Effects of Veterinary Fences on Wildlife Conservation in Zimbabwe

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ABSTRACT / In Zimbabwe, veterinary fences are used to control trypanosomiasis and foot-and-mouth disease, two important diseases that threaten cattle production and beef exports. Wildlife is implicated in both instances and the effects of fences on wildlife conservation and land use are discussed in relation to these two diseases. Advantages and disadvantages related to direct and indirect fence effects are outlined. Although the maintenance of fences for trypanosomiasis control is likely to become obsolete, control of foot-and-mouth disease will rely on fences for the foreseeable future. Most of Zimbabwe's protected wildlife areas are located in marginal agricultural land around the periphery of the country where cattle productivity is low. This land should be excluded from any involvement in the beef export industry rather than attempting its inclusion through cordoning and isolating individual protected areas. Within such land, the need for rigid veterinary restrictions should then disappear and allow more flexible strategies for disease control, including adaptive and imaginative approaches to land-use planning.

Any Third World country that aspires to export beef to international markets is required to meet high standards of veterinary hygiene and disease management. At present, Zimbabwe is committed to exporting beef to European markets. Often the veterinary measures demanded by these overseas markets conflict with other land uses, particularly those involving wildlife conservation and utilisation. These demands may not always be in the best interests of developing countries in that they actually dictate internal disease control policies. Veterinarians, ecologists, and land-use planners are obliged to comply with national policy decisions, but this should not preclude their questioning policy, or the search for alternative strategies to meet policy objectives.

In Zimbabwe, numerous diseases threaten cattle production, but two key diseases involving wildlife and fences are:

1) *Trypanosomiasis*. This is an important and widespread disease of man and livestock in Africa, covering an area roughly equivalent to the size of the continental United States. Pathogenic trypanosomes are transmitted by the bite of an infective tsetse fly (*Glossina* spp.), causing human sleeping sickness and nagana in cattle. The presence of trypanosomiasis is a major factor limiting livestock development across the African continent, and *Glossina* control or eradication is frequently considered necessary for rural development. This has, and will continue to have, profound effects on wildlife conservation since many species of African large mammals act as hosts of trypanosomes, although they may show little or no signs of infection themselves (Molyneux 1982).

2) *Foot-and-mouth disease* (*FMD*). Potentially the most damaging of all diseases to the livestock industry, FMD is caused by three distinct viruses. In contrast to temperate countries, it has limited pathogenic effect on livestock in tropical environments. Primarily it is a disease of economic importance that critically affects beef exports. Outbreaks of FMD in Zimbabwe have generally arisen in areas where cattle and buffalo (*Syncerus caffer*) have intermingled, buffalo being the only known long-term carrier and transmitter of the virus (Condy 1979a, Foggin 1981).

Since fences feature in the control of both trypanosomiasis and FMD, and since wildlife is implicated in both instances, we discuss the effects of fences on wildlife conservation in Zimbabwe in relation to these two diseases.

Management Strategies

Wildlife is commonly a reservoir of disease to which management is directed (Molyneux 1982) since an indigenous disease-resistant wild population usually transmits infection to a highly susceptible, exotic, domesticated population. The conventional measures adopted by veterinarians to manage trypanosomiasis and FMD in Zimbabwe include vaccination, prophylactic treatment, ground or aerial application of vector-targeted pesticides, and the use of host–control game and cattle fences. Table 1 summarizes these management tactics and their general effectiveness to date. While usually effective in containing disease and protecting livestock, frequently such measures have to

KEY WORDS: Veterinary fences; Disease management; Land use; Wildlife conservation

Table 1. Containment and eradication of foot-and-mouth disease and trypanosomiasis in Zimbabwe.

