CONSERVATION STRATEGY AND MANAGEMENT PLAN FOR THE BLACK RHINOCEROS (*Diceros bicornis*) IN KENYA

RHINO CONSERVATION PROGRAMME

MAY 1993

SPONSORED BY

SUMMARY

This plan provides detailed information on the policy, specific objectives and implementation schedules for the conservation and management of the black rhinoceros (*Diceros bicornis*) in Kenya over five years from January 1993. Implementation of the plan is designed specifically to ensure the continued existence of the black rhinoceros within secure wild populations in Kenya, to consolidate and develop further the existing conservation programme for this species, and in particular to promote increase in numbers up to and beyond realistic targets or minimum numbers which can be sustained in the wild in the long term.

The black rhinoceros continues to face very considerable and increasing threats to its survival throughout Africa, and now has a world population of approximately 2,500 animals, down by over 95% from around 65,000 in 1970. Following the pattern seen in many African countries, Kenya still stands to lose its remaining 400 black rhinos (16% of the world population), which include the only substantial wild breeding populations of the East African race/subspecies (*D.b.michaeli*), if it is not able to continue to protect them from poaching for their horns. The heavy depletion of the large wild populations in Zimbabwe in 1991-92 has demonstrated the continuing massive demand for rhino horn in the markets of the Middle and Far East. Efforts to halt or limit the trade in rhino horn have so far failed to have any noticeable positive effect, particularly in reducing the potential rewards for trade by speculators.

Kenya aims to secure all its remaining black rhino populations, and develop from these a genetically viable total population of at least 2,000 animals for conservation in the long term. Since the early 1970's, Kenya has pioneered the protection and breeding of black rhino in relatively small areas, or sanctuaries, which have been cost-effective in conservation terms. Since 1984, a Rhino Project, coordinated by the former Wildlife Conservation and Management Department of the Government of Kenya, has been in operation; it has succeeded in first slowing and now halting the precipitous decline of the black rhino in Kenya.

In cooperation with participating donors, NGO's and the private sector of rhino conservation in Kenya, the Kenya Wildlife Service, as the implementing authority, will continue with the elements of the former rhino project which have proved successful, and is engaged in a comprehensive rhino conservation and management programme. This involves the protection, surveillance and monitoring of all existing rhino populations in Kenya, and where animals are isolated, inviable and/or non-breeding, the capture and translocation of these into secure areas. Crucial to the success of the programme is protection of existing sanctuary rhino populations from poaching, and the management of these in order to obtain maximum sustainable breeding output, to maintain genetic diversity, and to provide to large numbers of surplus animals for translocation to complete the stocking of existing sanctuaries, and to establish new populations which have potential to increase to more than 100 animals. The capture and translocation of more than 50 black rhinos are planned in order to achieve these aims over the next five years. Re-establishment of large wild populations (100-500 black rhinos) will depend on the ability of KWS to maintain intensive protection of larger areas (> 500 km^2) from

poaching or destruction of suitable rhino habitat.

STATEMENTS

Statement from Hon N Katana Ngala EGH, MP, Minister of Tourism and Wildlife

Statement from Dr R E Leakey, Director, Kenya Wildlife Service

The fate of the black rhino in Africa has been a matter of grave concern for many since the calamitous decline of the species got underway in the 1960's. Our record in Kenya is not that different from the record in many of the range states; we lost thousands of rhinos and the species was almost eliminated. However, it was ***not*** *lost and today we can claim to be in a much more positive situation with the poaching virtually stopped and the black rhino population in sanctuaries increasing at a reasonable 5% per annum. During 1992, no rhino were known to have been poached, and the traffic in horn within Kenya was virtually non-existent as far as we can ascertain.*

This modest but real turn around is a cause for conservation optimism. It is of interest to reflect on the reasons and I would like to pay special tribute to all who have actively engaged themselves in the many facets of the Kenya rhino programme. I believe that the most important reasons for our success is that we have been able to eliminate corruption and disinterest from the wildlife authority itself. Motivated, well paid and well led rangers and wardens are probably the most important ingredient in Kenya's rhino programme. Adequate funding is clearly a corollary of this and the improved fortunes of KWS, aided by donors is gratefully acknowledged.

R E Leakey
DIRECTOR

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1.0 INTRODUCTION

The black rhinoceros *Diceros bicornis* has suffered a catastrophic decline across Africa in the last two decades, both in numbers and the extent of its range. Numbers plummeted particularly violently during the 1970's and early 1980's (from an estimated 65,000 in 1970 to under 10,000 by 1984). Although the rate of decline has reduced somewhat since 1986 (Figure 1), the situation is still very serious in all areas where the black rhino is still found in the wild. The present status of each of the four surviving races or subspecies of the black rhino is critical (Mace & Lande 1991).

Over the last decade in particular, very considerable amounts of money and resources have been expended in several African countries aimed at saving the black rhino from extinction. In spite of these efforts, the species still is in a desperately precarious state, and there is little hope for its persistence outside the seven countries (South African, Zimbabwe, Namibia, Kenya, Tanzania, Zambia, Cameroon) where relatively small remnant populations are still found. It is unlikely that there is any single population of black rhino now in existence numbering more than 500 animals.

Poaching for the horn has been, and continues to be the major cause of the decline. Despite sustained efforts to control the trade in rhino products, there has been little reduction in the poaching pressure on the black rhino in Africa as a result, and a significant failure of several consumer countries (e.g. Taiwan) to enforce existing legislation banning internal and external trade in rhino products. The substantial black rhino populations which remained in Zimbabwe (estimated at 2,000 animals in 1987) have been under intense poaching pressure since 1985, and appear to have suffered particularly badly in the last two years (1991-92); there are thought to be fewer than 500 animals left. In general, the diminishing total amounts of horn available from fewer unprotected or poachable rhinos have not slowed or halted the trade, reduced the price of rhino horn on world markets, nor the incentives to illegal hunters. Speculative buying of rhino horn in the Far East continues to maintain high prices and fuel demand for horn as stocks of live rhino diminish towards extinction.

The decline in the black rhino in East Africa has been particularly severe (Hillman & Martin 1979; Borner 1979, 1981; Western & Vigne 1984, 1985; Cumming *et al* 1989; Gakahu 1990), where the very large National Parks and Reserves such as Tsavo NP and the Selous GR each used to hold perhaps twice as many black rhino as currently exist in the world. Tanzania's black rhinos may number less than 150 animals, and the black rhino is almost certainly extinct in Uganda and Somalia. The black rhino dropped in numbers in Kenya from an estimated 20,000 in 1970 to under 500 animals in the early 1980's (Figure 1).

Numbers of rhino in Kenya started to be steadily reduced from the beginning of the century, as large areas of range were cleared of rhino for settlement, and rhino were considered vermin or a nuisance. For example, approximately one thousand black rhino were shot out from the Makueni settlement scheme from 1946-48 by the game control officer J A Hunter and his colleagues. The scientific and popular literature is full of accounts of the decline of the black rhino, and expressions of alarm, crisis and regret at

the ever worsening situation (e.g. Ritchie 1963; Hillman & Martin 1979).

FIGURE 1 DECLINE OF THE BLACK RHINO IN AFRICA AND KENYA: 1970-1992 (AERSG)

Throughout the 1970's and early 1980's, Kenya's black rhinos were poached in all areas, inside and outside of National Parks and Reserves, with few controls and little law enforcement. In addition to the removal of most of the black rhino in lowland areas (e.g. Tsavo NP, Meru NP) by well-organised poachers from the east of Kenya, many of the black rhino from highland and lowland rhino populations were also slaughtered by poachers from local areas.

The sanctuary policy

It was eventually recognised that the only hope for protecting the remaining black rhino in Kenya lay in concentrating security for rhinos within smaller areas of intensive protection. Resources and manpower had previously been spread too thinly over large areas to yield any benefit (see also Leader-Williams 1989, 1990; Leader-Williams & Albon 1988). From 1984 onwards, an active conservation programme devoted to the recovery of Kenya's black rhino populations was pursued. Undergoing slight metamorphoses as the 'National Save the Rhino Project' (July 1984), the 'Kenya Rhino Rescue Project' (KRRP 1985; Jenkins 1985a) and the 'Kenya Rhino Project' (since 1988: Jenkins 1989; Brett 1989a), the conservation policy has centred on the development of specially protected and fenced areas, or sanctuaries. Within these relatively small areas, many of which are completely enclosed by specially designed and monitored electric fences, a large proportion of the country's black rhinos have been protected from poaching and have slowly increased in numbers. Rhino sanctuaries were initially stocked mostly with unprotected rhino, typically isolated and vulnerable animals living in areas outside of National Parks or Reserves. After 1984, surplus rhinos from overstocked areas were used. A map of the present distribution of the black rhino in Kenya is shown in Figure 2.

Several new ring-fenced rhino sanctuaries were started under the Kenya Rhino Project, including Lake Nakuru NP, Ngulia rhino sanctuary (Tsavo West NP), Ngare Sergoi rhino sanctuary (Lewa Downs ranch), and Sweetwaters rhino reserve (Ol Pejeta ranch). The latter two sanctuaries have been developed through fruitful cooperation between the WCMD/KWS, private land owners and various conservation NGO's. In addition, other areas have been upgraded to rhino sanctuary status with the construction of some fencing and improved anti-poaching and surveillance (e.g. Nairobi NP, Aberdares NP (Salient)).

Two areas in particular (Solio ranch and Nairobi NP) which had been stocked with rhinos in the late 1960's and early 1970's had already shown rapid growth of their rhino populations, to the extent of having apparent over-populations, and a surplus of rhinos available by the late 1980's. These two areas have served as models followed in the subsequent development of new rhino sanctuaries in Kenya.

While sanctuaries have been developed and stocked, other important unconfined black rhino populations (e.g Masai Mara NR) were provided with improved rhino surveillance *in situ* (KRRP 1985). However, some poaching of rhinos in National Parks did continue up to 1986-87, when ironically information produced by rhino surveillance staff was used by some WCMD personnel and their associates to locate and shoot the last few

rhino remaining in some of the large distribution areas (e.g. Tsavo NP).

FIGURE 2 DISTRIBUTION OF THE BLACK RHINOCEROS IN KENYA

It has become clear that the sanctuary policy has been relatively successful as an emergency measure to protect and breed black rhinos (Gakahu 1989; Brett 1990, 1991). In the short term, sanctuaries or intensive protection zones hold the best hope for the recovery of the black rhino in East Africa, particularly in view of the desperate position for the species in neighbouring countries. Since 1986, black rhinos located in sanctuaries have suffered negligible poaching and have shown an annual increase in numbers of approximately 5%. This is less than half the rate of increase that could be obtained theoretically, once all the sanctuaries, particularly those which are fenced, have been stocked with a sufficient number of rhinos to ensure high calving rates.

Kenya holds the only substantial wild populations of the eastern race or subspecies of the black rhinoceros (*Diceros bicornis michaeli*); the only other significant numbers of this subspecies are found in northern Tanzania, and as an introduced population in South Africa (Addo NP). Apart from South Africa and Namibia, Kenya is the only country where black rhino numbers are known to be stable, or increasing (ARSG 1992). If the black rhino populations in southern Africa, particularly in Zimbabwe, continue to suffer the reductions that Kenya suffered, these countries may be obliged to adopt a conservation policy based more on smaller protected areas, and increase the number of small rhino populations specially protected as a backup to efforts to control poaching of any larger populations (> 100 rhinos) that remain.

All black rhinos in Kenya are state-owned. However, a large part of the limited success achieved so far can be attributed to the efforts and foresight of private landowners, particularly in Laikipia and Meru Districts, who have invested substantial resources in protecting black rhinos on their land at the same time as other rhino populations in National Parks and Reserves were being heavily poached. Since 1984, there has been an exceptional coalition between the WCMD/KWS, the private sector, and NGO's and donor organisations which realised the conservation potential of rhino sanctuaries. Surplus rhinos bred up in privately-owned sanctuaries have been used to stock new sanctuaries in National Parks, and surplus rhinos from both private land and National Parks and Reserves will continue to be used to complete the stocking of new sanctuaries in both sectors.

With continued cooperation all Kenya's relatively small black rhino populations can be managed interactively to enable the best breeding opportunities and output, particularly with the aim of restocking National Parks and Reserves within the KWS system, and in order to retain incentives for private land owners to maintain and breed up black rhino populations on their land as an added insurance policy for the black rhinos held on state land. This dual approach of rhino conservation on public and private land has been successful, and will be continued. At least the present number of black rhino (132), or approximately one third of the Kenya black rhino population, will continue to be held on private land (sections 4.7 and 5.2; Annex 3).

The costs and benefits of sanctuaries

Since Kenya embarked on the policy of creating *in situ* rhino sanctuaries relatively early compared with other countries, a considerable body of knowledge and experience has

been built up, particularly on sanctuary management, and the development and maintenance of necessary infrastructure (fencing, etc). The various wildlife authorities of southern Africa (particularly in South Africa, Namibia and Zimbabwe) have obtained equal or greater levels of knowledge and expertise in various areas of rhino conservation (e.g. capture and translocation), and many of these are potentially complementary to those of Kenya. KWS intends to maintain all lines of communication necessary to share a common pool of knowledge on rhino management with these and any other interested countries, particularly through the IUCN/SSC African Rhino Specialist Group (ARSG) and with the Rhino Management Group (RMG) of South Africa and Namibia, so that information and data relevant to solving commonly experienced problems are shared.

A number of lessons have been learnt in the development of rhino sanctuaries in Kenya, and there is every intention of exposing mistakes to be learnt from. Although there are clear advantages to the fenced sanctuary approach in affording effective protection of rhinos in small areas, there are some disadvantages which should be expressed here as a caution, and which are major concerns for the long-term consequences of the sanctuary policy:

1. Sanctuaries are relatively small, enclosed areas. They are very expensive to develop and maintain (section 5.3), and necessarily management-intensive. The costs required to develop rhino sanctuaries, and maintain them in the long term, are a major limitation to this approach.

2. It is unlikely that sanctuaries can remain viable after any major breakdown of security, or of maintenance of infrastructure or management capability (e.g. electric fence maintenance, rhino translocations, monitoring and management of enclosed wildlife numbers).

3. If there is total or partial breakdown of security in a rhino sanctuary, the original action of capturing and translocating rhinos and bringing them to a supposedly secure area can back-fire and actually work in the reverse direction. Scattered, remote rhinos may survive *in situ* better than clustered 'rescued' animals, gathered together in one area to unintentionally make the poachers' job easier. Just this situation did in fact occur in Kenya within the Meru NP rhino sanctuary during 1988, when, in addition to the elimination of a herded group of five white rhinos, all of the four black rhinos within a small fenced area were shot by poachers (see section 5.1.8).

The last remaining rhinos still existing from very large populations which have undergone heavy poaching episodes have clearly been extremely good at avoiding being poached (but not necessarily able to remain in breeding contact with other rhinos). Many of these rhinos (e.g. the last free-ranging rhinos in Tsavo NP, the remnant 'selected' from over 5,000 animals alive in 1968) are very wary, secretive and nocturnal. In the absence of improved security, these rhinos **may** be more likely to survive individually or in small breeding groups (e.g. trio of male, female & calf) if they are left *in situ*, rather than if they are captured and placed inside fenced areas.

For these reasons it is essential that the selection and establishment of enclosed rhino sanctuaries be undertaken with considerable care and planning, and also that some well-adapted indigenous rhino populations are secured by intensive *in situ* protection and surveillance, in addition to the intensively managed sanctuary populations. The latter must retain high standards of monitoring as a prerequisite for future management (e.g. Nairobi NP, Lake Nakuru NP).

Although substantial donor funding and inputs to sanctuaries (section 5.3) have enabled protection of many black rhinos in Kenya over the last decade, the most important ingredients in this success have been the discipline and commitment of all staff in each area. There has also been a facilitative relationship between the improvement in staff commitment and further provision of donor funds. The more recent success in protecting black rhinos in Kenya, in National Parks and Reserves as well as on private land, has been strongly related to the attitude of the people involved. Within KWS this has resulted from improved integrity, leadership and job satisfaction amongst rangers, NCO's and officers.

The new Plan

Given the experience gained in Kenya since 1984, a revised management plan for black rhinos is now required, in order to continue the development of new rhino conservation areas and consolidation of the management of the existing sanctuary network. Planning is required for the capture of remaining isolated, unprotected rhinos, and the relocation of surplus rhinos to complete stocking of existing sanctuaries, and re-establishment of black rhinos in secure release areas within National Parks and Reserves.

The last management plan/fund-raising document for black rhino conservation in Kenya was produced in 1985 (KRRP 1985). A briefer document on rhino conservation policy under KWS was produced in 1991 (Brett & Wanjohi 1990: Annex 7A to 'The Zebra Book' (A Policy Framework and Development Programme 1991-96)), on which several sections of this plan are based. Details given in Annex 7A for financing various rhino conservation areas and activities are still useable, and have formed the basis for WB/IDA funding to KWS through the PAWS project. Due to the similarity of numbers and fragmentation of black rhino populations in Kenya and South Africa, the RMG model has been followed, and the first RMG plan (Brooks 1988, 1989) has been used as a source of certain management guidelines followed here.

Some progress towards the production of a new Kenya plan was made during a Population and Habitat Viability Analysis (PHVA) workshop (organised by the CBSG of IUCN/SSC), held in Nairobi in November 1991. This meeting provided useful results in modelling future growth of each rhino population, and projections of demographic stability, genetic variability and potential for interactive management of all Kenya rhino sanctuaries as a metapopulation through exchange of rhinos between them. The future viability of each rhino area was considered from all aspects (e.g. habitat, carrying capacity, etc.), and the major threats facing the black rhino in all areas were evaluated

in detail. These threats include poaching, disease, loss of suitable habitat and genetic variability in small rhino populations, predation and competition with other herbivores for limited food resources. A final report has been produced by CBSG (Foose *et al* 1993), including detailed discussion of each of the major threats. Key results have been incorporated for future strategy and management action outlined here.

This plan presents status and historical information, programme objectives, management policy and implementation schedules for black rhino conservation in Kenya for the next five years (1993-1997). The first section (2.0) briefly describes the present status of the black rhino in Kenya, and provides information on the origin, composition, and translocation history of the remaining black rhino populations, and their importance in relation to the rest of Africa's remaining black rhino populations.

Objectives and targets for the Kenya rhino conservation programme are stated (section 3.0), followed by details of rhino conservation and management policy and guidelines (section 4.0), and projections for future growth of rhino populations. Also included is a 5-year programme of rhino translocation, based on the need to bring isolated or vulnerable rhinos into sanctuaries, and to move or harvest surplus rhinos from overstocked areas to stock new or existing rhino conservation areas. Criteria for selection of new rhino conservation areas, including estimates of carrying capacity and minimum security and management levels, are listed. This is followed by a section (5.0) which describes in some detail the status and conservation history of the important remaining black rhino populations in Kenya in all land categories, including KWS National Parks and Reserves, and private land rhino sanctuaries. Some assessment and recommendations for priority management action in each major area are included. Background information is given on the achievements of rhino projects undertaken to date, and some indication of their cost-effectiveness (i.e. what it has taken in terms of funding to each area to realise any success, and what pursuance of the 'sanctuary' policy has achieved). A research and monitoring programme (section 6.0), and implementation schedules for all activities are outlined (section 7.0).

Within the plan effort is made to provide the most realistic view of the present rhino status and future prospects for growth. This hinges for the most part on the provision of minimum figures for rhino population estimates, based on census and monitoring through individual identification of rhinos. In the decade before 1986, there were very considerable overestimates of rhino numbers, particularly of remnant populations in former large distribution areas (e.g. Tsavo NP), which have inflated overall national census figures in yhe past, and provided unreliable trends (e.g. Jenkins 1983a, 1985a). Also during this period, there was a huge gap between the funding, resources and overall discipline required for rhino conservation within National Parks, and those existing and provided by the wildlife authority (WCMD). In these respects there are parallels between the present situation in Zimbabwe in 1993 and that which existed in Kenya between 1976 and 1986.

The main text is devoted to the conservation of the black rhino in Kenya. There are a number of white rhinos in Kenya, and brief information on policy and the status of this species is given in Annex 2. Further reference to white rhinos is made in sections 4.7,

4.9 and 5.1.2.

2.0 THE STATUS OF THE BLACK RHINO IN KENYA

Kenya currently holds an estimated 420 black rhinos, this total number being fragmented across 25 small populations (Table 1). Almost half of these populations are very small groups of rhino numbering 10 or less, typically remnant groups from larger populations which were virtually eliminated through poaching in the 1970's and early to mid-1980's.

Two hundred and ninety rhinos (69% of the Kenya total) are now located in nine ring-fenced or partially fenced areas of intensive protection, termed **rhino sanctuaries** (mean area: 115 km^2; range 40-390 km^2). These comprise four sanctuaries which are, or are contained within, KWS National Parks (Nairobi NP, Lake Nakuru NP, Tsavo West NP and the Aberdares NP), and five sanctuaries located on private land (Solio, Lewa Downs, Ol Pejeta, Ol Jogi and Ol Ari Nyiro ranches). The status, and age and sex structure of these nine populations at the end of 1992 are shown in Table 2.

There are an estimated 110 additional rhinos (26% of Kenya total) located outside of rhino sanctuaries, most of which are also located outside of the system of KWS National Parks and Reserves, but which include several important populations which have been conserved through *in situ* protection of relatively large, unconfined areas of rhino habitat (> 1,000 km^2). With the exception of the Masai Mara NR rhino population, none of these populations is larger than 20 animals. The Mara population is an example of a free-ranging population that was recovered from severe poaching decline to a expanding state (from fewer than 13 animals (1985) to 32 (1992)) through intensified surveillance and protection without other intervention or enclosure with fencing.

Approximately 25 rhinos are located outside of any protected area (KWS Park or Reserve, Forest Reserve or private land rhino sanctuary), and are isolated, inviable groups or individuals, numbering less than 10 rhinos; these are here termed **outliers** (Table 1).

Rhino population estimates for Kenya provided to the AERSG/ARSG since 1987 (Table 3) illustrate the halting of the decline in numbers, and the slowly improving picture (see also Figure 1). The total Kenya rhino population probably bottomed out in 1987-88 with an estimated total of less than 350 animals, given the overestimates at that time of the number of animals remaining in Tsavo NP and other areas which used to contain large wild populations.

The present status of the black rhino country-wide is stable, and probably increasing. Although rhino populations in sanctuaries have increased annually at an average rate of approximately 5% since 1986, there has been a large variation in growth rates among them (Table 4), with the most successful populations (Solio Ranch and Nairobi NP) growing at 10% or more annually, while others (e.g. Lewa Downs and Ol Ari Nyiro ranches) have shown little, if any, increase over the same period (Table 3; see also Table 12).

TABLE 1 KENYA BLACK RHINO POPULATION ESTIMATES (December 1992)

NP/RESERVE Area/Section	Population Estimate	Area (km^2)	Density (km^{-2})	Census Precision Remarks
KWS NPs/Reserves:				
NAIROBI NP	60	114	0.53	Known Population
ABERDARES NP				Close to true population:
Salient	50	70	0.71	1992 monitoring
N area	4			1991-2 monitoring
LAKE NAKURU NP	31	142	0.22	Known Population
MASAI MARA NR	32	1690	0.02	1992 monitoring: FoC
TSAVO WEST NP:				Close to true population:
Ngulia RS	17	65	0.26	15 confirmed in 1993 monitoring
N area	15			1992 estimate from 1989 census
TSAVO EAST NP	2			1992 reports
AMBOSELI NP	5	390	0.01	Known population
Subtotal	**216**			
Private Ranches:				
SOLIO	66	68	0.97	1992 estimate from 1989-91 monitoring
OL ARI NYIRO	30	390	0.08	1992 estimate from 1988 census
LEWA DOWNS	13	40	0.30	Known population
OL PEJETA	11	93	0.12	Known population
OL JOGI	12	50	0.24	Known population
Subtotal	**132**			
Forest Reserves/Communal Land:				
MATTHEWS RANGE	17			1992 estimate from 1992 monitoring
LOITA HILLS	14			1992 estimate from 1992 monitoring
MT KENYA	10			1992 estimate from 1988 census
Subtotal	**41**			
Outliers/Others:				
TANA R DISTRICT	8			Reports 1991: K Smith/Informers
KARISSIA HILLS	6			1992 estimate from 1988 census
NDOTOS/KENO	3			1992 estimate from 1992 monitoring
LUONIEK RANCH	3			Split from Ol Ari Nyiro: 1991-2
CHYULU HILLS N	2			Reports 1991: R Bonham
WAJIR DISTRICT	2			Reports 1991: A Jama
JILORI-CHACAMA	1			Reports 1990: A Russell
ORPHANS	6			DSWT 3, Solio 2, Ol Pejeta 1
Subtotal	**31**			

TOTAL	**420**

TABLE 2 AGE AND SEX STRUCTURE OF BLACK RHINO POPULATIONS IN KENYA SANCTUARIES (December 1992)

CR = Census rating (du Toit 1989 - as shown in Table 3)

Rhino Sanctuary:	MALES:				FEMALES:				UNKNOWN SEX:				TOTAL	CR
TYPE & Name	Adults (>6 yr)	Subadults (4-6 yr)	Calves (<4 yr)	Total	Adults (>6 yr)	Subadults (4-6 yr)	Calves (<4 yr)	Total	Adults (>6 yr)	Subadults (4-6 yr)	Calves (<4 yr)	Total		
RING-FENCED:														
Lake Nakuru NP	10	3	1	14	8	2	3	13	0	0	4	4	31	1
Ngulia RS	3	3	0	6	5	3	0	8	0	2	1	3	17	1
Solio Ranch	12	2	9	23	19	4	4	27	5	6	5	16	66	2
Lewa Downs Ranch	1	0	1	2	5	4	2	11	0	0	0	0	13	1
Ol Jogi Ranch	2	3	1	6	3	1	1	5	0	0	1	1	12	1
Ol Pejeta Ranch	3	2	0	5	2	3	0	5	0	0	1	1	11	1
Subtotal	31	14	12	56	42	17	10	69	5	8	12	25	150	
PART-FENCED:														
Nairobi NP	17	6	8	31	16	6	5	27	0	0	2	2	60	1
Aberdares NP	8	2	2	13	12	3	5	20	9	0	3	12	50	2
Ol Ari Nyiro Ranch	10	0	0	10	5	0	0	5	0	0	0	15	30	3
Subtotal	35	8	10	54	33	9	10	52	9	0	5	29	140	
TOTAL	66	22	22	110	75	26	20	121	14	8	17	54	290	

TABLE 3 KENYA BLACK RHINO POPULATION ESTIMATES 1987-1992 (AERSG/ARSG November 1992)

2.1 Rhino ecotypes and translocation history

The total number of black rhinos in Kenya can be roughly divided into two groups or ecotypes: rhinos originating from low altitude areas (e.g. Tsavo NP) where several species of tsetse fly (*Glossina* spp, and the species of trypanosome they carry) are present, and rhinos originating from highland areas (e.g. Aberdares NP) where the tsetse fly is absent. The challenge of trypanosomiasis to rhinos, and their resistance to infection with this disease, is one potentially strong influence on genetic differences which may exist between animals of highland or lowland origin, combined with local adaptation to other associated differences in habitat, diet, altitude, temperature, rainfall, etc. However, the presence or absence of potentially pathogenic endoparasites and their vectors is considered to be the main criterion for separation of highland and lowland ecotypes. It is possible that some black rhino populations in Kenya may have evolved adaptations to these highland and lowland ecosystems. The known genetic background of different black rhino populations in Kenya and implications for their management are fully described in the PHVA report (Foose *et al* 1993: Section 5) and also in sections 4.6 and 6.3 of this plan.

