

Black Rhino 2000 update

Preliminary findings on Black Rhino habitat use in Hluhluwe/Umfolozu

by Richard H Emslie and Keryn Adcock

Since 1960 the population of Black Rhino in Hluhluwe Game Reserve has declined markedly from 280 in 1961 to about 200 in 1973, and to 70 today (Emslie & Adcock, 1989). The translocation of 52 Hluhluwe Black Rhino to re-establish populations elsewhere in southern Africa does not fully explain this decline. It has been most pronounced in north-eastern Hluhluwe, where 46 animals died of unknown causes in a four-month period in 1961 (Hitchins & Anderson, 1983). This decline is in sharp contrast to the performance of the other South African populations. For example, the adjoining Umfolozu Game Reserve Black Rhino (excluding the southern corridor) have increased from low numbers in 1960 to about 100 today. Between 1973 and 1985, the mean annual population growth rate in Umfolozu was estimated at 6.8% after accounting for translocations (Emslie & Adcock, 1989). Black Rhino Project 2000 aims to determine why the Hluhluwe Black Rhino population has declined in contrast to Umfolozu. In particular, we are examining the hypothesis that habitat changes are the primary cause of the Hluhluwe decline.

Improved habitat suitability assessments of potential new reserves for Black Rhino will follow from improved knowledge of Black Rhino habitat requirements. We are, therefore, studying Black Rhino habitat use in a range of areas with contrasting conditions and population performances.

Management actions such as burning, culling of herbivores and



A. Characteristic pruned appearance of bush browsed by Black Rhino

bush clearing alter the vegetation. We need to know how these management actions affect Black Rhino habitat quality.

Black Rhino: Difficult animals to study

Black Rhino are shy and elusive, often lying up in thick bush during the day, and feeding mainly at night. Visual feeding observations are, therefore, biased towards open daytime feeding sites. In addition, for much of the year one, on average, only encounters Black Rhino every 25 to 40 kilometres walked. Sometimes they can also be a wee bit irascible. Studying their feeding ecology therefore poses special problems.

Fortunately Black Rhino characteristically browse the bushes and trees they feed on, leaving branches looking as if they had been pruned (Photo A). Black Rhino pruning differs from elephant browsing which tends to leave the ends of branches shredded like a toothbrush. Thus Black Rhino leave a history of their feeding behind on the woody vegetation. A nature detective

approach can then be used to study Black Rhino woody plant feeding and habitat selection in the thickest to the most open bush, and also cover both day and night feeding. Information about the location and size of the food plants is also obtained.

Our basic approach has been to describe both the habitat and food eaten by Black Rhinos on many different sites. The data are collected on rectangular plots of ground called transects. Habitat description includes measures of vegetation structure, species composition by size class, tree densities, volume of food available to Black Rhinos and grass interference. By measuring the habitat in a number of ways we can determine what is the most appropriate way to describe rhino habitat. The amount of a food item eaten shows its dietary **importance**. The degree of **preference** and **rejection** of food items is obtained by comparing the proportion of each food item in the diet with its proportion in the habitat.

The habitat/feeding transects

were spread throughout study areas in north Hluhluwe (4 900ha) and west Umfolozi (4 675ha). Within each study area, rhino densities were known to vary. Thus our study areas contained sections with differing Black Rhino densities and past population performances. The transects covered a wide range of habitats and topography, from open hilltop ridges to thick riverine bush. They also included a range of areas with different fire histories, and all the major bush cleared areas in northern Hluhluwe.

We undertook three sets of woody plant feeding/habitat selection surveys in each area. Detailed and intensive pilot surveys in selected Hluhluwe and Umfolozi habitats were used to design suitable techniques, sampling strategies, and analytical methods for the extensive grid

surveys which followed. A total of 33 000 trees were sampled in these grid surveys. A spin off is that the vegetation data bases from these surveys should also be useful to other researchers working in the area in future.

