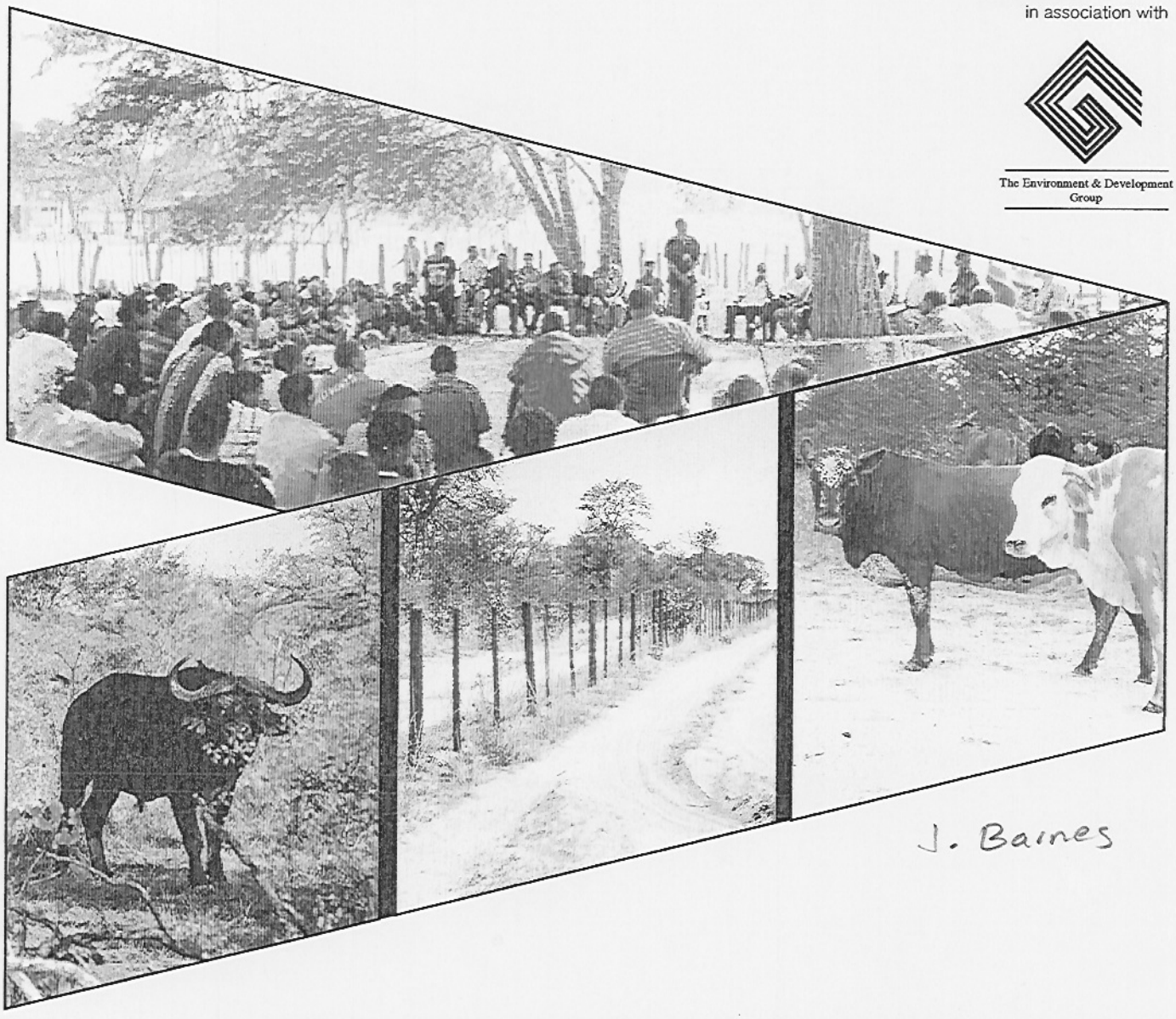
Scott Wilson

in association with

The Environment & Development Group



Environmental Assessment of Veterinary Fences in Ngamiland

Prepared for:

DEPARTMENT OF ANIMAL HEALTH & PRODUCTION

Volume 4:

Environmental Management Plan for Veterinary Fences in Ngamiland

in collaboration with:

DEPARTMENT OF WILDLIFE & NATIONAL PARKS BOTSWANA

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ENVIRONMENTAL IMPACT ASSESSMENT OF VETERINARY FENCES IN NGAMILAND

VOLUME 4

ENVIRONMENTAL MANAGEMENT PLAN FOR VETERINARY FENCES IN NGAMILAND

FOR

THE GOVERNMENT OF BOTSWANA

JOINTLY FUNDED BY
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AND
THE GOVERNMENT OF BOTSWANA

FINAL REPORT

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EXECUTIVE SUMMARY

The environmental management of veterinary fences is summarised in Volume 4, the *Environmental Management Plan.* This considers the following aspects and provides management measures to contain or mitigate the impacts to be implemented by DAHP staff and other organisations:

Fence Construction – in which the main impacts considered are impacts on vegetation along the route, archaeological resources along the fence route and the impacts of construction camps and fence workers.

Fence Operation and Maintenance – in which the main impacts considered are those of fence maintenance teams and fence workers, of wildlife-fence interactions and damage to the fences, the incidence of veldt fires, and fence quality assurance.

Surveillance and Vaccination Activities – in which the main impacts considered are those of the temporary camps and disturbance during vaccination and monitoring campaigns.

Fence Decommissioning – the impacts considered are similar to those of fence construction, including the removal of used materials and rehabilitation of the land.

Emergency Preparedness – includes planning for disease outbreaks, EIA provision, emergency training, and emergency stockpiles of fencing materials.

Policy and Institutional Arrangements – includes the policy adopted for the study to **"optimise the long-term net benefits to all stakeholders in Ngamiland from the sustainable development of all natural renewable resources, whilst ensuring cost-effective animal disease prevention and control measures".** It suggests that the Ad Hoc Committee on Fences be permanently established as the Committee on Veterinary Fencing, and defines the membership and tasks of the committee. Consultation and complaints procedures are outlined.

Monitoring – Various aspects of the veterinary fences require regular monitoring, including livestock diseases, especially for FMD in the gap area, fence monitoring, including regular fence drives and occasional spoor transects. A fence-monitoring form has been developed with DAHP and DWNP. Wildlife populations monitoring should be carried out as part of the DWNP wildlife aerial survey programme. Information for land use and monitoring of socio-economic changes also needs to be collated from existing sources and analysed. Consistent record-keeping and quality control are key aspects needed order to make the information useful.

Reporting – Monitoring reports required are identified, together with the organization responsible, and the need for publication of an annual report of the Committee on Veterinary Fences for openness and transparency on the effectiveness and impacts of the veterinary fences.

Resource Allocation – The costs of fence monitoring, training for emergency preparedness and for the emergency stockpiles are identified.

1. INTRODUCTION

The UK Department for International Development (DFID) is providing assistance to the Department of Animal Health and Production (DAHP), Ministry of Agriculture, Botswana to strengthen the capacity of the DAHP to implement new animal health and production policies which are cost effective, promote the integration of wildlife and livestock and maximise the sustainable use of Botswana's rangeland.

In response to the publicity generated by the construction of a number of veterinary fences to control the outbreak of Contagious Bovine Pleuro-Pneumonia (CBPP) in 1995, DFID agreed to support the assessment of the environmental impacts of the fences upon wildlife populations and the implications this has for conservation and natural resource management in Ngamiland.

A scoping exercise was carried out in 1997, which defined the terms of reference for the full environmental assessment of the fences in Ngamiland. The contract to undertake this work was put out to tender in late 1998, and Scott Wilson in collaboration with The Environment and Development Group were awarded the contract in May 1999.

