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Black rhinos and African elephants: lessons for conservation funding

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In theory, large reserves or parks reduce the risk of extinctions because they contain sizeable populations of endangered species of plants and animals. In practice, however, most developing countries do not have the resources to protect large areas and economically valuable species from illegal exploitation. This paper, modified from one published elsewhere (Leader-Williams and Albon, 1988) shows that the rates of decline of black rhinos Diceros bicornis *and African elephants* Loxodonta africana *are related directly to conservation effort and spending. The author concludes that, if local extinctions are to be avioded, conservation schemes must be funded adequately or resources must be concentrated in small parts of large reserves.*

Introduction

Since the 1930s many developed and developing countries have established national parks and nature reserves. The aim is usually to protect ecosystems, or large parts of them, together with their indigenous floras and faunas, in a state relatively untouched by human exploitation or occupation. According to conservation biology theory, large protected areas minimize the risk of extinctions arising from genetic isolation because they contain sizeable populations, corridors between parks further reducing isolation (Soule, 1986a). Several large conservation areas in Africa, such as Serengeti, Tsavo, Selous and Luangwa, come close to fulfilling these theoretical ideals. Yet the recent declines in large populations of both black rhino and elephant within these areas (Western and Vigne, 1985; Douglas-Hamilton, 1987; Cumming and du Toit, 1989) shows that there is a wide gap between theory and reality. This paper aims to examine the reason why this should be so, first, by evaluating a management strategy that failed to protect black rhinos and elephants from illegal exploitation in Luangwa Valley in north-east Zambia (Figure 1), and, second, by considering the wider implications for the funding of conservation where resources are limited.

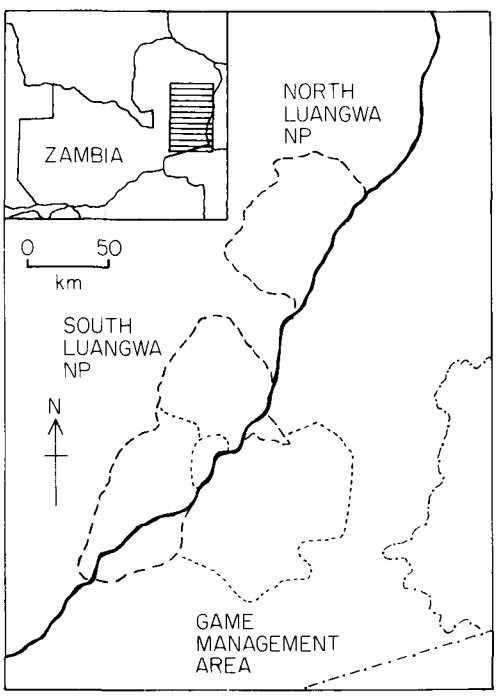

Figure 1. Map of Luangwa Valley showing North and South Luangwa National Parks, and the six areas patrolled regularly.

Background in Luangwa Valley

The socio-economic background of protected areas is relevant when looking at conservation schemes. Although there are obvious local variations, the example of Luangwa Valley

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(Marks, 1984; Abel and Blaikie, 1986) is fairly typical of many protected areas in Africa. The four national parks, totalling 16,660 sq km in area, were originally established as game reserves in the colonial era. The human inhabitants, who had previously utilized the area's products both for subsistence (meat, firewood, honey) and trade (ivory, rhino horn), were evicted. People were allowed to remain in six sparsely inhabited hunting areas, totalling 34,910 sq km, that border on the reserves, but were subjected to game and gun laws and to licence quotas set to protect wildlife. Hence, both reserves and hunting areas were managed increasingly for the benefit of outsiders, chiefly tourists and safari hunters, and earnings from wildlife went largely to central government and the private sector. Local residents, denied access to resources previously under their control, became increasingly impoverished and resentful.