			Host management				Vector regulation	
Disease	Causative agent	Mode of transmission	Susceptible host		Reservoir host	Effectiveness	Tactic	Effectiveness
Foot-and-mouth	Virus	Contagious	Vaccination	Short-term (6 months)	Eradication	Complete(?)	—	—
					Cordon sanitaire	Usually adequate	—	—
					Fence: game and/or cattle	Variable containment	—	—
Trypanosomiasis	Protozoan	Vector borne (*Glossina* spp.)	Prophylactic treatment Recurrent expense	Short-term (2 months)	Eradication	Complete	Habitat modification	Effective, but undesirable
					Game fence	Partial containment	Pesticide	Complete, but contaminates environment variably

be taken in response to emergencies, and generally with little advance planning.

In Zimbabwe, a typical corridor or *cordon sanitaire* consists of a 9-strand high-tensile steel-wire game fence 3 m high, separated by a varying distance (1–150 km) from a 4-strand barbed-wire cattle fence 1.3 m high. Approximately 2250 km of game and cattle fence lines are presently maintained as veterinary fences to control tsetse fly and trypanosomiasis in the north and FMD in the south and west of the country (Figure 1). Construction costs, which vary according to terrain, amount to approximately US $900 km^{-1} for cattle fences and US $3000 km^{-1} for game fences.

Tsetse Fly and Trypanosomiasis

In the early part of the century, extensive game destruction was practiced in southern Africa. In Zimbabwe, there was widespread indiscriminate hunting during the 1940s and 1950s (Buxton 1955) and some 700,000 indigenous animals were destroyed prior to 1960 in the course of tsetse control hunting operations (Anon. 1961). Subsequently, policy shifted to one of removing the preferred hosts of the tsetse fly (Cockbill 1967). The destruction of tsetse fly habitat through the removal of vegetation was also carried out in limited regions of the country. Game and cattle fences gradually became an integral part of control, with hunting authorized only in the corridors between them.

Originally the objective of the tsetse fly control program was to contain the fly rather than to eliminate it totally, and it was thought that this could best be achieved through a consolidation of fence lines over the full fly front—a process of "stabilization." Since the expense of eliminating the tsetse fly from marginal land may not be warranted in terms of any potential livestock production in the cleared area, manipulation of fly populations was subsequently aimed more at preventing reinvasion into presently productive livestock ranges. More recently the cost effectiveness of a "holding" operation has become questionable. Maintenance of the fence is expensive because of the great distances involved; it is difficult to sustain a high level of human motivation; and the fences do not totally exclude game, even under a high standard of maintenance. It has become clear, at least to veterinarians, that total elimination of the fly is preferable to a prolonged and costly holding operation.[1]

At present, pesticides are the most efficient method of eliminating the tsetse fly. However, they impose threats of varying magnitude to all other exposed animal species (Koeman and others 1980). Residual ground applications of organochlorines are currently giving way to aerial applications of endosulfan following successful trials in northwestern Zimbabwe (Hursey and Allsopp 1983). Endosulfan applied at very low dosage rates as a nonresidual pesticide is highly effective against *Glossina* spp.

Until recently the use of fences in tsetse control operations was considered essential to restrict the movement of wildlife and domestic livestock. However, pesticide application has permitted the fly front to be advanced despite the presence of significant wildlife populations, and maintenance of fences for tsetse control purposes is rapidly becoming obsolete.