As part of the Terms of Reference, an Environmental Management Plan is required to assist the Department of Animal Health and Production in the management of the veterinary fences. This report addresses this requirement of the TOR. In doing so, the advice given is confined to managing the environmental impacts of the fences and mitigating the potentially damaging effects. The different sections deal with the impacts arising during the phases of fence construction, operation and maintenance and decommissioning. It goes on to address issues arising out of emergency fencing.

One of the key tasks in environmental management is monitoring. The requirements for fence monitoring are discussed and the regular reporting necessary so that changes in management practice can be implemented if monitoring shows an unacceptable level of environmental impact occurring.The institutional arrangements and linkages with other departments are also discussed, including the establishment of an inter-organisational committee to consider the ongoing issues of veterinary fences and their environmental management.

2. FENCE CONSTRUCTION

The fence planning process should have developed the optimum route causing the least environmental damage. This will have been undertaken with due consultation with communities affected by the proposed routes and environmental impact studies. These requirements are outlined in Volume 5, the Guidelines on Environmental Impact Assessment of Veterinary Fences.

During fence construction, the main impacts that have been noted include the following:

- Impact on vegetation along the fence route
- Impact upon archaeological resources along the fence route
- Impacts of fence construction camps and fence workers

These impacts are dealt with in turn, identifying the mitigation measures required. The immediate responsibility for environmental management of fence construction lies with the fence contractor or the fence foreman in charge of the fencing team.

2.1. *Impacts upon vegetation along the fence route*

The construction of a fence involves the removal of trees and scrub along the fence route prior to erection of the fence and grading of the roads along each side. The width of such a strip will be about 10 m for single fencelines and 20 m for double fencelines. Large trees will be felled individually, whilst scrub and grasses will be removed and scraped aside by an earthmover or grader. This can lead to loss of vegetation cover, and where possible the direct removal of vegetation should be minimised.

The following mitigation measures may be considered during the construction period:

- Semi-mature and mature trees should not be removed wherever possible. Such trees along the route should be noted and slight deviations incorporated in the fence line to avoid them. If the trees lie in the path of a double fence, they should be retained in the space between the two fences.
- This avoidance of significant trees is especially important if there is a group of trees together, forming a local habitat.
- If felling is unavoidable, e.g. because the tree lies directly within the path of the fence road, note should be taken of the species. If a rare species is removed, replacement planting should be considered.
- Scrub and grasses removed from the area should be burnt under controlled conditions, to prevent later accidental firing of vegetation piles.

2.2. *Impact upon archaeological resources*

The removal of the soil during the grading of roads, and the sinking of posts up to 1 m in depth can damage unseen archaeological resources. Archaeological resources tend to be concentrated in fossil river valleys, basin margins and pans to be potential sites for archaeological resources. An archaeological impact assessment carried out on the proposed fence route will identify these potential sites, and those considered significant should be investigated further.

If during the erection of a fence and the grading of the road, archaeological artifacts are discovered, work on that particular section of the fence should be stopped whilst proper investigations are carried out. The National Museum should be informed as soon as possible, so that they can carry out timely surveys.

2.3. *Impacts of fence construction camps and fence workers*

Camps for the housing of fence erection teams have particular impacts upon the local environment, which are similar to all construction camps. The scale of the impact corresponds largely to the number of people in the team. The types of impact include:

- **Solid waste** – tins, paper, plastics, waste food – these should all be buried or burnt
- **Sanitary waste** – an adequate number of pit latrines should be dug and well maintained. They should be backfilled with earth when full, or when the camp moves on
- **Engine maintenance wastes, waste oil etc.** – the wastes from maintaining earth moving equipment, and other vehicles should be taken back to the nearest engine maintenance depot and disposed of safely along with other such wastes
- **Fuelwood** – the cutting down of trees for fuelwood should be avoided. Fencing teams should use fallen dead wood only for camp fires
- **Illegal hunting of wildlife** - During fence erection, the opportunity exists for fence construction workers (both government employees and contractors) to hunt wildlife in the vicinityof the fence. This is illegal and should be prevented. Disciplinary action should be taken against offenders.
- **Litter along the fence route** - During fence erection, fencing teams often throw away solid wastes, especially tin cans, bottles, plastic bags etc. This litter defaces the environment and should be kept to a minimum. Fencing teams should carry waste bags for such litter for safe disposal (burning or burial) every day.
- **Waste fencing materials** represent a special sort of litter. Waste wire in particular can cause problems if left in the environment, e.g. as snares of wildlife. These should be removed along with other litter every day.
- **Incidence of veldt fires** caused by construction teams - The incidence of veldt fires increases with the number of people using an area or travelling along a road. Fence workers should be made aware of the dangers of causing veldt fires, how to minimise the risks and the ways to control fires if they do break out.

3. FENCE OPERATION AND MAINTENANCE

During fence operation and maintenance, the many of the impacts listed under fence construction apply, especially the impacts of maintenance camps and fence workers. These are repeated below:

3.1. *Impacts of fence maintenance camps and fence workers*

Camps for the housing of fence maintenance teams have particular impacts upon the local environment, which are similar to all construction camps. The scale of the impact corresponds largely to the number of people in the team. The types of impact include:

- **Solid waste** – tins, paper, plastics, waste food – these should all be buried or burnt
- **Sanitary waste** – an adequate number of pit latrines should be dug and well maintained. They should be backfilled with earth when full, or when the camp moves on
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- **Waste fencing materials** represent a special sort of litter. Waste wire in particular can cause problems if left in the environment, e.g. as snares of wildlife. These should be removed along with other litter every day.

3.2. *Wildlife-fence interactions*

The main cause for environmental concern during fence operation and maintenance is the damage caused both to the fence itself and to wildlife, when an animal runs into and is hurt or caught in the fence leading to its death. There are several aspects to be addressed here:

- Approaching wildlife encountered near a fence
- Dealing with injured animals and carcasses
- Addressing areas of frequent wildlife fence interaction

Once a fence has been in place for some time, many animals get to know where the fences are and try to avoid them. However, under unusual conditions, e.g. when drought forces them to move their range in search of water and grazing, or when they are frightened, they may try and cross the fence and become entangled. Animals can become frightened when being chased by predators, by hunters and by vehicles moving along the fenced roads.

Apart from illegal hunting, the main effect from fence maintenance teams comes when they move along the road in vehicles. If drivers see animals becoming frightened by the approach of a vehicle along the road, they should slow down or stop to allow the animal to move away. Under no circumstances should the driver try to chase the animal at speed, since this will result in panic and attempts to run into the fence, e.g. ostrich and gemsbok, or ill-prepared attempts to jump or step over it, e.g. kudu, eland and giraffe. Both may result in the death of the animal.

If fence maintenance teams encounter injured or dead animals in or near the fence, they should record these on the fence monitoring forms, see below. In dealing with such incidents, they should:

- Identify the animal and find out the extent of the injury. If the animal can be released without further harm, and if it is considered that its injuries will not cause its death in the near future, it should be released carefully and allowed to recover.
- If the animal is likely to die from its injuries, it should be killed and removed from the fence
- If animal carcasses are discovered in the fence, they should be removed from the fence and dumped about 10 m from it. Where feasible the body should be buried, butif not, scavengers will quickly deal with the remains.

However, it is important to record the geographic location of all carcasses found along the fences, together with species, approximate age, sex, date and state of decomposition. The location of burial sites should also be recorded. Such a record enables a picture to be built up of the sections of fence where wildlife impacts are most frequent.