In 1972 Zambia affirmed its commitment to conservation by gazetting 9 per cent of its surface area as national parks and 22 per cent as game management areas. At that time Luangwa Valley held large populations of elephant (100,000) and black rhino (approximately 4000–12,000), though the latter were never counted accurately (Naylor *et al.*, 1973; Caughley and Goddard, 1975). However, Zambia's economy then began to decline because of falling copper prices and although central government spent quite heavily on conservation, the amount was low in relation to the vast areas under protection. Consequently park infrastructure and law enforcement efforts began to collapse. By the late 1970s, Zambia's internal socio-economic problems, coupled with dramatic price increases of ivory and rhino horn on the world market (Martin, 1982; Parker and Amin, 1983) had resulted in a serious outbreak of poaching in Luangwa Valley. By the mid 1980s elephants were reduced in numbers by 75 per cent to around 25,000 and rhinos to around 100 (Cumming and du Toit, 1989). Profits from this slaughter went not to the mainstream Zambian economy, but elsewhere, the smaller share to organized gangs who killed the animals and extracted ivory and horn within the parks, and the larger share, including foreign exchange, to middlemen who smuggled the trophies out of Zambia. Importantly, the slaughter provided little benefit to Luangwa residents, because most of the poachers came from areas bordering on to, but outside, Luangwa Valley, which provided access to major trunk roads (Leader-Williams, in press).

The anti-poaching operation

In late 1979 an anti-poaching operation called Save the Rhino Trust (SRT), funded in part by the Zambian Government through its National Parks and Wildlife Services (NPWS), was set up in Luangwa Valley. The following year an external conservation agency (WWF) donated a relatively large sum in conservation terms ($US0.5 million over 3 years) to SRT, and further donations were received from the Norwegian Agency for International Development (NORAD) and private individuals. The total spent on the operation during 1979–85 was around $US1 million. Vehicles were purchased and staff mobilized into units that undertook regular foot patrols in important areas with the aims of arresting poachers and protecting rhinos and elephants (Leader-Williams, 1985, in press).

In any such project it is essential to monitor the numbers of animals under protection. An index of rhino abundance was used, based on sightings made by patrols between 1979 and 1985, and the accuracy of this index was confirmed by comparing the results with a very accurate method of counting rhinos in one area. Sightings of elephants were monitored by patrols in the same way and produced similar rates of change to those obtained by aerial counts (Leader-Williams, 1988; Leader-Williams and Albon, 1988; Leader-Williams *et al.*, in press). Each area patrolled was of a different size and patrol intensity varied between areas. At one extreme, the remote 4636-sq-km North Luangwa National Park was visited by only 30 patrols during 1979–85. In contrast, a small area of 400 sq km was designated as the core of South Luangwa National Park (Leader-Williams, 1985) and one or two patrols were

permanently policing it from 1982, resulting in a total of 337 patrols during 1979–85.

In spite of this protection, rhinos declined at an overall rate of 63 per cent per year throughout Luangwa Valley. However, their rates of decrease differed between areas, and varied between 24 and 99 per cent per year. Such high rates of decrease in a species with a maximum recruitment rate of 7–11 per cent per year resulted in the virtual disappearance of rhinos in most areas of Luangwa Valley, and by 1985 rhinos were seen regularly only in the two smallest areas. Elephant numbers also declined at an overall rate of 12 per cent per year throughout Luangwa Valley. In one area they decreased at a rate of 42 per cent, but in others, where there were fewer elephants to start with, their numbers actually increased at rates of up to 18 per cent per year. Elephants, however, are known to recognize areas of relative safety, and the increases probably reflect local immigration rather than increased recruitment (Leader-Williams and Albon, 1988; Leader-Williams *et al.*, in press). The declines in both species were due to poaching, as evidenced by finds of axed skulls in all areas.