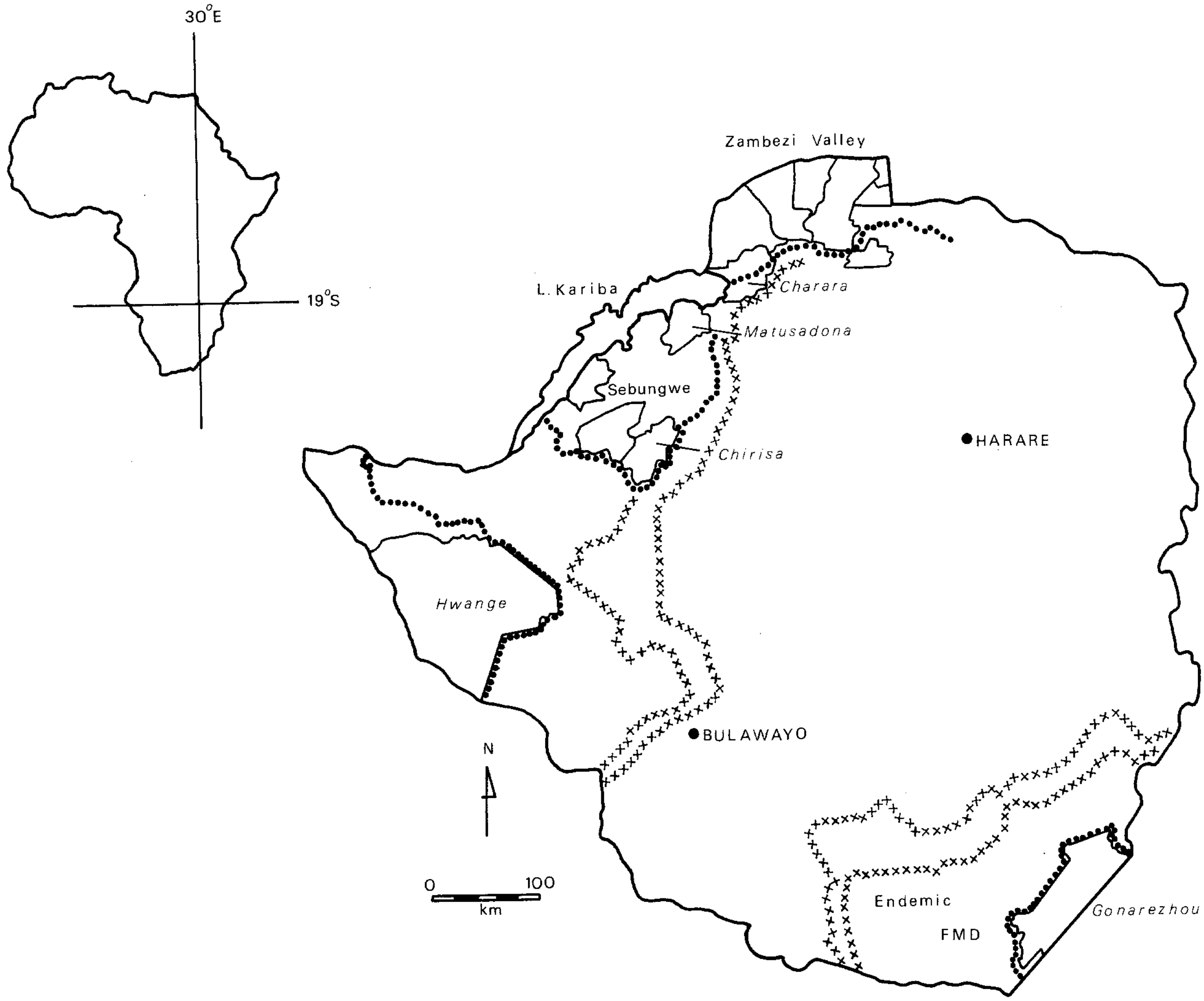

Figure 1. The extent and location of veterinary fences in Zimbabwe for the control of tsetse and trypanosomiasis and foot and mouth disease (FMD). *Small closed circles* (.....) are game fences and *crosses* (xxx) are cattle fences. *Solid lines* delineate Parks and Wild Life Land. *Place names* are those referred to in the text.

Foot-and-Mouth Disease

FMD is endemic in Zimbabwe, particularly in the southeast of the country adjacent to the Gonarezhou National Park. (Place names referred to herein are shown in Figure 1.) Although the mode of transmission is not yet clearly understood (Condy and Hedger 1974), sufficient evidence has been accumulated by veterinarians to implicate the buffalo as the most important host (Hedger 1976, Condy 1979b). This has led to the virtual extermination of buffalo in all cattle-producing and nonprotected areas in Zimbabwe. However, the existence of remnant groups leaves the possibility of further outbreaks and the close proximity of wildlife and cattle in the south of the country continues to pose a long-term threat.