If it becomes apparent that wildlife deaths along particular sections are occurring frequently, fence management decisions may have to be taken to alter the fence in some way, such as:

- Laying down sections, e.g. along the Setata Fence, but maintaining the readiness to re-erect the wires in the event of livestock disease
- Altering the configuration of the fence, e.g. by raising it so wildlife do not try to cross, lowering it so that wildlife can cross more easily, whilst still being a barrier to livestock, or
- By making the fence more visible.

In such an incidence, the fence foreman and the Veterinary Officer in charge should consult with DWNP and other informed organisations on the Veterinary Fencing Committee to decide upon the best approach.

3.3. *Incidence of veldt fires*

The incidence of veldt fires increases with the number of people using an area or travelling along a road. It is important to record the incidence of fires in the vicinity of the fence, indicating the location, date, the direction of spread, wind conditions, and whether the fire appears to have started near the fence, or whether it has been stopped by the fence.

Fence workers should be made aware of the dangers of causing veldt fires, how to minimise the risks and the ways to control fires if they do break out.

3.4. *Fence quality assurance*

The integrity of the fence is an important part of being assured that it is acting as a barrier against the movement of livestock and buffaloes. In the absence of an adequate recording system which identifies where and when the fence becomes broken and when it is repaired, it is difficult to provide an assurance of fence integrity and hence of its effectiveness. It is better to know the state of the fence on a regular basis.

This becomes more important when a fence separates two different livestock disease control zones, e.g. a vaccinated zone from a surveillance or FMD free zone. An auditable system of fence quality assurance, linked in with damage to or by wildlife interactions should be established for every fence.

4. SURVEILLANCE AND VACCINATION

Surveillance and vaccination are important components of the livestock disease control policies that complement the use of fences to control wildlife and livestock movements. In the context of Ngamiland, all livestock are vaccinated twice a year for Foot and Mouth Disease. They also receive other vaccinations, so that they are inspected at least five times per year for diseases such as FMD and CBPP. This forms part of the veterinary surveillance activities.

The majority of veterinary surveillance of livestock is conducted in the surveillance zones for clinical signs of diseases such as FMD. The cattle in the surveillance zone would not be vaccinated, and since they have potential contact with vaccinated cattle and possibly buffalo and other carriers of FMD, they act as sentinel animals. In the surveillance zones, livestock are blood sampled for serosurveillance to identify FMD-positive animals, which indicate that they have had contact with the disease.

A second form of surveillance refers to the monitoring of the movements of buffalo out of the Okavango Delta, and of cattle into the livestock free zones inside the delta. This is to minimise the risks of contact between livestock and buffalo. To date, such surveillance has been carried out by regular helicopter trips to monitor the presence of buffalo, and when they show signs of movement out of the delta to chase them back in again.

Other forms of surveillance, which require some research, would include the radio tagging of key individuals in buffalo herds and lone bulls living in the vicinity of areas where the buffalo might move out of the delta, and monitoring their movements. On the ground, a system of monitoring buffalo movements could be set up by DAHP and DWNP field staff who would also request local livestock owners and herdsmen to assist them in monitoring presence and movements of buffalo herds and lone males.

There are no particular environmental issues to be addressed here, apart from the issues mentioned under construction and maintenance camps that would apply to vaccination campaigns. The movement of buffalo back into the delta by helicopter requires skill and understanding of buffalo behaviour, and should be undertaken with care not to scare the herds unduly.

5. FENCE DECOMMISSIONING

From time to time, changes in veterinary fencing policy may require the decommissioning of fencing. It is important that this is done effectively, with the complete removal of posts and wire from the area. The practice of allowing the fence to disintegrate and disappear gradually is not acceptable environmentally. It is especially important that all loose wires are removed so that they do not act as a hazard to wildlife and to humans and their livestock.

In addition, the rehabilitation of the soils disturbed by the bush clearance during erection, and by the fence roads may be required. If the area is ecologically sensitive, and rehabilitation is required relatively quickly, the fenceline should be disc-bladed to cut up the impacted soils and re-seeded to speed up the re-vegetation process. The woody layer will take the longest time to recover, and the fence line scar will remain visible for an extended length of time.

If the fence road is still required, then it may be maintained as such. However, if it is considered undesirable to retain a road that leads directly into a significant wildlife area, then the road should be closed off with a physical barrier to allow the vegetation to re-generate without the constant passage of vehicles.

The environmental impacts associated with fence construction and maintenance camps mentioned above, also apply to fence decommissioning camps.

6. EMERGENCY PREPAREDNESS

6.1. Planning, including risk assessments

Preparedness for an outbreak of livestock diseases such as CBPP and FMD are an essential part of the livestock disease control policy. The first step should be to identify the areas where risks of disease outbreak are most likely to occur and institute a programme of regular disease surveillance. A series of scenarios of typical outbreaks can be developed. Whilst it is appreciated that outbreaks of disease rarely follow predicted patterns, e.g. the rate of spread of the 1995/96 CBPP outbreak in Ngamiland was far more rapid than predicted, it is nevertheless useful to use such scenario building to develop emergency preparedness plans.

The identification of the high-risk areas, and likely scale of primary outbreaks enable the DAHP to identify the need for emergency fences to isolate an outbreak, and of secondary lines of fences to stop the spread of disease away from the primary outbreak[1]. It is obviously not possible to identify the sites and areas of fences to isolate the primary outbreaks. However, the secondary fences will need careful planning since these will divide up the country and supplement the permanent fences.

During the erection of primary fence and secondary fences, the same environmental precautions, as described under fence construction, should be taken, and as they should during fence decommissioning afterwards.

6.2. EIA provision

The environmental consequences of the erection and operation of secondary emergency fences should be considered as a part of the planning process. If the country is divided up into emergency control zones separated by fences to be erected in the event of an emergency, the route of such fences can chosen to avoid the worst environmental impacts. In principle the following guidelines should apply:

- Fences should follow gazetted and actual land use boundaries
- Fences should follow land-forms and avoid cutting across habitats and ecosystems where possible
- Fences should avoid cutting across areas of known wildlife movement
- Fences should avoid areas of known or predicted archaeological resources
- Consultation with adjacent communities will help to identify areas of cultural or livelihood importance to be avoided
- Provision of stiles and gates will allow access to grazing, water sources, ancestral lands and veldt products

An EIA can be undertaken for the proposed route for the emergency fence, so that a) the route can be chosen that has the least environmental impact and, b) the plan can be implemented without delays in getting approval. The EIA carried out should be approved by the NCSCA under the procedures described in Volume 5, EIA Guidelines for Future Veterinary Fences.

The plan should also make it clear that after the emergency is over, the fence will be decommissioned.

[1] A primary outbreak is one where the disease is first discovered, and includes the cattle in the immediate area which may be infected, e.g. within a 10 – 20 km radius. If the primary outbreak is not controlled, secondary outbreaks will be found to be spreading through a much wider area. They are obviously more difficult to control, so most effort must go to controlling the primary outbreak. The primary emergency fence isolates the infected livestock; secondary emergency fences prevent the movement of livestock out of the wider area.

6.3. Emergency training

Part of emergency preparedness consists of training staff and livestock farmers to execute the plan as swiftly and efficiently as possible. Such training would include:

- Development of skills in identification of diseases, not only amongst DAHP staff, but also amongst farmers in at risk areas
- Preparation and distribution of extension messages on livestock disease control to farmers
- Mobilisation of staff and resources to cope with the outbreak
- The erection of primary fencing, taking into account the environmental management measures identified above
- The emergency vaccination of livestock potentially in contact with the primary outbreak
- The slaughter of infected cattle – this need not be implemented in training, but a simulation exercise could be undertaken.
- The decommissioning of primary fencing, taking into account the environmental management measures identified above.