It is intuitively obvious, but infrequently demonstrated (Harcourt, 1986), that the resources put into a conservation scheme will relate directly to its ultimate success. In Luangwa Valley there was a direct relationship between the rate of decrease of rhino and elephant numbers in each area and patrol effort, corrected for both size of area and initial sighting frequency of rhinos and elephants (Figure 2). Hence within Luangwa Valley patrol effort did deter poaching, but the effort was too thinly spread, even in the most heavily patrolled core area, to prevent the decline of rhinos. The information for rhinos in Figure 2 can be used to make the prediction that a decline in numbers could have been prevented only if five separate patrols had permanently covered the core area. But given the available manpower, to have achieved this would have meant the concentration of all patrols in the core area, leaving 98 per cent of the total area unprotected, as I suggested was necessary as early as 1982 (Leader-Williams, 1985).

Resources for conservation in Africa

A number of factors, such as external demand for trophies, poverty and corruption, result in poaching of rhinos and elephants. Given this, the detailed results from Luangwa Valley support the view that an important factor in the overall decline in rhino and elephant numbers across the rest of Africa is a shortage of manpower, and ultimately of resources, within national conservation departments (Cumming *et al.*, 1984; Bell and Clarke, 1986). Both black rhinos and elephants are widely distributed across Africa, often sympatrically but with rhinos always at lower densities than the more adaptable and wide-ranging elephant. Surveys during the 1980s provide information on gross population trends of both species in different countries (Western and Vigne, 1985; Douglas-Hamilton, 1987). As in Zambia, most large populations of rhinos and several large populations of elephants suffered serious declines. Rhino numbers remained the same or increased in only three countries, whilst elephant numbers increased in perhaps four. In 1980 a survey of manpower and spending by

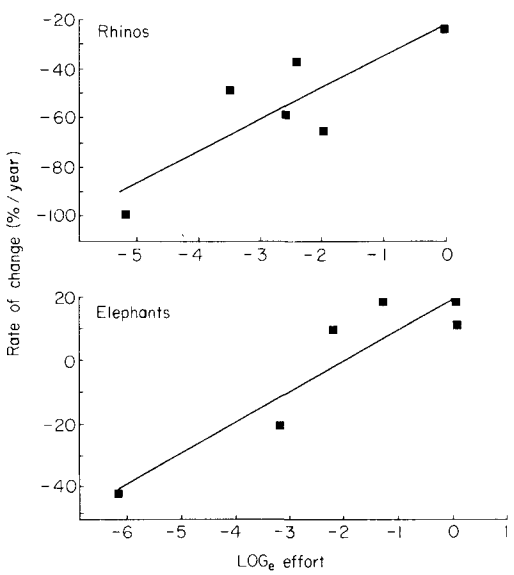

Figure 2. Relationship between annual changes in sighting rates of black rhinos and elephants and patrol effort in different areas of Luangwa Valley, corrected for size of area and initial sighting rate.

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central government within conservation areas showed wide national differences (Cumming *et al.*, 1984), and there is a direct relationship between spending, corrected for total area, and the estimated changes in rhino and elephant numbers in each country (Leader-Williams and Albon, 1988). To achieve a zero decline of rhinos the relationship predicts that spending should have been $US230 per sq km per year, and that $US215 was necessary for elephants (Figure 3). In Luangwa Valley, with government spending of $US11 per sq km per year, the external donation given to Zambia should have been spent entirely within 725 sq km over 3 years, confirming that all patrol effort should have been devoted to a relatively small area that would have held almost 300 rhinos. But because the external donation was spread over approximately 16,000 sq km, it added only a further $US10 per sq km per year, totalling less than 10 per cent of the spending necessary to prevent a decline of rhinos (Table 1). Hence, though the grants given to SRT were relatively large in conservation terms, they were in fact small in the more pertinent context of what they could realistically have been expected to achieve.