Vaccination against FMD is practiced routinely on an annual basis and during disease outbreaks, vaccination programs are stepped up in order to prevent the infection of healthy cattle by diseased animals. Vaccination provides immunity for six months only, and revaccination is necessary to provide continued immunity. Beef from vaccinated animals cannot be exported for up to two years after vaccination. Beef importers will not accept FMD vaccination as a sufficient control measure on its own, and insist on fences to contain the disease in endemic areas.

Fences as a Management Tactic

For the foreseeable future in Zimbabwe, fences will be a veterinary requirement for disease control. Even if pesticides eliminate the tsetse fly, fences will still be required to control the spread of FMD. Since both cattle and wildlife movements have to be restricted, control will probably take the form of conventional farm cattle fences used in conjunction with game fences to establish animal-free corridors. The functions of such *cordon sanitaires* are, first, to minimize contact between wildlife and cattle and, second, to keep healthy livestock from infected livestock.

In the commercial farming areas remote from wildlife populations, cattle fences alone would provide the necessary control. In rural areas adjacent to wildlife reserves, however, the presence of a fence is arguably important. Cattle or game movement into prohibited areas is prevented or at least limited; a fence is a tangible, easily understood boundary, and during times of disease outbreaks, its role is obvious. Although fences are seldom totally impervious barriers, partial protection is better than none at all. The rate of spread of disease is proportional to the amount of animal traffic, which fences facilitate holding to a low level.

Under intensive development, legislation or the voluntary subscription of farmers may be adequate measures to maintain *cordon sanitaires* but in undeveloped rural areas fences are an important management tactic. Movement of game cannot be curtailed without a fence and legislation alone restricting cattle movement will not prevent the spread of disease.

Direct Effects on Wildlife

Detrimental

1) Since the time that they were introduced to Africa, fences have been responsible for wildlife deaths through entanglement (Percival 1924). In Zimbabwe, game fences around Hwange and Gonarezhou National Parks have caused numerous deaths among giraffe (*Giraffa camelopardalis*), impala (*Aepyceros melampus*), sable (*Hippotragus niger*), kudu (*Tragelaphus strepsiceros*), and ostrich (*Struthio camelus*).

2) Wildlife may be cut off from water supplies where fences are aligned in straight lines that take no cognizance of important natural factors. For example, Tivuli Spring in the northern Sebungwe region of Zimbabwe lies immediately outside the game-fenced boundary of the Chirisa Safari Area. Animals break through the fence to reach the spring, where they are promptly shot in the course of tsetse control hunting operations.

3) Fences prevent the movement of game into suitable habitats outside protected areas. The northern Sebungwe game fence at its junction with the Sanyati River south of Matusadona National Park precludes movement of elephant (*Loxodonta africana*) and other species to both the south and the east, even though this country is uninhabited rugged terrain of little value for human settlement.

4) Fences disrupt seasonal movement and migration of animals, and prevent shifts along ecological catenas. Early hunters in Zimbabwe reported major movements of elephant prior to the turn of the century (Selous 1893), which do not occur today.

5) Fencing wire is a major source of snares used for poaching. Between February and July 1979, over 2000 snares all made with wire from the tsetse control game fence, were recovered in Chirisa Safari Area (Conway 1984).

Beneficial

1) Some protection is afforded against poaching since fences can inhibit game and human trespass. However, such protection is probably of limited value, particularly when viewed against the disadvantage of fences providing wire for snares.

2) Certain wild animals learn and recognize that fences separate safe and hostile territory. This is especially true in the case of elephant and tsetse control hunting, where, for example in the Chirisa Safari Area, elephants have learned to break boundary fences and destroy crops in adjacent communal lands between the hours of sunset and sunrise when the risk of being shot is low.

3) A boundary fence reduces the need for problem-animal control in areas adjacent to game reserves. In the Chirisa Safari Area, the incidence of crop destruction by elephants is far higher in the area north of the park, which is unfenced, than to the south, which is game fenced.

4) Ranchers and farmers adjacent to wildlife areas usually view fences favorably as providing protection against livestock disease, and preventing incursions into agricultural land. An exception to this might lie in the case of game ranchers who would prefer movement of wildlife onto private land.