6.4. Emergency Stockpiles of fencing materials

In order to be able to respond to primary outbreaks of disease as rapidly as possible, stockpiles of fencing materials should be maintained at strategic points. For FMD control it is suggested that there should be stockpiles at Gumare and at Seronga. For CBPP outbreaks, the FMD stockpiles could be mobilised. DAHP should have transport contingency plans to mobilise staff and equipment in an emergency.

Such a stockpile should consist of fencing materials for about 100 km of a single CBPP-type fence to stop the movement of cattle into or out of the outbreak area. Vaccines sufficient for the vaccination of about 2500 cattle may also be stored under refrigerated conditions, and used by rotation at the next campaign to prevent them becoming out of date. These should be stored in Maun and taken to the area in the event of an outbreak.

7. POLICY AND INSTITUTIONAL ARRANGEMENTS

7.1. Livestock disease control policy and the environment

It has become clear during the process of the EIA on veterinary fencing in Ngamiland, that livestock disease control policy cannot be disassociated from environmental and social issues. The objective used for the development of strategic livestock disease control policy options was to:

"Optimise the long-term net benefits to all stakeholders in Ngamiland from the sustainable development of all natural renewable resources, whilst ensuring cost-effective animal disease prevention and control measures."

This should remain the overall policy, emphasising the need for veterinary fencing to be just one tool in the kit available for livestock disease control, and that livestock farming is but one means of livelihood and use of the natural resources of Ngamiland. Diversity of livelihood strategies provides a greater strength to the economy and security against natural disasters such as drought and animal disease. However, it is also clear that alternative livelihood strategies, which depend upon other natural resources than grazing for livestock, need time and resources to be developed.

In view of the interaction between livestock disease control policies and the social and natural environment, it is essential that veterinary fences are included in the list of those developments requiring an Environmental Impact Assessment. This has been envisaged in the proposed legislation.

It is also essential that there is a wider forum for discussion of the issues than would be available within the Department of Animal Health and Production, or even the Ministry of Agriculture by itself. For this reason, it is considered necessary to strengthen the institutional arrangements. As outlined below, this should be based upon the existing Ad-hoc Committee on Fencing, which in itself has formed the Reference Group for the present study. The process of the study, which has built upon the close involvement of the Reference Group, has hopefully developed a deeper understanding of the issues amongst all the members.

7.2. Committee On Veterinary Fencing

To date, issues of wider concern about the veterinary fences have been considered by the Ad-hoc Committee on Fences (ACOF). As the name implies, this committee is not permanent and has been called together when there have been important issues to discuss. It is recommended that this committee be reconstituted as a permanent committee. It would be chaired by the National Conservation Strategy Coordinating Agency.

The new committee should be constituted with both government and non-governmental representation. The permanent members should include:

- Department of Animal Health and Production
- National Conservation Strategy Coordinating Agency
- Department of Wildlife and National Parks
- Department of Lands
- Kalahari Conservation Society
- Conservation International
- Hotels and Tourism Association of Botswana
- Botswana Wildlife Management Association

Other persons and organisations may be co-opted from time to time depending upon the issues and the district involved. Such bodies might include the Land Board, the District Administration and the Tribal Administration.

The tasks of the Committee on Veterinary Fencing would include:

- Overview of livestock disease control policy with regard to cordon fencing and the effects upon the environment and society

- Receipt and consideration of fence monitoring reports and quality assurance reports on a bi-annual basis
- Making recommendations to DAHP about the implementation of environmental management of fences, including the decommissioning of certain fences found to be causing problems through the fence monitoring process.
- Addressing particular issues of fences as they arise from time to time, and making appropriate recommendations
- Consideration of the DAHP livestock disease emergency preparations, including any EIAs for secondary emergency fences

The Committee on Veterinary Fencing should meet at least twice a year, and should produce an annual report on the state of the cordon fences, based upon the fence monitoring and quality assurance reports. This report should be made available to the general public.

7.3. Consultation

Consultation with communities and other stakeholders is an important procedure to ensure that the fences are sited correctly and that they do not adversely interfere with activities other than the movement of livestock. This is described in greater detail in Volume 5, Guidelines on EIA of Future Veterinary Fences. The process of consultation adopted by the present study team is described in Volume 6, Consultation Plan and Methodology.

If the Committee on Veterinary Fencing becomes aware of substantive issues concerning the existing fences or any proposed changes, they may commission a consultation process to be undertaken to clarify the particular issues and the impacts upon the environment and society.

7.4. Complaints procedure

If any person, community or organisation feels that they have grounds for complaint about any of the veterinary cordon fences or wishes note to be taken of any environmental or social impact associated with the fences, they should follow a specific complaints procedure. The Committee on Veterinary Fencing will be the responsible body to deal with such complaints.

- Persons or organisations wishing to make representation should write to the Chairman of the Committee, describing the details and requesting the consideration of the Committee.
- The Committee shall then consider the issue at the next meeting, requesting a personal representation if deemed necessary.
- The Committee may also request a site visit to acquaint the members with the issue
- The Committee will then make recommendations to DAHP or any other concerned organisation about the resolution of the issue.

8. MONITORING

8.1. Livestock disease monitoring

Livestock disease monitoring is part of the veterinary service maintained by the DAHP on behalf of the livestock industry. Monitoring includes:

- Response to farmers concerned about their animals' health, and the provision of advice
- Regular inspection of animals for clinical signs of disease during the vaccination campaigns – at least five times per year in Ngamiland
- Serological sampling and testing for antibodies against the three SAT types of FMD – this provides some indication of the numbers of animals with detectable antibody levels but does not show the antibody titres indicative of resistance to challenge. It also does not indicate the antigenic relationship between the vaccine used and the SAT viruses circulating in the buffalo populations in the Delta. However, the National Veterinary Laboratory has introduced a test that can distinguish between antibodies generated by live, wild virus and antibodies to vaccination.

In the light of the assessment of risks of animal disease in Ngamiland, and the effectiveness of the veterinary fences, it is suggested that these practices are augmented by improved vaccination. This could be achieved by development of a more appropriate vaccine with a better adjuvant and using it three times per year against FMD for cattle in the vicinity of the gap between the Northern and Southern Buffalo Fences. This would provide an additional opportunity for livestock disease monitoring in the area most at risk. This has been described in Volume 3. EIA of Fencing the Gap between the Northern and Southern Buffalo Fences.

For CBPP, it is probable that the first identification will come from requests for assistance from farmers, rather than through the regular inspections. One of the findings of the social study was that there was considerable uncertainty about the aetiology of the main livestock diseases. It is, therefore, argued that the farmers' knowledge about livestock diseases should be strengthened through a continued extension campaign, including identification of livestock diseases and first response procedures to isolate infected cattle and their contacts.

8.2. Fence monitoring

Fence monitoring is one of the keys to environmental management of the veterinary fences, as it is to the quality assurance of the effectiveness of the fence as a barrier to livestock and buffalo. A fence monitoring form has been developed for this study and has been tried out by both DAHP and DWNP. The findings have been used in the study, but more regular and systematic monitoring and reporting is necessary to improve both the methods and the information being gathered. In addition an Issues paper has been prepared to assist fence monitors, entitled Indicators of Fence/Wildlife Interaction. The salient points of this have been abstracted and put into Appendix 1. The form developed for fence monitoring is shown in Appendix 2. Further information about fence survey methods can be found in Volume 6 – Consultation and Methodology Plan.

Fence monitoring can be divided into two parts:

- Regular fence drives to inspect the state of the fence and indications of wildlife / fence interaction and
- Occasional, more detailed spoor transects to identify the species and sections of the fence where wildlife interactions are heaviest.

The regular fence drives should be undertaken by the DAHP fence foremen in charge of each fence, and, if possible, with a member of staff from DWNP. Ideally these should be undertaken at least once per week during the dry season, when access to water and food resources is critical for wildlife, and once per month during the wet season, November to June.