Around 60% of Kenya's black rhinos are located in populations of mixed origin (i.e. stocked with animals born in highland and lowland areas: Table 5). This has been the result of the translocation of at least 180 rhinos carried out over the last 30 years. The history of rhino translocation around Kenya over this time (depicted in Figure 3) has been characterised by the intermittent capture and translocation of inviable pockets of rhinos to safer protected areas or sanctuaries (e.g. Nairobi NP, Solio Ranch, Ngulia, Lewa Downs). This took place more, initially, because the rhinos were a nuisance (or occasionally a menace) in the area whence they were moved, and latterly because they were in danger of being shot by poachers unless captured. Most recently, there have also been many translocations of surplus rhinos from the two most successful of these sanctuaries (Nairobi NP and Solio) to stock or restock other well-protected areas, with the aim of 'seeding' new rhino conservation areas with breeding nuclei of rhinos.

Although there is clear potential for further increase in Kenya's sanctuary rhino populations, it is unlikely that the country total will increase substantially within the next five years unless the numerous outliers (Table 1), can be protected *in situ*, or captured and translocated to form, or be incorporated into larger populations which have potential for increase in size. As sanctuary populations increase, outlying populations or groups are likely to disappear (through poaching, natural mortality) unless they are captured and translocated to sanctuaries (see section 7.1.1).

TABLE 4 GROWTH RATES OF SELECTED KENYA BLACK RHINO POPULATIONS: 1962-1992

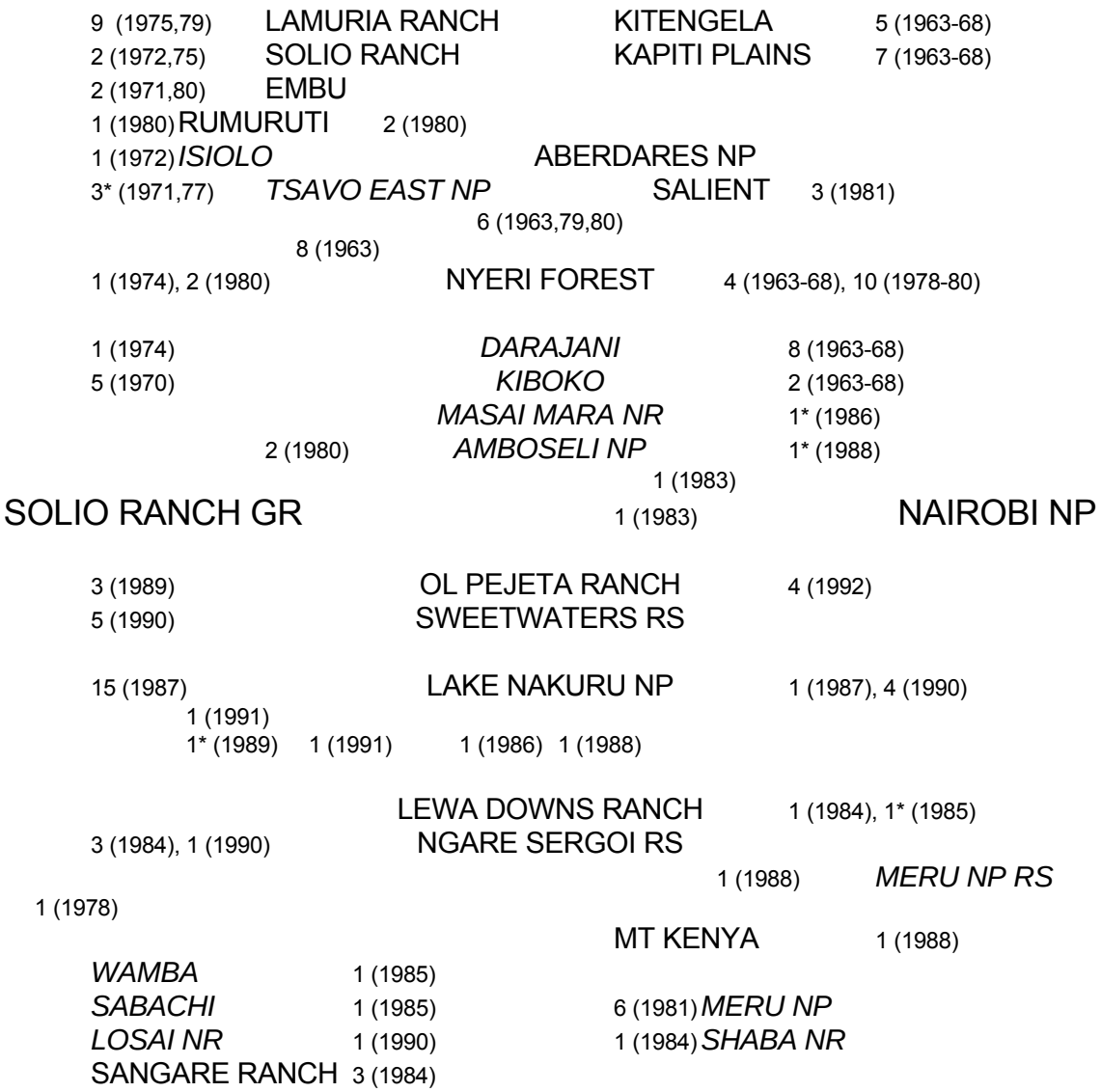
National Park or Reserve	Stocking Number(Date)	First Census Number(Date)	1992 Total	Annual Growth (%)
Nairobi NP	28(1967-69)	30(1970)	60	3.0: 1970-86
	10(1978-80)			5.7: 1986-90
(16 rhinos moved out: 1990-92)				11.0: 1990-92
Solio Ranch GR	23(1970-80)	30(1980)	66	12.0: 1980-86
				7.5: 1986-90
(30 rhinos moved out: 1987-91)				8.6: 1990-92
Lake Nakuru NP	17(1987)	19(1987)	31	6.0: 1987-90
	4(1990)			5.2: 1990-92
(1 rhino moved out: 1988)				
Masai Mara NR 0		108(1970)	32	9.9: 1986-90
		13(1985)		9.5: 1990-92
(1 rhino moved out: 1986)				

TABLE 5 SOURCES/ORIGINS OF FOUNDERS OF KENYA RHINO POPULATIONS (N > 10 rhinos; N = 1992 population size, S = number of source populations, **bold** = lowland/tsetse/trypanosomiasis areas)

NP/Reserve	N	S	Source of Founders (effective)
Solio Ranch	66	8	Solio/Lamuria, **Darajani**, **Kiboko**, Embu, Nyeri, Rumuruti, Isiolo, **Tsavo East NP**
Nairobi NP	60	4	**Darajani**, Kapiti, Kitengela, Nyeri
Aberdares NP	50	1	Indigenous (including 6 from Nyeri)
Ol Ari Nyiro R30	1	Indigenous	
Lake Nakuru NP	31	4	Solio, Nairobi NP, Kitengela, Nyeri
Masai Mara NR	32	1	**Indigenous**
Tsavo West NP	15	1	**Indigenous**
Ngulia RS	17	4	**Kibwezi**, **Taita**, **TWNP**, Nairobi NP
Lewa Downs 13	5	Solio, Matthews, **Shaba,** Kitengela, Nyeri	

Ol Pejeta	11	3	Solio, Nairobi NP, Lewa
Ol Jogi	12	3	Ol Jogi, **Kiboko**, Solio
Mt Kenya	10	1	Indigenous
Matthews Range	17	1	**Indigenous**
Loita Hills	14	1	**Indigenous**
Total	378	25	

FIGURE 3 TRANSLOCATION HISTORY OF KENYA BLACK RHINO: 1961-1992
Numbers of rhino translocated (year) from donor recipient area
(FENCED SANCTUARY , *LOWLAND/TSETSE AREA*, *=orphan rhino)



2 (1989) OL JOGI RANCH GR
2 (1979)
1 (1979) 1 (1989)

OL JOGI RANCH *TSAVO WEST NP* 1 (1990)
NGULIA RS 1 (1991)
6 (1992)

TAITA/BURA 3 (1986)
TSAVO WEST NP 1 (1989)
KIBWEZI 3 (1985) 7 (1961-62) ADDO NP (RSA)

2.2 Rating of Kenya rhino populations by the ARSG

The IUCN/SSC African Rhino Specialist Group (ARSG) currently rates (November 1992) African rhino populations into two main categories: Key (more than 50 animals) or Important (20-50 animals) populations for the survival of a rhino subspecies. There are three sub-categories (A, B & C) for each of these:

KEY POPULATIONS:

A N > 100 rhinos and
Population is increasing or stable
or, N > 50% of subspecies

B N = 51-100 rhinos and
Population is increasing or stable
or, N = 26-50% of subspecies

C N > 50 rhinos and
Population is decreasing (by < 25%)
or, N > 25% of subspecies
or, N > 100, even if Population is decreasing (by > 25%)

IMPORTANT POPULATIONS:

A n = 20-50 rhinos and
Population is increasing or stable

B N = 20-50 rhinos but
Population is decreasing, and in breeding contact
and within a protected area

C n > 20 but dispersed (with no breeding contact) outside protected area

Population change (increase, decrease or stability) is based on a 5-year trend (1987-1992), unless more current information is available to assess the 3-year trend (1989-1992), and is contrary to the 5-year trend. Trend is also considered independent of any

population change due to census improvement or management intervention, e.g. addition or removal of rhinos through translocation.

Six of Kenya's black rhino populations fall within this rating system:

Key B: Nairobi NP, Solio ranch (Solio is also Key B for white rhinos)

Important A: Aberdares NP, Lake Nakuru NP, Masai Mara NR

Important B: Ol Ari Nyiro ranch

In addition the dispersed rhinos/outliers in Kenya Forest Reserves (e.g. Matthews range, Mt Kenya) were classified as Important C.

After planned translocation of rhinos from Solio ranch and Nairobi NP to stock three other sanctuaries (Ol Pejeta, Lewa Downs and Ngulia rhino sanctuary (Tsavo West NP)) in 1993-94 (section 7.1.2), these three recipient sanctuaries would rise to Important A ranking, although the two donor sanctuaries may drop, albeit temporarily, to Important A from Key B ranking. The Aberdares NP population may shortly rise to Key B ranking through natural increase or translocation.

For purposes of directing potential donors to priority rhino projects submitted by African rhino range states for the November 1992 ARSG meeting, projects were given a 'Priority' rating if they were concerned with the conservation of a Key rhino population; projects were given an 'Important' rating if they were concerned with the conservation of an Important rhino population.

A project proposal submitted by KWS to ARSG, entitled 'Survey and relocation of selected rhino populations outside sanctuaries in Kenya', received an 'Important' rating, as applied to the conservation of dispersed and decreasing populations totalling 20 rhinos or more. A second project proposal by KWS for funding in 1993, entitled 'Monitoring rhino in sanctuaries and illegal trade in rhino horn', has also been submitted.

3.0 OBJECTIVES

The primary objective of the Kenya rhino programme is as follows:

-- **To develop and conserve for the long term a genetically viable population of at least 2,000 black rhinoceros of the East African race/subspecies (*Diceros bicornis michaeli*) in their natural habitat**.

Two thousand animals is recognised (du Toit *et al* 1987) as being the minimum number, or metapopulation, of black rhinos necessary to ensure the survival of this species in Kenya in the long term. The faster growth to this target can be achieved, the more the loss of overall genetic diversity will be reduced. In order to achieve this objective, the plan has the following subsidiary aims, and two specific targets:

A. Aims:

1. To protect the black rhinoceros (East African race/subspecies: *Diceros bicornis michaeli*) in all areas of Kenya.

2. To protect, and promote natural increase of all viable black rhinoceros populations through intensive *in situ* protection of unconfined populations, and of all populations located in sanctuaries: relatively small, defined areas (< 500 km^2) where there are developments in place (electric fencing, and intensive anti-poaching, surveillance and monitoring) specifically for this purpose.

3. Given adequate numbers of black rhinoceros bred up in sanctuaries, to continue to remove surplus rhinoceros from these areas on a basis of maximum sustained yield, in order to reintroduce black rhinoceros to selected larger areas of their former range, and complete stocking of new and existing sanctuary areas.

4. If security is sufficient and breeding output high, to release rhinos from within holding pens or fenced enclosures located within larger areas of protected rhino habitat, so that these surrounding areas are recolonised with rhinos, and enclosures can be eventually be removed altogether.

B. Targets:

1. To maintain and establish breeding populations in those conservation areas which have sufficiently large and diverse founder populations, in order to breed up a total of 450 black rhinoceros in Kenya by 1995.

2. To attain a target for 600 black rhinoceros in Kenya by the year 2000.

3. To develop at least one large wild population (at least 100 rhinos) in both a highland (e.g. Aberdares, Mt Kenya) and a lowland habitat (e.g. Tsavo) within the next 30 years (i.e. by 2025).

4.0 RHINO CONSERVATION AND MANAGEMENT POLICY

4.1 Black rhino management policy

1. All black rhinos will be protected, and be allowed to breed up as fast as possible within rhino conservation areas, including fenced sanctuaries.

2. All isolated, non-breeding or inviable rhinos or rhino groups will be captured and translocated into rhino sanctuaries for their own protection, and contribution to breeding.

3. Any recognised surplus of black rhinos will be removed from any sanctuary where the population is approaching, or has already reached or exceeded its carrying capacity (see section 4.4.1).

4. Surplus rhino removed (as 3.) will be used in completing the stocking of new or understocked rhino sanctuaries, and stocking new release areas which have been identified as priority rhino conservation areas by the Director, KWS and the National Management Committee (see section 4.2.1).

5. Efforts to halt the illegal trade in all rhino products will be supported.

4.2 KWS management and administration

4.2.1 Authority and committees

The Kenya Wildlife Service and its Director are advised by and communicate with three rhino conservation committees: the National Management Committee (NMC), the National Forum Committee (NFC) and the Association of Private Land Rhino Sanctuaries (APLRS). A smaller sub-committee of the NMC, composed entirely of KWS staff (here termed the KWS Rhino Management Group) will meet as and when necessary for consideration of particular management decisions, especially those concerning the timing, composition, location and destination of rhino captures and translocations.

The terms of reference of the rhino programme committees are given in Annex 4. The composition of the NMC and the NFC will be approved by the KWS Director. The APLRS is a registered association with its own membership and terms of reference focused on representation of the interests of the owners and managers of rhino sanctuaries on private land, and liaison between the Association and KWS.

All decisions concerned with rhino management policy and action in Kenya, including all translocations of black rhino, are approved by the KWS Director, in consultation with, and as advised by the KWS Rhino Management Group and/or the National Management Committee (NMC).

4.2.2 Sanctuary management and support

The KWS rhino conservation programme is administered from an office at KWS HQs, Langata, Nairobi, at present falling under a Rhino Programme Coordinator, reporting to Deputy Director Wildlife Services (Management) and Deputy Director Scientific Services (Research & Monitoring). Supervised by the Coordinator, KWS rhino programme officers (Warden or Research Officer) are in charge of administration, liaison with donors to various rhino projects and activities, rhino security and surveillance, research & monitoring, data collection, storage and analysis.

All rhino conservation activities in each KWS rhino sanctuary (Nairobi NP, Lake Nakuru NP, Aberdares NP, and Ngulia (Tsavo West NP)), with the addition of Kitchich station (Matthews range) fall under an Assistant Warden, reporting directly to the Warden or Senior Warden in charge of each area. These Assistant Wardens are responsible for (i), security and surveillance of rhinos, (ii), management and maintenance of all necessary sanctuary infrastructure (fencing, vehicles, water systems), as appropriate, (iii), all sanctuary staff, and (iv), production of quarterly reports.

All security of rhinos in Kenya will be supervised and directed through the OIC Wildlife Protection Unit (WPU) and the Warden in charge of rhino security & surveillance (based at KWS HQs), in liaison with the Senior Wardens of each National Park, and local WPU units, as necessary. Assistant research officers in each National Park with rhinos are assigned to supervise and participate in rhino population monitoring and data collection in collaboration with the Assistant Warden, analyse data collected and produce research reports.

All rhino captures and translocations approved by the KWS Director will be carried out by the KWS veterinary unit (under the Chief Veterinary Officer) and KWS capture unit (under the OIC capture unit). All fences enclosing rhino sanctuaries will be developed and maintained with the support and supervision of the KWS fence unit.

4.3 Security and Protection: status and strategies

4.3.1 Legal status

The black rhino is a specially protected animal in the Republic of Kenya under Presidential decree (p ii). At present, penalties for illegal hunting of rhinos, and illegal possession or trading of rhino products within Kenya are provided for in the Wildlife (Conservation and Management) Act of 1976 (Cap 376, Rev 1985). The rhino is listed under Part I of the First Schedule of game animals. For any offence under the Act "committed in respect of a protected animal, or in respect of any trophy of that animal", the guilty offender "shall be liable to a fine not exceeding Kshs.40,000, or to imprisonment for a term not exceeding ten years, or to both" (Part VI). No differentiation is made between black and white rhinos within the present Act (see also Annex 3).

In addition, under the Act (Part V), "any person unlawfully in possession of, or who unlawfully deals in any Government trophy" (including rhinos or rhino horn) "shall be guilty of an offence and liable to a fine not exceeding Kshs.10,000, or to imprisonment for a term not exceeding 12 months, or to both". Penalties for illegal hunting of any animal in a National Park are as follows: "a fine of not less than Kshs.5,000 and not more than Kshs.20,000, or to imprisonment for a term which shall not be less than six months, and not more than three years, with or without corporal punishment, or to both".

Minimum penalties are not specified for offenses relating to rhino, maximum penalties have rarely, if ever, been imposed for such offenses, and typically fines of around Kshs.5,000 or custodial sentences of the order of 1-2 months have been handed down in recent years. At present, stock theft appears to be regarded as a more serious offence than rhino poaching, or trafficking in rhino horn. Increases in penalties actually imposed for any illegal activities connected with rhino are clearly warranted, in order to provide a substantial deterrent to would-be offenders. New legislation is urgently required for provision or increase in minimum penalties specified for the illegal hunting of rhinos and the illegal possession of, or trade in rhino products. The Presidential statement of the specially protected status of the black rhinoceros is highly relevant in this regard.

4.3.2 Anti-poaching

The sanctuary/rhino surveillance approach has been an important factor in halting rhino poaching in many areas of Kenya. However, largely due to staff reductions carried out during the formation of KWS out of WCMD in 1990, it has become apparent that levels of security and anti-poaching are poor or inadequate in several important areas within the KWS system of National Parks and Reserves, as well as capability to provide necessary security in forest reserve areas and on private or communal land. A complete cessation of poaching by the staff of the wildlife authority (WCMD) has clearly been a highly significant factor in the improved status of rhino in recent years. In 1992 for the first time there was no confirmed record of any instance of rhino poaching in Kenya.

Minimum security staffing levels for KWS rhino conservation areas were given by Jenkins (1985a, 1989), and have been used as a reference for future manning and equipping. One particularly potent deterrent to poachers in other countries, apart from stiff penalties (section 4.3.1), is a high frequency or likelihood of being detected by anti-poaching patrols (see Leader-Williams 1988; Milner-Gulland & Leader-Williams 1992), and hence the intensity of patrol coverage. This will be increasingly important in sanctuaries bordering settled areas (e.g. Lake Nakuru NP, Aberdares NP), in necessitating maintenance of perimeter fencing and patrolling inside, and also in operational areas (e.g. Tsavo NP, Meru NP) where high levels of patrol effort will be essential in order to detect and intercept poachers before they reach or make incursions into rhino sanctuaries or release areas (e.g. Ngulia rhino sanctuary).

Under the KWS Wildlife Protection Unit (WPU), substantial strengthening of security in

all rhino areas is being undertaken, after an assessment carried out in late 1992 (Oloo 1992). This will centre particularly on increased staffing and provision of rangers for patrolling within and around rhino sanctuaries. The requirements for ranger staffing in the five major KWS rhino conservation areas are listed in Table 6. The provision of over 50 additional rangers for these areas (Nairobi NP, Lake Nakuru NP, Aberdares NP, Tsavo West NP, Matthews Range-Kitchich) has been approved for action following the recruitment and training of new staff in 1993. Deployment of these numbers of rangers in the designated areas will improve the ranger density to 6 km^2 per ranger or less, in each of the four fenced KWS sanctuaries (Table 6).

The rhino surveillance and security of the Masai Mara NR requires urgent re-assessment, re-staffing, re-supply with equipment and vehicles, and general up-grading. At present the unit is too dependent for its existence on one particular donor organisation (FoC). All private land rhino sanctuaries will be assessed or re-assessed for security requirements by the WPU in early 1993, in particular to bring all areas in line with minimum security standards for all rhino sanctuaries (section 4.7, Annex 3).

TABLE 6 TOTAL REQUIREMENT OF RANGER STAFFING AND DENSITIES IN KWS RHINO CONSERVATION AREAS (Oloo 1992)

Present establishment of rangers are listed in parentheses

Sanctuary/Conservation area	Area (km^2)	Sergeants	Corporals	Rangers	Total Ranger force	Ranger density (km^2 per ranger):	
						Present	Required
Nairobi NP	114	2 (0)	4 (1)	14 (6)	20 (7)	16	6
Lake Nakuru NP	142	1 (0)	4 (0)	18 (3)	23 (3)	47	6
Ngulia rhino sanctuary (Tsavo West NP)	65*	1 (0)	3 (2)	16 (9)	20 (11)	6*	3*
Aberdares NP (Salient)	70	1 (0)	2 (1)	12 (4)	15 (5)	14	6
Kitchich Station (Matthews Range)	>500	1 (1)	4 (0)	17 (6)	22 (7)	> 60	20
Total		6 (1)	19 (6)	77 (28)	100 (35)		

* Patrols of large area of Tsavo West NP (> 500 km^2) surrounding the Ngulia sanctuary essential for rhino protection and security

4.3.3 Control of illegal trade

Under the ratified CITES treaty, to which the Republic of Kenya is a party and signatory, the black (and white) rhino is listed under Appendix I, which prohibits all trade in rhino products. Under the Kenya Wildlife Act (1976), all hunting of rhinos is banned, and any illegal hunting carries the maximum penalties described in section 4.3.1. Any import or export of live rhinos (black and white) or rhino products from Kenya may only be permitted by the CITES secretariat through provision of a permit by the Kenya Wildlife Service as the wildlife management authority.

4.3.4 De-horning

Dehorning of black rhino has been carried out in at least two African countries in

response to critical situations of insecurity for particular black and white rhino populations. The success of de-horning as a management option under different circumstances has yet to be fully established. Current studies of dehorned and intact rhino in Namibia and Zimbabwe may yield clear results in time, particularly for the black and white rhino dehorned in Hwange NP. This number represents a substantial proportion of the total of over 200 black and white rhino dehorned in Zimbabwe in 1992. The poaching situation and the results of dehorning operations in Zimbabwe and Namibia will be monitored with particular interest.

