptive) or quantitative (numeric).

For each potential exposure event, consequences were assessed separately on a qualitative scale for individual affected farms, the local area around affected farms and at provincial and national levels. At each level, consequences were assessed on a scale of 0 to 4, as shown in Table 2. Further, these scores were weighted by a factor of 1 (individual farms) to 4 (National level) assuming that at each successive level overall consequences and their contribution to national impact are greater for the same score. The final overall consequence score was calculated as the weighted mean of the individual level scores, rounded to produce a value on the same 0 to 4 scale.

Table 2. Qualitative scale for assessing consequences at each level

Consequences	Score
Inconsequential	0
Minor impact	1
Significant impact	2
Major impact	3
Extreme impact	4

For example, assume a hazard has the following consequence profile:

- individual farm level = 3
- local level = 2
- provincial level = 2 and
- national level = 1

The overall consequence score for this hazard is (1x3 + 2x2 + 3x2 + 4x1)/sum of weights (10) = (3+4+6+4)/10 = 17/10 = 1.7, rounded to 2 = significant impact.

Based on this approach, an extreme overall consequences rating requires major or extreme impacts at all levels, while a major overall consequences rating generally requires major or extreme impacts at most levels. Hazards that do not have at least significant provincial and/or national impacts are unlikely to have more than minor overall consequences.

Risk estimation

Risk estimation is the process of combining the results of the entry, exposure and consequence assessments to produce an overall estimate of risk associated with the importation.

For this analysis, the entry and exposure assessments were first combined using the risk matrix in Figure 1, to produce an overall score for likelihood of entry and exposure. Because this is combining two likelihoods in series, it is essentially a multiplicative process, so that the overall likelihood cannot be greater than the lowest of the entry and exposure likelihoods. This matrix is again adapted from those used by Australia (Biosecurity Australia, (2009); Department of Agriculture, Fisheries and Forestry, (2012)) and similar to that proposed by Dufour et al. (2011), except with fewer levels.

A key principle behind this matrix is that high and moderate likelihoods are generally closer to one, compared to low and very low likelihoods which are close to zero. Therefore, when one or both likelihoods are high or moderate, the combined likelihood is unchanged from the lower of the two scores. Conversely, when both likelihoods are low or very low, the overall likelihood is reduced, compared to the lower of the two scores.

Figure 1. Risk matrix for combining likelihoods of entry and exposure

Entry Likelihood						
	High	Negligible	Very Low	Low	Moderate	High
	Moderate	Negligible	Very Low	Low	Moderate	Moderate
	Low	Negligible	Negligible	Very Low	Low	Low
	Very Low	Negligible	Negligible	Negligible	Very Low	Very Low
	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
		Negligible	**Very Low**	**Low**	**Moderate**	**High**
		Exposure likelihood				

The final step in risk estimation is to combine the overall likelihood score with the consequence score, to produce the final risk estimate. This was done using the risk matrix shown in Figure 2, again adapted from the Australian method (Biosecurity Australia, (2009); Department of Agriculture, Fisheries and Forestry, (2012)) and similar to Dufour et al., (2011).

Figure 2. Risk matrix for combining likelihood of entry and exposure and consequences

Entry & exposure Likelihood						
	High	Very Low Risk	Low Risk	Moderate Risk	High Risk	High Risk
	Moderate	Very Low Risk	Low Risk	Moderate Risk	High Risk	High Risk
	Low	Very Low Risk	Low Risk	Low Risk	Moderate Risk	Moderate Risk
	Very Low	Negligible Risk	Very Low Risk	Low Risk	Low Risk	Low Risk
	Negligible	Negligible Risk	Negligible Risk	Very Low Risk	Very Low Risk	Very Low Risk
		Inconsequential	**Minor impact**	**Significant impact**	**Major impact**	**Extreme impact**
		Consequences				

It is important to note that there is a significant difference in the underlying principles of the risk matrix in Figure 2 (combining likelihoods and consequences), compared to that for combination of likelihoods in Figure 1. Unlike the previous matrix, this is the combination of

a quantity (consequences) and a likelihood (entry and exposure). Therefore, the restriction on the outcome having to be less than the least of the input scores no longer exists.

Further, the three scores (likelihood, consequences and risk) are all on different scales, so that the risk outcome is a subjective assessment of overall risk resulting from the two inputs. As a result, the matrix is not necessarily symmetrical. As an example, a moderate likelihood of a major impact event (consequence), is considered *High Risk* (a moderate likelihood is still quite likely to happen and if the consequences are major this presents a high risk to the South African community and industries). The logic of other combinations can be argued similarly.

Importantly, the "*Very Low Risk*" category in this matrix equates to the acceptable level of risk proposed for this risk analysis and for imports into South Africa generally (but not to *Very Low* likelihood).

Risk Management

For hazards where the unmitigated (unrestricted) risk estimate meets the importing country's ALOP no further action is required. Where this is not the case, risk management is required. Risk management is the process of evaluating options to reduce the level of overall risk to an acceptable level. This can be an iterative process until the preferred risk management option is identified. However, an important principle is that the final option chosen should be no more restrictive than necessary to reduce the risk to meet the ALOP – i.e. risk management options should not be more onerous than necessary to provide the appropriate level of risk reduction.

For this risk analysis, risk management options for each hazard were identified in consultation with DAH staff and evaluated to identify a preferred option which met the above criteria. Where possible, these options were consistent with those applied for movement of wildlife within South Africa. Where this was not possible the options were designed to reduce risk to an acceptable level (*Very Low Risk*), without being any more onerous than necessary to achieve that aim.

Appropriate level of protection

The appropriate level of protection (ALOP), or acceptable level of risk, for sanitary or phytosanitary measures is defined by the Sanitary and Phyto-sanitary Agreement of the World Trade Organisation as "*the level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory*" (Anonymous, undated-a; Anonymous, undated-b). A country has the right to determine its own ALOP, while taking into account the aim of minimizing negative effects on trade. The ALOP must also be applied consistently between countries and commodities and should not be used in a discriminatory fashion (Anonymous, undated-b).

South Africa does not have a pre-existing public statement of its ALOP. This risk analysis is based on an acceptable level of risk of "*Very Low Risk*". This is consistent with existing disease control practices and import requirements in South Africa and also consistent with the ALOP for other risk-averse countries, such as Australia (Australian Government Department of Agriculture Fisheries and Forestry, 2011).

An important biosecurity principle applied in South Africa for all imports is that all risk mitigation must be managed at origin (pre-export). Any testing undertaken in South Africa is to confirm the efficacy of risk management measures imposed at origin and is not for the purpose of additional risk management.

Risk Communication

Risk communication is a critical component of any risk analysis. "*Risk communication is the process by which information and opinions regarding hazards and risks are gathered from potentially affected and interested parties during a risk analysis, and by which the results of the risk assessment and proposed risk management measures are communicated to the decision-makers and interested parties in the importing and exporting countries*" (OIE, 2014i). Risk communication is a 2-way process and should be ongoing throughout the period of the risk analysis, seeking input from and providing information back to stakeholders.

For this risk analysis, a Risk Communication Strategy was developed by DAH in early 2014 and implemented throughout the risk analysis process (Anonymous, 2014d). Details of the specific communications are described in the relevant section.

Risk Analysis

Evaluation of Veterinary Services for Zambia

Normal process for evaluating Veterinary Services (VS):

The Directorate has developed a questionnaire which aims to assist in establishing the resources (infrastructure, equipment and human) allocated to VS as well as their ability to control diseases of significance. This questionnaire is normally sent at the request of industry to a prospective trade partner, and a response to it assessed. Depending on the commodity of interest, specific disease questionnaires are sent together with the general questionnaire. Once the Directorate is satisfied with the responses supplied by the VS, a mission may be arranged to verify the information supplied.

Response time

The Veterinary Services and FMD questionnaires were sent via e-mail to the Zambian CVO in April 2014 and follow up reminder e-mails were sent in June 2014, July and September 2014 as no responses were received. An acknowledgment of receipt was received in June 2014. Verbal reminders were also given during the OIE General Session and the LTC meeting. A response was received only towards the end of September 2014 (signed on 19 September 2014), just before the final deadline that was set to allow for incorporation of the information into this Risk Analysis (Anonymous, 2014b). A copy of the Annual Report of the Directorate of Veterinary Services for 2013 was received at the same time and was used to supplement the evaluation (Anonymous, 2013).

General observations

The reply by the Zambian Veterinary Authorities is incomplete and does not really provide sufficient additional information on the disease situation in the country or in the area of origin for the sable antelope. In the general questionnaire, some questions have not been answered at all, for example those pertaining to the number of veterinarians registered in Zambia or the policies with regard to food waste from arriving international aircrafts.

Disease Reporting

The information provided indicates that communication seems to be a challenge in Zambia, with the 2013 Annual Report stating that only 41.4% of monthly district reports were received in the Central Office – which is particularly problematic in view of Zambia's reply revealing that the knowledge about animal diseases relies almost exclusively on passive surveillance and disease reporting. This also explains the poor OIE immediate notification history of Zambia on the WAHID website with only one report for 2010, none for 2011, one for 2012 and two for 2013, as well as the large number of OIE-listed diseases on the WAHID website country status report for which no information is available (OIE, 2013f). In addition, Zambia has provided no collated surveillance reports to South Africa and the disease outbreak information is difficult to analyse because it states only case numbers, rather than numbers of incidents / events or at least outbreaks and no maps have been attached.

Imports

Some useful information has been provided about the origin of imports, with South Africa and Namibia being countries from which live cloven-hoofed animals were legally imported during 2013 while beef was imported from the same countries, as well as the UK and Ireland. However, the reply does not state that these were the only countries that import permits were issued for and no further information about import conditions has been provided. Also, the risk of illegal importation from other neighbouring countries and the measures taken to address this risk is not addressed in any of the information supplied although spread from neighbouring infected countries almost certainly plays a role in the epidemiology of some of the diseases in Zambia.

Disease status (general)

With regard to the information provided about the disease status and disease control measures for the most important trade sensitive diseases, Zambia unfortunately has presented all the information merely in a summary table, without any details about the specific epidemiological situation and control programmes for individual diseases. Some of the information about control measures is rather difficult to understand, for example the movement restrictions for East Coast Fever (ECF) being *"applied based on the strains of ECF prevailing in that region"* with the requirement that cattle *"are only permitted to move from one district to another if the strain are the same or if the animals are free of the infection"*. It is difficult to believe that such detailed control measures requiring a large amount of testing could be applied effectively without detailed active surveillance data being available. Furthermore, very little information has been provided about the vaccines being used to control animal diseases.

Zambia has not submitted much information about the CBPP outbreaks experienced in recent years, including the one that was reported to the OIE in 2013, nor about the likely origin of these outbreaks. This raises the question whether illegal introductions of cloven-hoofed animals from neighbouring countries could have played a role, with particular reference to the transboundary transmission challenges mentioned in the recent publication about Zambian disease control (Y. Sinkala et al., 2014). With regard to PPR, the 2013 Annual Report mentions some sero-surveillance that was conducted in the past (sometime between 2009 and 2012) and that more was required but no surveillance report has been provided. Of particular concern is a discrepancy between the Zambian assertions in the reply to the general questionnaire that PPR has never occurred or been reported in Zambia and the OIE WAHID country disease status entry reflecting that the disease last occurred in 2010.

Foot-and-mouth disease

Zambia has not provided much information about the status and disease control measures for FMD with the specific FMD questionnaire not being returned at all. Information gleaned from the general questionnaire is that FMD surveillance also depends mostly on passive reporting. With regard to a FMD sero-monitoring report that is referred to in the reply to the general questionnaire, the document that has been attached contains only a protocol for such active surveillance with no results or report being supplied. Even in the Annual report from 2013, the FMD information is rather sketchy. It is of particular concern that the Annual Report mentions 110 cases of FMD in 2013, while no corresponding report of such an outbreak can be found on the OIE WAHID reporting system. Of similar concern is the discrepancy detected in the Zambian reply to the general questionnaire reflecting that no FMD outbreaks have occurred in the last 3 years, while an outbreak of FMD has been reported to the OIE in 2012, according to the WAHID emergency disease reporting information website, and the attached Annual Report states that 110 cases of FMD have been detected in 2013.

Although some information about the circulating FMD strains is provided in the FMD sero-monitoring plan, there seems to be no regular monitoring of the sero-types causing the various outbreaks and no information has been provided anywhere in the reply sent by Zambia about the sero-types being involved in the more recent outbreaks during 2013. In reference to a recent article about FMD in Zambia (Y. Sinkala et al., 2014), the presence of other than the SAT serotypes of FMD in Zambia, particularly O and A, can thus not be excluded. The O serotype was last reported to occur in Zambia in 2000 according to the OIE Handistatus information from before 2005 (OIE, 2014a). The decision mentioned in the FMD sero-monitoring plan about changing from the trivalent to a bivalent SAT FMD vaccine in 2009 seems to have been based on limited ongoing serological evidence.

It was noted that FMD vaccination campaigns are being conducted but there is little evidence of regular 6 monthly vaccination rounds as required – noting that the Botswana FMD vaccine manufacturers, this being the vaccine that is being used by Zambia, does recommend 4 – 6 months intervals between vaccinations. Mention has been made in the 2013 Annual Report about difficulties with the *"second round of FMD vaccination"* in certain areas that *"was not undertaken due to lack/limited funding"* – and no reference has been made to booster vaccinations for those animals being vaccinated for the first time.

Conclusion

Considering Zambia's reliance on passive surveillance, the information provided raises doubt over whether Zambia would be in a position to detect exotic and trade-sensitive diseases, like CBPP, PPR, Nairobi sheep disease, Rift Valley Fever etc. in a timely and reliable manner. It also raises doubts about the efficacy of any disease control and biosecurity efforts being instituted by the Government Veterinary Authorities in Zambia, including the ability of Zambia to provide trade-related guarantees, like those for the certification of effective pre-export quarantine of live animals. These doubts are particularly pertinent for diseases for which no active surveillance data can be provided although the non-specific nature of their symptoms makes it impossible to reply on passive surveillance alone, as well as for diseases that are transmitted not only by direct contact between animals but also by indirect means, like vectors, fomites and animal products.

Based on the information above, it also serves no purpose in organizing a visit to Zambia as the information supplied is far from sufficient to warrant a verification exercise.

Hazard Identification

A total of 42 potential hazards were identified through the initial consultative process (see Tables 3 and 4). After consideration of the criteria defining a hazard, 27 potential hazards were excluded (Table 4) and 15 hazards remained for further consideration (Table 3). For convenience and considering their similar epidemiology and risk management, *Brucella abortus* and *Brucella melitensis* were considered together as "Brucellosis", making a final list of 14 hazards for assessment.

Contagious bovine pleuropneumonia, Nairobi sheep disease and peste des petits ruminants were specifically retained on the hazard list, despite the fact that there is no recognised involvement of sable antelope in their transmission or epidemiology. This was done because these particular diseases are exotic to South Africa and could have potentially severe impact should they be introduced and although there is no recognised involvement of sable in the epidemiology of these diseases, there is also no definitive scientific evidence that they are not involved or able to transmit the disease(s). Therefore it was determined that more detailed consideration of these diseases was warranted.

A number of diseases (bluetongue serotypes exotic to South Africa, Nairobi sheep disease, Rift Valley fever) were specifically retained on the hazard list because information from Zambia was inadequate to be confident that they were not present. Bluetongue, *Theileria* spp and Trypanomomes were also retained because of concerns about the possibility of strains or subtypes different to those already present in South Africa possibly being present in Zambia.