Table 1. Cost of Save the Rhino Trust during 1979-85 relative to areas under protection

Funding	$US1,088,610
Funding per sq km per year	$US10
GRZ spending per sq km per year	$US11
Area to achieve $US250 per sq km	725 sq km

The annual sum of $US230 per sq km that it was necessary to spend in 1980 to maintain the integrity of populations of valuable species within conservation areas, and talk of grants of $US0.5 m being small, may make funders of conservation despair at its apparent high costs. However, it is important to be aware that *in situ* conservation is much more economical than *ex situ* conservation (see also Harcourt, 1986). At their normal densities of 0.4 rhinos per sq km, effective protection of each rhino would have cost $US575 per year in 1980 if all conservation costs had been charged to rhinos as the main indicator species. Moreover, 1 sq km of Africa can contain a lot more than 0.4 rhinos, in the case of Luangwa around 2.2 elephants, several hundred impala, many thousands of trees and much else besides. Even if the sum for effective protection of African conservation areas has risen to perhaps $US400 per sq km today, it is still safe to say that *in situ* conservation represents excellent value for money. This can be amply demonstrated by comparing *in situ* costs with London Zoo's animal adoption scheme, which is based on what it costs to look after and feed one animal for each year (Anon, 1988). Adoption of a rhino costs £2000 and of an elephant £6000. Hence, the pachyderm equivalent for 1 sq km of Africa kept in a zoo can be estimated conservatively at £14,000 (0.4 x 2000 + 2.2 x 6000) or $US22,000, a 50-fold difference.

Future directions

This study is of wide relevance to conservation practice. Conservation biologists have concentrated upon theoretical implications of the size

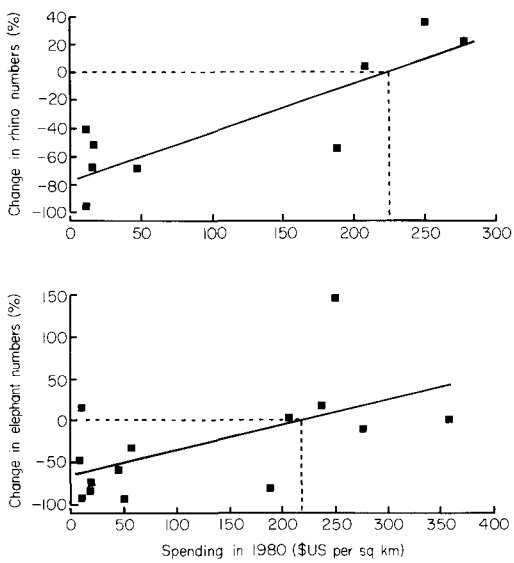

Figure 3. Relationship between change in black rhino numbers during 1980–84 and elephant numbers during 1981–87, and conservation spending in various African countries during 1980. To achieve a zero per cent change it was necessary to spend $US230 and $US215 per sq km respectively.

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of protected areas and of reduced population size and inbreeding depression (Soule, 1986a, b), but there are few empirical studies that evaluate the efficiency of resource use in achieving conservation objectives.

Because of limited funding, theoretical aspects of conservation biology may sometimes obscure realistic goals in developing countries. Evidence presented here for two widely distributed and valuable species threatened over large areas shows clearly that extinction rates are related directly to protection effort. If funding for conservation cannot be increased, then concentrating resources upon selected areas provides a pragmatic option for black rhinos and elephants, as well as for other endangered species in a similar predicament, such as lowland gorillas or pygmy chimpanzees (Susman and Mubalamata; 1984, Tutin and Fernandez, 1984). Indeed, the success of sanctuaries in stabilizing numbers of the remaining black rhino in Kenya in the past year or so (P. Jenkins, pers. comm.) and the recovery from near extinction of the southern white rhino and vicuna has resulted from pursuit of such policies (Owen-Smith, 1980; Torres, 1984). Whilst concerns over genetic isolation and chance extinction are real (Soule, 1986b), it appears preferable to retain well-protected small populations than to suffer local or total extinctions, which arise from spreading scarce resources too thinly.