The third set of surveys took place in late winter, soon after the 1989 control burns. These aimed to determine how the burns and water distribution influenced Black Rhino feeding. They also contrasted postburn and late dry season feeding with summer feeding (measured in the previous surveys). We needed to develop a very rapid transect technique to obtain an almost instantaneous measure of feeding, yet still cover a large enough area to adequately measure the highly variable and low density of fresh feeding signs since the burns.

In Hluhluwe a rapid follow-up

survey in the early growing season compared habitat use on burnt and unburnt areas.

Other related collaborative research

The use of soft herbaceous plants by Black Rhinos is being studied in joint research with Bruce Page and his students at the University of Natal's Department of Biological Sciences. A scanning electron microscope is being used to identify leaf fragments in the dung.

Richard Eckhart of Cedara is also collaborating with research into the dietary quality and chemical composition of key spizes (species/size class).

General feeding patterns in Hluhluwe and Umfolozi

In Hluhluwe, *Spirostachys africana* (Tambothi) thickets, riverine bush, and lowland forest margin sites are key habitats.

EXPERIENCE THE REAL AFRICA

If you wish to experience the Africa we are trying to preserve and conserve, then join us on an Afro Ventures scheduled Safari, or let us tailor make a Safari to suit your requirements.

WE OFFER

- | | |
|---------------------|---|
| Botswana | 9-day luxury accommodated safaris and 10, 15, or 16-day camping Safaris through the National Parks and including Victoria Falls.
» NEW: 8-day Kalahari/Okavango Venture exploring Deception Valley and the Okavango Delta
» NEW: 8 day "Wings over Botswana" flying safari including Xugana, Tsaro, and Chobe Game Lodges |
| Zimbabwe | 12-day Zimbabwe Explorer
» NEW: 14 day Accommodated "Zimbabwe Panorama" covering all the highlights of Zimbabwe. |
| Namibia | » NEW: 18 day "Namibia Venture" including the Damaraland Wilderness Reserve and the Caprivi
» NEW: 8 day "Wings over Namibia" Flying Safari including Lianshulu, Mokuti, Damaraland, and Hobatere Lodge
» NEW: 9 day "River and Game Safari" to Caprivi |
| South Africa | » NEW: All Accommodated 10 day Eastern Highlights and 13 day South African Panorama |

For further information and our brochure, call us on (011) 789-1078 or fax (011) 886-2349.



Safari operators to Botswana, Namibia, Zimbabwe, Swaziland and South Africa, since 1972



B. *Spirostachys africana* (Tambothi) thicket: one of the most preferred and important habitats of the Black Rhino.

Acalypha glabrata (Forest false nettle) was a particularly important species in Hluhluwe riverine areas accounting for 13,9% of total summer woody browse offtake. The recently reintroduced elephants also commonly used these habitats, although much of their feeding was above rhino height. We frequently found trees which had been pushed over by elephant and later browsed by rhino, especially *Acacia karroo* (Sweet thorn): a case of the elephant helping the rhino. It appears that on balance the elephant will improve the habitat more for the Black Rhino than they will compete with them.

In Hluhluwe and Umfolozi young *S. africana* thicket was a key habitat, being both preferred and important (Photo B). *S. africana* was the dominant item in the Black Rhino's summer diet in both Hluhluwe and Umfolozi, accounting for 22,5% and 24,1% respectively of all woody browse eaten. Cyclone Demoina has been beneficial to the Black Rhino as many young *S. africana* have grown up on the flood damaged Black Umfolozi floodplain. Black Rhino, however, reject mature *S. africana* and *Acacia grandicornuta* (Horned thorn) wood-

land. Although the species composition of these two *S. africana* communities is similar, their size structures differ. The implication is that subtle changes in bush structure may be very important to the rhino, even if the species composition remains very similar. Similarly, in early stages of developing forest in Hluhluwe, *Berchemia zeyheri* (Red ivory) is a preferred plant. However, after it has grown up to become a canopy dominant all its foliage is out of rhino reach. Our decision to study at a spize rather than the more commonly used species level was, therefore, vindicated. Black Rhino are not botanists selecting only for Latin binomials.