5) Wildlife can enjoy protection from potentially devastating diseases such as rinderpest. Indeed, in East Africa, fence protection (together with cattle vaccination) enhanced the survival of wildebeest (*Connochaetes taurinus*) and buffalo against rinderpest during recurrent outbreaks of the disease between 1930 and 1970 (Sinclair 1979, Plowright 1982).

Indirect Effects on Wildlife

Detrimental

1) Fences create barriers or "hard edges" (Martin and Taylor 1983) between dissimilar forms of land use, which lead to a conflict of interests. For example, crops in communal peasant lands may be grown next

to the game fence in a deliberate attempt to attract wild animals across the fence in the hopes that they will be shot, using the excuse of crop protection, to provide meat. Predators may also be drawn across the fence to prey upon livestock.

Rural communities tend to aggregate along fences because of the access provided by the fence maintenance roads. Often the land immediately adjacent to the wildlife area is not better than anywhere else in the vicinity, but, for reasons of access and those given immediately above, the undesirable situation arises where cultivated fields line the game reserve boundary. In turn, this raises the incidence of trespass into the protected area for purposes of poaching, honey gathering, and wood cutting. In attempts to minimize the effects of these hard edges, buffer zones have been proposed as an alternative strategy (Taylor 1982).

2) Fences can contribute to problems of overpopulation in protected areas by limiting natural dispersal. Laws and others (1975) considered the absence of dispersal to be the major factor leading to overpopulation in Murchison Falls National Park. The high density of animals leads to excessive habitat use and the need for a reduction of population numbers.

3) Fences contribute to displacement effects (Jones 1982) in which large game animals, denied particular habitats, are obliged to occupy "marginal land" which often becomes degraded through overutilization. In the Chirisa Safari Area, a notable effect of the game fence is that of increased habitat damage by animals in the immediate proximity of the fence. This appears to be caused mainly be elephants whose movement has been thwarted by the fence, and who then spend considerable time in the vicinity of the fence and seriously damage trees.

4) Once established, both the fence itself and all the practices associated with it are extremely difficult to remove. Precedents are set and traditions die hard. For example, tsetse control hunting continues in parts of Zimbabwe, even though pesticides have eradicated the fly for some considerable distance from the control fence.

5) Fences cause a long-term inflexibility that limits planning and often forecloses options. Taylor (1982) describes such an approach as a negative control measure as opposed to positive control measures that allow flexibility and adaptations to the changing circumstances and attitudes in Africa today.

Beneficial

1) Land category boundaries are reinforced where fences are aligned along such boundaries. This facilitates administration, aids law enforcement, and minimizes land boundary disputes.

2) Totally conflicting land uses can be practiced adjacent to each other through the use of fenced barriers. Although not necessarily desirable on ecological or economic grounds, such situations are not uncommon. For example, in the Charara Safari Area, bananas are grown under irrigation for export using water from Lake Kariba. Without a suitable game fence to deter elephants, this would not be possible. At the same time, the safety of adjacent wildlife populations, which might otherwise trespass, is ensured.

Proposed Future Approach to Fences

In the near future in Zimbabwe, there is a strong likelihood that tsetse fly will be eliminated, and only the problem of FMD will remain. One possible approach to controlling FMD is to create a *cordon sanitaire* around every designated wildlife area, and eliminate all game outside these areas (perhaps with the exception of nonhost species for FMD). However, most of Zimbabwe's protected wildlife areas are located in nonarable marginal land, where the productivity of cattle in the areas surrounding these reserves is low. It is doubtful whether the expense of cordoning off every National Park or Safari Area would ever be justified by the returns from livestock production around them. The removal of all game outside protected areas would not only be a costly operation, but would also be wasteful of a resource that might in fact be the most appropriate land use for the terrain involved.

