Darwin Initiative for the Survival of Species

Final Report

1. Darwin Project Information

Project Reference No.	162/12/004
Project title	Building capacity for conservation of a critically endangered flagship species
Country	Kenya
UK Contractor	Zoological Society of London
Partner Organisation (s)	Kenya Wildlife Service, IUCN SSC AfRSG
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Project website	
Author(s), date	Dr R. Amin, B. Okita-Ouma, Dr R. Emslie, K. Adcock (15th July 2007)

2. Project Background/Rationale

This project implements priorities listed in the Kenya 5-year Black Rhino Strategy (KBRS), which was produced jointly by Kenya Wildlife Service (KWS), ZSL, African Rhino Specialist Group (AfRSG) and other stake-holders/NGOs and endorsed at the highest level within KWS. The project was developed in collaboration with the KWS rhino programme co-ordinator and the KWS rhino scientist, alongside input from the IUCN SSC AfRSG. Kenya held, at the end of 2003, 86% of the estimated 500 remaining critically endangered eastern black rhino (*Diceros bicornis michaeli*). The 5-year KBRS has given the highest priority to their biological management to help achieve and maintain rapid meta-population growth to increase rhino numbers. Specific training and capacity-building in rhino monitoring (from field data collection to end-reporting) were identified as urgently required. Procedures to assess black rhino habitat carrying capacity have become a necessity to assist in developing new viable populations in Kenya and to manage existing rhino sanctuaries, most of which face loss of suitable habitat through high rhino- and competing browser- densities. Delivering these objectives meets the CBD and coincides with key objectives of the 1998 Kenyan National BAP, namely building technical capacity, improving access to resources and training, and strengthening of research and monitoring capacity.

3. Project Summary

This project's purpose is to develop a team of skilled Kenyan researchers and park field personnel capable of significantly contributing to the achievement of one of Kenya's key conservation goals: namely, increasing the numbers of the critically endangered eastern black rhino (*Diceros bicornis michaeli*), and conserving its natural habitat. It aims to develop human capacity and procedural mechanisms within the Kenyan Rhino Conservation Programme to 1) train personnel in field rhino monitoring, data collection, analysis and reporting; 2) produce standardised annual rhino status reports which assess the numbers, performance and population dynamics of Kenya's black rhino populations to aid biological management decision making; and 3) assess black rhino habitat conditions and carrying capacities in fenced rhino sanctuaries, allowing the management of habitats by adjusting rhino and other browser population densities.

The project outputs are as follows:

i) 20 trained instructors (rhino officers) in rhino monitoring; ii) 20 trained officers undertaking data quality control, basic processing & reporting using the GIS based Rhino Information Management System; iii) 165 rangers trained in rhino monitoring (by local instructors with support and monitoring from Darwin fellows); iv) 1 KWS rhino programme coordinator, 1 KWS rhino scientist and 10 rhino officers/researchers trained in the synthesis and interpretation of annual park and national rhino status reports; v) Standardised annual rhino status reports at both park and national level; vi) A black rhino ecological carrying capacity model for Kenya with estimates for 11 rhino parks; trained staff and set procedures for rhino habitat assessments; vii) 2 KWS rhino scientists trained in the use of RHINO mark recapture population estimation tool; viii) Fully operational GIS based Rhino Information Management System in 11 parks and KWS headquarters; ix) Field staff trained in wildlife and sanctuary management (2 MSc, 1 BSc and 4 Certificates); x) 1000 rhino conservation education booklets published and distributed to schools; xi) 4 peer-reviewed papers published; xii) 2 radio broadcasts.

The project logical framework is provided in the appendix.

The operational plan was modified as follows:

Training in habitat assessment was originally planned for October 2004 but was rescheduled for July 2005 (permission obtained from Darwin Secretariat - 2004). In 2004 it became clear that the scientific staff of KWS were not in a position to take over the routine browse monitoring planned for the Kenyan Rhino Programme, as they had become regionalised and could not build this function into their extended duties. Together with the Kenyan Rhino Coordinator, Martin Mulama, it was decided that the training should involve several suitable rhino programme field staff and relevant staff from the private rhino sanctuaries.

1. The training of two park Education Wardens (Elema Hapicha – Lake Nakuru NP and Lucy Makosi – Tsavo West NP) at the ZSL education centre (2 weeks in July 2006). This was an extra activity and enabled the two Kenyan education officers to develop important skills, obtain much needed hands-on experience and to work with the UK education staff to develop materials and finalise the rhino education cards. The Darwin Secretariat approved the use of project savings (2005). ZSL provided funds for accommodation and food. ZSL's zoo flat was also be used to keep costs down.
2. *Habitat assessment field work was originally scheduled for July-August 2004, but was delayed. This was because the KWS Rhino Programme vehicle, which was to be used, was required for vital black rhino translocations to new areas in Kenya over that period. Finally, ECC field work took place in two stages, using a hire-vehicle. During September and October 2004, 6 key black rhino areas were successfully surveyed for black rhino browse availability and species composition. These were: Nairobi NP, Maasai Mara/ Trans-Mara, Lake Nakuru NP, Aberdares NP-Salient, Solio Ranch and Sweetwaters Ranch. In January and February 2005, the remaining three Kenyan rhino sanctuaries Ngulia, Lewa and Ol Jogi were surveyed. The Darwin Secretariat was informed of this change and approval was obtained (2004).*

The Articles under the Convention on Biological Diversity covered by this project include:

- Articles 6 (general measures for conservation & sustainable use). The new national 5-year black rhino strategy (2007–2011) which has recently been developed (Stakeholder workshop - Feb 2007) has placed increased emphasis on communities particularly those in the buffer zones of the large protected areas like the Tsavos.
- Article 7 (identification and monitoring). The project has focussed on establishing an integrated, standardised monitoring system for rhino numbers and status, and for habitat change which through continuous and annual status reporting and feedback is providing the necessary information for protection, meta-population management and programme implementation.

- Article 8 (in situ conservation). The project's activities were undertaken in all rhino conservation areas in Kenya for the recovery of rhino population and its habitat. These are: 1) Aberdare National Park; 2) Chyulu Hills National Park; 3) Laikipia Game Reserve; 4) Lake Nakuru National Park; 5) Lewa Wildife Conservancy; 6) Maasai Mara Game Reserve; 7) Meru National Park; 8) Mugie Game Reserve; 9) Nairobi National Park; 10) Ol Jogi Game Reserve; 11) Sweetwaters Game Reserve (Ol Pejeta); 12) Tsavo East National Park; 13) Tsavo West National Park (Ngulia Rhino Sanctuary). In all these areas black rhino act as umbrella species for the habitats / ecosystems because their conservation requirements, by default, encompass those of other smaller species.
- Article 12 (research and training). Training and research were important components of the project. The project has built in-country Kenyan technical capacity to effectively and sustainably run the necessary rhino monitoring, habitat assessment, and biological management decision-making aspects of the Kenyan rhino conservation programme. In addition, this project has contributed to achieving key objectives of the 1998 Kenyan National Biodiversity Action Plan, namely: 1) developing the expertise within Kenya to promote the protection of natural habitats for the maintenance of viable populations (e.g. of black rhino) in their natural surroundings; 2) providing a scientific and technical education and training programme to facilitate the conservation and sustainable management of key components of Kenya's biodiversity (e.g. rhino and rhino habitat); and 3) establishing a range of field-based tools and infrastructure supporting Kenya's capacity for protected area management. Further, because rhinos, elephants and other large browsers (e.g. giraffe) can significantly modify their habitat, their occurrence at high density can severely impact on the community structure and biodiversity of restricted areas. This is especially the case inside smaller (<200km^2) fenced sanctuaries within which most of Kenya's rhino are conserved. The improved rhino monitoring, habitat assessments and status reporting is therefore benefiting not only the management and conservation of rhinos but also positively impacting on the effective conservation of many other species.
- Article 13 (public education and awareness). The public education and awareness was only a very small element of the project (rhino education cards developed in English and Swahili). However, extra activities were undertaken in this area. Training was provided to the education officers of Lake Nakuru and Tsavo West NPs on a newer approach to training young children based on learning through discovery techniques.
- Article 15 (access to genetic resources). Blood serum and faecal samples were provided for MSc student research projects. The projects included: 1) studying elevations of serum iron, transferrin saturation and GGT in captive black rhinos as compared to wild populations (paper has been accepted for publication in the Veterinary Record) and 2) monitoring cortisol levels in captive animals.

The Darwin project has made significant progress towards building a body of skilled field personnel in Kenyan rhino areas, undertaking black rhino monitoring, data collection, data analysis and reporting. Field rangers are receiving ongoing training by a team of 28 trained local instructors. Over 150 rhino rangers have been trained so far; recently c. 400 ranger recruits were trained by the trained instructors at the KWS national ranger training school and has been built into the curriculum will continue. Twenty-six staff from 13 reserves have been trained in the production of annual park status reports and three sets of park reports have been produced. The KWS rhino scientist has also been trained in the production and interpretation of national status report.

Twelve park staff from 6 key national parks have also been trained in sanctuary wildlife management (6-month certificate course - 3 students receiving Distinctions and best student awards). Three senior staff and park wardens have been trained in Conservation Biology and Wildlife Management (2 MScs and 1 BSc with one student receiving Distinction in MSc from University of Canterbury) thus building much needed capacity at the research and managerial level.

The project has successfully developed and implemented field tools and procedural mechanisms for rhino monitoring, data collection and analysis. Field rangers have been trained to accurately complete patrol and sighting forms. The project has produced rhino master ID files which experienced accredited observers keep up-to-date and use to check sighting data. A GIS based black rhino information management system is being used to store and analyse monitoring data. At least two staff in each area have been trained in its use and data quality control procedures. Four programme scientists have been trained in the RHINO mark-recapture population estimation tool, and population estimates have been made using this software for three areas.

The quality of black rhino monitoring in Kenya has significantly improved. Valuable information on the productivity, health and overall status of Kenya's black rhino populations has been compiled.

Nine reserves have been assessed in detail for black rhino browse availability and species composition. Maps of rhino-relevant vegetation types, browse availability and suitability have been produced using survey data and satellite imagery. Environmental information including rainfall and soil / geology have been compiled. Procedural manuals for habitat assessment and scoring browse availability have been produced. The habitat monitoring work and carrying capacity modelling has improved understanding of habitat features affecting black rhino densities and productivity in Kenya. The capacity of Kenyans to undertake periodic habitat evaluation has been developed, enabling sound management of new and existing rhino areas. Management actions are now taken based on this information to optimally manage black rhino habitats and browser densities. Examples include translocation of surplus rhinos from Nairobi, Lake Nakuru National Parks and Solio GR to create new populations in Mugie Sanctuary, Meru National Park and Ol-Pejeta extension, removal of 155 elephants from Ngulia Rhino Sanctuary to reduce the browser impact on the vegetation and developing an extension to the sanctuary and creation of a wider IPZ. Kenya, for the first time since the 1970s, is achieving annual growth rates above the target 5%.

Community education and awareness was not a large component of the project. The project team realise its importance and has focussed on establishing a new approach to teaching based on learning by discovery. A pilot project has been established at the Lake Nakuru NP education centre and some materials have been developed and training provided to the education wardens.

Additional significant accomplishments this project has significantly contributed are as follows:

1) the project has assisted in the process of initiating the East African Community Rhino Management Group (comprising of Kenya, Tanzania and Uganda) with the overall goal to promote the establishment and maintenance of a viable and well distributed meta-population of 2000 eastern black rhino as flagship species for biodiversity conservation within the East African region through coordination and provision of technical support. The main benefits at both regional and individual country level include: a) easier sourcing of rhinos to build-up numbers in Tanzania and Uganda; b) improved capacity through training and sharing of information (monitoring, veterinary expertise etc.); c) improved standardised data collection and status reporting; d) increased security of rhino and other wildlife species; e) regional prioritisation of rhino areas; f) creation of new viable populations (minimising risk); g) enhanced meta-population management; h) increased tourism and revenue; greater leveraging of international funds; improved wider species programme cooperation; i) further consolidation of regional socio-economic cooperation.
2) Comprehensive review of previous National 5-year conservation strategy and facilitation in the development of the 2007-2011 conservation strategy and its write-up. This new 2007-2011 strategy aims to resolve; coordination concerns, site specific challenges and maintain capacity and standards set in monitoring and biological management. More emphasis is to be placed on buffer zone or neighbourhood communities, implementing systems that are socio-economically sustainable and politically acceptable. Therefore, securing the whole environment of the rhino and ensuring that the gains are more consistent and sustained across all conservation areas. This includes greater emphasis on the large free-ranging areas and the forest populations. Six strategic objectives with

associated indicators, actions and set responsibilities have been developed to achieve this.

3) Significant management decisions including the removal of 255 elephants from Ngulia Rhino Sanctuary and its expansion to a size of 90 km^2; creation of an Intensive Patrol Zone in Tsavo West NP with the planned translocations of 10 rhinos in late 2007 to create a free-ranging population which still has a potential of 5000 rhinos in Tsavo given good security; de-stocking some of the fenced areas (Nairobi NP, Lake Nakuru NP, Solio GR) based on the outputs of the habitat and ECC assessments and creation of new rhino areas (Mugie RS, Meru NP Rhino Sanctuary, Ol-Pejeta extension).

4. Scientific, Training, and Technical Assessment

Training in Rhino Monitoring: Training of 20 rhino officers as instructors to train field rangers on a regular basis Intensive on-site training of 165 field rangers in rhino monitoring techniques (by newly trained local instructors with support from Darwin Fellows)

The Darwin AfRSG training course was designed for use directly in operational situations where instructors work with trainees in the field, that is, to be integrated within the normal management structure of the conservation area. Training 'on site' has the advantage that trainees do not have to be removed from the field for any length of time, which may otherwise compromise daily duties and reserve security. Training can instead be combined with other routine functions, making both the training and the patrol and monitoring function itself a responsibility of the management structure. The alternative is to bring in outside instructors or attend a training school. Besides disrupting daily duties and increasing costs, this results in the loss of personal contact and continuity provided by an in-line instructor.

Instructor trainees were selected by the KWS Rhino Programme Office. A minimum of two staff were selected from each area to attend the 6-day training workshop held in Lake Nakuru NP. The selection of the trainees was based on the following criteria.

1) Personal experience in the field. They must have the ability to conduct effective anti-poaching and monitoring patrols, locate animals and observe and record in the field.

2) Leadership qualities. They must have the ability to motivate and inspire confidence in their staff.

3) Communication skills. They must have the ability to convey information to their trainees and evaluate their response, and engage with communities.

Staff turnover and inexperience are likely to be the main weaknesses of any training approach, and the training programme seeks to overcome these problems by:

1. Ensuring each component of the training course is a stand-alone module, so that a new trainee can join into the training course at any stage, without having to know things from other modules.

2. Providing standardised training materials. Each instructor is given a self-contained package of training resource materials. This ensures that correct information is conveyed, and in a standardised format.

3. Suggesting methods. Instruction is essentially a function of an individual's personality. The course suggests methods that are known to work, yet allows the flexibility to let instructors communicate a concept in their own way.

4. Providing background material for the instructor. Training courses for instructors could also be conducted, but in the absence of specific training for instructors, the rationale for each component of the training course is clearly stated.

The training package consists of the following:

- Instructor's Handbook comprising of an introduction and 12 course modules, the trainees workbook and an appendix.
- Set of laminated posters

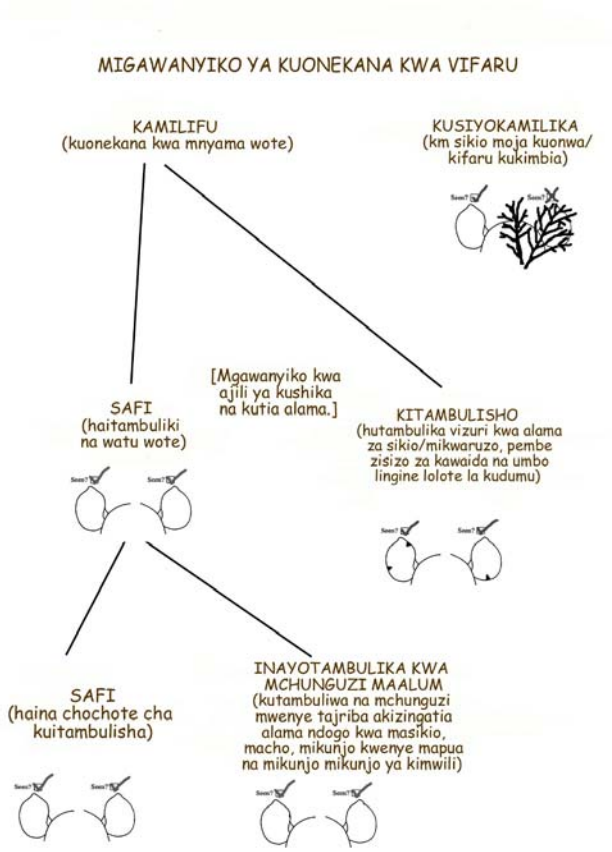
- A master copy of the Trainees' workbook - each trainee in the field is given their own copy of this. Evaluation exercises are completed in the workbook, which allow the monitoring of trainee progress.
- Field recording forms

The 12 modules were designed to achieve the following training objectives:

1. Conservation Background: Problems currently faced in rhino conservation; the need for conservation and protection programmes; the role of the patrol-guard.
2. Rhino Biology: Black (and white) rhino physical and life-history features; daily activity and other behavioural characteristics.
3. Patrol and Tracking Techniques: Locating rhino in the field; approaching rhino safely; observing rhinos undetected
4. Mapwork and GPS: Map reading, location of a patrol/position using a map; record the location of rhino in the field using a grid base-map of an area.
5. Using Binoculars: Function of binoculars; handling and care; how to use binoculars for observation of rhino.
6. Ageing Rhino: Importance of accurate ageing; discrimination of age-classes A-F.
7. Sexing Rhino: Importance of positive sexing; discrimination of sexes.
8. ID Features – Ears: Use of ears as an I.D. characteristic; how to record ear notches
9. ID Features – Horns: Use of horns as a diagnostic character; how to record horn lengths and shapes
10. Use of the Field Recording Notebook: Use of body scars, and broken tails as diagnostic characters; how to record these and generally how to use the field recording notebook
11. Condition Assessment: Assessing the physical body condition and health of the rhino
12. Clean Rhino: Definition of clean animals, and how to sample them in an unbiased way to facilitate the production of unbiased population estimates.

Please see Supplementary Item 1 for some of the training material. Examples of the posters are provided below.

a)



b)

c)

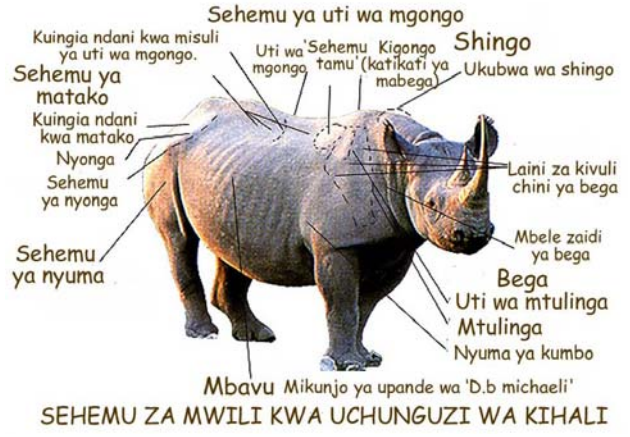


Figure 1: Example of Swahili training posters: (a) classification of rhino sightings; (b) importance of good monitoring data; (c) regions for the assessment of body condition.

The training workshop (6th – 12th October 2003):

Figure 2: Course participants - 26 people from 13 different locations took part in the Darwin AfRSG Rhino Monitoring Instructor's course.

Name	Location
Moses Mugambi	Aberdare National Park
Charles M Gatawa	Aberdare National Park
Stephan Maina	Aberdare National Park
Hillary Ngetch	Chyulu Hills National Park
Munene Rauni	Chyulu Hills National Park
Edward Paya	I'lngwesi Group Ranch
Cedric Khayale Aduvaga	KWS Head Quarters, Nairobi
Anthony Wandera	KWS Head Quarters, Nairobi
Timothy Mwanzia	Lake Nakuru National Park
Polycarp Okuku Okomo	Lake Nakuru National Park
Edwin Kisio	Lewa Wildife Conservancy, Laikipia district
John Kaitikoi	Lewa Wildife Conservancy, Laikipia district
Daniel Kashu	Maasai Mara Game Reserve, Narok
Memusi Ole Nkoitoi	Maasai Mara Game Reserve, Narok
Patrick Leseketeti	Meru National Park
Aden Abass Jelle	Meru National Park
Richard Chepkwony	Nairobi National Park
Humphrey Lenaitoti	Nairobi National Park
Francis E. Ekai	Ol Jogi Game Reserve, Laikepia district
Stephan Elimilim Eregae	Sweetwaters Game Reserve (Ol Pejeta), Laikipia district
Dickson Kariuki	Sweetwaters Game Reserve (Ol Pejeta), Laikipia district
Benson Irungu	Solio Ranch, Laikipia district
Lekishon Kenana	Tsavo East National Park
Mohamed Kamanya	Tsavo East National Park
Nur Gufu	Tsavo West NP-Ngulia Rhino Sanctuary
Adhan Auri Berhe	Tsavo West NP-Ngulia Rhino Sanctuary

Course Structure: The Instructors training programme focussed on familiarising participants with the modular structure, logical layout, and the information content of the training material. The emphasis was on trainee self-sufficiency and initiative, and on formal testing of the participant's abilities and knowledge for each training subject. A high standard of between 72 and 100% (depending on the subject) was needed for trainees to pass the tests. One re-test was allowed on each subject for participants who did not pass the first test.

Training began with an introductory session, covering:

- rhino conservation background and Kenya's role in rhino conservation
- the importance of monitoring rhino
- the organization of the training manual
- the training material provided, and
- what is expected of instructors.

Participants were then "thrown in the deep end" early on. After the introductory session, trainees were divided into four groups. Each trainee had to choose one of the first 6 training modules, read the training material, and prepare and finally present the training module to his group of colleagues. Participants were assisted in their preparation and presentations by the Darwin fellows, and a group leader (a more experienced rhino officer chosen to lead each group). These presentations were not formally evaluated by the Darwin team, the idea being primarily to give participants some initial experience with the course material and with having to use this to train others.

In the late afternoon, the presentations were discussed in a plenary session, and a set of "tips and traps" for presenters was compiled. Overnight, participants had to study the information from the first 6 modules, and next morning they sat formal tests on these subjects:

1. Conservation Background
2. Rhino Biology
3. Patrols and tracking
4. Mapwork and use of a GPS
5. Use of Binoculars
6. Sexing Rhino

From the second day on, specific modules were taught to trainees in detail, and testing was carried out on each module after allowing trainees to study overnight. Trainee instructors were required to attain a high standard of expertise in and understanding of each of these modules:

7: Ageing Rhino

8: Identification features: Ears

9: Clean Rhino

10: Identification features: Horns

11: Identification features: Body Marks, and Use of the Field Recording Booklet

12: Body Condition Assessment

The Thursday was spent in the field at Lake Nakuru National Park, focussing on obtaining rhino sightings, careful rhino observation, and use of the field recording booklet. (Ideally, several modules should have been tested in the field situation, but this was not possible with 26 trainees and limited time for the entire Instructor's training course. It was planned that the people attending the course were already well-experienced in field techniques relating to monitoring rhino).

On Friday, trainees were asked to prepare (in the morning) and formally present (in the afternoon) one of two training modules: *Ageing Rhino* or *Identification Features: Ears*. Their presentations were evaluated by the Darwin fellows according to set criteria. To make the trainee Instructors feel more comfortable, a small "audience" of outsiders was brought in to be "trained".

Evaluation criteria for the presentations:

ID features: Ears
1: Presentation (30 points)
4- Training material well organised?
4- Didn't just read?
4- Talked to everyone?
4- Used posters?
4- Answered questions?
4- Tested trainees? - left ear vs right ear?
6-Tested ? - drawing ear notches on the field form?
2: Content (70 points)
4- Difference between black and white ears/ structure of black rhino ears
4- Why ear notches / tears are valuable in ID
8- Left vs right ear
Drawing notches/tears:
9- Position
4- Size
4- Shape
4- Angle/direction
9- Emphasise importance of observation and data quality - check each ear

Ageing Rhino
1: Presentation (30 points)
4- Training material well organised?
4- Didn't just read?
4- Talked to everyone?
4- Used posters?
4- Answered questions?
10- Tested trainees? Age levels A to F?

2: Content (70 points)
3- Explain why ageing is important
3- Explain why "standardised"
3- Ageing system A to F
2- A = 0-3 months
2- B = 4-12 months
2- C = 1-2 years
2- D = 2-3.5 years
2- E = 3.5 to 6.9 years
2- F = 7 years +
3- A to D main way is size relative to mother

4- General- why ID rhino
8- Ears are main way to tell clean vs ID rhino
4- Filling in forms - clean and ID rhino
8- Filling in forms - tick boxes

4- 4 key levels - Inguinal Region
4-Base of Vulva
4-Base of Tail
4-½ way between base of tail and sacral bump
3- F adults difficult if alone - body size
3- E to F - use horns mainly
4- Boundary points are TOP of age class
3- Ageing rhino <1yr by horns
3- Age cards for field use
3- Can use horn growth but areas differ
5- Don't guess - put ? Is not sure - quality
5- On boundary: do A/B, B/C, C/D, D/E etc

Re-testing of trainees who did not initially obtain a pass mark for any module, was undertaken on the Saturday.

Course Outcome: The final results achieved by participants are given in the table below. To become a fully accreditation Darwin AfRSG Rhino Monitoring Instructor, a trainee needed to achieve a pass mark in all key aspects of the Instructor's course. 18 participants achieved accreditation, and were presented with certificates in a formal closing ceremony.

All those who failed to achieve accreditation failed one or more training subject. They did however all accomplish good overall marks of between 79% and 85%, showing that each of these trainees had the potential to become accredited after acquiring more experience and with extra studying. In some cases, trainees were not at ease speaking in English, which may have contributed to their failure to reach the desired standard in certain modules. Aspiring Instructors were re-tested at a later date when they felt they were ready.

Results obtained by course participants. To achieve Darwin AfRSG accreditation as an Instructor in rhino monitoring, a pass mark was required in each and every subject. The shaded names were assessed as not yet fully competent as monitoring Instructors, while the unshaded names became fully accredited Darwin AfRSG rhino monitoring instructors.