Table 3. List of identified potential hazards for sable antelope from Zambia requiring further evaluation

Agent/disease	Relevance to Sable	Presence in Zambia	Presence in RSA	Controlled/notifiable disease in RSA	Hazard	OIE Code measures acceptable	Comments
Amblyomma variegatum	+	+	-	+	Yes	NA	
Anthrax	+	+	+	+	Yes	Yes	
Bluetongue	+	?	+	+/-	Yes	Yes	Exotic serotypes notifiable and subject to control if they occur. OIE provisions not feasible for sable
Bovine tuberculosis	+	+	+	+	Yes	NA	
Brucella abortus	+	+	+	+	Yes	No	
Brucella melitensis	+	+	+	+	Yes	No	
Contagious bovine pleuropneumonia	?	+	-	+	Yes	NA	No reference to antelope in OIE
Foot and mouth disease	+	+	+	+	Yes	No	
Nairobi sheep disease	?	?	-	+	Yes	NA	
Paratuberculosis (Johne's disease)	+	+	+	+	Yes	NA	
Peste des petits ruminants	?	+	-	+	Yes	Yes	Assuming effective quarantine
Rabies	+	+	+	+	Yes	Yes	
Rift Valley Fever	+	?	+	+	Yes	Yes	No active outbreaks, depends on Zambian information
Theileria spp (including *T parva*)	+	?	+	+/-	Yes	NA	Exotic *Theileria* species subject to control (spp of concern not covered)
Trypanosomosis	+	+	+	+	Yes	NA	Depending on *Tryp*. Subspp. (exotic *T. congolensi* sub-types or *T. brucei*)
Key:	+	Present					
	-	Absent					
	?	No information available					
	NA	Not applicable					

Table 4. List of identified potential hazards for sable antelope from Zambia NOT requiring further evaluation

Agent/disease	Relevance to Sable	Presence in Zambia	Presence in RSA	Controlled/notifiable disease in RSA	Hazard	OIE Code measures acceptable	Comments
Anaplasmosis	+	+	+	-	No	NA	
Babesiosis	+	+	+	-	No	NA	
Border disease (pestivirus)	?	?	+	-	No	NA	
Bovine virus diarrhoea (pestivirus)	?	+	+	-	No	NA	
Chlamydophila abortus	?	?	+	-	No	NA	
Coccidiosis	+	+	+	-	No	NA	
Congo-Crimean haemorrhagic fever	?	?	+	-	No	NA	
Corona virus	?	?	+	-	No	NA	
Corynebacterium pseudotuberculosis	?	?	+	-	No	NA	
Cryptosporidium	?	?	+	-	No	NA	
Dermatophilosis	?	?	+	-	No	NA	
Echinococcosis	+	?	+	-	No	NA	
Ecto & Endo parasites	+	+	+	-	No	NA	Prescribed treatments
Epizootic haemorrhagic disease	?	?	+	-	No	NA	
Heartwater	?	+	+	-	No	NA	
Infectious bovine rhinotracheitis	?	?	+	-	No	NA	
Lumpy Skin disease	?	+	+	+	No	NA	Notifiable only
Malignant Catarrhal Fever	?	?	+	+	No	NA	Notifiable only
Pneumocystis	?	?	+	-	No	NA	
Q Fever	?	?	+	-	No	NA	
Rinderpest	?	-	-	+	No	NA	Globally eradicated
Rotavirus	?	?	+	-	No	NA	
Sarcoptes	?	?	+	-	No	NA	
Schistosomiasis	?	+	+	-	No	NA	

Agent/disease	Relevance to Sable	Presence in Zambia	Presence in RSA	Controlled/notifiable disease in RSA	Hazard	OIE Code measures acceptable	Comments
Toxolasma gondii	?	?	+	-	No	NA	
Trichinellosis	?	?	+	+/-	No	NA	Not considered a hazard for cloven-hoofed animals
West Nile fever	?	?	+	-	No	NA	

Key:		
	+	Present
	-	Absent
	?	No information available
	NA	Not applicable

Risk Assessment & Risk Management

Amblyomma variegatum

Amblyomma variegatum, or the tropical bont tick, is a three-host tick endemic to much of sub-Saharan Africa. *A. variegatum* is not an OIE listed disease, but is considered an important pest of livestock and wildlife in Africa because it is a known vector for heartwater (*Ehrlichia ruminatum*) and *Rickettsia africae* (African tick-bite fever), as well as a possible vector for Crimean-Congo haemorrhagic fever and Nairobi sheep disease (W. A. Geering et al., 1995; Anonymous, 2009a; K.C. Prine and A.C. Hodges, 2013). It is also recognised as having longer mouth parts than other *Amblyomma* spp ticks, resulting in larger bite wounds which are prone to screw worm fly infestation, significant skin damage and secondary infections (Anonymous, 2009a).

A. variegatum is present in Zambia, but not in South Africa (G. R. Thomson, 2010; D. Keet, 2014). It is notifiable in South Africa and, as an exotic pest, is subject to official control measures should it occur. It is therefore considered a possible hazard associated with the importation of sable from Zambia. *A. variegatum* is not OIE-listed and there are no published recommended measures for importation from a known infected country.

Entry assessment

The expected pathway of entry for *A. variegatum* with imported sable is for live ticks to infest the sable prior to or during preparation for export and be transported with the sable when they are imported into South Africa.

Sable antelope are susceptible to tick infestation but are generally high-value animals which are likely to be observed for ticks and treated as necessary while being prepared for export. However, despite likely past treatments there is still potential for ticks to be present and to be translocated with the sable at the time of shipment unless risk mitigation measures are imposed. The current shipment has been held in isolation for a number of years, during which time they are likely to have had multiple tick treatments, but the potential for ticks to be present at the time of export still cannot be ignored.

Given the above considerations, the likelihood of entry of *A. variegatum* into South Africa with imported sable is considered to be *Low*.

Exposure assessment

The expected pathway for exposure is for introduced ticks to drop off the sable after introduction into South Africa and subsequently find and attach to local hosts at the point of destination.

If ticks are introduced into South Africa they are likely to survive and be able to infest in-contact animals in South Africa. However, there is some uncertainty about environmental suitability and the tick's ability to survive and compete with local species, hence the likelihood of exposure in South Africa is considered *Moderate*.

Consequence assessment

It is assumed that if exposure to *A. variegatum* occurs in South Africa then the parasite will establish and spread at least locally, depending on environmental and climatic suitability and ability to compete with other tick species. Once the presence of the tick is identified there is also likely to be buyer-resistance to trading with known infected areas. Expected impacts are therefore mostly due to tick worry and associated production loss on affected farms and trade impacts at local and Provincial levels.

The consequence assessment for *A. variegatum* is summarised in Table 5. Overall, the expected consequences were assessed as *Significant*, although there is considerable uncertainty about this value, depending on how well the tick establishes and spreads in the local environment.

Table 5. Summary consequence assessment for A. variegatum

Agent/disease	Consequence level	Score	Comment
Amblyomma variegatum	Individual farms	2	Production loss and tick worry
	Local	2	Local trade impacts, depending on how well it establishes and spreads in the local area
	Province	3	Likely to be regional trade impacts
	National	1	Minor impact nationally, depending on how well it establishes and spreads
	Overall (weighted) Score	**1.9**	**Significant**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Low* with a *Moderate* exposure likelihood results in an overall likelihood of entry and exposure of *Low*. Further, combining an overall likelihood of *Low* with *Significant* consequences produces an overall risk score of *Low Risk* (Figure 2). An overall risk estimate of *Low Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Previous assessments have proposed two acaricide treatments during quarantine as an appropriate risk management for *A. variegatum* in the imported sable, specifically, the suggested initial treatment with a pour-on acaricide containing a pyrethroid, followed a week later by an injectable treatment by injectable ivermectin or related product to also treat for internal parasites (G. R. Thomson, 2010; D. Keet, 2014). This proposed treatment regimen is considered appropriate to reduce the entry likelihood (and also overall likelihood of entry and exposure) to *Negligible* and hence overall risk to *Negligible Risk*.

Conclusion

The unrestricted risk of *A. variegatum* was assessed as *Low Risk* to South Africa overall. However, this risk can be readily reduced to *Negligible Risk* by appropriate acaracide treatment during pre-export quarantine in Zambia as described above.

Anthrax

Anthrax is an acute, infectious bacterial disease affecting many species of domestic and wild animals, and humans. Affected animals often present as cases of sudden death, with staggering, trembling and difficult breathing prior to collapse. Death usually occurs soon after clinical signs are first seen. Anthrax occurs throughout much of Africa, including in both Zambia and South Africa, with periodic outbreaks occurring in both countries. Anthrax is notifiable in both countries. An effective preventive vaccine is available and South Africa has an active control program for anthrax based on quarantine in the case of outbreaks and vaccination of livestock and optionally of valuable game species. Only some information on anthrax control has been provided by Zambia in table format (Anonymous, 2014b), without details about the reported occurrence of this notifiable disease, nor about the coverage achieved by the farmer applied vaccination programme, the vaccines used or the efficacy of the quarantine measures applied, in the case of outbreaks.

The *Code* provides the following recommendations for safe movement of ruminants, equines and pigs in relation to anthrax (OIE, 2014b):

"*That the animals:*

1. *showed no clinical sign of anthrax on the day of shipment;*

AND

2. *were kept for the 20 days prior to shipment in an establishment where no case of anthrax was officially declared during that period; or*
3. *were vaccinated, not less than 20 days and not more than 12 months prior to shipment in accordance with the Terrestrial Manual.*"

The symptoms of anthrax are rather specific and passive surveillance, as practiced by Zambia is generally considered adequate for detection. Thus, although not specific for wildlife, the OIE recommendations are considered adequate to manage any anthrax risk in sable imported from Zambia and no further risk assessment is required.

Bluetongue

Bluetongue is a vector-borne viral disease affecting domestic and wild ruminants, including buffalo and most species of African antelope. Transmission of infection is by a variety of *Culicoides* spp. midges. Sheep are particularly susceptible and develop severe clinical disease characterised by inflammation, haemorrhages and cyanosis of the mucous membranes of the mouth and nose, as well as the coronary bands. Many clinical cases eventually die and those that recover have a prolonged recovery period before returning to normal production (D. W. Verwoerd and B. J. Erasmus; OIE, 2013a). Infection is largely inapparent in species other than sheep, although some deer and wild ruminants will show clinical signs. Infection in

cattle rarely results in clinical disease except for BTV8 serotype in Europe, which can cause severe clinical disease in cattle. Cattle are also important in the epidemiology of infection because they often have a prolonged viraemia after infection and can act as subclinical carriers of infection (OIE, 2014d).

Bluetongue virus is distributed globally wherever the vectors are found. There are 26 documented serotypes of bluetongue (OIE, 2014d; P.C. Mertens et al., undated). However, different serotypes occur in different parts of the world and can cause quite varying disease patterns (OIE, 2013a).

The incubation period for bluetongue is usually 5-10 days and the infective period as defined by the OIE is 60 days (OIE, 2013a; OIE, 2014c).

Diagnosis of bluetongue is usually based on characteristic clinical presentation and gross pathology, confirmed by virus isolation or reverse-transcriptase and real-time PCR on tissue samples from clinical cases (D. W. Verwoerd and B. J. Erasmus; OIE, 2014d). Group-specific ELISA tests and serotype-specific virus neutralisation tests are available for serological screening for population freedom (OIE, 2014d).

Control of bluetongue can be based on protecting animals from vector exposure and vaccination. Vaccination is based on attenuated live virus vaccines which provide good immunity against homologous serotypes but poor cross-protection against other serotypes, so that vaccines are usually polyvalent.

Bluetongue is endemic in South Africa and is notifiable (OIE, 2013e). The serotypes present are well documented and understood. However, several serotypes are not present in South Africa and are not wanted. These unwanted serotypes include particularly BTV26 (Kuwait) and BTV25 (Toggenburg orbivirus, isolated from goats in Switzerland).

Bluetongue is assumed to also be endemic in Zambia and is reported as being notifiable (OIE, 2013f). However no other information is available on the strains that are present, any surveillance that may have been done, other than passive surveillance, or distribution and occurrence within the country.

OIE Code recommendations

The OIE Code provides the following guidance for the importation of *ruminants and other susceptible herbivores* from bluetongue infected countries or zones (OIE, 2014):

"*That the animals:*

1) *were protected from Culicoides attacks in a vector-protected establishment for at least 60 days prior to shipment and during transportation to the place of shipment; or*
2) *were protected from Culicoides attacks in a vector-protected establishment for at least 28 days prior to shipment and during transportation to the place of shipment, and were subjected during that period to a serological test according to the*

Terrestrial Manual to detect antibody to the BTV group, with negative results, carried out at least 28 days after introduction into the vector-protected establishment; or

3) *were protected from Culicoides attacks in a vector-protected establishment for at least 14 days prior to shipment and during transportation to the place of shipment, and were subjected during that period to an agent identification test according to the Terrestrial Manual, with negative results, carried out at least 14 days after introduction into the vector-protected establishment; or*
4) *were vaccinated, at least 60 days before shipment, in accordance with the Terrestrial Manual against all serotypes whose presence in the source population has been demonstrated through a surveillance programme in accordance with Articles 8.3.16. to 8.3.21., and were identified in the accompanying certification as having been vaccinated or, if demonstrated to have antibodies, have been protected from vectors for at least 60 days prior to shipment; or*
5) *demonstrated to have antibodies for at least 60 days prior to dispatch against all serotypes whose presence has been demonstrated in the source population through a surveillance programme in accordance with Articles 8.3.16. to 8.3.21."*

These requirements are recognised as being adequate to manage the risk of introducing exotic bluetongue serotypes with the imported sable. However, the vector protection requirements are considered as possibly excessive and certainly impractical for a large shipment of wildlife. Further, unless Zambian authorities can provide documentation of a surveillance program to identify all serotypes present in Zambia (or absence of serotypes of concern) to allow compliance with options 4 or 5, these options are also not applicable. Therefore, further risk assessment was undertaken to determine an appropriate risk-management strategy.

Entry assessment

The main pathway of entry for exotic serotypes would be for one or more of the serotypes to enter Zambia either by natural spread or in imported animals, establish in the Zambian population and infect the imported sable prior to or during preparation for export, with viraemia persisting through to importation into South Africa.

The serotypes of concern to South Africa are not known to occur in Zambia, and Zambia does not legally import live animals from areas where these serotypes occur (northern Africa, Middle East, Europe) (Anonymous, 2014b). However Zambia has not provided any documentation of what serotypes are known to be present and any surveillance that might be in place to support such knowledge. Therefore Zambia's status for these serotypes is effectively unknown.

If Zambia were able to provide evidence of surveillance to demonstrate absence of serotypes of concern and that live animal imports or illegal imports have not taken place from areas where these serotypes are endemic, the likelihood of entry would be very low. However, considering the above uncertainties, the likelihood of entry of unwanted bluetongue serotypes into South Africa is assessed as *Low*.

Exposure assessment

The pathway for exposure of South African animals to unwanted bluetongue strains introduced in the imported sable would be for an imported animal to be fed on by a midge vector which subsequently feeds on a local animal and transmits the infection.

Other serotypes of bluetongue are endemic throughout South Africa, as are the *Culicoides* vectors. Considering this, the likelihood of exposure should entry occur is assessed as *High*.

Consequence assessment

Consequences of introduction of exotic bluetongue serotypes depend on the particular serotype introduced, the level of cross-protection with local serotypes and vaccines and the clinical severity of disease produced. Overall, the impact of deaths and associated production losses are assumed to have a *Significant* impact at all levels, as summarised in Table 6. The overall consequences are therefore assessed as *Significant* impact.

Table 6. Consequences impact for exotic bluetongue serotypes

Agent/disease	Consequence level	Score	Comment
Bluetongue (exotic serotypes)	Individual farms	2	Deaths and production loss - Depends on level of cross protection with local types and vaccines
	Local	2	Local spread with deaths, abortions, production losses
	Province	2	Provincial spread and associated production impacts
	National	2	National spread and associated production impacts
	Overall (weighted) Score	**2**	**Significant impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Low* with a *High* exposure likelihood results in an overall likelihood of entry and exposure of *Low*. Further, combining an overall likelihood of *Low* with *Significant* consequences produces an overall risk score of *Low Risk* (Figure 2). An overall risk estimate of *Low Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Significant* consequences associated with bluetongue, an overall likelihood of entry and exposure of *Negligible* is required to reduce the overall risk to *Very Low Risk*.

Three options for risk management for bluetongue were considered, as summarised in Table 7.

Table 7. Risk management options considered for bluetongue

Risk management option	Comments/conclusion
1. Presentation by Zambian authorities of adequate assurances regarding the imports of susceptible species being limited to countries and regions that are free of BT 25 and 26.	This is considered to provide acceptable risk management to reduce the likelihood of entry to *Negligible*.
2. Two sets of serological tests, 21 days apart, with negative or stable titres specific for BT serotypes 25 and 26, respectively, during pre-export isolation or quarantine.	This would be considered to provide acceptable risk management to reduce the likelihood of entry to *Negligible*. However, such tests for serotypes 25 and 26 have not yet been developed.
3. Vector-protected quarantine in accordance with the OIE *Code*.	This is considered to provide acceptable risk management to reduce the likelihood of entry to *Negligible* but is unlikely to be feasible for a large shipment of sable antelope.

Options 2 and 3 would provide additional benefits of preventing the introduction of other vector transmitted viruses that may be present in countries in which BT serotypes 25 and 26 were diagnosed but which are absent from the southern African subregion and that are not specifically considered in this Import Risk Analysis.

Conclusion

The unrestricted risk of bluetongue was assessed as *Low Risk* to South Africa overall. However, this risk can be readily reduced to *Very Low Risk* by the following options:

1. Presentation by Zambian authorities of adequate assurances regarding the imports of susceptible species being limited to countries and regions that are free of BT 25 and 26, OR
2. Vector-protected quarantine in accordance with the OIE *Code.*

Bovine tuberculosis

Bovine tuberculosis is a chronic infection of cattle and other species, caused by the bacterium *Mycobacterium bovis*. Bovine tuberculosis has a long incubation period and is often a sub-clinical infection, with minimal effects on livestock production (G. R. Thomson, 2010; D. Keet, 2014). However it is an important zoonosis, with prevalence in human populations closely correlated with local prevalence in cattle. Transmission is usually by the aerosol route, but can also occur through ingestion of contaminated feed. The incubation period is not specified by the OIE but can be quite variable and often lengthy, depending on circumstances. Bovine tuberculosis is a strictly controlled disease in many countries and some countries have active eradication programs in place (D. V. Cousins et al., 2004).

Tuberculosis is also an emerging important disease of wildlife and infection has become established in a number of game reserves in eastern and southern Africa. Some species, including buffalo, lechwe and possibly kudu appear to be maintenance hosts, capable of maintaining infection in the population in the absence of cattle (G. R. Thomson, 2010; D. Keet, 2014).

Bovine tuberculosis occurs in South Africa in both livestock (cattle) and wildlife (mainly buffalo). It is a notifiable disease and subject to official controls. In particular, *M. bovis* is subject to strict controls on infected buffalo farms, including controls on other susceptible game species. All buffalo must be tested for tuberculosis prior to translocation. Farms where tuberculosis is confirmed are subject to quarantine, forward and backward tracing and development of an action plan to control and/or eradicate the disease, including appropriate testing. Positive animals are recommended to be culled and for herds to be cleared of quarantine they must undergo 5 consecutive negative tests over a period of at least 15 months (Anonymous, 2002). Controls apply to all susceptible species on the farm, not just to buffalo (M. Maja, 2013). Similar controls are applied in cases where tuberculosis is detected in other farmed game species.