The potential success, failure or impact of dehorning on rhino populations will be strongly influenced by a number of factors: the openness of the habitat and visibility of rhinos; the predation pressure, particularly from hyaena and lion; the intraspecific impacts of dehorning individual rhinos (e.g. adult males); poaching pressure and the incentives for poaching; the rates of re-growth of rhino horns of rhino of different ages (see Pienaar *et al* 1991); the quality of re-grown horn and the necessity for repeated dehorning (Milner-Gulland *et al* 1992); and the existence of local public relations campaigns (e.g. Zambia ACC/SPD). The potential sale of horn from repeated dehorning is unlikely to yield consistent or sustainable returns, due to the drop in the quality of the secondary horn growth. This strategy ignores the potential capture mortality resulting from the high number of immobilisations required.

For the present, de-horning should be an option employed only in situations where other measures, including anti-poaching efforts, cannot yield adequate security, and is a preferable or a more practicable and effective alternative to capture and translocation of the same rhinos to a more secure area. KWS recognises that dehorning can be a successful option under particular circumstances and habitats (e.g. low density rhino populations, low pressure from predators, open habitat), but will only approve this measure in specific circumstances, as in the past. The dehorning of whole populations will not be considered unless as a measure of last resort, although the dehorning of individual animals will be approved by the Director, KWS for particular purposes on a case-by-case basis (e.g. the trial release of rhinos which may wander into potentially insecure areas).

4.4 Management of existing rhino populations

As described in section 2.1, the black rhinos of Kenya can be divided into highland and lowland ecotypes, based largely on the presence or absence of trypanosome endoparasites and the tsetse fly species (*Glossina* spp) which are the vectors. Approximately 60% of the total number of black rhinos in Kenya, and 75% of those located in sanctuaries, are part of 'hybrid' populations founded by rhinos originating from highland and lowland areas. Most of these populations are located in highland areas (e.g. Nairobi NP, Solio ranch), but which were stocked with large numbers of animals from the Tsavo area in the 1960's (Table 5, Figure 3).

The total black rhino population in Kenya is thought to be too small to allow totally separate management of highland and lowland rhino populations for genetic reasons

(see also PHVA report: Foose *et al* 1993). This is particularly limited by the small numbers of 'pure' lowland black rhino populations. For these reasons Kenya black rhinos will be treated for management purposes as one population, or metapopulation. However it may be desirable to maintain at least one 'pure' population in highland (e.g. Aberdares NP) and lowland areas (e.g. Masai Mara NR) which do not have rhino introduced from other populations.

Through the tsetse/trypanosomiasis monitoring work accompanying translocations of rhino from Nairobi NP to Tsavo NP (section 6.4), the feasibility of routinely moving upland rhinos to lowland tsetse-infested areas has now been established (i.e. the ability of upland rhinos to become resistant to infection with trypanosomes after translocation). However, each recipient area and all translocated rhinos need close monitoring before and after each translocation. The intention is to move large numbers of surplus rhinos from the sanctuaries, most of which are located in highland areas, to restock the large areas of unconfined lowland rhino habitat that are capable of supporting thousands of black rhino (e.g. Tsavo NP), and certainly populations of more than 100 animals (see targets: section 3.0).

There are a large number of practical limits and constraints on rhino translocations (Brett (1990) gives more detail), and in particular the constraints on moving rhinos into sanctuaries with already established residents (see section 2.1). Practical limits also apply to long-distance moves of rhinos across Kenya, and logistically easier translocations will be favoured (i.e. Solio ranch to stock other up-country sanctuaries (e.g. Lewa Downs); Nairobi NP to restock lowland areas (e.g.Tsavo NP)).

4.4.1 Carrying capacities

The concept of carrying capacity is compromised by a multitude of variables, including ecological and social components. These hinder the estimation of usable numbers for use in management, particularly in harvesting surplus numbers of a wildlife species on the basis of maximum sustained yield. The RMG management plan for southern Africa (Brooks 1988, 1989) describes useful approaches to carrying capacity as applied to the management of the black rhino. For application in the Kenya rhino sanctuary context, the basic approach will be to estimate and employ figures for **carrying capacity** (CC) at which (1), negative effects on rhino breeding output are observed (e.g. as a reduced percentage of calves in the population, or increased calving intervals of cow rhinos), or (2), negative effects are recorded on resources (e.g. browse availability, water) vital for supporting continual breeding of rhinos, or (3), when social effects (e.g. density-dependence on intraspecific aggression) increase mortality or reduce breeding output, or (4), when adverse genetic effects arise.

Carrying capacities for each fenced rhino sanctuary have been estimated (e.g. by habitat assessment: Foose *et al* 1993 (PHVA)) and are shown in Table 7. Black rhino populations will be managed between carrying capacity and a lower figure, here termed the **management level** (ML). Numbers will be permitted to build up by 5-10 animals above ML, depending on overall population size, before removals take place. These periodic removals will improve the efficiency and cost-effectiveness of the capture and

translocation operations, will minimise the disturbance to the rhinos and also allow time for annually repeated surveys to provide reliable population trends and necessary performance indicators.

TABLE 7 BREEDING AND MANAGEMENT DATA IN KENYA RHINO SANCTUARIES (December 1992)

CC = Carrying Capacity (Brett 1989a; Foose *et al* 1993) ML = Management Level (section 4.4.1)

Rhino Sanctuary:	Population	MANAGEMENT DATA:					BREEDING PERFORMANCE INDICATORS:			
TYPE & Name	Total	Area (km^2)	Density (km^{-2})	CC	ML	Surplus (Tot-ML)	Sex Ratio	% Calves (< 4 yrs)	% Cows + Calves	% Calves (< 2 yrs)
RING-FENCED:										
Lake Nakuru NP	31	142	0.22	65	50	0	1.08	25.8	100	0.7
Ngulia RS	17	65	0.26	65	50	0	0.75	5.9	20	1.5
Solio Ranch	66	68	0.97	60	45	21	0.85	27.3	95	7.4
Lewa Downs Ranch	13	40	0.33	25	20	0	0.18	23.1	60	5.0
Ol Jogi Ranch	12	50	0.24	20	15	0	1.20	25.0	100	2.0
Ol Pejeta Ranch	11	93	0.12	90	70	0	1.00	9.1	50	1.1
SubTotal	150	458	0.33	325	250	21	0.81	22.7	81	2.4
PART-FENCED:										
Nairobi NP	60	114	0.54	65	50	10	1.11	26.2	100	6.1
Aberdares NP	50	70	0.64	100	75	0	0.65	24.4	92	4.3
Ol Ari Nyiro Ranch	30	390	0.08	100	75	0	2.00	6.7	40	0.3
SubTotal	140	574	0.24	265	200	10	1.02	25.0	88	1.9
TOTAL	290	1032	0.28	590	450	31	0.90	23.8	91	2.1

In the absence of good information about density-dependent effects on breeding in Kenya rhino sanctuaries (see Hall-Martin & Penzhorn (1977), Hall-Martin (1986), Brooks (1975), Brooks *et al* (1980) for information from SANP and NPB reserves), and despite being an arbitrary figure, approximately 75% of CC will be used to set management levels for managed black rhino populations in Kenya (Table 7).

This theory and practice leave aside completely the constraints, difficulties and effects of this management on the sex ratio and age structure of any translocates, and subsequent effects on both the donor and recipient populations or resident groups. Though the concept and use of figures for carrying capacity may be of immediate benefit for management of rhino populations in this manner, it must not be thought of as a fixed and unchangeable figure for a given area, and must be adapted regularly to fit changing habitats, and inter- and intra-specific effects (e.g. density-dependence).

Calving intervals, the proportion of calves in a population, and the ratio of cows to calves can and will be used as indicators of breeding performance in rhino populations (Table 7). However rhino populations should never be allowed to actually reach the population level at which breeding output is reduced (CC). Monitoring of the impact of rhino density on browse availability and condition, and also on non-fatal intraspecific aggression, may provide early indicators of carrying capacity being approached before any negative effects come into play. It has been noted over several years in the high density population at Solio ranch that depletion of reserves of particular browse species (e.g. whistling thorn, *Acacia drepanolobium*) may be very marked before any reduction

in breeding output, or increase in intra-specific aggression, is observed. These very noticeable impacts have lead to the harvest of 30 black rhinos from the Solio population in the last six years.

4.4.2 Management for maximum sustained yield

All rhino sanctuaries will be managed in order to obtain maximum growth rates of their rhino populations, with the following guidelines:

1. All rhinos will be managed for maximum breeding output so that numbers of rhinos increase as fast as possible.

2. When rhino numbers approach the carrying capacity of enclosed sanctuaries, maximum breeding rates will be maintained by translocating out a maximum sustained yield of rhinos to other rhino conservation areas which satisfy certain criteria (see section 4.5.2).

3. Surplus rhinos moved out of existing sanctuaries will be used to complete the stocking of existing sanctuaries. Once sanctuary populations have reached or exceeded their management levels (ML), surpluses will be used to restock larger areas of unconfined rhino habitat in the National Parks and Reserves which used to hold large numbers of black rhino (e.g. Tsavo NP, Aberdares NP, Mt Kenya NP, Meru NP), conditional on security in these recipient areas and other criteria being met (see section 4.5.2).

4. All rhino populations and their habitat requirements will be monitored in order to enable management decisions for 2. (above).

4.4.3 Modelling population performance

Modelling of future breeding performance of rhino sanctuary populations in the PHVA analysis (Foose *et al* 1993) were based on previous performance in the same areas (1986-1990: 4.7% mean growth rate). Although some sanctuary populations (Nairobi NP, Solio ranch) have grown at around 10%, others have performed poorly. In the absence of catastrophes, the PHVA analysis projected that a realistic mean rate of growth that could be achieved would still be 4.7%, assuming that most of the remaining outliers could not be recruited into the sanctuaries. Through planned completion of stocking of three rhino sanctuaries (Lewa Downs, Ol Pejeta, Ngulia) with at least 20 rhinos each in 1993-94, it is anticipated that the growth rates in these areas may rise to that recorded in Nairobi NP and Solio Ranch.

Projections of the growth rate of the Kenya black rhino population are shown in Figure 4. If the entire rhino population grew at 10% per annum, there would be 660 rhinos after five years (1997) and 1060 after ten years (2002). If sanctuary populations only grow at 4.7%, and other populations remain static, the maximum numbers attainable would be 490 rhinos after five years, and 600 after ten years. The latter, more realistic projections have been used as targets for breeding within the next ten years (section 3.0). These

projections also take into account the mortality due to capture and translocation (9.1%: section 4.5.1), assuming this remained as the same level. At the realistic rate of 4.7% for the sanctuary populations only (assuming conservation of new areas (e.g. Tsavo NP) with sufficient total capacity) the primary objective of this plan (2,000 rhinos) will only be reached in the year 2032 (forty years from the present).

FIGURE 4 PROJECTIONS OF KENYA BLACK RHINO POPULATION GROWTH: 1993-2002

4.4.4 Rainfall, habitat and rhino densities

Although the past and present distribution of the black rhino in Africa covers a remarkably wide range of habitats, including hyper-arid regions (e.g. northwest region of Namibia), water resources must be available and rhinos have to drink regularly (every 3-4 days) unless numerous favoured succulent browse plants (e.g. *Euphorbia*, *Sansevieria* spp) are available and are consumed. Rainfall and the availability of water resources are important determinants of the production of browse, and the habitat quality and suitability of a given rhino conservation area, particularly those reserves enclosed by fencing or other barriers to dispersal or seasonal movements of wildlife.

The mean annual rainfall received by Kenya rhino conservation areas varies considerably from 400 mm to 1000 mm (Figure 5). Some areas (e.g. Tsavo NP, Lewa Downs) receive a very marked bimodal pattern, with peaks of rainfall in April-June and November-December. Some other areas have their rainfall spread more between these peaks, with more rain falling typically in July-August than in November-December; a good example of this is the pattern for Ol Ari Nyiro ranch (Figure 6). The Masai Mara NR area does have a bimodal rainfall distribution of rainfall, with peaks in April-May and November-December, but receives substantial amounts of rainfall between these peaks raising the mean annual total to over 1000 mm, the highest amount of the rhino distribution areas considered (Figure 5).

These rainfall patterns contrast with those generally seen in southern Africa, where a single rainy season is the norm. The spread of rainfall over the year in Kenya results in longer periods of vegetation growth, and less pronounced dry seasons, and probably also in generally higher carrying capacities for rhinos in conservation areas in Kenya. For example, little adverse effects on health and breeding output of black rhinos on Solio ranch have been noted at densities approaching 1.5 rhinos/km^2 (Brett 1989b); in contrast, marked depression of breeding output has been noted in the Hluhluwe-Umfolozi GR complex in Natal at rhino densities exceeding 0.5 rhinos/km^2 (Brooks 1975; Brooks *et al* 1980; Hitchins & Anderson 1983). Southern African rhino managers have routinely removed rhinos from areas where such densities are exceeded (Brooks 1988, 1989), and when negative effects on rhino populations have been recorded.

The drought susceptibility of some of the existing fenced rhino sanctuaries (e.g. Ol Jogi, Lewa Downs) has become apparent since their development. The effects of drought on rhino and other herbivore species have been exacerbated by the enclosure and restriction of movements of animals which would otherwise disperse to locate better food and water resources during such periods. As a result rainfall will be an important consideration in the assessment of future rhino sanctuaries or release areas (section 4.5.2). Existing rhino sanctuaries which are susceptible to drought will be encouraged to increase the total size of their fenced areas (if they have not already done so), in order to reduce the impact of drought and generally increase carrying capacities (see also Foose *et al* 1993: PHVA habitat working group report).

FIGURE 5 MEAN ANNUAL RAINFALL OF RHINO CONSERVATION AREAS IN KENYA: 1982-1991

FIGURE 6 MEAN MONTHLY RAINFALL PATTERNS OF FOUR KENYA RHINO CONSERVATION AREAS: 1982-1991

4.4.5 Translocation criteria

Selection of outlier rhinos for translocation to sanctuaries

The criteria for the selection of outlier rhinos for capture and translocation to sanctuary populations will be as follows:

1. The rhino is in danger of being poached.

2. The rhino is isolated from other rhinos, or is part of a 'doomed', inviable and/or potentially inbred group, which through translocation would become part of a viable population.

3. The rhino is not breeding, because of 2.(above) or other reasons (e.g. aggression).

Other factors influencing the priority of individuals for translocation into sanctuaries are:

A. The costs of capture and translocation. Two capture operations of individual rhinos in remote areas in late 1989 and early 1990 cost (in total) $7,000 and $12,000 per rhino respectively, largely due to extensive helicopter time used. The high cost of catching an individual rhino in particularly difficult conditions may in some cases outweigh the small benefit to a recipient population (in terms of its contribution to improved breeding output), particularly if the rhino is a male (point C.).

B. The rhino is of large genetic value, because of its genetic uniqueness: remoteness from other populations, the habitat type and possible local adaptation of the rhino or source of genetic variation. This factor is hard to quantify, but may become clearer following on-going genetic studies (see section 6.3).

C. The rhino is a female. Females are particularly valuable in increasing breeding output in a recipient population.

4.4.6 The supply of sanctuary rhinos for translocation

It has been stated above that enclosed rhino sanctuaries will be 'harvested' as they approach their carrying capacities, and once population totals rise to 5-10 rhinos above their management levels, these numbers will be translocated out in a group to supply other areas. Using the carrying capacities and management levels given in Table 7 (section 4.4.1, modified from Foose *et al* 1993), the potential availabilities of rhinos for translocation in the next ten years are shown in Table 8. Three rates of growth are used for these estimates: the rates of growth used for PHVA modelling (3.8% - Foose *et al* 1993: Table 12 of PHVA report), 4.7% (mean sanctuary population growth 1986-90) and 10% (maximum breeding rates, as recorded in Nairobi NP and Solio ranch).

TABLE 8 THE AVAILABILITY OF RHINOS FOR TRANSLOCATION FROM RHINO SANCTUARIES: 1993-2002

Key: r = annual growth rate (%), ML = management level, Trans = number of rhino available for translocation

National Park or Reserve	r(%)	ML	1992 Total	1993 Trans	1994 Trans	1995 Trans	1996 Trans	1997 Trans	1998 Trans	1999 Trans	2000 Trans	2001 Trans	2002 Trans
Nairobi NP	3.8	50	60	6	5		6			6			6
Solio Ranch	3.8	45	66	16	5		5			5			5
Totals		95	126	22	10	0	11	0	0	11	0	0	11
Nairobi NP	4.7	50	60	6	5		7		5		5		5
Solio Ranch	4.7	45	66	16	5		6		5			6	
Totals		95	126	22	10	0	13	0	10	0	5	6	5
Nairobi NP	10	50	60	6	5	5	5	5	5	5	5	5	5
Solio Ranch	10	45	66	16	9	5		9		9		9	
Lake Nakuru NP	10	50	31						5	5	5	5	5
Totals		145	157	22	14	10	5	14	10	19	10	19	10

At realistic and modest rates of population growth (3.8-4.7%: Table 8), only Solio Ranch and Nairobi NP will have rhinos available for translocation within the next decade. Initial destocking of both sanctuaries in 1993-94 (32 rhinos available) is required for both populations to reach their respective management levels (ML). At maximum growth rates (10%: Table 8), Nairobi NP and Solio Ranch could each provide 9-10 rhinos every two years for translocation. If the Lake Nakuru rhinos bred at this enhanced rate for the next decade, it could start to provide five rhinos per year from 1998.

The PHVA report gives further details of potential harvest from other rhino sanctuaries. Based on the intrinsic growth of their rhino populations, only Ol Pejeta (after stocking to reach 20 rhinos) and Ol Jogi ranches are likely to achieve donor status (i.e. rhino numbers exceeding ML) in the future, where rhinos will have to be moved out. Ol Pejeta would have rhinos available from the year 2023 at around six rhinos available every two years; Ol Jogi would exceed capacity in 2013. Other areas (e.g. Ngulia, Lewa Downs, Aberdares) are unlikely to ever require removals of rhinos to other areas, surplus animals ideally dispersing to colonise the neighbouring very large potential distribution areas (i.e. Tsavo NP, Forest Reserves).

4.5 Establishment of new rhino populations

4.5.1 Capture and translocation procedures

The record of success for translocations of black rhinos in Kenya carried out since 1984 has been fair. Of a total of 77 rhinos captured and translocated over this period, all of which have been moved into or between sanctuaries, seven rhinos have died during capture (9.1% mortality). If all immobilisations (including those for treatment, tagging, etc) are included (in which there have been no deaths due to immobilisation), the total

mortality has been 5.3% (7 deaths from 131 immobilisations). Figure 7 shows the numbers of rhinos translocated by year since 1984, and the number of capture mortalities which have occurred.

More serious has been the number of rhinos killed in fights with resident animals after translocation. There have been nine mortalities as a result of fighting since 1984, all of animals introduced to fenced sanctuaries (77 rhinos), and killed as a result of fighting with resident dominant males (12% mortality: Figure 7). Six of these nine deaths were of males (four adults, two subadults), but interestingly, the other three deaths have been of subadult females introduced and killed by dominant males. A further subadult female received severe injuries from attacks by resident rhinos several months after introduction to Lake Nakuru NP from Solio ranch; this animal was isolated, treated and subsequently translocated to the Lewa Downs sanctuary, where it was introduced and has integrated successfully.

More subadult rhinos have been translocated than adult rhinos since 1984 (Figure 8), being generally easier animals to move, since they have no dependents, would normally be dispersing in order to establish themselves within the natal area, and have their whole breeding life ahead. Subadult males may also stand a better chance of integrating into a sanctuary with already established residents. However, the number of mortalities to 4-5 year old females shows that these animals may have some problems, and that older females have better chances of survival after translocation. Indeed, there are no records of any mortalities of adult females through fighting after translocation. The difficulty with this category of rhinos (adult females) is that they often have dependent calves, particularly in successful donor sanctuaries with high breeding output. A fuller description of these and other practical constraints on translocation of rhinos between populations is given in Brett (1990).

The timing and composition of translocations and introduction of rhinos to a new rhino sanctuary may be critical to carrying out successful stocking and minimising fighting mortality. The consensus of rhino managers in southern Africa (Brooks 1989; Hitchins, du Toit, pers comms) is that large numbers of rhinos should be moved into a vacant area within a relatively short time, giving little chance for already-established residents to assert themselves, and become dangerously aggressive to newcomers.

In Kenya, many fighting mortalities have occurred when individual rhinos, or small groups, have been introduced to fenced sanctuaries with established residents (e.g. Lewa Downs, Ol Pejeta). The successful stocking of Lake Nakuru NP with 15 rhinos from Solio ranch over a relatively short period in 1987 appears to support the case for rapid stocking of new areas with an adequate founder population. However, the case is not clear cut, and intermittent stocking of a sanctuary over a long period has been accomplished in Kenya without serious fighting mortality. In Kenya's most successful stocking operation, 23 rhinos were introduced into Solio ranch GR, but this total was composed of small groups or individuals added intermittently over a ten-year period (1970-80); there was only one fighting mortality (a subadult male) over this time.

FIGURE 7 NUMBERS OF RHINOS TRANSLOCATED BY YEAR: 1984-1992 WITH CAPTURE AND FIGHTING MORTALITIES

FIGURE 8 AGE AND SEX BREAKDOWN OF RHINOS TRANSLOCATED: 1984-1992

In view of the fighting mortality that has occurred in fenced sanctuaries after introduction of rhinos into areas with already established residents, in future operations to stock new rhino sanctuaries or release areas, at least 20 rhinos will be released within the shortest practicable period. Based on the history of successful stocking and development of rhino sanctuaries in Kenya so far, the suggested model to be applied is as follows: a fenced and easily-protected area of 60-120 km^2, stocked with 20-25 rhinos over a short period, and the founder population allowed to build up naturally to at least 60 rhinos before removals of surplus animals commence.

4.5.2 Selection of new rhino conservation areas

When assessing the suitability for new sanctuaries or reserves for stocking with black rhinos, the following guidelines will be observed (modified from Brooks (1988, 1989)):

1. The habitat must be suitable for rhinos, preferably with a previous history of a high density of black rhinos in the same area. Mean annual rainfall should ideally exceed 400 mm.

2. The poaching threat should not be severe, or if it is, effective control must be demonstrated. If rhinos are being moved to unrestricted or unfenced areas, the security, surveillance and monitoring in combination must be sufficient to demonstrate population growth despite occasional poaching of rhino.

3. The potential rate of increase of the rhino population in the recipient area should equal or exceed that of the donor area.

4. The total founder population should be at least 20 rhinos.

5. The carrying capacity should be at least 100 rhinos.

6. The number of founders should not exceed 50% of the carrying capacity.

7. There should be no known disease or other health risk to the rhinos; a known challenge to translocated rhinos by a particular disease must be monitored through research work designed specifically to each area of infection (e.g. section 6.4).

8. Current or proposed land-use must be compatible with conserving the species.

9. Smaller areas stocked (e.g. less than 200 sq km) should be fenced or have sufficent boundaries to prevent rhinos dispersing.

10. Owners of private land rhino sanctuaries must accept and adopt this plan.

11. The management authorities of Forest Reserves (Forest Department) and National Reserves (County Councils) with rhinos must accept and adopt this plan, and have agreements on security of specific rhino distribution areas drawn

up with KWS. For forest reserves, these must additional to the existing Memorandum of Understanding between the Forest Department and KWS.

All present black rhino populations and their areas/habitats will also be assessed using the present ARSG and RMG guidelines, listed in Annex 6. Present and future private land rhino sanctuaries will also be assessed using criteria listed in Annex 3.

4.5.3 Priority future conservation areas

The areas listed below will be priority areas for initial or further stocking with surplus black rhino from sanctuaries within the next five years and conservation of black rhinos in the long term, together with current rhino sanctuaries and conservation areas. Each satisfies the selection criteria (section 4.5.2, above), and other areas will be considered for approval by the KWS Director, if they also satisfy these criteria.

National Parks and Reserves:

Aberdares NP: eastern sector of Salient (Treetops area); northern area: Chebuswa

Tsavo West NP: Ngulia rhino sanctuary periphery; Ngulia valley/Ndawe areas

Tsavo East NP: southern release area; northern release area: Yatta plateau

Masai Mara NR: western sector/unoccupied range; Musiara/Njakatiak, Mara Triangle

Meru NP: western and northwestern areas: Kindani area

Forest Reserves:

Aberdares: northern area (Chebuswa/Phase III area); Karameno FR (Phase II area)

Mt Kenya: Kihari Hill, Sirimon areas

Ngare Ndare: stocking with dispersal/future surplus of rhinos from Lewa Downs ranch

Private Land:

Ol Pejeta Ranch: Completion of stocking of Sweetwaters rhino sanctuary

Lewa Downs Ranch: Completion of stocking of entire ranch

The stocking of Forest Reserves (e.g. Kihari, Karameno) is dependent on construction of adequate fencing of reserve boundaries (see section 7.2), and implementation of adequate security in the enclosed areas. The latter will require rhino surveillance team(s) based in the same areas, and close monitoring of human activities which may be permitted within forest reserves (e.g. collection of firewood). Security standards on private land must be adequate before any rhinos are translocated from donor private

land rhino sanctuaries.

4.6 Maintenance of genetic diversity

The following guidelines will be observed:

1. New rhino populations will be founded by at least 20 rhinos, preferably unrelated breeding animals.

2. Founder populations will be allowed to expand as fast as possible to numbers not exceeding the carrying capacity of the area.