Name	Conservation Background	Biology	Patrol / Tracking	GPS	Bino-culars	Sexing Rhino	Ageing Rhino	ID features: Ears	Clean Rhino	Field Forms (+Horns)	Body Condition	Presen-tation	Overall Average
Pass Mark	**80%**	**80%**	**80%**	**80%**	**80%**	**100%**	**80%**	**73%**	**80%**	**80%**	**80%**	**80%**	

Participants' assessment of the Instructors' Training Course: Delegates were asked to anonymously assess various aspects of the course using a scale of 1-5 (poor/fair/OK/good/excellent)

Ratings	Average	Median	Mode
Quality and quantity of course materials	4.7	5	5
Relevance of course to job	4.9	5	5
Presenters	4.5	4.5	5
Tests during course	4.6	5	5
Time for course	Almost all indicated it would have been better to have had more time	A number suggested 10 days (c.f. 6.25)	
Overall assessment of course	4.5	5	5
Venue	4.8	5	5

The table above indicates that the course was very well received, getting ratings of very good to excellent for all items assessed. The only exception was the assessment of the time for the course where virtually all delegates would have liked the course to be longer. A number suggested it would be better to take about 10 days rather than the 6.25 taken. Probably another 2 days would have been ideal, as we had to work till 8-9pm on two nights.

Some comments from participants follow below. Interestingly some asked for regular field follow ups, and training in entering data into computer (both of which were aspects built into the Darwin project and subsequently covered). An additional module on how to teach the course and presentation skills was added to the course.

- The course was fantastic – but the only problem was the limited time
- The course was quite impressive
- The course was excellent, but I will encourage refreshing our mind every now and then.
- The course was excellent but need more days when having such a course again.
- The course was very much relevant – More important is that we need a regular field follow up to give us morale and make sure everything is running smoothly.
- Materials – excellent.
- Course relevant to the job a great deal.
- This is a very good thing to be doing.
- Very good course - Materials, Relevance to Job, Presenters and Tests all excellent.
- It was very good – but also need more time.
- After getting the data from the field we need to be told how to enter it on the computer.
- The course was excellent. Keep it up. Thanks for the idea of bringing improvement in our daily duties and performance.
- Content and testing on quality control was excellent.
- First and foremost I take this chance to congratulate you all for your efforts. The course tutorial manual should be shifted to teaching first (presentation) and also to include follow up trip visits.

Training Photos

Figure 3: Trainee undertaking presentations and written exams

Support: Further support was provided to those who had narrowly failed and subsequently were retested. Five passed the tests and became accredited instructors. These included the Masai Mara rhino officer and Naikara/Laleta community officer. In addition, eight of the Certificate students (see below: training in research and management) were trained in July 2004 as Rhino monitoring instructors by a Darwin fellow and four local instructors (from the initial training who were attending the Certificate course). The students were also formally tested and five students qualified as instructors. Please see Supplementary item 2 for training report).

The project at the end had created a pool of twenty eight rhino monitoring trainers in the rhino reserves and parks (a process which is continuing). The newly trained instructors were initially supported and mentored during a 2 month intensive training phase of the park staff. They were also assisted in developing training charts. On-going support was subsequently provided as needed. Almost all the instructors have been very good in training their fellow staff. The majority of them required minimal support and the Darwin Fellows and KWS headquarter staff have been extremely pleased with the confidence the instructors have shown in delivering the course. The training has been undertaken both in Swahili and English and thus been effective. The instructors are continuing training on an on-going basis. Their progress is continuing to be monitored by KWS Rhino Programme office through site visits and monthly reports and support provided as required.

Figure 4: One of the 28 project-trained site-level instructors imparting monitoring skills.

KWS rhino scientists at the headquarters now have the capacity to train further instructors. Comprehensive start-up training was provided to rangers of the newly created sanctuaries at Mugie ranch and Meru NP by the KWS field assistant and 2 park instructors from Tsavo East NP and Aberdare NP. The Darwin fellows were very impressed by the standard of training conducted by the local trainers and this is also evident in the monthly progress reports from the two new areas.

The project has further institutionalised the process by incorporating the basic training into the curriculum of the KWS Field (paramilitary) training school at Manyani so that all new ranger recruits have the basic skills in wildlife monitoring. The first set of 421 ranger recruits were trained in basic wildlife monitoring in May 2007 by project trained KWS rhino staff. This is a fantastic achievement by the KWS team.

The rhino monitoring in most areas has improved significantly and much higher quality data is being collected for informed decision making. Monitoring approaches and training have also been refined for the difficult terrains. For example, in Aberdares NP where rhino monitoring is particularly difficult due to the thick vegetation and difficult terrain, rangers were trained in the detection and collection of rhino signs such as spoor, dung and browsed vegetation. A 2 month pilot transect survey was also conducted by the Kenyan field scientist and Aberdare monitoring staff. The project team also trained monitoring staff in the collection of indirect sightings in Chyulu Hills NP. The sightings of rhinos in Tsavo East NP have greatly improved following training and support. The development of a Security and Monitoring System for the whole park is being considered. Similarly, the collection of standardised data in Solio GR, a private reserve, has improved considerably. The revised population estimate has shown that the reserve is overstocked and 30 rhinos were subsequently moved to the extended Ol-Pajeta PS in February 2007.

In Ngulia Rhino Sanctuary, the dry season full-moon night census has been improved using better planning and equipment to obtain more comprehensive population information. A complete (from data capture to analysis) intensive 4-night water-hole photographic survey programme was undertaken in 2006 included the use of third-generation night-vision equipment and high-resolution digital cameras. This provided much improved data on rhino numbers and structures and these surveys are being continued.

The monitoring staff at the newly established sanctuaries in Mugie Ranch (2004) and Meru NP (2005) are performing extremely well. They have been analysing their field data (including tracked radio horned animals) and have produced a technical report on rhino movement patterns and establishment home ranges following the introductions.

Training of 20 rhino officers in field data quality control, entry, processing and reporting based on Kenyan Rhino Information Management System and standard software packages (Microsoft Word, Excel – basic use of these with standard KWS reporting templates)

It was decided early through the site assessment that it would be more effective to change the 5-day computer and data-management training workshop into an extensive on-site training programme. This approached worked out very well. A Kenyan graduate was trained as an instructor. Subsequently, a 3-week intensive training was conducted in each national park. Training manuals in Microsoft word, excel and powerpoint were produced.

The project implemented data quality-control procedures in the Kenyan rhino reserves to ensure that data are collected on an on-going basis and are of the best possible quality. Standardised rhino sighting forms were developed and field rangers trained to approach and observe rhino, and accurately complete the standardised sighting forms as part of the rhino monitoring training (please see Supplementary item 20). At least 2 experienced accredited observers from each area were trained in setting up and accurately maintaining master Rhino ID files, checking the field sighting forms and classifying the sighting information into: (1) first class ID sighting with ID number assigned; (2) first-class clean sighting; (3) incomplete sighting. Rhinos are filed in the Master ID files according to the following categories: (1) identifiable always by all rangers (clear ID features, ear notches mainly); (2) identifiable based on more subtle features (but defendable features, not

location or behaviour) by key observers, it is essential evidence or really good drawings or photos are kept in the file; (3) possibly identifiable but insufficient evidence on file to justify ID; (4) Definite clean animals.

The recent provision of high resolution digital cameras (along with GPS and binoculars) through EAZA funding will help with further improving the process. With the better cameras usable photographs can also be obtained from further away from the rhinos, both reducing the risk to the rhino officer concerned, but also reducing the disturbance to the rhinos themselves.

The Kenyan rhino information management system "*Kifaru*" has been implemented and is operational in the majority of the Kenyan reserves. It is a comprehensive geographic information database management system which allows data to be stored and analysed to produce a range of reports, such as monthly sighting reports of individual rhino, patrol movements and the availability of manpower resources, which can be used to optimise deployment of patrols and analyse population performance. In each reserve at least two experienced field staff with experience in the use of computers have been trained to use the system and have the responsibility to ensure data are entered on a regular basis and reports are generated to assist park/rhino management. This process is monitored through the standardised monthly status reports submitted to the KWS Rhino Programme Office and site evaluation visits. Annual status reports are also produced from the data in the *Kifaru* system.

Kifaru system has been implemented in the following parks and reserves: Aberdare National Park, KWS Head Quarters, Lake Nakuru National Park, Lewa Wildife Conservancy, Maasai Mara Game Reserve, Meru National Park, Mugie Game Reserve, Nairobi National Park, Ol Jogi Game Reserve, Sweetwaters Game Reserve (Ol Pejeta), Tsavo East National Park, Tsavo West National Park (Ngulia Rhino Sanctuary) and Laikipia Conservancy.

Chyulu Hills National Park doesn't have an electricity supply and monthly sighting forms are sent to Headquarters to be entered and analysed in the system. A solar panel system has now been bought by KWS and the system will be implemented at the Park HQ in the next couple of months by the Rhino Programme Office. The system could not be implemented on time in Solio Private Ranch because there was no dedicated officer to run and update the database. This requirement has now been fulfilled by the management of the private ranch. Monitoring team has already been trained and setup (2005-2006) and the knowledge on the population has greatly improved. Kifaru will be implemented on a new computer purchased by KWS in September 2007.

Training of park officers and rhino scientist in the production of annual park and national status reports

A 6-day workshop on the production of park status reports was undertaken at KWS Training Institute, Naivasha (17th – 22nd January 2005). 26 field officers attended the workshop from the following areas: Aberdare National Park, Chyulu Hills National Park, KWS Head Quarters, Laikipia Game Reserve, Lake Nakuru National Park, Lewa Wildife Conservancy, Maasai Mara Game Reserve, Meru National Park, Mugie Game Reserve, Nairobi National Park, Ol Jogi Game Reserve, Sweetwaters Game Reserve (Ol Pejeta), Tsavo East National Park, Tsavo West National Park (Ngulia Rhino Sanctuary).

The field officers were trained in population data analysis and preparation of annual status reports. The status report templates, which met the needs of the different areas, were refined on the first day.

The main training workshop started on the second day with report backs by individual reserves using a standardised reporting format. A list of key points to emerge from these presentations was drawn up by Darwin fellows and formed the basis of a report back presentation to delegates, together with assessments.

The field officers were then introduced to the principles of status reporting, recommended best metapopulation management practices and in particular the critical need to maintain rapid population growth rates (for demographic, strategic and genetic conservation reasons). The main

causes of poor growth were outlined and how various performance indicators derived from the ongoing ground-based rhino monitoring could be used to assess the reproductive performance of populations; and in so doing help inform translocation decision-making. The officers were then briefly shown how population estimates could also be derived from the ID-based monitoring data being collected, even if all animals do not possess obvious identifying features. A summary of how Bayesian mark recapture methods such as RHINO have proved useful for estimating rhino numbers in incompletely known populations was provided. The basic principle behind such techniques was explained graphically in order that delegates could understand the importance of giving equal attention to identifiable and clean rhinos as well as correctly classifying all sightings. The presentation concluded by focusing on the importance of keeping and using ID master files in rhino monitoring programmes. Guidance was given on 1) how to classify rhinos in master files using five categories as well as 2) the need to keep separate up to date files for males and females currently in the park, as well keeping files with data on all animals no longer in a population (as they have either died or been translocated). Darwin fellows then reviewed reserve ID master files which had been brought to the course, identifying any specific problems and assisting delegates improve their files during a practical session at the workshop. This session also provided an opportunity for Darwin fellows and KWS rhino programme staff to encourage rhino officers and to praise improvements in the files. At the end of the course, two framed certificates were presented for the best new ID master file and the most improved ID master file.

Kenya Wildlife Service's rhino scientist Mr Ben Okita presented the results of his Darwin MSc study at this workshop which contrasted and analysed the performance of six Kenyan black rhino populations in relation to a number of factors including population densities, removals and rainfall. This presentation was very well received.

Following these presentations delegates were shown how to calculate basic performance indicators such as adult mortality rates, average observed inter-calving intervals, and the average percentage of adult females calving per year. Delegates were split into groups and given worked examples. In addition to calculating specific parameters the groups also had to interpret their results in terms of population performance and the necessity to translocate some animals out.

To help build morale and a sense of team work, the workshop was also addressed in closing by Kenya Wildlife Service's Rhino Coordinator and Darwin fellow Martin Mulama. He updated delegates on forthcoming initiatives that were planned including a major ear-notching programme. This was very topical as earlier report backs and the various ID master files had indicated that a number of black rhino areas had a very high proportion of clean animals without any obvious identification features.

For the remainder of the course, delegates had access to a computer lab where they were able to type up their individual reserve status reports. Darwin fellows, KWS's rhino scientist Ben Okita and the field assistant who had worked with rhino officers were on hand to give assistance and help with queries. Comments from staff are provided in Supplementary item 3.

It was extremely encouraging to the Darwin fellows that at the status reporting workshop, delegates worked late every night (often hours after the official day ended) without complaint in an attempt to learn as much as possible and complete their individual Park reports. Subsequent annual status reports were produced by the Kenyan team with minimal guidance.

Training of KWS rhino scientists in producing population estimates using RHINO Bayesian Mark Recapture rhino population estimation software (May 2004)

The Kenyan rhino coordinator (M.Mulama) and KWS's rhino scientist (B.Okita) were trained at a hands-on interactive course in May 2004. Two KWS rhino programme assistants (C.Kayale and A.Wandera) were also later trained to give them an improved understanding of how field sighting data can be used and the importance of data and master ID file quality control. This new knowledge has assisted them in support work to rhino monitoring programmes in the field.

RHINO software analyses rhino sighting data, where some but not necessarily all the animals in the population are individually recognizable; and together with additional information on deaths, translocations and ear-notching programmes generates population estimates with confidence levels. Thus RHINO provides the tool to analyse the sightings data being collected by rhino rangers trained in ongoing routine ID monitoring programmes (the Darwin funded training course backed up by repeat follow up support visits by Darwin Fellows and KWS affiliated staff has trained rhino rangers throughout Kenya how to monitor rhino individually in the field). RHINO has been designed to deal with many of the violations of classical mark-recapture assumptions of equal catchability and population not changing.

The course was presented using a data projector to interactively demonstrate all aspects of the software. A number of presentations were also given on the background to mark-recapture, how to classify first-class sightings as either clean or identifiable for mark-recapture analysis purposes, the new multi-area analysis option, and the performance characteristics of RHINO under different conditions. Students were taught how sample size (number of first-class rhino sightings), the proportion of rhino that are identifiable, and the size of the population influences estimate precision and bias for the different estimates (mode, median and mean). They were also taught how to use the simulation options in RHINO to be able to determine the probable precision and bias of RHINO estimates under a differing set of conditions, and in particular how to determine the likely gain in accuracy by increasing either sample size and/or the proportion of rhino that are identifiable (through ear-notching). RHINO's inbuilt statistical advisor was explained – illustrating how it recommends which measure is likely to be the best to use in each case, as well as checking for possible problems with entered priors. Students were also shown how to access the context sensitive help text and the Camtasia help videos.

Students also learned how to enter and import sightings data into RHINO, and how to use RHINO to filter their data prior to analysis. They also learned how to enter records which detail deaths, introductions, removals, ear-notching and changes in status of dependent calves to independent subadults.

The course also taught the students how to enter informative and uninformative priors as well as how to identify and deal with sightings of "sighting-happy" rhino. If the latter are not identified and dealt with, estimates can be biased. Students also learned how to generate reports.

The students each had access to a computer on which the software and a suite of test datasets had been loaded. Students were therefore able to learn by doing – reinforcing the class lessons. This also had the advantage of allowing the instructor to determine whether or not the students had fully understood and were able to use each component of the software. Many sample analyses were undertaken to expose students to all aspects of the software. Although there were no formal exams, the students demonstrated they were able to import data and correctly analyse it using the software's various features.

Training of field officers/rangers in Wildlife Sanctuary Management, KWS Training Institute (Certificate course)

Twelve of the most promising young KWS rhino field staff successfully completed their 6-month course (Sept 04). The original project plan was to train 4 staff (1 in years-1, 3 and 2 in year-2). However, during the first year's on-site training the project team identified the need to build this wildlife management capacity in each of the six KWS national parks. Following discussions with the principal of the KWS training institute, a reduction in the accommodation fees was agreed (from 800 Kenya shillings to 400 Kenya shillings per day) to allow 2 extra officers to be trained. The project also used this as a leverage to obtain extra funding from USAID to enable 2 officers from each of the six key areas to undertake the training. The course was also modified to meet some of the specific needs of the programme. The UK and Kenyan Darwin fellows (R Amin, M Mulama) taught the key module on Sanctuary Wildlife Management Techniques. The Darwin project team also set up the course field projects and provided supervision.

All the students performed very well. Three students (2 from Tsavo West NP and 1 from Aberdare NP) were awarded Distinctions, the only ones in the Institute's 2003/04 academic year, and were also presented with the best student awards.

Name	***Area***	***Grade***
Geoffrey W. Wafula	*Tsavo West NP*	*Distinction and Best Student Award*
Boniface Oyugi	*Tsavo West NP*	*Distinction and Best Student Award*
Raphael M. Kapemba	*Aberdare NP*	*Distinction and Best Student Award*
Moses Mugambi Njogu	*Aberdare NP*	*Upper Credit*
Mohammed M Kamanya	*Tsavo East NP*	*Upper Credit*
Patrick K Boit	*Tsavo West NP*	Upper Credit
Stanley M Muthaura	*Lake Nakuru NP*	Upper Credit
Timothy M Kano	*Lake Nakuru NP*	Upper Credit
Hillary K Ng'etich	*Cyulu Hills NP*	*Lower Credit*
Benson Letuya Nkoyo	*Cyulu Hills NP*	Lower Credit
Benson Ngige Njuguna	*Nairobi NP*	Lower Credit
Sheila Ochieng	*Nairobi NP*	Lower Credit

The graduation ceremony was held at the KWS Training Institute, Naivasha in January 2005. The following is an extract from the email message received from the KWS Rhino Programme Office.

"The KWS Director said he would ensure continued training of KWS staff, and that he would not like to see the graduates stop there. He also urged them to use the knowledge they have acquired to serve the society and help in tackling conservation problems and continue being fully committed to this work. He also thanked the Darwin Initiative who have helped in supporting KWS and training of the students. He highlighted rhinos and elephants as species that require special protection, quoting the current rhino figures worldwide and in country and commended the rhino unit for the capacity building as these are species that require specialised skills to conserve and that capacity building is necessary for conservation. He urged all the graduates to maintain professionalism and high standards of integrity.

The KWS chairman urged all graduates to act as catalyst as their skills are essential for conservation He crowned it all by quoting Dr Julius Nyerere, former Tanzanian president who once said in 1961 that "...successful conservation require three main things: specialised knowledge; trained manpower; and money...." For the graduates, KWSTI has equipped them with the first 2. He also urged them to put into practice what they have learnt and not to stop there....
The course coordinator of the rhino class really commended the students as very disciplined and hard working. The event was excellent, with an army band entertaining us. Our guys were very happy, I passed your congratulatory message to them, and they said BIG THANKS.

Many thanks to you Raj, Darwin Initiative and ZSL. We have created a wave and it is sweeping. We must make the wave bigger and bigger, and slowly turn around things to true and professional conservation."

This capacity building initiative has been extremely valuable and the twelve monitoring staff have brought essential technical capacity into the programme. The majority of Kenyan rhinos are conserved in enclosed sanctuaries and the effective management of the sanctuaries is critical. For example, Lake Nakuru National Park is a fully fenced 188 Km^2 rhino sanctuary. It has over 100 black and white rhinos. It is also a Ramsar site with around 450 species of birds including a very large population of greater and lesser flamingos. Because rhinos and other large animals (e.g. buffalo and giraffe) can significantly modify their habitat, their occurrence at high density can severely impact on the community structure and biodiversity of the restricted area. The park also has a problem with alien invasive species. In addition, the expanding nearby town is having a

major impact on the park (pollution, declining water table etc.). The sanctuary management training has provided the basic skills to tackle some of these key matters in the coming years. The students are extremely motivated and are now making important contributions to the conservation programme. The Darwin project team also assisted in setting up several much needed field projects including the night census study at Tsavo West NP rhino sanctuary, indirect monitoring based methods at Aberdares NP and Chyulu Hills NP, impact of the invasive species in Lake Nakuru NP and genetic study based on faecal, blood and tissue DNA analysis.

Please see Supplementary item 4 for feedback from students and park wardens

Training in research and capacity building at management level

UK-based MSc study including training of rhino scientist in detailed population data analysis and preparation of annual status reports (Oct 03 – Sept 04).

The rhino scientist Ben Okita was awarded a Distinction in his MSc. His six month field project was based on the population dynamics and status reporting of six Kenyan black rhino populations. Ben achieved a mark of eight one percent. The Darwin fellows provided extensive supervision throughout this project both in Kenya and in the UK during data analyses and writing of thesis. Guidance and support was also provided during the six-month lecture element of the course.

Ben analysed the data for six of Kenya's rhino populations for his MSc thesis study. In the process, Ben learnt many useful skills which has proved to be very useful in the building up and institutionalisation of the status reporting. Ben's work significantly contributed to the starting of the status reporting and analysis process as a result.

Ben's MSc analyses produced a number of very interesting findings and these were presented to senior decision-makers in Kenya Wildlife Service. For example, the results highlighted problems in Ngulia rhino sanctuary providing clear evidence of density dependent reduction in rhino population growth rates in recent years. Ben's work contributed to the removal of 255 elephants from the sanctuary in October 2006, the extension of the sanctuary in May 2007 and the creation of the IPZ in Tsavo West NP as a complementary free-ranging population in this key area with the potential of creating a continental Key-1 population. In addition, Ben's analysis of the underlying performance of the harvested Nairobi National Park provided evidence to support the set percentage harvesting strategy being recommended by the AfRSG. This finding was referred to Information Document 59 at the recent CITES CoP13 held in Bangkok, Thailand. Ben is buoyed with enthusiasm and on completion of his MSc was promoted to senior management as Rhino Programme Research Scientist and is now the Rhino Coordinator (please see Supplementary item 5 for Ben's MSc thesis).

Students' assessment of the MSc Course in Conservation Biology, at the University of Kent, Canterbury, UK

Use a scale of 1-5 (poor/fair/OK/good/excellent)

Ratings	Score	Comments
Quality and quantity of course notes	5	Were nearly complete with further readings
Standard of lecturing	4	Good. Majority of lecturers had long term field experience which improved lecture standards
Standard of field practicals	4	These were well organised and quite relevant, but would have been better if students were asked to write field reports.
Venue	4	Conducive
Relevance or value of course to your job	5	Very relevant! Improved my scientific reading and writing, and research skills.
Overall assessment of course	5	Very good and all was completed as scheduled by the University in spite of occasional University Union strike.

Topics undertaken

- Biodiversity law
- Communities, Conservation, Conflict and Change
- Conservation education
- Conservation of ecosystems
- Conservation of Species
- Ecology and Conservation
- Managing protected areas
- Sustainable resource use

Which topics did you enjoy most

- Biodiversity law
- Communities, Conservation, Conflict and Change
- Conservation of ecosystems
- Managing protected areas

General comments (e.g. how would use this training to improve day to day sanctuary conservation work)

The course was very useful both for rhino conservation in Kenya and for my career development. I now feel a more qualified scientist in conservation, with greater understanding on Kenyan rhino issues. The dissertation in particular was immensely useful. Through this, I received intense coaching from my supervisors, and now feel confident I can produce Kenya black rhino status reports, and train others on the same for rhino management and decision making.

It is my joy that some of the key strategic objectives of the Kenya Black rhino conservation policies have been partially met through this MSc training. Knowledge will be disseminated to rhino staff through on-site trainings and workshops that will lead to 12 individual parks/rhino reserves producing their own annual rhino status reports by February 2005. Presentations will also be made to the KWS Director and senior staff, Park managers, and scientists based at KWS headquarters by November 2004.

It was also a great opportunity to interact with other students from different areas of the world and share their conservation experiences. For instance, it was my first time to learn deeply from one of my classmates how the Amazon Forest in Brazil supports the world.

I would recommend that we get more staff from different cadres trained. It motivates us and adds quality and value to the conservation work we do.

Kenya-based MSc study in wildlife management (Oct 03 – Jan 06)

Lekishon Kenana was the resident rhino scientist in Tsavo East NP. He has shown enormous potential and in past training always came top of the class. The Darwin Fellows have known him since he joined the Rhino programme in 2001. He is very hard working and did his very best in very difficult conditions in Tsavo East NP. Lekishon Kenana was therefore chosen after careful consideration by the project team for the training in Wildlife Management (MSc) at Moi University, Kenya. Lekishon Kenana registered for his MSc at Moi university in September 2003. However due to a university lecturers' strike the course only started in January 2004. Lekishon finished the teaching element of the course in January 2005. He then started his one year field project in Tsavo West Ngulia Rhino Sanctuary on the impact of the high density of elephants and rhinos on the vegetation. Lekishon successfully completed his MSc in Jan 2006 and was subsequently given the important position of Senior Scientist Savannah by KWS. Kenana's MSc project has helped to get a better understanding of the impact of intense herbivory on the vegetation (please see Supplementary item 6 for Lekishon's MSc thesis).

Students' assessment of the MSc Course in wildlife management, at Moi University Kenya.

Use a scale of 1-5 (poor/fair/OK/good/excellent)

Ratings	Score	Comments
Quality and quantity of course notes	4	Were good and well selected
Standard of lecturing	4	Lectures were good though some could be enhanced by use of power point presentations
Standard of field practicals	3	Ok but too few
Venue	4	Conducive
Relevance or value of course to your job	5	Very relevant
Overall assessment of course	3	Strikes, long delays in marking of thesis and course administration problems made the course take longer time than necessary

Topics undertaken

- Advance biostatistics
- Research skills
- Ecological productivity
- Behavioural ecology
- Applied vertebrate physiology
- Advanced population dynamics
- Advanced wildlife management
- African plant and community ecology
- Graduate seminar
- Applied ecology

Which topics did you enjoy most

- Thesis
- Advanced biostatistics
- Behavioural ecology

General comments (e.g. how would use this training to improve day to day sanctuary conservation work).

The course has equipped me with the skills I require in my day to day activities as a scientist. The thesis in particular exposed me to scientific thinking and writing, in the course of my research I got the opportunity to learn more on statistical analyses and interpretation and computer programming which have great application in my work and are necessary skills for the organisation that I work for.

Kenya-based BSc study in wildlife management (Sep 03 – Mar 07)

The Tsavo West NP Rhino Warden (Adhan Berhe) started his BSc course in Wildlife Management in September 2004 at Moi University, Kenya. Adhan was selected for this training because of his commitment to rhino conservation over the years, his keenness to learn and the progress he had made (he already had gained a Certificate and Diploma in Wildlife Management whilst with the Rhino Programme) and his achievements as Rhino Warden in a key area (Ngulia Rhino Sanctuary). Adhan has supported and mentored many of the rangers (Adhan started as a ranger) and had developed a very good monitoring and security team at the Sanctuary and effectively managed the project's site activities including the training and implementation of the field tools and procedures.

Adhan undertook his final year project on community engagement in Tsavo East NP. He did very well in his studies. Adhan achieved either a first or second class in all the modules in the first two years; his final degree results are due to be officially out soon. On successful completion of his BSc studies, Adhan was promoted to Officer in Charge of Rhino for the whole Tsavo region.

Training in habitat assessment

This was originally planned for October 2004 but rescheduled for July 2005 (permission obtained from Darwin Secretariat). In 2004 it became clear that the scientific staff of KWS were not in a position to take over the routine browse monitoring planned for the Kenyan Rhino Programme, as they had become regionalised and could not build this function into their extended duties. Together with the Kenyan Rhino Coordinator, Martin Mulama, it was decided that the training should involve several suitable rhino programme field staff and relevant staff from the private rhino sanctuaries.