The fence drives should identify and record:

- Location and date of any damage or break in the integrity of the fence, based upon distance from a fixed point, e.g. Namibian border, or main road etc.
- Confirmation of the actions taken to correct any damage reported in previous fence inspections, if not carried out at the time.
- Evidence of livestock movement across the fence line
- Actions to trace illegal movement of livestock
- Evidence of wildlife / fence interactions such as spoor around newly damaged sections, animals entangled in the fence or carcasses beside it.
- Actions taken to free live animals or remove and dispose of carcasses.
- Sightings of other animals along the fence line and their movements.
- Incidence of fire, identifying origin and direction of movement of the fire, if adjacent to the fence.

In order to prevent double counting, the fence drives along each fence should be carried out on a single day. In addition, sites of damage to fences or wildlife entangled with the fence should be marked with coloured tape and numbered.

The incidence of fire along the fence lines reported through the fence monitoring drives, should be backed up by comparison with the satellite imagery scars analysed by the Ministry of Agriculture.

It will be the responsibility of DAHP to collect, collate and analyse the fence monitoring data. For quality assurance purposes, this information should be subjected to external audit and verification.

The frequency of the more detailed spoor counts should be varied depending upon the length of time that the fence has been in place. For newly erected fences, spoor counts should be carried out once per month for the first two years, decreasing to four times per year thereafter. After ten years, this can be reduced to twice per year, depending upon the level of wildlife / fence interaction. Transects of 100 m should be studied on each side of the fence, every 5 kms over the length of the fence.

It is suggested that the responsibility for the detailed spoor counts lies with the DWNP.

8.3. Wildlife populations monitoring

For longer-term changes in wildlife populations over the wider areas associated with the veterinary fences, reliance has to be put in the use of aerial surveys. These need not be surveys specially designed for fence monitoring, but part of the surveys carried out annually or bi-annually by DWNP. However, the data collected by these surveys needs to be analysed in relation to changes in wildlife populations on either side of the fences, and compared to changes occurring in similar situations elsewhere in the country. This analysis is described in greater detail in Volume 6 – Consultation and Methodology Plan.

This analysis should be carried out by DWNP.

In addition other organisations and researchers may carry out wildlife surveys from time to time. Whilst these may not be designed with the objective of assessing the impacts of fences upon wildlife, they can complement and confirm (or otherwise) the findings of the DWNP surveys. If the results of these surveys are made available to DWNP, they can be incorporated into the annual report made to the Committee on Veterinary Fencing.

8.4. Land use and Socio-economic impact monitoring

One of the concerns about the socio-economic impacts of fences is that they change land use patterns and may disadvantage poorer sections of the community, e.g. by reducing access to grazing, water resources and veldt products. They may also affect the viability of certain CBNRM activities. Thus the information that needs to be monitored includes:

- Changes in land use, e.g. claims for fenced ranches, locations of boreholes sunk, licences for tourism activities – lodges and camp sites, provided by Land Boards and District Administrations
- Changes in livestock numbers on each side of the fence – from DAHP
- Changes in population numbers and economic status – 10 year census figures
- Performance of CBNRM operations in areas adjacent to the fences, and compared with those further away from the fences – from organisations such as BoCoBoNet
- Performance of tourism operations in areas adjacent to fences in comparison to overall performance of the sector – from HATAB and BWMA.

This should be the responsibility of the Department of Lands and Housing.

8.5. Record Keeping and Quality Control

It is important that records of the regular livestock disease control and fence monitoring activities are maintained by the organisations that have the prime responsibility for them. The completion of fence monitoring forms, already developed, needs to be improved through training, since it is apparent there is some variation in the quality of the responses and the understanding of the columns. Consistency of response is important if the information is to be analysed meaningfully.

One of the aspects of livestock disease control that needs to be strengthened is the quality control assurance system of the fences. The fence monitoring forms provide a basis for this, but assurance that damages to the fences are mended in a short space of time is essential if the fences are to be effective as barriers to animal movement. Where the fence is recorded as damaged on the fence monitoring form, an additional record sheet needs to be completed when the damage has been repaired. From these records, information about the incidence of fence damage and the speed of repair can be analysed. This will provide quantitative information about the length of time, location and extent of which the integrity of the fence has been breached. This, in turn, can feed into quantitative analyses of the risk of livestock diseases occurring. In addition, the information can be used to back up any negotiations regarding the quality of protection offered against livestock disease in Botswana. Records provide the evidence – the auditable paper trail – of such a quality assurance system.

Supervisory staff will be responsible for verification of fence monitoring data, through visits to fences, fence maintenance camps and through discussion with the fence foreman and his staff

9. REPORTING

9.1. Monitoring reports

The following reports should be presented to the Committee on Veterinary Fences:

Type of report	Organisations responsible	Frequency of reporting	Records and analyses required
Livestock Disease monitoring	DAHP	Bi-annually	• Incidence of disease outbreak, • Suspected outbreaks investigated • Vaccination records • Results of serological testing
Fence Monitoring	DAHP	Bi-annually	• Regular fence monitoring drives • Damage and maintenance records by fence • Wildlife/fence interactions, including mortalities • Fire incidence • Analyses of fence integrity
Spoor Counts along fences	DWNP	Bi-annually	• Records of animals moving along the fences, 100m transects every 5 km of fence • Trends noticed
Wildlife Population surveys	DWNP	Annually	• Wildlife populations on each side of the fences • Trends in species populations
Land-use and socio-economic monitoring	Dept. of Lands and Housing; Local Government	Annually	• Land use changes • Livestock population changes • Human population and economic status changes • CBNRM and tourism performance

9.2. Annual report of the Committee on Veterinary Fences

The Committee on Veterinary Fences should produce an annual report on the effectiveness of the veterinary fences as a barrier to livestock and buffalo movement, and the changes in habitat, wildlife populations, land use and socio-economy around the fences. The report should include an analysis of these changes and the contribution of the fences to them. It should be crosscutting and independent of any of the individual interests of the committee members.

10. RESOURCE ALLOCATION

10.1. Finances – fence maintenance and monitoring

Many of the activities involved in environmental management of the fences are essentially included as part of good operational practice and should not involve any extra costs. Thus the annual per km costs of maintaining the fences are:

	CBPP fence		Buffalo fence		Electrified fence	
	Single	Double	Single	Double	Single	Double
Materials @5% of construction cost	123	246	326	652	910	1820
Maintenance camp labour cost	3380	3380	3380	3380	3380	3380
Transportation @ 5% of transport costs for construction	7	7	7	7	11	11
TOTAL Pula per km	**3,510**	**3,633**	**3,713**	**4,039**	**4,301**	**5,201**

Routine fence monitoring and supervisory drives, however, will add an additional expense, based upon the vehicle costs. Assuming that each fence monitoring drive will be undertaken once a week during the dry season and once a month during the wet season, i.e. 40 times per year, covering an estimated 1000 km of the fences in Ngamiland @ 2.5 Pula per km. The total cost per year will be 100,000 Pula or an additional 100 Pula per km. Analysis of the records and report production would require 10 days per year of a Veterinary officer @ Pula 220 per day, or Pula 2,200 per year.

Spoor counts will involve surveys, at a maximum of 12 times per year for new fences, decreasing to 4 times per year. Based upon our experience, it is possible to carry out spoor counts on up to 150 km of fence per day. Thus for five days would be necessary to undertake spoor counts on all 1000km of fence. A spoor counting team would include a DWNP research officer, 2 trackers and one driver, for a total of 30 days per year for the existing fences, at a cost of P 220, P 50 and P50 each per day respectively, i.e. a team cost of P370, or Pula 7,400 per year.