Bovine tuberculosis is reported as occurring in Zambia and is notifiable (OIE, 2013f). Tuberculosis is also reported to be endemic in lechwe in the Kafue area of Zambia, where these particular sable were captured (D. V. Cousins et al., 2004; G. R. Thomson, 2010; D. Keet, 2014). Zambia has provided little information on control measures in place, or on distribution or occurrence of bovine tuberculosis, despite a formal request for information. In the response to the general questionnaire, Zambia cites active and passive surveillance for tuberculosis but no evidence of this is provided and tuberculosis is also absent from the disease distribution section of the 2013 Annual Report (Anonymous, 2013; Anonymous, 2014b).

Screening for bovine tuberculosis is usually based on detection of a delayed-type hypersensitivity response to *M. bovis* antigen, using either single or comparative intradermal skin tests or blood-based assays such as the gamma interferon or lymphocyte proliferation assays (OIE, 2009b). These tests have not been validated for sable (or other wildlife). However, no alternative tests are available that have been validated for sable, so these are assumed to provide at least adequate performance, particularly when applied at a population level.

Control and eradication of bovine tuberculosis is usually based on quarantine and test and cull programmes on infected farms, supported by general movement controls (including testing) to limit spread (D. V. Cousins et al., 2004). Screening can be based on herd-testing using intradermal tuberculin tests, sometimes supported by gamma interferon assays or the inspection of animals for presence of tuberculous lesions at slaughter.

OIE Code recommendations

The OIE *Code* does not provide guidance for species other than domestic bovines (cattle, water buffalo and bison) or farmed cervidae, as defined in the *Code.* For the importation of

domestic bovines for breeding or rearing the *Code* provides the following guidance in relation to bovine tuberculosis infections (OIE, 2014e):

"That the animals:

1) *showed no sign of bovine tuberculosis on the day of shipment;*
2) *originate from a herd free from bovine tuberculosis that is in a country, zone or compartment free from bovine tuberculosis; or*
3) *were subjected to the tuberculin test for bovine tuberculosis with negative results during the 30 days prior to shipment and come from a herd free from bovine tuberculosis; or*
4) *have been isolated for at least 90 days prior to entry into the herd including protection from contact with wildlife reservoirs of bovine tuberculosis and were subjected to at least two tuberculin tests carried out at a six-month interval with negative results with the second tuberculin test performed during the 30 days prior to entry into the herd.*

The guidelines for importing farmed cervidae for breeding or rearing are essentially the same except they specifically reference bovine tuberculosis of farmed cervidae.

These guidelines do not apply for wildlife or susceptible game species, although they could be used in the absence of more specific guidelines. However, Zambia is not a free country and does not have a free zone or compartment for bovine tuberculosis. Further, Zambia has provided no evidence that they have appropriate systems to identify and certify free herds or flocks with any confidence in the integrity of such certification. In fact, available knowledge suggests that bovine tuberculosis is endemic in wildlife and that lechwe are acting as a maintenance host in the area from which these sable were captured.

Finally, the testing option was considered unlikely to provide adequate risk reduction, particularly as a more general requirement for future shipments and given the high value of the sable antelope to be imported and the high value of other game species, including buffalo that they will come into contact with in South Africa. It is reported that the particular shipment of sable under consideration have been tested for tuberculosis early in their isolation period (G. R. Thomson, 2010; D. Keet, 2014). However given uncertainty about the validity of the tests in sable, the lengthy period that has passed since that time, the potential for application to future game imports and experience with breakdowns in moving "tested" buffalo, it was considered appropriate to undertake further risk assessment for bovine tuberculosis. A previous analysis of data from projects for the translocation of "disease-free" buffalo that had been born from infected parent stock in the FMD and Corridor disease Controlled Areas has shown that of approximately 3,500 buffalo that completed all five stages of the translocation process, 50 were detected with tuberculosis at Stages 1 to 3, two at stage 4 and two at Stage 5, despite prior testing for bovine tuberculosis as part of the translocation projects (W.F. Ungerer, 2010).

Entry assessment

The primary pathway for entry of tuberculosis into South Africa would be for one or more of the sable under consideration to have been infected either prior to or during preparation for

export and that infection was maintained in the herd until the point of export and entry into South Africa.

Considering that bovine tuberculosis appears to be endemic in Zambia, including in the area from which these sable were sourced, there is a moderate to high likelihood of exposure of animals to infection prior to export. Assuming that exposure and infection occurred, the likelihood of infection persisting until arrival in South Africa is high. The overall likelihood of entry of bovine tuberculosis with imported sable from Zambia is considered to be *Moderate*, in the absence of further risk mitigation.

Exposure assessment

The pathway for exposure in South Africa, should entry occur in the imported animals, is for an infectious animal to have close contact with local wildlife or livestock, or for local wildlife to subsequently graze land where imported animals have grazed and be exposed to infection.

Considering the chronic and often sub-clinical nature of tuberculosis, the likelihood of exposure of South African animals should entry occur is considered to be *High*.

Consequence assessment

It is assumed that if exposure to bovine tuberculosis occurs in South Africa then it will establish and spread at least locally, depending on local environment, animal movements and how quickly it is detected. Exposure and detection of infection in buffalo in particular will lead to movement restrictions and control measures on the affected farm, including all susceptible species. If infection is detected in other wildlife species, even in the absence of buffalo, movement restrictions and control measures are likely and even without such measures there is likely to be buyer resistance and trade effects on affected farms and in the local area. Accordingly, the impact on affected farms was considered to be *Extreme*, with *Minor* effects at the local level and *Inconsequential* impact at Provincial and national levels.

The consequence assessment for brucellosis is summarised in Table 8. Overall, the expected consequences were assessed as *Minor*.

Table 8. Summary consequence assessment for bovine tuberculosis

Agent/disease	Consequence level	Score	Comment
Bovine tuberculosis	Individual farms	4	lost trade, quarantine, buyer resistance
	Local	1	lost trade, buyer resistance
	Province	0	negligible provincial impact
	National	0	negligible national impact
	Overall (weighted) Score	**0.6**	**Minor impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Moderate* with a *High* exposure likelihood results in an overall likelihood of entry and exposure of *Moderate*. Further, combining an overall likelihood of *Moderate* with *Minor* consequences produces an overall risk score of *Low Risk* (Figure 2). An overall risk estimate of *Low Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Minor* consequences associated with brucellosis, an overall likelihood of entry and exposure of *Very Low* is required to reduce the overall risk to *Very Low Risk*. The following options were considered for risk management for bovine tuberculosis (Table 9):

Table 9. Risk management options considered for bovine tuberculosis

Risk management option	**Comments/conclusion**
1. Country, zone or compartment freedom in accordance with the OIE *Code.*	This was considered to provide acceptable risk management but is not possible for the current shipment.
3. Herd freedom in accordance with the OIE *Code.*	This was considered to provide acceptable risk management but is not feasible for the current shipment as Zambia has not provided any evidence to show that they could provide adequate confidence in herd or flock certification.
4. A single comparative intradermal test for bovine tuberculosis during pre-export quarantine, within 30 days of shipment.	This option was considered inadequate to reduce the likelihood of entry to *Very Low* in the absence of prior testing and isolation, due to the possibility of false negatives or incubating animals, and so was rejected as an appropriate option.
4. Government supervised testing of all adult animals on two occasions at least 15 months apart, using a comparative intradermal test, with negative results. The tests to be undertaken whilst in government supervised isolation from other susceptible species and the last test to be undertaken whilst in pre-export quarantine.	This option was considered to provide adequate risk mitigation to reduce the likelihood of entry from *Moderate* to *Very Low* and the overall risk to *Very Low Risk*.

The testing requirement is considered necessary for imports of susceptible species from Zambia because of the apparent lack of effective control measures for tuberculosis in Zambia

and the fact that bovine tuberculosis is endemic in other species in the area where the imported sable were sourced.

The rational for two tests at least 15 months apart is that the sable in this specific shipment are from an area where tuberculosis is thought to be endemic in lechwe and possibly other species. If a single test is applied prior to export there is a significant risk of failing to detect infection due to the occurrence of false negative results. However, holding the animals in isolation for 15 months and testing twice during that period provides time for the disease to spread and establish within the group and for incubating animals to become test-positive, so that infection is much less likely to be missed at the final test. This approach is also consistent with requirements for removing quarantine from known infected or suspect Buffalo and sable herds in South Africa.

In the case of the current shipment, assuming that Zambia are able to certify that the sable have been in isolation under continuous government veterinary supervision since the first test in 2010 and no new animals have been added during this period, this would require a single additional test while in pre-export quarantine. However it has not been established yet whether Zambia would be able to provide such guarantees. If official supervision of isolation and original testing cannot be certified, the isolation period would need to restart and two comparative intradermal tests at least 15 months apart with negative results would be required.

Conclusion

The unrestricted risk of bovine tuberculosis was assessed as *Low Risk* to South Africa overall. However, this risk can be readily reduced to *Very Low Risk* by the following options:

1. Country or zone freedom in accordance with the OIE *Code*, OR
2. Herd or Flock freedom in accordance with the OIE *Code*, OR
3. Government supervised testing of all adult animals on two occasions at least 15 months apart, using the comparative intradermal test, with negative results. The tests to be undertaken whilst in government-supervised isolation from other susceptible species and the last test to be undertaken whilst in pre-export quarantine.

Brucellosis

For the purposes of this risk analysis "brucellosis" includes infection with either *B. abortus* or *B. melitensis*. There are many similarities between the two diseases and risk management measures are likely to be the same, so it is sensible to consider them together.

Brucellosis due to *B. abortus* is a highly infectious disease affecting mainly cattle and a variety of wildlife species, including buffalo, although wildlife (other than buffalo) are not thought to be important in the epidemiology of the disease (J. Godfroid et al., 2004a; G. R. Thomson, 2010; D. Keet, 2014). *Brucella* infection generally causes late abortions and infertility in cattle, often resulting in abortion "storms" in susceptible populations, hence the common name "contagious abortion". *B. melitensis* is a similar infection affecting primarily sheep and goats and again a variety of wildlife species, including sable antelope (J. Godfroid

et al., 2004b; G. R. Thomson, 2010; D. Keet, 2014). Transmission is usually by direct contact of susceptible animals with an aborted foetus or birth products from an infected animal (or contaminated land/environment). The *Brucella* organism can survive up to 8 months in protected environments (W. A. Geering et al., 1995). Both *B. abortus* and *B. melitensis* are zoonotic infections, causing severe recurrent ("undulant") fever in infected humans (W. A. Geering et al., 1995; J. Godfroid et al., 2004a; J. Godfroid et al., 2004b). The OIE does not specify an incubation period for brucellosis but it can be lengthy, because infected cows usually only show signs by aborting in late pregnancy. Chronic infection is common and chronically infected cows shed large numbers of organisms at subsequent calvings.

Both *B. abortus* and *B. melitensis* occur in South Africa and are notifiable and subject to official controls. In particular, *B. abortus* occurs in buffalo[1] and is subject to strict controls on infected farms, including controls on other susceptible game species. In particular, all buffalo must be tested for brucellosis prior to translocation. Farms where brucellosis is confirmed are subject to quarantine, forward and backward tracing and development of an action plan to control and/or eradicate the disease, including appropriate testing. Positive animals are recommended to be culled and for herds to be cleared of brucellosis quarantine all the animals must undergo at least three consecutive negative tests over a period of at least 15 months (Anonymous, 2002). Controls apply to all susceptible species on positive farms, not just to buffalo (M. Maja, 2013). Similar controls are applied in cases where brucellosis is detected in other farmed game species.

The sable antelope to be imported are destined for the wildlife industry and are thus almost certainly going to come into contact with other wildlife species including buffalo, some of which are very valuable. The health status of these animals will thus be affected by any disease that may evade the risk mitigation measures taken during the import of the sable antelope. In the case of FMD, *Theileria parva*, brucellosis and tuberculosis, the properties on which these contact animals are kept, all susceptible wildlife species and especially the buffalo present on these properties, would be subject to the control measures prescribed in the Buffalo Protocol (Anonymous, 2002) and the new Contingency Protocol as prescribed in March 2013 (M. Maja, 2013). These documents are thus considered essential disease control policy documents and are referred to under the relevant disease sections in this Risk Analysis.

[1] With regard to the control of wildlife diseases in South Africa, it should be noted that the prescribed disease control measures for buffalo are very strict – both to manage the risk of FMD and Corridor Disease as diseases for which buffalo are asymptomatic carriers, as well as to protect both the livestock and the valuable buffalo industries from brucellosis and tuberculosis, chronic erosive diseases that have found their entry in some buffalo populations in South Africa. Every buffalo thus has to test negative for all four of these diseases before every movement and the movement of buffalo from brucellosis and tuberculosis infected herds is prohibited while the movement of buffalo from FMD and CD infected herds is restricted to the relevant disease control areas in South Africa. The control measures prescribed in the case of brucellosis and tuberculosis infected buffalo herds include other susceptible species on the same property. Should these diseases be diagnosed in other wildlife species, even in the absence of buffalo, the property is also placed under quarantine and similar control measures as those applicable for buffalo are prescribed.

Both *B. abortus* and *B. melitensis* are reported as occurring in Zambia and *B. abortus* is notifiable, whereas *B. melitensis* is not (OIE, 2013f). *B. abortus* appears to be endemic in Zambia, while *B. melitensis* was last reported in 2012. Zambia has provided little additional information on control measures in place for brucellosis or on distribution or occurrence of either agent in the country, despite a formal request for information. In the response to the general questionnaire, Zambia cites active and passive surveillance for brucellosis but no evidence of this is provided and brucellosis is also absent from the disease distribution section of the 2013 Annual Report (Anonymous, 2013; Anonymous, 2014b).

Diagnosis of clinical disease due to brucellosis is usually based on identifying the causal agent in aborted foetuses, other gestational products or other tissues such as udder and lymph nodes, using selective culture, impression smears or PCR (OIE, 2009a). Screening for presence of *B. abortus* infection is usually done using a variety of serological techniques, most commonly Rose-Bengal Test (RBT), Complement Fixation Test (CFT) or the indirect ELISA assay (OIE, 2009a). These tests are also commonly used for screening for *B. melitensis* in small ruminants, although standardisation of these assays may be less reliable for small ruminants (J. Godfroid et al., 2004b). False positives to all of the serological tests can occur due to serological response in vaccinated animals, so care must be taken in interpreting results in vaccinated populations (J. Godfroid et al., 2004a). These tests have not been validated for sable. However, no alternative tests are available that have been validated for sable, so these are assumed to provide at least adequate performance, particularly when applied at a population level.

Control of brucellosis is generally by test and cull programs to remove infected animals, along with movement controls to prevent spread and vaccination to reduce prevalence. Vaccines are generally live-attenuated preparations, based on either Strain 19 or RB51 strains for bovine brucellosis and Rev. 1 strain for *B. melitensis* (J. Godfroid et al., 2004a; J. Godfroid et al., 2004b; OIE, 2009a). Vaccination is usually undertaken at a young age to induce immunity before first pregnancy and to minimise cross-reactions with serological tests used for control.

Critical uncertainties and knowledge gaps

A key uncertainty for brucellosis is the performance of the available tests in sable or other wildlife. However, in the absence of validated alternatives these tests are assumed to be adequate for use on a population basis. The preferred tests for use in wildlife in South Africa are the RBT and CFT.

OIE Code recommendations

The OIE *Code* does not provide guidance for species other than "bovids, sheep and goats, camelids or cervids", as defined in the *Code*. For the importation of bovids, sheep and goats, camelids or cervids for breeding or rearing the *Code* provides the following guidance in relation to *Brucella* infections (OIE, 2014j):

"That the animals*:*

1. *showed no clinical sign of infection with Brucella on the day of shipment;*
2. *originate from:*
    a. *a country or zone free from infection with Brucella as relevant;*

OR

    b. *a herd or flock free from infection with Brucella and all sexually mature animals were tested for infection with Brucella with negative results within 30 days prior to shipment;*

OR

    c. *a herd or flock not qualified free from infection with Brucella:*
        i. *in which no case has been reported during the year prior to shipment;*
        ii. *the animals were isolated for 30 days prior to shipment and all animals in isolation were tested for infection with Brucella within that period with negative results; in the case of post-parturient females, the test was carried out at least 30 days after giving birth.*

These guidelines do not apply for wildlife or susceptible game species, although they could be used in the absence of more specific guidelines. However, Zambia is not a free country and does not have a free zone for brucellosis. Further, Zambia has provided no evidence that they have appropriate systems to identify and certify free herds or flocks with any confidence in the integrity of such certification. Finally, the option for a single test was considered unlikely to provide adequate risk reduction, particularly as a more general requirement for future shipments. It is acknowledged that the particular shipment of sable under consideration was tested for brucellosis on several occasions. On the first occasion in October 2009, one bull (of 150 animals tested) was positive on both Rose-Bengal and c-ELISA tests but was subsequently negative on complement fixation test at slaughter one month later. On the second occasion, 140 adult animals were tested in January 2010, with negative results and have been maintained in "isolation" since that time. However given uncertainty about the validity of the tests in sable, the fact that one sample was positive on initial screening, the lengthy period that has passed since that time, the potential for application to future game imports and experience with breakdowns in moving "tested" buffalo, it was considered appropriate to undertake further risk assessment for brucellosis. A previous analysis of data from projects for the translocation of "disease-free" buffalo that had been born from infected parent stock in the FMD and Corridor disease controlled areas in South Africa has shown that of approximately 3,500 buffalo that completed all five stages of the translocation process, 17 were detected with brucellosis at Stages 1 to 3 and one at Stage 5, despite prior testing for brucellosis (W.F. Ungerer, 2010).