In the end due to the number of reserves and level of interest, 18 park staff attended a 5-day training workshop held at Nairobi NP (please see Supplementary item 7 for the training programme). The trainees were selected by the Rhino Programme and were required to have a qualification of at least a Certificate in Wildlife Management (or equivalent qualification) as the course required the use of calculators and spreadsheets and some knowledge of rhino browse species including their identification in the field.

On the first day, the staff trainees were introduced to the basics of browse availability assessment and carry capacity. They were then led through the contents of the manual (each trainee was given a copy – please see Supplementary item 8). The trainees then practiced conversions between percentages and proportions. The browse availability cover field books were introduced and evening revision given. On day 2 the trainees sat a test to see how well they understood the manual. This was followed by a revision of three methods of canopy cover assessment followed by a practical. Methods of average browse canopy depth assessment and calculating percentage vertical fill were then presented. The trainees then practised these methods in the field. This was followed by a revision with field practical of ranking and assessment of relative percentage of browse availability (BA) by species within layers. The trainees were then shown how to calculate overall BA and BA of components within a plot. On day 3, the trainees carried out assessments in seven plots set up in the park. The results were then analysed back in the classroom and individual observer variability assessed. This was followed by a lesson on survey planning, calculating BA's per vegetation type and for an entire reserve. On day 4, the trainees carried out a field survey of ten plots with supervision from the Darwin fellows. On the final day the trainees undertook data analysis with support from the Darwin fellows

It became apparent during the training that not everyone was suited to the vegetation assessment work. It was also realised that further training would be required for the most suitable trainees. A team of eight of the most promising staff were provided further field training over five days as part of the carrying capacity assessment of the new extension of the Ol-Pejeta rhino sanctuary. Since the training, the trained Kenyan staff have successfully assessed Meru NP rhino sanctuary. This is an important step in the longer term vegetation and carrying capacity monitoring by the Kenyan team.

Training in Education and Community Awareness

The community education and awareness was only a very small component of the project. The main output was the production of rhino education cards. However, the project team realised the importance of this work and undertook some training at two key education centres in Lake Nakuru NP and Tsavo West NP.

Lake Nakuru NP: The park has a relatively new education centre, but has a long established programme of talks for schools and local community groups since it was established as a field study centre in 1976. Besides the many local groups who use the centre, many schools travel long distance to take advantage of the residential accommodation it provides. Dormitories are able to house over 80 people for a week's stay. The centre is strategically placed to cater for central and

north rift valley and the western region of Kenya.

The centre aims to encourage greater awareness of wildlife conservation and issues involved in the management of wildlife in the national park. The park is immensely rich in biodiversity, being a Ramsar site with about 450 bird species (including a very large flamingo population) and a key rhino sanctuary with over 100 black and white rhinos.

While the Education Centre provides expertise in delivering talks to secondary schools and students, we identified a need to provide training and support in order to develop an educational programme for primary schools (children aged 7 – 14), which represent the bulk of school visits.

Methodology and approach: ZSL's Head of Education, Claire Robinson, accompanied the Darwin project team on two trips in January 2005 and 2006 to work with the park education warden, Elema Hapicha. Claire's travel costs were met by ZSL. In the first visit, some training was provided on techniques for teaching young children and approaches to activities suited to this age group. Some changes were suggested to the layout of the Education Centre itself to make it more child-friendly and a visit was made to a local school to understand how the education system and Kenyan national syllabus worked. A pilot project was setup to establish a new approach to teaching and education programmes at Nakuru. While much of the learning in schools is achieved through listening to the teacher and remembering facts, the alternative approach planned for the national park is that of learning by discovery. Children would be encouraged to learn through observation, through touching a variety of skins, skulls and other biofacts at the disposal of KWS, and through engaging in activities. A 'treasure chest' of activities would support the bus tours that regularly take place in the Park. This would be evaluated and refined before moving on to other projects. It was also appreciated that there would be a need to prepare teachers of visiting schools for these new activities so that they can support them.

Tsavo West NP: Claire also worked with education staff at Tsavo West NP, where a new Education Centre is being built.

The Education Wardens (Elema Hapicha and Lucy Makosi) from the two parks subsequently spent a period of 2 weeks in July 2006 at the ZSL education centre. The ZSL education centre has seven teaching staff and receives approx 90,000 school visits per year. This visit enabled the two Kenyan education officers to develop important skills, obtain much needed hands-on experience and to work with the UK education staff to develop materials and finalise the education booklet. The Darwin Secretariat approved the use of project savings. ZSL provided funds for accommodation and food. ZSL's zoo flat was also be used to keep costs down.

ZSL is providing additional support to the education wardens via emails. Eight thousand pounds were also provided by ZSL (from one of the organisation's patron) to KWS for building accommodation facilities at Tsavo West Education Centre. The project team has also assisted in developing a funding proposal for mobile education unit.

Field Tools

In order to monitor rhino populations, the Kenyan Rhino Programme has implemented a standardised patrol system to obtain information on sightings and mortalities. Rhino surveillance personnel collect information from daily vehicle and foot patrols. Rhino are identified individually and registers of the features of individual animals are maintained. Where needed, recordings are also made of sightings of 'clean' rhino (those that are not individually recognisable). Monitoring data are used to provide estimates of population size, age and sex structures, calving rates (breeding performance), mortality rates (by age and sex) and the distribution and movement of rhino. This information is used to gauge the performance of each population and guide biological management decision-making processes, such as introductions and removals, in order to achieve the national target of increasing the total rhino population as rapidly as possible. The individual identification of rhino requires properly skilled and motivated observers, a system of strict control on data quality at observer and data-recording levels and the support of the wider conservation-management structure.

Successful management of all black rhino populations, including those managed for maximum sustained breeding output and avoidance of over-population, will depend on uninterrupted and detailed population monitoring. The objective of monitoring is to obtain:

1) Confirmation of the presence and health of individual rhino.
2) Personal-history records of all rhino.
3) Details of births and mortalities, and, where possible, matings.
4) Identities of breeding animals.
5) Provenance of calves.

In addition, monitoring of law enforcement can be very useful in guiding patrol deployment and increasing protection, as well as providing measures to assess performance.

Figure 5: Rangers carrying out daily monitoring and anti-poaching patrols.

Figure 6: A field ranger carefully observing a rhino using a pair of binoculars from a safe distance.

Individuals are recognised by a combination of features (ear notches, distinctive body marks, horn shape, age and sex). Animals that cannot be recognised by a combination of these features are considered "clean". Rhino are sexed and aged using the standardised A–F age categories. Body-condition scoring is also extremely useful but needs well-trained personnel. The use of continental age and body-condition assessment scores also allows results to be compared between parks, including those in other range countries.

Figure 7: An ear-notched and easily recognizable eastern black rhino on the plain in Lake Nakuru NP, Kenya.

Figure 8: A field ranger completing a rhino sighting form.

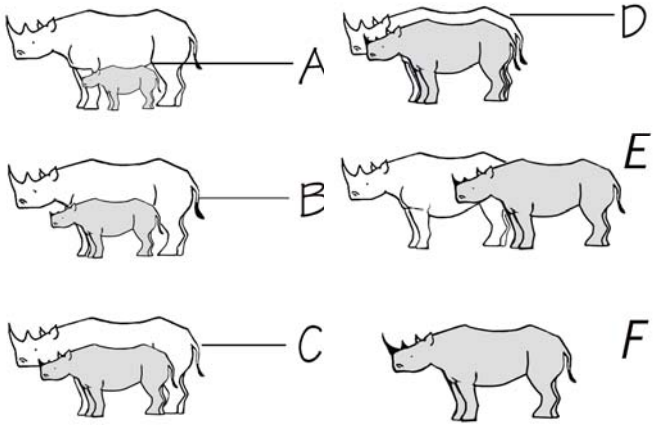


Figure 9: Standardised A–F age classes used to monitor individual rhino

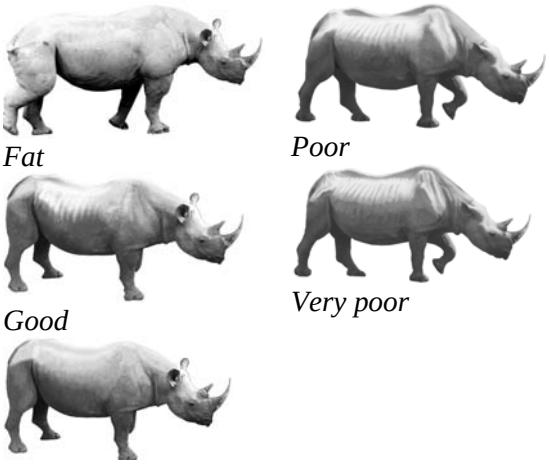


Figure 10: Standardised body condition scores

The Darwin project has implemented / improved a number of key elements in the system of collection, storage and analysis of information is as follows.

1) Standardised record books for rhino surveillance teams for patrol records, sightings records and mortalities.
2) Record books used by Kenyan Wildlife Service (KWS) vets for all mortalities/autopsies. Horns are marked, catalogued and stored in a secure place.
3) Record books and capture data forms used by KWS vets for recording details of all captures and translocations. All immobilised rhino have body measurements, blood and tissue samples taken.
4) Rhino "ID" master files used for data quality control.
5) A computer Geographic Information System (GIS) database containing (a) records of all individually known rhino, including history and breeding records, (b) sightings of ID and clean rhino, and (c) patrol movements and the tools to analyse population breeding performance, (population size, growth rates, percentage of calves in the population, cow/calf ratios, sex ratios, calving intervals), population age structure, carrying capacities, individual-rhino sighting frequencies and patrol effort.

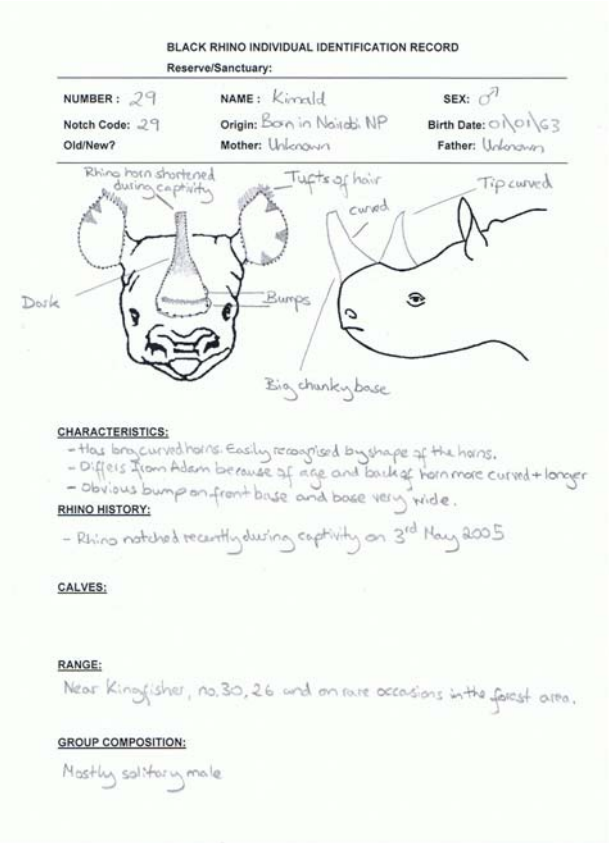
A formalized training programme for personnel can greatly accelerate the process of acquiring high standards of observational and data-collection skills. The capacity building and training elements of the project were discussed above.

Quality of rhino monitoring data

The Kenyan Darwin Project has implemented data quality-control procedures in the reserves / parks to ensure that data are collected on an on-going basis and are of the best possible quality. Data recording booklet has been developed and field rangers have been trained to approach and observe rhino, and accurately complete the standardized sighting forms. This information is then checked by experienced accredited observers and the sightings are classified in accordance with the 'ID' master files into: (1) first class ID sighting with ID number assigned; (2) first-class clean sighting; (3) incomplete sighting.

Rhino ID master files have been set up in all the Rhino areas. All rhino sighted are classified and filed according to the following categories: (1) identifiable always by all rangers (clear ID features, ear notches mainly); (2) identifiable based on more subtle features (but defendable features, not location or behaviour) by key observers, good drawings or photos are kept in the file; (3) possibly

identifiable but insufficient evidence on file to justify ID; (4) Definite clean animals. The files are also used to capture and transfer the knowledge/skills of the highly experienced key observers which otherwise would be lost during staff transfers or retirements. The photographic sequences kept in the files should allow changes in the animals to be tracked over time and also allow Kenya to develop guidelines on horn and body-size appearance with rhino age at sanctuary level, thus improving the accuracy of estimations of ages of rhino in future. The trained data controllers are responsible to keep the information in the files accurate and up-to-date.


BLACK RHINO INDIVIDUAL IDENTIFICATION RECORD

Reserve/Sanctuary:

NUMBER : 29 NAME : Kimaid SEX: ♂

Notch Code: 29 Origin: Born in Nairobi NP Birth Date: 01/01/63

Old/New? Mother: Unknown Father: Unknown

CHARACTERISTICS:

- Has long curved horns. Easily recognised by shape of the horns.
- Differs from Adam because of age and back of horn more curved + longer
- Obvious bump on front base and base very wide.

RHINO HISTORY:

- Rhino notched recently during captivity on 3rd May 2005

CALVES:

RANGE:

Near Kingfisher, no. 30, 26 and on rare occasions in the forest area.

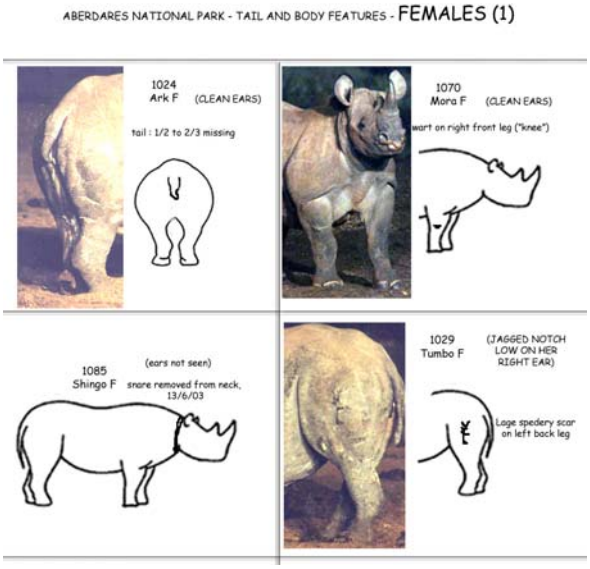
GROUP COMPOSITION:

Mostly solitary male

Figure 11a (above): A rhino Master ID record

Figure 11b (right): some summary records from rhino "ID" master file.

Figure 12 (above): An accredited observer carefully checking a completed sighting form



Most rangers require a lot of practice in drawing ID features and instructors therefore try to ensure that rangers are adequately trained in completing sighting forms correctly. The use of high-resolution digital cameras recently provided will further improve this process.

Figure 13: A ranger being trained to complete rhino sighting forms correctly.

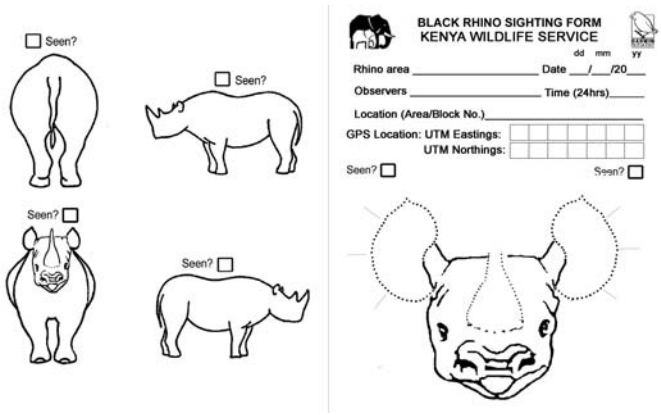


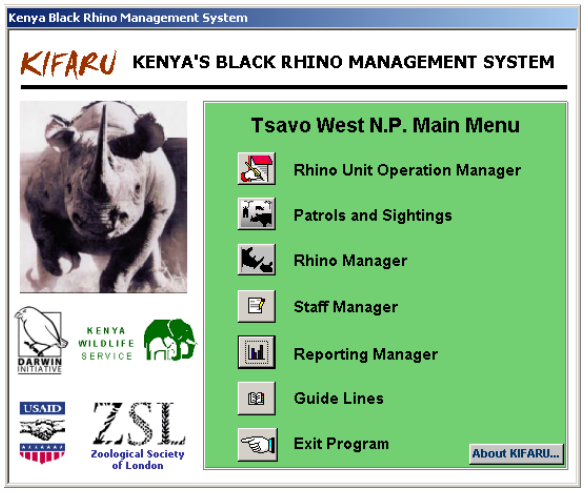
Figure 14: One side of the standardized form used to record details of rhino sightings.

Kenya Black Rhino Information Management System (KIFARU©)

KIFARU© has been implemented and is operational in the majority of reserves (USAID provided funding for the field computers). It is a comprehensive geographic information database management system which allows data to be stored and analysed to produce a range of reports, such as monthly sighting reports of individual rhino, patrol movements and the availability of manpower resources, which can be used to optimise deployment of patrols and analyse population performance. Digital shape files of key topographical features (roads, rivers etc) were obtained / produced for the Rhino Conservation Areas and incorporated into the system.

In each reserve field staff have been trained to use KIFARU©. Standardised monthly reporting template has been developed and the system is being used to produce these. The reports are submitted to the Park Senior Warden and the KWS Species Department Rhino Programme Office at the end of each month who then check the reports and provide management feedback to the field Rhino Warden and his staff. This ensures the system is up-to-date and the information is used for monitoring, surveillance and biological management. For example, field rangers on patrols should regularly log their position using a Global Positioning System (GPS) receiver or pocket grid maps produced by the project. These positions are then entered into the KIFARU database system and plotted on the Park GIS map. This information, along with individual-rhino sighting positions, information on illegal activities (such as snares) and indirect rhino sightings, is useful for planning daily patrols.

Management needs to ensure that average sighting levels per rhino does not decline below the threshold levels. Once the absence of an individual exceeds a critical period, intensive searching must be carried out within, and then outside, it's known home-range.



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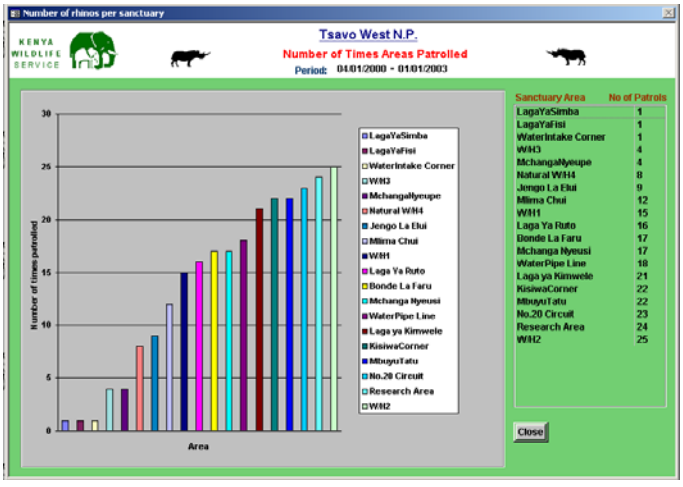

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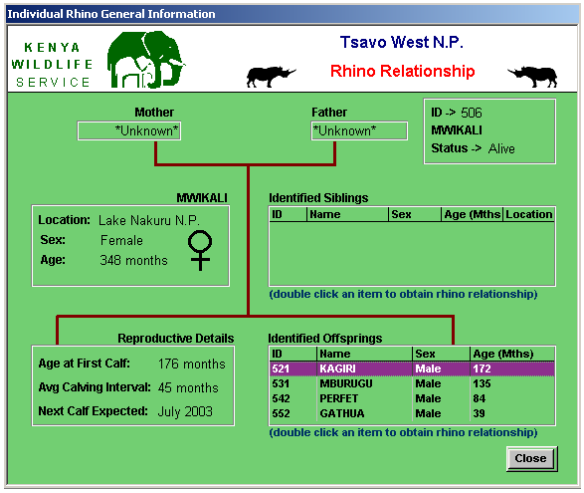

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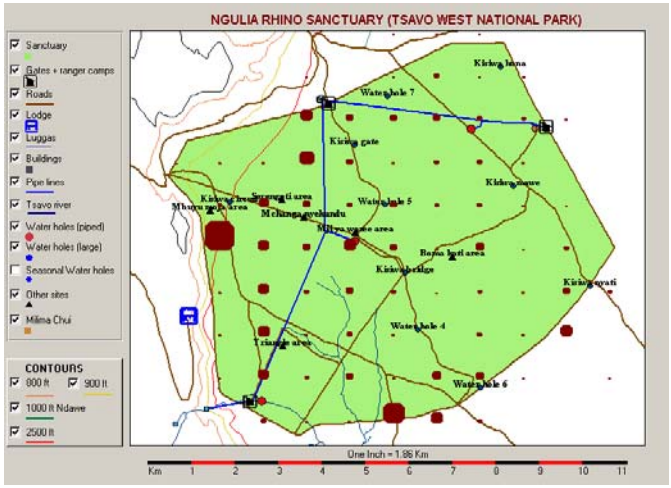


d.

Figure 15: Various pages from the Kenya Black Rhino Information Management System (KIFARU©): a. main tools in KIFARU©; b. patrol effort and movement along with information on poaching threats and animal distributions helps in more effective deployment of patrols; c. reporting element provides information on demography, population structures and performance indicators; d. GIS element of the system provides information on home ranges, feeding patterns and patrol intensities.

A monitoring procedures / protocol document was produced and provided to each area and staff briefed in its use (please see Supplementary item 9).

Metapopulation status reporting

National status reporting is a key component of implementing the Kenyan conservation strategy. In the past metapopulation performance has been 'averaged out', thus performance issues within individual populations may have been overlooked. To promote optimal metapopulation performance it is necessary to look at the age and sex composition, calving rates, causes and rates of mortality, and body condition within each population. Reasons for suboptimal performance can then be determined and solutions put in place to avoid demographic and genetic problems and maintain growth rates.

The Darwin project has implemented a formal national-status reporting programme. Standardised park and national status reporting templates were developed. Twenty-six officers from all the rhino reserves were trained in population data analysis and preparation of annual park-status reports. KWS scientists were also trained to analyse population performance data and synthesis national status report (discussed in the training section).

The park-level status reports supply information on population size, age and sex structure, translocations and mortalities (including causes), as well as a number of standardized biological performance indicators (age at first calving, percentage female calving, proportion of adult females with calves, intervals between calving, mortality rates and net population growth rates).

The individual park reports are synthesized and analysed at a national level. The resultant national report interprets and contrasts the status, performance and population dynamics of all eastern black rhino populations in Kenya. The feedback from the national-status summary report is vital to programme managers and staff because it places the results of individual-reserve reports into a metapopulation context. Without regular park-level status reporting and the production of interpreted national status report summaries, a problem may also remain undetected far longer. For example, the 2004 and 2005 status reports showed clear density dependence in a number of populations stocked at or near ECC. The reports indicated that a number of Kenyan rhino populations can become donor populations. In addition, the *c.* 5% underlying population growth in Nairobi NP following a period with an average 5% annual removal of rhino provided empirical

support to the Set Percentage Harvesting approach advocated by the IUCN/SSC's AfRSG.

The production of annual park and national status reports commenced in 2004 and it is very encouraging that management actions are being taken based on this information to optimally manage black rhino habitats and browser densities, and thus promote the increase of black rhino numbers. Examples include translocation of surplus rhino from Nairobi NP, Lake Nakuru NP and Solio GR considering sex ratio and age structures to create new populations in Mugie RS, Meru NP and Ol Pejeta extension, and removal of 255 elephants from Ngulia RS to reduce the browser impact on the vegetation, extension of the sanctuary and the creation of the IPZ in Tsavo West NP. In response to the declining Aberdare population, the Aberdare area has been divided into management sectors and officers have been put in place. Baseline surveys are also being undertaken. The aim is to have very intensive management for the area and build up numbers by initially translocating some rhinos into the area. The production of annual status reports needs to be continued by the management.

Habitat assessment and ecological carrying capacity

To achieve rapid growth of the national herd, the rhino and the habitats in which they live must be managed so that rhino breeding performances are maximised, death rates are minimised, and the rhino food resource base is not compromised, wherever possible. Monitoring and managing black rhino numbers at a level below the carrying capacity of the habitat is one important way of promoting rhino productivity, and preventing *density-dependent* declines in rhino breeding performances and increases in mortalities. Introductions of rhino into new areas can be planned at well below carrying capacity to minimise social stresses and losses during the settling-down period, and promote maximum opportunities for population growth.

Density-dependent effects on black rhino population parameters are similar to those reported for other large mammal species such as white rhino, moose, red deer, bovids and equids (e.g. Owen-Smith 1988, 1990; Clutton-Brock & Albon 1989; Freeland & Choquenot 1990; McCullough 1992). These include delayed ages at first calving, delayed time to next conception after giving birth (longer inter-calving intervals), lowered calf and subadult survival, lowered survival of old animals, overall slow or declining population growth rates. Given the population dynamics of such large long-lived animals, it has been estimated that the Maximum Sustained Yield [MSY: commonly called maximum productivity carrying capacity (MPCC)] for rhino should be around 75% of ECC (Owen Smith 1988; McCullough 1992), and therefore that densities should not be allowed to increase above this threshold level although optimal stocking levels may be lower than this during drought years. Managing populations at or below 75% of ECC should minimize the risk of density-dependent effects negatively affecting populations. By reducing densities of black rhino and/or other browsers to below habitat carrying capacity, there is also a reduced risk of negatively affecting the long-term rhino carrying capacities of the areas. Decisions on off-takes should also be guided by both the results of monitoring of population status and performance, as well as using improved estimates of ECC.