Costs of spoor counting along 1000 km of fence

	Quantity	Rate	Total cost
Spoor counting team	30 days	370	11,100
Commuted allowance	30 days for 4 persons	84	10,080
Transport	4 x 1000 km	2.5	10,000
Analysis	10 days	220	2,200
Total			33,380

Aerial wildlife surveys are carried out by DWNP and so are included in an existing budget. The additional cost of analysing the data to identify the correlation of wildlife population trends with the fences might involve one week for one DWNP Research Officer per year, or Pula 1,100 per year.

The collection, compilation and analysis of land use and socio-economic data might involve the commissioning of an NGO for say a total of Pula 10,000 per year. The total costs of fence monitoring may be summarised as follows:

	Cost per year, Pula	Cost per km of fence, Pula/km
Routine fence drives	100,000	100
Analysis of fence monitoring records	2,200	2.2
Spoor count surveys	33,380	33.4
Analysis of aerial survey data	1,100	1.1
Land use and socioeconomic data	10,000	10
Overall compilation and analysis and annual fence report production	10,000	10
TOTAL	156,680	156.7

10.2. Training of Fence Monitoring Staff

Fence monitoring staff should be trained in fence monitoring and recording procedures. Supervisory staff should be trained in the aggregation, collation and analysis of fence monitoring data and in quality control procedures. An appropriate sum should be included in the fence-monitoring budget to cover this.

10.3. Extension and publicity

Production and dissemination of information to communities adjacent to the fences on their value for disease control. A description of the diseases, showing clinical signs, and indicating the damage to livestock and rural livelihoods that they can cause, should be included as part of the livestock extension messages, e.g. at cattle crushes during vaccination campaigns and in the media. This can be incorporated as part of the animal health service provided by DAHP

10.4. Training – Emergency preparedness

A simulated training exercise for developing emergency preparedness for dealing with an outbreak of livestock disease might include the following:

- Planning of simulation exercise,
- Identifying of area for exercise and warning local people
- Mobilisation of staff and resources to cope with the simulated outbreak
- The erection of primary fencing, taking into account the environmental management measures identified above – a 10 km stretch of CBPP fencing might be erected
- The emergency vaccination of livestock potentially in contact with the primary outbreak – say 100 cattle for the simulation exercise
- The slaughter of infected cattle – this would not be implemented in training, but a simulation exercise could be undertaken.
- The decommissioning of primary fencing, taking into account the environmental management measures identified above.

Excluding senior staff costs, the budget for such a simulation exercise might be:

• 10 km of CBPP fencing including labour and commuted allowance @ Pula 5,511	Pula 55,000
• Transportation and mobilisation of staff	Pula 15,000
• Vaccines 100 doses @ Pula 6.5 + 30% costs	Pula 8,500
• Decommissioning expenses 10 km @Pula 300	Pula 3,500
• Miscellaneous expenses	Pula 3,000
TOTAL	**Pula 85,000**

10.5. Emergency Fencing Stockpiles

The costs of emergency fencing material stockpiles based in Gumare, and Seronga would be:

100 km of CBPP fencing materials and wire @ Pula 2,469	Pula 246,900
Total cost for stockpiles based in 2 locations	Pula 493,800
Stockpile of vaccines, 2,500 doses @ Pula 6.5	Pula 16,250
Total emergency stockpile	**Pula 510,050**

APPENDIX 1. INDICATORS OF FENCE / WILDLIFE INTERACTION

Prepared by Daniel Mughogho, Department of Wildlife and National Parks, as Issue Paper No 2.

1. BACKGROUND INFORMATION

Wildlife managers perceive fences as either agents of habitat fragmentation (Harris et. al. 1991) or barriers that curtail and disrupt seasonal migration patterns of wildlife. The disruptions of annual migration patterns confine wildlife to isolated pockets. In the longer run this could lead to inbreeding, resulting in reduced vigour, and culminating in increased mortalities due to diseases (Snustad et. al 1997). It is believed that the presence of fences leads to habitat degradation due to over-exploitation of resources by wildlife in confined areas. Bush clearing and grading of fence lines during the construction phase that results in changes in the structure and shape of the landscape creates edges.

It is well recognised in wildlife management that "soft edges" enhance the quality of the habitat by offering an increased diversity of habitat structure and shape. (Harris 1998, Gates, pers.com.) This increased diversity is manifested in the number of animals that congregate along fences. The edge effect also manifests itself in the decline in diversity and numbers of wildlife away from the fence.

However, "hard edges" marked by fences, can be "ecological traps". Animals get trapped in these boundaries and get entangled in fences resulting in death or serious injury. This happens when there is a sudden build up in wildlife numbers caused by either fire outbreaks or predators chasing them. It has also been observed that wildlife confined to the immediate environs of fences suffer high levels of predation due to lack of escape routes, amongst other factors. In some cases, young fail to cross fences and get abandoned along fence lines, thereby becoming easy targets for predators. This is mainly due to congregation of predator species that opportunistically concentrate their hunting efforts along fences. The concentration of wildlife along fences results in increased hunting success. The easy and improved access provided by fence lines also tends to result in increased illegal off take.

However, in some cases, fences are constructed to serve specific purposes such as preventing the spread of highly contagious diseases or to protect habitats from encroachment by human settlements or other competing land use activity. The existing fences in western Ngamiland were constructed to control the spread of the cattle lung disease to other parts of the country in order to safeguard the cattle industry.

It is apparent form the foregoing that fences play a very important role in shaping events in the ecological landscape. It is therefore vital that efforts are made to closely monitor interactions between fences and wildlife. This is necessary to enable management to put in place mitigating measures to minimise the conflicts. In this case monitoring based on Mentis (1984) is defined as "the maintenance of regular surveillance to test a hypothesis that no change in predefined properties of a system which is vulnerable to impacts, the nature, timing and location of which are not necessarily known". It is this definition of monitoring that recommendations in the paper are based upon. The whole monitoring process is aimed at finding out areas, points, time and changes in behaviour that might have resulted from contacts between fences and wildlife. The information collected may aid development of effective mitigating measures.

2. VULNERABLE SPECIES - WHAT TO LOOK FOR

Aerial surveys are the quickest and most useful for detecting general and widespread evidence of animal activity such as tracks along the fence line. It is however, extremely difficult from the air to see the impact on the fence itself. It is also difficult to tell exactly which species are involved, especially when there are no actual sightings of the animals. It is sometimes possible to see carcasses on the fence, but this becomes difficult when these are promptly removed and destroyed. Therefore the best way of monitoring interaction between fences and wildlife is through ground surveys along fence lines, looking for spoors, bent droppers and broken wires, and repairs to the fence.

Botswana is a semi-arid country, and as a result most wildlife species require large home ranges to sustain themselves. It is species with extremely large home ranges that are heavily impacted by fences. In most cases, movements are triggered by seasonal changes in ecological conditions, or unequal distribution of resources within a home range. In Botswana, it appears that most of the observed seasonal movements are linked to changes in the availability of water, either as standing surface water after rains or from moisture bearing fruits, tubers and roots, that vary greatly in their distribution.

In Botswana, species that are likely to be affected by fences include Gemsbok, Giraffe, Eland, Elephants, Red Hartebeest, Ostrich, and Wildebeest. It is therefore essential that fence monitors are familiar with the physical characteristics, spoors, droppings and behaviour of animals in the area. A brief description of the distinguishing features and spoor characteristics and behaviours of the key species are presented to assist monitors to recognise the source impacts they observe in the field. A brief mention is made of how some of the species are most likely to react when they encounter fences or are disturbed.

Gemsbok (Oryx gazella)

This animal has long straight horns and distinctively marked face that are white with dark brown patches between the horns. The body is fawn grey in colour. The tail is comprised of long black hair. The spoor is heart shaped, hooves have sharp points and the fore hooves are larger than the hind. Gemsbok is a dry season roughage eater and can survive for long in the desert without drinking water. They sustain themselves by eating succulent subterranean roots, rhizomes and bulbs. They acquire these roots by digging.