Black Rhino are thought to be creatures of thick bush. When disturbed they like to retreat into cover, and spend much time lying up in thick bush in the heat of the day. Many of the highly preferred species in Hluhluwe occur in thick riverine bush, *S. africana* thickets and along forest margins. However, in Umfolozi, despite there being a large volume of potential browse available in dense *Olea europaea* subsp. *africana* (Wild olive) and *Brachylaena ilicifolia* (Small bitterleaf) bush, or *Croton menyhartii* (Rough-leaved

croton) thicket, the Black Rhino browsed little in these habitats. What feeding there was, was largely restricted to a few species along paths. In contrast, the most preferred habitat in the Umfolozi pilot survey was very open, heavily grazed short grass country with a few small *Acacias*. Black Rhino also ate more food in this habitat than in the dense bush. More open areas are thus more important food areas than generally thought. Open areas are particularly favoured after the burns.

Proportional composition of the diet: A question of balance?

Despite the different species composition of the Umfolozi and Hluhluwe study areas, a striking feature was the very similar contribution to the diet by a number of important species that occurred in both areas. The implication is that Black Rhino may need a mixed or balanced diet, and are unable to subsist only on one or two key species.

We found this to be true for captive rhino too. We noticed that when faced with a selection of fresh browse, our boma study Black Rhino did not eat all of the most preferred species first. She chose to mix her diet, eating species which were intermediate in acceptance, or even rejected in the wild, before finishing the more preferred *S. africana* and *A. karroo*. The Natal Parks Board game capture unit also found that when fed only on *S. africana* Black Rhino lost condition, but were healthy when fed a mixed diet (Peter Hitchins, pers comm).

Many woody species defend themselves chemically. This may explain why there is a limit to the amount of a species the rhino can eat. On the other hand the animals may only be able to obtain key nutrients, amino acids or trace elements from different species.

Future chemical analysis is needed to shed more light on this point.

The importance and preference of *Acacias*

In both reserves at least half of the ten most preferred species were *Acacias* or their close relatives. Black Rhino also showed a clear preference for the smaller *Acacias*. As they grew in size they became less and less preferred. Within the *Acacias*, Black Rhino showed different degrees of selection for different species. Some less common species were the most preferred: *A. senegal* (Three-thorned acacia), *A. borleae* (Sticky Acacia) and *A. gerrardii* (Red thorn), but the more wide-spread *A. karroo* and *Dichrostachys cinerea* (Sickle bush) were more important in the diet. The latter two species each accounted for about 10% of the summer woody

diet in both study areas. We were able to advise management to think twice about reclearing bush cleared sites where young *Acacias* were growing up; and if they wanted to partially reclear these areas, which species they should leave.

Grass interference affects

Black Rhino feeding:

Implications for Hluhluwe

A key finding of the project is that Black Rhino habitat quality declines as grass density and height increases. When preferred small *Acacias* are hidden by grass, the Black Rhino are forced to select the next biggest size class they can find. They avoid very tall grass areas, except to travel through them on a path. This was especially the case in north Hluhluwe where the grass has been 2m high in places during the last two summers

(Photo C). The volume of browse hidden by grass in the Hluhluwe study area was four times greater than in Umfolozi. This partly explains why three times more transects in Hluhluwe than in Umfolozi had no feeding on them at all. Heavy culling of large grazers is, therefore, likely to reduce Black Rhino habitat quality by promoting the expansion of tall grass areas.

Grass interference, however, cannot be invoked as the cause of the Hluhluwe decline, as grazer numbers were high during much of the period of population decline.

It is likely that conditions will improve for Black Rhino in future, as the record grass levels in Hluhluwe are undoubtedly largely a result of the exceptionally high rainfall over the last few years. The build up in grazer numbers, following the change to process based management in Hluhluwe/

PROPERTY & FINANCIAL SERVICES.



FOUNDED 1862

CAPE TOWN: 26-1730. DURBAN: 304-2731. EMPANGENI: 2-3811

JOHANNESBURG: 883-8585. PINETOWN: 72-3591.