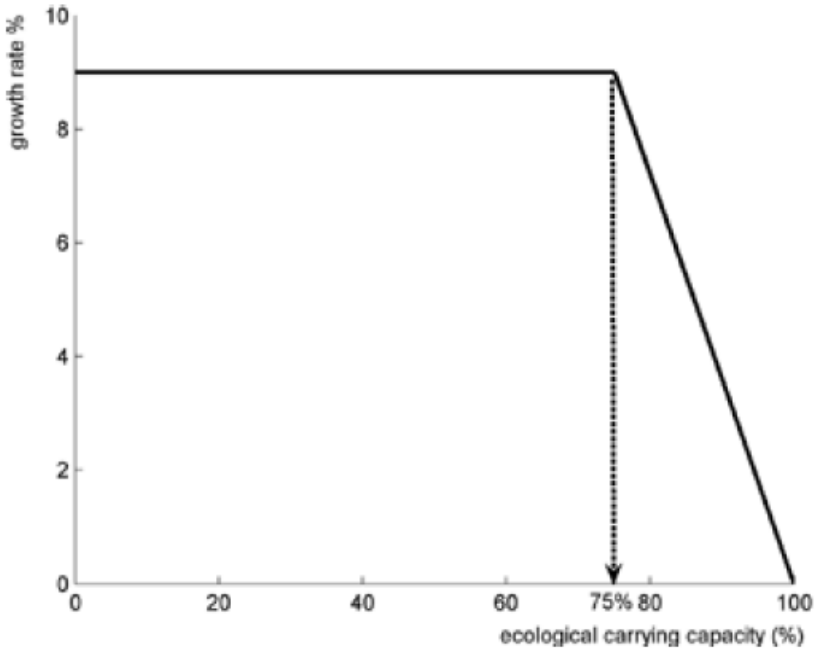
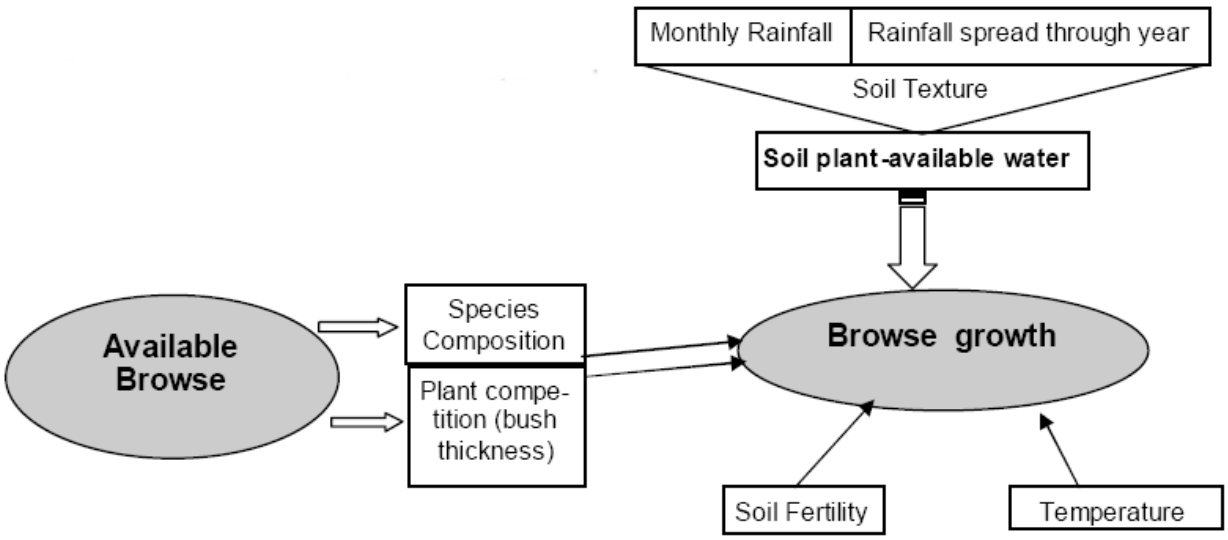


Figure 16: 75% of ecological carrying capacity is the *approximate* highest density at which population productivity of K-selected species like rhino is unaffected by density-dependent feedback. Productivity curves for large mammals are skewed towards carrying capacity, and are not near ½ of carrying capacity as with smaller mammals. This is owing to their typically high adult survivorship, long gestation periods and relatively old ages at first calving, which limit the range over which life-history parameters can change in response to changing density or food supply (see McCullough 1992 for a summary large-herbivore population dynamics).

Ecological carrying capacity or zero growth density estimates are needed as an overall guide to stocking levels for rhino areas. It is not easy to measure ECC. Past estimates of eastern black rhino ECC have differed widely in the reports of different observers for the same area. In particular, non-experts have tended to over-estimate substantially the ECC. Nevertheless, it is easy to conceptualize that a habitat at a given point in time must be able to support sustainably a limited number of any given herbivore species. This ECC is probably most closely defined as 'the maximum number of animals of a species (sustainably) supportable by the resources of a specified area' (Caughley 1976; McCullough 1992).

The estimation of ECC is multi-faceted. For a given amount of standing 'browse-plant biomass' the browse productivity (growth rate) and quality are primary determinants of black rhino carrying capacity. Rainfall, soil quality and temperature influence these parameters on a broad scale and measures of these factors are also required.



At a broad level, black rhino carrying capacity is determined by: (a) the amount of browse (woody plants and dicotyledonous herbs) available in the area; (b) the amount of annual growth in this available browse. Browse growth depends on its species composition, competition between plants in thick bush areas, the amount of soil water available to the plants, the fertility of the soil and temperature conditions for nitrogen mineralization and plant growth. Water availability is determined by rainfall patterns and soil texture. The component of available browse + growth suitable for black rhino determines actual carrying capacity. Available browse can be impacted by competing browser species and fire.

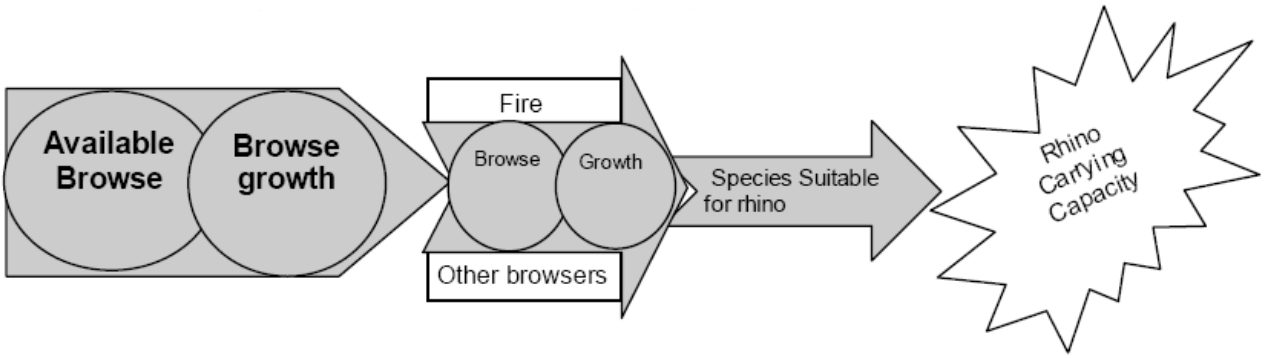


Figure 17: Broad-scale determinants of African browser carrying capacities.

Field Work: This was originally scheduled for July-August 2004, but was delayed. This was because the KWS Rhino Programme Vehicle, which was to be used, was required for vital black rhino translocations to new areas in Kenya over that period. Finally, ECC field work took place in two stages, using a hire-vehicle. During September and October 2004, 6 key black rhino areas were successfully surveyed for black rhino browse availability and species composition. These were: Nairobi NP, Maasai Mara/ Trans-Mara, Lake Nakuru NP, Aberdares NP-Salient, Solio Ranch and Sweetwaters Ranch. In January and February 2005, the remaining three Kenyan rhino sanctuaries Ngulia, Lewa and Ol Jogi were surveyed. The Darwin Secretariat was informed of this change and approval was obtained.

Field Methodology: Initially it was planned to place monitoring plots along several transects crossing each rhino area. However, logistically this proved to be too time consuming. Too much time was spent walking and too little assessing vegetation; plus such transects were also unsatisfactory in adequately sampling each main vegetation type. Instead, in each reserve or park, the road/track network was used to access the entire rhino area, and plots were located between 40m to 2km from these, as was necessary to place plots within specific vegetation types.

100-150 detailed vegetation plots were assessed and photographed within each of the 9 rhino areas. Rhino feeding data was also compiled from observations made at each site. These plots sampled all the major vegetation types in each area, and catalogued amounts and composition of black rhino browse based on a refined standardised method (Adcock et. al.). The rhino rangers at each location assisted with field work, primarily to provide protection and navigation in the conservation areas. Where possible, however, they also assisted with plant identification and recording of rhino feeding signs. Many of them were thus able to improve their botanical and observational skills.

Data analysis. Landsat 7 imagery of each rhino area was obtained to assist with vegetation mapping and extrapolation of results from surveyed plots (please see Supplementary item 10). Figure 19 provides an example of output from the imagery combined with surveyed rhino browse availability and suitability data. Auxiliary data on variables linked to black rhino carrying capacity were compiled into a database for Kenyan rhino areas (game count data, soil and geology data, long-term rainfall and temperature records).

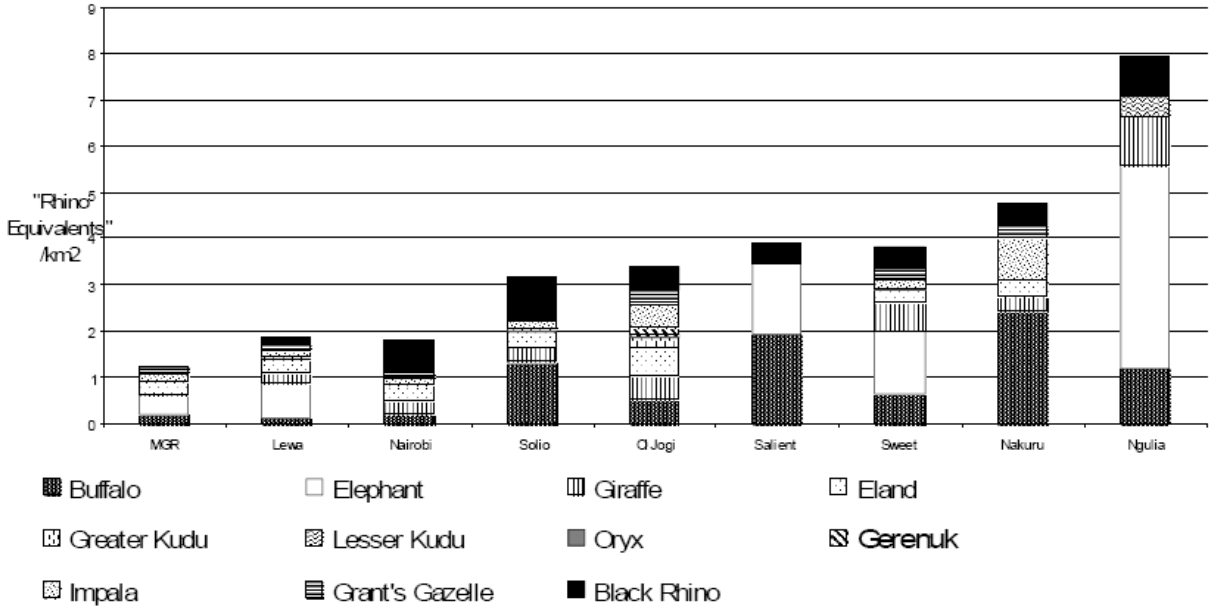


Figure 18: Breakdown of estimated browsing herbivore biomass in potential competition with black rhino in nine sanctuaries (end of 2005). Ngulia RS with its large overall BA has the greatest browsing biomass, owing to elephant and giraffe, while the Aberdares NP - Salient (which has even higher browse availability and much higher rainfall) has an intermediate browser biomass. Lake Nakuru NP biomass is high, probably owing to the high groundwater levels promoting browse supply. Ol Jogi Ranch browsing biomass is notably high given its low rainfall and poor soils. Masai Mara NR browser biomass is the lowest of the nine areas but this area also has the least available browse.

The information from the vegetation plot assessment was combined with Landsat-7 satellite imagery data to give overall browse-availability and browse suitability index maps. Rhino area features such as roads, buildings and drainage line courses were digitised. Image processing and image classification was undertaken to determine area sizes of vegetation types in each of 9 Kenyan black rhino areas. It has been very difficult to classify the images in any purely automated way. It became necessary to demarcate broad sub-areas which had different geologies, topographies and vegetation structures (such as plant species/height/patchiness/density), and to classify within these. In many cases this involved extrapolating from each field browse availability plot, rather than relying on pure image classification. Bayesian classification (in IDRISI GIS) was used in all cases after extracting signatures from training sites. The Bayesian approach was excellent in that it gives the probability of each pixel belonging to each possible vegetation class. The probability of acceptance in a class could then be varied by sub-area to derive more accurate classifications per zone.

All drainage line vegetation had to be digitized by hand and classified using buffer zone around the lines. Drainage line vegetation is of vital importance to black rhino as the under-story vegetation is unique and palatable (and not picked up by satellite images). None of these have affected the budget but delays have been experienced due to much more time required for the field surveys and the data processing.

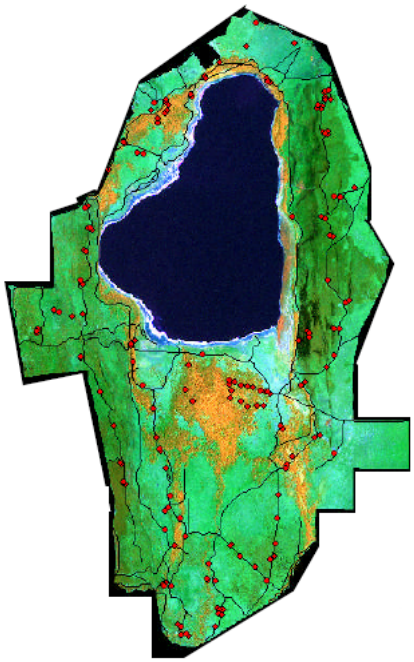


Figure 19a: Landsat image of Lake Nakuru NP showing location of browse assessment plots, drainage lines and general roads.

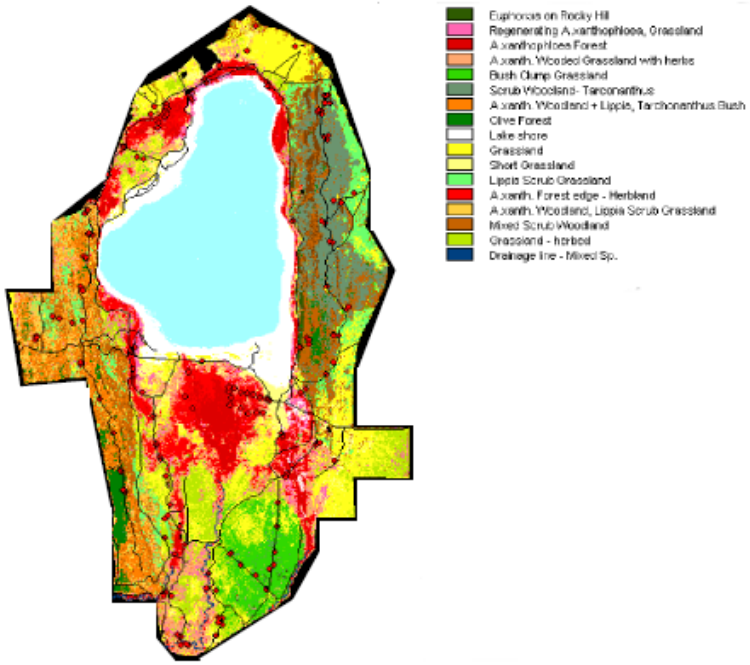


Figure 19b: Vegetation types of Lake Nakuru NP.

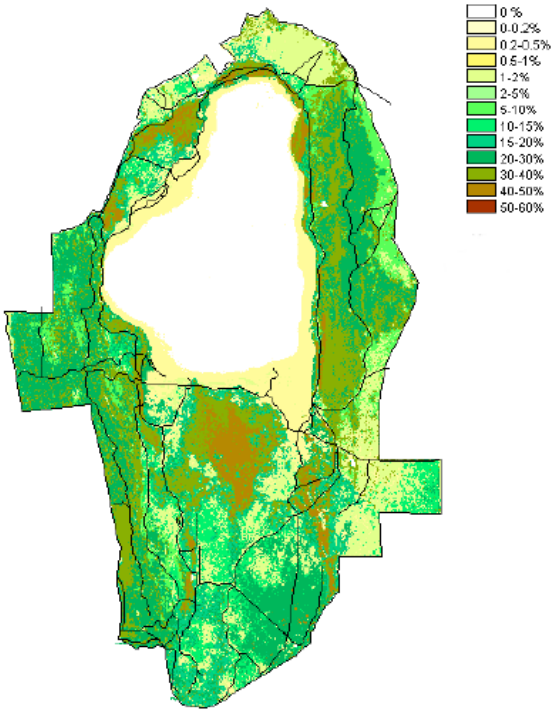


Figure 19c: Total browse availabilities for the vegetation types of Lake Nakuru NP.

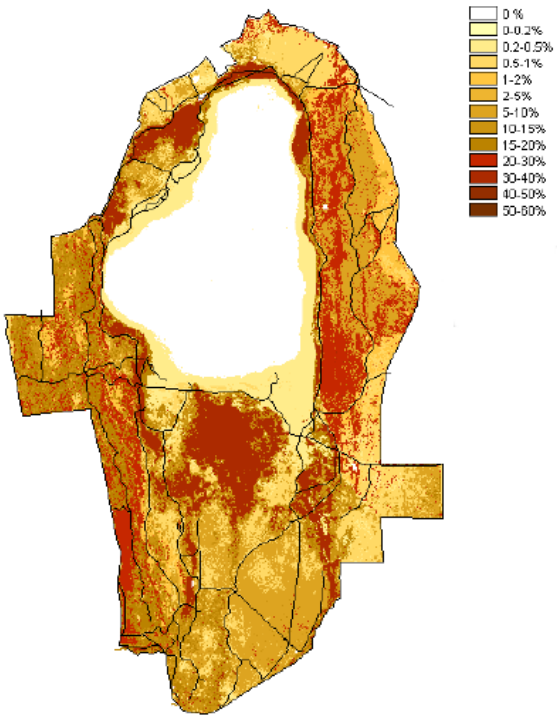
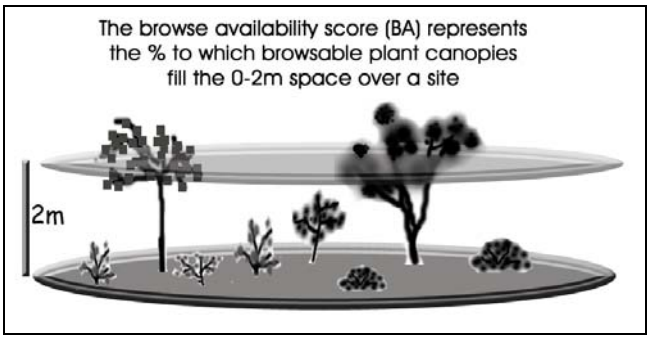
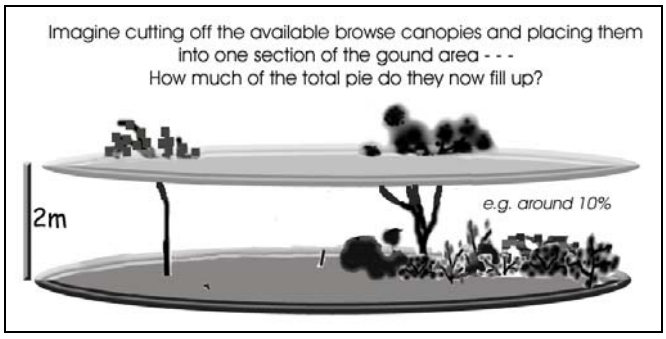


Figure 19d: Browse availability (%) of high and medium suitability species in the vegetation of Lake Nakuru NP.

Methods

Determination of browse availability and suitability indices





Browse availability for black rhino was assessed as an index. This index (abbreviated as BA) represents the % to which browsable material (leaves and twigs) fills the 0-2m volume over a rhino habitat: 100% BA would mean that the 0-2m space over an entire rhino area or vegetation type is filled with browse, 20% BA means that 20% of the 0-2m space over the area is filled with browsable material (training posters shown above).

Total Browse Availability (BA) is an index representing the sum of all browsable biomass potentially available to a black rhino in the 0-2m height range. This was divided into BA of High, Medium and Low Suitability plant types for black rhino. Each species was given a score on a 1 to 3 scale for its suitability as black rhino food. Palatable and preferred species important for rhino were scored 1, plants of neutral or slightly lower preference but still important in black rhino diets were given a 2, while species rejected by black rhino (even when very abundant) were given a 3. Plants of unknown diet preference or importance to rhino were scored 2. BAs of species receiving the same score were summed.

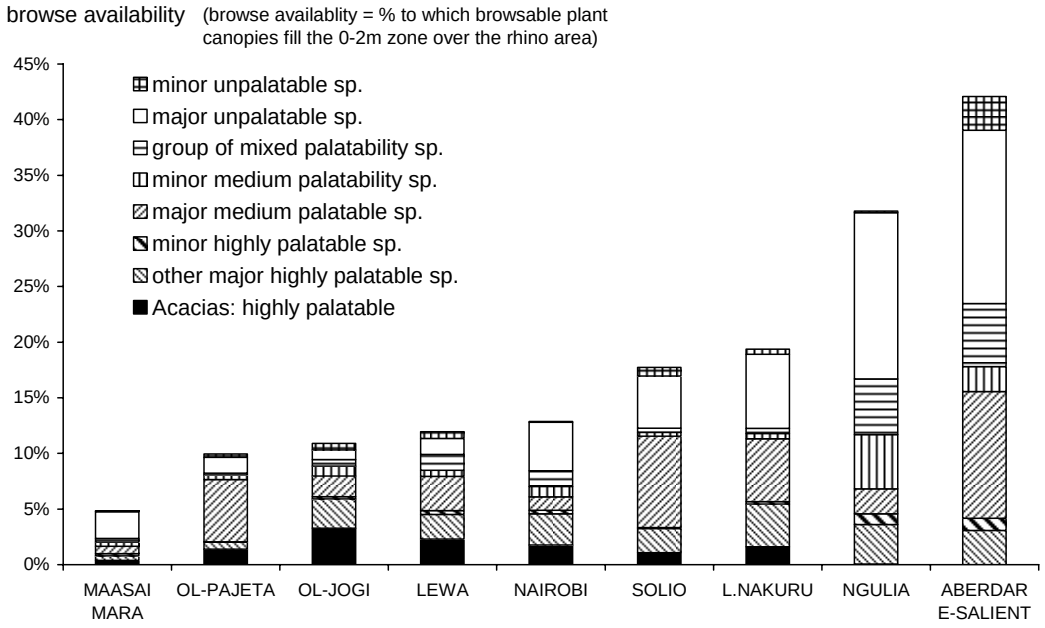


Figure 20: Amounts of available browse in each of the nine main Kenyan black rhino areas and the compositional breakdown of this browse by palatability class (i.e. the suitability of the browse component for black rhino). Each class comprises several woody or forb species. Black rhino browse is almost totally within a 0–2 m height range and the browse availability (BA) measure indicates the percentage to which this 2 m layer is filled by browsable plant canopies. BA was sampled by vegetation type and a weighted average BA was obtained accounting for the proportional area of each vegetation type within each rhino sanctuary.

The Aberdares NP Salient and Masai Mara NR have the most and least browse respectively, but most of their browse is not suitable rhino food. Ol Jogi Ranch and Lewa WC have the most favourable browse by proportional composition.

Species % contribution to BA: the percentage breakdown of available BA by species (or species group in the case of certain herbs). The field method used to assess BA is given in detail in the training manual. Browse resources were assessed by averaging measurements from plots in different vegetation types within each reserve. The area size of each vegetation type was calculated and the percentage that each type made up of the entire reserve was determined.