Therefore the presence of excavation sites, tracks and droppings in an area provides a good indicator of the extent of the interaction between the fence and wildlife. Generally, fences are not considered as a threat to gemsbok because they dig holes big enough to enable them to crawl under the fence. It is therefore important that all excavations observed along the fences are examined. These might provide clues as to whether fences are a hindrance to gemsbok movements or not.

Although there have been reported cases of gemsbok crawling under fences, it has been observed that in some cases, they go straight for the fence using brute force, while attempting to cross them after being frightened. This is common in areas where illegal activities are rampant. They sometimes succeed in breaking wires or even break droppers and cross. Therefore in areas with broken droppers and wires, fence monitors should take time to examine any spoors and droppings present to determine which species caused the breakage. Gemsbok are however, not always successful in crossing fences, they sometimes get entangled in the wires and die, or get mortally wounded. Gemsbok carcasses have been seen with wires around their necks or lying close to damaged droppers.

Elephant (Loxodonta africana)

Elephant is the largest land mammal and it is highly unlikely that fence monitors can mistake it for some other species when sighted. Elephant's feet have a thick layer of cartilage and the soles of the feet are horny and superficially cracked. The mosaic of the cracks is visible in the spoor. The presence of spoors might be an indication of the recent interaction between elephants and the fence. Fences do not appear to affect the movement of elephants, which can cross them with ease. Spoors have been observed crossing fences with minimal effect on the wires or droppers. However, there have been instances where family groups with young have been observed breaking wires to enable young elephants to cross.

Giraffe (Giraffa camelopardalis)

Giraffe are very common in Botswana and are easily identified by their height ranging between 4 and 6 meters. Giraffe have problems crossing fences because their limbs flex very little during each stride, which produces a stiff-legged gait. In most cases they tend to break the fence and carry the wire away from the fence line for long distances. In some cases these wires wrap around their legs and necks.

Sometimes herds of giraffes can be seen trotting up and down a fence. The spoors of giraffe look similar to those of a cow but are slightly bigger. Since giraffe are big, in most cases carcasses or their remains will be found near the fence lines. The skeletal bones are easily identifiable. Giraffe seem especially vulnerable to getting one of their hind legs caught between the fence strands, falling down, with the hind leg then caught in a scissor like twist of the fencing wire. Where an animal such as a giraffe has died in the fence and has been eaten by predators, the sand may be disturbed and darkened by the blood.

Red Hartebeest (Alcelaphus buselaphus)

Red hartebeest have high humped shoulders, slopping backs and elongated heads, held high on their upright necks. The colour of their body is generally reddish brown but there are variations of yellowish fawn or tawny. Males usually have saddle of darker colour than the remainder of the body. It extends on the mid-back from shoulders to the base of the tail. The forehead is black, with a broad patch of reddish brown across the face between and in front of the eyes and a black band on top of the muzzle. Hartebeest are gregarious occurring in groups of up to 20 animals or even larger. Their spoor is similar to giraffe.

Hartebeest are adapted to the arid environment of the Kalahari system; they are therefore not water dependent. They however, sustain themselves by having large home ranges. Fences become a problem when they are constructed across their home ranges. Their gait and physiological set up does not allow them to jump over fences. They attempt to cross fences by walking or running through them. This creates problems for the young, which can get separated from the herd, and are thus vulnerable to predators.

Eland (Taurotragus oryx)

Eland are the largest of the African antelope with adult males standing at 1.7 m at the shoulder while females may attain heights of up to 1.5m. They are rufous-fawn in colour with narrow white stripes down their flanks. In some areas, eland have a dun colour without stripes. They have hooves, which mark broadly in the spoor with the front distinctly larger than the hind. Eland are prodigious jumpers and have been observed clearing obstacles as high as 2 meters. They jump over fences by walking slowly towards them, pause whilst settling back slightly on their hindquarters then jump. They are however timid animals and when disturbed can easily get entangled in the fence. It is important that fence monitors move stealthily when assessing the interaction between fences and wildlife. Any slight noise or disturbance may frighten animals forcing the flee over long distances or bolt towards the fence resulting in unnecessary mortalities. Under such circumstances there is a high probability of young separating from the family herd.

Kudu (Tragelaphus strepsciperos)

Kudu males stand about 1.4 m at the shoulder while females are smaller with heights of up to 1.25m. Their body colour is fawn-grey and they have a series of white stripes unevenly spaced across the back from behind the shoulder to the hump. The ear is the distinct feature of the Kudu. They are particularly large and broad for the size of their head, are pink inside with patches of white hair on the fringes near their notches and on the outside near their rounded tip. Kudu are shy and retiring species that are most active early in the morning and late in the afternoon. In the heat of the day they spend time in thickets or wooded patches. They are always alert and flee at the slightest disturbance. Kudu are versatile jumpers and can easily clear obstacles as high as 2.5m with the greatest of ease. This suggests a fence is not an obstacle to Kudu. However, when disturbed Kudu can get entangled in the fence and sometimes might under-estimate the height of the fence and thus get caught by the top strand of the fence.

Blue wildebeest (Connochaetes taurinus)

The blue wildebeest is a silvery-grey with a tinge of brown colour. They have a humped shoulder with a deep neck and the hindquarters are lightly built and the legs are slender. The head is massive and elongated broadening out at nostrils and lips. The chins have a distinct beard. The hooves on the front feet wear to rounded tips and are larger than those of the hind feet. Wildebeest are gregarious and tend to move widely within their range depending on resources such as quality of graze or water. In Botswana, long seasonal movements have been reported and it appears that these movements are linked to water availability. Rainstorms and fires normally attract these animals in their direction in search of water and/ or green flush. It is these movements in need of sustaining resources that make wildebeest vulnerable to fences. Wildebeest cannot jump across or dig under fences. They usually try to cross fences by breaking through the strands.

Ostrich (Struthio camelus)

The Ostrich is the largest living bird. An adult ostrich measures close to 2.5 meters high and weighs close to 150 kilograms. The adult male is jet black with white primary plumes in the wings and tail. Females are normally grey or grey brown in colour and are slightly smaller than the male. The legs are long and powerful with two toes. Ostrich can therefore run at speeds of about 50 kilometres per hour. Unfortunately they cannot fly. It is this characteristic that makes them vulnerable to fences. In fenced areas large groups of ostriches can be seen restlessly pacing up and down along the fence. When frightened under such circumstances, the bird will attempt to cross the fence and in the process can either break droppers and wires strands or bend droppers.

Fence monitors should therefore closely scrutinise droppers for feathers as these can sometimes be left hanging on droppers. In the process, large numbers of ostrich can lose their lives and in case of breakages in the fence, the immediate bush should be searched. It has been observed that in some cases, animals die far from the scene of impact.

3. FENCE MONITORING METHODS

There are a number of ways of monitoring interactions between fences and wildlife. In Botswana, aerial surveillance and ground surveys have been tried. Aerial monitoring is ideal for reconnaissance purpose especially a few weeks after the fences have been put up. It covers extensive areas over a short period of time and helps in pointing out areas where ground surveys / monitoring should be concentrated. Aerial surveys are however expensive and in the long run do not provide the much needed information.

3.1. Ground Surveys

The most important and useful data is the one collected during ground surveys. The most important information that must be recorded should include; the number of animal sighted on either side of the fence by species. A GPS should be used to record the geographical location of all animals sighted during the survey. If this is not possible, the distance of the sightings relative to the starting point of the survey should be recorded. This information is useful for plotting animal sightings on a base map.