3. 1-2 rhinos (unrelated animals) will be moved into each population every generation (ca. 10 years). This will involve the movement of rhinos between small sanctuary populations, as well as the capture and translocation of outlying unprotected rhinos into sanctuaries.

4. Genetic management (equating to 3.) may also be achieved by removal of (old) breeding males, and allowing succession of breeding to other, preferably unrelated adult males already present in the population. Males removed could be used in stocking new (unfenced) release areas.

4.7 Black rhinos on private land

All black rhinoceros in Kenya, including all those held on private land, are state-owned, and no sale or purchase is permitted. The Kenya Wildlife Service will make and implement all decisions necessary to their survival in Kenya, in particular for the maintenance of sufficient security. No transfer of black rhino between properties will be permitted without permission of the Director, KWS. Assessment of each existing and future private land rhino sanctuary will be made using specific criteria, listed in Annex 3 to this plan.

The substantial past investment and efforts of the private sector in conservation of black rhinos are recognised, particularly those made during the periods when rhinos were being decimated within National Parks and Reserves. The holding of secure populations of black rhino on private land is regarded as an important 'insurance policy' for those rhinos held in National Parks, Reserves and other areas of state land (and vice versa). The present total of 132 black rhinos held on private land will be regarded as a minimum total holding in this land category. However, no future translocation of rhino will take place from National Parks and Reserves to private land except in cases where individual rhinos are required to satisfy genetic or demographic needs (e.g. section 4.6: point 3.). Private land rhino sanctuaries may only be stocked with rhinos from other private land rhino sanctuaries, or with isolated, inviable outliers.

Assuming all the criteria for holding black rhino on private land are satisfied (sections

4.5.2; Annex 3), and the areas rank sufficiently high in priority over National Parks and Reserves for receiving rhinos in the first place, private land owners will be encouraged to generate funds for their protection and management, particularly through wildlife-based tourism in these areas. The objective is to enable private ranches holding black rhinos to attain at least self-sufficiency, and ideally to profit from their presence.

4.8 Economic and tourism potential

All black rhinos in Kenya are important and valuable animals for tourist viewing, and, as one of the 'big five' game species, provide as much viewing satisfaction to visitors as does the elephant, lion or leopard; this factor has probably increased with the rhino's endangered status and general scarcity. However, the best rhino habitats are generally areas of dense bushland or forest, where rhinos are unlikely to be sighted by visitors, unless the rhinos are attracted to particular lodges or viewing sites (e.g. The Ark Lodge in the Aberdares NP Salient). In general, the more open the habitat and the higher the density of rhinos, and in particular, the more habituated the rhino are to tourist vehicles, the more rhinos are likely to be seen by paying visitors and therefore the more valuable they are for tourist viewing.

Of the estimated 420 black rhinos in Kenya, only about 160 animals are likely to be regularly seen in the KWS National Parks and Reserves. These include (in rough order of viewing probability):

Nairobi NP	60
Masai Mara NR	30
Aberdares NP (Salient)	30
Lake Nakuru NP	30
Tsavo West NP (Ngulia RS)	10
Amboseli NP	5

It is difficult to assess how much tourism revenues from different Parks are dependent on the presence, and more importantly, the visibility of black rhinos. But there must be a major contribution to gate revenues from these, particularly when the areas are known and publicised as rhino sanctuaries. Lake Nakuru NP gate receipts have climbed steadily since 1987 when rhinos were introduced from Solio Ranch. One can virtually be guaranteed a sighting of black rhino in Nairobi NP because of their high density and the particular tameness of several well-known rhinos. Given the rhinos viewing value, the policy for managing rhinos and moving rhinos between populations will be adapted to maintain high rhino densities in the present and future 'showcase' rhino sanctuaries, such as Nairobi NP and Lake Nakuru NP.

In order to reduce the potential negative impact on tourist viewing in areas with high rhino density, the intention is to select those animals for translocation which are more secretive, or with home ranges located in dense bush, where they are less accessible to tourist viewing. Many rhinos do become habituated to the presence of vehicles and general disturbance, and become in general much less aggressive; many of these are

well known by the drivers of tourist vehicles, and thus can almost be guaranteed to their clients. These popular rhinos are clearly poor candidates for translocation. In general, rhino numbers in prime viewing areas should not be adversely affected by translocations of surplus rhinos to other protected areas, as the densities at which rhinos are moved out should be large enough to ensure good viewing at management levels (section 4.4.1).

4.9 Future policy

It should be stressed that the policy of protecting and breeding up black rhinos in relatively small fenced sanctuaries has been, and will continue to be a vital holding action in sustaining the present modest, but real growth in black rhino numbers in Kenya. The present nine rhino sanctuaries only have a total capacity of approximately 600 rhinos (section 4.4.1: Table 7). The ultimate objective is to use the sanctuary populations as a 'breeding bank' of actively managed rhinos for provision of a continuous supply of surplus rhinos to restock the much larger, unrestricted areas of rhino habitat in National Parks and Reserves (e.g. Tsavo NP, Aberdares, Mt Kenya). It is these areas which are capable of supporting the minimum viable populations of rhino (e.g. 2,000 rhinos) which will no longer require active management in order to maintain their genetic variability, or reduce the probability of demographic instability or the high risk of minor catastrophes. To this end, emphasis and priority will be placed on management and translocation of rhinos which will lead to the establishment of large wild populations (N > 100 rhinos).

With the present low numbers of black rhinos in Kenya, it will not be desirable or justifiable to allow any kind of private ownership. At present the commercial interests of private owners may run contrary to the biological interests of such an endangered species. For example, in cases where a private land owner wishes to 'sell' rhinos to another party, lack of agreement on 'price' for transfer of rhinos between populations on private land may stall and prevent translocations which are desirable from a biological standpoint. In addition, purchase of rhinos in small numbers (e.g. individuals or pairs) would not conform with agreed principles of conservation biology for the species (e.g. founding new populations with at least 20 rhinos).

Once the species has attained sufficient numbers (e.g. more than 2,000 animals), it is conceivable that private ownership might be positively beneficial for further breeding and conservation of rhinos on private or communal land, where the animal achieves a recognised value which can be readily realised through tourist viewing or sale. KWS could also achieve significant revenue through such sale of rhinos, as now being practised (with appropriate and necessary conditions attached) by the Natal Parks Board in South Africa.

5.0 STATUS AND HISTORY OF BLACK RHINO POPULATIONS

5.1 National Parks, Reserves, State and Communal land

Summary statistics of Kenya rhino populations, their sex ratios and age distributions (section 2.0: Tables 1 and 2), and details of the history of rhino translocations to and from each area (section 2.1: Figure 3, Table 5) should be referred to when reading the following descriptions of the status and history of rhino populations and conservation activities in each area. Maps of each of the four KWS rhino sanctuaries (National Parks) are provided in Annex 1.

5.1.1 Nairobi NP

When Nairobi NP was gazetted in 1946, there were a few rhinos in the area, although most were only recorded as passing through. With further settlement in the suburban areas, some rhinos took up residence in the National Park, although only six were known to live permanently in the Park by 1962. From June 1963 to March 1968, 34 rhinos were moved by the capture unit of the Game Department into Nairobi NP from several highland and lowland areas of Kenya (Hamilton & King 1969), including Kitengela (5 rhinos), Kapiti plains (7), Nyeri Forest (4), Kiboko (2) and Darajani (8). Of these, 27 rhinos survived and established themselves inside the Park. Patrick Hamilton and John King counted thirty rhinos (+3) in the Park in August 1968. Further stocking of the Park took place from 1978-1980, when a further 10 rhinos were captured and introduced from the Nyeri Forest. Little information is available on the timing and composition of these particular captures and translocations, though some details were recorded by Mwenge & Associates (1980).

Little monitoring of the rhino population took place from 1970-1984, and ground counts by Wanjohi (1984) and Waweru (1985) estimated a total of only 30-35 rhinos. Although Waweru recorded an expanding population (seven calves out of the total of 30 rhinos (23% calves)), the total numbers seen indicated that there had been little if any growth in the population since stocking. There may well have been some loss from the population through animals wandering out of the Park and disappearing during the 1970's and early 1980's.

It became evident that substantial growth in the population had occurred when a WWF-sponsored survey of Nairobi NP in October 1988 (Goss 1990) individually identified a minimum of 55 rhinos, a total far larger than expected, also showing a large proportion (22%) of calves. The 1988 survey suggested that the earlier surveys of 1984-85 must have been underestimates, particularly of the number of rhinos resident in forest areas of the Park. This survey has been used as baseline information for subsequent detailed daily monitoring, which continues to date.

As outlined in the 1985 management plan (KRRP 1985), Nairobi NP was upgraded to rhino sanctuary status with the construction of a fence between the Carnivore and Cheetah Gate in 1988 (Phase I), and the completion of fencing along the western boundary (Main Gate to Mbagathi river) and southwestern corner (Phase II) in 1991.

Rhino surveillance and fence maintenance units were provided with vehicles and monitoring equipment, and have operated without interruption to date.

There are now 60 individually known black rhino in the Park. The present rhino surveillance team have recorded 22 births in the Park since the beginning of 1989 and only 2 deaths, and approximately 11% growth has been maintained over this time (Tables 4 and 12).

Since 1989 it has been recognised that the black rhino population of Nairobi NP is at, or exceeding its carrying capacity, presently estimated at 65 rhinos (Foose *et al* 1993; Table 7). Generally increased levels of fighting have been noted, with injuries sustained by several males in the last three years. Several rhinos continue to move out of the National Park to the south, typically at night. However, there has been little if any increase in the calving intervals or reduction in birth rates of cow rhinos; all cows except one had a calf at foot in 1992. In addition, two orphaned rhinos ('Sam' from the Masai Mara NR, and 'Amboseli') have been successfully raised by the Sheldrick Trust in the southwest corner of the Park, and these are now slowly integrating into the Park rhino population. A third orphaned female calf ('Scud'), born in Nairobi NP, is also being raised for future re-introduction.

Sixteen rhinos have been moved out of the Park between 1989 and the end of 1992 (Figure 3) to stock three other rhino sanctuaries, a number more than replaced by the 22 calves born within this period. Studies are ongoing to obtain information upon which an improved estimate of the carrying capacity for rhino in the Park can be made (see sections 4.4.1 and 6.2). Meanwhile the population will be managed between 50 (Management Level: see section 4.4.2) and 60 rhinos (density of 0.44-0.53 rhinos/km^2), and a series of translocations are planned to use the present 10 surplus Nairobi NP rhinos to complete stocking of Ngulia rhino sanctuary (Tsavo West NP), and subsequently to commence re-establishment of black rhino in Tsavo East NP (section 5.1.8).

If the offtake of rhinos from Nairobi NP is carefully managed, this Park could provide a substantial and continuous supply of rhinos for re-stocking Tsavo NP (as projected in Table 8), or other priority areas to be identified in southern Kenya in the future. With Solio ranch, Nairobi NP is one of the two most important breeding rhino sanctuaries which will provide further surplus rhinos for stocking other areas. Due to the generally open habitat, relatively high density and clear habituation to tourist vehicle activity and aircraft movements, black rhinos are a major attraction for visitors to Nairobi NP, where they are virtually guaranteed viewing and provide a major asset to the Park.

5.1.2 Lake Nakuru NP

Lake Nakuru NP was selected as a priority area for the development of a rhino sanctuary in 1983, and received top priority for funding and development in 1985 (Jenkins 1983a, 1985a, 1985b; KRRP 1985). Two adult indigenous animals (a pair, which never bred) were known to exist in the Park before the perimeter was ringed with an electric fence, and stocking commenced in 1987 (Figure 3). Firstly, one large adult

male was introduced from the Kitengela area outside Nairobi NP, and one adult male (originating from the Nyeri forest) was introduced from Lewa Downs. Then, in a successful operation which was carried out in four phases over three months, 15 rhinos were translocated into the Park from Solio ranch. In 1990, stocking was completed with a further four rhino from Nairobi NP, widening the genetic base of the founder population.

With the exception of one subadult (4-year old) female from Solio, which received serious fighting injuries in 1987 and was moved to Lewa Downs, all translocated rhinos have established themselves without problem. There was considerable initial concern over the mineral deficiencies that were known to exist in the area, and extensive studies from 1987 onwards (Jonyo *et al* 1988; Jonyo 1989; Maskell & Thornton 1989) described the nature of the deficiencies in soil and browse samples collected from throughout the Park. On the basis of these studies, mineral supplements have been provided at several points in the Park since.

Since 1987, the breeding record and general health of the introduced rhinos at LNNP have been excellent. Each of the seven female black rhinos translocated from Solio ranch (of which all except one were subadults at capture) has now had a calf, and one (the adult) has produced two. Of the three females brought to LNNP from Nairobi NP in 1990, one has already calved. Only one death (accidental) was recorded in 1991. There are now 31 black rhinos at LNNP. With the expectation of refinement after further ecological monitoring, the population will be managed between 50 and 60 black rhinos (density of 0.35-0.42 rhinos/km^2), whereby LNNP could eventually provide 5 rhinos for translocation every 2 years (projection of a modest 4.7% growth; see also Table 8).

There is concern over the potential effects of overpopulation of other browsers (e.g. Rothchild's Giraffe (*Giraffa camelopardalis rothschildii*)) and several grazers on the food reserves and habitat for the rhino. Considerable effort is needed to monitor and manage herbivore populations to the advantage of black (and white) rhinos as priority species for conservation and breeding at LNNP (section 6.2). Continuing pollution of Lake Nakuru with untreated effluent from Nakuru town is a major concern for the future conservation of this RAMSAR site, and of all the wildlife living in the Park, including rhinos.

If the habitat and food reserves for rhino can be maintained, LNNP should duplicate the success of Solio ranch and Nairobi NP as a highly successful rhino sanctuary. The increase of black rhinos at LNNP has started to repay the very large investment of the several donors and NGO's (section 5.3), and is so far the one clearly successful result of the Kenya Rhino Rescue Project (KRRP 1985) of the WCMD period.

Lake Nakuru NP has also been identified as one KWS protected area within which to develop a breeding population of white rhinoceros. A pair of white rhinos were introduced to LNNP from Solio ranch in 1990-91. Further translocation of white rhinos from Solio is planned for 1993, in order to establish a breeding nucleus. A total of six white rhinos were promised for LNNP by the owner of Solio Ranch in 1987, and a founder population of at least 12 (eight females, four males) will be sought.

5.1.3 Tsavo West NP (Ngulia RS)

Tsavo West NP was identified as a priority area for the development of a rhino sanctuary in 1983 (Jenkins 1983a), though the original choice of the Ol Turesh-Kitani area as a sanctuary was ruled out due to gross habitat change. Although it did not appear in the published Kenya Rhino Rescue Project Plan (KRRP 1985), the Ngulia-Kichwa Tembo area was subsequently chosen for development of a fenced sanctuary (Hamilton & Woodley 1985a, 1985b). The Ngulia area was one of the two strata of very high density (1-1.5 rhinos/km^2) recorded by John Goddard during his aerial surveys of Tsavo rhinos in the late 1960's (Goddard 1969, 1970a).

Due to pressure to rescue several highly vulnerable rhinos at Kibwezi in 1985-6, a small 3 km^2 area was fenced below the Ngulia escarpment, into which three females from Kibwezi were released. After extension of the sanctuary to 20 km^2 in 1987, three further females captured from the periphery of Tsavo (Taita: Bura/Luoleni ranch) were released. Final extension of the fenced area to 65 km^2 was completed in 1990, and three piped water holes fed from a single borehole and a spring on the Ngulia/Kalanga escarpment, have been installed across the sanctuary. A further 10 rhinos (one isolated rhino from Tsavo West NP, one from Ol Jogi ranch, eight from Nairobi NP) have been introduced into the sanctuary to date. Since 1986 there have been two break-outs of rhino from the fenced area after release (two females: 1987, 1992) and one break in (one adult male in 1986).

The objective of the low electric fence (one metre high) at Ngulia differs from all other existing rhino sanctuary fences, in that it is not permanent, and is designed purely to contain and establish a breeding nucleus of rhinos in one area. Once a sufficient founder population has been established and breeding has commenced, the fence will be removed, and the sanctuary population can merge with the remnant rhino population living outside the sanctuary, particularly in the Ngulia Valley and Ndawe escarpment areas. Elephants confined inside the sanctuary fence are causing appreciable habitat change around the three piped waterholes; due to this, and with the scheduled establishment and completion of stocking of the Ngulia sanctuary with 20 rhinos (density of 0.31 rhinos/km^2) or more by the end of 1993, progressive removal of sections of the fence will commence from the end of 1994.

Due to the dense bush cover, monitoring and surveillance of the Ngulia rhinos has always proved very difficult, with efforts to census the rhinos initially confined to footprint identification (Brett 1987, 1988a). One rhino was poached in the sanctuary in 1989, and the status of the rhinos inside the fence was unclear for some time, with the likelihood that more rhinos had broken out of the fence. It has now become clear that the only reliable method of monitoring and confirming the presence of the Ngulia rhinos is through surveillance and photography of rhinos during the dry season at night during full moon periods (as described by Cilliers (1989)). Full-moon monitoring from July-October 1992 confirmed the presence of 11 of the expected 12 rhinos inside the fenced area. Four calves have been born in the sanctuary since 1986; the present density is 0.25 rhinos/km^2.

Extensive monitoring has been undertaken on the distribution and densities of tsetse flies in the Ngulia sanctuary, and infection with trypanosomes of eight rhinos translocated from Nairobi NP during 1990-92 (Mihok *et al* 1991). This work has confirmed the ability of rhinos of highland origin (section 2.1) to build up resistance to these infections without need for treatment if they are maintained in good condition during translocation and holding. Further translocations will be carried out when tsetse fly densities and trypanosomiasis challenge are low to moderate, and when browse condition is good, so that translocated rhinos can be fed well during the holding period prior to release. Portable metal holding pens are being used to release rhinos in suitable areas, both for reduced initial tsetse/trypanosomiasis challenge, and in order to release successive groups of rhinos into unoccupied ranges inside the fenced area.

5.1.4 Aberdares NP

The Aberdares forest was known to hold one of the highest densities of black rhino in Kenya in the 1940's and 1950's, with densities of at least one rhino per km^2 estimated (Woodley pers comms). Rhinos were a considerable hazard for security forces operating in the Aberdares forests during this period. Most of the forested areas and suitable rhino habitat are found outside of the National Park in the forest reserves at lower altitudes surrounding it, though large numbers continue to be found in the 70 km^2 Salient to the National Park.

During the late 1970's and early 1980's the Aberdares forests suffered extensive illegal hunting of rhinos, particularly from poachers using packs of dogs. Snaring was and still is a significant problem in the area. The tourist lodges in the Salient (Ark and Treetops) had always been visited by large numbers of rhinos, but the decline in the rhino population was also witnessed here, particularly at Treetops. The rhino population in the Karameno forest area was completely eliminated during this period. Estimated rhino numbers in the National Park fell from 450 in the early 1970's to 132 in 1982, and down to 30 in 1987 (Sillero-Zubiri & Gotelli 1991). The last major outbreak of rhino poaching in the National Park was in 1984.

The only other potential threats to the rhino population in the Aberdares are predators (spotted hyaena (*Crocuta crocuta*) and lion (*Felis leo*)); high populations of hyaena around 1986 (Sillero-Zubiri & Gotelli 1991) resulted in at least one calf mortality, and the removal of the ears and tails of several other rhino calves, the signs of which are still seen in today's adults (see also Hitchins (1986)). No case of predation on black rhino by lions in the Salient have be witnessed.

The Aberdares NP Salient was identified as a priority area for the development of a rhino sanctuary from 1983 onwards (Jenkins 1983a, 1985a; KRRP 1985). An ambitious plan was drawn up to fence the entire National Park, funded and coordinated by the charity Rhino Ark (Kuhle 1989; see also section 5.3: Tables 9 and 10). Phase I of this plan, fencing of the Park boundary of the Salient, was successfully completed in 1990. It became clear that further phases would have to follow the forest reserve boundary outside the National Park, to include the main areas of potential rhino habitat inside the fenced area. The fences have been designed more as a general barrier to wildlife from

leaving the park/reserve and raiding crops in settlement areas outside, particularly to elephants, baboon, and burrowing wildlife (porcupines, bushpigs). To this end, Boral ring-lock mesh wire, buried to 3 feet deep, has been a key component of the Aberdares fence, in addition to anti-baboon devices in particular sectors.

Most of the present information on the Salient rhino population is derived from sighting records at the Ark and Treetops lodges. Over 26 rhinos were individually identified and photographed during 1987 (Hardy & Aggett 1987). More recently 31 different rhinos have been identified at the lodges during June-July 1991. This monitoring exercise has continued intermittently despite the lack of a rhino surveillance unit, and over 40 rhinos are now individually identified in the Salient. Five new calves were noted during 1991, as well as three further births and three deaths which were recorded in 1992.

At present a conservative total of 50 black rhinos in the Salient is assumed, not including an additional four rhinos resident in the Chebuswa area of the northern Aberdares NP. An accurate figure for the total number of black rhinos in the Aberdares cannot be derived, but is likely to be between 50 and 60 animals. There is clear evidence of good breeding, with mating and courtship recorded on several occasions. An accurate census of the population will only come after at least another year of intensive monitoring of the Salient and surrounding areas, based on individual identification work at hides placed at salt licks, in addition to, and including those at the present lodge sites.

With approximately 50 rhinos in the Salient, and evidence of some rhinos moving out of the area, to avoid any fighting with residents it would be most prudent to introduce more rhinos to low-density, peripheral areas of the Salient, and allow the rhinos within the Salient to breed up to higher numbers (Table 7: 24% calves (1992)). The area around Treetops, the new sub-HQs, the Karameno area to be bounded by the Phase II fence, and the Chebuswa area to be bounded by the Phase III fence are thought to be the most suitable areas for release of further rhinos (e.g. surplus from Solio ranch).

Adequate security, fencing and monitoring are essential conditions for introduction of black rhinos to the enclosed National Park and forest reserve areas (e.g. Chebuswa, Karameno), which could absorb very large numbers of surplus rhinos from Solio ranch. As a first step, trial releases of 2-3 rhinos into selected areas of the Aberdares bounded by the new fence line will take place from 1994 onwards. Further introductions will follow into these areas of the Aberdares NP and forest reserves. These will depend on the results of the initial releases and subsequent intensive monitoring of the rhinos' movements, including the use of radio-telemetry, and accumulation of better knowledge of the distribution and numbers of rhinos in the Salient, and also in the Chebuswa area of the northern Aberdares NP.

5.1.5 Masai Mara NR

This area contained large numbers of black rhino in 1958, when Sheldrick and Fraser-Darling counted over 150 animals. John Mukinya of the Game Department individually identified and studied the home range patterns and feeding behaviour of 108 rhino

inside the Reserve in 1971-72 (Mukinya 1973). Poaching reduced numbers to fewer than 13 rhino by 1985.

A sanctuary area was proposed for the Masai Mara (Jenkins 1983a, 1985a), but this was never implemented. However, an improved rhino surveillance operation funded and largely directed by FoC and WWF personnel since then has resulted in a dramatic improvement in the situation. In spite of generally less than adequate levels of security, the Mara black rhino population has increased rapidly in numbers (Table 4) to a present total of 32 animals, of which at least six are known to move back and forth across the international border into Tanzania (northern Serengeti NP). Breeding success has continued, with six calves born in the last two years.

The only poaching in the last nine years occurred in 1988, when 'Halima' a well-known cow rhino, resident in the Musiara area, was shot. This animal had lost her first two calves to predators (lion), and her third calf 'Sam' was moved to the Sheldrick Trust at Nairobi NP in 1986 for its own survival, after further repeated attacks by lion.

With adequate security the Mara rhino population will continue to grow, and it already provides an excellent example of how a small number of rhino, survivors of periods of serious poaching, can recover to reasonable numbers with improved rhino surveillance and security alone. Ideally there will soon be some migration of rhino across the Talek to recolonise some of the thickets north of the river (and also satisfy the demand for rhino-viewing by tourists in the Musiara area).

The single subadult female living north of the Talek river ('Naishuru', the last calf of 'Halima') did cross the river to the south in October 1992, and stayed for one week in the Olmisigiyoi area. It is hoped that she will regain contact with the numerous rhinos in the latter area with future excursions. As she is only 4 years old there is little prospect of this rhino breeding for at least another two years, in which time she may have moved south, or perhaps other rhinos will have moved north. For the present there will be no need to move another rhino to release in her present range, specifically to provide a mate. However, if breeding contact is not made with other rhinos within two years, potential mates should be moved in. A larger re-stocking exercise for some areas of the Mara should also be contemplated in the future, which should be centred on the Musiara/Njakatiak area, and possibly also the Mara triangle.

5.1.6 Matthews Range - Kitchich - Ngeng Valley

The Matthews range still has an important indigenous black rhino population, although it appears to be somewhat fragmented, and composed of several smaller sub-populations, some of which are clearly isolated from the largest grouping in the central Kitchich/Ngeng Valley area. The area is relatively remote and vulnerable to poaching by bandits from the east of Kenya, particularly so for rhinos that have tendencies for dangerous wandering out of the hills to the bushland to the east and northeast of the range. Several of these peripheral, isolated rhinos were captured and translocated to the Lewa Downs sanctuary in 1984-5 and 1990.