REMMINGTON/GRAY: RMBT - E



C. Tall grass conditions prevailing in much of north Hluhluwe over the last two summers. Black Rhino avoid such areas.



D. Acacia karroo scrub.



E. Acacia karroo woodland.

Umfolozi, should further improve conditions for Black Rhino in future.

Habitat use and vegetation changes

A major problem has been how to piece together the details of what has happened to the vegetation in the absence of much data. Thanks to the transects done in 1970 by Peter Hitchins and Orty Bourquin we at least have a window on some of the past. Studies of the spatial patterning of different trees have also been successfully used to study successional processes in the Zululand bush (Smith & Goodman, 1987; Whateley & Wills, in press). By studying community spize composition and structure we can also infer possible successional pathways.

Acacia nilotica (Scented thorn) has been identified as a pivotal species in the change from open scrub to evergreen forest in Hluhluwe (Whateley & Wills, in press). Vegetation succession over much of Hluhluwe (Fig 1) appears to move from open grassland through *A. karroo* thicket (Photo D) (Fig 1A) through tall spindle *A. karroo* woodland (Photo E) with small *A. nilotica* (Fig 1B) to *A. nilotica* and *Rhus pentheri* (Common crowberry) closed woodland (Fig 1C), going to either *Euclea schimperi* (Bush guarri) and *B. zeyheri* lowland forest (Fig 1D) in wetter north Hluhluwe or *Euclea divinorum* (Magic guarri) woodland in drier south Hluhluwe (Whateley & Wills, in press). Our results have strongly corroborated the above hypothesised successional sequence. In classifying the Hluhluwe vegetation we found that the tall *A. niloticas* were lumped with the suite of forest species, while the smaller size classes of *A. nilotica* were associated with more open woodland and grassland species. We also found that the later



F. Seedling of *Euclea shimperi* growing next to bole of *Acacia nilotica*.



Ga. Picture of woodland in transition from stage C to D (see Fig 1). Note the dark barked tree in the centre. It is an *Acacia nilotica*. Canopy dominants are *Euclea shimperi*, *Rhus pentheri* and *Berchemia zeyheri*.



Gb. A close up of *A. nilotica* showing a young *Berchemia zeyheri* growing next to its bole.

successional closed woodland and especially the dry evergreen forest types represent poorer habitat for Black Rhino than earlier successional stages. Closed woodland and forest habitats have increased in extent over the last few decades, leading to a decline in Black Rhino carrying capacity in Hluhluwe. In contrast, woody succession in Umfolozi is at an earlier stage. The increase in extent of *Acacia* scrub over the last twenty years has favoured Black Rhino.

Being boom and bust strategists favouring full light, *Acacias* do not regenerate well under other *Acacias* (Smith & Goodman, 1987; Whateley & Wills, in press). The *Acacias* do, however, provide perches for birds which eat the

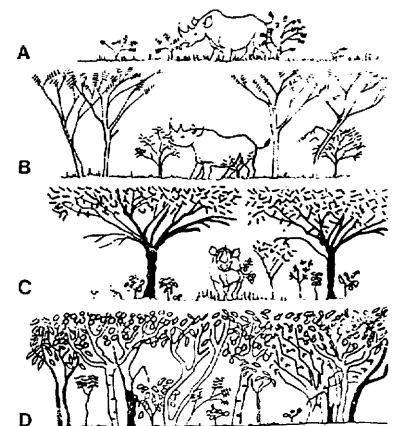


Figure 1

fruit of dry forest species such as *B. zeyheri* and *E. shimperi*. Bird droppings contain the seeds from the fruit. The result is that seedlings of these forest species are significantly associated with sites under *A. nilotica* canopies rather than in the open (Whateley & Wills, in press, Photo F). Forest species do not require full light. Many evergreen species also defend themselves chemically. In addition, stemflow increases the water available to the developing forest trees (Bob Scholes, pers. comm). Grass species composition also changes under the canopies and is dominated either by

Panicum maximum which does not burn well, or if heavily grazed a *Dactyloctenium* lawn (Whateley & Wills, in press). Fires do not penetrate closed *A. nilotica* woodland and this combined with a change in grass species composition towards less flammable species means that the forest seedlings are well protected from fire. In time they grow through the canopies of the *A. niloticas* which eventually die leaving their characteristically diamond fissured dark trunks as a testament to what has happened (Fig 1D).

