Assessment of the proposed Mkomazi Rhino sanctuary, Mkomazi Game Reserve, Tanzania

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Summary

1. A multitude of non-biological and biological criteria were investigated to assess the suitability and feasibility of establishing a black rhino sanctuary in Mkomazi Game Reserve, Tanzania.

2. The area was found to offer good habitat in an isolated setting suitable for the establishment a rhino sanctuary.

3. Attention needs to be granted to upgrading the security training of the personnel.

4. Socio-political problems, although apparently not of great concern, should be given continuing attention through good and effective extension work. Propagation of the potential educational, spiritual and financial assets of the reserve and rhino to the surrounding communities should be advocated.

5. The estimated maximum productivity carrying capacity (EMPCC) for the 45 km2 sanctuary is 20 animals or a density of 0.45 animals km-2.

6. In order to maximize the long-term survival of this population attention should be given to possibly expanding the sanctuary to house a minimum of 40 animals.

Introduction

With the decline of the black rhinoceros Diceros bicornis population in Africa over the last 30 years, new in situ approaches to conserving the species had to be implemented. Three basic methods exist and differ depending upon the size of area and intensity of protection offered. These include:

a. The conventional approach of allowing animals to roam within large (either open or closed), free-ranging conservation areas with relatively limited protection offered owing to the size of the area.

b. A smaller, open, but intensively protected area (known as an intensive protection zone - IPZ) within a larger conservation area in which the rhino were introduced or where they are naturally concentrated.

c. The relatively small, enclosed, and highly protected sanctuary.

In the face of rampant poaching the first method becomes very difficult to manage and control. It was in such situations that rhinos were lost within most African parks and conservation areas, recently highlighted by the rapid decline of the Zambezi Valley population in Zimbabwe (Milliken, Nowell & Thomson 1993). The sanctuary and IPZ approaches offer greater chances of success, as found in Kenya (Brett 1992). Thus, a number of the range states, such as Zimbabwe (Anon 1992) and Tanzania (Anon 1993), have recently incorporated these approaches in their conservation plans.

Tanzania identified that their remnant black rhinos (estimated to be less than 100 animals (Anon 1993)) from two taxonomic subspecies, the eastern (D. b. michaeli) and southern (D. b. minor) ecotypes, should be concentrated within IPZ's in some of their major parks and reserves, in addition to establishing a number of rhino sanctuaries. The Serengeti and Tarangire National Parks, and Mkomazi Game Reserve were identified as possible sanctuary sites for D. b. michaeli.

The recent decision by the National Parks Board of South Africa to replace the extralimital D. b. michaeli population, established in the Addo Elephant National Park since the 1960's, with the indigenous arid-adapted south-western ecotype D. b. bicornis has made the Addo population (the fifth largest D. b. michaeli population) available for translocation (Knight & Hall-Martin 1993; Hall-Martin & Knight 1994). As Tanzania has few rhino scattered over vast areas, and relatively few excess animals are obtainable as of yet from the Kenyan sanctuaries, the availability of the Addo population of 35 animals offers an ideal source from which to establish sanctuaries within Tanzania.

The aim of this report is to assess the feasibility and potential of establishing a viable rhino sanctuary in the Mkomazi Game Reserve, northern Tanzania.

Approach

A combination of property assessment methods (Brooks 1989; Emslie 1993; Hamilton & Woodley 1985; Morkel 1989) were used in assessing the Mkomazi Rhino Sanctuary (MRS). The assessment criteria were divided into non-biological and biological categories. Within each of these different aspects were addressed.

1. Non-biological criteria with their points of concern are:

a. Topography and climate: - gradient; marshes; cliffs.
b. Location: - freedom from disturbance; proximity to settlements.
c. Security and management: - physical features; staff training, density and co-operation; communications equipment; motivation; management style; staff relationships.
d. Financial security and long-term tenure.
e. Socio-political aspects: - community relationships and programmes.
f. Fencing and bomas: - quality; electrification; maintenance.
g. Logistics of introducing and removing animals: - roads; terrain; airfields; support services.