Security at Kitchich has been improved significantly in the last two years, and the rhino surveillance officer is slowly building up an identification file of the black rhinos in the area. In addition to the estimated 17 rhinos in the Matthews range, 3 rhinos have been monitored in the southern Ndotos at Keno, including a female and calf, and one adult bull which wanders very widely in this area (to Losai NR and Laisamis); this animal will be captured in early 1993. The rhino surveillance staff continues to monitor an isolated group of six rhino on the east side of the Karissia Hills, which also moves between there and the Matthews range. In October/November 1991, monitoring work confirmed that nine individual rhinos live close to the Kitchich station, with a further five at Ngare Narok at the north end of the Matthews range (including one calf). How much movement of rhinos there is between these two areas is not clear.

The staff at Kitchich, presently consisting of seven KWS rangers, eight armed subordinate staff, five Eden Trust rhino scouts, and one driver, are well motivated, operate in difficult conditions and would benefit from more attention and encouragement. Continued efforts to improve security and intelligence gathering through strengthening this station are required, together with a build-up of knowledge of the black rhinos in the area. With adequate security, it is hoped that the Matthews rhino population will increase in a similar manner to the Masai Mara NR rhino population, although the possibly low level of breeding contact between the Matthews rhinos may result in slow increase in numbers at best.

5.1.7 Loita Hills

Similar in many respects to the situation in the Matthews range, the Loita Hills hold a population of black rhino thought to number 14 animals. Equally, this population appears to be fragmented into smaller groups with limited breeding contact. The employment by FoC and the Eden Trust of local Masai rhino scouts in the area has been an undoubted success, particularly in developing a feeling of ownership of these rhinos by the local community. However, much more information on the Loita rhinos is needed, particularly in order to confirm the numbers and distribution of rhinos, and establish their age structure, sex ratio and breeding prospects. Ideally, sufficient information would be forthcoming to detect all calves born at an early stage, and establish the movements of some individual rhinos and how cohesive the total number of rhino in this population is.

There is some evidence of breeding taking place in the area, with at least one calf born in the last two years. In addition, there has been some evidence of rhinos moving between the Masai Mara NR and the Loita hills area. The objective is to maintain the surveillance and protection of these rhinos, and improve monitoring information. Continued employment of Masai rhino scouts could simultaneously increase the participation of the local community in the conservation of these rhinos, perhaps through the development of revenue-earning capacity based on tourism.

5.1.8 Other populations and outliers

A small area at Kindani/Kanjo in the northwest of **Meru NP** was developed as a rhino

sanctuary in 1988 by the Eden Trust, enclosed by a low electric fence identical to that of the Ngulia rhino sanctuary in Tsavo West NP. It was believed that a remnant cow and calf from the National Park had been enclosed by the fence when it was completed. A further adult male was captured in the Park and moved into the sanctuary in 1988, as was a breeding male from the Lewa Downs rhino sanctuary.

Due to lack of any security, surveillance or monitoring within and outside of this fenced area, the Meru rhino sanctuary proved to be a fiasco, and served as an example of how capture and enclosure of black rhinos in an unprotected area can backfire, by effectively presenting poachers with rhinos which were easy to locate and kill. All of the rhinos and several elephants were shot inside the sanctuary in 1988-89, the same period in which the remaining herd of five white rhinos at the Meru NP headquarters were shot by poachers. The Meru sanctuary was abandoned in 1990, and the fence was moved to enable the extension of the Ngulia sanctuary fence in that year.

No rhinos remain in the Meru area, the last rhino being an isolated female which died on Kiagu hill, Tharaka, in 1991. Superb rhino habitat remains in Meru NP, however, and re-introduction of black rhinos to Meru can be planned as soon as security can be guaranteed for rhinos within the National Park, particularly in the west or northwest, where release and re-establishment of black rhinos would be most suitable. This should take place following trial releases of black rhinos in Tsavo East NP.

Tsavo NP (West and East) still contains remnant groups of black rhinos which have persisted to the present, and have avoided poaching through living in remote or inaccessible areas, and through being extremely shy and/or nocturnal and difficult to locate. For these same reasons it has proved difficult to locate these rhinos for capture and translocation to the Ngulia rhino sanctuary. Several of these isolated rhino have moved over very large areas, and although good at avoiding being poached, it is thought that few of them have maintained sufficient breeding contact for small groups or pockets to increase in numbers.

The 1988 rhino census (Goss 1990) located 8-11 rhinos in the Ngulia-Ndawe-Muganga areas of **Tsavo West NP**, with some neighbouring the Ngulia sanctuary. No rhinos were located in Tsavo East NP. Since then 3-4 further isolated rhinos have been located in the Mzima Springs and Mangalete areas of Tsavo West NP, and two isolated animals have been sighted in Tsavo East NP. Further census and assessment of the Tsavo rhinos is required in 1993, particularly in order to decide whether to capture isolated individuals and move them to the Ngulia sanctuary, or to leave groups which are maintaining breeding contact alone and protect them *in situ*.

After completion of stocking of the Ngulia sanctuary with 20 rhinos in 1993, and some time to ensure commencement of breeding inside, the fence will be taken down in stages to allow further colonisation of the peripheral areas, and breeding contact with the remnant rhinos in the Ngulia/Ndawe areas. Further rhinos may be added to the partially fenced area from Nairobi NP or Solio ranch.

One location in southern **Tsavo East NP** has been selected as a site for re-introduction

of black rhinos, initially through experimental release of 2-3 rhinos translocated from Nairobi NP, followed by intensive monitoring of their movements and behaviour. This operation will test the feasibility of establishing large numbers of rhinos (> 20 rhinos) each in two selected areas of Tsavo NP without the need for electric fencing; also for further releases in the initial area selected to result in adequate founder populations with good prospects for further increase and successful recolonisation of rhinos within the huge potential dispersal area.

The establishment of large secure breeding nuclei in several areas of Tsavo NP have the best prospects of eventually producing a large wild population numbering over 100 rhinos (as already achieved in the restocking of Kruger NP with rhinos translocated from the Natal Parks and Zimbabwe (Hitchins 1984)). Given adequate security, the potential of Tsavo NP for holding at least 5,000 black rhino (as Goddard 1969, 1970a, 1970b) still exists.

Mt Kenya (NP and forest reserves) is believed to hold 10 black rhinos, located in two groups: one in the immediate area of **Kihari** hill (five rhinos) and the other in the **Sirimon** area (five rhinos, although these appear to be fragmented into isolated individuals over a wide area; see also Goss (1990)). Given improved security and surveillance, and in particular, the construction of an electric fence (similar to that of the Aberdares) along the forest reserve/settlement boundary to the west, the Kihari area has good prospects for re-introduction of rhinos from Solio ranch, to add to the existing group of rhinos in this area, and found a viable breeding nucleus. Trial release, establishment and monitoring of rhinos at Kihari hill are planned for 1994-96, though fencing of the western forest reserve boundary and placement of adequate security and a rhino surveillance unit are preconditions for this. The Sirimon area rhinos require improved surveillance in order to decide whether to capture and translocate them (e.g. to Kihari area, if feasible), or to protect them *in situ*.

Amboseli NP and the surrounding areas contained well over 100 rhinos before the 1980's, including several famed for the prodigious length of their front horns (e.g. 'Gertie'). In 1974-75 the warden, J M Kioko, counted more than 36 rhinos in the National Park alone. The decline of the Amboseli rhinos through poaching, largely through spearing by local Masai, has been well documented (Western & Sindiyo 1972; Western 1982). The dissatisfaction of local people with restrictions imposed on their movements and use of resources within the National Park was a significant factor.

The decline through poaching has continued to the present, although there were some signs of a recovery of the population in the mid-1980's. In 1991, three rhinos were poached within the National Park. After these deaths, there were four rhinos remaining in the Amboseli area, of which two continue to move into Tanzania on the slopes of Mt Kilimanjaro for long periods. The single young adult female remaining inside the Park at the end of 1991 gave birth to a calf in 1992, bringing the total to five. The fifth rhino is a large adult male which wanders widely within and outside of the National Park.

Due to overriding local political considerations it has been decided to leave all these rhino in Amboseli NP, in spite of the fact that they have no future there by themselves,

and from all biological considerations, should be moved to another rhino conservation area. Serious degradation of rhino habitat has taken place, and no re-introductions of rhinos to Amboseli can seriously be contemplated until security has been significantly improved inside the National Park and the surrounding areas, and the habitat has recovered sufficiently for the species to thrive (see also section 4.4.4).

The remaining Amboseli rhinos could form part of a future re-introduction of the species to Amboseli when conditions become suitable. If and when this were undertaken, the re-introduction should be done with sufficient numbers (> 20 rhinos) to guarantee some future prospect of long-term viability for the population, independent of provision of adequate security. If viewing value and community relations are the only considerations that remain at present for rhinos at Amboseli, the Park could conceivably be stocked only with surplus males from other sanctuaries.

Information, reports and/or sightings of very small numbers of rhinos, often isolated individuals, have been obtained from outlying areas of Kenya in the last two years. These include the **Tana River District**, where up to eight rhinos were thought to exist in 1991, based on informers' reports. Due to breakdown of security in this region, it is unclear at present whether these animals are still alive. Rescue capture and recovery of these rhinos is likely to be impossible without the use of a helicopter (e.g. Puma, Sea King) capable of lifting at least 3 metric tonnes (i.e. a rhino plus crate). The alternative is to protect these rhinos *in situ*, ideally within the proposed Tana Delta wetlands National Reserve or Park.

At least one other rhino was located in 1989 near the Kenya coast at **Jilori-Chacama**. Other outliers reported since 1989 include two rhinos at the north end of the **Chyulu hills** range, and at least two rhinos located in the north of **Wajir District**, in the Bute region southeast of Moyale. These animals are so remote they may be unrecoverable, although attempts will be made to locate them for capture and translocation in 1994, along with other inviable outliers (section 7.1.1).

5.2 Private land rhino sanctuaries

The private sector rhino sanctuaries have played an essential role in conserving black and white rhinos in Kenya, particularly since 1970. Private land rhino sanctuaries have been an important back up to the conservation of black rhino in National Parks and Reserves, particularly when security for rhinos became non-existent in several areas during breakdown of discipline within the WCMD during the late 1970's and early-mid 1980's. In several cases ranch owners have funded and managed their rhino sanctuaries without any assistance from the Wildlife Department or NGO's, and with considerable success, in spite of the fact that none of the black rhinos in Kenya are privately owned.

About a third (132 rhinos) of the total number of black rhinos in Kenya, and all but two of the country's white rhinos were located on private land at the end of 1992. Twenty-one black rhino births were recorded on private land during 1991-92. Maps of each of the

five private land rhino sanctuaries are provided in Annex 1.

5.2.1 Solio Ranch

Solio ranch has been the most successful of any rhino sanctuary in Kenya by a substantial margin, this success achieved entirely at the owners' expense. As a result it has served as a model for fenced rhino sanctuaries, followed subsequently by other areas (e.g. Lake Nakuru NP, Lewa Downs). The Solio reserve was stocked with 23 rhinos between 1970 and 1980, which originated from a variety of areas, including 11 rhinos captured and translocated from neighbouring ranches which were being subdivided for settlement at that time (Figure 3, Table 5). By 1986, at least 80 black rhinos had been bred up within the 65 km^2 reserve (Table 12), with population growth rates exceeding 10% per annum for much of this period (Table 4). Overstocking was recognised at this time, made evident through marked removal of whistling thorn (*Acacia drepanolobium*) from many areas of the reserve which held rhino densities far exceeding 1 rhino per km^2. The high rhino numbers were clearly overbrowsing the food reserves available.

From 1984 to 1990, 30 black rhinos were captured on Solio and moved to four other rhino sanctuaries (Figure 3), including the important initial stocking of the Lake Nakuru NP rhino sanctuary with 15 black rhinos in 1987. A photographic census of the Solio black rhinos in 1989 (Brett 1989b) identified a minimum of 60 rhinos, and showed that high breeding output had continued despite the clear overbrowsing of the reserve which had taken place. Rapid breeding has continued since, with another 11 rhinos born in the reserve in the last two years. Further removals or harvesting of rhinos from the Solio reserve will be necessary to maintain the present breeding rate and food resources.

An extension of approximately 13 km^2 to the Solio reserve was completed and opened in 1991, which contains almost continuous closed and unbrowsed rhino habitat. This area has already absorbed at least 10 black rhinos from the main reserve, and will take some pressure off the rhino browse in general, in addition to the effects of several planned translocations of rhinos out of the reserve in 1993-94. These include the translocation of eight rhinos each to complete the stocking of the Ol Pejeta and Lewa Downs rhino sanctuaries, and the commencement of additions of rhinos to National Parks and Reserves (Aberdares, Mt Kenya and Tsavo).

5.2.2 Ol Ari Nyiro Ranch

This ranch (also known as Laikipia ranching) was thought to contain at least 60 indigenous black rhinos before 1987, protected by the ranch management at the owners' expense, with substantial assistance from donors (WWF and EAWLS). Improved security followed serious depletion of the rhino population through poaching by Pokot people from 1978-80. A subsequent monitoring project estimated 43 rhinos in the area (Brett 1988b; Brett *et al* 1989), and determined the movements of a number of rhinos through radio-telemetry, including some rhinos which wandered widely off the ranch into areas vulnerable to poaching. The sex ratio of the population appeared strongly biased towards males, and low calving rates were noted. Only one rhino is

known to have been poached on the ranch since 1987.

One rhino calf was born on the ranch in 1991, but as in the past years breeding output has remained low and several rhinos have wandered off the ranch to the north, west, and possibly the east of the ranch since 1988. Three Ol Ari Nyiro rhinos were resident in the north part of **Luoniek ranch** at the end of 1992, including a cow and calf, and one adult male. The present estimate of rhino numbers on Ol Ari Nyiro is less than 30, as a result of these excursions of rhinos out of the ranch and their subsequent disappearance, and possible overestimate of the population size in 1980/81 and 1987/88.

In order to prevent further loss of rhinos from this population there is a need for the construction of barriers along ranch boundaries in order to contain all rhinos within the ranch. Equally, a thorough resurvey of the rhino population is needed, together with an assessment of its conservation needs. At present, the population appears to be in danger of fragmenting as the rhinos of both sexes continue to disperse. Introduction of additional female rhinos (e.g. from Solio ranch) could improve overall breeding output, and the capture of the isolated rhinos on Luoniek ranch and their translocation to a small fenced enclosure at the south end of Ol Ari Nyiro is planned for early 1993.

5.2.3 Lewa Downs Ranch

The Ngare Sergoi rhino sanctuary was developed in 1983 (Jenkins 1983b), initially a fenced segment of 20 km^2 of the Lewa Downs ranch, which was doubled in size four years later. Entirely at the expense of the founder/funder, Mrs A Merz, Ngare Sergoi was constructed and initially stocked with three isolated and vulnerable rhinos captured from several areas to the north (Wamba, Ol Donyo Sabachi, Shaba NR), and also with five rhinos from Sangare Ranch (Nyeri district) and the periphery of Nairobi NP. Three females were added from Solio ranch in 1984 (Figure 3) to make a total of 11 rhinos.

Although the security and management of the Lewa Downs sanctuary have been consistently of a very high standard, the area has suffered frequent misfortune, together with the general effects of a relatively dry area on enclosed wildlife, including black and white rhinos. With a sex ratio biased strongly in favour of females, and with individual dominant bulls showing intolerance to other introduced rhinos (adult and subadult males, and a subadult female), six black rhinos have been killed as a result of fights. Fortunately ten calves have also been born. The subsequent translocation of several male rhinos in and out of the sanctuary (Figure 3) has not resulted in resumption of regular breeding by all of the adult females. At present there is no adult male inside the fenced sanctuary, although the young adult male moved out onto the main ranch in 1991 showed signs of his potency when one of his matings resulted in a calf born towards the end of that year.

The drought susceptibility of the Lewa Downs sanctuary has been recognised. The Ngare Sergoi sanctuary in its present size is not viable in the long term and does not have sufficient capacity (Foose *et al* 1993). In order to make the Lewa Downs rhino population viable for the future, more habitat needs to be made available for the rhinos,

both black and white. To this end, Lewa Downs ranch has recently fenced the entire ranch as a rhino sanctuary/wildlife conservancy (total area: 161 km^2), and the carrying capacity and prospects for the Lewa Downs sanctuary are much improved. An adult male will be moved into the Ngare Sergoi sanctuary in early 1993, and stocking of the entire ranch area will be completed with the translocation of eight more rhinos from Solio ranch and Nairobi NP, also during 1993. Subsequently the internal sanctuary fence will be removed to allow the rhino populations to merge and only be restricted by the peripheral ranch fence. Colonisation of the newly-fenced Ngare Ndare forest reserve (area: 52 km^2) with rhinos moving there from Lewa Downs will also be possible, and the carrying capacity of the total area (213 km^2) will rise to over 100 black rhinos.

5.2.4 Ol Pejeta Ranch

Due to its proximity and close similarity in habitat and conditions to the Solio ranch reserve, the Sweetwaters game reserve on Ol Pejeta has an equal if not greater potential for protecting and breeding up large numbers of black rhinos. Developed in 1988 (Brett 1988c), the reserve has been only partially and intermittently stocked with eight rhinos from Solio and four rhinos from Nairobi NP. Of these, two rhinos (four year old females) have been killed in fights with resident adult bulls, and one bull died after, and as a result of capture and translocation to Ol Pejeta from Nairobi NP. Two calves have been born, of which one has survived.

Including the single ex-orphan adult male 'Morani', which is maintained separately within a small enclosure, Sweetwaters now has 11 rhinos, and requires further stocking to reach a total of at least 20 animals. At least eight rhinos will be translocated to Ol Pejeta from Solio in 1993-94. There is a risk of further mortalities from fighting between introduced rhinos and resident adult males. Careful selection of the age and sex of introduced rhino (see section 2.1), and of release sites, should minimise this risk. If adequate stock can be introduced, the Ol Pejeta sanctuary can be expected to breed up to at least 70 rhinos before approaching the carrying capacity of the reserve.

Due to the present negative effects of approximately 80 elephants within the sanctuary, both on maintenance of the perimeter fence and on browse and cover available to black rhinos in the longer term, the removal of most of the elephants from inside the rhino sanctuary is essential. For the present the numbers of elephants in the sanctuary will be halved, if practicable, to 40 animals. The effects of this removal and the impact of those elephants remaining on the vegetation and behaviour of rhinos in the sanctuary must be monitored. Judging from the experience gained on Solio ranch, which excluded all elephants during the late 1970's, no more than a few elephants are compatible with a fenced rhino sanctuary which is to stand any chance of success.

5.2.5 Ol Jogi Ranch

The Ol Jogi black rhino population, presently 12 animals, was founded by three rhinos in 1979: an adult male captured in the Ol Jogi area, and two adult females, captured at Kibwezi by, and purchased from, the game trapper Carr-Hartley (Figure 3). These rhinos were de-horned and held in a small enclosure prior to their release into the 50

km^2 Pyramid reserve in 1980. Since then the breeding trio have bred exceptionally fast, with nine calves born between February 1980 and the present. The first female born in the reserve ('Malaika') in turn gave birth to the tenth calf born, which died soon after birth. This female has since calved once more. Seven out of the nine calves born to the two original females have been males. Only one other rhino, a subadult female from Solio, has been successfully introduced to this population. The oldest calf, a male born in 1982, was removed to the Ngulia sanctuary after it had killed two introduced white rhinos in 1989.

Due to the extreme drought susceptibility of the ranch, the over-utilisation by large numbers of herbivores, particularly grazers (Waweru 1991), and the general lack of management in the reserve directed at maintaining habitat, there is continuing concern about the viability of this area as a rhino sanctuary (also expressed in Foose *et al* 1993). However, it is fortunate that the black rhinos themselves do not appear to be showing any noticeable adverse effects on health and condition as yet, though continued over-utilisation at all browse levels (e.g. by giraffe) will eventually have a negative impact, particularly if browse reserves are seriously depleted. The carrying capacity of this reserve for rhinos is presently only 20 rhinos.

In addition, there is a potentially very serious inbreeding problem developing, where father-daughter, mother-son and brother-half-sister matings are likely to have already occurred. The calf which died, mentioned above, was the offspring of either a father-daughter or brother-half-sister mating. Because of the large number of male calves born, replacement of the present breeding male(s) may be problematic. Older resident animals are likely to dominate or kill introduced males. In order to introduce a new breeding male (e.g. from Solio ranch) with any chance of survival, integration and subsequent mating, all of the present adult and subadult males (> 4 years old) need to be removed to allow an introduced adult male to establish himself without risk of fighting mortality.

These proposed changes of breeding males will reduce or remove the immediate inbreeding problem, but the viability of the Ol Jogi reserve must be improved in order to increase the carrying capacity and to allow further increase in the rhino population to more than 20 rhinos, which at present could not be accommodated without problems. Acquisition and addition of further land to the Ol Jogi reserve is suggested, together with improved management directed at increasing the carrying capacity of the reserve for black rhinos. This will require some change in priorities for the reserve by the owner, in order to recognise its importance as a rhino sanctuary, improve the prospects for further increase in rhino numbers, and avoid inbreeding. Biopsy darting for collection of skin samples from each rhino is also suggested, for genetic analyses of levels of genetic variability, calf parentage and the extent of inbreeding (section 6.3).

5.3 Developments and funding: 1984-1991

In assessing the merits of the present rhino conservation policy in Kenya it is important to be able to review the amount and effectiveness of funding supplied by donor

organisations and NGO's to various rhino projects, particularly for the development of rhino sanctuaries. In 1989 and 1992, all donors and NGO's which had provided substantial funding for rhinoceros conservation in Kenya since the commencement of the Kenya Rhino Project in 1984 were asked to provide full details of the year, destination and amount of funds provided. The results are presented in Table 9, which gives funding totals by each donor/NGO to each conservation area or activity by year from 1984 onwards. Table 10 shows the total funding for by each donor/NGO to each rhino conservation area/activity, and Table 11, the total external funding to each area by year.

Internal funding from WCMD/KWS (e.g. salaries) and from the Wildlife Fund Trustees are not included in these tables. The tables are not intended to provide the reader with a comprehensive account of all funds spent on rhino conservation in Kenya over this period. However, they will serve as useful guides to the additional funds required and raised by donors in order to support both the wildlife authority (WCMD/KWS) and the private sector in developing and maintaining priority rhino conservation projects or activities, which include, but are by no means exclusively, rhino sanctuaries.

A total of just over 100 million Kenya shillings (equivalent to approximately three million pounds sterling) has been raised by donors/NGO's and spent in Kenya over the eight year period 1984-1991. More than half of this amount was spent in the development (including fencing) and maintenance of two KWS rhino sanctuaries, Lake Nakuru NP and Aberdares NP, with the majority of funds raised and spent by two respective dedicated charities, the Rhino Rescue Trust and Rhino Ark. Considerably lower, though significant amounts have been raised and spent on two other KWS sanctuaries (Ngulia, Nairobi NP) and two private land rhino sanctuaries (Lewa Downs, Ol Ari Nyiro). Other important areas receiving funding have been the Masai Mara NR, Matthews range (Ngeng Valley) and the KWS rhino capture unit.

To summarise, the most important developments in KWS National Parks and Reserves and in two private land rhino sanctuaries, funded to the extent and detail shown in Tables 10 and 11, are described in brief below:

National Parks and Reserves

Lake Nakuru NP was developed from 1986 onwards as the first National rhino sanctuary (Jenkins 1985b), including the construction of a 74 km perimeter electric fence, and sub-headquarters offices, stores and accommodation; also fence maintenance posts, holding pens, bridges and development of water supplies from several boreholes. Several vehicles and much assorted equipment, and supplies and funds for recurrent/maintenance needs have been provided, and also funding for the major rhino capture and translocation operation from Solio ranch to Lake Nakuru NP in 1987.

Ngulia rhino sanctuary (Tsavo West NP) was developed from 1985 onwards with the capture of three rhinos near Kibwezi and their eventual translocation into a small 3 km^2 fenced enclosure. The sanctuary has been extended in three phases to the present

area of 65 km^2, accompanied by the construction of semi-permanent fence maintenance and guard posts, a sub-headquarters, holding pens and a water system fed to three piped tanks supplied from one borehole and a spring. Funds have been provided for equipment and maintenance of the sanctuary fence, water system and vehicles have also been provided, as well as for capture and translocation operations.

Nairobi NP was upgraded to rhino sanctuary status from 1988 onwards with the construction of electric fencing along the northern and western boundaries of the Park, and with the provision of equipment and vehicles for rhino surveillance and fence maintenance.

Aberdares NP was also upgraded to rhino sanctuary status from 1988 with the construction of electric fencing along the boundary of the Salient (Phase I), and the construction of guard posts, a sub-headquarters, bridges and other infrastructure; also with the provision of vehicles and surveillance equipment, and recurrent funds for the operation and maintenance of necessary vehicles and plant. Extension of the fence along the boundary of the Forest Reserve to the north (Phase II) is ongoing.

In **Meru NP**, a small fenced rhino sanctuary was developed and funded by one NGO in 1988, which proved to be a failure due to lack of security (section 5.1.8); all fencing and materials were subsequently removed, and used to extend the fence at the Ngulia rhino sanctuary in 1990.