On your next visit to Hluhluwe, look at the bush by the road around the Zincakeni Dam and you will see a developing forest somewhere between Fig 1 stages C and D (Photo Ga, b). To appreciate how dynamic Hluhluwe vegetation is, look across the Zincakeni Dam to the

developing *E. schimperi* forest on the other side (Photo H). This was open enough to allow zebra capture from landrovers in the 1950s.

A. karroo woodland areas are more open, and experience a higher fire frequency than *A. nilotica* closed woodland. This probably explains the lower numbers of forest species they contain.

Our results show that the trend towards increasingly advanced bush thickening in north Hluhluwe on the whole represents a deterioration in habitat quality for Black Rhino. It is interesting that the noted botanist Henkel (1937) did not record *E. shimperi* in his survey of Hluhluwe, yet in our Hluhluwe study area it is now the most dominant species on the basis of its overall canopy cover. It is

also strongly rejected by Black Rhino. We have remeasured some of Peter Hitchin's vegetation transects from twenty years ago, and young *E. shimperi* plants appear to have grown up over this period.

A key question is therefore: Why have extensive areas of closed *A. nilotica* closed woodland and dry evergreen forest developed in Hluhluwe, when the reserve was much more open in the past? The past hunting out of elephant and the changes in the influence of man are implicated in these changes (Jim Feely & Alf Wills, pers comm).

Iron Age smelting sites are scattered throughout Hluhluwe/Umfolozi. One often comes across old kraal sites while walking in the bush. Smelting required large amounts of charcoal, and

ENDANGERED WILDLIFE TRUST DESERT ELEPHANT & RHINO TOURS

Led by Garth Owen-Smith

The Endangered Wildlife Trust offers you the unique opportunity to join leading conservationist Garth Owen-Smith on a special nine-day safari through Damaraland and the Kaokaveld Nature Reserves.

Experience the extraordinary beauty of the desert and see for yourself the remarkable conservation work of Garth Owen-Smith with the desert elephants and rhino. The tours cover all aspects of desert ecology and also visits the Himba Tribe. There are daily walks and hikes and plenty of opportunity for bird watching.

The tour cost is R4168 per person (based on fares and rates at November 1990) and includes return airfare

1991 TOUR DATES ARE

- June 6 to 14
- August 1 to 9
- October 10 to 18
- November 14 to 22
- December 5 to 13

The first and last nights are at Palmwag Lodge and the rest of the time is spent camping under the stars in the desert. All camping equipment, meals, and transportation is included. Tours are limited to only ten people and this may be the last year of the Owen-Smith tours so do not miss this extraordinary opportunity.

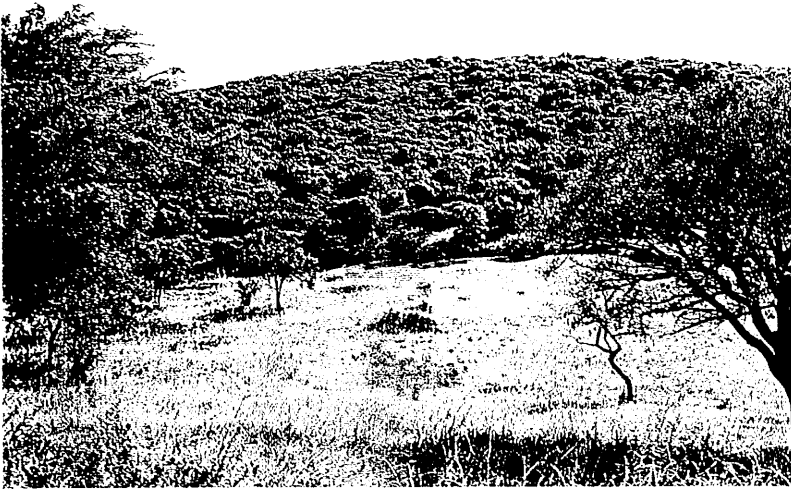
For further information and bookings, please contact Gill Sagar Miller Weedon Travel P O Box 5027 Johannesburg 2000