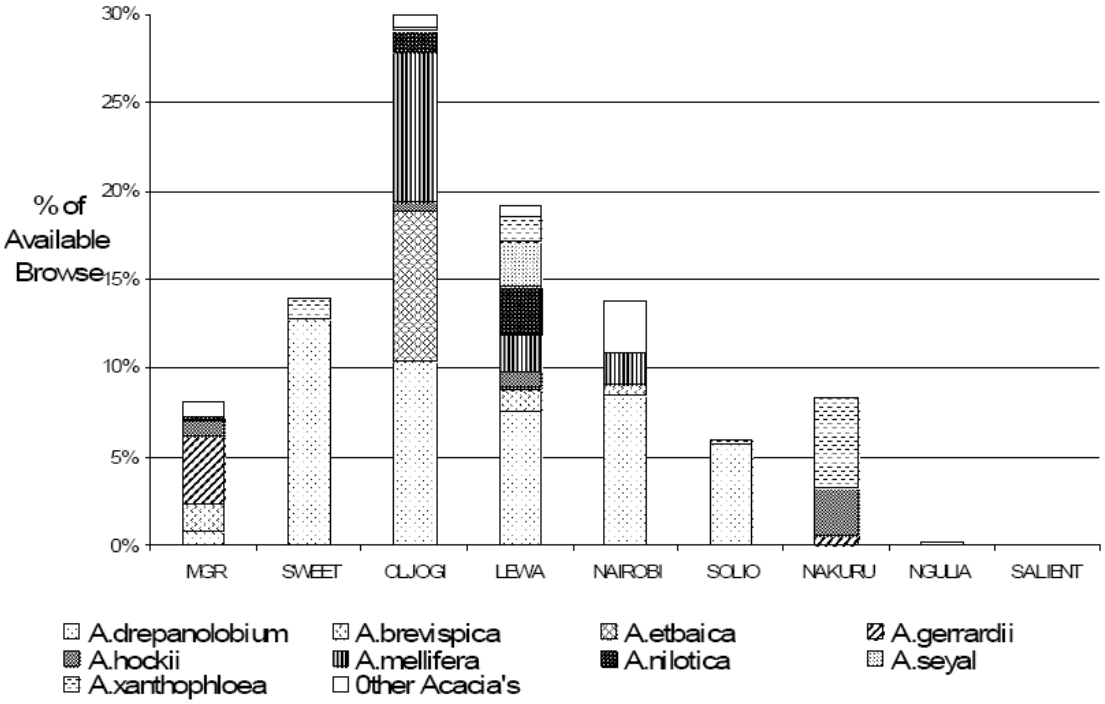


Figure 21: Contribution to available browse by Acacia's (high suitability for black rhino)

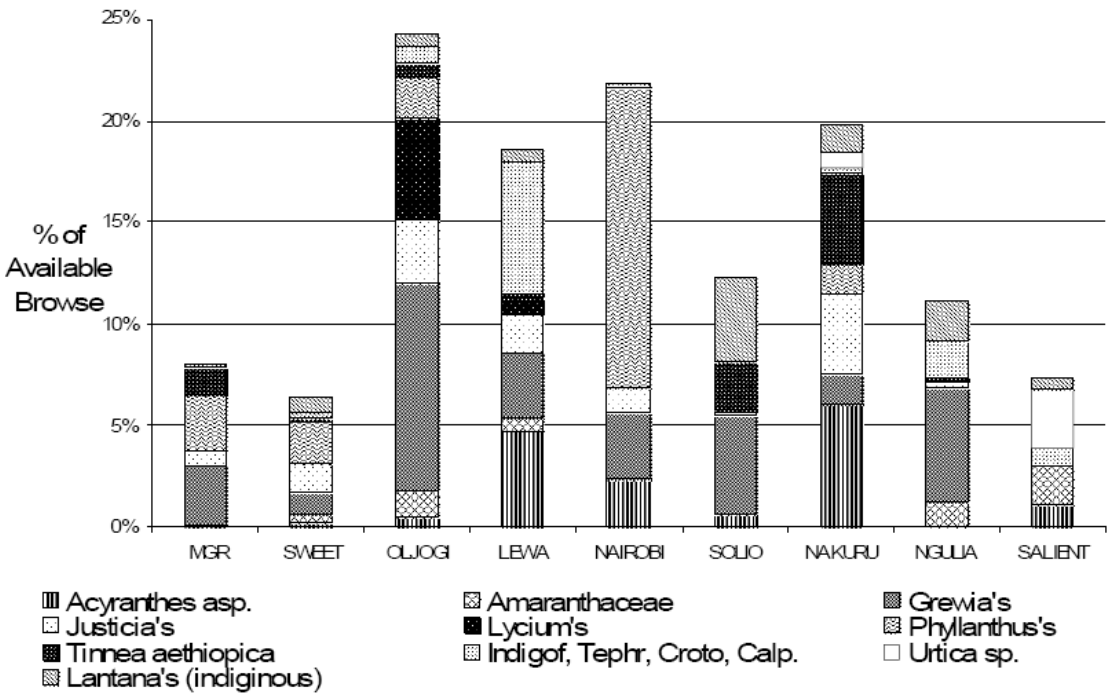


Figure 22: Contribution to available browse by main plants of high suitability for black rhino (excluding Acacia's)

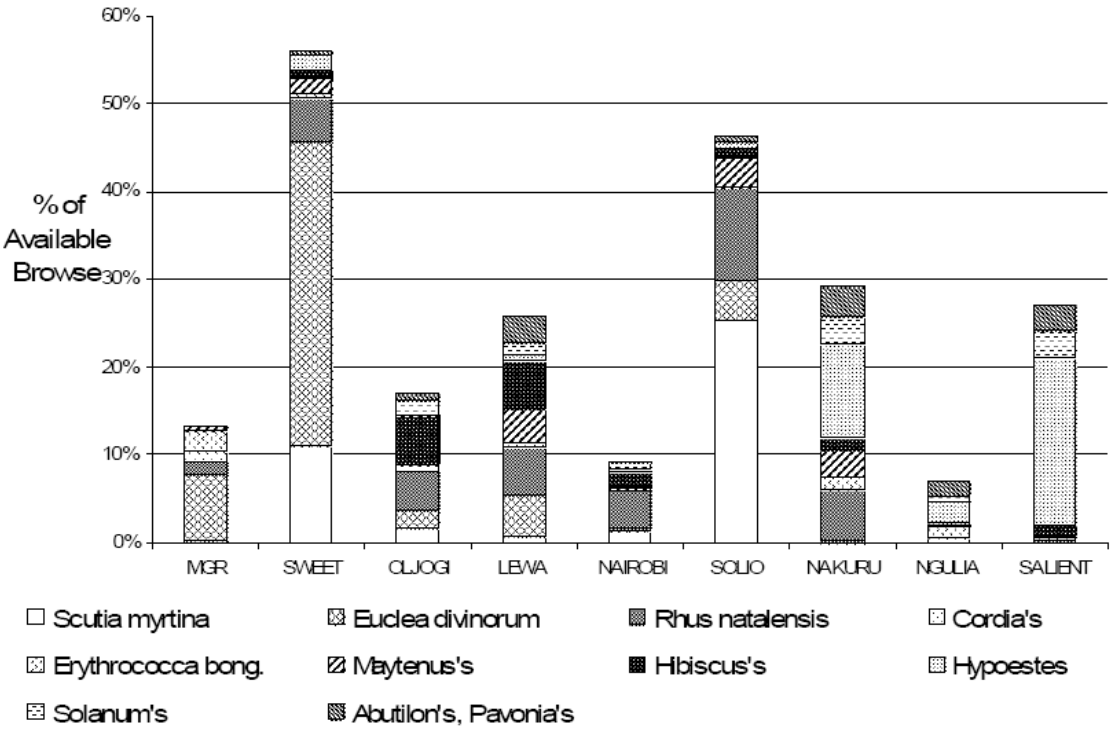


Figure 23: Contribution of available browse by main plants of medium suitability for black rhino

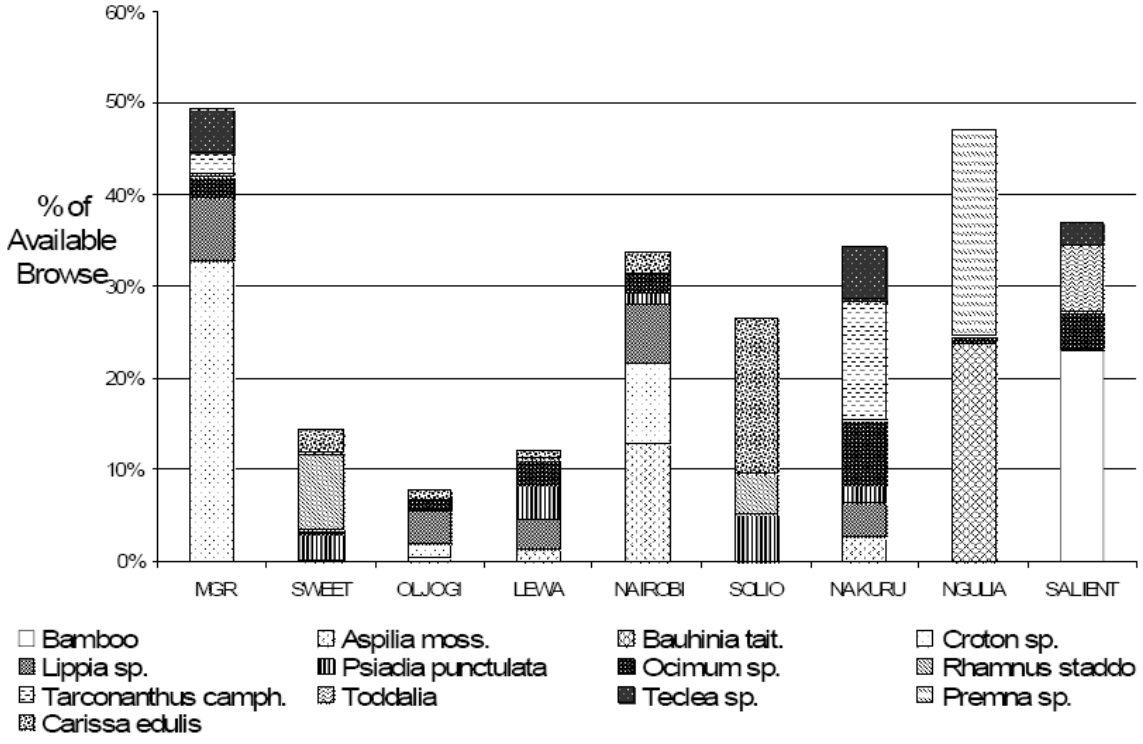


Figure 24: Contribution of available browse by main plants of low suitability for black rhino

Vegetation type information was obtained from a variety of reports, but in most cases types more relevant to black rhino browse needed to be identified in the field. The ability of remote-sensing image analysis to distinguish different vegetation types also determined the final classifications. LANDSAT image data from 2001 was used in IDRISI image processing software to classify images using training sites defined by information from ground plots (i.e. the vegetation surveys). For Masai Mara, Matt Walpole kindly contributed his set of over 300 monitoring sites. For Lewa, the vegetation work of Botha (1999) was used for the Ngare-Ndare forest section.

Determination of a browse growth index

Browse growth depends on many factors, not all of which could be accounted for here:

- plant species and even ecotype composition,
- competition between plants,
- amounts of soil water available to the plants (affected by rainfall patterns, evaporation, soil texture and site location in sloping terrain - run-on / run-off)
- soil nutrient status,
- temperature conditions for nitrogen mineralization and plant growth, plus frost incidence.
- the current or recent browsing impact (via browser density) and
- the fire regime.

An index of basic potential plant growth rate (cm per year) was estimated from monthly rainfall data for each rhino area. From the work of Birkett (2002), Birkett and Steven-Woods (2005), and Scholes (pers. com.) woody plants were assumed to grow 1 cm for every 20 mm of rainfall over the initial 20 mm falling in a month. However, some lesser growth was also assigned to the first 20 mm of rainfall, or monthly rainfalls of < 20 mm. In summary:

If avg. monthly rainfall > 20 mm,

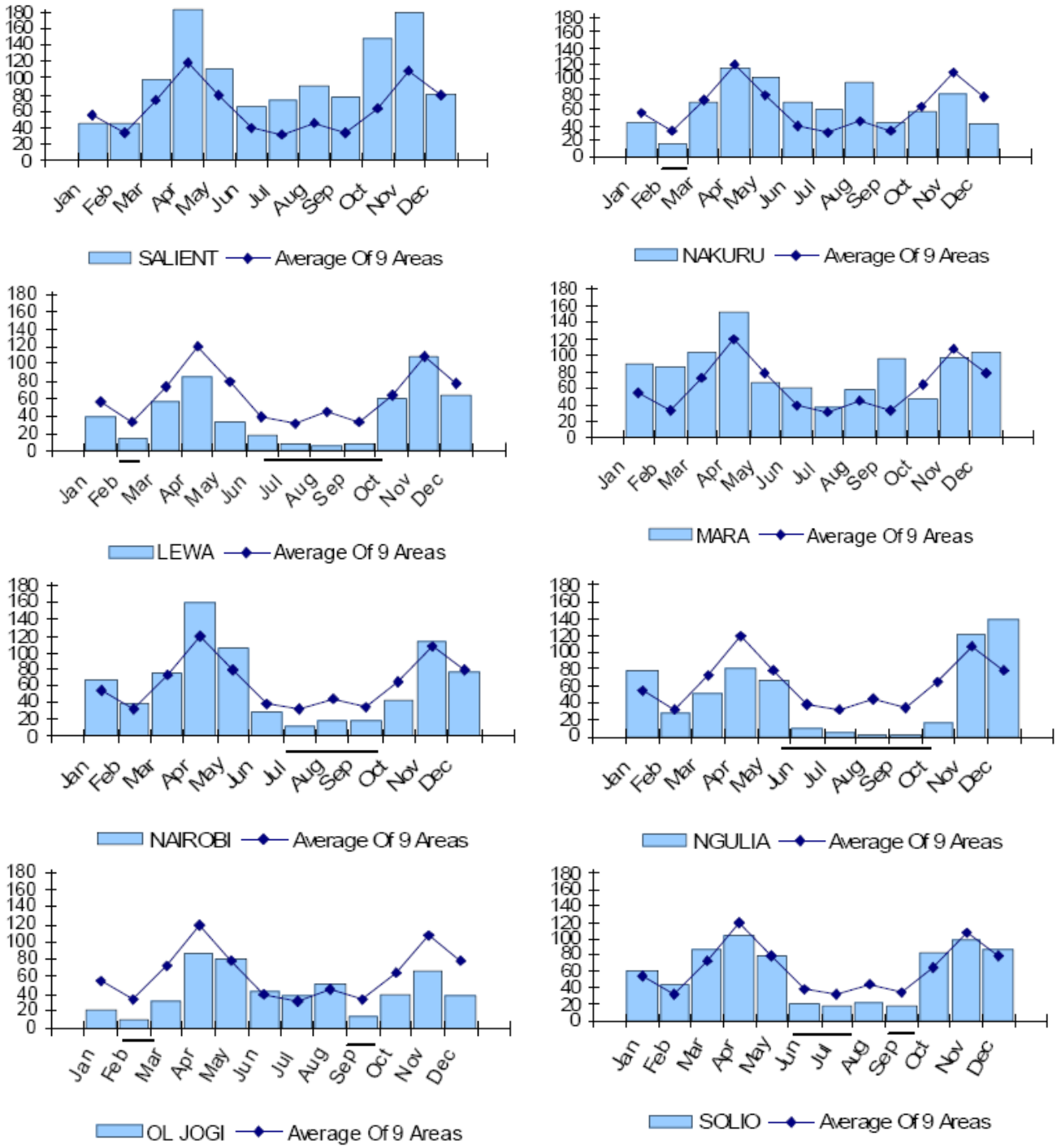
then growth in cm = (avg. monthly rainfall -20 /20) +0.5.

If avg. monthly rainfall > 0 but < 20 mm,

then growth in cm = avg. monthly rainfall / 20 x 0.5.

Else growth = 0.

Basic potential growth data was translated into BA values by adding the calculated centimetres of growth to average canopy dimensions of browse in each rhino area, and determining the additional % fill of the 0-2m layer that would result.



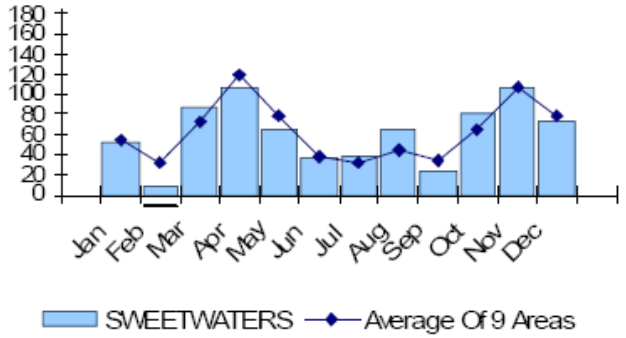
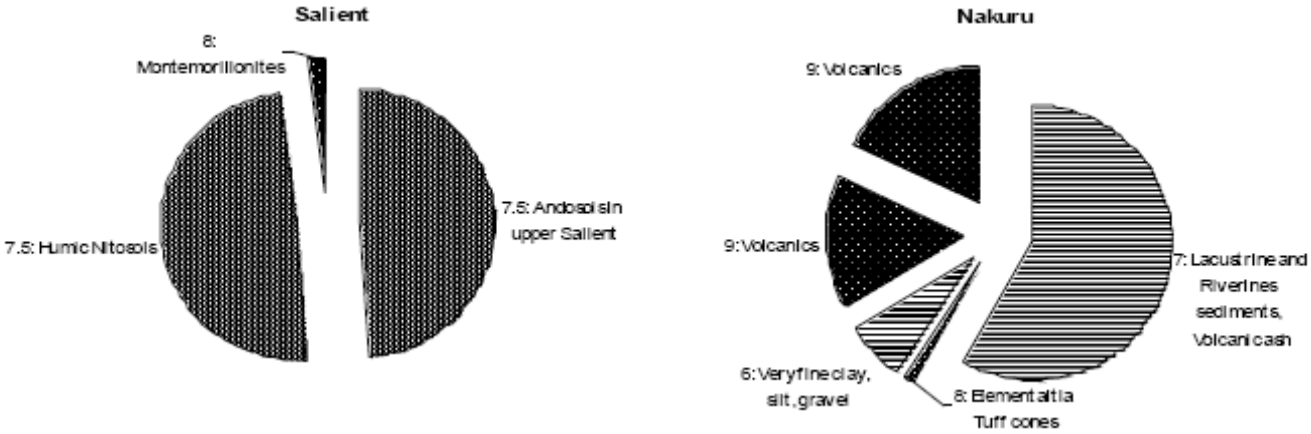


Figure 25: Monthly rainfall patterns in the nine rhino areas. Months with less than 20 mm average rainfall (where little or no plant growth will occur) are underlined. The average rainfall pattern of all nine areas is shown on each graph for comparison. Among dry areas, Lewa WC and Ngulia RS have the longest runs of dry months (<20 mm), while Ol Jogi Ranch has a surprisingly even spread of rainfall. Among high rainfall areas, Aberdares NP Salient and Mara GR have no very dry months, and Lake Nakuru NP only has one.

Determination of substrate nutrient status index

Soil nutrient status affects species composition and plant nutritional quality (Scholes 1990, Scholes and Walker 1993, Bell 1982), as well as plant growth rates (Prins and van de Jeugd 1992). Soil and / or geological information on each area was obtained from various reports and maps (Maskall and Thornton 1996, Schmitt 1991, Sombroek, Braun and Van Der Pouw 1980, Ndede 2003, plus various parks data and reports). In some cases the geology and soils were assessed by observations made in the field. Scholes (1990) and Scholes and Walker (1993) provided a summary of the general relationships between parent geology and resulting soil texture and nutrient status. This together with other information on silica content and grain sizes of different geologies was used to assign nutrient status scores to geological types on a 1-9 scale. Where soil data were available, a 1-9 nutrient status score was assigned based on the equation: Nutrient status score = %Clay score (1-3) X base status score (1-3) of Fey (1993) (also information from McVicar and Villiers 1991). The overall nutrient status of a rhino reserve was obtained by multiplying the nutrient status scores of each soil or geology type by its proportional area in the reserve. For the CC model, the area-weighted average soil nutrient status indices were translated to a 1 to 3 scale: 1 = score 1-3.5; 2 = score 3.51 to 6.5; 3 = 6.51 to 9.

Nutrient influences were imposed on the BA growth component of the model using proportional BA-growth modifiers (multipliers): 1=0.75, 2=1, 3=1.5. Thus high nutrient areas (3) were presumed to grow twice as much under a given rainfall as low nutrient areas (1) (as per Prins and van de Jeugd 1992, and following from results in Fritz *et. al*. 1992 where the large herbivore biomass on fertile soils was on average 2 times that on infertile soils.



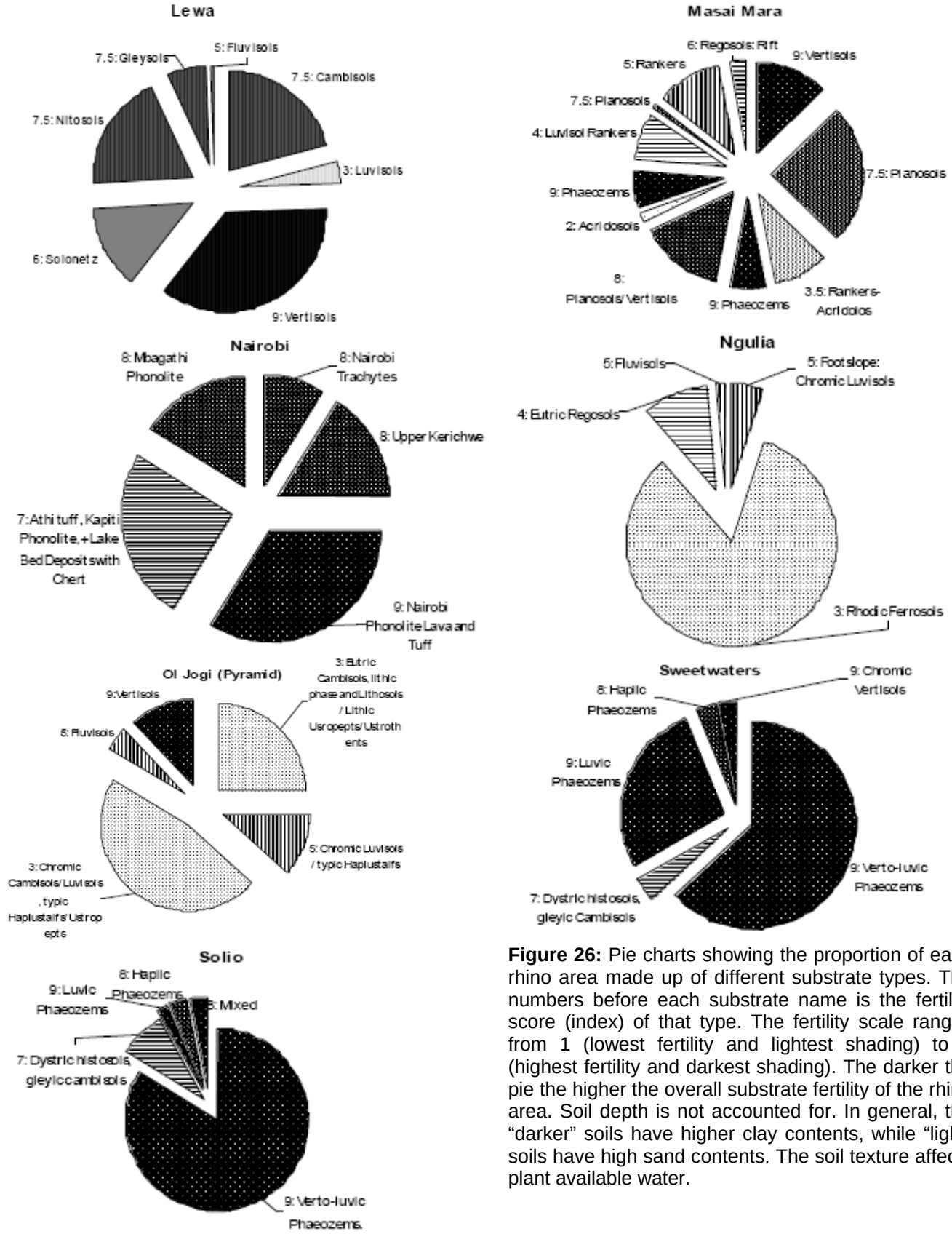


Figure 26: Pie charts showing the proportion of each rhino area made up of different substrate types. The numbers before each substrate name is the fertility score (index) of that type. The fertility scale ranges from 1 (lowest fertility and lightest shading) to 9 (highest fertility and darkest shading). The darker the pie the higher the overall substrate fertility of the rhino area. Soil depth is not accounted for. In general, the "darker" soils have higher clay contents, while "light" soils have high sand contents. The soil texture affects plant available water.

Determination of a rainfall concentration index

A rainfall concentration index was based on a standardized standard deviation of average monthly rainfalls. This index describes the degree to which rain is concentrated into a few months (i.e. high rainfall concentration) versus many months of the year (low rainfall concentration). It was felt that this parameter has an additional influence on browser carrying capacity by affecting the level of "greenness" and leafiness of the vegetation through the year.

Determination of a temperature index

Plant growth slows in months with low average temperatures and also when high average temperatures prevail (Fichtler *et. al.* 2004). The average July minimum temperatures were used to develop an index of temperature effects. Temperature effects were scored on a 0 to 3 scale as follows: 0 = <2.9^{o}; 1 = 3 ^{o} to 6.9 ^{o}, 2 = 7 ^{o} to 10 ^{o}, 3 = > 10 ^{o}. Scores of 0 mean frequent, fairly severe frosts in peak winter months, while scores of 3 mean hot growth conditions.

Temperature impacts were imposed (for modelling convenience) on the BA growth component of the model using proportional BA-growth modifiers (multipliers): 0=0.5 1=0.75, 2=1, 3=0.95.

Determination of a fire impact index

Fire frequency and extent – the most easily measured aspects of fire regimes, are generally positively correlated with average annual rainfall across sites, because rainfall (along with grazing animal biomass) determines the build-up of grass fuel loads each season. However, these fire attributes, when compared at face value across sites, on their own are not very informative about fire impacts on browse resources. Woody plant ability to withstand fire and re-grow each season is also positively correlated with increasing rainfall. Average annual rainfall thus determines the "potential" woody cover and recovery rate of a habitat, with soil texture also influencing potential by affecting water infiltration rates (Sankaran 2005, Van Langevelde *et. al.* 2003). Thus theoretically, for a given rainfall (and browser density below CC), there is a fire regime which could maintain the browse at similar levels over time, while fire frequencies or severities above or below this level lead to declines or increases in browse availability respectively (deduced from park fire data and field observations in this study, and implicit in the aforementioned references). Fire impacts on rhino browse within a site were therefore rated according to the estimated severity, extent, and proportion of a year wherein there is a decline in browse availability due to fire, accounting for average topkill, plant mortality rates, time to re-sprouting, speed of sprout growth and average percentage of the rhino area burned per year (based on information from studies such as Dublin *et. al* 1990, Broomhall 1997, Roques *et. al.* 2001, Balfour and Howison 2001, Okello in prep., and various unpublished ecological fire reports and fire data from study areas).

Fire impact was scored on a 0 to 4 scale, and its impacts were imposed (for modelling convenience) on the BA growth component of the model using proportional BA growth modifiers (multipliers): 0=1; 1=0.95, 2=0.9, 3=0.85; 4=0.75.

Determination of impact of browser competition

To understand the potential impact of browser densities on black rhino and their food resources, the metabolic biomasses of additional browsing species were converted to "rhino equivalent" biomasses. First, the average mass of individuals in a population was estimated, as 66% of the average between adult male and female masses, using data in Owen-Smith (1993). Some exceptions to this rule are described in the table below.

Browsing Species	66% of Avg. of Mean Male and Female Mass	Metabolic Mass (Mass^0.75)	Proportion of Browse (dicot. herbs and woody plants) in Diet from the 0-2m Zone			Black Rhino Equivalents per Animal		
			Ngulia RS	Salient Aberdares NP	General	Ngulia RS	Salient Aberdares NP	General
Buffalo	**386**	87.1	**0.40**	**0.40**	0.20	0.233	0.233	0.117
Eland	**310**	73.9			0.50			0.248
Grant's Gazelle	**36**	14.8			0.90			0.089
Thompson's Gazelle	**14**	7.1			0.10			0.005
Gerenuk	**23**	10.5			0.80			0.056
Giraffe	**668**	131.4	**0.90**		0.15	0.792		0.132
Impala	**33**	13.9			0.30			0.028
Greater Kudu	**141**	40.9			1.00			0.274
Oryx	**129**	38.3			0.15			0.039
Black Rhino	**792**	**149.3**			**1.00**			**1.000**
Elephant	**2150**	315.7	**0.70**	**0.70**	0.40	1.48	1.48	0.85
Lesser Kudu	**49**	18.5			1.00			0.124
Wildebeest	**140**	40.7			0.10			0.027
Cattle	**250**	62.9			0.10			0.042
Goats/Sheep	**28**	12.2			0.30			0.024
Nyala	**56**	20.5			0.60			0.082
Springbuck	**23**	10.4			0.90			0.062
Bushbuck	29	12.5			1.00			0.084
Duiker	11.6	6.3			1.00			0.042

Table 1: Conversions of browsing species metabolic biomass to black rhino equivalents. In general 66% of the average of mean adult female and adult male mass (from Owen-Smith 1993) is used as the average mass of an individual of a given species. Exceptions are black rhino, where 1200 kg is used as the average adult mass; Elephant, where the average of Coe's individual mass (1725kg) and the 66% of mean adult weights from Owen Smith (2574 Kg) is used. Ngulia RS and Salient Aberdares NP are special cases where bush structure is generally low and grass availability is limited. Wildebeest were included in the Masai Mara GR only due to their huge seasonally numbers.

Next, the proportion of browse in each species' diet and the proportion to which a species' browse feeding occurred in the rhino feeding layer of 0-2m height range was estimated from literature (van Holt 1999, Kuria 1995, Dublin 1995, Birkett 2002, Birkett and Steven-Woods 2005, Pellew 1983, Cerling *et. al.* 1999, Codron *et. al.* 2006). Then the average metabolic mass of each species was multiplied by this proportional browse feeding in the 0-2m layer, and expressed as a proportion of black rhino average metabolic biomass. The "rhino equivalent" biomass was then multiplied by the recent maximum and mean population estimate for each species in each rhino area. Finally, the density per km^2 of "rhino equivalents" was calculated for each place.