Vehicles, equipment and salaries for locally employed rhino scouts have been provided from 1986 onwards for the support of successful rhino surveillance and monitoring activities in **Masai Mara NR**, **Loita Hills**, **Matthew Range/Kitchich** and **Amboseli NP**.

The **Rhino Capture Unit** has been provided with four rehabilitated Isuzu and Bedford lorries, and much necessary equipment and tentage, veterinary supplies for rhino captures, and recurrent costs necessary for construction of holding pens, care of translocated rhinos, and the maintenance of vehicles and equipment.

TABLE 9 FUNDING TO KENYA RHINO CONSERVATION AREAS AND ACTIVITIES BY YEAR AND DONOR/NGO: 1984-1991

All figures in Kenya Shillings

DONOR/NGO	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL
African Fund for Endangered Wildlife (AFEW)									
Lake Nakuru NP			60,000						**60,000**
Ngeng Valley					86,000	86,000			**172,000**
African Wildlife Foundation (AWF)									
General			1,500	55,900					**57,400**
Lake Nakuru NP			112,000	100,000					**212,000**
Tsavo NP		9,600	9,600	238,820	31,351	305,252	585,511	84,912	**1,265,046**
David Sheldrick Wildlife Trust (DSWT)									
Aberdares NP					9,484				**9,484**
General	325,860	38,339	141,660	143,085	280,915		150,000		**1,079,859**
Lake Nakuru NP		53,521	7,898	20,090	10,369				**91,878**
Orphan Care					60,000	80,000	90,000	100,000	**330,000**
Tsavo NP		88,100	8,860	132,455	152,198	126,585	265,200	80,000	**853,408**
East African Wildlife Society (EAWLS)									
Aberdares NP					594,640		65,900	501,660	**1,162,200**
Anti-poaching		23,900	91,220	225,280	217,480				**557,880**
Lake Nakuru NP		55,320	55,800	64,940	23,880	1,100	2,960	141,660	**345,660**
Meru NP	6,000								**6,000**
Nairobi NP	25,680	14,100		4,760		108,040			**152,580**
Ol Ari Nyiro Ranch	223,600	25,260	3,520	144,100		185,000	1,360		**582,840**
Rhino awareness	145,780	192,220	49,920	88,380	270,160				**746,460**
Tsavo NP	169,900		22,160	10,000			480,500	986,280	**1,668,840**
Eden Wildlife Trust (EWT)									
Aberdares NP			32,000	53,632	26,112	508,180	480,000		**1,099,924**
Amboseli NP							36,000	27,200	**63,200**
General/Helicopter	480,000	288,000				465,000	120,000	90,000	**1,443,000**

DONOR/NGO	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL
Loita Hills						72,000	72,000	36,000	**180,000**
Lewa Downs Ranch					60,800	100,000	100,000	50,000	**310,800**
Masai Mara NR	70,400	454,400	70,048						**594,848**
Meru NP				272,640	241,984				**514,624**
Ngeng Valley	84,480	84,480	84,480	99,840	110,400	304,600	399,500	197,881	**1,365,661**
Tana river						12,000	12,000	4,000	**28,000**
Tsavo NP			307,200	240,000	96,000	568,000	135,000	1,688	**1,347,888**
Elsa Wild Animal Appeal (EWAA)									
Aberdares NP					89,600	83,175			**172,775**
Lake Nakuru NP			5,412	10,052		66,540			**82,004**
Friends of Conservation (FoC)									
Capture Unit						1,600,000	763,572	505,301	**2,868,873**
Masai Mara NR (+ WWF)		950,000	800,000	810,000	960,000	1,105,000	702,325	721,532	**6,048,857**
Frankfurt Zoological Society (FZS)									
Lake Nakuru NP			898,426						**898,426**
Overseas Development Administration (ODA-UK)									
Aberdares NP								5,208,000	**5,208,000**
General			986,000						**986,000**
Peoples Trust for Endangered Species (PTES)									
General					1,121,400				**1,121,400**
Rhino Ark									
Aberdares NP					3,392,000	3,280,000	10,634,819	9,913,580	**27,220,399**
Rhino Rescue Trust (RRT)									
Aberdares NP					393,750				**393,750**
Lake Nakuru NP			5,826,953	5,006,470	4,606,855	1,826,586	1,221,649		**18,488,513**
Tsavo NP						80,000	282,586		**362,586**
Wildlife Conservation International (WCI-NYZS)									
Aberdares NP						1,000,000			**1,000,000**
Nairobi NP					2,000,000	350,000	26,612	967,475	**3,344,087**
Research				380,000	190,000	95,000			**665,000**
World Wide Fund for Nature (WWF)									

DONOR/NGO	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL
Aberdares NP						900,000	441,526	59,258	**1,400,784**
General support (USAID)					720,000	2,100,000			**2,820,000**
Lake Nakuru NP			560,000	527,100	180,000	300,000	38,207	54,212	**1,659,519**
Lewa Downs Ranch			307,000	860,000	1,300,000	720,000	501,051	673,533	**4,361,584**
Ol Ari Nyiro Ranch			958,000	1,131,800	1,346,960	1,605,600	19,360	12,901	**5,074,621**
Zoological Society of London (ZSL)									
General							537,204	186,278	**723,482**
Ol Ari Nyiro Ranch				98,290	232,082	167,895			**498,267**
TOTALS	**1,533,684**	**2,279,225**	**11,401,643**	**10,719,621**	**18,806,408**	**18,203,542**	**18,166,832**	**20,605,342**	**101,700,407**

TABLE 10 FUNDING BY DONORS/NGOs TO KENYA RHINO CONSERVATION AREAS AND ACTIVITIES: 1984-1991

All figures in Kenya Shillings

AREA \ DONOR	AFEW	AWF	DSWT	EAWLS	EWT	EWAA	FoC	FZS	ODA	PTES	R ARK	RRT	WCI	WWF	ZSL	TOTAL
Aberdares NP			9,484	1,162,200	1,099,924	172,775			5,208,000		27,220,399	393,750	1,000,000	1,400,784		**37,667,316**
Amboseli NP					63,200											**63,200**
Anti-poaching				557,880												**557,880**
Awareness				746,460												**746,460**
Capture Unit							2,868,873									**2,868,873**
General		57,400	1,079,859		1,443,000				986,000	1,121,400				2,820,000	723,482	**8,231,141**
Lake Nakuru NP	60,000	212,000	91,878	345,660		82,004		898,426				18,488,513		1,659,519		**21,838,000**
Lewa Downs					310,800									4,361,584		**4,672,384**
Loita Hills					180,000											**180,000**
Masai Mara NR					594,848		6,048,857									**6,643,705**
Meru NP				6,000	514,624											**520,624**
Nairobi NP				152,580									3,344,087			**3,496,667**
Ngeng Valley	172,000				1,365,661											**1,537,661**
Ol Ari Nyiro R				582,840										5,074,621	498,267	**6,155,728**
Orphan Care			330,000													**330,000**
Research													665,000			**665,000**
Tana river					28,000											**28,000**
Tsavo NP		1,265,046	853,408	1,668,840	1,347,888							362,586				**5,497,768**
TOTALS	**232,000**	**1,534,446**	**2,364,629**	**5,222,460**	**6,947,945**	**254,779**	**8,917,730**	**898,426**	**6,194,000**	**1,121,400**	**27,220,399**	**19,244,849**	**5,009,087**	**15,316,508**	**1,221,749**	**101,700,407**

TABLE 11 FUNDING TO KENYA RHINO CONSERVATION AREAS AND ACTIVITIES BY YEAR: 1984-1991

All figures in Kenya Shillings

AREA \ DONOR	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL
Aberdares NP			32,000	53,632	4,505,586	5,771,355	11,622,245	15,682,498	**37,667,316**
Amboseli NP							36,000	27,200	**63,200**
Anti-poaching		23,900	91,220	225,280	217,480				**557,880**
Awareness	145,780	192,220	49,920	88,380	270,160				**746,460**
Capture Unit						1,600,000	763,572	505,301	**2,868,873**
General	805,860	326,339	1,129,160	198,985	2,122,315	2,565,000	807,204	276,278	**8,231,141**
Lake Nakuru NP		108,841	7,526,489	5,728,652	4,821,104	2,194,226	1,262,816	195,872	**21,838,000**
Lewa Downs Ranch			307,000	860,000	1,360,800	820,000	601,051	723,533	**4,672,384**
Loita Hills						72,000	72,000	36,000	**180,000**
Masai Mara NR	70,400	1,404,400	870,048	810,000	960,000	1,105,000	702,325	721,532	**6,643,705**
Meru NP	6,000			272,640	241,984				**520,624**
Nairobi NP	25,680	14,100		4,760	2,000,000	458,040	26,612	967,475	**3,496,667**
Ngeng Valley	84,480	84,480	84,480	99,840	196,400	390,600	399,500	197,881	**1,537,661**
Ol Ari Nyiro Ranch	223,600	25,260	961,520	1,374,190	1,579,042	1,958,495	20,720	12,901	**6,155,728**
Orphan Care					60,000	80,000	90,000	100,000	**330,000**
Research				380,000	190,000	95,000			**665,000**
Tana river						12,000	12,000	4,000	**28,000**
Tsavo NP	169,900	97,700	347,820	621,275	279,549	1,079,837	1,748,797	1,152,880	**5,497,768**
TOTALS	**1,533,684**	**2,279,225**	**11,401,643**	**10,719,621**	**18,806,408**	**18,203,542**	**18,166,832**	**20,605,342**	**101,700,407**

Private Land

In the private sector, very large but unknown amounts of money have been spent by the owners of **Solio** and **Ol Jogi** ranches from 1970 onwards in constructing and developing their respective reserves. The financial burden in maintenance and management of these areas since must have been very substantial. Rhino security and monitoring work on **Ol Ari Nyiro** ranch has been supported by the owner with considerable assistance from donors. Large amounts of money have been raised for the complete rhino sanctuary development on **Lewa Downs** ranch, added to the commitment and support for rhino protection provided by the land owners concerned. Finally, a complete rhino sanctuary was developed in 1989 and has been financed and maintained entirely by Lonrho at **Ol Pejeta** ranch.

Effectiveness of funds

To compare with the funding for rhino sanctuaries and developments outlined above, some idea of the relative success of different rhino sanctuary areas in terms of actual tangible results (e.g. increase in rhino numbers) can be gained from Table 12. In each fenced rhino sanctuary which has been stocked with rhinos, the size of the stocking, and numbers of births, deaths, the numbers of rhino supplied to stock other rhino sanctuary, the present total number, and the net increase in rhino numbers are presented.

The longest running sanctuaries, Nairobi NP and Solio have clearly been the most successful, and between them have provided 46 surplus rhinos to stock other areas. The Solio and Nairobi NP rhinos have, respectively, doubled and quadrupled their numbers since stocking, including numbers of rhinos 'harvested'.

The newer rhino sanctuaries have started to show signs of population increase, although the clearest success so far has been Lake Nakuru NP with 10 calves born and only one death. Lewa Downs has produced the same numbers born, but has suffered from seven deaths from fighting and accidents, and has yet to show substantial increase. Ngulia has had relatively poor breeding output so far, which should improve after the completion of stocking. All stocked sanctuaries have shown net gain in numbers with the exception of Ol Pejeta and Meru.

For the largest existing indigenous rhino populations, the rhino sanctuary and/or surveillance projects undertaken during the period have resulted in persistence and increase in rhino populations (e.g. Aberdares NP, Masai Mara NR, Ol Ari Nyiro ranch, Matthews Range, Loita Hills). With the exception of the Masai Mara NR, where improved surveillance has had a remarkably positive effect (increase in numbers from 13 (1985) to 32 (1992)), lack of precision in census and monitoring of rhino numbers, particularly in any earlier years of the project (1984-87) have made it difficult or impossible to confirm population trends in these areas, or to attribute them to the funding and inputs provided, or lack of them.

TABLE 12 BREEDING SUCCESS IN ENCLOSED RHINO SANCTUARIES STOCKED WITH BLACK RHINOS: 1963-1992

Rhino Sanctuary	No. rhinos stocked (founder population)	Start Year of sanctuary	No. Births	No. Deaths	Total Number of rhinos (1992)	No. rhinos supplied to other sanctuaries	Net Increase in rhino numbers (Factor)
Solio Ranch	23	1970	?	?	66	30	73 (4.2)
Nairobi NP	38	1963	?	?	60	16	38 (2.0)
Lake Nakuru NP	21	1987	10	1	31	1	9 (1.5)
Ol Jogi Ranch	5	1979	10	2	12	1	8 (2.6)
Lewa Downs Ranch	15	1984	10	8	13	4	2 (1.1)
Ngulia (Tsavo West NP)	15	1986	4	2	17	0	2 (1.1)
Ol Pejeta Ranch	14	1989	2	4	11	1	0 (1.0)
TOTAL	129				211	53	132 (2.1)

6.0 RHINO MONITORING AND RESEARCH PROGRAMME

6.1 Rhino population monitoring

Successful management of all black rhino populations, including those managed for maximum sustained breeding output and avoidance of overpopulation, will depend on uninterrupted and detailed population monitoring. A rudimentary system of monitoring of the rhino populations in sanctuaries is already in place, with data and records collected in standard formats (see Annex 5). The objective of all such rhino population monitoring is to obtain the following:

1. Confirmation of the presence and health of individual rhinos.

2. Personal history records of all rhinos.

3. Details of all births and mortalities, and, where possible, matings.

4. Identities of breeding animals.

5. Parenthood of calves.

The following data will be collected to provide this information:

1. Individual identification of all rhinos
    - Photographic records for sightings
        - Individual features: horn shape, ear notches, etc.
        - Ear-notching and ear-tagging (see Hitchins 1989)
    - Identification of rhino sign
        - Track measurements and marks, where possible

2. Ageing of rhinos, especially immatures (see Annex 5)
    - Size against mothers (Hitchins 1970, Emslie *et al* 1993)
    - Track size criteria

3. Daily rhino sightings, providing
    - Confirmation of presence and health of all rhinos
    - Details of all matings, births and mortalities

4. Personal history records of all known rhinos

This information in turn will be used to calculate:

1. Absolute population sizes or estimates in each area, obtained through individual identification and/or regular ground and aerial surveys.

2. Annual population performance indicators (e.g. percentage of calves in the

population, cow/calf ratios, sex ratios, calving intervals, group size: as Tables 2 and 7).

3. The recruitment rate to each population.

4. The age structure of each population.

5. The density of rhinos in each area.

The present system of collection, storage and analysis of information is as follows (see Annex 5):

1. ID cards, and photofiles for individual ID of rhinos. All individually known rhinos are given a four-digit ID number (allocation shown in Annex 5).

2. Record books for rhino surveillance teams for patrol records, sightings records, mortalities.

3. Record books used by KWS vets for all mortalities/autopsies. Skulls and lower jaw bones are aged (du Toit 1986; Hitchins 1978) marked, catalogued and stored, and entire skeletons will be collected where possible and deposited with the National Museum of Kenya in Nairobi.

4. Record books and capture data forms used by KWS vets for recording details of all rhino captures and translocations. All immobilised rhinos have body measurements taken, and are aged from wear to the upper tooth row (du Toit 1986).

5. A computer database of all individually known rhinos, including history and breeding records.

6. Spreadsheet analysis of densities, population breeding performance, carrying capacities, management levels and 'harvest' of surplus rhinos to maintain maximum breeding output.

Rhino surveillance personnel in several rhino conservation areas (e.g. Nairobi NP, LNNP, Ngulia RS, Masai Mara NR) collect information from daily vehicle and foot patrols. Most of the black rhino in the protected areas are identifiable from individual features (e.g. horn shape), and individual identification is the basis of all monitored information. All rhinos immobilised for translocation, tagging or treatment will be ear-notched to assist future identification. Training of rhino surveillance officers and rangers will continue in all areas, particularly that of rangers and scouts based on a series of training modules for rhino scouts monitoring black rhino populations in Natal (Sandwith 1990).

Staff in private land rhino areas are required to monitor their rhino populations in order

to obtain the minimum information required to identify all individuals, regularly census and establish population trends (section 4.7; Annex 3), and those areas where little or no monitoring is in place will be obliged to provide minimum information and monitoring capability for rhino populations on their land.

Operation of a system which will confirm the presence and health of each known individual rhino in each population within a certain period will be essential in future. The ability of rhino surveillance teams to sight and confirm the above will vary between different areas, due to differences in the terrain to be covered, the density of rhinos, the vegetation cover/habitat and the temperament of the rhinos. Once the absence of any individual exceeds a critical period (termed the Maximum Interval between Sightings (MIS), e.g. 1 month), intensive searching will be carried out for this particular individual first within, and then outside its known normal home range or area. Where appropriate and necessary in rhino areas with high vulnerability or poaching challenge (e.g. Tsavo NP, Lewa Downs), security units should be deployed.

MIS's for individually known rhinos should apply in the following conservation areas:

Nairobi NP	2 weeks (plains/gorges habitat)
	1 month (forest habitat)
Lake Nakuru NP	1 month (all areas of NP)
Ngulia RS	2 months (monitoring at piped waterholes)
Aberdares NP	2 months (monitoring at Ark, Treetops, salt licks)
Masai Mara NR	2 months (all areas of NR)

In order to keep track of sightings frequencies for individually known rhinos in each area, sighting frequency forms (Annex 5) will be completed. This will also assist security of individual rhinos, where surveillance officers can mount intensive searches of known home ranges to locate animals which have not been sighted for a period longer than the required MIS. Maximum Intervals between Sightings will be re-classified after one year of routine use in each area. After this time the sightings patterns and frequencies for individual areas and individual rhinos will have become clear. At this stage it will be possible for each rhino surveillance unit head to decide on an updated MIS. In any sanctuary, any rhino not sighted for one year will be considered dead, or no longer part of the population monitored.

In areas where routine daily monitoring of the rhino population is not in effect, and population estimates can only be calculated on the basis of additions (births, translocation, known immigration) or removals (mortalities, translocation, known emigration) of rhino since the last time the total rhino numbers were known, a total census of the population will be required. In these cases no longer than three years should elapse before a full census is repeated.

6.2 Ecological monitoring in rhino sanctuaries

The successful management of rhino sanctuaries and other small Parks and Reserves, particularly those enclosed by fencing, and/or surrounded by human settlement, will depend critically on detailed ecological monitoring. Particular attention will be paid to assessment of vegetation status, and the numbers and population dynamics of several species of grazing and browsing herbivores, as well as predator species. In rhino sanctuaries, priority should be given to the requirements of the black rhino. This should entail complete protection for this species, and maintenance of the habitat conditions and population structure to promote maximum sustainable breeding output.

Judging by the events that have taken place already in fenced rhino sanctuaries in the last 10-15 years (e.g. Solio Ranch GR, Lewa Downs RS, Ol Jogi Ranch GR; Lake Nakuru NP, Nairobi NP), these enclosed systems are susceptible to major fluctuations in the numbers of different species. The following changes have already been observed: die-offs of eland, greater kudu, oryx and wart-hog in dry years (e.g. Lewa Downs); overpopulation of waterbuck and impala at low predator numbers (LNNP); increase and decrease in predator numbers (Aberdares NP: hyaena); large increases in numbers of giraffe, zebra and buffalo in several areas (Ol Jogi, Lewa Downs, LNNP); overbrowsing of favoured browse species by black rhino (made more acute by giraffe grazing at lower browse levels after depleting reserves at higher levels) (Ol Jogi). In addition three sanctuaries have existing or potential problems with elephant (Ngulia RS, Ol Pejeta, Lewa Downs, Ol Ari Nyiro). Confinement of elephant is causing noticeable habitat change, problems with fence maintenance, and possibly disturbance to rhinos. Particularly in the areas mentioned above, there is a need for a monitoring system appropriate to the whole enclosed ecosystem.

Appropriate long-term vegetation monitoring will be carried out by KWS in enclosed and un-confined rhino sanctuaries in National Parks and Reserves, and the numbers and inter-relationships of other major predator and herbivore species will be monitored, particularly the number of potential competitors with the rhino. Private land rhino sanctuaries are encouraged to employ their own resident ecologists or research assistants to carry out relevant ecological monitoring in consultation with KWS ecologists.

Vegetation monitoring in rhino sanctuaries will concentrate on the following techniques:

1. Routine ground photography from fixed points/cairns (N,S,E,W directions) at the end of wet and dry seasons, and use of these points as markers for long-term transects. Photographic points will be selected to provide coverage of several representative areas of rhino habitat and feeding areas.

2. Aerial photography of fixed points/transects as for 1.(above), and the use of satellite imagery, if appropriate, feasible, and affordable.

3. Determination of rhino diet and identification of key browse species through direct (feeding observations) and indirect methods (feeding site observation,

faecal analysis). Inventories of preferred browse species will be compiled and reference herbarium specimens catalogued and stored in each area.

4. Ground monitoring of browse abundance and availability, including belt transects, exclosure plots; measurement of bush/tree heights, browse levels and stem diameters; measurements of woody vegetation cover.

In addition, the susceptibility of enclosed areas to major and minor fires is potentially a big threat to the rhino populations they may contain, especially to their food resources and cover. Fire policies will be devised for each management area. Determining management should involve controlled and/or rotational burning programmes or the total exclusion of fire, for which the maintenance of firebreaks will be essential.

6.3 Genetic studies

Research is required on the molecular genetic differences between black rhino populations and ecotypes in Kenya; this has been recommended by the PHVA workshop (Foose *et al* 1993). At present data from genetic analyses are not available to resolve fully the question of whether there are significant genetic varieties of black rhino within Kenya, and if so, whether these (e.g. highland and lowland ecotypes: section 2.1) should be readily intermixed. For these reasons, every black rhino immobilised requires assessment of levels of genetic variation within chromosomal and mitochondrial DNA. Foose *et al* (1993: section 5) provides additional background information on past results of genetic analyses on samples collected from Kenyan black rhinos.

More detailed analyses of genetic material collected in the past, and in the future, may enable detection of levels of inbreeding, and also degrees of relatedness between individual rhinos. These analyses could affect management decisions in the future, in particular those involving the choice of particular animals for translocations between sanctuaries in order to minimise inbreeding.

Genetic analysis of samples collected from Kenya black rhinos will continue in collaboration with NMK and CRES/ZSSD. All individual rhinos immobilised during translocation or treatment are sampled for blood and tissue, the latter conveniently collected from notches cut from ears for marking purposes.

As data on the population dynamics, survivorship, individual life histories and breeding performance of well-monitored rhino populations accumulate, the value of computer modelling and projections of the future performance and inbreeding levels in each area will increase. In collaboration with IoZ/ZSL and IUCN/SSC CBSG, computer analyses of well-known small rhino populations in Kenya are providing indications of how soon action will have to be taken to avoid inbreeding (VORTEX: Foose *et al* (1993), GAPPS: Dobson *et al* (1991)). Projections of harvest or removal of surplus rhinos above carrying capacity can also be made.

Biopsy darting will be used to sample tissue from selected rhinos where specific

questions about lineage and genetic variability can be answered through genetic analyses, including the use of DNA fingerprinting and the use of mini-satellite DNA probes. The black rhino population on Ol Jogi ranch is an example of a potentially dangerous inbreeding situation, which will be monitored through sampling in 1993 of each rhino for tissue through biopsy darting.

6.4 Disease resistance and monitoring

Studies will continue in collaboration with ICIPE, KETRI, ILRAD and KARI on establishing the feasibility of routine translocations of black rhino from upland areas of Kenya, free of tsetse fly and trypanosomiasis, to lowland tsetse-infested sanctuaries or release areas. These involve the movement of a few selected 'guinea-pig' rhinos from upland sanctuaries (e.g. Solio Ranch, Nairobi NP) to lowland areas (e.g. Tsavo NP, Meru NP), holding them in bomas, monitoring their infection by trypanosomes, and characterising the latter collected from rhino and from tsetse fly populations surveyed in the recipient area. Most of the successful rhino donor sanctuaries are located in non-fly areas, and most of the potential release areas for large numbers of rhino are located in tsetse fly/trypanosomiasis areas.

Work completed so far in monitoring eight rhinos translocated to Tsavo from Nairobi (Mihok *et al* 1992) indicate that upland rhinos can easily become resistant and habituate to infection with trypanosomiasis in tsetse fly areas, as long as their nutritional status is good, and rhinos are moved into tsetse areas at times of low tsetse densities and reduced trypanosomiasis challenge. However, there are several species of tsetse fly each potentially or actually carrying several species of trypanosome, and these will vary from area to area, often markedly within small areas (e.g. Ngulia rhino sanctuary). For different recipient lowland areas, even within Tsavo NP, further monitoring work must be carried out in each case, and because of the large numbers of rhinos that need to be moved, these studies are of particular urgency and importance to the future management of the black rhino in Kenya.

6.5 Boma management and post-translocation monitoring

Critical to the successful introduction of translocated rhinos to new areas is the intensive monitoring of rhinos managed in bomas, or holding pens, prior to release, and the detailed monitoring of the movements and behaviour of rhinos after release. The KWS Veterinary and Capture Units will provide all necessary care, provision and adaptation of penned rhinos to local browse, dietary supplements where appropriate, and treatment for any diseases or ailments. Where donor and recipient areas differ widely in habitat and browse species available, it will be particularly important for translocated rhinos to become thoroughly adapted to the new diet and, if possible, only to be released after a gain in condition and body weight is noted during the holding period before release. All translocated rhinos will be tipped (tip of anterior horn cut off) in order to prevent subsequent injuries during confinement and after release, reduce the risk of total accidental horn loss in confinement, and also to provide horn samples for analysis

(see section 6.8).