Telephone (011) 720-3215 or 728-5189 (after hours). Fax (011) 725-2934



MILLER WEEDON TRAVEL





H. View looking across Zincazeni Dam in Hluhluwe. The area behind the dam has developed into a dry *Euclea shimperi* and *Berchemia zeyheri* forest. In the 1950s the area was open enough to allow Zebra capture from a Landrover. The area in the foreground has been cleared.

A. nilotica is thought to have been one of the main species selected by Iron Age man in Zululand (Dumisane Ngobese, pers comm). In addition, early man would have burnt regularly to attract animals to hunt, and perhaps more importantly to make walking easier and safer (Tony Ferrar, pers comm). Doing fieldwork in very tall grass is not only unpleasant but you cannot see the area through which you are walking. Over the last two years we have regularly played 'bush golf' by suddenly disappearing from sight down warthog burrows hidden by the grass. It would have been very unlikely if Iron Age man had not burnt frequently in the past.

In the early days of the European control of the reserve, the use of fire was discouraged (Foster, 1955; Mark Graham, pers comm). Later, during the anti-tsetse campaigns burning was not encouraged as the Harris fly traps were wooden. Fire kills above ground growth of young *Acacias* making them coppice from the base. This coppice has a high protein content and is selected by Black Rhino. However, when *Acacias* grow taller their bark protects them from fire. By

allowing trees to grow above the level that they are affected by fire, the change towards reduced fire frequencies in the first half of this century will have promoted a more rapid development of *A. nilotica* woodland.

Soon after World War II, DDT was sprayed over the Hluhluwe/Umfolozi area to eliminate tsetse. The biological effects of this action are hard to gauge. Many insect seed predators were probably killed resulting in increased recruitment of many woody plants (Alf Wills, pers comm).

The reintroduced elephants are regularly stripping the bark from *A. niloticas*. Already, the elephants appear to be opening up gaps in the closed woodlands allowing tongues of fire to spread into areas previously protected from fire (Alf Wills, pers comm). Elephants are also pushing over many *A. karroo*. Thus the elephants together with the current increased fire frequencies, should create conditions more suitable for regeneration of *A. karroo* scrub rather than the development of closed woodland.

Habitat use and bush clearing

One surprising finding was that many of the most rejected species

in Hluhluwe occur on bush cleared areas in the wetter low lying areas of northeast Hluhluwe. *Euclea crispa* (Blue guarri), *Rhoicissus tridentata* (Bitter grape), *Maytenus senegalensis* (Confetti tree), *Lippia javanica* (Lippia), and *Diospyros lycoides* (Blue bush) have flourished on these wetter bush cleared sites after the removal of *Acacia* thickets. Fortunately bush clearing on drier sites elsewhere in Hluhluwe/Umfolozi has, if anything, been beneficial given the growth of young *Acacias* following clearing.

The 1961 Black Rhino die-off in northeast Hluhluwe occurred soon after extensive bush clearing started in north Hluhluwe. We feel the bush clearing may have been the catalyst that precipitated this population crash. In the late 1930s and early 1940s Hluhluwe Game Reserve was famed for the number of Black Rhino it contained (Doug Pheasant, pers comm; Atwell, 1947). By the late 1950s Black Rhino were still very common, but the vegetation had had another decade to develop. Perhaps the population would have started to decline soon in response to changing habitat anyway? The removal of large areas of *Acacia* thicket and woodland in north Hluhluwe would have undoubtedly precipitated the decline if the animals were already beginning to experience nutritional stress as a result of changing habitat.