Determination of prior estimates of black rhino carrying capacities

Prior estimates of the black rhino CC were available in Brett (1989) and Anon. (1993) based on the opinion of rhino experts familiar with the areas. These were adjusted by undertaking a more detailed review of actual population performances in the rhino areas since 1993, coupled with additional ecological insights accrued since then based on field rhino feeding surveys and estimated home ranges (Darwin Initiative project and others) and other research (Okita 2004, Birkett *et. al.* 2002, KWS rhino programme population estimates and black rhino performance data up to 2005). The uncertainties around the Ngulia and Aberdares Salient population sizes presented a problem in understanding these populations.

Range sizes were calculated using home range software. The minimum convex polygon method and the Kernel Estimation method were used. Only older subadults and adult rhino which showed approximately stable ranges over a 3 year period were used to produce reserve home range averages. Unfortunately, only 5 of the nine areas had suitable sighting data for home range estimation (Lewa, Sweetwaters, Nairobi, Nakuru and Masai Mara (courtesy of Matt Wapole) (please see Supplementary item 11).

Selection of black rhino CC model variables

The analysis was undertaken for both the Kenyan data and the combined Kenyan and Southern Africa data (to give a continental wide model). Existing data from Southern Africa were processed in the same way. The combined dataset improved the Carrying Capacity (CC) modelling process. Pearson product moment correlation matrix was calculated for the potential black rhino CC determinants (CC model independent variables) and prior CC estimates (CC model dependent variable). A range of transformations of the variables were investigated based on a linear model using the Predict Software Package and the logged transformations were found to have the strongest relationships. The CC estimate was very strongly correlated with all the browse availability and browse growth variables. For example, correlation coefficients with Log Total BA: 0.826; Log Suitable BA: 0.862; Log Total BA Growth inc. fertility, temperature and fire: 0.803; and Log Suitable BA Growth inc. fertility, temperature, fire: 0.863. Annual Rainfall on its own did not have a very strong relationship with CC (corr. coeff. 0.536).

Maximum rhino densities in the 24 areas also showed similar but less stronger correlation patterns with the various browse and environmental variables (correlation coefficients with Log Total BA: 0.705; Log Suitable BA: 0.713; Log Total BA Growth inc. fertility, temperature and fire: 0.709, and Log Suitable BA Growth inc. fertility, temperature, fire: 0.748). This was to be expected as not all areas were thought to be at or near CC.

Estimated average male range size, which is hypothesized to be a "natural" indicator of habitat carrying capacity, also showed the same general correlations patterns with the CC estimates, and lends independent support to the hypothesized importance of browse and browse growth variables in determining black rhino CC.

Finally, the total "Rhino Equivalent" biomass density followed similar correlation pattern with the independent variables as the CC and male range size estimates.

An important feature of the data is that suitable browse availability is a better correlate of estimated CC than total BA. This lends general credence to the suitability ranks assigned to browse species (despite the difficulties in assigning ranks). Not all available browse is good for black rhino.

For environmental variables, annual rainfall has a low correlation with total BA (corr. coeff. 0.357), and even less with suitable BA (0.242). Fire category has a moderate negative relationship with BA as can be expected. Browse availability and suitability appear to be uncorrelated with nutrient status (corr. coeff. -0.023 for total BA, 0.124 for suitable BA), July minimum temperature (0.132 for total BA, 0.043 for suitable BA) and rainfall concentration (-0.199 for total BA, -0.107 for suitable BA). Rainfall concentration is correlated (negatively) with annual rainfall: the lower the annual rainfall, generally the higher the concentration of rainfall into a few months of the year. Some rhino areas do not follow this pattern, however, especially those showing fair amounts of "winter" rainfall (e.g. Ol Jogi GR).

Development of black rhino CC model

The final variables chosen for the black rhino CC model were Log Suitable BA and Log Suitable BA Growth including fertility, temperature and fire, using Log CC estimate as the dependent variable. Although the correlation between Log Suitable BA and Log Suitable BA Growth inc. fertility, temperature, fire was 0.642, it was felt that both variables were required in the model: conceptually the growth variable should represent the resources available to "carry" the rhino sustainably, however as growth fluctuates annually with rainfall and fire, the standing amount of available / suitable browse represent the buffer which irons out some of the resource viability for black rhino (i.e. even when annual growth is zero there is still food for the rhino).

Both linear regression and nonlinear modelling approaches were applied to the CC model construction. The simpler linear regression model was found to be adequate and was therefore preferred over the non-linear models (Nabney 2002, Crawley 2007). The summarized regression statistics are shown in Table below. A very highly significant adjusted r-square of 0.896 was obtained (P-value: 1.82E-11). The intercept and both model variables were highly significant (P-values for intercept: 0.0000008, Log Suitable BA: 0.0000046, and Log Suitable BA Growth inc. fertility, temperature, fire: 0.0000042).

Multiple R	0.951
R Square	0.905
Adjusted R Square	**0.896**
Standard Error	0.308
Observations	24

Analysis of Variance:

	Df	Sum of Squares	Mean Square	F	Significance F
Regression	2	19.02939272	9.514696358	100.1413	**1.82539E-11**
Residual	21	1.995266697	0.0950127		
Total	23	21.02465941			

	Coefficients	Standard Error	t Statistic	P-value	Lower 95.00	Upper 95.00
Intercept	1.553	0.233	6.680	0.0000008	1.070	2.037
Suitable BA	0.690	0.116	5.944	0.0000046	0.449	0.932
Browse Suitable BA Growth inc. fertility, temp, fire	0.427	0.071	5.990	0.0000042	0.279	0.575

Table 2: Summary of regression statistics for the black rhino carrying capacity model.

The Carrying Capacity estimation tool was implemented in Excel and Kenyan Scientists were trained in its use (please see Supplementary item 12).

Development of total browser CC model

A total browser CC model was also developed. Correlation analysis showed that the total and "other" browser density (as rhino equivalents per km^2) are highly correlated with total BA (corr. coeff 0.717 and 0.698 respectively). These correlations with Total BA are stronger than those with Suitable BA (corr. coeff. 0.637 and 0.656 respectively). This makes sense as the suitability ratings were designed specifically for black rhino. In fact total and "other" browser density are most strongly correlated with the composite variable representing the average of Total BA and Total BA Growth incorporating fertility, temperature and fire (corr. coeff 0.821 and 0.792 respectively). This composite browse-growth variable was chosen as the main independent variable in the total browser CC model. The variable Rainfall Concentration also had relevant correlations with total and "other" browser density (corr. coeff 0.463 and 0.458 respectively). This variable was also selected for use in the total browser model as it particularly captures the degree of lack of dry season rainfall and therefore potential lack of "green bite" browse material. This is particularly relevant for smaller herbivores relying on leaf and small shoot material (e.g. Owen Smith 1990). It may also capture the degree to which elephants switch to browsing once grass dries off and loses nutritional value at the start of the dry season(s).

A total browser model was developed based on the Maximum Total Rhino Equivalents / Km^2 as the dependent variable. A highly significant adjusted r-square of 0.800 was obtained (P-value = 8.9E-08). The intercept and browse/browse growth variables were highly significant (P-values for intercept: 1.04E-09, for Log average(Total BA, Total BA Growth inc. fertility, temperature, fire): 0.0000013). The Rainfall Concentration variable was of marginal significance (P-value = 0.0177).

Based on graphing the observed maximum recent browser densities versus this model predicted total browser CC, we decided to take 70% of the model predicted CC as a more likely reflection of the real total browser carrying capacities, because around 10 out of the 22 study sites used in the total browser model had known or hypothesized excessive total browser densities for the 0-2m layer.

For comparison, a second browser CC model was made using observed mean recent browser densities (mean total rhino equivalents per Km^2) as the dependent variable and with the same independent variables. Again a very highly significant adjusted r-square of 0.78 was obtained (P-value = 1.9E-07). The intercept and browse/browse growth variables were highly significant (P-values for intercept: 2.37E-08, for Log average(Total BA, Total BA Growth inc. fertility, temperature, fire): 0.000004). The Rainfall Concentration variable was again of marginal significance (P-value = 0.0136). The two models (70% of maximum total browser density, and mean total browser density, as rhino equivalents per Km^2) were very similar.

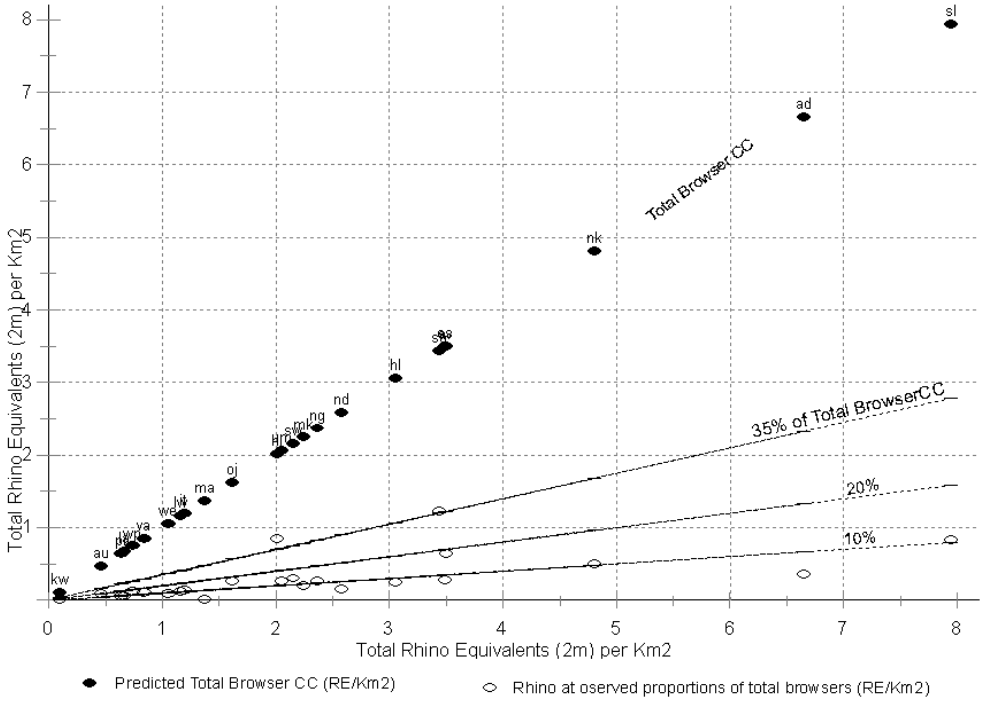


Figure 27. Graph of predicted total browser CCs as rhino equivalents per Km^2 (black dots); and black rhino densities at the percentages of estimated total browser CC observed from herbivore population data. The dark lines show 35%, 20% and 10% of estimated total browser CC. Across the study sites (but excluding ESH (es) and SAL (sl)), black rhino commonly form 10-15% of the total browser biomass feeding in the 0-2m layer (mean 13% median 10.7%). However we hypothesize (based on two cases SOL (so) and NAI (ni)) that under certain circumstances, black rhino can comprise at least 30% of total browser biomass for their feeding layer. These are thought to be cases where removal pressure or historical circumstances have lead to much lower densities of competing browsers than in most African areas. Implications are that black rhino do suffer competition from competitors. More research is needed to clarify competitive and compensatory relationships between black rhino and other browsers. Please see Supplementary item 13 for more details.

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5. Project Impacts

The project has achieved its purpose of developing a team of skilled Kenyan researchers and park field personnel capable of significantly contributing to the achievement of one of Kenya's key conservation goals: namely, increasing the numbers of the *Critically Endangered* eastern black rhino (*Diceros bicornis michaeli*), and conserving its natural habitat. Kenyans themselves (without the need for external consultants) are now undertaking the training, monitoring, data collection, data quality control, storage, analysis and reporting using the implemented training, procedures and field tools. All of these elements have significantly improved and thus the information on rhino population sizes and dynamics along with habitat conditions and estimated park carrying capacities (Annual Status Reports, Monthly Progress Reports, Data in Rhino Information Management System, Master ID files). This information has enabled the Kenyan rhino programme and the Rhino Management Committees to make recommendations for rhino metapopulation management for population growth and for habitat management/conservation (discussed in more detail in other sections of the report). Ultimately, the annual rate of growth of rhino numbers has for the first time since 1970 increased above the national conservation target of 5% over the past 3 years (Kenyan Annual Status reports and IUCN AfRSG report) and is currently one of the fastest growing national populations in the world (in terms of growth rate). New rhino areas have been created and conserved (Mugie Rhino Sanctuary, Meru NP Rhino Sanctuary, Ngulia Rhino Sanctuary extension, Ol-Pejeta GR extension, Ol-Jogi GR extension) and other new areas are being planned (Lewa extension, Tsavo West IPZ).

Other major impacts have been the start of greater regional collaboration in rhino conservation through initiating the setup of the EAC-RMG and the development of the new 5-year conservation strategy (with revised goals & strategic objectives and new set of actions & indicators) driven by Kenyans rather than outside experts thus having greater ownership. The rhino programme with its training and rigorous approach to management is now regarded as a model to follow for the other intensively managed species programmes within Kenya. This is now filtering into other activities of KWS.

This project has built in-country Kenyan technical capacity to effectively and sustainably run the necessary rhino monitoring, habitat assessment, and biological management decision-making aspects of the Kenyan rhino conservation programme (Articles 7 - identification and monitoring, 8 - in situ conservation and 12 - research and training). It has recently helped develop the new 5-year rhino conservation strategy which has placed increasing emphasis on community partnerships and engagement (Article 6 – General Measures for Conservation & Sustainable Use). In addition, this project has contributed to achieving key objectives of the 1998 Kenyan National Biodiversity Action Plan, namely: 1) developing the expertise within Kenya to promote the protection of natural habitats for the maintenance of viable populations (e.g. of black rhino) in their natural surroundings; 2) providing a scientific and technical education and training programme to facilitate the conservation and sustainable management of key components of Kenya's biodiversity (e.g. rhino and rhino habitat); and 3) establishing a range of field-based tools and infrastructure supporting Kenya's capacity for protected area management.

Further, because rhinos, elephants and other large browsers (e.g. giraffe) can significantly modify their habitat, their occurrence at high density can severely impact on the community structure and biodiversity of restricted areas. This is especially the case inside smaller (<200km^2) fenced sanctuaries within which most of Kenya's rhino are conserved. The improved rhino monitoring, habitat assessments and status reporting is therefore benefiting not only the management and conservation of rhinos but would also positively impact on the effective conservation of many other species. Rhinoceros act as umbrella species for the ecosystems they inhabit because their conservation requirements, by default, encompass those of other smaller species. If rhinoceros can be successfully conserved and protected within an area, then the other species in the area will also benefit.

Appendix 1 shows the contribution made by different components of the project to the measures for biodiversity conservation defined in the CBD Articles.

Building capacity of ranger staff

The ranger rhino monitoring training and support has boosted morale and significant improvements in monitoring and data quality are being seen through the monthly reports, status reports and visits. The trained instructors are now conducting all the training themselves with minimal support from the KWS HQ staff. The basic monitoring course has also been incorporated into the curriculum of the National field ranger and officer paramilitary training school at Manyani. The local instructors recently trained 421 trainee rangers in basic wildlife monitoring with specific emphasis on rhino monitoring and surveillance. This process will ensure that all field rangers and officers joining the Kenya Wildlife Service have the basic monitoring skills which will benefit the conservation of wildlife in Kenya.

The trained field staff are maintaining / running all the field tools setup by the project. The outputs from these tools again have been institutionalised in the form of standardised monthly progress reports and annual status reports. Trained park officers and rhino programme staff are now producing status reports and these are being used for informed decision making through the park offices and national committee and the feedback received through monthly reports reviews and annual status reports has also greatly helped to motivate and improve morale of staff on the ground. As rhino is a flagship biodiversity programme it is having a positive impact on many other species.

Building capacity in Research and Management

Ben's MSc training in the UK has given him enormous confidence and he is significantly contributing to the programme back in Kenya. His findings and subsequent status reports have helped KWS make informed metapopulation management decisions. Ben was promoted to a senior position and appointed as the Kenyan Rhino Coordinator when Martin Mulama left KWS in 2006. Ben has matured as a scientist and programme manager. Ben is a key member of the KWS species department, often serves as the acting head of the department when Mr Patrick Omondi, the head of the Department is away and provides input to the other species management programmes. Ben has enormous potential to further his career at KWS. He integrates very well with the other staff within KWS and external partners and has the support of an excellent KWS Director and the other senior management staff.

Ben has already made important contributions to the programme such as facilitating the successful removal of 255 elephants from Ngulia Rhino Sanctuary, expansion of Ngulia rhino sanctuary by an extra 26km^2, initiating (with UK Darwin fellow) the setup of the IPZ and EAC RMG. Ben also teaches the students on the certificate and diploma courses in Wildlife Management at the KWS training institute. He also does various talks and presentations, the most recent being on sustainable training at the Tropical Biology Association Conference held at the Natural Museum of Kenya in July 2007 and CITES Conference in Hague , Netherlands in June 2007.

Lekihon Kenana's MSc training at Moi University has also proved to be extremely fruitful. Lekishon came top of the class in all the training workshops at KWS and received Grade A in his MSc. He is very bright, diligent worker and has huge potential within the Research Department at KWS. Kenana was promoted to Senior Scientist Savannah after completing his MSc and is responsible for the research and management work in this key area. This also includes the rhino habitat assessment work.

Adhan Berhe (Tsavo West Ngulia Rhino Warden) completed his BSc in Wildlife Management in March 2007. Adhan has worked in the Rhino Programme for over ten years starting as a ranger. Over these years at Ngulia Rhino Sanctuary, he successfully completed his Certificate and Diploma courses at Mweka College. He was subsequently promoted to Rhino Warden. Adhan is a very knowledgeable and experienced in field operations. He has been promoted, on completion of his BSc studies, to the Rhino Officer in Charge of the whole Tsavo region (Tsavo East NP, Tsavo West NP including Ngulia Rhino Sanctuary and the newly created IPZ, and Chyulu Hills NP). The new 5 year strategy has placed increasing emphasis on the building up of the free-ranging populations in the large areas particularly Tsavo which still has the potential of over 5000 rhinos. Adhan is a key person in the successful implementation of the IPZ. Adhan like Kenana and Ben has grown in confidence and did two excellent presentations at the IUCN African Rhino Specialist meeting held in Tsavo West NP, Kenya. Over fifty delegates attended the 5-day meeting all of whom were very impressed with Adhan. The whole Darwin team is very keen for Adhan to progress further and hopefully one day become the Rhino Coordinator which would be a tremendous achievement starting from the ranger level.

The Certificate training programme for promising field officers / rangers in Sanctuary Wildlife Management has been another major impact of the project. This was found to be a very effective way of building local capacity quickly. It was the first time officers and rangers had a chance to be formally trained together in such a way. Darwin fellows taught a key module on sanctuary management techniques and were extremely impressed with the eagerness of the students to learn as much as they could. All worked extremely hard and this showed in the final exam results (please see training section). Having all together meant they were able to motivate and get the best out of each other. All twelve staff have remained in the Rhino Programme and are contributing in key areas in training, monitoring and management. Two trained staff moved to the newly created rhino sanctuary at Meru NP and significantly helped in creating an effective monitoring team. Many of the trained staff have the potential to progress further within the KWS system. During the next few years Kenya will move into a new phase of conservation of the black rhinoceros. KWS also aims to be a world leader in wildlife conservation through its management strategy. The very best trained staff will be required for this.

Training was provided to the park education wardens Elema Hapicha and Lucy Makosi in techniques based on learning through discovery particularly for young children. Both education wardens are implementing this approach and are very keen to develop their education programmes further. This was an extra activity. A Darwin post project application was submitted particularly focussing on community engagement elements in the Tsavo and Meru Conservation Area.

There is a genuine and strong partnership between the UK partner ZSL and the KWS. This partnership is boosted by past experience within the partnership of over 20 years and is planned to continue through a range of projects. The almost daily contact between ZSL Darwin staff and the KWS team strongly remains. KWS invited ZSL to review the previous 5-year national conservation strategy, facilitate the 5-day stakeholder workshop to produce the next 5-year strategy and help with the write-up of the new strategy. ZSL will continue to provide technical support as needed in the implementation of the strategy. The ZSL Darwin fellow has been proposed by Biodiversity Monitoring and Research Division of KWS to be a member of the National Rhino Technical Committee. KWS is also working closely with ZSL, AfRSG and the Tanzanian and Ugandan Wildlife Authorities to initiate regional co-operation (through the setup of an East African Committee Rhino Management Group) for enhancing increase in rhino numbers and for spreading the risks.

As KWS is a parastatal organisation under the Office of the President (KWS), the Government of Kenya (GoK) is involved. For example, the GoK provided emergency funds for the removal of the 255 elephants from Ngulia Rhino Sanctuary. It is helping in the establishment of the Intensive Patrol Zone (IPZ) in Tsavo West NP and provided tax exemption (VAT and Duty), through the Ministry of Wildlife and Tourism, for equipment imported into the country for rhino conservation.

The private land black rhino sanctuaries and the county council run Masai Mara GR have also been important partners in the Darwin project.

The Darwin project had no direct activities for sustainable initiatives which empower and benefit local communities. However, the presence of rhino appears to be a major contribution to park/reserve gate revenues, which helps to fund the parastatal KWS, whilst also leading to the significant creation of jobs within the tourism industry. Rhinos are an important flagship species, and invariably if they are well managed and protected, many other species living with them will also benefit. Therefore improved rhino conservation contributes to maintaining a healthy tourist industry with its attendant economic and social benefits.

Park Name	2000	2001	2002	2003	2004	2005
Aberdares NP	44,039	40,214	41,163	32,469	44,039	48,337
Lake Nakuru NP	162,358	201,335	229,808	216,654	256,966	344,598
Meru NP	5,590	8,229	6,563	5,210	6,417	8,935
Nairobi NP	112,227	100,471	90,447	80,042	92,544	99,927
Tsavo East NP	123,332	132,427	152,776	131,555	158,478	180,077
Tsavo West & Chyulu Hills NPs	75,533	78,969	76,046	69,840	92,658	105,748
Total	**1,200,758**	**1,265,301**	**1,467,002**	**1,253,728**	**1,402,052**	**1,674,693**

Table 3: State rhino areas visitor statistics from 2000 to 2005

KWS is also now placing increasing effort, through both its strategic 5-year plan and the black rhino conservation strategy, on community development and engagement programmes. This includes conventional approaches to community development including schools, water-dams, clinics etc. There is also a need in some of the PAs (Tsavo, Meru) to improve local community relations through greater involvement in natural resource management and land use planning. The prospect for community eco-tourism projects where there are few competing land use issues has also improved through the increase in rhino numbers.

6. Project Outputs

The project outputs are provided in the table in Appendix II based on the coding and format of the Darwin Initiative Standard Output Measures.

All the main project outputs were achieved. The only ones not achieved were the 2 radio broadcasts. Some delays were experienced with field habitat assessment and ECC work firstly as result of the KWS Rhino Programme vehicle which was required for vital translocations. The habitat field work therefore took place in two stages, using a hire-vehicle. This delay also had an impact on the remaining elements of the habitat assessment and ECC work. The Darwin Secretariat was informed of these changes in the work plan and these were approved. The lack of digital cameras with sufficient optical zoom and resolution was hampering the setting up of top quality ID master files in some areas. The Darwin team secured funds for equipment from the EAZA Rhino Campaign.

The project outputs are as follows.

i) 20 trained instructors (rhino officers) in rhino monitoring; ii) 20 trained officers undertaking data quality control, basic processing & reporting using the GIS based Rhino Information Management System; iii) 165 rangers trained in rhino monitoring (by local instructors with support and monitoring from Darwin fellows); iv) 1 KWS rhino programme coordinator, 1 KWS rhino scientist and 10 rhino officers/researchers trained in the synthesis and interpretation of annual park and national rhino status reports; v) Standardised annual rhino status reports at both park and national level; vi) A black rhino ecological carrying capacity model for Kenya with estimates for 11 rhino parks; trained staff and set procedures for rhino habitat assessments; vii) 2 KWS rhino scientists

trained in the use of RHINO mark recapture population estimation tool; viii) Fully operational GIS based Rhino Information Management System in 11 parks and KWS headquarters; ix) Field staff trained in wildlife and sanctuary management (2 MSc, 1 BSc and 4 Certificates); x) 1000 rhino conservation education booklets published and distributed to schools; xi) 4 peer-reviewed papers published; xii) 2 radio broadcasts.

Additional outputs included:

Training

- Eight extra staff trained as accredited rhino monitoring instructors (including in 2 newly created rhino sanctuaries).
- Sixteen extra staff trained in data analysis and production of annual status reports.
- Two extra scientists trained in the use of "RHINO" Bayesian mark recapture population estimation tool.
- Six extra staff trained in the use of Kifaru Rhino Information Management system and data analysis.
- Three extra staff trained in habitat assessment.
- Eight extra KWS park staff trained in wildlife sanctuary management (certificate course), the target was four.
- The Kenyan rhino scientist's (now the Rhino Coordinator) MSc was upgraded to a UK based study at DICE, University of Canterbury.
- Training of the Education Wardens (Ms Elema Hapicha and Lucy Makosi) of Lake Nakuru National Park and Tsavo West National Park in techniques for teaching young children based on learning through discovery.

Key management decisions / actions

- Removal of 255 elephants from Ngulia Rhino Sanctuary (Mainly funded by Kenyan Government).
- Extension of Ngulia Rhino Sanctuary by 30km^2 (several donors provided funds for the materials etc)
- Creation of Intensive Protection Zone in Tsavo West NP.
- Translocation of surplus rhinos from Nairobi NP, Lake Nakuru NP and Solio GR to create populations in Mugie Reserve, Meru NP and Ol Pejeta extention (undertaken by KWS vets).
- Production of 2007-2011 National Black Rhino Conservation Strategy (stakeholder's workshop funded by KWS).
- Initiation of the formation of East African Committee Rhino Management Group.

Other outputs

- Design and implementation of rhino sighting booklet.
- Rhino monitoring and reporting procedural / protocol document.
- Standardised rhino conservation area monthly reporting template.
- Paper Grid Maps for Patrols for areas requiring maps: Nairobi NP, Lake Nakuru NP, Tsavo East NP, Tsavo West NP. (Ngulia RS), Aberdare NP, Masai Mara GR.

The only outputs that were not achieved were the 2 radio broadcasts. However, a number of project dissemination activities were undertaken as summarised in section 11 of the report.

Full details of all publications and material that can be publicly accessed are provided in Appendix III.