Post-release movement and behaviour will be monitored by radio-telemetry where conditions (e.g. closed bushland or forest) make routine sighting or detection from the ground difficult or impossible. Horn-implant radio transmitters (Telonics unit IMP/300/L, or units installed by Pienaar & Hall-Martin (1991)), or transmitters attached to elastic collars or ear-tags will be used. Released rhinos will also have distinctive marks cut into toe-nails to assist identification of tracks, in addition to ear-notching to enable identification of the animal by sight (Annex 5).

Translocation of rhinos to new areas, particularly those with already resident populations of rhino, can only be considered successful after the animal has integrated successfully and maintained good condition and consistent home range movements for six months after release.

6.6 Parasitology

Endoparasite loads of translocated rhinos will be monitored in selected areas, as well as wild rhinos in any monitored populations which show negative effects on health and condition as a result of heavy parasite burdens. Studies of the species and densities of endoparasites in rhinos translocated from Nairobi NP to Tsavo West NP are ongoing, and have already assisted KWS vets in decisions over whether to de-worm individual rhinos.

Attention will be given to the occurrence and life history details of the black rhino-specific, and apparently harmless bot fly *Gyrostigma rhinocerontis*, which has disappeared from many areas of Kenya as the black rhino has been eradicated (Dewhurst, pers comm). Large numbers of bot fly larvae have been collected from the dung of rhinos captured in Nairobi NP, indicating healthy populations in this area. Attention will be given to improving prospects of re-infection of rhino populations and recipient areas (e.g. Tsavo NP) where *Gyrostigma* spp may be extinct, and can be re-introduced with translocated rhinos from Nairobi NP.

6.7 Nutrition

Particular conservation areas for the black rhino in Kenya are known to suffer from deficiencies of certain minerals in the soil and browse (e.g. Lake Nakuru NP). In collaboration with ICL, mineral studies will continue in these areas as necessary, in order to assess the potential impact of these deficiencies on the health and breeding of rhinos in these areas, and the requirements for the provision and recommended composition of mineral supplements.

The nutrition of rhinos is of particular concern in management of rhinos in sanctuaries, and of rhinos confined in bomas. The chemical defences of food plants may have an important influence on the suitability of rhino habitat. This particularly applies to those

defences raised by plants in response to browsing pressure, and which may become toxic to rhinos at high browsing intensities. In collaboration with NMK, EAH and ecologists from ZNPWLM, studies will be initiated on the phytochemistry of browse plants consumed by black rhinoceros under different feeding intensities, taking into account browse preferences, plant phenology and habitat conditions (e.g. seasonal variation/droughts). Phenolic compounds in browse plants will be analysed using standardised techniques. In addition, the metabolites of secondary plant compounds excreted in the urine and/or faeces of rhinos will be measured. These measurements could provide an indication of the response of different key browse species to feeding intensity as a function of rhino density, and ultimately some measure of maximum tolerable rhino density or the carrying capacity for a given area. These studies could also provide an early warning for the assessment of habitat quality in areas which are seriously overbrowsed, or undergoing periods of drought which impact on rhino health, condition or breeding performance.

6.8 Source identification of rhino horn

Samples of rhino horn will be collected from all dead or immobilised rhinos. In collaboration with the University of Cape Town, these samples will undergo isotopic analysis in order to type samples to origin or source. Source identification has already proved successful in analysis of horns from various regions of southern Africa (Van der Merwe, pers comm). Similar work on horns originating from different geographical regions of Kenya may enable future detection of origin of horns recovered from the illegal trade, inside and outside of Africa. Horns of translocated rhinos are of particular interest, because horn growth and the isotopic ingredients of new growth will differ between each geographic area where a rhino has lived, and thus differing isotopic spectra may be found along the length of the horn according to each location, and the period of a rhino's residence in each area.

7.0 IMPLEMENTATION SCHEDULE

7.1 Capture and translocation programme

7.1.1 Rescue of outliers

Where groups or individual black rhinos are found to be without security, isolated (no breeding contact with other rhinos) or otherwise judged to be inviable, they will be captured and translocated to sanctuaries or secure release areas. The location and capture of such rhinos are often very difficult and/or prohibitively expensive, and with the funds and capture facilities available it must be accepted that it will be impossible to recover some isolated rhinos. The use of helicopters (e.g. Puma, Sea King) capable of lifting a rhino and crate may allow capture and recovery of several of these outliers, but may be of limited use at high altitudes. Such outliers requiring capture are listed below, in approximate order of priority (see also Table 1). The survey and translocation work planned for 1993 will aim to establish the location and status of many of these animals, with immediate capture and translocation to follow if feasible.

Area	Number of rhinos
Keno/Losai NR/Laisamis	1-3
Luoniek Ranch/Amaya/Losuk	3
Karissia Hills	6
Chyulu Hills (north)	2
Jilori-Chacama	1
Wajir District	2
Tana River District (if Tana Delta National Reserve is not gazetted)	8

7.1.2 Translocation of surplus rhinos

With the current state of sanctuaries having surplus rhinos, and those requiring completion of stocking, several substantial capture and translocation operations in Nairobi NP and Solio Ranch are required. Given projections of continued surplus, further removal of rhinos from Nairobi NP, Solio and Lake Nakuru will be carried out in the next decade. From the realistic projections of 4.7% growth in Nairobi NP and Solio Ranch in the next five years (Table 8; Foose *et al* 1993), minimum numbers of rhino to be translocated are listed in Table 13. Choice of translocates will be adapted to maintain a 1:1 sex ratio in donor and recipient areas if possible.

Additional rhinos to these which exceed management levels after 1994, if birth rates are actually higher than 4.7%, will be translocated to specified destination sanctuaries or release areas. These may include Amboseli and Meru National Parks, conditional on adequate security and habitat availability (see also section 5.1.8). After initial removal of surplus rhinos in 1993-94 from Solio and Nairobi NP, the numbers of rhinos removed will not exceed the numbers of rhinos born in the preceding year.

TABLE 13 TRANSLOCATION IMPLEMENTATION SCHEDULE

DONOR SANCTUARY	RECIPIENT SANCTUARY/AREA	1992 TOTAL	1993		1994		1995		1996		1997	
Nairobi NP	Ngulia (Tsavo West NP)	17	4									
Nairobi NP	Tsavo East NP	2	2		5		4	3			5	
Solio Ranch	Lewa Downs Ranch	13		8								
Solio Ranch	Ol Pejeta Ranch	11		8								
Solio Ranch	Aberdares NP	50				3			3			
Solio Ranch	Mt Kenya (Kihari Forest)	5				2			3			
TOTAL		98	22		10		7		6		5	

7.1.3 Other translocations

There are two sanctuaries which require introduction and/or removal of selected rhino in order to achieve demographic stability (e.g. provision of breeding male) or improved composition of a small population in order to avoid incidence of inbreeding, and improve breeding performance. Translocations necessary to correct these situations are listed below.

Area	Action required
Lewa Downs Ranch	Introduce breeding male (from Keno/Losai NR/Laisamis)
Ol Jogi Ranch	Remove 3-4 adult males (to Lewa Downs) Introduce breeding male (from Solio)
Ol Ari Nyiro Ranch	Introduce breeding females

7.2 Development and maintenance programme

This section briefly outlines the priority developments and management actions that will be required in each KWS rhino conservation area, with a schedule for implementation within the next five years (1993-1997). Many of these items have had funding committed for them within the IDA PAWS project, also scheduled within the next five years. Only those items confirmed for funding by the PAWS project are indicated as such. This coincides with PAWS workplans and implementation schedules already drawn up for the project years 1992/93 and 1993/94. Commitment to funding by other donors and NGO's is indicated in each table. Priority projects with no source of funding located are also indicated.

The listings of requirements for each area are not comprehensive, and include only major priority items identified at the beginning of 1993 for provision or construction within the next five years. Each rhino conservation area, particularly the fenced rhino sanctuaries carries a heavy maintenance burden, and as in the last few years, the assistance of several donors and NGO's (e.g. WWF, DSWT, AWF, EWT, FoC) in maintenance of rhino sanctuaries and key activities (e.g. translocations) and provision of contingency/emergency funding has been crucial to their success, independent of recurrent funds/votes allocated to each area by KWS for expenditure by respective wardens. This requirement for additional funds for recurrent and contingency expenses in different rhino conservation areas will continue to exist within the next five years.

Lake Nakuru NP

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Water development: Lanet/Lion Hill scheme											PAWS/WWF
Water development: Pwani scheme (includes new borehole)											PAWS
Accommodation for rangers/fence staff: 15 houses											PAWS
Purchase of vehicle: Suzuki LWB Pickup											WWF
Replacement of vehicle: Toyota Hi-Lux											None
Rehabilitation of Isuzu lorry											None
Surveillance equipment: 4 prs binoculars											None

Aberdares NP

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Fencing FR boundary: Phase II (Wandari Gate - Rhino Gate)											Rhino Ark
Fencing FR boundary: Phase III (Rhino Gate - Shamata Gate)											Rhino Ark
Fencing FR boundary: Phase IV (Ruhoruini - Chinga)											Rhino Ark?
Fencing FR boundary: Phase V (Chinga - Gatakaini)											Rhino Ark?
Vehicle for rhino surveillance: Suzuki LWB Pickup											WWF
Accommodation for rangers/fence staff: 15 houses											PAWS
Hides for rhino surveillance at salt licks											None
Surveillance equipment: 3 prs binoculars, 2 night scopes											None
VHF radios: 2 base/mobile sets, 5 handsets											None
Construct holding pens - permanent (3)											Werikhe/FoC
Radio-tracking equipment											None

Ngulia rhino sanctuary (Tsavo West NP)

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Accommodation: Assistant Warden's house											PAWS
VHF radios: 2 mobile sets, 3 handsets											AWF
Purchase vehicle: Suzuki LWB Pickup											Savanna Club
Replace vehicle: L/R 110 Pickup											None

Replace vehicle: Suzuki LWB Pickup											None
Rehabilitation of tractor											WWF/KWS
Rehabilitation of Bedford lorry											None
Surveillance equipment: 5 prs binoculars, 1 night scope											None

Nairobi NP

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Construct Outpost: Mbagathi River											None
Construct Outpost: Marimbeti/Embakasi											None
Replace electric fence: Carnivore to East Gate											None
Construct holding pens - permanent (3)											DSWT/FoC
Accommodation for capture rangers at Banda Gate: 10 houses											PAWS
Replace rhino surveillance vehicle: L/R 110 Pickup											None
Replace fence maintenance vehicle: Suzuki LWB Pickup											None
Surveillance equipment: 4 prs binoculars, 2 night scopes											None

Kitchich - Matthews Range - Ngeng Valley

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Replace vehicle: Toyota L/Cruiser											None
Accommodation for rangers: 10 houses/rondavels											None
Surveillance equipment: 35 mm Camera plus lenses											PAWS
Surveillance equipment: 4 prs binoculars, 2 night scopes											None
VHF radios: 3 base/mobile sets, 5 handsets											None

Tsavo East NP

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Construct holding pens - temporary (3)											DSWT/EWT
Accommodation for rangers: 5 tents/rondavels											EWT/DSWT
Vehicle for rhino surveillance: Suzuki LWB Pickup											M Werikhe
VHF radios: 1 mobile, 3 handsets											None
Radio-tracking equipment											PAWS/WWF
Surveillance equipment: 2 prs binoculars, 1 night scope											None

Mt Kenya (Kihari Forest)

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Fencing FR boundary SW, W & NW of Kihari Hill											None
Construct holding pens - temporary (3)											PAWS
Accommodation for rangers: 6 houses											PAWS
Radio-tracking equipment											None
Surveillance equipment: 3 prs binoculars											None

Masai Mara NR - Loita Hills

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Rhino surveillance vehicle: L/Cruiser or L/Rover											None

Surveillance equipment: 3 prs binoculars, 1 night scope											None

Capture Unit

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Capture lorry (6 x 6)											PAWS
Equipment/spare parts/maintenance for capture lorries											FoC
Portable/temporary metal holding pens (6)											None

Rhino surveys and census - general

Action/Input required	1993		1994		1995		1996		1997		Donor identified
Vehicle for rhino programme office: KWS HQs											None
Survey of outliers for relocation: UNEP/ARSG proposal 1											None
Support for intelligence/monitoring: UNEP/ARSG proposal 2											None
Full census of Ol Ari Nyiro ranch black rhinos											None
Full census of Solio ranch black rhinos											None
Full census of Tsavo West NP black rhinos											None
Routine census of Ngulia black rhino at water holes											-
Routine census of Aberdares NP black rhino at salt licks											-
Routine census of Matthews range rhinos at salt licks											-

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Joseph Mburugu	Mark Stanley Price (AWF)	Ian and David Craig (Lewa)
John Jonyo	Maurice Coreth (RRT)	Fuz Dyer (Ngare Sergoi)
Dieter Rottcher	Jock Dawson (RRT)	Colin Francombe (Ol Ari Nyiro)
Perez Olindo	Ed Wilson (WWF)	Kuki Gallmann (Ol Ari Nyiro)
Ted Goss	Holly Dublin (WWF)	Alec Wildenstein (Ol Jogi)
Sam Ngethe	Jonah Western (WCI)	
Daniel Sindiyo	Nehemiah Rotich (EAWLS)	
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ANNEX 1 MAPS OF KENYA RHINO SANCTUARIES

MAP OF NAIROBI NP

MAP OF LAKE NAKURU NP

MAP OF ABERDARES NP SALIENT

MAP OF NGULIA RHINO SANCTUARY - TSAVO WEST NP

MAP OF SOLIO RANCH - GAME RESERVE

MAP OF LEWA DOWNS RANCH - RHINO SANCTUARY

MAP OF OL PEJETA RANCH - SWEETWATERS RHINO SANCTUARY

MAP OF OL ARI NYIRO RANCH (LAIKIPIA RANCHING)

MAP OF OL JOGI RANCH - PYRAMID GAME RESERVE

ANNEX 2 THE WHITE RHINOCEROS IN KENYA

There are close to 74 white rhinoceros in Kenya, all of the southern race (*Ceratotherium simum simum*). Evidence from fossils and cave paintings in Kenya and northern Tanzania suggests that the white rhinoceros, presumably similar to the northern race (*C.s.cottoni*), was widespread and a part of the East African savanna fauna until 3,000 years ago or less (M Leakey pers comm), when it was probably displaced by pastoralists who could easily kill such tame animals. The reintroduction of white rhinos into Kenya, all of which were imported from South Africa (20 in the 1970's, five in 1992), cannot therefore be judged as a case of bringing in an ecologically exotic species.

A list of the numbers and distribution of the white rhino in Kenya is shown in Table 14, below. All but two of the white rhinos in Kenya are at present located on private land and are privately owned. KWS will be conserving this species along side the black rhino, and establishing at least one breeding population in enclosed National Parks with appropriate habitat, particularly those with good potential for tourist viewing (Lake Nakuru NP). Once sufficient numbers of white rhinos have been bred up in such National Parks, KWS may generate revenues from sale of animals to the private sector in Kenya, or to other Governments or parties outside Kenya.

Unlike the black rhino, white rhinos in Kenya are the property of the landowner. They may be purchased and sold at mutually agreed prices, inside or outside of the Republic of Kenya. However all decisions over their sale, movement, management and protection must be made with the approval of, and in consultation with KWS. Any movement of white rhino in and out of the Republic of Kenya must have the written approval of the Director of the Kenya Wildlife Service, as authorising party to the CITES convention. KWS may enforce management decisions for the white rhino on private owners as for any other species of wildlife in the Republic, particularly if they compromise or conflict with measures to conserve the black rhino in Kenya.

TABLE 14 KENYA WHITE RHINO POPULATION ESTIMATES (December 1992)

NP/RESERVE Area/Section	Population Estimate	Area (km^2)	Density (km^{-2})	Census-Precision Remarks
KWS NPs/Reserves:				
LAKE NAKURU NP	2	140	0.01	Known Population
Private/Group Ranches:				
SOLIO	55	68	0.81	1991 census, minimum
LEWA DOWNS	11	40	0.25	Known population
OL JOGI	2	55	0.04	Known population
MT KENYA GAME R	2	-	-	Known population
OL CHORO OIROUA	2	-	-	Known population
TOTAL	**74**			

ANNEX 3 CRITERIA FOR PRIVATE LAND RHINO SANCTUARIES

The following criteria will be used in assessment of private land or communal land areas which hold black rhino in Kenya, or assessment and selection of those that wish to hold them in future. These criteria will be considered in addition to those applying to all potential new areas for rhino conservation in Kenya (section 4.5.2), and for assessment of existing rhino populations (Annex 6).

Security Risk

-- Proximity to dense human populations
-- Lack of security on international boundaries
-- Legal/protection status of rhino in recipient areas
-- Comparative security status of region
-- Adequacy of physical boundaries of property (e.g. perimeter fencing)
-- Anti-poaching capabilities on property

Habitat Suitability

-- Practicality of future population monitoring, management and manipulation (e.g. terrain constraints on capture and translocation)
-- Vegetation status:
    - Proportional browse species composition
    - Key browse species and size classes
    - Grass component
    - Density of other browsers (e.g. giraffe, kudu)
    - Grazer populations
    - Soil nutrient status
    - Water availability
-- Carrying capacity (property size and habitat suitability)

Management competence and control, and funding available

Conservation Record/Attitude

Disease threat/risk

Predator densities and threats (e.g. hyaena densities)

In-situ management concerns

- Ability of area to maximise production of rhinos
- Monitoring capability
- Adequacy of protection
- Change in owner, or owner's circumstances
- Commitment to provide full-time professional expertise

Current and potential future land use or classification

Legal aspects

ANNEX 4 RHINO PROGRAMME COMMITTEES

A. National Management Committee (NMC)

Chairman: Director, KWS. Established in March 1988; 21 meetings have been held up to the end of 1992.

Terms of Reference:

i. Feedback from rhino conservation areas: wardens and rhino sanctuary OICs

ii. Management of all rhino conservation areas and sanctuaries:
Security
Infrastructure, maintenance, staffing

iii. Monitoring, data collection, population densities & trends
Rhino population surveys
Captures and translocations
Habitat studies
Genetic considerations
Mortality patterns

iii. Funding: priorities for funding requirements
a. Advise donors (NFC)
b. Monitor funding, expenditure and effectiveness

iv. Rhino conservation areas and sanctuaries
a. Assess priority areas for rhino conservation
b. Assess new rhino conservation areas

B. National Forum Committee (NFC)

Chairman: Director, KWS. Established in March 1988; 11 meetings have been held up to end of 1992.

Terms of Reference:

i. Funding requirements
a. Capital costs of construction for infrastructure in new and existing rhino sanctuaries
b. Recurrent costs: assistance with operating costs as necessary
c. Vehicles & Equipment: new & refurbished; maintenance
d. Capture & translocation of rhinos

ii. Information for donors:
    a. from National Management Committee
    b. from rhino conservation areas

C. Association of Private Land Rhino Sanctuaries (APLRS)

Established in May 1988; Officially registered in May 1990; 14 meetings have been held up to the end of 1992.

Terms of reference:

i. Representation of the interests of the private sector involved in the conservation of all rhinos on private land;

ii. Security, management and liaison and/or collaboration with KWS.

ANNEX 5 RHINO MONITORING: DATA AND RECORD FORMAT

The following pages present samples of Data cards and Record Books used by KWS rhino surveillance personnel in monitoring black rhino populations.

RHINO IDENTITY CARD

RHINO SIGHTINGS RECORD

RHINO SIGHTINGS FREQUENCY FORM (example from LNNP)

RHINO CAPTURE RECORD

RHINO MORTALITY RECORD

RHINO AGE AND SIZE CLASSES

RMG: Emslie, Adcock & Hansen (1993)
after Hitchins (1970)

THE ALLOCATION OF INDIVIDUAL BLACK RHINO ID CODE NUMBERS

All rhinos are given one code number (at origin population) which they retain for life

Area	From	To
Nairobi NP	0000	0499 (e.g. Fatuma 0008)
Lake Nakuru NP	0500	0999 (e.g. Kiserian 0502)
Aberdares NP	1000	1499
Masai Mara NR	1500	1999
Amboseli NP	2000	2499
Lewa Downs Ranch: Ngare Sergoi RS	2500	2999
Laikipia Ranching: Ol Ari Nyiro Ranch	3000	3499
Ol Jogi Ranch: Pyramid Game Reserve	3500	3999
Ol Pejeta Ranch: Sweetwaters RS	4000	4499
Solio Ranch	4500	4999
Tsavo West NP: Ngulia RS	5000	5999
Tsavo NP	6000	6999
Meru NP	7000	7499
Mt Kenya	7500	7999
Matthews Range: Kitchich	8000	8499
Loita Hills	8500	8999

ANNEX 6 CRITERIA FOR EVALUATION OF RHINO POPULATIONS (ARSG)

NB Maximum score is 39, minimum is 13

A. POPULATION SIZE

3: Medium over 200 in discrete population
2: Small 25-200 in discrete population
1: V Small < 25 in discrete population

B. GENETIC RARITY

Assessment of Evolutionarily Significant Units (ESUs), Subspecies, Locally adapted populations (e.g. Highland/Lowland Kenya)
3: High
2: Moderate
1: Low

C. EXPANSION PROSPECTS

3: Good Area of suitable habitat sufficient for >100 additional rhino; no significant limiting factors such as water availability, disease, predation, competing herbivores (elephants in confined areas)
2: Moderate 50-100 rhinos (additional)
1: Poor <50 rhinos (additional)

D. STRATEGIC PLANNING

3: Good Detailed strategy/action plan being effectively implemented by management authority
2: Some Draft strategy/action plan **or** partial implementation of an approved strategy/plan
1: Nil No strategic planning for rhino conservation

E. POACHING THREAT

3: Low No significant poaching threat at present
2: Moderate Some threat of subsistence poaching (on species other than rhino) and/or limited commercial poaching (< 2% offtake)
1: High Considerable threat of commercial poaching

F. RECENT POPULATION TREND

3: Up (% net annual increase)
2: Stable
1: Down

G. SURVEY QUALITY

3: Good — Intensive ground survey or specialised aerial survey within last year or certainty of little change since earlier survey
2: Moderate — Scientific survey conducted before last year, or non-scientific reconnaissance survey
1: Poor — Only guesses available

H. GENETIC DIVERSITY

3: No likelihood of loss of genetic diversity through inbreeding and genetic drift
2: some likelihood
1: strong likelihood

I. DEMOGRAPHIC VIABILITY

Adequacy of breeding contact, birth rates, sex ratios, age distribution
3: Good
2: Moderate
1: Poor

J. RECURRENT EXPENDITURE

3: High — > US$ 200/sq km/yr
2: Moderate — $50-200
1: Low — < $50

K. MAN POWER

3: High — 1 man/20 sq km or less
2: Moderate — 1 man/20-50 sq km
1: Low — 1 man/> 50 sq km

L. LOCAL PARTICIPATION

3: High — Local people receive direct benefits, auxiliary scouts, tourist revenue
2: Some
1: Low

M. ECONOMIC POTENTIAL

3: High tourism/safari potential, being realised with rhino as a major attraction/component
2: Moderate

1: Low

ANNEX 7 LIST OF ACRONYMS

AERSG	African Elephant and Rhino Specialist Group (IUCN/SSC)
AFEW	African Fund for Endangered Wildlife
APLRS	Association of Private Land Rhino Sanctuaries
ARSG	African Rhino Specialist Group (IUCN SSC)
AWF	African Wildlife Foundation
CBSG	Captive Breeding Specialist Group (IUCN/SSC)
CC	Carrying Capacity
CITES	Convention on International Trade in Endangered Species of wild fauna and flora
CR	Census Rating (as du Toit 1989, ARSG 1992)
CRES	Centre for Reproduction of Endangered Species (ZSSD)
CWS	Community Wildlife Service (KWS)
DSWT	David Sheldrick Wildlife Trust
EAH	East African Herbarium (NMK)
EWAA	Elsa Wild Animal Appeal
EWT	Eden Wildlife Trust
ESU	Evolutionarily Significant Unit
FoC	Friends of Conservation
FZS	Frankfurt Zoological Society
GoK	Government of Kenya
GMF	Gallmann Memorial Foundation
GR	Game Reserve
ICIPE	International Centre for Insect Physiology and Ecology
ICL	Imperial College London
IDA	International Development Association
ILRAD	International Laboratory for Research on Animal Diseases
IUCN	International Union for the Conservation of Nature and Natural Resources (World Conservation Union)
IPR	Institute of Primate Research (NMK)
IoZ	Institute of Zoology (ZSL)
KARI	Kenya Agriculture Research Institute
KETRI	Kenya Trypanosomiasis Research Institute
KRRP	Kenya Rhino Rescue Project
KWS	Kenya Wildlife Service
KNP	Kenya National Parks
LNNP	Lake Nakuru National Park
MIS	Maximum Interval between Sightings
ML	Management Level (e.g. 75% of Carrying Capacity)
MMNR	Masai Mara National Reserve
MoTW	Ministry of Tourism and Wildlife
NANC	Namibia Dept of Agriculture and Nature Conservation
NFC	National Forum Committee
NGO	Non-Governmental Organisation
NMC	National Management Committee
NMK	National Museums of Kenya
NNP	Nairobi National Park