2. Biological criteria include:

a. Local conservation plan recommendations and ecotype distribution.
b. Soil and vegetation descriptions and the influence of past management practices: - A reconnaissance of the altitudinal variation in vegetation types was undertaken by walking a single transect from the river base to the upper slopes of Hafino hill situated within the sanctuary. Tree and shrub species were identified where possible, otherwise samples were collected for later identification. In addition, the trees and shrubs were noted for signs of browsing by the larger herbivores (elephant Loxodonta africana, eland Taurotragus oryx, giraffe Giraffa camelopardalis lesser kudu Tragelaphus imberbis, gerenuk Litocranius walleri and impala Aepyceros melampus) in the area. Signs of past cattle posts were noted.
c. Estimated 'carrying capacity' (ECC) and the estimated founder population size: - The ECC is based upon a description of the habitat and a comparison of rhino densities noted from the region. The estimated minimum and maximum founder population sizes are a compromise between maximizing the potential breeding success of a population, the ECC and reducing the possibility of in-breeding depression (Emslie 1993).
d. Veterinary considerations: - The possibility of outbreaks of wildlife diseases such as Trypanosomiasis and anthrax were investigated.
e. Availability of water and possibility of fires: - The provision of drinking water both within and outside the sanctuary, and the frequency of fires were investigated.

Following Emslie (1993), no objective numerical scoring system for each of the above criteria was used, as in many cases and particularly the non-biological criteria, they can be directly improved upon. Instead each criterium was given a pass or fail, which was further subdivided as follows:

Fail (F) = Fail.
Pass (P-) = Pass but room for improvement.
Pass (P) = Pass - standard to good.
Pass (P+) = Pass - very good.

Results - non-biological

1. Non-biological criteria.

a. Topography and climate.

The ± 45 km2 sanctuary is situated on the north eastern side of the isolated Kisiwani mountain range at the south-western extreme of the Mkomazi - Tsavo plains (Fig 1). From the base of the Kisiwani Mountains in the south west the terrain within the sanctuary ranges from flat to gently undulating terrain ranging between 680 - 800 m above sea level to a circular mountain (called Hafino), nestled in the north eastern corner of the sanctuary, that rises to 1233 m above sea level. The slopes are not excessively steep with an average gradient of 1:2.3 m and 1:4.3 m on the western and eastern sides, respectively. A small rocky precipice (±40 m high) is restricted to the upper eastern slopes of the hill. In addition a small koppie exists in the northern section of the reserve. A seasonal river bisects the sanctuary. This river periodically forms a small marsh or vlei in the central north western section of the sanctuary.

Although the sanctuary receives an average of 750 mm (range: 380 - 1600 mm) rainfall per annum (Harris 1972), the aridity index revealed that evapotranspiration was about 50 % greater than precipitation (Harris 1972). Drought years (those years in which the annual rainfall is < 80 % of the long-term average (Tyson 1986)) occurred in 30 % of years. They are considered to be major catastrophic events negatively affecting rhino population growth (Foose, Lacy, Brett & Seal 1992). As far as possible sanctuaries should be sighted in areas with reduced probability of droughts. However, in those cases where they can potentially be problematic, the stocking rate of rhino should be on the conservative side.

Score: P.
Reservations & recommendations: The cliffs on Hafino hill could be problematic, particularly during the introduction phase, and should possibly be fenced off.
Droughts are a potential problem in MGR.

b. Location

The sanctuary is about 1.5 km from the Kisima camp head quarters. The nearest village (Kisiwani) is approximately 20 km from the camp HQ/sanctuary complex. A single track, passing the Hinjiro game scout post, links it with the village.

Score: P+.
Reservations & recommendations: The sanctuary is relatively free from disturbance, with no thoroughfares in close vicinity. The closeness of the sanctuary to the camp HQ is ideal for logistical support and security.

c. Security and management

The sighting of the HQ camp within 1.5 km of the sanctuary and at a relatively high elevation (± 820 m) on the Kisiwane foothills opposite the major portion of the sanctuary, offers both a good observation platform and close proximity for quicker reaction times in the event of emergencies. A cutline (± 40 m wide) has been cleared around the perimeter of the sanctuary to provide easy access to vehicles both in and outside the proposed fence, as well as good visibility of the line. Although the single vehicle track is still rather rough, plans are afoot to improve this.