A far better approach is to recognize that most of the marginal land on the periphery of the country is of little value to the beef export industry, and *exclude* it from that particular land use. Instead of a mosaic of fenced wildlife areas all around the country, it might be less expensive to cordon off entire peripheral regions. Within such areas, the need for rigid veterinary restrictions would disappear, and a far more flexible approach to disease management could be adopted. Perhaps most important of all, the region could be planned for correct land uses, and wildlife conservation and utilization would play an appropriate role.

A model area in which a veterinary corridor separates a FMD area from an export livestock area (Figure 2) is discussed in the following section, illustrating a number of land management options.

Cordon sanitaire. This would be similar to the corridors already described, with certain important differences. Paired fence lines should follow land use or physical boundaries, even if this is slightly more expensive, rather than straight lines that cut across natural barriers such as topographical features. The use of the corridor for watershed protection is an impor-

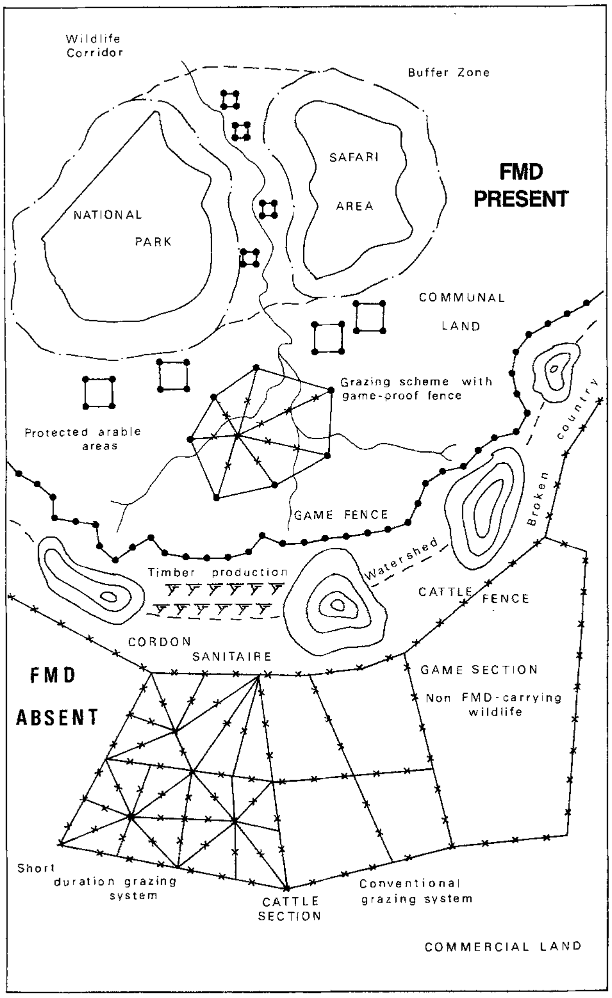

Figure 2. Diagrammatic model region (not drawn to scale) indicating land management options in relation to disease control and the planned use of fences. Game fences (●—●) protect arable blocks of land and grazing schemes where wildlife and foot and mouth disease (FMD) are present, and cattle fences (x—x) are used where FMD is absent. Paired game and cattle fences form a *cordon sanitaire* along natural boundaries to separate wildlife- and cattle-orientated production systems.

tant possibility, requiring only intelligent planning.

The fence need only be proof against FMD infectious wildlife species; other species can enter the corridor. This permits the dispersion of wildlife into desired game-ranching areas within the beef production zone, and is consistent with government policy encouraging the spread of wildlife onto private land.

The corridor would be free of cattle and those wildlife species which are a potential FMD hazard.

The corridor should not be unproductive. Possible uses are indigenous or exotic woodlots, production of endemic or exotic animal species unaffected by FMD, crop production, and recreation.

Export beef ranching area. This is an organized system of paddocks for cattle management, which can contain all wildlife species that are not FMD hosts.

Foot-and-mouth-infected area. Typical land uses would be protected wildlife areas, wildlife utilization areas where safari hunting and sustained yield cropping take place, livestock ranges that might be shared with wildlife, dryland and irrigated crop production, and forestry operations.