NP	National Park
NPB	Natal Parks Board
NR	National Reserve
NYZS	New York Zoological Society
ODA	Overseas Development Administration (UK)
OIC	Officer In Charge
PAWS	Protected Areas & Wildlife Service Project (IDA/WB)
PHVA	Population & Habitat Viability Analysis
PTES	Peoples Trust for Endangered Species
RMG	Rhino Management Group (South Africa/Namibia)
RRT	Rhino Rescue Trust (UK)
RS	Rhino Sanctuary
SANP	South Africa National Parks
SSC	Species Survival Commission
TENP	Tsavo East National Park
TWNP	Tsavo West National Park
WB	World Bank
WCI	Wildlife Conservation International (NYZS)
WCMD	Wildlife Conservation and Management Department
WPU	Wildlife Protection Unit (KWS)
WWF	World Wide Fund for Nature
ZNPWLM	Zimbabwe Dept of National Parks and WildLife Management
ZSL	Zoological Society of London
ZSSD	Zoological Society of San Diego

FIGURE 4 TRANSLOCATION HISTORY OF KENYA BLACK RHINO: 1963-1992
(FENCED SANCTUARY , *LOWLAND/TSETSE AREA*, *=orphan rhino)

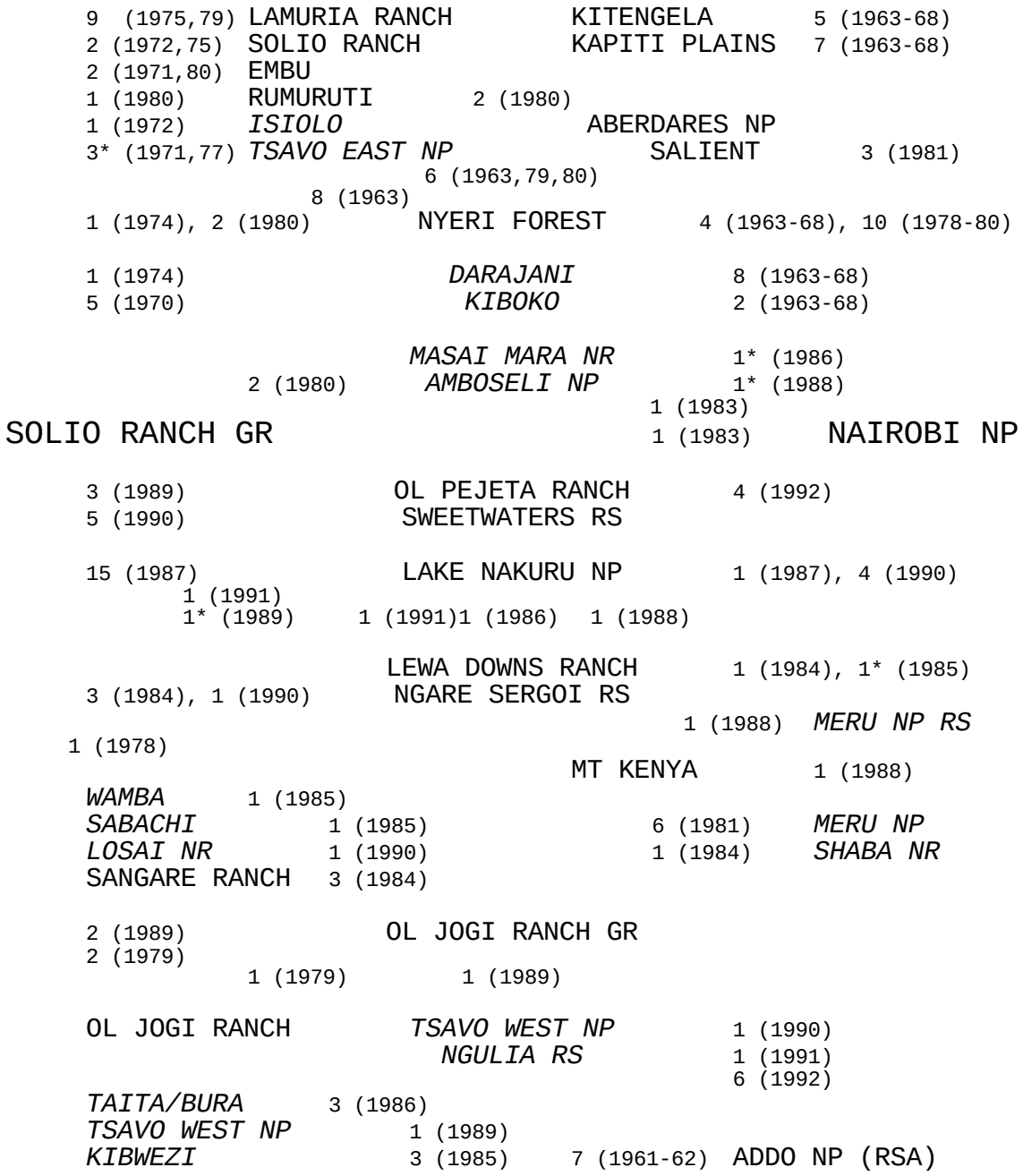

TABLE 1 KENYA BLACK RHINO POPULATION ESTIMATES (December 1992)

NP/RESERVE Area/Section	Population Estimate	Area (km^2)	Density (km^{-2})	Census Precision Remarks
KWS NPs/Reserves:				
NAIROBI NP	60	114	0.53	Known Population
ABERDARES NP				Close to true population:
Salient	50	70	0.71	1992 monitoring
N area	4			1991-2 monitoring
LAKE NAKURU NP	31	142	0.22	Known Population
MASAI MARA NR	32	1690	0.02	1992 monitoring: FoC
TSAVO WEST NP:				Close to true population:
Ngulia RS	17	65	0.26	15 confirmed in 1993 monitoring
N area	15			1992 estimate from 1989 census
TSAVO EAST NP	2			1992 reports
AMBOSELI NP	5	390	0.01	Known population
Subtotal	**216**			
Private Ranches:				
SOLIO	66	68	0.97	1992 estimate from 1989-91 monitoring
OL ARI NYIRO	30	390	0.08	1992 estimate from 1988 census
LEWA DOWNS	13	40	0.30	Known population
OL PEJETA	11	93	0.12	Known population
OL JOGI	12	50	0.24	Known population
Subtotal	**132**			
Forest Reserves/Communal Land:				
MATTHEWS RANGE	17			1992 estimate from 1992 monitoring
LOITA HILLS	14			1992 estimate from 1992 monitoring
MT KENYA	10			1992 estimate from 1988 census
Subtotal	**41**			
Outliers/Others:				
TANA R DISTRICT	8			Reports 1991: K Smith/Informers
KARISSIA HILLS	6			1992 estimate from 1988 census
NDOTOS/KENO	3			1992 estimate from 1992 monitoring
LUONIEK RANCH	3			Split from Ol Ari Nyiro: 1991-2
CHYULU HILLS N	2			Reports 1991: R Bonham
WAJIR DISTRICT	2			Reports 1991: A Jama
JILORI-CHACAMA	1			Reports 1990: A Russell
ORPHANS	6			DSWT 3, Solio 2, Ol Pejeta 1
Subtotal	**31**			
TOTAL	**420**			

TABLE 2 AGE AND SEX STRUCTURE OF BLACK RHINO POPULATIONS IN KENYA SANCTUARIES (December 1992)

CR = Census rating (du Toit 1989 - as shown in Table 3)

Rhino Sanctuary:	MALES:				FEMALES:				UNKNOWN SEX:				TOTAL	CR
TYPE & Name	Adults (>6 yr)	Subadults (4-6 yr)	Calves (<4 yr)	Total	Adults (>6 yr)	Subadults (4-6 yr)	Calves (<4 yr)	Total	Adults (>6 yr)	Subadults (4-6 yr)	Calves (<4 yr)	Total		
RING-FENCED:														
Lake Nakuru NP	10	3	1	14	8	2	3	13	0	0	4	4	31	1
Ngulia RS	3	3	0	6	5	3	0	8	0	2	1	3	17	1
Solio Ranch	12	2	9	23	19	4	4	27	5	6	5	16	66	2
Lewa Downs Ranch	1	0	1	2	5	4	2	11	0	0	0	0	13	1
Ol Jogi Ranch	2	3	1	6	3	1	1	5	0	0	1	1	12	1
Ol Pejeta Ranch	3	2	0	5	2	3	0	5	0	0	1	1	11	1
Subtotal	31	14	12	56	42	17	10	69	5	8	12	25	150	
PART-FENCED:														
Nairobi NP	17	6	8	31	16	6	5	27	0	0	2	2	60	1
Aberdares NP	8	2	2	13	12	3	5	20	9	0	3	12	50	2
Ol Ari Nyiro Ranch	10	0	0	10	5	0	0	5	0	0	0	15	30	3
Subtotal	35	8	10	54	33	9	10	52	9	0	5	29	140	
TOTAL	66	22	22	110	75	26	20	121	14	8	17	54	290	

Census Reliability Rating: 1 = Known population/Total count;
(Du Toit 1988) 2 = Estimate based on rhino survey within last 2 years;
3 = Estimate based on rhino survey over 2 years old, or recent non-specific survey;
4 = Informed guess

AREA	SIZE (km^2)	BLACK AND RHINO CENSUS NUMBERS RATING (1 - 4)						TREND	TREND
		1987	1988	1989	1990	1991	1992	87-92	91-92
Aberdare National Park	766	60 (4)	41 (1)	41 (2)	44 (2)	49 (1)	49 (2)	Stable	Stable
Amboseli National Park and surrounds	800	10 (1)	10 (1)	9 (1)	7 (1)	2 (1)	5 (1)	Down	N/A
Chyulu Hills/Sultan Hamud	N/A			1 (1)	1 (1)	4 (2)	2 (2)	N/A	N/A
Jilori/Chacama	N/A		1 (1)	1 (1)	1 (2)	1 (2)	1 (3)	N/A	N/A
Karissia Hills/Maralal	N/A		6 (1)	6 (1)	6 (2)	6 (2)	6 (3)	Stable	Stable
Lake Nakuru National Park	140	2 (1)	20 (1)	20 (1)	28 (1)	30 (1)	30 (1)	Up	Stable
Laikipia Ranch - Ol Ari Nyiro	390	47 (1)	43 (1)	43 (2)	44 (2)	40 (3)	35 (3)	Down	Down
Lewa Downs Ranch - Ngare Sergol	40	11 (1)	13 (1)	13 (1)	14 (1)	12 (1)	11 (1)	Stable	Stable
Loita Hills/Nguruman Escarpment	N/A	5 (3)	12 (1)	12 (2)	12 (2)	14 (1)	14 (2)	Stable	Stable
Luoniek Ranch	N/A					4 (1)	3 (1)	N/A	N/A
Marsabit National Reserve	140	5 (4)	0					N/A	N/A
Masai Mara National Reserve	1680	19 (1)	25 (1)	25 (1)	24 (1)	30 (1)	30 (1)	Up	Stable
Meru National Park and surrounds	870	>5 (3)	1 (1)	1 (1)	1 (1)	0		N/A	N/A
Mount Kenya NP and surrounds	N/A	50 (4)	10 (1)	10 (1)	10 (2)	10 (2)	10 (3)	Stable	Stable
Nairobi National Park	114	>32 (2)	57 (1)	57 (1)	61 (1)	62 (1)	65 (1)	Up	Up
Ndoto Mountains/Keno/Losal NR	N/A				1 (1)	3 (2)	3 (2)	N/A	N/A
Ngeng Valley/Matthews Range/Kitchich	N/A	18 (2)	21 (1)	20 (2)	20 (2)	14 (1)	17 (2)	Stable	Up
North Horr	N/A	3 (3)	0					N/A	N/A
Ol Jogi Ranch	50	7 (1)	9 (1)	10 (1)	11 (1)	11 (1)	11 (1)	Up	Stable
Ol Pejeta Ranch - Sweetwaters	93			4 (1)	8 (1)	8 (1)	11 (1)	Up	Stable
Orphans (Nbi 3, Solio 2, Ol Pej 1)	N/A		5 (1)	5 (1)	5 (1)	6 (1)	6 (1)	N/A	N/A
Solio Ranch	68	91 (1)	73 (2)	58 (1)	56 (1)	63 (1)	65 (2)	Up	Up
Tana River Delta/Garsen	N/A	6 (3)	14 (1)	14 (1)	12 (2)	8 (2)	8 (3)	Down	Down
Tsavo National Park (West & East)	20200	150 (4)	10 (1)	10 (2)	16 (2)	17 (3)	17 (3)	Stable	Stable
Tsavo West NP - Ngulia sanctuary	65		9 (1)	9 (1)	11 (1)	13 (1)	13 (1)	Up	Stable
Wajir District	N/A					2 (4)	2 (4)	N/A	N/A
TOTAL		**>521**	**388**	**388**	**383**	**408**	**414**	Down	Stable

TABLE 3 STOCKING AND GROWTH RATES IN KENYA RHINO SANCTUARIES: 1962-1992

National Park or Reserve	Stocking Number(Date)	First Census Number(Date)	1992 Total	Annual Growth(%)
Nairobi NP	28(1967-69) 10(1978-80)	30(1970)	61	3.0:1970-86 5.7:1986-90 **10.0**:1990-92
(8 rhinos moved out: 1990-92)				
Solio Ranch GR	23(1970-80)	30(1980)	65	12.0:1980-86 7.5:1986-90
(26 rhinos moved out: 1987-90)				
Lake Nakuru NP	17(1987) 4(1990)	19(1987)	30	6.0:1987-90
1 rhino moved out: 1988? - Mawingo				
Masai Mara NR	0	108(1970) 13(1985)	28	9.9:1986-90

TABLE 4 SOURCES/ORIGINS OF FOUNDERS OF KENYA RHINO POPULATIONS

NP/Reserve	N	S	Source of Founders (effective)
Solio Ranch	65	8	Solio/Lamuria, Darajani, Embu
Nairobi NP	61	4?	Darajani, Kapiti, Kitengela, NF
Aberdares NP		45	1? Indigenous (but some from NF?: 1978)
Laikipia R	35	1	Indigenous
Lake Nakuru NP		30	4 Solio, Nairobi NP, Kitengela, NF
Masai Mara NR		30	1 Indigenous
Tsavo West NP		15	1? Indigenous (but some from Darajani?)
Ngulia RS		13	4 Kibwezi, Taita, TWNP, Nairobi NP
Lewa Downs	11	5	Solio, Matthews, Shaba, Kitengela, NF
Ol Pejeta		11	3 Solio, Nairobi NP, Lewa
Ol Jogi		11	3 Ol Jogi, Kiboko, Solio
Mt Kenya		10	1 Indigenous
Matthews Range		20	1 Indigenous
Loita Hills	14	1	Indigenous

TABLE 7 BREEDING AND MANAGEMENT DATA IN KENYA RHINO SANCTUARIES (December 1992)

CC = Carrying Capacity (Brett 1989a; Foose *et al* 1993) ML = Management Level (section 4.4.1)

Rhino Sanctuary:	Population	MANAGEMENT DATA:					BREEDING PERFORMANCE INDICATORS:			
TYPE & Name	Total	Area (km^2)	Density (km^{-2})	CC	ML	Surplus (Tot-ML)	Sex Ratio	% Calves (< 4 yrs)	% Cows + Calves	% Calves (< 2 yrs)
RING-FENCED:										
Lake Nakuru NP	31	142	0.22	65	50	0	1.08	25.8	100	0.7
Ngulia RS	17	65	0.26	65	50	0	0.75	5.9	20	1.5
Solio Ranch	66	68	0.97	60	45	21	0.85	27.3	95	7.4
Lewa Downs Ranch	13	40	0.33	25	20	0	0.18	23.1	60	5.0
Ol Jogi Ranch	12	50	0.24	20	15	0	1.20	25.0	100	2.0
Ol Pejeta Ranch	11	93	0.12	90	70	0	1.00	9.1	50	1.1
SubTotal	150	458	0.33	325	250	21	0.81	22.7	81	2.4
PART-FENCED:										
Nairobi NP	60	114	0.54	65	50	10	1.11	26.2	100	6.1
Aberdares NP	50	70	0.64	100	75	0	0.65	24.4	92	4.3
Ol Ari Nyiro Ranch	30	390	0.08	100	75	0	2.00	6.7	40	0.3
SubTotal	140	574	0.24	265	200	10	1.02	25.0	88	1.9
TOTAL	290	1032	0.28	590	450	31	0.90	23.8	91	2.1

TABLE X THE AVAILABILITY OF RHINOS FOR TRANSLOCATION FROM RHINO SANCTUARIES: 1993-2002

National Park or Reserve	r(%)	ML	1992 Total	1993 Trans	1994 Trans	1995 Trans	1996 Trans	1997 Trans	1998 Trans	1999 Trans	2000 Trans	2001 Trans	2002 Trans
Nairobi NP	3.8	50	61	6	5	6			6				6
Solio Ranch	3.9	45	66	16	5		5			5			5
Totals		145	158	22	10	6	5	0	6	11	0	0	11
Nairobi NP	4.7	50	61	6	5	7		5			5		5
Solio Ranch	4.7	45	66	16	5		6		5			6	
Totals		145	158	22	10	7	6	5	5	0	5	6	7
Nairobi NP	10	50	61	6	5	5	5	5	5	5	5	5	5
Solio Ranch	10	45	66	16	9	5		9		9		9	
Lake Nakuru NP	10	50	31							10	5	5	5
Totals		145	158	22	14	10	5	14	5	24	10	19	10

All figures in Kenya Shillings

DONOR/NGO	1994	1995	1996	1997	1998	1999	1990	1991	TOTAL
African Fund for Endangered Wildlife (AFEW)									
Lake Nakuru NP			60,000						60,000
Ngeng Valley					86,000	86,000			172,000
African Wildlife Foundation (AWF)									
General			1,500	55,900					57,400
Lake Nakuru NP			112,000	100,000					212,000
Tsavo NP		9,600	9,600	238,820	31,351	305,252	585,511	84,912	1,265,048
David Sheldrick Wildlife Trust (DSWT)									
Aberdares NP					9,484				9,484
General	325,860	38,339	141,660	143,085	280,915		150,000		1,079,859
Lake Nakuru NP		53,521	7,898	20,090	10,369				91,878
Orphan Care					60,000	80,000	90,000	100,000	330,000
Tsavo NP		88,100	8,860	132,455	152,198	126,585	265,200	80,000	853,498
East African Wildlife Society (EAWLS)									
Aberdares NP					584,640		65,900	501,660	1,152,200
Anti-poaching		23,900	91,220	225,280	217,480				557,880
Lake Nakuru NP		55,320	55,800	64,940	23,880	1,100	2,960	141,660	345,660
Laikipia Ranching	223,600	25,260	3,520	144,100		185,000	1,360		582,840
Meru NP	6,000								6,000
Nairobi NP	25,680	14,100		4,760		108,040			152,580
Rhino awareness	145,780	192,220	49,920	88,380	270,160				746,460
Tsavo NP	169,900		22,160	10,000			480,500	986,280	1,668,840
Eden Wildlife Trust (EWT)									
Aberdares NP			32,000	53,632	26,112	508,180	480,000		1,099,924
Amboseli NP							36,000	27,200	63,200
General/Helicopter	480,000	288,000				465,000	120,000	90,000	1,443,000
Lolta Hills						72,000	72,000	36,000	180,000
Lewa Downs Ranch					60,800	100,000	100,000	50,000	310,800
Masai Mara NR	70,400	454,400	70,048						594,848
Meru NP				272,640	241,984				514,624
Ngeng Valley	84,480	84,480	84,480	99,840	110,400	304,600	399,500	197,881	1,365,881

DONOR/NGO	1994	1995	1996	1997	1998	1999	1999	1991	TOTAL
Tana river						12,000	12,000	4,000	28,000
Tsavo NP			307,200	240,000	96,000	568,000	135,000	1,688	1,347,888
Elsa Wild Animal Appeal (EWAA)									
Aberdares NP					88,600	83,175			172,775
Lake Nakuru NP			5,412	10,052		66,540			82,004
Friends of Conservation (FoC)									
Capture Unit						1,600,000	763,572	505,301	2,868,873
Masai Mara NR (+ WWF)		950,000	800,000	810,000	960,000	1,105,000	702,325	721,532	6,048,857
Frankfurt Zoological Society (FZS)									
Lake Nakuru NP			888,426						888,426
Overseas Development Administration (ODA-UK)									
Aberdares NP								5,208,000	5,208,000
General			986,000						986,000
Peoples Trust for Endangered Species (PTES)									
General									
Lake Nakuru NP									
Rhino Ark									
Aberdares NP					3,382,000	3,280,000	10,634,819	9,913,580	27,220,399
Rhino Rescue Trust (RRT)									
Aberdares NP					393,750				393,750
Lake Nakuru NP			5,026,953	5,006,470	4,606,855	1,026,586	1,221,649		18,488,513
Tsavo NP						80,000	282,586		362,586
Wildlife Conservation International (WCI-NYZS)									
Aberdares NP						1,000,000			1,000,000
Nairobi NP					2,000,000	350,000	26,612	967,475	3,344,087
Research				380,000	190,000	95,000			665,000
World Wide Fund for Nature (WWF)									
Aberdares NP						900,000	441,526	59,258	1,400,784
General support (USAID)					720,000	2,100,000			2,820,000
Lake Nakuru NP			560,000	527,100	180,000	300,000	38,207	54,212	1,660,519
Laikipia Ranching			958,000	1,131,800	1,346,960	1,605,600	19,360	12,901	5,074,821
Lewa Downs Ranch			307,000	860,000	1,300,000	720,000	501,051	673,533	4,361,584
Zoological Society of London (ZSL)									
General							537,204	186,278	723,482

DONOR/YEAR	1994	1995	1996	1997	1998	1999	1990	1991	TOTAL
Laikipia Ranching				98,290	232,082	167,895			498,267
TOTALS	1,533,994	2,278,225	11,491,943	10,710,821	17,995,998	18,293,542	18,100,832	28,995,342	109,570,097

All figures in Kenya Shillings

AREA \ DONOR	AFEW	AWF	DSWT	EAWLS	EWT	EWAA	FoC	FZS	ODA	PTES	R ARK	RRT	WCI	WWF	ZSL	TOTAL
Aberdares NP			9,484	1,162,200	1,099,924	172,775			5,208,000		27,220,399	393,750	1,000,000	1,400,784		**37,667,316**
Amboseli NP					63,200											**63,200**
Anti-poaching				557,880												**557,880**
Awareness				746,460												**746,460**
Capture Unit							2,868,873									**2,868,873**
General		57,400	1,079,859		1,443,000				986,000					2,820,000	723,482	**7,109,741**
Laikipia R				582,840										5,074,621	498,267	**6,155,728**
Lake Nakuru NP	60,000	212,000	91,878	345,660		82,004		898,426				18,488,513		1,659,519		**21,838,000**
Lewa Downs					310,800									4,361,584		**4,672,384**
Loita Hills					180,000											**180,000**
Masai Mara NR					594,848		6,048,857									**6,643,705**
Meru NP				6,000	514,624											**520,624**
Nairobi NP				152,580									3,344,087			**3,496,667**
Ngeng Valley	172,000				1,365,661											**1,537,661**
Orphan Care			330,000													**330,000**
Research													665,000			**665,000**
Tana river					28,000											**28,000**
Tsavo NP		1,265,046	853,408	1,668,840	1,347,888							362,586				**5,497,768**
TOTALS	**232,000**	**1,534,446**	**2,364,629**	**5,222,460**	**6,947,945**	**254,779**	**8,917,730**	**898,426**	**6,194,000**	**0**	**27,220,399**	**19,244,849**	**5,009,087**	**15,316,508**	**1,221,749**	**100,579,007**

TABLE BREEDING SUCCESS IN SANCTUARIES STOCKED WITH RHINOS

Rhino Sanctuary	No. rhinos stocked	Start Year	No. Births	No. Deaths	1992 Total	Number Supplied	Increase (Factor)
Solio Ranch	23	1970	?	?	66	30	73 (4.4)
Nairobi NP	38	1963	?	?	61	16	39 (2.0)
Lake Nakuru NP	21	1987	10	1	31	1	9 (1.5)
Ol Jogi Ranch	5	1979	10	2	12	1	8 (2.6)
Lewa Downs Ranch	15	1984	10	8	13	4	2 (1.1)
Ngulia (Tsavo West NP)	15	1986	4	2	17	0	2 (1.1)
Ol Pejeta Ranch	14	1989	2	4	11	1	0 (1.0)
TOTAL	129				211	53	134 (2.1)

TABLE 10 TRANSLOCATION IMPLEMENTATION SCEDULE

DONOR SANCTUARY	RECIPIENT SANCTUARY/AREA	1993		1994		1995		1996		1997	
Nairobi NP	Ngulia (Tsavo West NP)	4									
Nairobi NP	Tsavo East NP	2		5		4	3			5	
Solio Ranch	Lewa Downs Ranch	4	4								
Solio Ranch	Ol Pejeta Ranch	4	4								
Solio Ranch	Aberdares NP Salient			3				3			
Solio Ranch	Mt Kenya (Kihari Forest)			2				3			
TOTAL		22		10		7		6		5	