The planned positioning of a scout post atop the Hafino hill within the sanctuary will grant an excellent observation and communication platform.

The permanent availability of an aircraft at the nearby airfield enhances the security and reaction potential.

Radio communications are excellent: a VHF radio repeater station on the top of the Kisiwani mountain provides excellent communications throughout the sanctuary and the entire Mkomazi Game Reserve; all vehicles are fitted with radios; portable sets are available (on constant charge from solar panels and wind-driven generators); staff are competent with the use of radios.

Staff at present consists of Mr Tony Fitzjohn (TFJ) and 9 other staff members, including an administrative officer all paid by the George Adamson Wildlife Preservation Trust. The majority of staff are not trained in the use of weapons (with the exception of TFJ and his 2 IC (Mr Elisaria Nnko) or general security procedures. Plans are to have the staff compliment increased to 12 personnel (10 on duty at any one time ie. 1 man/±4 km2). The Tanzanian army are to give training in the use of weapons and security operations.

A co-operative and enthusiastic attitude existed between the management and staff of the sanctuary, the wildlife personnel from MGR (led by Mr Mungure) and Kenyan National Parks Service from the adjoining Tsavo National Park.

Housing conditions are good having recently been renovated. A good rapport existed between the sanctuary management and staff, and the Division of Wildlife personnel. There was a strong commitment to the rhino project and Mkomazi as a whole by both the sanctuary staff and Wildlife personnel. Staff members are encouraged and praised for showing self-initiative. The sanctuary staff are well paid. With the blessing of the Division of Wildlife, the salaries of the wildlife department personnel within the MGR are supplemented by the George Adamson Wildlife Preservation Trust. This has had a considerable positive affect on morale amongst the staff (Mungure pers comm.).

Score: P.
Reservations & recommendations: Upgrade of security training and perimeter road. Staff density exceeds South African recommendations but are on par with that in Kenyan sanctuaries (1 man/3 - 9 km2). There was an overall willingness to learn and seek advice from experts associated with similar operations.There is plenty of enthusiasm amongst the staff for the project.

d. Financial security and long-term tenure.

The Mkomazi Project, of which the rhino reintroduction is only a part, is under the direction of Mr T Fitzjohn. It is overseen by an international board of trustees of the George Adamson Wildlife Preservation Trust. All funds are raised externally in the United States and Europe. The project, endorsed by the Tanzanian Division of Wildlife, is listed as a National Project with priority status attracting full Tanzanian Government support.

Score: P.
Reservations & recommendations: Short-term commitment and financial support appears sound but need the long-term commitment from the government in the event the sanctuary is established.

e. Socio-political aspects

Before the official inception of MGR in the 1950's, the area had been under constant pressure from illicit hunters and predominantly Maasai cattle herders (Harris 1972). Once the reserve was gazetted, the prevailing philosphy of multiple land use allowed the cattle herders to remain in the reserve on temporary grazing permits. However, the actual increase of both human and cattle numbers saw a depletion of wildlife numbers and species

diversity. This expansion occurred predominantly from the Umba river area in the south east section of the reserve and the signs of past habitation are evident. The fact that the cattle herders had only been granted temporary grazing permits were ignored. A final commitment to save the reserve and its remaining wildlife by the Tanzanian government in 1988 lead to an unpopular forced removal of the people and cattle (with many of the latter dying in the process) to the Kisiwani, Njiro, Gonja and Ndea areas. The George Adamson Wildlife Preservation Trust under the direction of T Fitzjohn established itself in the reserve in 1989, with a commitment to help with the rehabilitation of the wildlife and reserve.