Entry assessment

The primary pathway for entry of brucellosis into South Africa would be for one or more of the sable under consideration to have been infected either prior to or during preparation for export and that infection was maintained in the herd until the point of export and entry into South Africa.

Considering the lack of information about brucellosis status and control in Zambia, the fact that both agents appear to be endemic in the country and the suspect positive result from one of the sable antelope from 2009, the likelihood of exposure of animals to infection prior to export is uncertain but probably low to moderate. Given the generally long incubation period and chronic nature of brucellosis infection, any animals infected prior to export are highly likely to maintain infection through the export process. However, considering the uncertain role of sable antelope in the epidemiology of brucellosis and the likely limited opportunities for direct contact with infected cattle, sheep or goats, the likelihood of entry of brucellosis into South Africa with sable antelope from Zambia is considered to be *Low*.

Exposure assessment

The pathway for exposure in South Africa, should entry of brucellosis occur in the imported animals, is for a pregnant animal to either abort or give birth in contact with local wildlife or livestock, or for local wildlife to subsequently graze land where imported animals have aborted or given birth.

Considering the highly infectious nature of *Brucellae* and their ability to survive extended periods in the environment, the likelihood of exposure should entry occur is considered to be *High*.

Consequence assessment

It is assumed that if exposure to brucellosis occurs in South Africa then it will establish and spread at least locally, depending on local environment, movements and how quickly it is detected. Exposure and detection of infection in buffalo in particular will lead to movement restrictions and control measures on the affected farm, including all susceptible species. If infection is detected in other wildlife species, even in the absence of buffalo, movement restrictions and control measures are likely and even without such measures there is likely to be buyer resistance and trade effects on affected farms and in the local area. Accordingly, the impact on affected farms was considered to be *Extreme*, with *Minor* effects at the local level and *Inconsequential* impact at Provincial and national levels.

The consequence assessment for brucellosis is summarised in Table 10. Overall, the expected consequences were assessed as *Minor*.

Table 10. Summary consequence assessment for brucellosis (B. abortus or B. melitensis)

Agent/disease	Consequence level	Score	Comment
Brucellosis	Individual farms	4	lost trade, quarantine, buyer resistance, production losses/abortions
	Local	1	some local spread, lost trade, buyer resistance
	Province	0	negligible provincial impact
	National	0	negligible national impact

	Overall (weighted) Score	**0.6**	**Minor impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Low* with a *High* exposure likelihood results in an overall likelihood of entry and exposure of *Low*. Further, combining an overall likelihood of *Low* with *Minor* consequences produces an overall risk score of *Low Risk* (Figure 2). An overall risk estimate of *Low Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Minor* consequences associated with brucellosis, an overall likelihood of entry and exposure of *Very Low* is required to reduce the overall risk to *Very Low Risk*. The following options were considered for risk management for brucellosis (Table 11):

Table 11. Risk management options considered for brucellosis

Risk management option	**Comments/conclusion**
1. Country or zone freedom in accordance with the OIE *Code.*	This was considered to provide acceptable risk management but is not possible for the current shipment.
2. Herd or Flock freedom in accordance with the OIE *Code.*	This was considered to provide acceptable risk management but was not feasible as *B. melitensis* infection is currently not notifiable in Zambia and Zambia has not provided any evidence to show that they could provide adequate confidence in herd or flock certification.
3. A single serological test for brucellosis during pre-export "isolation" (not quarantine), within 30 days of shipment, as outlined in the Code.	This option was considered inadequate to reduce the likelihood of entry to *Very Low* in the absence of prior testing and isolation, due to the possibility of false negatives or incubating animals, and so was rejected as an appropriate option. This is particularly the case for the current shipment, given the measures applied to suspect sable and in-contact buffalo in South Africa and the suspect reactor detected at testing of this shipment in 2009 that was never satisfactorily resolved.
4. Serological testing under government supervision of all adult animals on two occasions at least 15 months apart, with negative test results for both the RBT and CFT. All testing to be conducted at a	This option was considered to provide adequate risk mitigation to reduce the likelihood of entry from *Low* to *Very Low* and the overall risk to *Very Low Risk.*

government approved laboratory. The tests to be undertaken whilst in government supervised isolation from other susceptible species and the last test to be undertaken whilst in pre-export quarantine.	

The proposed testing requirement is considered necessary for imports of susceptible species from Zambia because of the apparent lack of effective control measures for brucellosis in Zambia and the lack of knowledge of the status of the source population(s) for the imported sable. It is also consistent with requirements for removing quarantine from known infected Buffalo and sable herds in South Africa.

The rationale for two tests at least 15 months apart is that game shipments could be sourced from disparate sources in a country where there is apparently no official control over brucellosis and the status of the source population is unknown. If a single test is applied prior to export there is a significant risk of missing a small number of false negatives. However, holding the animals in isolation for 15 months and testing twice during that period provides time for the disease to spread and establish within the group, if it is present, so that infection is much less likely to be missed at the final test. In the case of the current shipment, assuming that Zambia can certify that the sable have been in isolation under continuous government veterinary supervision since the first test in 2010 and no new animals have been added during this period, a single additional test while in pre-export quarantine would be required. However it has not been established yet whether Zambia would be able to provide such guarantees. If official supervision of isolation and original testing cannot be certified, the isolation period would need to restart and two serological tests at least 15 months apart with negative results would be required.

Conclusion

The unrestricted risk of brucellosis was assessed as *Low Risk* to South Africa overall. However, this risk can be readily reduced to *Very Low Risk* by the following options:

1. Country or zone freedom in accordance with the OIE *Code,* OR
2. Herd or Flock freedom in accordance with the OIE *Code,* OR
3. Serological testing under government supervision of all adult animals on two occasions at least 15 months apart, with negative test results for both the RBT and CFT. All testing to be conducted at a government approved laboratory. The tests to be undertaken whilst in government supervised isolation from other susceptible species and the last test to be undertaken whilst in pre-export quarantine.

Contagious bovine pleuropneumonia

Contagious bovine pleuropneumonia (CBPP) is a highly infectious, serious respiratory disease affecting mainly cattle and water buffalo, caused by *Mycoplasma mycoides* subsp. *mycoides* Small Colony variant (MmmSC). CBPP can manifest in a variety of forms,

including acute, sub-acute and chronic disease. The incubation period is set at 6 months (OIE, 2014k) and a long-term carrier state is common in recovered animals (F. Thiaucourt et al., 2004). Sub-acute and sub-clinical infections are also common (OIE, 2014f), posing significant problems for control and eradication. CBPP causes severe respiratory distress and transmission is mainly via aerosol from infected exhalations or direct contact with infected animals (F. Thiaucourt et al., 2004).

CBPP is a cause of significant direct losses from lost production and indirect losses due to lost trade opportunities in many developing countries where it is still endemic, particularly in Africa. Most more-developed countries have eradicated CBPP and implement strict measures to prevent reintroduction.

African buffalo and other wild ruminants are thought not to play a role in the epidemiology of CBPP (G. R. Thomson, 2010; D. Keet, 2014; OIE, 2014k), however at the same time there is no strong evidence to say that they might not be. Because of the potential consequences for South Africa should CBPP be introduced it was considered appropriate to include CBPP in this risk analysis, despite the expectation that sable are unlikely to be carriers.

Diagnosis of CBPP is usually by clinical signs and gross pathology, with confirmation by culture of MmmSC from nasal swabs, lung tissue or pleural fluid. More recently PCR assays have been used for confirmation of MmmSC in culture or directly on tissue (F. Thiaucourt et al., 2004; OIE, 2014f). Serological assays, including CFT and cELISA, are the tests of choice for population screening for freedom from infection or for movement (for cattle). These assays have the advantage of not detecting antibody response in vaccinated animals and so can be used for screening in vaccinated populations (F. Thiaucourt et al., 2004; OIE, 2014f). The CFT is reported as having a similar sensitivity to the cELISA (~64%) and higher specificity (99.9% compared to 98%) (OIE, 2014f). The CFT can also be more difficult to standardise between laboratories, so results may not always be comparable (F. Thiaucourt et al., 2004). These tests are not validated for other species, but no alternative, cost-effective screening tests are available.

Control is generally by stamping out (slaughter) in previously free countries or zones and by quarantine (usually with slaughter out of infected herds), vaccination and movement controls in endemic areas.

South Africa is considered free of CBPP, although this is not an official OIE status. CBPP is notifiable and would be subject to official control and eradication if it occurred in South Africa. Zambia is recognised as an infected country, with infection mainly confined to the Western and North Western Provinces, where it is controlled by vaccination and movement controls (Anonymous, 2013; Anonymous, 2014b). Vaccination coverage in affected areas is estimated at around 85% of adult cattle and seroprevalence is declining in some formerly high prevalence districts sufficiently to allow mass vaccination to cease (Anonymous, 2013). In 2013 one outbreak also occurred in Copperbelt Province but was successfully eradicated (Anonymous, 2013).

Critical uncertainties and knowledge gaps

The key uncertainty for CBPP is whether or not sable are able to transmit infection. Although the consensus appears to be that wildlife are unlikely to be involved, in the absence of direct evidence to the contraty this risk analysis assumes that they may be able to be infected and transmit infection to other susceptible animals.

The other uncertainty relates to the performance of tests for CBPP, which have not been validated for wildlife. However in the absence of alternatives these tests are assumed to be adequate when used as a population-based test.

OIE Code recommendations

The OIE *Code* chapter on CBPP is limited to applying to bovids and water buffalo and also does not provide any guidance for importation of live animals from an infected country or zone for breeding or rearing (OIE, 2014k). Therefore, further risk assessment for CBPP was undertaken.

Entry assessment

The pathway for entry of CBPP into South Africa with the imported sable is for the sable to be infected prior to or during preparation for export and for infection to persist in one or more animals to the point of entry into South Africa.

For this particular proposed shipment, the sable were captured in the Kafue National Park, which borders the Western Province and extends into the North Western Province of Zambia, where CBPP is known to occur, so exposure of the sable to CBPP is possible but not necessarily likely. The sable were also reportedly tested by CFT subsequent to capture with all negative results (G. R. Thomson, 2010; D. Keet, 2014). Therefore, the likelihood of entry of CBPP into South Africa with sable from Zambia is assessed as *Very Low*, without further risk mitigation. The rationale for *Very Low* rather than *Negligible* likelihood is the lack of definitive information on the potential for sable to be infected and act as carriers of CBPP in the absence of cattle.

Exposure assessment

The pathway for exposure of local South African animals, should CBPP be introduced by the imported sable is for the sable to come into contact with and transmit infection to local animals. CBPP is transmitted by aerosol and close contact. Therefore, assuming one or more infected animals are introduced to South Africa and come into contact with local susceptible animals, the likelihood of exposure is *High*.

Consequence assessment

The consequence assessment for CBPP is summarised in Table 12. South Africa is free of CBPP and any incursion would be treated as a foreign disease and eradicated by stamping out. As a result, there would be *Extreme* impacts with destruction of stock, including potentially the loss of valuable genetics, and disruption of business for individual farms.

There would be *Major* impacts at the local level due to movement restrictions and consequent trade impacts. There would also be *Significant* impacts at the Provincial level due to trade effects and response management. There would also be a *Major* impact nationally due to loss of trade, control measures and compensation payments. The overall consequences are assessed as being *Major* impact.

Table 12. Consequence summary for contagious bovine pleuropneumonia

Agent/disease	Consequence level	Score	Comment
Contagious bovine pleuropneumonia	Individual farms	4	stamping out
	Local	3	quarantine, movement restrictions, trade impacts
	Province	2	movement restrictions & trade impacts as well as managing the response
	National	3	loss of trade, control measures
	Overall (weighted) Score	**2.8**	**Major impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Very Low* with a *High* exposure likelihood results in an overall likelihood of entry and exposure of V*ery Low*. Further, combining an overall likelihood of V*ery Low* with *Major* consequences produces an overall risk score of *Low Risk* (Figure 2). An overall risk estimate of *Low Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Major* consequences associated with CBPP, an overall likelihood of entry and exposure of *Negligible* is required to reduce the overall risk to *Very Low Risk*.

The OIE Code does not provide any guidance for importation of animals from a CBPP infected country or zone. Two options for risk management for CBPP were considered as summarised in Table 13:

Table 13. Risk management options for CBPP

Risk management option	Comments/conclusion
1. A single serological test of all animals, with negative results, using either CFT or cELISA during pre-export quarantine, within 30 days of shipment.	This option was considered inadequate to reduce the likelihood of entry to *Negligible* because of the lack of validation of the assays for wildlife, the long incubation period for CBPP and the potential for false negative results.

2. Two serological tests of all animals, with negative results, using either CFT or cELISA, at least 6 months apart. Animals to be held in isolation, subject to continuous government veterinary supervision from the time of the first test, with the second test being during pre-export quarantine, within 30 days of shipment. Testing to be undertaken in a government approved laboratory.	This option was considered to provide adequate risk mitigation to reduce the likelihood of entry from *Very Low* to *Negligible* and the overall risk to *Very Low Risk*.

The rationale for two tests at least 6 months apart is that this provides time for any incubating animals to seroconvert and also an opportunity to detect infected animals that are false negative at the first test. If a single test is applied prior to export there is a significant risk of failing to detect infection due to the occurrence of false negative results. However, holding the animals in isolation for 6 months and testing twice during that period provides time for the disease to spread and establish within the group and for incubating animals to become test-positive, so that infection is much less likely to be missed at the final test. Given the evidence of surveillance and control of CBPP in Zambia and the fact that the disease is transmitted by direct contact with infected animals and fomites do not seem to play a role, the biosecurity guarantees that Zambia seems to be able to provide for the isolation period are considered sufficient. In the case of the current shipment, assuming that Zambia would be able to certify that the sable have been in isolation under continuous government veterinary supervision since the first test in 2010 and no new animals have been added during this period, this would require only a single additional test while in pre-export quarantine. In the case of the official isolation requirement not being certifiable, the isolationperiod would need to re-start and two serological tests at least 6 months apart with negative results would be required.

Conclusion

The unrestricted risk of CBPP was assessed as *Low Risk* to South Africa overall. However, this risk can be readily reduced to *Very Low Risk* by the following option:

1. Two serological tests of all animals, with negative results, using either CFT or cELISA, at least 6 months apart. Animals to be held in isolation, subject to continuous government veterinary supervision from the time of the first test, with the second test being during pre-export quarantine, within 30 days of shipment.

Subject to certification by the Zambian veterinary services of the isolation period, the previous test on this particular shipment could be recognised as their first test, so that only the second test during pre-export quarantine would be required for this particular shipment.

Foot-and-mouth disease

Foot-and-mouth disease (FMD) is a highly infectious viral disease of cloven-hoofed animals. Susceptibility and ability to transmit infection varies among species. In livestock, it is often a disease with high morbidity and low mortality, with affected animals developing vesicular lesions and ulcerations of the muzzle and mouth and around the coronary bands of the feet. Infected animals produce variable amounts of virus in vesicular secretions and transmission is most commonly by direct contact with an infected animal, although transmission via indirect contact (fomites) also occurs. It is usually a very debilitating disease resulting in severe production loss, although the mortality rate is usually low (G. R. Thomson and A. D. S. Bastos, 2004). FMD is recognised as one of the most important transboundary animal diseases internationally because of its ability to spread rapidly and cause significant production and welfare losses. In countries where animals are used for draught power, FMD can severely disrupt other agricultural activites because of animal's inability to work, causing consequent human hardship. FMD is endemic in parts of Africa, Asia, Middle East and South America (G. R. Thomson and A. D. S. Bastos, 2004; OIE, 2013b).

There are seven immunologically distinct serotypes of FMD virus, SAT1, SAT2, SAT3, A, O, C and Asia1. Historically, FMD in southern Africa is predominantly caused by the three SAT (Southern African Territories) serotypes, but cases due to other serotypes also occur (G. R. Thomson and A. D. S. Bastos, 2004; OIE, 2013b). The OIE specifies an incubation period of 14 days (OIE, 2014g). Many cases recover and eliminate infection within 28 days. However, a proportion of cases become carriers (persistent infection beyond 28 days) for a variable period up to several years. African buffalo are recognised as being persistent carriers, and are thought to be the only wildlife species capable of maintaining infection in the absence of domestic livestock (G. R. Thomson and A. D. S. Bastos, 2004; OIE, 2013b).

Diagnosis of FMD is by the typical clinical signs of the disease, with confirmation of clinical cases by antigen ELISA, lateral flow assay, RT-PCR or virus isolation, performed on vesicular fluids or probang samples. Serotype-specific ELISAs and virus neutralisation assays are available for serological screening in unvaccinated animals, based on viral structural proteins. Non-structural protein (NSP) ELISAs are also available and have the advantage of being able to differentiate antibody due to natural infection from that resulting from vaccination. However, NSP ELISAs are not serotype specific (OIE, 2012).

FMD control measures vary, depending on the status of the country or area concerned. In countries or zones where FMD is considered exotic, response to FMD incursions is usually aimed at eradication and measures may include zoning, quarantine, stamping out, movement controls and/or vaccination. High levels of border security are maintained to prevent incursions.

In endemically infected countries, control is primarily based on vaccination, using a variety of vaccines. Movement controls and response to outbreaks may also be implemented to try and minimise spread. Vaccines are the primary control tool but are generally specific to one or more serotypes, so it is essential that homologous serotypes to those present in the country are included in the vaccine. Vaccine-induced immunity is also generally short-lived, so that booster vaccinations are required on a regular basis, usually six-monthly. The logistics of

managing vaccine supply and vaccination programs in developing programs mean that even with government sponsored and managed programs vaccination coverage is often poor and outbreaks continue to occur in the face of ongoing vaccination (G. R. Thomson and A. D. S. Bastos, 2004; OIE, 2013b).