Evidence to support the nutritional stress hypothesis comes from transects done in northeast Hluhluwe by Peter Hitchins in 1970. At this time the Black Rhino population in the area was lower than peak levels, but much higher than it is today. In 1970 the rhino were eating far more of what is now rejected, based on comparison with our (1989) findings. We have just redone Peter's transects to obtain a more direct comparison. The ratio of palatable to

unpalatable plants eaten was 13:1 in 1989, but only 3:1 in 1970. The rhino were eating large amounts of certain species twenty years ago, that given the choice, they will hardly touch now. For example, Peter recorded 37% of *L. javanica* plants eaten in 1970, while in our study area the proportion was 0,16%. This suggests the population was under nutritional stress. This could have contributed to the lower calving success recorded by Peter Hitchins (Hitchins & Anderson, 1983) for the Hluhluwe population in the early 1970s.

In summary our results to date have strongly supported the hypothesis that vegetation changes have had a primary role in influencing population performance in both Hluhluwe and Umfolozi.

Relative rhino densities estimated from browse offtake

The Hluhluwe study area tree density was almost three times greater, and the available browse volume was double that of Umfolozi. However, the feeding recorded in the grid surveys indicates that the density of Black Rhino in the north Hluhluwe study area was only 70% of the density in west Umfolozi. During the summer the proportion of available browse eaten was also much lower in Hluhluwe (1,1% compared to 3,7% in Umfolozi).

Rhino feeding in the late dry season after burns

The first post burn survey revealed that soon after a fire the offtake per hectare was greater in burnt patches than unburnt ones. Thus rhino were not being forced to restrict their feeding to unburnt areas. Somewhat surprisingly we found that straight after the burns Black Rhino commonly ate burnt twigs. Preliminary analysis has

shown that this food has a very low nitrogen content, but appears high in calcium.

A greater diversity of species was eaten after the burns, some of them having been rejected in summer. Perhaps the heat of the fire denatures the proteins in the chemicals used to defend such species, or maybe disguises the smell of different species. Chemical analysis is needed to explain this change in eating habits.

Different parts of the Umfolozi study area showed very different levels of offtake, with much less feeding in dry places far from available water. Overall, feeding levels in the Hluhluwe study area were 75% higher than Umfolozi: the opposite to the summer surveys. Clearly a number of the rhino had moved south out of west Umfolozi or into the Corridor. This was confirmed by a Natal Parks Board rhino identification survey the following month. Water availability therefore clearly influences habitat preference during the dry season.

Feeding in the early wet season

Black Rhino feeding patterns changed markedly in the early wet season compared to other times of the year. The animals selected ground herbs and nibbled the freshly sprouting shoots of burned shrubs. They also ate far less woody matter, and so their dung texture changed from coarse to fine. These feeding patterns should result in a high quality diet, enabling the rhino to build up condition after the lean dry season. Freshly coppicing shoots were found to have a high protein content.

Current and future analysis of feeding/habitat data bases

To separate out the effect of the many environmental and man-

agement influences on Black Rhino feeding we have devised a new analytical approach. This involves combining statistical techniques from the different disciplines of plant ecology and geology. We are busy refining the method and analysing the data at the moment. Put simply the approach involves the following steps:

Describe the gradients in the vegetation. This is biologically more realistic than trying to pigeonhole areas into separate discrete habitat types. It also enables large and complex vegetation data sets to be reduced to a level the human brain can understand.

Draw maps of the habitat using the vegetation gradients (and not spatial coordinates) as the X and Y axes. The position of a site on these maps therefore gives information about its spize composition. This is different from normal maps where position on the map refers to position on the ground. Transects with similar spize compositions occur close together on the maps. It is also possible to identify successional pathways on these maps.

Superimpose contours of Black Rhino feeding importance and preference on to the habitat maps to produce joint feeding/habitat maps. The precision of the estimates of feeding over the maps can also be derived and mapped.

Plot how the spize composition of the vegetation has changed on our habitat maps (eg by remeasuring past vegetation transects and plotting how their position on the map has changed).