Although no survey of the peoples attitudes towards the reserve was undertaken the following comments are drawn from an interview with Harrie Simons and Truus Nicolson both social pastoralist group leaders and lay missionaries for the Roman Catholic church who have lived within the Kisiwane community for six years and have the trust of the community. They are actively involved in improving the understanding between the community and the activities of the reserve. Their work which is funded by the Dutch government, Mkomazi Trust and recently the WWF includes the establishment a secondary school, soccer team, medical dispensary, a mobile education facility and women's groups amongst the Maasai to improve literacy and their overall lot. Emphasis is rather on participatory support where the community are encouraged to contribute in the planning, labour and implementation of the projects, rather than just receiving financial hand-outs. This gives the projects greater meaning and value to the community, plus emphasises the possible benefits from a positive relationship between the community and MGR.

In Harrie Simons and Truus Nicolson opinion there appears to be limited resentment towards the Mkomazi Game Reserve by the Maasai, as they were well aware that their permission to graze within the reserve was only a temporary one. Moreover, there is an active movement amongst the Maasai women not to return to the nomadic lifestyle owing to the hardships they personally endured in the isolated bomas or manyetas. The more numerous Wapare and Wasambar tribe members within the Kisiwane and Usambaras areas were never historically associated with the reserve and thus have no negative feelings towards it.

In the light of the above facts it would appear that the introduction of black rhino into the MGR would be:

i) Compatible with past practises given possible improved conditions arising from bush thickening around old cattle posts.

ii) Compatible with the desire to rehabilitate the reserve and its wildlife populations.

iii) Little affected by the limited to dwindling negative feelings towards the reserve by the surrounding communities.

iv) A possible catalyst for the sanctuary concept for rhinos and other endangered species within Tanzania as a whole and for the tourist industry within MGR. Spin-offs from this could be in-turn felt amongst the local communities through job creation, curio manufacturing, proportion of gate fees etc.

Score: P.
Reservations & recommendations: Community involvement and education about the MGR should remain a priority. Gauging the communities opinions through open, independent and objective sources will always be beneficial to the Mkomazi project and the survival of the MGR. The programme should be spread to the other border communities as money becomes available.

f. Fencing and bomas

A 2 m high, 12 strand high tensile steel wire fence with six electrified strands and a cantalier is planned to be constructed around the 30 km boundary of the sanctuary (Dufresne pers comm.). The cleared boundary cut-line has been well sited to maximize habitat variation and minimize the crossing of seasonally waterlogged vlei areas and deep gullies or dongas. The few possibly problematic dongas have been scoured and flatted to reduce erosion. The fence is to cross the periodically waterlogged and impassable cotton soils in the vlei at the narrowest point, which makes the construction of a permanent causeway logistically and financially possible. The wide open cut-line around the fence will facilitate security and maintenance of the fence. The fence is to be constructed by a reputable fence construction company with extensive experience in the Kenyan sanctuaries.

The bomas are to be built on a gap-pole style (Walker 1992), except for the adjoining walls between compartments which are to be solid to reduce potential conflict between animals in adjacent compartments. The emphasis is on simplicity yet efficiency. The bomas are to be sited on a slightly elevated site amongst trees for shade, near a water point (to which water is piped from near the camp), within 1 km of the airstrip and alongside a small koppie that would provide ideal security. Furthermore, they are within 2 km and under direct observation from the camp HQ.

Score: P.
Reservations & recommendations: Although the plans for the bomas and fences are excellent they are still to be constructed. Consideration must be given to providing water outside the sanctuary for elephants to reduce any possibility of break-ins.

g. Logistics of introducing and removing of animals.

A 2.0 km long gravel airstrip within 1 km of the sanctuary and bomas makes the airlifting of animals into and out of the sanctuary logistically easy. Besides the single large hill within the sanctuary, the terrain is relatively flat and accessible which would facilitate the possible capture of animals in the event they have to be removed.

Score: P.
Reservations & recommendations: Conditions are favourable for the introduction, recapture and removal of animals. The animals can be airlifted directly into the reserve from South Africa.

Results – biological

Biological criteria include:

a. Conservation plan recommendations and ecotype distribution.