In most cases the flushing distance for wildlife in fenced areas is high and it is difficult to identify the species by sight. In such cases the best tool is to record spoors seen along the fence or in the sampling transects established along the fence-lines. It is therefore absolutely necessary that monitoring teams are familiar with spoor or footmarks identification of animals in their area of operation. Where possible the knowledge of local trackers, should be sought to be part of the fence survey team.

3.1.1. Line transects or quadrat sampling

In this method of sampling, a transect or a line of a particular length is set out randomly or systematically along the fence line. The observer then counts all animals, or signs thereof, carcases and all wildlife/fence interactions such as broken or repaired wires, damaged droppers or poles. It is important that in all cases a predetermined observation distance, perpendicular to the fence (Richard et al 1996). The mid-point of the observation distance should be the fence line. In the cases of Botswana,

data from previous surveys suggest that the zone of maximum interaction ranges between 5 to 30 metres on either side of the fence, and transects should extend at least 100 m from the fence on both sides

It is important that during intensive monitoring, a series of quadrats of reasonable size should be established on either side of the fence. In these quadrats, spoors or any visible animal signs should be recorded. It is highly unlikely that live animals will be sighted in these quadrats. In this case it is recommended that the spoors/tracks or droppings of animals found in the quadrats are closely examined and identified. Spoors are easier than droppings to identify to species, though it is necessary to collect data on animal droppings since they stay longer in the quadrant. Despite the difficulty of pin pointing droppings to specific species, the number of droppings, tracks, etc. can be a good indicator of the extent and time that animals spend in an area.

In the case of Botswana, it is suggested that the sampling transects or quadrats should be 200 m x 50 m. However, the dimension of the sampling transects could be varied depending on the length of the fence line and type of habitat prevalent in the area being surveyed. The decision as to the exact size and number of sampling plots will in most cases largely depend upon logistical considerations.

This method of sampling is time consuming and labour intensive. In addition, it requires individuals who are familiar or have knowledge of tracking. It is important that all quadrats or transects set along the fence line are sampled in one day and records are made of all animal sightings, in order to avoid double counting. There may also be a problem if established sampling zones are not sampled at the same time of day, since this may affect the actual sightings of animals recorded. This emphasises the importance of spoor records as well as actual sightings.

The other method that is recommended for monitoring wildlife/fence interactions on very long fences is similar to the line transects method described above. The only difference is that in this method there is no observation distance and the transect length is much longer. This technique ensures large areas to be sampled in the shortest possible amount of time. In this method the fence line is systematically divided into segments ranging in size between 1000 and 3000 metres spaced every 5 km. Observers drive slowly in these sampling segments and record all wildlife/fence interactions. The observers stop whenever necessary to inspect spoors or interactions (bent droppers, broken wires etc.) in order to establish which species caused the damage. The weakness of this method is that most of the effects of the fence that occur further from the fence line are missed.

3.1.2. Spoors and droppings

Spoors are easier than droppings to identify to species. It is necessary to collect data on animal droppings, as they stay longer in the quadrant. Although it is often too difficult to pin droppings to specific species, the number of droppings, tracks etc found in area can be a good indicator of the extent and time that animals spend in an area.

3.1.3. Evidence of predators

The concentration of prey species along the fences attracts a variety of predators in the vicinity of the fence. Normally predators are active during the night and even those that are active during the day are extremely difficult to detect due to their extremely developed stealth skills. The best way of establishing their level and abundance is through spot surveys over a series of randomly established transects along the fence.

3.2. Aerial surveys

Aerial surveys involving the use of aircraft flying at predetermined heights (e.g. 300 feet) along the fence line and at speeds not exceeding 90 knots with multiple observers is very useful for sampling large areas. Although aerial surveys might not necessarily give data on what species are responsible for the observed wildlife/fence interactions, they pinpoint areas of greatest impact. Aerial surveys are therefore important for determining areas where ground surveys should be concentrated. It is also possible from the air to see species that have actually been affected by the fence. The possibility of double counting is eliminated in aerial surveys because a large area is covered systematically within a short period.

3.3. Timing of surveys

In Botswana, the sampling area is large; therefore any schedule of sampling must take this factor into account. The type of information from the surveys also plays a part in determining the frequency of sampling. It is argued that most of the animal movements are related to variability of food and water resources in both time and space. It is towards the beginning and during the dry season that resource availability are critical. It is recommended that monitoring should be intensified between July and November. During these months monitoring should be done once per week. In the wet season, between November and June monitoring should be done at least once per month.

3.4. Procedures for dealing with carcasses

There are a number of ways of dealing with carcasses found along the fence. One of them is to leave the carcasses to rot. This is not recommended because it could lead to an accumulation of carcasses on the fence. All carcasses should be removed and dumped about 10 metres from the fence. Where feasible, attempts should be made to bury the carcasses. The geographic location of all carcasses found on the fence line should be recorded, together with species, age and sex (where these can be identified) date and state of decomposition. The location of burial sites, if different, should also be recorded.

4. RECORDING AND REPORTING PROCEDURES

4.1. Fence Monitoring Forms

The information gathered during monitoring should be entered in appropriate columns on the data form shown in Appendix 2. This form has a number of columns, it is important that information collected is entered in an appropriate column.

1. **'Date' column**-The date of the survey should be entered in this column.

2. **'Patrol start'**- The mileage on the speedometer reading should be entered in this column at the start of the survey.

3. **'Patrol Direction'** The intended direction from the starting point of the survey. It should be indicated in this column whether the survey is heading north, south, east or west.

4. **'End of Patrol'**-The mileage on the speedometer at the end of the patrol should be entered in this column.

5. **'Fence damage/Repairs'**- it should be indicated in this column if the fence is damaged by writing the word 'D' in the column. In cases where the damage has been repaired the word 'R' should entered. And it should be noted in the 'remark section', which is the last column, what types of repairs were made.

6. **'Posn.'** - If one has a GPS, the geographical location in terms of latitude and longitude of any damage or repairs observed along the fence should be entered in this column. In cases where there is no GPS, the speedometer reading from the starting point of the survey should be entered in this column.

The other portion of the form is reserved for information indicating the presence of animals. Animal seen (alive or dead) or spoors are recorded in this section of the form. In the **'Species'**, the name of animals (dead or alive), or their spoors should be recorded.

8. **In the 'No.'** column, the total number of animals (dead or alive) or spoors seen should be recorded.

9. **'Posn'**. The geographical location of the animal seen should be recorded here. In the absence of a GPS, the speedometer reading should be recorded in this column.

10. 'Dist. to fence'- The distance in meters from the fence where animals or their signs were seen.

11. 'Left/ right of fence' A record of which side (north or south, east or west) of the fence the animals were sighted should be recorded in this column.

12. In case of spoors, the information on the direction where animals are headed to should be recorded in the **'Spoor Direction'** column.

13. 'Time Seen'- Time when the animals or their signs were seen should be recorded in this column.

14. 'Remarks'. In this column all information on interactions between the fence and wildlife and any other information that might be useful for management must be recorded under this section.

4.2. Reporting procedures

The reports of fence monitoring should be collated on a regular basis, e.g. quarterly, and sent to the appropriate authorities, DAHP and DWNP, for preparation into an annual fence monitoring report.

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APPENDIX 2. FENCE MONITORING FORM

DATE	PATROL START FROM	Patrol Direction to	END OF ATRO km	No. of orker	De- bus	FENCE DAMAGE/ REPAIRS	POSn km	SPECIES live/dead/spoor	ANIMAL SIGHTINGS No.	Dist. to fence	Left/Right of fence	Spoor Direction	Time Seen	REMARKS eg.cause of death, sex/age, fire/water
* Age of carcasses should be recorded in REMARKS as F (fresh), Y (less than a year old) or O (older than one year).														