Use the rhino feeding contours to determine the effects of vegetation change on rhino use. These feeding/habitat maps will also allow us to detect the stages in woody plant succession most favourable for Black Rhino. It may even be possible to identify

threshold stages in vegetation succession, beyond which habitat quality for rhinos rapidly declines. This knowledge might allow managers to detect when to move Black Rhino before their performance starts to decline. Such analyses may also indicate the types of habitat in which bush clearing could be most beneficial to Black Rhino. We foresee that the analytical approach we have developed could have wider applications in the field of plant/herbivore relations.

We designed our surveys so we could use the powerful multivariate statistical tools available to disentangle the effects of management (burning regimes and bush clearing) from those of environmental factors (eg altitude, aspect, slope, distance from the river, and geology) on Black Rhino habitat use. We are busy with this analysis at present.

Thus in conclusion we are a long way down the road to meeting our Black Rhino feeding ecology related goals, and are currently busy with data analysis. Details of other Project 2000 work will follow in other editions of the Endangered Wildlife journal.

Acknowledgements

Black Rhino 2000 is a joint project of the Endangered Wildlife Trust, Natal Parks Board, SA Nature Foundation and Total SA. We would particularly like to thank Paul Cuthbert, Welcome Dube, Rupert Nanni and Vincent Shongwe for help with fieldwork; Richard Eckhart and Bruce Page or help with analysing specimens;

Trevor Morley and Marilyn Pattenden for commenting on an earlier draft; and to KwaZulu for providing us with Ortho-photos. Lastly, and not least, thanks to Alf Wills for those many stimulating evenings over the years spent discussing the ecology of Hluhluwe/Umfolozi.

References

- Atwell, L, 1947. The Natal Game Reserves. *African Wildlife* Vol. 1
- Emslie, R H & Adcock, K, 1989. Status, history and performance of Black Rhinoceros *Diceros bicornis* populations in South Africa, the TBVC states and Namibia. Abstract in Koedoe 32/2, currently being updated and edited for publication in full.
- Foster, W E, 1955. History of the Umfolozi Game Reserve, unpublished, Natal Parks Board.
- Henkel, J S, 1937. Report on the plant and animal ecology of the Hluhluwe Game Reserve, with special reference to tsetse flies. *The Natal Witness*, Pietermaritzburg, 35 pp.
- Hitchins, P M & Anderson, J L, 1983. Reproduction, population characteristics and management of the Black Rhinoceros *Diceros bicornis* minor in the Hluhluwe/Corridor/Umfolozi Game Reserve Complex. *S.Afr.J. Wildl.Res.* 13(3).
- Smith, T M & Goodman, P S, 1987. Succession dynamics in an *Acacia nilotica/Euclea divinorum* savannah in southern Africa. *J.Ecol.* 75, pp 603-610.
- Whateley, A & Willis, A J, (in press). Colonisation of a sub-tropical woodland by forest trees in South Africa. *J.Stb.Afr. Ecol.*, Vol. 1.

About the authors

Richard Emslie is a graduate of Cambridge University where he obtained his Honours degree in Applied Biology in 1979 and Masters degree in 1987. In 1980 he commenced an applied grazing ecology study in the Umfolozi Game Reserve in Zululand, Natal. He examined the effects of both climate, and big and small grazers (from the White Rhino to insects) on grass dynamics to come up with policy recommendations for process based management of the reserves. This work is being prepared for a Doctorate at the University of the Witwatersrand. Richard lectured for a year at the University of the Western Cape, and started Black Rhino 2000 in July 1987. He has been elected as one of two specialist experts on the recently formed Rhino Management Group.

Keryn Adcock was until recently research assistant on the project. A graduate of the University of the Witwatersrand, she is about to submit her thesis on the effects of lack of fire on Cathedral Peak vegetation for a Masters degree at the University. She has recently been appointed the first woman senior professional officer (ecologist) in the Natal Parks Board working in the Hluhluwe/Umfolozi Game Reserve.

Address

Hluhluwe Game Reserve
PO Box 25
Mtubatuba, 3935
Natal, South Africa



Show You Care
By What You Wear

EWT Corporate Award 1990

A proportion of the sales of every item in the Pugs up-to-the-minute casual sportswear collection goes to the EWT.

For more information call Rod or Mary Turner-Smith on (011) 728-4558