FAO has developed and the OIE endorsed a "*Progressive Control Pathway for FMD control (PCP-FMD)*" to provide a pathway for infected countries to work towards achieving FMD-free status (Anonymous, 2011b). This pathway has been developed to assist endemically infected countries to progressively reduce the level and impact of FMD with the aim of eventual eradication where feasible. The pathway has a series of 5 "stages", with progressively increased control and reduced level of disease at each level. Expected activities at each stage and requirements for progression between stages are described to assist countries in implementing the pathway.

FMD status of South Africa

The majority of South Africa is officially a free zone for FMD without vaccination (OIE, 2014o). FMD infection in South Africa is limited to a small infected zone around Kruger National Park, in the north east of the country. This is surrounded by a protection zone, in accordance with OIE requirements (Anonymous, 2014a). Strict movement controls are in place to prevent incursion of FMD into the free zone, including prohibition on all movements of cloven-hoofed animals from the infected zone into the free zone and movements from the protection zones that are not part of the free zone into the free zone only in accordance with OIE guidelines for movements of animals/products from infected zones or countries into free zones/countries (Anonymous, 2014a).

Although buffalo within the infected zone are endemically infected, extensive surveillance has shown that the three SAT serotypes are the only serotypes present. Other serotypes have never been known to occur in South Africa, other than one outbreak associated with type O in 2000, caused by illegal swill feeding of pigs. This outbreak was subsequently eradicated by stamping out (OIE, 2014a).

Intensive surveillance is undertaken in the protection zone and also in the area of "*high surveillance area of the free zone with movement control*" and the "*high surveillance area of the free zone*", which are designated surveillance areas adjoining the protection zone or international borders. Surveillance in the free zone is predominantly based on passive surveillance, supported as necessary by active surveillance activities (Anonymous, 2014a).

FMD status of Zambia

Zambia has an infected status for FMD (Anonymous, 2013; Anonymous, 2014b). However, as previously discussed, Zambia has provided little information about their status and disease control measures for FMD in response to South Africa's questionnaire and did not respond to the FMD-specific questionnaire at all. There appears to be no regular monitoring of the sero-types causing the various outbreaks and no information has been provided about the sero-types being involved in the more recent outbreaks during 2013. However, it is noted that serotypes A and O cannot be excluded as being present in Zambia and in fact serotype O was

detected in Zambia in 2000 and is possibly still present, as no evidence has been provided that it was eliminated (Y. Sinkala et al., 2014).

FMD control in Zambia appears to rely primarily on vaccination, supported by movement controls in areas where outbreaks occur. The reliability of these measures is uncertain, given the paucity of information provided by Zambia. There is certainly some doubt as to the efficacy of vaccination with difficulties with the *"second round of FMD vaccination"* in certain areas that *"was not undertaken due to lack/limited funding"* (Anonymous, 2013).

An FAO and OIE sponsored southern African sub-regional seminar in 2011 reported that FMD is endemic in southern and eastern Zambia and that there was a constant threat of introduction from Tanzania in the North. The group concluded that Zambia's FMD situation was consistent with being at Stage 2 on the PCP pathway (Anonymous, 2011a). Key outcomes for stage 2 of the PCP are (Anonymous, 2011b):

- ongoing monitoring of circulating strains and risk in different husbandry systems
- risk-based control measures implemented for the sector or zone targeted based on the FMD strategic control plan
- clearly established that the impact of FMD is being reduced by the control measures
- further development of an enabling environment for control activities

The proposed next steps were for each country (including Zambia) to "*prepare appropriate documentary evidence as required by the FMD PCP in support of their current stage*" and that "*those entering Stage 3 should already start to collate data and documentation for a dossier to the OIE*" (Anonymous, 2011a). There has been no evidence of any progression as proposed by Zambia or of provision of any evidence to support the outcomes above for them to achieve Stage 2 of the PCP.

In view of the above information, it is assumed that FMD is endemic in Zambia and is not well controlled. In addition, exotic serotypes A and O, that are not present in the South African infected zone, are likely to be present in addition to the three SAT serotypes. SAT topotypes present in Zambia also differ from those present in South Africa (Anonymous, 2010; G. R. Thomson, 2010).

Role of sable antelope in FMD transmission

Sable antelope are susceptible to FMD infection and may remain persistently infected for up to 56 days (N. P. Ferris et al., 1989; E. C. Anderson et al., 1993; Anonymous, 2010). However, it appears that natural infection is probably uncommon and their role in transmitting FMD infection is uncertain, but probably not significant in areas where the disease is endemic (G. R. Thomson, 2010).

Critical uncertainties and knowledge gaps

The main uncertainties relating to FMD are the current distribution and prevalence of FMD infection in Zambia and the potential for sable to become infected and transmit infection, possibly in the absence of obvious clinical signs.

OIE Code recommendations

The Code chapter on FMD does not provide any guidance on requirements for safe importation of cloven-hoofed wildlife from FMD infected countries or zones. However, the *Code* does provide the following recommendations for importation of *domestic ruminants and pigs* from FMD infected countries or zones (OIE, 2014g):

"that the animals:

1. *showed no clinical sign of FMD on the day of shipment;*
2. *were kept in the establishment of origin since birth, or*
   a. *for the past 30 days, if a stamping-out policy is in force in the exporting country, or*
   b. *for the past 3 months, if a stamping-out policy is not in force in the exporting country,*

   and that FMD has not occurred within a ten-kilometre radius of the establishment of origin for the relevant period as defined in points a) and b) above; and
3. *were isolated in an establishment for the 30 days prior to shipment, and all animals in isolation were subjected to diagnostic tests (probang and serology) for evidence of FMDV infection with negative results at the end of that period, and that FMD did not occur within a ten-kilometre radius of the establishment during that period; or*
4. *were kept in a quarantine station for the 30 days prior to shipment, all animals in quarantine were subjected to diagnostic tests (probang and serology) for evidence of FMDV infection with negative results at the end of that period, and that FMD did not occur within a ten-kilometre radius of the quarantine station during that period;*
5. *were not exposed to any source of FMD infection during their transportation from the quarantine station to the place of shipment."*

Considering that these measures are not applicable to wildlife, the lack of information about the current situation regarding FMD in Zambia and the potential consequences of an incursion in South Africa, these measures were considered inadequate to meet South Africa's ALOP without further risk assessment. In fact, to our knowledge, no FMD-free country has ever used these provisions to import animals from an FMD infected zone or country.

Entry assessment

The main pathway for introduction of FMD into South Africa with the imported sable would be for one or more sable to become infected prior to or during preparation for export and for the infection to be maintained within the group until they arrived in South Africa. Transfer of FMD virus by contaminated fomites is also recognised as a potential high risk and must be managed during quarantine by strict hygiene practices including introduction of hay and forage as is also recommended in the *Code* (section 8.7.31) for importation of straw or forage from FMD-infected countries (OIE, 2014g).

FMD is assumed to be endemic in Kafue National Park, where the sable for the current shipment were originally sourced. Given the time that has elapsed since capture it is unlikely that FMD has persisted since capture, for this particular shipment. However, no information is available about the FMD situation at their current location, or the level of biosecurity

during their current "isolation". Taking these factors into account, as well as uncertainty about the potential role of sable in translocation of FMD infection, the likelihood of entry of FMD into South Africa with sable imported from Zambia is assessed as *Low*.

Exposure assessment

The expected pathway for exposure of susceptible animals in South Africa, should FMD be introduced is for infected sable to be released into South Africa on arrival and mix with local susceptible species resulting in transmission of infection. The likelihood of exposure of susceptible animals in South Africa, assuming the virus was introduced with the sable, is assessed as *High*.

Consequences assessment

The consequence assessment for FMD is summarised in Table 14. Consequences are expected to be *Major* or *Extreme* at all levels. These consequences are due to the implementation of a stamping out policy, affecting individual affected farms, movement controls hampering and preventing domestic trade, costs associated with compensation and implementing the response, lost international trade and reputational loss. This assessment is supported by the estimated cost of lost exports following FMD outbreaks and resulting suspension of South Africa's FMD Free Zone status in 2011. This is estimated to have cost the South African economy up to R 3 billion per year in lost exports over the three years from February 2011 (Anonymous, 2014c). This cost doesn't include the costs incurred by individual farmers or costs of the response, compensation and regaining Free Zone status. Nor does it include intangible costs such as reputational loss for the ability to prevent and control animal diseases.

Table 14. Consequences summary for foot-and-mouth disease

Agent/disease	Consequence level	Score	Comment
Foot and mouth disease	Individual farms	4	stamping out, lost production
	Local	4	movement controls and stamping out
	Province	3	quarantine and trade restrictions
	National	4	lost trade, reputation, control costs etc
	Overall (weighted) Score	**3.7**	**Extreme impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Low* with a *High* exposure likelihood results in an overall likelihood of entry and exposure of *Low*. Further, combining an overall likelihood of *Low* with *Extreme* consequences produces an overall risk score of *Moderate Risk* (Figure 2). An overall risk estimate of *Moderate Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the assessed *Extreme* consequences and overall *Moderate Risk* associated with the import of sable from Zambia, risk management is required to reduce the overall likelihood of

introduction and exposure for FMD to *Negligible*, in order to reduce the overall risk to the acceptable level of *Very Low Risk*. Further, because of the severity of the expected consequences, it is appropriate that this risk should be fully mitigated pre-border (i.e. in Zambia) to minimise the likelihood of FMD being detected while in quarantine in South Africa and the potential impacts that this could cause. Thus, risk management measures are required to reduce the likelihood of entry to *Negligible*.

Risk management options considered for FMD are summarised in Table 15.

Table 15. Risk management options for foot-and-mouth disease

Risk management option	**Comments/conclusion**
1. Free country or zone (with or without vaccination)	Acceptable risk
2. Free compartment (self-declared), as defined in the OIE *Code*.	Acceptable risk, subject to an adequate PVS assessment and the country/zone having free status prior to the declaration of the compartment.
3. OIE *Code* recommended measures for domestic livestock and pigs from an infected country or zone	These measures are considered inadequate to reduce the likelihood of entry to *Negligible,* especially for game animals, coming from an endemically infected country with poor FMD control. They would be considered adequate to manage the risk in the following circumstances: • from a protection zone that is part of an OIE-recognised infected zone (no endemic FMD and no current outbreaks) or • a country or zone at Stage 3 or higher on the PCP pathway for FMD This approach is consistent with FMD movement controls currently imposed within South Africa.

Conclusion

The overall risk estimate for the introduction of FMD in sable imported from Zambia was *Moderate,* in the absence of further risk mitigation measures. Taking into account South Africa's principle that all risk mitigation must be undertaken at the source and the likely extreme consequences of introduction of FMD into South Africa, the only measure that were considered adequate to reduce the risk to an acceptable level of *Very Low Risk* were:

1. importation from an officially Free (OIE recognised) country or zone,
2. importation from a free (self-declared) compartment declared in accordance with the OIE *Code*,
3. importation from a protection zone that is part of an OIE-recognised infected zone, in accordance with the OIE guidelines, or
4. importation from an infected country or zone that is at Stage 3 or higher on the PCP Pathway for FMD, in accordance with the OIE guidelines.

Nairobi sheep disease

Nairobi sheep disease is a tick-borne viral infection, affecting mainly sheep and sometimes goats. It is transmitted mainly by *Rhipicephalus* spp. ticks and occurs mainly in areas of eastern Africa, including Kenya, Uganda, Tanzania and Ruanda (F. G. Davies, 1978; W. A. Geering et al., 1995). It is a highly pathogenic virus, causing fever, debilitation, gastroenteritis and abortions and has a high mortality rate. Incubation period is from 1 to 15 days, often in the 2-6 day range and many cases die during the early stages of disease, within 12 hours of onset of fever. Nairobi sheep disease can be confused with Rift Valley fever or peste des petits ruminants (or vice versa), on clinical presentation. Nairobi sheep disease is an OIE-listed disease, however there is no relevant chapter in the *Code* for the disease.

Sheep and goats are the main susceptible species, with cattle, buffalo, horses and pigs resistant to infection. Natural infection and mortalities have been reported in blue duikers. However, serological studies on 317 wild ruminants of a variety of species from an area where Nairobi sheep disease was endemic in sheep and goats, found only small numbers of animals with low antibody titres, consistent with cross-reactions with other viruses related to Nairobi sheep disease, suggesting that wildlife are unlikely to be important in maintaining the disease (F. G. Davies, 1978), although there is no strong evidence that they are unable to transmit infection.

Confirmation of clinical cases is usually by virus isolation or PCR assay. Screening for population freedom or evidence of prior exposure can be done using a variety of serological assays, including ELISA, CFT and AGID, although cross-reactions can occur with other related viruses (F. G. Davies, 1978; Anonymous, 2009b; S.A. Metwally, 2012). These tests are available and used in sheep and goats. However, they are not validated for wildlife.

Control of Nairobi sheep disease is primarily by vector control. In endemic areas a successful strategy is based on allowing a stable endemicity to develop and only attempt active control if the disease extends outside its normal range. Modified live and inactivated vaccines have been developed experimentally but have not been used commercially.

Nairobi sheep disease does not occur in South Africa, is a notifiable disease and would result in an eradication response if it occurred. *Rhipicephalus* spp. ticks do occur in South Africa and are assumed to be competent vectors for the virus.

Nairobi sheep disease is not recorded historically as occurring in Zambia but is not notifiable according to the OIE WAHID country status report (OIE, 2013f), although it is mentioned on the ‘National list of notifiable animal diseases’ submitted by Zambia in September 2014 (Anonymous, 2014b). The current status is unknown, as are details of any surveillance which may (or may not) have been undertaken.

Critical uncertainties and knowledge gaps

The main uncertainties in relation to Nairobi sheep disease are in relation to the potential role of sable and the status of Zambia. Although there is no clear evidence for a role of sable or related species in the epidemiology of Nairobi sheep disease, there is evidence of natural infection of blue duikers and also of low serological titres in other wildlife in an endemic

areas. Although the serological titres were attributed to cross-reactions, infection with Nairobi sheep disease virus cannot be excluded and accordingly the potential for sable to transmit infection also cannot be ignored.

Also, as mentioned above, Zambia's status for Nairobi sheep disease is unknown, as are details of surveillance and the potential for illegal introduction of infection from endemic countries.

OIE Code recommendations

The *Code* does not provide any guidance for importing animals on account of Nairobi sheep disease, so further risk assessment is required.

Entry assessment

The primary pathway for Nairobi sheep disease to enter South Africa with the imported sable would be for infected animals to enter Zambia from an endemic area and establish undetected infection in Zambia, with transmission to the sable prior to or during preparation for export and infection persisting until entry into South Africa. Alternatively, entry could be via an infected tick entering South Africa on imported sable.

Considering that Nairobi sheep disease is not known to occur in Zambia, that Zambia doesn't import significant numbers of live animals from endemic countries (Zambia questionnaire) and uncertainty about the potential role of wildlife in the transmission of Nairobi sheep disease, but also taking into consideration that there are doubts about the effective border control in Zambia and the generally poor surveillance data available, the likelihood of entry of Nairobi sheep disease with Zambian sable was assessed as *Low*.

Exposure assessment

The pathway for exposure of animals in South Africa would require an introduced infected animal to come into contact with a tick vector once in South Africa and for the tick vector to become infected and in turn transmit and establish infection either in wildlife or sheep or goats. Alternatively, if infection was introduced in an infected tick, this tick would have to subsequently feed on and transmit infection to local wildlife or sheep or goats. The proposed initial point of introduction is thought to be free of *Rhipicephalus* spp. ticks, although once introduced into South Africa, the sable would be free to move to other destinations at any time.

Considering the above pathway, the likelihood of exposure of South African animals to Nairobi sheep disease if it is introduced in the imported sable is assessed as *Moderate*.

Consequences assessment

The expected consequences of entry and establishment of Nairobi sheep disease in South Africa are summarised in Table 16. South Africa is free of Nairobi sheep disease and any incursion would be treated as a foreign disease and eradicated by stamping out or other drastic control measures that may be prescribed. As a result, there would be *Extreme* impacts

with destruction of stock, including potentially the loss of valuable genetics, and disruption of business for individual farms and at the local level. There would also be *Major* impacts at Provincial level due to trade effects and response management and nationally due to loss of trade and reputation, control measures and compensation payments. The overall consequences are assessed as being *Major* impact.

Table 16. Consequences summary for Nairobi sheep disease

Agent/disease	Consequence level	Score	Comment
Nairobi sheep disease	Individual farms	4	stamping out
	Local	4	movement controls and stamping out
	Province	3	quarantine and trade restrictions
	National	3	lost trade, reputation, control costs etc
	Overall (weighted) Score	**3.3**	**Major impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Low* with a *Moderate* exposure likelihood results in an overall likelihood of entry and exposure of *Low*. Further, combining an overall likelihood of *Low* with *Major* consequences produces an overall risk score of *Moderate Risk* (Figure 2). An overall risk estimate of *Moderate Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Major* consequences associated with introduction of Nairobi sheep disease, an overall likelihood of entry and exposure of *Negligible* is required to reduce the overall risk to *Very Low Risk*. The OIE does not provide any guidance for importation of susceptible species from a country infected with Nairobi sheep disease.

Proposed risk management for Nairobi sheep disease is for imported sable to be maintained in a tick-free quarantine station for a period of at least 21 days prior to export. During this time they are to be treated for ticks with at least two treatments as proposed for prevention of *Amblyomma variegatum*. These measures are considered adequate to reduce the likelihood of entry of Nairobi sheep disease with imported sable to *Negligible*.