The relatively small sums that international conservation agencies have available to spend on valuable species in developing countries are most likely to achieve results in one of two contrasting situations. First, in low-spending countries only if they are concentrated at appropriate levels over small areas, such as the Kenyan rhino sanctuaries or the Virunga mountain gorilla population (Harcourt, 1986; P. Jenkins, pers. comm.). Second, over large areas only if the money is allocated to a relatively high-spending country with a well-developed infrastructure like Zimbabwe, which is now in need of extra resources to prevent Zambians killing rhinos in the Zambezi Valley (Cumming, 1987).

In poor countries, large conservation areas and sizeable populations of valuable species can probably only be maintained with a radical change in approach, combining the rectification of socio-economic problems (Abel and Blaikie, 1986; Bell, 1987) with more investment in park infrastructure and policing. The most realistic option, both for disadvantaged rural people and for conservation areas, lies with requests from host governments for appropriately directed conservation and rural development projects funded by international aid agencies, either directly or through 'debt-swap-for-nature' schemes (Cartwright, 1989). Investment of sufficient funds should persuade countries against unsustained exploitation of valuable resources and, in particular, residents of the areas concerned must be allowed to participate in plans for their local conservation areas (Bell, 1987). If wildlife populations then recover, development can aim to become self-sustaining. For this to happen, earnings from sources such as tourism, licence fees and trophy sales must in part be recirculated, rather than going only to central government and business, both to pay for continued policing and to benefit local residents.

Such a project is now under way in Luangwa Valley (Dalal-Clayton, 1988), with the elephant as its linchpin. It is worth bearing in mind that at least 75,000 elephants have been lost from Luangwa since the 1970s. A ban on the licensed hunting of elephants was imposed in 1980 in response to the escalating poaching, yet the sale of between 100 and 200 elephant licences to foreign hunters between 1980 and 1985 could have raised a sum equivalent to the external donation given to Zambia in 1980, without even considering the value of the ivory or of the meat for local people. The aim, therefore, must be to achieve more balanced accounting, to develop the area and its valuable wildlife for the benefit of the human inhabitants and to replace the current conflict between them and protected areas with a custodial and participatory relationship that benefits both parties (Marks, 1984; Abel and Blaikie, 1986; Bell, 1987). The Luangwa project has the full support of the President of Zambia, Dr Kenneth Kaunda, who heads the project's steering committee. It is being funded mainly by NORAD and will concentrate

initially on South Luangwa National Park and Lupande Game Management Area. After the failure of underfunded protectionist policies in preventing major declines in rhino and elephant numbers across Africa, schemes such as that now operating in Luangwa provide the best hope for the recovery of depleted populations and maintaining sizeable populations of valuable species in large conservation areas (Soule, 1986a, b).

Conclusion

This paper demonstrates the principle that adequate resources need to be invested to achieve given objectives in conservation, whether for protection or development. Individual nations, funding agencies and conservation biologists together will have to determine policies suitable for particular areas (Caro, 1986) and define how much conservation is enough and can be afforded. This may require making selective and unpalatable decisions (cf. Lovejoy, 1976, 1986) instead of bowing to particular interest groups that believe all conservation is necessary. In determining how much conservation is affordable the economic value of each species must be taken into consideration. Hence, the sum of $US230 per sq km of protected area should not be considered as an immutable figure, since it refers to 1980 and to two sympatric species on one continent, but rather as a starting point for realistic calculations of funding required to achieve conservation objectives on a global scale (Myers, 1988). Although less valuable species or ecosystems may cost less to conserve, the required sum for rhinos and elephants will no doubt be higher today, probably around $US400 per sq km, because of inflation and raised stakes. Are such large sums ever likely to be available for protected areas and endangered species? Undoubtedly yes, but only if we can harness even a small fraction, say 5–10 per cent, of the $US40,000 million currently spent each year by bilateral aid organizations to conservation. Can we afford not to rise to this challenge?

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