With wildlife being a major land use, there would be room for imaginative schemes involving buffer zones between intensive agriculture and wildlife core areas. One approach to the conservation and use of communal resources such as wildlife, forestry, and grazing outside of protected wildlife areas is the introduction of a fencing program for arable lands and the establishment of local management companies run by the communities themselves to administer the resources outside the fenced agricultural areas. A proposal for such a project in the Sebungwe region (Martin 1986) is at present being considered by the Zimbabwe government.

There would be no restriction on contact between cattle and wildlife, other than the prohibition of cattle in gazetted wildlife areas. Cattle would be permanently restricted to the FMD area, and could be marketed internally, used for draught purposes, or kept traditionally as a form of personal wealth. A vital need would be the introduction of appropriate cattle management schemes, as the dangers of overstocking in sensitive marginal lands are high.

Conclusions

Planning

Having accepted the need for fences and outlined an adaptive approach to their future use, it remains to emphasize the desirable features of a fence. Apart from the primary objective of disease control, fence planning should consider land use and watershed protection, follow natural boundaries and not only land category boundaries, and provide control of wildlife and livestock appropriate to local needs. Major fences should also be combined with secondary fences for crop protection and grazing management. As far as possible, the "emergency" approach to installing fences should be avoided. If the above considerations are satisfied, fences would not only enhance the objectives of wildlife conservation and utilization, but also those of agricultural and rural land management.

Implementation

Once a fence has been properly planned, installed, and legally gazetted in terms of veterinary regulations, it is important for the fence to become institutionalized. Government agencies, rural populations, and the public at large should recognize and support the objectives for which the fence was planned, and respect the physical structure itself. Fence maintenance should be an on-going national budgetary item.

Research and Development

There still remains a lengthy lag between both veterinary and land-use research findings, and their practical application. While the importance of continued research cannot be overemphasized, urgent action is required on the part of decision makers and administrators to implement research findings before certain land-use options are foreclosed. Complacency regarding the use of fences must be avoided, and there should be an on-going reassessment of policy in the light of new knowledge. In the case of FMD, wild buffalo calves have been captured (Coetsee and Taylor 1978) to establish a foot-and-mouth-free herd of buffalo (Condy and Hedger 1978), with the ultimate objective of reintroducing the disease-free animals back into cattle areas where FMD has been eradicated. Initially this move was prompted by a desire to reconcile opposing interests between cattle producers and safari operators. However, the possibility of using buffalo as domesticated draught animals has recently attracted attention (Drury 1982), and this could have wide-ranging implications for rural populations in marginal land, or tsetse-infested, areas.

Land Use

Onyiah (1978) and Jordan (1979) have described how the natural habitat of the tsetse fly has been destroyed, together with its wildlife hosts, in the course of human encroachment into wild areas, thereby providing land for rural subsistence without recourse to any designed control measures. Molyneux (1982) concludes that deforestation in Africa through population pressure alone is leading to the destruction of natural ecosystems, which are subsequently occupied by cattle to the exclusion of the natural fauna (including the tsetse fly). Bourn (1978) and Omerod (1978) have debated the large-scale changes arising from tsetse removal which involve complex relationships between rainfall and carrying capacity, and cattle overgrazing and land degradation. The important point to emerge is that there is little to look forward to if a similar pattern is followed in Zimbabwe. Unless we adopt appropriate land-use strategies, the outlook for conservation in its broadest sense is bleak.

A major threat to wildlife conservation lies not so much in fences per se, but rather in a blind acceptance of the desirability of extending veterinary controls to all parts of the country to meet external demands. Under pressure from beef importers, it would be all too easy to adopt a policy that attempted to make the entire country disease free for cattle production, regardless of land capability. Wildlife populations would be reduced to those in a few heavily cordoned enclosures, grudgingly accepted to satisfy the conservation lobby. There is little reason for the developed world to influence land use in the marginal areas of Zimbabwe, especially if it is short-term economic exploitation at the expense of land. We must find our own solutions where veterinary problems conflict with desirable development.

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Note

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