Paratuberculosis

Paratuberculosis, or Johne's disease, is a chronic gastro-intestinal infection, mainly affecting cattle, sheep and goats but which does occur in other ruminants, including wildlife. It is caused by the bacterium *Mycobacterium* subsp. *paratuberculosis*. Paratuberculosis has a long incubation period, with many animals infected early in life but not showing clinical signs until 4-5 years of age or older. There is no cure and affected animals usually waste away and eventually die. Diarrhoea is a common feature in cattle but not always in other species (J. E.

Lombard, 2011). Paratuberculosis is an OIE-listed disease, but the Code does not provide any guidance on requirements for safe movements of animals.

Paratuberculosis has a virtually world-wide distribution, including most countries in sub-Saharan Africa (Anonymous, 2010). Paratuberculosis has been recognised as affecting a variety of game and wildlife ruminants, usually as spill-over of infection from domestic livestock (Anonymous, 2010; E. J. Manning, 2011). In one instance, 20 of 373 Zambian antelope were sero-positive for paratuberculosis (H. Krauss et al., 1984; Anonymous, 2010). Strains of *M. paratuberculosis* are divided broadly in C (cattle) and S (sheep) strains based on genetic and cultural characteristics and host preference. However, host preference is not absolute and strains will cross-infect when opportunity arises (R. J. Whittington et al., 2000; R.J. Whittington and E.S.G. Sergeant, 2001; R. J. Whittington et al., 2001).

Paratuberculosis is present but limited to certain areas in South Africa and is notifiable and strictly controlled in livestock to prevent its spread and also because of potential risks to wildlife, in which the disease has never been diagnosed. There is very little Johne's disease in cattle, but infection is well established in some sheep breeds in certain areas in the Western and Eastern Cape provinces. It is not known which strain(s) of *M. paratuberculosis* occur in South Africa. Known infected farms are quarantined (movements off the farm for slaughter only or to another quarantined farm) and are permitted to use vaccine to aid in control of clinical disease. Similar measures would be applied to infected game farms should they occur. In line with the control measures that are applied on suspect and infected farms in South Africa, strict risk mitigation measures are applied for the import of susceptible animals from countries or zones with an infected or unknown status. Pooled faecal culture in liquid medium followed by PCR detection of the antigen with testing of an adequate sample size is prescribed according to (N. K. Dhand et al., 2010).

Paratuberculosis is not notifiable in Zambia and there is no record of reported cases to the OIE (OIE, 2013f). However, the disease is present in Zambia, as is also the case in most other sub-Saharan countries and as noted above there is some evidence suggesting possible infection of antelope in Zambia (H. Krauss et al., 1984; C. D. Buergelt et al., 2004; Anonymous, 2010).

Screening for paratuberculosis may be based on either serological testing (ELISA or AGID), faecal culture or PCR. Generally all tests have poor sensitivity in young or pre-clinical animals, with sensitivity increasing as disease progresses. Generally, serological tests tend to be slightly less sensitive and less specific than faecal culture (S.S. Nielsen and N. Toft, 2008). Also, liquid medium culture appears to have a higher sensitivity than solid medium and "S" strains have specific cultural requirements that differ from those of commonly used media for cattle (R. J. Whittington et al., 1999). Faecal culture can also be undertaken on pooled samples to reduce cost and pooled culture is the recommended test for surveillance (M. T. Collins, 2011) and or population freedom (OIE, 2014s). A recently published liquid medium has been validated for use for pooled culture of both "C" and "S" strains in Australia (R. J. Whittington et al., 2013). A variety of PCR assays are also available for paratuberculosis, however most of these, other than the Australian HT-J PCR assay (K. M. Plain et al., 2014), are not well validated even for livestock. Faecal culture or PCR is also

recommended as the preferred detection option for non-livestock species, where serological assays have not been well characterised (M. T. Collins, 2011).

On-farm control of paratuberculosis varies depending on species, industry sector and individual circumstances. Generally, control is based on a combination of hygiene, particularly segregation of young animals from older animals likely to be excreting organisms, grazing management, selective culling of high-risk animals and vaccination (F. Garry, 2011; E. A. Patton, 2011; S. Robbe-Austerman, 2011; A. J. Roussel, 2011).

Critical uncertainties and knowledge gaps

The main uncertainty in relation to paratuberculosis is whether or not sable can become infected and transmit infection. However, a number of other wildlife species have been shown to be susceptible to paratuberculosis, so it cannot be excluded that sable are similarly susceptible.

OIE Code recommendations

The OIE *Code* does not provide any guidance for movements in relation to paratuberculosis, so that further risk assessment is required.

Entry assessment

The primary pathway for entry of paratuberculosis into South Africa would be for one or more of the sable under consideration to have been infected either prior to or during the preparation for export (probably as a calf) and that infection was maintained in the herd until the point of export and entry into South Africa. The long incubation period makes it quite feasible that one or more animals could be infected prior to entry, remain healthy throughout the isolation period and not develop clinical disease until post-quarantine in South Africa.

Paratuberculosis occurs in Zambia, although little is known about its occurrence and there is no apparent control over the disease. There is serological evidence of presence of paratuberculosis in antelope in Zambia, although it is impossible to known whether this represents genuine infection or not. Further, the susceptibility of sable to paratuberculosis is unknown. There is therefore some uncertainty about the overall likelihood of entry of paratuberculosis but it is considered to be *Low*, in the absence of further risk mitigation.

Exposure assessment

The pathway for exposure in South Africa, should entry occur in the imported animals, is for an infectious animal to have close contact with local wildlife or livestock (particularly young animals), or for local wildlife to subsequently graze land where imported animals have grazed.

Considering the chronic and often sub-clinical nature of paratuberculosis and the ability for the organism to survive for months under favourable conditions, the likelihood of exposure of South African animals should entry occur is considered to be M*oderate*.

Consequence assessment

It is assumed that if exposure to paratuberculosis occurs in South Africa wildlife then it will establish and spread at least locally, depending on local environment, animal movements and how quickly it is detected. Exposure and detection of infection in wildlife would lead to movement restrictions and control measures on the affected farm, including all susceptible species and even without such measures there is likely to be buyer resistance and trade effects on affected farms and in the local area. Accordingly, the impact on affected farms was considered to be *Extreme*, with *Minor* effects at the local level and *Inconsequential* impact at Provincial level. At a national level, a *Significant* impact is likely if infection is not detected and controlled early, because of the potential impact on wildlife.

The consequence assessment for brucellosis is summarised in Table 17. Overall, the expected consequences were assessed as *Minor*.

Table 17. Summary consequence assessment for paratuberculosis

Agent/disease	Consequence level	Score	Comment
Paratuberculosis	Individual farms	4	lost trade & buyer resistance
	Local	1	lost trade & buyer resistance
	Province	0	Negligible impact
	National	2	significant impact if not detected early, because of potential JD impact in wildlife
	Overall (weighted) Score	**1.4**	**Minor impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Low* with a *Moderate* exposure likelihood results in an overall likelihood of entry and exposure of *Low*. Further, combining an overall likelihood of *Low* with *Minor* consequences produces an overall risk score of *Low Risk* (Figure 2). An overall risk estimate of *Low Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Minor* consequences associated with brucellosis, an overall likelihood of entry and exposure of *Very Low* is required to reduce the overall risk to *Very Low Risk*. The following options were considered for risk management for paratuberculosis (Table 18):

Table 18. Risk management options considered for paratuberculosis

Risk management option	Comments/conclusion
1. A single serological test using either ELISA or AGID during pre-export quarantine, within 30 days of shipment.	This option was considered inadequate to reduce the likelihood of entry to *Very Low* because of the lack of validation of the assays and the poor sensitivity compared to faecal culture, and so was rejected as an appropriate option.
2. Pooled faecal PCR of all animals with negative results, while in pre-export quarantine.	This option was considered inadequate to reduce the likelihood of entry to *Very Low* because of the lack of validation of available PCR assays for wildlife, in particular considering the potential that the very different nature of wildlife faeces could impact on performance of the assay.
3. Pooled faecal culture in liquid medium of all animals with negative results, while in pre-export quarantine (N. K. Dhand et al., 2010). Testing to be undertaken in a government approved laboratory.	This option was considered to provide adequate risk mitigation to reduce the likelihood of entry from *Low* to *Very Low* and the overall risk to *Very Low Risk*.

Appropriate testing of animals for import is thus considered essential and in line with the control measures that are applied on suspect and infected farms in South Africa. The same risk mitigation measures are also applied for the import of other susceptible animals from countries or zones with an infected or unknown status and are particularly appropriate in this case given the serological evidence of possible infection in wild antelope in Zambia (H. Krauss et al., 1984).

Conclusion

The unrestricted risk of paratuberculosis was assessed as *Low Risk* to South Africa overall. However, this risk can be readily reduced to *Very Low Risk* by the following option:

1. Pooled faecal culture in liquid medium of all animals with negative results, while in pre-export quarantine. Testing to be undertaken in a government approved laboratory.

Peste des petits ruminants

Peste des petits ruminants (PPR) is a serious viral disease of sheep, goats and related wild bovidae. It is spread mainly by aerosol or direct contact, has an incubation period of 21 days for the purposes of the *Code* and there is no carrier state (OIE, 2014l). PPR has been previously diagnosed in a number of wildlife species, including members of the family *Hippotraginae*, of which sable antelope is a member (D. Keet, 2014). Wild ruminants are not

thought to play an important role in the epidemiology of the disease (OIE, 2014l), although there are no specific studies demonstrating that sable are not capable of playing a role.

South Africa is officially free of PPR (OIE, 2014p). PPR is notifiable in South Africa and would be subject to official control and eradication measures should it occur. PPR is notifiable in Zambia and was last reported in Zambia in November 2010 (OIE, 2013f), although Zambia's official reply to the DAFF questionnaire indicated that the disease was never reported. Therefore Zambia's status for PPR is considered uncertain, but there is a possibility that it may be present and/or undetected and/or unreported.

Diagnosis of PPR is based on clinical signs and pathology, with confirmation by agent identification using immunocapture ELISA, counter immunoelectrophoresis, agar gel immunodiffusion or PCR. Recommended tests for screening for population freedom or for movement of animals are the competitive ELISA or virus neutralisation assay (OIE, 2014t). These assays were developed primarily for use in sheep and goats and are un-validated for use in wildlife. However, validated alternatives are not available.

Control of PPR is usually based on stamping out, with slaughter of affected and in-contact animals, quarantine and movement controls and strategic vaccination. In endemic areas the disease is generally controlled by vaccination of sheep and goats (OIE, 2013c).

Critical uncertainties and knowledge gaps

A critical uncertainty for PPR is the status of Zambia for this disease. As noted, Zambia reported a case of PPR to the OIE in November 2010, but no other information is available either for this outbreak or subsequently. In their response to the South African questionnaire, Zambia stated that PPR is "Not Reported" and that they have both passive and active surveillance in place (Anonymous, 2014b). The 2013 Annual Report mentions some sero-surveillance that has been conducted in the past (sometime between 2009 and 2012) and that more is required but no surveillance report or other details have been provided (Anonymous, 2013).

There is also some uncertainty about the potential role of sable in spreading PPR. However, PPR has been diagnosed in other antelope of the same family and their ability to transmit infection cannot be excluded.

A further uncertainty is associated with the performance of the OIE-recommended tests, which are not validated for sable or other wildlife. However, these are the only tests available and so should be used with caution.

OIE Code recommendations

The *Code* provides the following recommendations for importation of wild ruminants from countries or zones considered infected with PPR (OIE, 2014l):

"*That the animals:*

1. *showed no clinical sign suggestive of PPRV infection for at least the 21 days prior to shipment;*
2. *were submitted to a diagnostic test for PPRV infection with negative results no more than 21 days prior to shipment;*
3. *were kept in a quarantine station for at least the 21 days prior to shipment."*

These recommendations are considered adequate in principle to manage any risk of PPR in sable imported from Zambia. However, while these recommendations are considered adequate to manage any risk of PPR, given the highly contagious nature of this disease and the possible role of fomites in its transmission, a very effective pre-export quarantine would be required to provide the biosecurity guarantees implied by the OIE recommendations.

Unfortunately neither the evidence provided in the Zambian reply to South Africa's request for information, nor the general information available from the literature or the OIE website, allow for the conclusion that Zambia would be able to provide the necessary guarantees and certification for such a quarantine process. This concern is deepened by the contradictory information about the PPR status of Zambia combined with the absence of any evidence of regular sero-surveillance or effective border control, the current trend of the disease moving southwards in Africa thereby endangering the SADC region, the absence of pathognomonic symptoms that would allow for purely passive surveillance and the potential role of sub-clinically infected animals in the epidemiology of this disease. Thus, while Zambia may be able to certify that the animals did not display clinical symptoms during their pre-export isolation and that direct contact with susceptible species was avoided, it cannot be excluded that a break in biosecurity may allow for some of the animals to become infected by indirect means shortly before departure. Thus further risk assessment is required for PPR.

Entry assessment

The expected pathway for entry of PPR into South Africa would be for exposure of sable prior to or during preparation for export, with the infection circulating within the group and persisting until arrival in South Africa.

Considering the conflicting information about the PPR status of Zambia and the uncertainty about Zambia's ability to detect and report PPR in a timely and reliable manner there is considerable uncertainty about likely occurrence and prevalence of PPR in Zambia. There is also some uncertainty about the potential role of sable in the epidemiology of PPR. However, the potential for exposure and infection of sable in Zambia cannot be excluded and the likelihood of entry of PPR with imported sable from Zambia is therefore assessed as *Low*.

Exposure assessment

The expected pathway of exposure for PPR to local susceptible animals in South Africa would be for infectious sable to enter South Africa and mix with susceptible local animals, either other wildlife or livestock, which they might come in contact with and for transmission to occur.

Given the highly infectious nature of this virus, the likelihood of exposure of local susceptible animals, should the virus be introduced, is assessed as *High*.

Consequence assessment

For the consequence assessment, it is assumed that local susceptible animals (wildlife or livestock) are exposed to PPR and become infected and that infection spreads to local sheep and goat populations, initiating an outbreak of PPR in South Africa.

The consequence assessment for PPR is summarised in Table 19. South Africa is free of PPR and any incursion would be treated as a foreign disease and eradicated by stamping out or other measures as required. As a result, there would be *Extreme* impacts with destruction of stock, including the loss of potentially valuable genetics, and disruption of business for individual farms. There would be major impacts at the local level due to movement restrictions and consequent trade impacts. There would also be *Significant* impacts at the Provincial level due to trade effects and response management. There would be *Extreme* impacts nationally due to loss of trade, control measures, compensation payments and reputational loss. The overall consequences are assessed as being *Major* impact.

Table 19. Consequence summary for PPR

Agent/disease	Consequence level	Score	Comment
Peste des petits ruminants	Individual farms	4	stamping out, business disruption, etc
	Local	3	Movement restrictions, trade impacts
	Province	2	Movement restrictions, trade impacts
	National	4	lost trade, reputation, control costs etc
	Overall (weighted) Score	**3.2**	**Major impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Low* with a *High* exposure likelihood results in an overall likelihood of entry and exposure of *Low*. Further, combining an overall likelihood of *Low* with *Major* consequences produces an overall risk score of *Moderate Risk* (Figure 2). An overall risk estimate of *Moderate Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Major* consequences associated with PPR, an overall likelihood of entry and exposure of *Negligible* is required to reduce the overall risk to *Very Low Risk*.

The OIE recommended guidelines for importation of wild ruminants from a PPR infected country (above) are considered adequate in principle to manage the risk of PPR in imported sable from Zambia and to reduce the likelihood of entry of PPR to *Negligible*. However, for these guidelines to be considered acceptable for the current shipment would require further clarification and guarantees from Zambia. In particular, Zambia would be expected to clarify their PPR status and provide evidence of surveillance to support this. Zambian veterinary

authorities would also be expected to provide acceptable assurances of their capability to manage control of the quarantine station and to manage biosecurity and infection risk during the pre-export quarantine period.

Conclusion

The unrestricted risk of *PPR* was assessed as *Moderate Risk* to South Africa overall. However, this risk can be reduced to *Very Low Risk* by applying the OIE recommendations, provided that Zambian veterinary authorities can provide adequate assurances about PPR status, current and historical PPR surveillance and ability to manage biosecurity and infection risk during quarantine.

Rabies

Rabies is a highly fatal viral infection affecting all warm-blooded vertebrates, including humans. It is generally transmitted by the bites of affected animals and has an incubation period of up to 6 months (OIE, 2014m). Rabies is present in South Africa and is a notifiable disease. Rabies is subject to official controls in South Africa by preventive or post-exposure vaccination and euthanasia of affected animals. Rabies also occurs and is notifiable in Zambia. Some information has been provided by Zambia about the control of this notifiable disease (Anonymous, 2014b), with some additional data in the 2013 Annual Report (Anonymous, 2013), although the information about cases was difficult to analyse without maps.

The Code provides the following recommendations for importation of wildlife from countries considered infected with rabies (OIE, 2014m):

"*That the animals:*

1. *showed no clinical sign of rabies the day prior to or on the day of shipment; and*
2. *were kept for the six months prior to shipment in an establishment where separation from susceptible animals was maintained and where there has been no case of rabies for at least 12 months prior to shipment."*

Since rabies is a disease that is easy to recognize by the veterinary authorities and thus lends itself to the passive surveillance practiced by Zambia, the OIE recommendations are considered adequate to manage any rabies risk in Sable imported from Zambia and no further risk assessment is required.