The project outcomes and outputs are (were) disseminated in the following way:

- Reports: A ZSL conservation series report which comprehensively reviews the conservation work over the last 5-year strategy period (target audience – wildlife conservation practitioners, All Kenyan rhino stakeholders and rhino field staff, rhino conservation agencies and donors, zoological institutions).
- Published Papers: International Year Zoo Book - Special addition on Rhinos & Elephants: 2 papers published: a) An overview of the conservation status of and threats to rhinoceros species in the wild; and b) An integrated management strategy for the conservation of Eastern black rhinoceros *Diceros bicornis michaeli* in Kenya (The *International Zoo Yearbook* is an international forum for the exchange of information on the role of zoological organisations in the conservation of biodiversity, species and habitats. Investigative and data-collection work into the biology and behaviour of wild animals is increasingly dependent on co-ordinated effort and shared results between all institutions engaged in the study and preservation of wildlife); papers submitted to Pachyderm (peer-reviewed journal of the IUCN African Elephant, African Rhino and Asian Rhino Specialist Groups; available both in printed form and online), Veterinary Record (peer reviewed journal of the British Veterinary Association); 2 papers on ECC and vegetation work being prepared.
- A project information sheet (as part of the ZSL field conservation projects pack) available both as printed copy and PDF file on the ZSL website.
- The new National Black Rhino Conservation strategy (copies to be provided to stakeholders, funding agencies, conservation agencies).
- ZSL and KWS websites.
- Major presentations and lectures: IUCN SSC AfRSG meetings in Kenya (2004) and Swaziland (2006); Rhino Mayday (2005 and 2007); Angers International Forum (2004), KWS conference on Research Imperatives for Biodiversity Conservation and Management (2007).
- Lectures to students at KWS Naivasha Training Institute; KWS ranger training school.
- Education material.
- Specific outputs of the project disseminated to Kenyan programme staff through standardised monthly field reports and feedbacks; annual status reports and training.

Much of the project is institutionalised and KWS with ZSL support will undertake future information dissemination work as needed.

7. Project Expenditure

Agreed major changes to budget included:

- Hire of a vehicle for a period of 2 months for habitat assessment work.
- Two week visit to the UK by KWS education wardens to the UK from project savings.
- Salary for a project field assistant.
- Purchase of a laptop.

Officer costs: This was kept as low as possible through the use of ZSL and KWS facilities.

Travel & subsistence: Savings were made by buying cheapest flights well in advance, multi-tasking on visits and use of KWS accommodation where ever possible.

Printing, conference and seminars: Much more training work was undertaken.

Capital items: A laptop and camera were purchased for field work.

Others: Field assistants were hired for field support work.

8. Project Operation and Partnerships

The Kenya Wildlife Service (KWS) was the key collaborating institution in Kenya. KWS is a parastatal body under the Office of the President, with the mission "To work with others to sustainably conserve, protect and manage Kenya's invaluable biodiversity for the benefit of the people and as a world heritage". The "Kenyan Rhino Conservation Programme" is one of Kenya's flagship biodiversity programmes, and is a key contributor to KWS's vision and mission. The other local partners were the Association of Private Land Rhino Sanctuaries and Narok County Council who administer Masai Mara GR. Under the wildlife legislation in Kenya (The Wildlife Conservation and Management Act, CAP 376 and The Wildlife Conservation and Management Amendment Act No. 16 of 1989), black rhinoceros remain the property of the State; irrespective of the tenure system of the land in which it is conserved. Thus the overall responsibility for the conservation of black rhino lies with the KWS. The other project partner was the African Rhino Specialist Group (AfRSG) of the IUCN's Species Survival Commission. It comprises official rhino range-state representatives and technical experts. All the project Darwin fellows (Rajan Amin, Ben Okita, Richard Emslie, Keryn Adcock) are members of the AfRSG. The AfRSG's mission is to promote the longer-term conservation of Africa's rhinos, and where necessary, the recovery of rhino populations to viable levels. It provides up-to-date technical information, expertise and planning collaboration on all aspects of rhino conservation management to all agencies involved in African rhino conservation.

The development and implementation of the Darwin project work plan was undertaken jointly by all project partners. This was done through regular emails (almost daily), phone calls and site activities. All the project partners worked together very closely as they have done for many years.

The work plan had to be modified for the habitat work. Some delays were experienced with field habitat assessment as result of the unavailability of the KWS Rhino Programme vehicle which was required for vital translocations. The habitat field work therefore took place in two stages, using a hire-vehicle (permission obtained from Darwin Secretariat). This delay also had an impact on the remaining elements of the habitat assessment and ECC work. The training in habitat assessment was originally planned for October 2004 but was rescheduled for July 2005 following consultation with Martin Mulama the host project leader (permission obtained from Darwin Secretariat). In 2004 it became clear that the scientific staff of KWS were not in a position to take over the routine browse monitoring planned for the Kenyan Rhino Programme, as they had become regionalised and could not build this function into their extended duties.

There were no similar Darwin or other projects which occurred at the same time in Kenya. The only other Darwin project was David Harper's flamingo project. Masai Mara vegetation data from the DICE project (Matt Walpole) was used along with the Darwin surveyed data for the habitat assessment and ECC work. The experience and outputs of this Darwin project work is informing two other current projects - Implementing a Recovery Plan for the Critically Endangered Pygmy Hog in Assam. Crisis to biological management: rhinoceros, grassland and public engagement - Nepal.

The Ministry of Environment and Natural Resources is charged with the responsibility of coordinating all environmental matters in the country and is the National Focal Point on matters pertaining to the implementation of the CBD. The project's main partner Kenya Wildlife Service as the National Wildlife Agency is one of the main institutions responsible for implementing the Kenya National Biodiversity and Action Plan. Thus there was no direct consultation between the Ministry of Environment and ZSL. However the ministry is aware of the project.

The main international partner was the IUCN's Species Survival Commission through the AfRSG. Our other project partners were the University of Canterbury, DICE (Ben Okita's MSc). Funding was leveraged from a number of organisations including Africa Wildlife Foundation, Chester Zoo, D' Amneville Zoo, European Zoos and Aquaria (EAZA), Save the Rhino International, USAID, USF&W, WWF.

The project has had a catalytic impact in a number of areas in the monitoring and biological management of the black rhino and their habitat (discussed in more detail in other sections of the report). KWS and its partners, the private landowners and county council with Darwin project team advisory support, are not only maintaining the gains achieved in this project but are also further institutionalising the process and securing additional habitat for the creation of new populations. This is extremely encouraging. A new 5-year Black Rhino Conservation Strategy has followed this project. The strategy retains the vision of conserving in-situ at least 2000 black rhinoceros as contained in the 1993 and 2001 black rhino conservation strategy and management plans. It however includes revised goals and strategic objectives. The target of 2000 cannot be achieved within fenced areas alone so the remaining still extensive range and intact habitat in Tsavo, Meru and the North of Kenya needs to be secured and made ready, over the next 5 years, for the spill over from sanctuaries which have reached carrying capacity. This should be possible through good science and monitoring setup by the Darwin project and community engagement and from learning the lessons of earlier attempts to do this in Tsavo East. Towards this goal, in 2006, KWS board approved implementation of a rhino Intensive Protection Zone (IPZ) in Tsavo West which should receive rhino in 2007 (trained rangers are already in place, holding pens are being constructed and required equipment purchased (KWS vehicles, tents, EAZA monitoring equipment, radio transmitters and receivers etc). For this to succeed in the longer term, as poaching is expected to continue, private, community and county council lands should continue playing the important role they are playing as breeding reservoirs underpinning the Park populations.

This Darwin project only had a very small element for community engagement although some extra education based activities from project savings were implemented. A Post Project application was submitted focussing on communities but was unsuccessful in the last application round. The Darwin Committee felt it was a valuable project. They especially mentioned that it was a sensible follow up to an excellent main project, engaging with local land users who present a key threat to appropriate management of the areas in question. However, the committee felt that the proposed work appeared ambitious and sounded like it was greater than would fit within the scope of a Post project. The Darwin team feel this work is essential and are considering resubmitting the post project application with reduced scope or submitting it as a main project.

Progress in community relations around State protected land and some private land holdings has generally been poor over the years with increasingly unsupportive communities to rhino and conservation in general. Goodwill creation is therefore critical to reduce this increasing risk to the well-being of rhinos and their habitats from community indifference to or active participation in poaching, encroachment and illegal extraction of ecosystem goods.

One approach is to encourage, where there are few competing land use issues, Community Conservation Areas with rhino as a driver for ecotourism. In this case white rhino are preferred due to the ease of management and lower conservation status but black rhino might be appropriate once the land is secured. Where this is not possible and around many National Parks with rhino, local partnerships need to be forged and support given to addressing misconceptions, resource partitioning, access rights and more holistic and poverty-sensitive approaches to land management. Finally, the economics and benefits of rhino to the local and wider Kenya community are not scientifically determined and this needs to be done through appropriate research. Means to promote the link between rhino and community development needs to be explored.

Community needs to be better defined to identify the key elements which are relevant to rhino specifically. Most projects to date are addressing the wider issues of water, transport, infrastructure, schools and clinics which inevitably focus on the better off elements in society. The communities surviving on subsistence means with few alternative livelihood options and more likely to be involved in poaching should be targeted and opportunities explored for increasing awareness and undertaking mutually beneficial activities between rhino conservation areas and communities.

9. Monitoring and Evaluation, Lesson learning

During the lifetime of the project, progress was monitored in terms of:

1) whether the training course for future trainers in rhino ID monitoring was held (2 courses held – main 5-day course at the beginning of the project and another one for the KWS rangers and officers attending the Certificate course, further training & testing, mentoring and support undertaken in the field);

2) whether accreditation tests were developed for a) trained instructors of the standardised rhino monitoring course, and b) field ranger trainees (accreditation tests developed for each module and used in the training programme – please see Supplementary item 1);

3) the number of trainers who both took and passed these accreditation tests (28 accredited instructors), and the number of rhino monitoring training course sets that were distributed (30 sets);

4) the quality of field rhino monitoring data produced, assessed through repeat on-site visits by project staff and evaluation of the standardised monthly reports submitted by the field officers to the rhino programme at KWS headquarters (standardised monthly reports submitted by rhino conservation areas showing significant improvements in the quality of the data in areas of concern, site visit reports);

5) whether the Kenyan Rhino Information Management system (database) and GIS was completed, how many copies were provided and installed, whether the training course in its use was held, and the number of officers trained (Kifaru installed, at least two staff trained, user manual provided in all areas except Chyulu Hills NP due to lack of electricity supply and Solio Private Range due to lack of qualified staff. Solio Range now has a dedicated manager after monitoring staff were trained in 2005 and 2006. KWS has also purchased the necessary equipment (computer) for installation in Solio Private Ranch in August 2007 and will train additional staff);

6) whether the rhino programme staff were trained in detailed field data analysis, interpretation of rhino population dynamics and effective status reporting for decision-making (26 staff trained through 6-day workshop and on-site training & support);

7) the number and quality of park status reports produced (status reports produced for 2004, 2005 and 2006, reviewed and used for decision making);

8) the number and quality of national status report summaries produced by the KWS rhino programme (initial summary produced in 2004 (as part of Ben's MSc), 2005 and next in 2007 – summaries to be produced every 2 years to follow IUCN AfRSG meetings and be used for decision making);

8) the increase in national status report quality over time (report assessments and IUCN AfRSG reports);

9) whether a Kenyan black rhino ecological carrying capacity model, and associated habitat monitoring system and procedural manual were produced (completed – please see Supplementary items 8 & 12), whether training was given in their use (5-day workshop and intensive field training conducted), and the number thus trained (basic training to 18 trainees, advanced training to 8 staff);

10) whether 2 rhino scientists were trained in the use of RHINO Bayesian Mark Recapture Population Estimation tool (hands-on workshop held; 4 trained staff);

11) the number of copies of RHINO software provided (4 copies);

12) whether RHINO population estimation tool has been used to improve rhino population estimates in parks with unidentifiable rhino (RHINO applied to 4 populations – Nairobi NP; Ngulia RS; Ol Pejeta GR; Lake Nakuru NP);

13) whether 2 MSc, 1 BSc, 4 Certificates were completed (2 MScs, 1 BSc, 12 Ceriticates successfully completed);

14) the number of lectures / courses given by Darwin Fellows in Kenya (4 course modules in Sanctuary Management taught so far at Naivasha Training Institute; Ben Okita is continuing to teach this course module - 60 hours each year);

15) rhino conservation education cards produced (both English and Swahili version – please see Supplementary item 14) and printed as required by KWS education department;

16) details of reports/papers produced and of publicity given to the Darwin Initiative (2 papers published; 2 papers submitted for publication; 2 papers being finalised and to be submitted in August 2007, 1 ZSL conservation series publication (~100 pages) to be produced in September 2007);

17) whether publicity photographs of the project and its activities were submitted to the Darwin Initiative (publicity photographs submitted to Darwin Initiative – Darwin 2005 annual report contained 2-page summary on the project and Elliot Morley's visit) .

There were extra activities undertaken described in the other sections of the report.

The overall assessment of progress at the end of the project will be: 1) the degree to which local Kenyan capacity to undertake rhino monitoring, and collect, store, quality control, analyse and write up these data has improved; 2) whether information on rhino population sizes and dynamics, habitat conditions and estimated park carrying capacities has improved and whether this has helped the Kenyan rhino programme and the Rhino Management and Technical Committees make recommendations for rhino metapopulation management for population growth and for habitat management/conservation. In time, the success of the project will be measured by the quality and amount of in-country training, monitoring, habitat assessment and status reporting that takes place once the project has finished, and by the rate of increase in black rhino numbers.

In addition, KWS rhino programme staff were able to monitor the success of the project by tracking the number of trainers accredited, and the number of rhino monitoring field rangers trained and accredited in ID-based rhino monitoring techniques. KWS's rhino programme staff at headquarters analysed the monitoring data and park reports produced, which enabled them to assess improvements in the quality and quantity of captured rhino monitoring data and its analysis and interpretation which followed from project activities. KWS headquarter rhino programme staff were also involved in the 6 monthly field assessments. KWS rhino programme staff and the Kenyan Rhino Management Committees can also confirm the information needed to guide biological decision-making has improved (e.g. population estimates, comparative measures of rhino population performance, and habitat status and potential carrying capacities in each area).

There were no major problems experienced. Minor problems occurred which hampered progress but these were resolved (discussed in other sections)

A review of the outputs of the previous 5-year strategy (on which this Darwin project was based) was undertaken in January 2007. The outputs of this review were used at the Stakeholders workshop to develop the new 5-year National Conservation Strategy. The ZSL facilitated workshop undertook a SWOT analysis and the results of this analysis and the review were used to revise the goals and strategic objectives with new set of actions and indicators. The draft strategy has been sent to experts and KWS partners for comments before being finalised in August 2007.

Informal review visits were also undertaken by 1) UK Minister of the Environment (1 full day visit) 2) ZSL Director of Conservation Programmes Dr Glyn Davies, ZSL Director General – Mr Ralph Armond and ZSL Secretary - Professor Paul Harvey of Oxford University (2 day visit)

The following are key lessons from the project:

- Where appropriate, to maximise chances of uptake of training, the training should follow an outcomes-based approach and include formalised testing procedures to assess the degree of understanding/competence of trainees. Trainees should only be accredited if specific set standards of knowledge and competence are shown for each aspect of the training (i.e. trainees should not simply be presented with certificates of attendance). Formal accreditation, and the pride and recognition it brings, should act as motivator, build confidence and promote uptake of training.
- Training material should be carefully designed with clear rationale, purpose, learning assumptions, specific outcomes, assessment criteria, performance system and teaching suggestions for each topic (the project training material along with suitable training material from other Darwin projects could be made available on the Darwin website as examples to be used). Trainees should also be carefully selected.
- Where appropriate, the training should be institutionalised as much as possible, multiple trainers trained and an on-going on-site modular teaching approach implemented to increase the chances of training continuing into the future despite staff turnover.

- Where possible on-going support and mentorship to trained staff should be put in place following initial training to maximise the chance of outputs being disseminated and put into practice.
- Suitable formal short courses for training suitable field staff can be very productive in building capacity quickly which also improves morale in the field.
- Staff need to know what is expected of them. Terms of Reference (ToR), which provide clear guidance on responsibilities, should therefore be drawn up for each relevant rhino staff member involved in the project. The ToR ideally should be established at the start of the project and updated as necessary.
- Focus areas of the project should also have required reporting and evaluation procedures associated with them (in our case monthly field reports, six monthly field assessments, annual status reports, habitat reports etc). These can then be used to identify problems with implementation at an early stage and take necessary remedial action/training.

10. Actions taken in response to annual report reviews (if applicable)

All the issues raised by the reviews of the annual reports were discussed with all the project partners and addressed appropriately. The following actions were taken by the project team. **Please note that some of the outputs are different from the final outputs as they reflect what was achieved when the response was made**.

Comment 1: One unclear aspect of sustainability relates to the expectations from individuals given formal training within the programme, especially those in whom greater investment is made (MSc). It is not clear if they have signed contracts to continue work within the programme for a given period subsequent to studies and if jobs have been identified that will accommodate and acknowledge their newly won skills. Otherwise there is a danger of new skills causing trainees to obtain improved employment elsewhere.

Action: The BSc and MSc students have a bonding agreement with KWS for a period of 3 years. The rhino scientist Ben Okita has been promoted to senior management as a Research Scientist following completion of his MSc. KWS will also provide a scientific position for the second MSc student on completion of his studies in December 05. The KWS park and senior management staff have encouraged and supported the certificate students in the undertaking of park level scientific work along with their day-to-day park duties. A number of important field projects, some of which are listed in the 5-year conservation plan, are being initiated. The students undertook preliminary studies on some of these topics during their one-month field attachment. A letter from KWS Human Resources Department is also provided in Supplementary item 15.

Comment 2: Project website

Action: The project information is available on both the ZSL website http://www.zsl.org/field-conservation/deserts-and-rangelands/conserving-the-black-rhino,22,AR.html

and the KWS website http://www.kws.org/darwin.html

A project information sheet and poster has also been produced (please see Supplementary item 16 and 19).

Comment 3: Course comments by participants are provided – are subsequent courses modified in the light of such comments?

Action: Feedback from field staff and students are continuously being used to improve delivery of the field training. The ID instructors training course has been improved with a new version. The Swahili ranger's field booklet has also been updated. The computer software training manuals have also been revised. The certificate student feedback forms have been passed to KWS Training Institute teaching staff and the KWS HR department.

Comment 4: Monitoring, evaluation and lessons - Monitoring and evaluation appears to be sound, with training examined by outcomes based skills testing, frequent field visits by Darwin fellows and KWS staff and checks on reports and supervision. The interaction of highly skilled fellows who had substantial prior knowledge in the field and prior relationships with the partner organisations has no doubt contributed to the success of this evaluation and quality control process. Will KWS have guaranteed funding for continuation of training post-project?

Action: The project has been planned to require minimal training funds to continue into the future. A large element of the capacity building is training staff that can teach others. The instructors trained and mentored in the initial phase of the project are now assisting in training more instructors (8 more staff were recently trained with 5 receiving accreditation). 23 instructors have so far been successfully accredited. These field instructors are training field staff on an on-going basis back on their own reserves. The process of testing and accrediting both trainers and trainees has also helped institutionalise the process and provide recognition to those accredited. It was also very encouraging to see the Darwin trained local instructors (without any additional Darwin assistance or prompting) trained staff in rhino monitoring in a newly established rhino population at Mugie ranch and were able to set up high quality ID master files.

Twenty six park officers from 13 national parks and reserves have also been trained in the production of status reports. It is also planned that the park personnel to be trained in habitat assessment will train and mentor additional field staff on an on-going basis.

The implemented procedural mechanisms and support tools such as quality control and reporting procedures, Kenyan GIS based Rhino Information Management System, RHINO software, habitat assessment procedural manual, and carrying capacity estimation model will also help this process. Local staff are being trained and mentored in their use and should have the ability and confidence to continue to use these tools after the project formally ends.

Three of the Darwin Fellows (R Amin, K Adcock & R Emslie) have long-term commitments to African rhino conservation, and therefore formal and informal contact with KWS will be maintained and support provided beyond the lifetime of this Darwin Initiative project.

KWS management is also totally committed to this programme. Partner NGOs are fully supportive of this project and have already contributed significant monitoring equipment, computers and other operational material upon which this proposed Darwin Initiative is built. Darwin fellows will work with KWS to obtain additional funds (from supporting NGOs) that are required for the management of the reserves.

Comment 5: Training - the procedures themselves for identifying and monitoring rhinos also appear sound. The project has developed a series of templates and assistance tools. There was mention of the development of map cards for use when GPS are unavailable and the project should be encouraged to develop more alternative low technology tools in the event of further computer crashes or other problems. Again, participation of local staff in the development of these tools would assist in knowledge transfer to other parts of the reserve management.

Action: The field tools are interactively being developed with the local staff. The maps have been produced in consultation with the park staff and are also being used by non-rhino staff in several parks. There have been requests from 2 of the areas to train other non-rhino park staff in basic use of field equipment (binoculars, GPS, cameras) and in the use of computer and software. The rhino instructors at Lake Nakuru NP have now started training non-rhino park staff. A similar training programme is also being planned for Nairobi NP.

Comment 6: Education and community awareness activities - now that the core training procedures have begun, it would be good to see the project expand on their planned public awareness activities, especially community education.

Action: We have started to develop the education and community awareness activities; the majority of these are extra activities being funded through project savings.

Comment 7:

To what extent do the rhino personnel receive training in social skills such as conflict resolution, community participation and communication to assist them in community interactions and reduce 'people and parks' types of tensions?

Action: Some material and training has been provided to rhino wardens (Nakuru, Tsavo West Ngulia RS) for community education and awareness. Training has also been provided to the education officers of Lake Nakuru and Tsavo West NPs with the ultimate aim of promoting wildlife conservation and change of people's attitudes towards wildlife. The project also managed to get some funds for much needed water borehole for the surrounding Tsavo West NP local community and accommodation facilities for the Tsavo West Community Education Centre. The community aspect was only a very small element of the original project but will be developed further in the final year.

11. Darwin Identity

Efforts to publicise the Darwin Initiative were undertaken on an on-going basis. These included logos and acknowledgements in the following areas:

Project training material and reports:

- Instructor's rhino monitoring training manual, posters and accreditation tests.
- Field ranger's booklet.
- Kenyan Rhino GIS Information Management System "*Kifaru*" manual (please see supplementary item 21).
- SSC IUCN African Rhino Specialist Group meetings in Kenya (2004) and Swaziland (2006).
- Ben Okita's DICE MSc dissertation report (DICE, University of Canterbury).
- Lekishon Kenana's MSc dissertation report (Moi University).
- Adhan Berhe's BSc project report (Moi University).
- Twelve KWS student's Certificate course project reports.
- Rhino monitoring instructor's certificate.

Presentations and talks:

- Rhino Mayday meetings (2005, 2007).
- SSC IUCN African Rhino Specialist Group meetings in Kenya (2004): Following some training, the Tsavo West NP (Ngulia RS) rhino warden did two presentations at the 2004 meeting attended by over 50 people (rhino managers, experts and donors) from many parts of Africa and organisations in Europe and America. They were very impressed with Adhan's presentations. An overall Darwin Initiative project presentation was also given at this meeting.
- SSC IUCN African Rhino Specialist Group meeting in Swaziland (2006). A session was dedicated to the Darwin project: Overview; Population performance in Kenyan rhino sanctuaries; Habitat characteristics and carrying capacities; Standardised approach for assessing black rhino browse availability.
- Angers international forum (France), July 04.
- KWS conference on Research Imperatives for Biodiversity Conservation and Management (2007).

Field tools (set up in each rhino conservation area – total 13 areas):

- Kenyan Rhino GIS Information Management System "*Kifaru*" with user manual.
- Rhino Master ID files.
- Monitoring protocols.
- Rhino sighting forms.

Articles and publicity material:

- Darwin project details on the KWS and ZSL website.
- A project information sheet produced and made available to various stakeholders, donors and visitors.
- ZSL Lifewatch project articles
- Rhino visitor displays at London Zoo and soon at Whipsnade Wildlife Park.
- International Year Zoo Book. Special edition on rhinos articles.
- Paper submitted to the journal "Pachyderm" on Crisis management of Ngulia Rhino Sanctuary, Kenya.
- Paper on Modelling Black Rhinoceros (*Diceros bicornis*) Carrying Capacity Relationships in Africa. The manuscript is being finalised and will be submitted to a suitable journal in a month's time.
- Paper on Spatial Patterns of plants in a heavily browsed versus slightly browsed area in Kenya. The manuscript is being finalised and will be submitted to a suitable journal in a month's time.
- Two page feature in the Darwin Initiative annual report (2005) on the field visit by the UK Minister for the Environment and Agri-environment.

Other activities

- The UK Minister for the Environment and Agri-environment spent a full day reviewing the many elements of the project in the field. Staff from the various Kenyan parks and reserves were extremely delighted to meet the minister and show the work undertaken by the Darwin Initiative. A photographic record of the visit is provided in Supplementary item 17. KWS quoted the Minister saying the following at the end of the visit.

  > *"...and I am particularly impressed to see the way this Darwin scheme has been applied to the field work, the training, the data collection, and it is an excellent scheme, it is exactly the kind of scheme the Darwin Initiative was set up to support; the partnership between ZSL, Kenya Wildlife Service and the local people...this is what we want to see: that partnership. And it is a great success and it is a great tribute to everybody who has been involved, the people doing the field work, the people doing the training, the people doing the data collection, and of course the way the information is being taken by KWS in relation to its management.*
  >
  > *It is very sophisticated, it is very well done, and you should all be congratulated. I will only be too pleased, when we have our annual Darwin lecture, to say that I have seen this scheme and how it is a great success"*

- Rhino rangers' awareness at ZSL's Whipsnade Wildlife Park in May 2006 as part of the EAZA Rhino Campaign.

There have been several Darwin projects in Kenya each making a contribution to raising awareness of the Darwin Initiative. Since this Darwin project is a flagship programme it has a high profile. The majority of the senior staff within KWS are aware of the Darwin Initiative and its aims through the close collaboration. This is also the case at the field level with the park officers and rangers involved in the programme. Their capacity building was a key element of the project and they have been very grateful for Darwin's support at this level. The Darwin contribution is also known at the Training Institute, Naivasha and the local Moi University where some of the workshops and formal training took place. The majority of the KWS's partners (WWF, AWF, Eden Trust, Save the Rhino International etc) are also fully aware of the contribution of the Darwin Initiative. The private landowner black rhino sanctuaries as project partners also understand the Darwin identity. Project updates were also provided to the British High Commission so they are aware of this project. The Commission was involved in the field project visit by the UK Minister for the environment, Elliot Morley in 2005. Ben Okita also had an hour meeting with the British ambassador (Mr Adam Wood) and briefed on the project and the Darwin Initiative. The UK Darwin fellow has also had meetings with the Embassy staff in Kenya. The Darwin fellows also provide a background to the Darwin Initiative when ever they introduce the project work to someone in Kenya.

The rhino is a Flagship programme in Kenya currently covering 13 of the major National Parks, Reserves and Sanctuaries. Many of these areas are designated rhino reserves or sanctuaries and rhinos are seen as umbrella species as their conservation requirements, by default, encompass those of other smaller species. The Darwin project was a national programme covering all these areas. The project had a clear identify through implementing key priorities in the Kenyan 5-year plan. The project partners KWS and AfRSG ensured the project was seen as such and gave full credit to the Darwin Initiative.

12. Leverage

The project has successfully managed to build close links with several international organisations and leveraged the following additional funds over the 3 years.