The proposed repatriation of Addo black rhino to MGR falls within the bounds of the accepted management plan for black rhinos in Tanzania (Anon 1993). Mkomazi was designated as one of three possible areas for the establishment of the D.b. michaeli ecotype sanctuaries within Tanzania. Furthermore, the Acacia - Commiphora habitat of MGR is suitable for this ecotype. Moreover, the Addo rhino originated from such lowland type vegetation, being caught in the Kiboko area, not far from the Mkomazi-Tsavo complex.

Score: P+.
Reservations & recommendations: Meets the Tanzanian black rhino conservation plans requirements.

b. Soil and vegetation descriptions, and the influence of past management practices.

The volcanic origin of most of the surface rock in the area has resulted in soils relatively rich in nutrients (Harris 1972). The 400 m altitudinal variation within the sanctuary provides a variation in soil types - typical of a catena - ranging from red (aridisols), through brown (colluvial) to black (alluvial) soils. The red to reddish brown, lighter textured and silty loams that range from the upper slopes to fairly low on the catena are the most common soils in the sanctuary. They characteristically have low organic matter contents with rapid water infiltrating properties. The relatively narrow brown to grey brown soils found at lower levels are richer in nutrients and clays. Although they have reduced water filtrating properties they do not become waterlogged nor crack extensively like the low-lying black soils. The latter soils are associated with drainageways and vleis and as a result of considerable base accumulation they have poor water penetrating properties. Although they potentially hold alot of water, the amount of water available to plants is relatively low.

Although the soils as a whole show no general mineral deficiencies, there is a gradient of improving nutrient status down the catena slope in Mkomazi (Harris 1972).

Vegetation structure and composition generally follows that of soil types (Bell 1982). Bushlands were the dominant vegetation type in the sanctuary, as it is in the MGR (Harris 1972). The presence of Hafino hill in the sanctuary provided for a diversity of soils and thus vegetation types. The upper hill slopes (> 1100 m), which make up a minor proportion (±100 ha) of the reserve, consisted of upland open grasslands - dry woodlands. Tree and shrubs included Combretum molle, C. zeyheri, Albizia harveyi, Vellozia sp., Tephrosia spp.. While grasses consisted of Panicum spp., Chloris spp. and Cyndon dactylon.

Moving down the slope to mid altitudes (800 - 1000 m), the tree layer was more dominant, becoming closed in places, with more small shrubs and herbs and less grass. Common trees and large shrubs included Acacia senegal, A. bussei, A. tortilis, A. mellifera, Dichrostachys

cinerea, Delonix elata, Boscia angustifolia, Terminalia spinosa,T. prunoides, Grewia nematopus, G. cf. microcarpa, Maerua kirkii, and Barlaria sp. Species such as Afzelia cuanzensis, Ziziphus mucronata, Balanites sp., Commiphora spp., Combretum aculeatum and Sterculia africana were found less frequently. Smaller shrubs, forbs and creepers included Heliotropium eduardii, Vigna sp., Crotalaria spp., Indigofera spp., and number of Tephrosia spp.

On the flatter ground with grey-brown red soils between ±720 - 800 m, the trees (>4 m high) were relatively scarce, with the larger shrubs (2-3 m high) being the dominant structural form. The trees consisted predominantly of Commiphora spp., A. tortillis, Albizia anthelmintica, Delonix elata, Boscia angustifolia, and B. salicifolia. The shrubs and herbs consisted of A. tortillis, A. bussei, A. mellifera, G. bicolor, G. cf. microcarpa, G. cf. forbesii, Cadaba sp., Ehretia sp., Strychnos sp., Z. mucronata, Salvadora persica, T. spinosa, T. prunoiodes, Sericocomopsis sp., Lantana rhodesiensis, and Indigofera spp.

On the black cotton soils (< 720 m), the trees were almost entirely absent. Shrubs (<2-3 m) were common and included G. bicolor, G. cf. microcarpa, G. cf. forbesii, A. mellifera, A. ancistroclada, A. seyal, several Tephrosia spp. and Indigofera spp., Commiphora spp., Cassia sp. and Solanum sp.