Rift Valley fever

Rift Valley fever (RVF) is an acute vector-borne viral infection of domestic and wild ruminants, spread by a variety of mosquito species, including *Aedes*, *Anopheles*, *Culex* and other genera. Susceptibility and pathogenicity vary according to species but morbidity and mortality can approach 100% in sheep and goats, with abortions of pregnant animals and severe febrile illness and death particularly in young animals. RVF is also a zoonosis, causing severe influenza-like symptoms in humans, with sometimes more serious complications or death. Direct transmission to humans can occur through handling of infected animals and

meat. Outbreaks tend to occur in 5-25 year cycles, associated with seasonal conditions, availability of susceptible hosts and conditions favouring vector proliferation, with only sporadic cases occurring in the "inter-epizootic period" (W. A. Geering et al., 1995; OIE, 2009c). During the inter-epizootic period the virus is thought to be maintained in a sylvatic cycle in asymptomatic wild ruminants and other species, or by maintenance in vector populations (OIE, 2009c).

RVF has an incubation period of 1-6 days and an infective period of 14-30 days (OIE, 2009c; OIE, 2014n). There is no specific information on susceptibility of sable to RVF, but equally no definitive information to indicate that they are not susceptible (G. R. Thomson, 2010). The OIE indicates that wild ruminants, including buffaloes, antelopes, wildebeest, etc, are susceptible so it is reasonable to assume that sable are similarly susceptible (OIE, 2009c).

RVF is known to occur in South Africa and is notifiable and subject to official control measures when it occurs. RVF is notifiable in Zambia but has never been reported to the OIE (OIE, 2013f). Zambia's response to the DAFF official enquiries as to current status for RVF just indicates that the disease was never reported and the OIE country information on the WAHID website indicates that the status of RVF in Zambia is unknown (OIE, 2013f). Given the reliance on passive surveillance and the poor return of monthly reports in Zambia (41.1%), as well as the widespread sporadic occurrence of the disease in the region, Zambia's status for RVF is considered uncertain but likely to be present and unreported.

Diagnosis of RVF is usually based on typical clinical signs and pathology, with confirmation by agent identification using virus isolation, antigen-detection ELISA, immunopathology or PCR. Recommended tests for screening for population freedom or for movement of animals are the ELISA or virus neutralisation assay for detection of circulating antibody (OIE, 2014u). These assays are un-validated for use in wildlife. However, validated alternatives are not available.

Control of RVF during an outbreak is based on a combination of measures, including vector control, movement controls and vaccination, using a live attenuated or inactivated vaccine. Specific RVF control measures during the interepizootic period are usually not required

Critical uncertainties and knowledge gaps

A critical uncertainty for RVF is the status of Zambia for this disease and the Zambian authorities' ability to identify, report and respond to an outbreak. In the absence of any information on Zambia's status and the lack of any specific surveillance for the disease, it is assumed that RVF occurs in Zambia and that outbreaks could occur undetected or unreported in the vicinity of animals for export to South Africa. The ability of the Zambian veterinary authorities to detect and respond to epizootics is uncertain but assumed to be poor, given the lack of historical information on the disease.

A further uncertainty is associated with the performance of the recommended vaccines in sable, as they have not been evaluated or registered for this species.

OIE Code recommendations

The Code provides the following recommendations for importation of "ruminants" from countries or zones considered infected with RVF **during an epizootic** (OIE, 2014n):

"*That the animals*:

1. *showed no sign of RVF on the day of shipment;*
2. *did not originate in the area of the epizootic;*
3. *were vaccinated against RVF at least 14 days prior to shipment;*
4. *were held for at least 14 days prior to shipment in a quarantine station, which is located in an area of demonstrated low vector activity outside the area of the epizootic. During this period the animals showed no sign of RVF;*
5. *either:*
    a. *did not transit through an area experiencing an epizootic during transportation to the place of shipment; or*
    b. *were protected from vector attacks when transiting through an area experiencing an epizootic."*

Further, the Code also provides the following recommendations for importation of "ruminants" from countries or zones considered infected with RVF **during an inter-epizootic period** (OIE, 2014n):

"*That the animals*:

1. *showed no sign of RVF on the day of shipment;*
2. *met one of the following conditions:*
    a. *were vaccinated against RVF at least 14 days prior to shipment with a modified live virus vaccine; or*
    b. *were held for at least 14 days prior to shipment in a mosquito-proof quarantine station which is located in an area of demonstrated low vector activity. During this period the animals showed no clinical sign of RVFV infection;*

AND

3. *either:*
    a. *did not transit through an area experiencing an epizootic during transportation to the place of shipment; or*
    b. *were protected from vector attacks when transiting through an area experiencing an epizootic."*

The OIE recommendations outlined above are adequate in principle to manage the risk of RVF in sable imported from Zambia, although the vaccines for RVF are not registered for use in sable antelope. Further, the recommendation for pre-export quarantine in a vector-proof facility is impractical for a large shipment of antelope. However, application of measures recommended in the *Code* would depend on the ability of the Zambian authorities to provide documented evidence of RVF status and their ability to detect and respond to epizootics and thus allow exports only from areas of low vector activity. Because of

uncertainty about Zambia's ability to provide this evidence, RVF was taken to a full risk assessment.

Entry assessment

The expected pathway for entry of RVF would be for exposure of sable to occur prior to or during preparation for export, with the infection maintaining within the group and persisting until arrival in South Africa. This would require proximity of RVF to the area where the sable are held and presence in the area of competent vectors to introduce and transmit infection among the sable. Given the ubiquity of the vectors, it is assumed that vectors are likely to be present across most of Zambia so that potential for exposure mainly depends on presence of active RVF infection in proximity to the sable.

The lack of information about RVF in Zambia and the uncertainty about Zambia's ability to detect and report RVF in a timely and reliable manner and to respond and manage outbreaks are a serious concern in relation to the likelihood of introducing RVF into South Africa from Zambia with a shipment of sable. Considering these uncertainties, the likelihood of entry of RVF with imported sable from Zambia is assessed as *Low*.

Exposure assessment

The expected pathway of exposure for RVF to local susceptible animals in South Africa would be for infectious sable to enter South Africa and for local vectors to feed on the infected sable and transmit infection to local animals in the vicinity, either other wildlife or livestock.

Given the acknowledged presence of suitable vectors across much of South Africa, the likelihood of exposure of local susceptible animals, should the virus be introduced, is assessed as *High*.

Consequence assessment

For the consequence assessment, it is assumed that RVF virus enters South Africa and that local susceptible species are exposed and become infected, resulting in local spread and establishment of infection which may or may not initiate an epizootic.

The consequence assessment for RVF is summarised in Table 20. RVF is endemic in South Africa, so any effects of the introduction would be incremental. However, there may be *Significant* impacts at individual farm and local levels, due to deaths, lost production, control costs, lost trade and human health impacts. Provincial and National impacts are likely to be *Minor*, compared to the overall impact of the ongoing cycle of RVF in South Africa. The overall consequences are assessed as being *Minor* impact.

Table 20. Consequences summary for Rift Valley Fever

Agent/disease	Consequence level	Score	Comment
Rift Valley Fever	Individual farms	2	Mortalities and lost production, control costs, depending on topotype
	Local	2	local spread, control costs and trade effects
	Province	1	minor impact compared to ongoing cycle of RVF in South Africa
	National	1	minor impact compared to ongoing cycle of RVF in South Africa
	Overall (weighted) Score	**1.3**	**Minor impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Low* with a *High* exposure likelihood results in an overall likelihood of entry and exposure of *Low*. Further, combining an overall likelihood of *Low* with *Minor* consequences produces an overall risk score of *Low Risk* (Figure 2). An overall risk estimate of *Low Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Minor* consequences associated with RVF, an overall likelihood of entry and exposure of *Very Low* is required to reduce the overall risk to *Very Low Risk*.

The OIE recommended guidelines for importation of ruminants from an infected country are considered adequate in principle to reduce the likelihood of entry of RVF to *Very Low*. However, the ability of the Zambian authorities to adequately determine the occurrence and extent of an epizootic, to identify areas of low vector activity and to provide appropriate certification to meet the requirements is uncertain. Further, current vaccines are not evaluated or registered for use in sable and use of a mosquito-proof quarantine station is impractical for large shipments of wildlife.

The following risk management is proposed, based on an adaptation of the OIE guidelines.

That export only takes place during an inter-epizootic period and that the animals:

1. showed no sign of RVF on the day of shipment;
2. were held for at least 14 days prior to shipment in a quarantine station, which is located in an area of demonstrated low vector activity. During this period the animals showed no sign of RVF;
3. either:
    a. did not transit through an area experiencing an epizootic during transportation to the place of shipment; or
    b. were protected from vector attacks when transiting through an area experiencing an epizootic.

These measures are considered to provide adequate risk mitigation to reduce the likelihood from *Low* to *Very Low*, provided that Zambian veterinary authorities can provide adequate demonstration of their ability to determine areas of low vector activity and to detect RVF and define an epizootic and inter-epizootic period.

Conclusion

The unrestricted risk of *RVF* was assessed as *Low Risk* to South Africa overall. However, this risk can be reduced to *Very Low Risk* by implementation of a modified version of the OIE guidelines, requiring 14 days in a quarantine station in an area of demonstrated low vector activity, no clinical signs of RVF and protection from exposure to RVF during transit, provided that Zambian veterinary authorities can provide adequate demonstration of their ability to determine areas of low vector activity and to detect RVF and define an epizootic and inter-epizootic period.

Theileriosis

Theilerosis covers a group of infections by protozoan parasites of the genus *Theileria*. The most important species in southern Africa is *T. parva*, the cause of East Coast Fever (cattle adapted biotype) and Corridor disease (buffalo adapted biotype) (J. A. Lawrence et al., 2004a; J. A. Lawrence et al., 2004b). *T. annulata* is also an important pathogen of cattle, but distribution is thought to be restricted to northern Africa, southern Europe, the Middle East and Asia (E. Pipano and V. Shkap, 2004). *T. lestoquardi* is an important cause of theileriosis in sheep and goats and has a similar distribution to *T. annulata*.

Clinical signs of East Coast Fever include fever, enlargement of superficial lymph nodes, pulmonary oedema and petechial and echymotic haemorrhages of mucous membranes. As disease progresses, wasting and loss of milk production occur and most cases eventually end in death (J. A. Lawrence et al., 2004b). Other forms of theileriosis present with similar signs to those of East Coast fever but anaemia and jaundice may also be features (J. A. Lawrence, 2004; J. A. Lawrence et al., 2004a; E. Pipano and V. Shkap, 2004; OIE, 2014v).

Transmission of theileriosis is by tick vectors, *Rhipicephalus appendiculatus, duttoni* and *zambeziensis* for *T. parva* and *Hyalomma* spp. for *T. annulata* and *T. lestoquardi* (OIE, 2009d).

East Coast fever is caused by a cattle-adapted strain of *T. parva* which circulates primarily in cattle. Cattle appear to be the primary reservoir of infection and wildlife appear not to play a role in the epidemiology of the disease (J. A. Lawrence et al., 2004b). In contrast, Corridor disease is due to a spill-over of a buffalo-adapted strain of *T. parva* into cattle. In endemic areas, most buffalo become infected at a young age and act as life-long carriers. Thus, most cases of Corridor disease occur where cattle co-graze with infected buffalo or graze the pastures recently grazed by infected buffalo (J. A. Lawrence et al., 2004a).

Corridor disease occurs in South Africa, but is confined to recognised endemic areas and strict movement controls are in place to prevent further spread of the disease (Anonymous, 2002). This includes the individual testing of all buffalo to be moved for *T. parva* with the

movement of buffalo from infected herds being restricted to the Corridor disease controlled areas. Although Corridor disease is present in South Africa, East Coast fever is not, having been eradicated in 1955, following a prolonged eradication campaign (J. A. Lawrence et al., 2004b). The presence of *R. appendiculatus* and *R. zambesiensis* in South Africa will allow establishment of an endemic carrier state in cattle if East Coast fever is re-introduced. *T. annulata* and *T. lestoquardi* have never occurred in South Africa and would be subject to control and eradication if they were introduced. *Hyalomma marginatum rufipes* is widely distributed in South Africa and has been shown to be a competent vector of *T. annulata*. However, risk of natural transmission is considered to be small since the immature stages of this two-host tick feeds on birds (F. Jongejan et al., 1983).

East Coast fever is endemic in Zambia, with 17,000 cases and 2,300 deaths reported from seven of the ten provinces (three provinces did not report or submitted nil reports) in 2013 (Anonymous, 2013). Control is by vaccination and movement restrictions on affected herds (Anonymous, 2014b). However, Zambia has stated that the movement restrictions for East Coast Fever (ECF) are being "*applied based on the strains of ECF prevailing in that region*" with the requirement that cattle "*are only permitted to move from one district to another if the strain are the same or if the animals are free of the infection*". It is difficult to believe that such detailed control measures requiring a large amount of testing could be applied effectively without detailed active surveillance data being available. No information is available on the occurrence of *T. annulata* and *T. lestoquardi* in Zambia. Given the known distribution of these agents to northern Africa, Europe and Asia, their occurrence in Zambia appears unlikely unless they were introduced with imports of live animals from endemic areas but the doubts about the effective control of illegal imports into Zambia are cause for concern in this regard (Y. Sinkala et al., 2012; Y. Sinkala et al., 2014).

The role of sable in the epidemiology of *T. parva*, *T. annulata* and *T. lestoquardi* is unknown, although wildlife, other than buffalo and waterbuck, are generally not thought to be important in the epidemiology of these agents (J. A. Lawrence et al., 2004a; J. A. Lawrence et al., 2004b; G. R. Thomson, 2010; D. Keet, 2014). However, *Theileria* sp. infecting sable and roan antelope (*T. sp.* (sable)) are also recognised and are capable of causing clinical disease in infected antelopes (S. E. Thomas et al., 1982; A. M. Nijhof et al., 2005; J. C. Steyl et al., 2012). Although *T.* sp. (sable) or *T.* sp. (sable-like) infections are recognised to occur, little more is known about them and the organism(s) involved are not well characterised.

T. sp. (sable) is recognised to occur in both Zambia and South Africa. Further, strains of *T.* sp. (sable) in Zambia and South Africa are likely to be similar due to the known translocation of many sable between the two countries over a period of nearly two decades (G. R. Thomson, 2010). However, research has not been undertaken to demonstrate whether this is truly the case or whether the strains in the two countries have diverged.

Diagnosis of East Coast fever and other theilerioses is usually based on characteristic clinical signs and presence of the tick vector, with confirmation by microscopic examination of peripheral blood or lymph node smears (J. A. Lawrence et al., 2004b; OIE, 2014w). An indirect fluorescent antibody (IFA) test is also available for serological screening. ELISA assays have also been developed but lack specificity (OIE, 2014w).

Newer molecular diagnostic methods, such as PCR and reverse line blot hybridisation provide very useful tools for differentiating the various *Theileria* species and for epidemiological studies (OIE, 2014w). One emerging issue affecting diagnosis is that of mixed infections, with evidence that conventional PCR and reverse line blot assays may fail to detect *T. parva* where it is part of a mixed infection and parasitaemia is low relative to other *T.* spp (R. Pienaar et al., 2011). This could affect the ability of conventional tests to detect low-level parasitaemia due to competition with other species and may require gene sequencing or other methods to resolve. South Africa thus uses the Hybrid II assay, a real-time hybridization PCR method, to diagnose *T. parva* infections in buffalo where mixed-infections with *T.* sp. (buffalo) occur. Even this test has been shown to not be able to detect every individual infected animal in an infected herd and thus the contingency protocol for buffalo has been adapted to prescribe that in the case of even just one buffalo testing positive for *T. parva* the whole herd is considered to be infected and subject to the relevant control measures (M. Maja, 2013).

Microscopic examination of blood or lymph node smears, PCR and IFAT are all recommended or suitable methods for individual animal screening for movement and a combination of these tests is used in South Africa for the testing of every buffalo prior to movement.

Control of theilerioses generally relies on acaracide use to control tick populations, vaccination to prevent clinical disease and direct losses and movement controls to restrict spread of disease. Vaccination against *T. parva* is based on a method of infection and treatment in which cattle are given a subcutaneous dose of a live vaccine and a simultaneous treatment with a long-acting tetracycline antibiotic. This treatment results in a mild or inapparent infection followed by recovery. Recovered animals demonstrate a usually life-long immunity to homologous strain of *T. parva*. Immunised animals usually become carriers of the vaccine strain of *T. parva* (OIE, 2014w) and vaccine strains can initiate clinical disease if introduced into populations not previously exposed to the same antigenic type (J. A. Lawrence et al., 2004b).

Critical uncertainties and knowledge gaps

The main critical knowledge gap in relation to theileriosis for this risk analysis is the potential for sable to transmit cattle-adapted or vaccine strains of *T. parva,* or *T. annualata* or *T. lestoquardia*. Although wildlife are generally not considered to be important in the epidemiology of the disease in endemic populations, there is no clear evidence to demonstrate that sable (or other wildlife) are unable to be transmit infection. A further concern is that if sable are able to be infected it is feasible that low-level parasitaemias may result and that these could be easily masked by concurrent infection with sable-adapted strains. There is also some uncertainty about the relationship between strains of *T.* spp. (sable) in Zambia and South Africa. Although historical movement patterns suggest that strains are likely to be closely related this has not been further investigated to determine whether or not the strains may have diverged.

Finally, Zambia has not provided adequate information to provide confidence that *T. annualata* or *T. lestoquardia* might not have been introduced into Zambia through either legal or illegal animal imports.

OIE Code recommendations

The OIE *Code* does not provide any guidance for the importation of wildlife from countries infected with theileriosis (OIE, 2014v), so further risk assessment is required.