1. Save the Rhino International: (£4,750) for living costs in the UK for Ben Okita's MSc studies.
2. Africa Wildlife foundation: ($7,000) for additional MSc costs (including laptop etc).
3. US Fish and Wildlife ($20,000) for MSc projects field costs.
4. D' Amneville Zoo (64,000 euros) for rhino field conservation support (~20,000 euros per annum).
5. Zoological Society of London (£4,000) for the repair of field monitoring vehicle at Ngulia rhino sanctuary.
6. Zoological Society of London (£4,000 per annum) for water system maintenance at Ngulia rhino sanctuary.
7. Zoological Society of London (£2400 per annum) for a new water pump at Ngulia rhino sanctuary.
8. Zoological Society of London (£1000) for travel costs for ZSL's head of education.
9. Zoological Society of London (£1,000), Zurich Zoo (2,000 euros) for removal of elephants from Ngulia Rhino Sanctuary.
10. Zoological Society of London (£2,000) for boma construction in the IPZ,
11. USAID: (1 million Kenya Shillings) for training of field officers in Sanctuary Wildlife Management, Genetic faecal DNA study (56,000 Kenya Shillings).
12. Lord Parmoor - ZSL (£25,000) for water and community related projects in Tsavo (please see Supplementary item 18).
13. EAZA rhino campaign (~£15,000) for field monitoring equipment.
14. Additional KWS investment into rhino programme (Cost for moving elephants, purchase of vehicles, setting up of IPZ etc).

The Darwin supported new national 5-year rhino conservation strategy is being developed which attempts to address the longer term funding needs for the programme. The strategy includes the following:

Establishment of endowment fund: KWS (Endowment) Fund was envisaged in Sec. 5A of the Wildlife (Conservation and Wildlife) (Amendment) Act. Once it is set up the funding of specific expenditures and programmes e.g. rhino conservation could be designated to this fund. This would provide predictability in budgeting and the implementation of planned activities and strategic and management plans.

Eco-tourism: The presence of rhino appears to be a major contribution to park/reserve gate revenues. Lake Nakuru NP gate receipts have almost doubled since 2003 as one can now easily see white rhino and there is a good chance to see black rhino. About eighty percent of the visitors that visit Tsavo West NP visit Ngulia RS. 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. The present and future 'showcase' rhino sanctuaries, such as Nairobi NP and Lake Nakuru NP are therefore also very important sources of revenue and need to be managed carefully. Realising this, KWS has established a system of fare revenue retention for state rhino conservation areas. Thus, increased revenues should be allocated to managing rhino areas as detailed in annual work plans. This will act as a motivational tool for rhino conservation areas hence boosting the species conservation efforts.

Annual work plans: A system of annual work plans has been put in place and several annual planning meetings for allocating/using funds were held between KWS Rhino Programme and donor partners including international agencies through the agreed co-ordination mechanism, annual work plans and proposals.

Revenue generating opportunities: With the increases seen in rhino numbers (>5% national target growth) KWS is now exploring a range of revenue generating opportunities and support (e.g. Nairobi Ride with Rhino, rhino postcards).

13. Sustainability and Legacy

Sustainability and lasting legacy was achieved by this project as follows: 1) improving the human capacity within Kenya to conserve and increase Kenya's black rhino numbers; 2) creating a pool of rhino monitoring trainers in a number of parks (and mentoring them as they learn); 3) institutionalising a system of on-site on-going modular training in rhino monitoring by these trainers, which is likely to continue because it does not require staff to be away from station/duty for long periods, does not require additional funding for expensive courses at external training venues, and because it is modular and on-going is also ideally suited to handle staff turnover; 4) institutionalising basic training in wildlife monitoring by incorporating into the curriculum of the national wildlife paramilitary school so that all rangers joining the wildlife system have the basic skills; 5) providing tailor-made data-handling and decision support tools (field data recording booklet, Rhino master ID files, standardised monthly reports, Rhino Information Management System and GIS, RHINO population estimation software, carrying capacity model, manual/procedures and a system for habitat assessment) which continue to be used; 6) improving the quality and reliability of rhino monitoring data as a direct result of this project; 7) promoting the important process of standardised annual status reporting and use of these reports to assist biological decision making, by developing the in-country skills needed for this to continue beyond this project; 8) developing a core team of Kenyans to continue the habitat assessment and Carrying Capacity work; 9) building management and research capacity through 2 MScs, 1 BSc and 12 Certificates in Wildlife Management; 10) providing some training to KWS education wardens in *learning through discovery* techniques for teaching young Kenyans and making young Kenyans aware of the value of rhinos and of rhino conservation issues via an educational cards for schools.

These approaches could also be adapted for application to other threatened species in future.

Almost all the project achievements are likely to be endured as they are key elements of both the existing and the new 5-year National conservation strategy. All the project staff remain within the KWS and partner organisations and many have been promoted. ZSL, AfRSG and KWS have worked closely together for many years. ZSL has been a key partner of KWS for over 20 years. The project Darwin fellows are all members of the AfRSG and are in regular contact. ZSL and the AfRSG continue to provide technical support to the Kenyan rhino programme. ZSL facilitated the development of new 5-year strategy and will continue to play an active role in its implementation. The ZSL Darwin fellow has been proposed by Biodiversity Monitoring and Research Division of KWS to be a member of the National Rhino Technical Committee.

The project's experience and expertise in implementing monitoring systems, training, habitat and metapopulation management are already being transferred to two Darwin projects in different parts of the world (Crisis to biological management: rhinoceros, grassland and public engagement – Nepal; Implementing a Recovery Plan for the Critically Endangered Pygmy Hog in Assam.

The following additional funds are/were sought to continue aspects of the project.

- *A Darwin Post Project application was submitted (*CBNRM in Tsavo and Meru Conservation Buffer Zones in support of rhino conservation) but unfortunately didn't get funded. The feedback from the committee is provided in another section of the report. We are planning to address the issues raised by submitting as a main project with additional suitable partners or reducing scope for a post-project application.
- A proposal for funding of a mobile education unit has been produced and submitted to several organisations including the EAZA Rhino Campaign.
- A Darwin fellowship application was also submitted to further develop capacity in habitat management.
- ZSL is providing support for the IPZ bomas (rhino holding pens).

14. Value for money

In addition to leveraging and obtaining matching funds, the project has where possible 1) used tried and tested approaches with a high chance of success (e.g. rhino monitoring training); 2) trained trainers in field rhino monitoring and institutionalised on-going training (both in the field and at the KWS ranger training school) and status reporting so that the training and hence value can continue after the end of the project; 3) maximised the likelihood of training continuing into the future after the project has ended as the on-site modular course ensures that staff are not required to be away from station or away from duty for long periods, and no additional funding are needed to cover the costs of future courses being given by those trained; 4) mentoring of those being trained has built both skills and confidence, and so maximised the chance that skills learned are put into practice; 5) Set-up tailor-made data-handling and decision support tools, procedures and training material that the trained Kenyans are running themselves; 6) Helped review the previous 5-year strategy and facilitated the development of the new 5-year strategy; 7) Saved money where ever possible (reduction in accommodation for student on Certificate course, booking air-tickets well in advance to get cheapest flights etc.); 8) leveraging of additional funds and equipment and undertaking extra activities.

Added value to this project was provided by the direct involvement of specialist members of the IUCN African Rhino Specialist Group and the close involvement of the project leader with KWS over the last fifteen years, which allowed collaboration and synergy of project objectives with wider issues.

Appendix I: Project Contribution to Articles under the Convention on Biological Diversity (CBD)

Please complete the table below to show the extent of project contribution to the different measures for biodiversity conservation defined in the CBD Articles. This will enable us to tie Darwin projects more directly into CBD areas and to see if the underlying objective of the Darwin Initiative has been met. We have focused on CBD Articles that are most relevant to biodiversity conservation initiatives by small projects in developing countries. However, certain Articles have been omitted where they apply across the board. Where there is overlap between measures described by two different Articles, allocate the % to the most appropriate one.

Project Contribution to Articles under the Convention on Biological Diversity		
Article No./Title	**Project %**	**Article Description**
6. General Measures for Conservation & Sustainable Use	5	Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	25	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
8. In-situ Conservation	30	Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
12. Research and Training	30	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
13. Public Education and Awareness	8	Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
15. Access to Genetic Resources	2	Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.
Total %	**100%**	**Check % = total 100**

15. Appendix II Outputs

Please quantify and briefly describe all project outputs using the coding and format of the Darwin Initiative Standard Output Measures.

Code	Total to date (reduce box)	Detail (←expand box)
Training Outputs		
2	Number of Masters qualifications obtained	2 (1 with Distinction in Conservation Biology from University of Canterbury, UK; and the other with Grade A in Wildlife Management from Moi University, Kenya)
3	Number of other qualifications obtained	1 (BSc in Wildlife Management) , 12 (certificate in Wildlife Sanctuary Management) - Three students (2 from Tsavo West NP and 1 from Aberdare NP) were awarded Distinctions, the only ones in the Institute's 2003/04 academic year, and were also presented with the best student awards.
4a	Number of undergraduate students receiving training	1
4b	Number of training weeks provided to undergraduate students	3 year full time BSc course with training also provided on field project in the Tsavo

Code	Total to date (reduce box)	Detail (←expand box)
6a	Number of people receiving other forms of **short-term** education/training (i.e not categories 1-5 above)	a) 28 officers and rangers from 13 reserves trained as accredited instructors in rhino monitoring; b) At least 150 rangers trained from 13 reserves trained in rhino monitoring techniques; c) c. 400 ranger recruits trained in basic wildlife monitoring (course incorporated into the ranger school curriculum) d) 24 staff from 13 reserves trained in data quality procedures and use the Kifaru GIS information management system & basic data analysis; e) 4 KWS scientists trained in the use of RHINO mark recapture population estimation tool; f) 26 officers from 13 reserves trained in data analysis and production of status reports; g) 18 staff provided basic training in rhino habitat assessment techniques; h) 8 staff provided advanced training in rhino habitat assessment techniques; i) 2 staff trained in the use of the ECC model; j) 10 staff trained in night monitoring techniques; k) 24 staff trained in the use of analysis, reporting, presentation computer software packages; l) 2 KWS education wardens (Lake Nakuru NP and Tsavo West NP) provided training in teaching young children particularly focussing on learning through discovery.
6b	Number of training weeks not leading to formal qualification	Total: 60 weeks 1: Instructor's training workshop; 1: basic habitat assessment workshop; 1: advanced habitat assessment training; 1: status reporting workshop; 8: intensive on-site training field rangers in monitoring; 30: intensive field officers and rangers training data quality control procedures inc. Master ID files, use of standard software packages, GIS based rhino information management system and data analysis & reporting; 1: mark-recapture workshop; 6: education wardens training; 4: new site training : Mugie and Meru NP; 4: indirect sighting training Aberdare and Chyulu-Hills NPs; 1: night census techniques training; on-site support by project field assistants over the lifetime of the project; 2: training of ranger recruits in wildlife monitoring.

Code	Total to date (reduce box)	Detail (←expand box)
7	Number of types of training materials produced for use by host country(s)	Five: 1) Rhino monitoring training material (posters, accreditation tests) and manual revised; 2) Kenyan GIS based information management system manual; 3) Revised habitat training manual with practical exercises and tests 4) Monitoring and data quality control protocols 5) Computer software tools training manuals: a) word, b) excel and c) power-point
Research Outputs		
8	Number of weeks spent by UK project staff on project work in host country(s)	Total: 75 weeks
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	1 National black rhino conservation plan 1: Regional concept plan (for East African Committee Rhino Management Group
11a	Number of papers published or accepted for publication in peer reviewed journals	2 published 1 accepted 1 submitted 2 being prepared
11b	Number of papers published or accepted for publication elsewhere	3 2004 IUCN AfRSG proceedings 3: 2006 IUCN AfRSG proceedings
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	1
12b	Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country	1
13b	Number of species reference collections enhanced and handed over to host country(s)	1 – vegetation survey data
Dissemination Outputs		
14b	Number of conferences/seminars/ workshops **attended** at which findings from Darwin project work will be presented/ disseminated.	2 (IUCN AfRSG meeting) 2 (Rhino Mayday) 1 (Angers international forum) 1 Catalysts for Conservation Symposium 1: KWS conference on Research Imperatives for Biodiversity Conservation and Management (2006) 1: Biodiversity conservation and management practices - Tropical Biology Association–Kenya Wildlife Services Biodiversity Workshop (2007)
15a	Number of national press releases or publicity articles in host country(s)	1: Publicity article on UK Minister's visit to the project (KWS website)
15c	Number of national press releases or publicity articles in UK	2 ZSL Lifewatch magazine articles
18a	Number of national TV programmes/features in host country(s)	1: NTV (Nation TV) feature on rhino monitoring and conservation.

Code	Total to date (reduce box)	Detail (←expand box)
18b	Number of national TV programme/features in the UK	1: Channel 5 documentary on rhinos (a short feature on threats)
Physical Outputs		
20	Estimated value (£s) of physical assets handed over to host country(s)	Laptop (£800 – agreed with the Darwin Secretariat) Digital still camera, lens (£750) Satellite images for 9 areas.
22	Number of permanent field plots established	Over 1000 plots: 100-150 plots in each of the 9 well established reserves
23	Value of additional resources raised for project	£106650 + KWS investment into rhino programme (Cost for moving elephants, purchase of vehicles, setting up of IPZ etc).

16. Appendix III: Publications

Provide full details of all publications and material that can be publicly accessed, e.g. title, name of publisher, contact details, cost. Details will be recorded on the Darwin Monitoring Website Publications Database that is currently being compiled.

Mark (*) all publications and other material that you have included with this report

Type * (e.g. journals, manual, CDs)	**Detail** (title, author, year)	**Publishers** (name, city)	**Available from** (e.g. contact address, website)	**Cost £**
Book	An overview of the conservation status of and threats to rhinoceros species in the wild, R Amin, K Thomas, RH Emslie, T Foose, N van Strien (2006), International ZooYearbook, Vol 40, Special edition Elephants and Rhinoceros	Blackwell	Zoological Society of London	-
Book	An integrated management strategy for the conservation of Eastern black rhinoceros *Diceros bicornis michaeli* in Kenya, R Amin, B Okita-Ouma, K Adcock, RH Emslie, M Mulama, P Pearce-Kelly (2006), International ZooYearbook, Vol 40, Special edition Elephants and Rhinoceros	Blackwell	Zoological Society of London	-
Journal	Crisis management of Ngulia Rhino Sanctuary – Kenya, B Okita-Ouma, D Mijele, R Amin, F Gakuya, D Ndeereh, I Lekolol, P Omondi, D Woodley, M Litoroh, R Kock (2007), Pachyderm	IUCN	IUCN (http://www.iucn.org/themes/ssc/sgs/afesg/pachy/)	-

Journal	Modeling black rhinoceros (*Diceros bicornis)* carrying capacity relationships in Africa	Being prepared for submission in August 2007	-	-
Journal	Spatial patterns of plants in a heavily browsed versus slightly browsed area in Kenya (draft title)	Being prepared for submission in September 2007	-	-
Information Sheet	Kenyan Black rhino information sheet	Zoological Society of London	Conservation Programmes, Zoological Society of London, Regents Park, London NW1 4RY	-
Document	Kenyan 5-year black rhinoceros conservation strategy	KWS	Rhino Programme Kenya Wildlife Service Langata Road, Nairobi, Kenya	-
Document	Conservation action plan for the long-term management of the black rhinoceros in Kenya - review	ZSL	Conservation Programmes, Zoological Society of London, Regents Park, London NW1 4RY	-
Manual	Instructors rhino monitoring training manual and posters	AfRSG	ZSL, KWS, AfRSG	-
-	Kenyan rhino sighting form	ZSL, KWS	ZSL,KWS	-
Document	Kenyan rhino habitat assessment report	ZSL, KWS, AfRSG	ZSL, KWS	-
-	Black rhino ECC model	ZSL, KWS, AfRSG	ZSL, KWS	-
Document	Habitat assessment training manual	AfRSG, ZSL, KWS	KWS	-
-	Kenyan rhino Education cards	ZSL, KWS	ZSL, KWS	-
-	Rhino Poster	ZSL, KWS	ZSL, KWS – Please see Supplementary item 19	

17. Appendix IV: Darwin Contacts

To assist us with future evaluation work and feedback on your report, please provide contact details below.

Project Title	Building capacity for conservation of a critically endangered flagship species
Ref. No.	162/12/004
UK Leader Details	
Name	Dr Rajan Amin
Role within Darwin Project	Project leader
Address	Conservation Programmes, Zoological Society of London, Regents Park, London NW1 4RY
Phone	
Fax	
Email	
Other UK Contact (if relevant)	
Name	
Role within Darwin Project	
Address	
Phone	
Fax	
Email	
Partner 1	
Name	Mr Benson Okita-Ouma
Organisation	Kenya Wildlife Service
Role within Darwin Project	Project leader / coordinator (host country)
Address	Kenya Wildlife Service, PO Box 40241-00100, Nairobi, Kenya,
Fax	
Email	
Partner 2 (if relevant)	
Name	
Organisation	
Role within Darwin Project	
Address	
Fax	
Email	

18. Appendix V: Project Logical Framework

Project summary	*Measurable indicators*	*Means of verification*	*Important assumptions*
Goal:			
To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve • the conservation of biological diversity, • the sustainable use of its components, and • the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources			
Purpose			
To build local capacity to ensure that Kenya Wildlife Service has the human resources and information systems necessary to 1) achieve the targets for black rhino conservation mandated in it's Kenya 5-year Black Rhino Strategy; and 2) meet CBD objectives.	Improved information on rhino population sizes and dynamics, and rhino habitat carrying capacities and conditions, to be used for effective management and implementation of the Kenyan 5 year Black Rhino Strategy.	Annual national and park rhino status reports, -providing indicators of population performances, and recommedations for rhino meta-population and habitat management across 11 Kenyan parks. Regular reviews & feedback reports from Kenyan Rhino Management and Technical Committees (RMC & RTC) and the IUCN AfRSG.	High level support within the Kenya Wildlife Service for the aims of the Kenya rhino management strategy. Adequate KWS funds and staffing to protect and manage rhino areas. Continuing successful grants to implement annually reviewed conservation strategies.
Outputs			
a) A comprehensive, quality controlled system for monitoring of black rhino and their habitats in Kenya. --- b) A body of trained and accredited instructors for the AfRSG rhino monitoring course who are capable of continuing in-country training of field rangers. --- c) A body of trained and accredited rhino monitoring field rangers. --- d) Rhino officers trained in rhino monitoring data quality control, entry, basic processing & reporting. --- e) [i] Rhino programme coordinator, and scientist, trained in detailed field data analysis, interpretation of population dynamics and effective status reporting for decision-making. ---	Consensus among stakeholders (including KWS and international conservation NGOs) on the utility of the approach. --- Minimum of 20 rhino officers from 11 parks trained and tested. Those that pass accredited. --- Minimum of 165 field rangers from 11 parks trained and tested. Those that pass accredited --- Minimum of 20 rhino officers from 11 parks trained and tested. Those that pass accredited --- Rhino programme coordinator and support scientist from KWS headquarters trained. ---	Reports on meetings with stakeholders, annual reports, and project final report. --- Numbers of staff trained and levels of achievement attained summarised in training assessment reports. --- Monthly field monitoring reports; 6 monthly assessment reports summarising number of staff trained & accredited and levels of achievement attained. --- Monthly reports; 6 monthly on-site assessments. --- Numbers of staff trained. Quality of annual status reports. ---	Retention of staff with specialised training skills and experience, and high staff motivation. --- A high % of participants pass assessments and continue present positions. --- Highly trained and motivated instructors. Well motivated field rangers. High levels of staff retention. --- Highly motivated staff and high levels of retention. --- Well-motivated staff and high levels of staff retention. ---

e) [ii] Rhino officers / researchers from parks trained to produce basic annual park reports for KWS headquarter staff to use in national status reporting	At least 11 rhino officer/researchers trained (1 from each population)	Numbers of staff trained. Quality of annual park reports/data submitted to KWS headquarters staff.	Well-motivated staff and high levels of staff retention.
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f) Three sets of park and national annual status reports.	Reports published and reviewed by the RMC & RTC.	Management actions. Reviews and feedback reports from the RMC & RTC.	Sufficient quality data from the field.
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g) Fully revised Rhino Information Management System + GIS, user manual, tutorials & training (see d).	Fully working system in 11 parks.	Rhino monitoring data in system database, monthly park reports.	High level of support for equipment maintenance and repairs.
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h) A black rhino ecological carrying capacity model with procedures and training for habitat assessments, habitat monitoring and updating the model.	Data established on various variables / determinants of rhino ecological carrying capacities for each park, model developed, carrying capacities estimated, monitoring system established.	Improved ecological carrying capacity estimates for each park. Number of park researchers/ecologists trained. Habitat monitoring reports and procedural manual.	Past & current environmental data available (e.g. average monthly rainfall, soils/geology). Highly motivated staff.
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i) Rhino scientists trained in the use of Rhino 2.0 Bayesian Mark Recapture Population Estimation tool.	RHINO population estimation tool used in parks with unidentifiable rhino. At least two scientists trained.	Improved rhino population estimates for such parks.	Correct monitoring of recognisable & unrecognisable rhino, highly motivated staff continues in present position.
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j) 2 MSc, 1 BSc and 4 Certificate studentships, and 1 BSc projects completed	Students enrolled university/college, examination and projects reports.	BSc, MSc reports and certificates.	Courses passed by University / College. BSc student available to undertake field project.
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k) Publications and publicity.	Rhino conservation education booklet (1000 copies distributed to schools), 4 peer-reviewed papers, 2 radio broadcasts.	2 copies of all publications sent to Darwin Initiative	Outlets for publications and publicity willing to participate.

Activities	**Activity Milestones (Summary of Project Implementation Timetable)**
TRAINING	Yr 1: Preparation of material for AfRSG rhino monitoring training for instructors course (4 wks Jul-Aug); Yr 1: Workshop to train rhino officers as instructors to train field rangers on a regular basis (1 wk Sep); Yr 1: Preparation of material for AfRSG rhino monitoring training for park rangers course (2 wks Aug); Yr 1: Preparation of material for field data management, processing and reporting workshop (2 wks Aug); Yr 1: Workshop to train rhino officers in field data quality control, entry, processing and reporting based on Kenyan Rhino Information Management System (1 wk Oct); Yr 1: On-site training of field rangers by newly trained local instructors with support from Darwin Fellows in rhino monitoring techniques and data recording (8 wks Nov); Yr 2: Workshop to train park scientists/researchers in habitat assessment (1 wk, Oct)
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REPORTING	Yr 2: Development of rhino annual national and park status reporting templates (2 wks, Apr); Yr 2: Training of rhino scientist in detailed population data analysis and preparation of annual park and national status reports (24 wks Apr-Sep); Yr 2: Training of rhino coordinator in synthesis and interpretation of annual national status report (4 wks Aug-Sep); Yr 2: Production of first annual park status reports (2 wks Sep); Yr 2: Synthesis and interpretation of first annual national status report (2 wks Sep); Yr 3: Training of 11 park officers/scientists in data analysis and production of basic annual park status reports (4 wks Aug); Yr 3: Production of second annual park status reports (4 wks Aug); Yr 3: Synthesis and interpretation of second annual national status report (2 wks Aug); Yr 4: Production of third annual park status reports (4 wks Aug); Yr 4: Synthesis and interpretation of third national status report (2 wks Aug).
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ASSESMENT/ MANAGEMENT	Yrs 2-3: 6 monthly assessment of training, data quality, entry and reporting procedures, and any on-site training by rhino scientist and Darwin Fellows (Jul,Feb,Sep,Mar); Yrs 2-4: Special sittings of the Kenyan Rhino Management- and Rhino Technical Committees held to jointly review the findings of the annual status reports and work through the decision-making process that will identify what rhino management activities will be needed during the forthcoming period The objective is to establish best practices within these committees on dealing with and planning from these status reports (Aug/Sep); Yrs 1-4: 6 monthly reports sent to Darwin Initiative (Apr, Oct); Yr 4: Final project report sent to Darwin Initiative (Apr).
EDUCATION, TECHNICAL SUPPORT & TOOLS	Yr 1: Development and implementation of GIS park maps and enhanced Rhino Information Management system (10 wks May-Nov); Yr 2: Rhino conservation education booklet published and distributed to schools (Jan); Yrs 2-4: 2 radio broadcasts; Yrs 3-4: Advisory support provided for training of rhino officers/rangers and for habitat assessments as needed.
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SCIENTIFIC TRAINING & RESEARCH	Yr 1: Compilation & preliminary analysis of environmental information in each area for development of black rhino ECC model (4 wks, Oct); Yr 2: Preliminary carrying capacity model developed (4 wks, Sep); Yr 2: Training of 2 rhino scientists in producing population estimates using RHINO Bayesian Mark Recapture software (1 wk, Apr); Yr 2: Manual and databases for black rhino habitat monitoring and assessment developed and training course run (4 wks, Oct); Yr 2: Additional habitat assessment in new & existing rhino areas undertaken (8 wks, Nov-Dec); Yr 2: Habitat assessment reports for new and existing 11 sanctuaries/parks produced (4 wks, Dec); Yr 2: Carrying capacity model finalised, 2 papers submitted for publication (4 wks, Feb); Yrs 2-3: Several 1 day courses taught in meta-population species management (Diploma/Certificate in Wildlife Management at KWS Training Institute); Yr 1: 2 students enrol in MSc Wildlife Management, Moi University and University of Kent (Aug, Sep); Yrs 1-3: 4 students undertake Certificate course in Wildlife Management at KWSTI (Jun-Oct); Yr 2: 1 student enrols in BSc Wildlife Management, Moi University (Apr); Yr 2: MSc field projects initiated (Apr, Aug); Yr 2: UK-based MSc thesis submitted (Sep); Yr 3: Local-based MSc thesis submitted (Aug); Yr 3: 1 BSc student completes project on a specific biological management topic; Yr 2-3: 4 papers submitted for publication.

Supplementary items

Supplementary item 1	Rhino monitoring instructors training material
Supplementary item 2	Rhino monitoring instructors training report – Certificate students at Naivasha KWS Training Institute
Supplementary item 3	Status reporting training workshop – students comments
Supplementary item 4	Student's assessment of Certificate course
Supplementary item 5	Ben Okita's MSc dissertation in Wildlife Sanctuary Management
Supplementary item 6	Lekishon Kenana's MSc dissertation
Supplementary item 7	Habitat assessment training workshop programme
Supplementary item 8	Black rhino habitat assessment training manual
Supplementary item 9	Kenyan black rhino monitoring protocols
Supplementary item 10	Processed satellite imagery results
Supplementary item 11	Rhino home range outputs
Supplementary item 12	ECC model tool
Supplementary item 13	Habitat assessment and ECC report
Supplementary item 14	Rhino education cards (English &Swahili versions)
Supplementary item 15	Letter from KWS HR confirming retention of trained staff for a period of at least 3 years
Supplementary item 16	Project information sheet
Supplementary item 17	Record of the UK Minister for the Environment and Agri-Environments review visit to the project
Supplementary item 18	Lord Parmoor's project visit article in ZSL Lifewatch magazine
Supplementary item 19	Rhino poster
Supplementary item 20	Field data recording forms
Supplementary item 21	Kenya GIS based Rhino Information Management System "Kifaru" User Manual