Entry assessment

The pathways identified for an unwanted *Theileria* spp. or biotype to be introduced into South Africa with sable imported from Zambia and their associated likelihoods are summarised in Table 21.

Table 21. Summary of potential entry pathways and likelihoods for exotic Theileria spp.

Pathway	**Likelihood and rationale**
Cattle adapted *T. parva* (East Coast Fever) infection of sable prior to or during preparation for export and infection persisting until the sable are imported into South Africa.	*Negligible* likelihood Sable not a recognised host of *T. parva.* Previous testing 140/140 negative on PCR and 139/139 negative on IFAT for *T. parva* (G. R. Thomson, 2010; D. Keet, 2014).
T. annulata or *T. lestoquardia* introduced into Zambia from endemic areas and infecting sable prior to or during preparation for export and infection persisting until the sable are imported into South Africa.	*Low* likelihood Sable not a recognised host of *T. annulata or T. lestoquardia* and agents not known to be present in Zambia, but no evidence of effective typing of the parasites causing ECF outbreaks, which could lead to an incursion of foreign *Theileria spp.* being missed. Live animal imports to Zambia mainly from South Africa and Namibia although other sources not specified (Anonymous, 2013; Anonymous, 2014b) and doubts over effective import control (Y. Sinkala et al., 2014).
Infection of sable with cattle-adapted vaccine strains of *T. parva* prior to or during preparation for export and infection persisting until the sable are imported into South Africa.	*Low* likelihood Rationale as for *T. parva* wild strains.
Ticks infected with one of the above strains being present on the sable when introduced into South Africa.	*Low* likelihood Requires a source of infection, either from the sable themselves or from nearby cattle or other susceptible species.

Overall, the likelihood of entry of known pathogenic *Theileria* spp. or biotypes is considered *Low*.

Exposure assessment

The principal pathway for exposure, should an exotic *Theileria* spp. be introduced with the imported sable is for the sable to go to an area where competent vectors are found and be parasitised by a vector, which becomes infected and subsequently transmits the infection to local wildlife or livestock. An alternative pathway would be for infected ticks to be introduced with the sable and subsequently transmit the infection when feeding on local hosts. Although the initial destination of the imported sable is reportedly an area that is free of ticks (G. R. Thomson, 2010), there is no guarantee that they will stay at that location and no means of preventing them from moving to areas where ticks do occur.

The likelihood of the imported sable coming into contact with tick vectors sufficient to transmit infection, if present, to local wildlife or livestock is assessed as *Moderate*.

Consequence assessment

The expected consequences of introduction of a pathogenic exotic *Theileria* spp. or biotype are summarised in Table 22. There will be a only a *Minor* impact on the imported sable but a *Significant* impact on affected farms because of effects on naïve game species and lost trade. The local and provincial effects are assessed as a *Major* impact, due to local spread, deaths and lost trade. The national impact is assessed as *Significant* depending on the species/biotype introduced and the rate of spread nationally. The overall consequences of introducing a pathogenic exotic species or biotype are assessed as *Major*.

Table 22. Consequences summary for Theileriosis

Agent/disease	Consequence level	Score	Comment
Theileria spp (exotic spp, including cattle-adapted and vaccine strains of *T parva*)	Individual farms	2	minor effect on imported sable, potentially significant effect on naïve game species, lost trade
	Local	3	local spread and lost trade, deaths, depending on severity of disease
	Province	3	local spread and lost trade, deaths, depending on severity of disease
	National	2	depending on rate of spread nationally and species (e.g. *T. annulata*)
	Overall (weighted) Score	**2.5**	**Major impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Very Low* with a *Moderate* exposure likelihood results in an overall likelihood of entry and exposure of V*ery Low*. Further, combining an overall likelihood of V*ery Low* with *Major* consequences

produces an overall risk score of *Low Risk* (Figure 2). An overall risk estimate of *Low Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Major* consequences associated with brucellosis, an overall likelihood of entry and exposure of *Negligible* is required to reduce the overall risk to *Very Low Risk*.

The OIE Code does not provide any guidance for importation of wildlife from a theileriosis infected country or zone. Two options for risk management for theileriosis were considered as summarised in Table 23:

Table 23. Risk management options for theileriosis

Risk management option	**Comments/conclusion**
1. A single test of all animals, using IFAT and PCR hybridization assay, with negative results for *T. parva*, *T. annulata* and *T. lestoquardia* in all animals during pre-export quarantine, within 30 days of shipment. All animals to also be treated with an acaricide during the quarantine period to eliminate any ticks present	This option was considered inadequate to reduce the likelihood of entry to *Negligible* because of the potential for masking of potentially pathogenic *Theileria* species present at a low-level parasitaemia by other more prevalent species (*T.* spp. sable).
2. A single test of all animals, using IFAT and PCR hybridization assay, with negative results for **all** *Theileria* spp. in all animals during pre-export quarantine, within 30 days of shipment. All animals to also be treated with an acaricide during the quarantine period to eliminate any ticks present. Testing to be undertaken in a government approved laboratory.	This option was considered to provide adequate risk mitigation to reduce the likelihood of entry from *Very Low* to *Negligible* and the overall risk to *Very Low Risk*.

If the animals test positive for a *Theileria* spp., further testing to establish the species of Theilerias, including differential tests and gene sequencing, could be considered and an import permit could be granted based on the assurance that the animals do not test positive for *T. parva*, *T. annulata* or *T. lestoquardia*.

Conclusion

The unrestricted risk of *Theileriosis*, without further risk management, was assessed as *Low Risk* to South Africa overall. However, this risk can be readily reduced to *Very Low Risk* by the following risk management option:

1. A single test of all animals, using IFAT and PCR hybridization assay, with negative results for **all** *Theileria* spp. in all animals during pre-export quarantine, within 30

days of shipment. All animals to also be treated with an acaricide during the quarantine period to eliminate any ticks present

Trypanosomoses

Trypanosomosis is caused by infection with blood-borne parasites of the genus *Trypanosoma*. These are flagellated parasites that live in blood, lymph and various tissues of vertebrate hosts and are transmitted mainly by blood-sucking tsetse flies of the genus *Glossina* (OIE, 2013d). Trypanosomes are endemic in wildlife populations in southern Africa, wherever wildlife and tsetse flies co-exist. Many wildlife species in these areas act as natural (often asymptomatic) reservoirs for trypanosome infection of livestock. In domestic livestock, trypanosomes cause severe but non-specific clinical disease, which may present as acute, sub-acute or chronic manifestations (R. J. Connor and P. van den Bossche, 2004) with substantial differences in pathogenicity depending on the subspecies and strains causing the disease (A.L.A.R. Osório et al., 2008; P. Van den Bossche et al., 2011; J. Nakayima et al., 2013; M.Y. Motloang et al., 2014). *T. brucei* subspecies rhodesiense and ghambiense are the agents responsible for "sleeping sickness" in humans and are important zoonoses in areas where they occur. For the purposes of this risk analysis, *T. brucei* subspecies causing sleeping sickness (exotic to South Africa), pathogenic subtypes of *T. vivax*, for example haemorrhagic type that are not present in South Africa and drug-resistant trypanosome strains that have also never been reported in South Africa, are the only trypanosomes of concern. Other trypanosomes are either already present in South Africa or not considered a hazard. The non-tsetse transmitted *T. evansi*, although exotic to South Africa, is also not considered specifically in this risk analysis as its presence in Southern Africa has not been confirmed and the testing methods used to detect tsetse-fly transmitted trypanosome species would cover *T. evansi* as well.

Diagnosis of trypanosomosis can be difficult due to intermittent parasitaemia which can occur. Traditionally, diagnosis was by microscopic examination of blood smears or wet preparations. However, while highly specific, false negatives are common due to the poor sensitivity of the technique. More recently, serological assays have proved useful (IFAT and ELISA) and PCR/RFLP appear to be more sensitive than microscopic examination of buffy coat preparations (R. J. Connor and P. van den Bossche, 2004; M. V. Mamabolo et al., 2009; K. Gillingwater et al., 2010).

Trypanocides are available to treat infected animals and these can provide relief from clinical disease. However response to trypanocides depends on nutritional and other factors that can affect the ability of the animal to respond, so that treatment cannot be relied on to sterilise the infection. Chronic cases in particular are generally unresponsive to treatment and trypanocides are also quite toxic chemicals with a narrow dose range, so adverse treatment reactions are common. Trypanocide resistant strains can also further complicate the effectiveness of control strategies (R. J. Connor and P. van den Bossche, 2004).

Trypanosomosis is notifiable and occurs in South Africa, confined to the north east of KwaZulu-Natal Province, where tsetse still occur. Historically, tsetse distribution was much wider, but was reduced back to this small area by the rinderpest epidemic and active tsetse control programs (K. Kappmeier et al., 1998). Currently only *T. congolense* and *T. vivax* are

known to occur in South Africa, including "Savannah" and "Kilifi" genotypes of *T. congolense* and resulting clinical disease is considered more severe with the former and more mild with the latter (M.Y. Motloang et al., 2014; L. Ntantiso et al., 2014). Because trypanosomosis is limited by the tsetse distribution in South Africa, there are no specific movement restrictions for these diseases within the country. Treatment and control strategies are implemented in the tsetse distribution area when necessary and the issue of trypanocide resistance has never arisen with the strains of trypanosomes present in South Africa.

Human sleeping sickness due to local infection does not occur in South Africa (L. Blumberg, National Institute for Communicable Diseases, personal communication). Further, *T. brucei* supspp., the cause of sleeping sickness, was not found in an extensive survey of both cattle and tsetse and is presumed to not be present (M. V. Mamabolo et al., 2009).

Trypanosomosis is notifiable in Zambia, is considered endemic and occurs through much of the country. This includes *T. brucei* animal and human sleeping sickness. Zambia has an active tsetse and trypanosomosis control program, although the effectiveness of this program is unclear. In 2013, 2 432 cases and 115 deaths among animals were reported from six of the ten provinces with four provinces not reporting or with Nil returns (Anonymous, 2013). Further, no information is available from the Zambian authorities on specific subtypes of trypanosomes that are present, the pathogenicity of those strains that occur in Zambia or the occurrence of trypanocide resistance. The literature however reports a wide variety of *Trypanosome* species in Zambia, including those causing human sleeping sickness (J. Masumu et al., 2006; J. Masumu et al., 2009). Trypanocide resistance has also been reported from Zambia (R. J. Connor and P. van den Bossche, 2004).

Wildlife hosts are important in maintaining a sylvatic cycle and providing an important reservoir of infection for livestock. Sable in particular may be infected but rarely show clinical disease (G. R. Thomson, 2010; D. Keet, 2014).

Although tsetse-transmitted trypanosomosis is an OIE-listed disease, the Code does not include a chapter on trypanosomosis, so no guidance on movement requirements is provided. Therefore further risk assessment is required.

Entry assessment

The pathway for entry of trypanosomes is assumed to be with sable that were infected either prior to or during preparation for export. Testing has already demonstrated that the current shipment under consideration were infected with *T. congolense* at the time of capture, although the relationship of the strains present to strains already present in South Africa was not established. It is also possible that they were concurrently infected with *T. brucei* and that infection was either masked by other trypanosomes or not detected due to intermittent parasitaemia.

The Kafue National Park, where the sable were sourced, lies within the tsetse distribution area of Zambia, so that exposure prior to capture is likely and in fact 10 of 142 animals sampled post-capture were positive for *T. congolense* and 9 for "non-pathogenic" trypanosomes (G. R. Thomson, 2010; D. Keet, 2014). However, the extent or duration of

subclinical infection in sable is unknown, as is the potential for exposure to tsetse and further infection and spread during the past 5 years of isolation. Accordingly, the likelihood of entry of unwanted trypanosomes into South Africa with sable imported from Zambia is considered *Moderate*.

Exposure assessment

The main pathway of exposure for South African wildlife or stock would be for infected sable to move to the tsetse endemic area following their importation and be fed on by tsetse which subsequently fed on local animals.

The likelihood of exposure of South African animals is negligible if the sable remain at their proposed destination in the tsetse free area of South Africa. However, once they have entered South Africa, it is not possible to restrict their movement within the country on account of trypanosomosis, so that they would be free to move to the tsetse endemic area of KwaZulu-Natal at any time. Should infected animals move to the tsetse area, the likelihood of exposure of local animals would be high. Therefore, the overall likelihood of exposure depends greatly on their final destination in South Africa. Assuming that movements to the tsetse endemic area are relatively unlikely, the overall likelihood of exposure is considered to be *Moderate*.

Consequence assessment

The consequences of entry and exposure of exotic trypanosomes in South Africa depend on just which strains are introduced. The assessment here is based on a worst-case scenario that *T. brucei* capable of causing sleeping sickness is introduced. If trypanocides-resistant strains of *T. congolense* or highly virulent strains of *T. vivax* were introduced there would be a significant impact on affected sites but impacts at Provincial and National levels would be minor.

The consequence assessment for trypanosomosis is summarised in Table 24. Assuming *T. brucei* and sleeping sickness are introduced, impacts would be *Inconsequential* for affected farms but *Major* impacts would occur at local, provincial and national levels due to the public health consequences and expectation of tsetse eradication. Impacts would be further complicated by concerns that the tsetse range may extend in coming years due to climate change and implementation of trans-boundary friendship parks. Overall, the consequences are assessed as *Major* impact.

Table 24. consequences summary for trypanosomosis

Agent/disease	Consequence level	Score	Comment
Trypanosomosis (highly pathogenic *T vivax*, tyrpanocide resistant *T. congolense*, *T brucei*)	Individual farms	0	not detected in time for action on farm, no production effects
	Local	3	human cases and public health impacts

	Province	3	human cases and public health impacts
	National	3	tsetse eradication strategy, public health impacts
	Overall (weighted) Score	**2.7**	**Major impact**

Risk estimation

From the likelihood matrix in Figure 1, combining an entry likelihood of *Moderate* with a *Moderate* exposure likelihood results in an overall likelihood of entry and exposure of *Moderate*. Further, combining an overall likelihood of *Moderate* with *Major* consequences produces an overall risk score of *High Risk* (Figure 2). An overall risk estimate of *High Risk* requires further risk management to reduce this to the acceptable level of *Very Low Risk*.

Risk management

Given the *Major* consequences associated with trypanosomosis, an overall likelihood of entry and exposure of *Negligible* is required to reduce the overall risk to *Very Low Risk*.

The OIE does not provide any guidance on recommended measures for safe importation of animals from trypanosomosis-infected countries. Treatment of animals to sterilise infection is not an option as current trypanocides do not sterilise infections. Therefore, the only alternative available for consideration is that of testing.

The proposed risk management measure is a single PCR and RFLP assay with negative results (for all trypanosomes) on all sable while in pre-export quarantine, with testing to be undertaken in a government approved laboratory. If the animals test positive, further testing to establish the species and strains of trypanosomes could be considered e.g. using experimental animal inoculation. Alternatively, the positive animals could be removed from the consignment followed by quarantine of the remaining animals in a vector-free area with a second negative test after a suitable time period. This approach is assessed as reducing the entry likelihood and overall likelihood of entry and exposure to *Negligible* and therefore the overall risk is reduced to an acceptable *Very Low Risk.*

Conclusion

The unrestricted risk of trypanosomosis was assessed as *High Risk* to South Africa overall. However, this risk can be readily reduced to *Very Low Risk* by the following option:

1. a single PCR and RFLP assay with negative results (for all trypanosomes) on all sable while in pre-export quarantine for the shipment to be accepted, with testing to be undertaken in a government approved laboratory.

Risk Communication

In terms of the Risk Communication Strategy that was developed by DAH on early 2014 and communicated to all stakeholders, the following steps were taken:

- The process commenced with a call for information and opinions regarding hazards and risks with regards to the importation of sable antelope from Zambia in a letter dated 3 March 2014. Comments were requested by 14 March 2014. Sixteen comments were received and were considered in the development of a risk communication strategy, and the risk analysis process.

- The Risk Communication Strategy was posted on the DAFF website and communicated to all other role players on 8 April 2014. The Risk Communication Strategy explained the context of the Court Order, the steps of the risk analysis to be followed, the environment, communication challenges and animal disease objectives. It also contained a preliminary draft action plan.

- A request for peer review, on the risk analysis to be conducted on the import of sable antelope from Zambia, was sent to the Chief Veterinary Officers of Botswana, Namibia and Swaziland in April 2014 and confirmation was received from Botswana and Namibia that they would assist with the peer review process.

- A request for the identification of hazards associated with the importation of sable antelope from Zambia was sent out in a letter dated 7 August 2014 in order to facilitate the Risk Assessment step of the Risk Analysis. Scientific motivation together with peer reviewed references was requested. Eight responses were received and, together with the previous comments, were considered during the risk analysis process.

- A request was sent out in a letter dated 4 September 2014 for inputs on the Entry and Exposure assessments on the hazards identified with regards to the importation of sable antelope from Zambia. This request included a list of all the hazards that had been identified for the risk analysis process and detailed scientific input was requested for each of the hazards. Comments were requested by 18 September 2014 and due to technical difficulties experienced the deadline was extended to 13 October 2014. Four responses were received and taken into consideration.

- The Department also sent out a request for inputs on the consequence assessment and risk management on the hazards identified with regards to the importation of sable antelope from Zambia in a letter dated 26 September 2014. Comments were requested by 13 October 2014. Five inputs were received and taken into consideration.

- The risk communication is being concluded by this current draft of the risk analysis being circulated for comments to stakeholders and neighbouring Veterinary Services. The comments received will be taken into consideration for the finalisation of the risk analysis that will be considered by the DAH in formulating the policy regarding the importation of these sable antelope as prescribed in the Court Order dated 27 February 2014.

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