The leguminose flora, and particularly the Acacia spp., Tephrosia spp. and Indigofera spp., were relatively diverse and abundant throughout the sanctuary. They were also relatively well utilized by the resident large browsers (Table 1). Other popular browse species (that is during June) appeared to be Grewia spp, Commiphora spp., Terminalia spp., Ziziphus mucronata, and Boscia spp.

Table 1. Number of leguminous and other plant species, and the number of species with signs of ungulate browsing in the black cotton soil, low altitude (< 800 m) red-brown soils and higher altitude (> 800 m)red-brown soils.

Plant type	Black cotton soils		Low altitude red-brown soils		Higher altitude red-brown soils	
	# species	# browsed	# species	# browsed	# species	# browsed
Legumes	7	0	5	2	12	6
Others	6	2	31	12	29	12

The vegetation within the sanctuary appears to compare favourably with the bush-scrub and bush-woodlands habitats in Tsavo, as described by Goddard (1970) and Greenway (1969). The relatively wide diversity of legumes and other browse species indicates its suitability as good rhino habitat. Although, the survey was unfortunately not undertaken in the dry season, Harris (1972) did however list important black rhino dry season legume species, such as Indigofera spinosa and Tephrosia villosa, as occurring in the MGR that could potentially be used during this stressful period.

The bush thickening, particularly by A. mellifera or D. cinerea, as evident around the old kraals in the sanctuary is normally most suitable for black rhino (Goddard 1968).

Score: P.
Reservations & recommendations: The altitudinal variation provides for important habitat diversity. Leguminous flora is common throughout the reserve. Past cattle activity in combination with rainfall and fire appears to have stimulated bush-thickening in certain areas would be beneficial to black rhinos.

c. Estimated 'carrying capacity' and recommended founder population size.

A maximum density of 0.04 rhino km-2 were noted in the western areas of MGR by Harris (1972). From an aerial survey, Goddard (1969) estimated the density to range between 0.04 - 0.15 rhino km-2 within MGR. At the time of both surveys the reserve, and particularly in the eastern half, was inundated with cattle and people. This disturbance was probably an important factor restricting the rhino to the western half of the reserve. Moreover, poaching was rampant at the time which could have accounted for their relatively low densities, similar to what Goddard (1969) reported for the good habitat in the Rombo area in Tsavo West.

Water in Mkomazi was identified as an important limiting factor for the large herbivore community (Harris 1972). The reserve is characterised by a wet-season dispersal pattern by many of the migratory large herbivores, while during the dry season they retreat to permanent water supplies in Tsavo to the north or to the Dindura dam area in western Mkomazi. Areas in Tsavo with similar habitats and plant communities to that found in the proposed Mkomazi rhino sanctuary had much higher rhino densities of 0.9 animals km-2 (Goddard 1969, 1970). These higher densities were maintained through the presence of permanent water in close proximity to ideal rhino habitats. Given that these were open free-ranging communities, densities within a confined area would therefore be lower. For this reason the estimated carrying capacity (ECC) of Ngulia sanctuary within Tsavo West was lowered to 0.75 rhino km-2 from the free-ranging density of 1 rhino km-2 (Foose, Lacy, Brett & Seal 1992). The proposed 75 % of ECC equates with the estimated maximum productivity carrying capacity (EMPCC) as suggested by Emslie (1993).

As the vegetation of Mkomazi and Ngulia sanctuaries are considered to be similar (Brett pers comm.), their EMPCC's should therefore be comparable. However, erring on the conservative side, it is proposed that the EMPCC for Mkomazi should be about 60 % of Ngulia's EEC, giving a recommended density of 0.45 rhinos km-2. This is comparable with that proposed for the higher rainfall Aberdares sanctuary, and the Aber-Salient area (Foose, Lacy, Brett & Seal 1992). Accordingly, this equates to an EMPCC of ± 20 animals in the 45 km-2 Mkomazi sanctuary. However, as populations of < 30 animals were expected to have a reduced probability of surviving 200 years from computer simulations (Foose, Lacy, Brett & Seal 1992), consideration should be given at a later stage of possibly increasing the Mkomazi sanctuary to accommodate around 40 animals. At the recommended stocking rate, the sanctuary would need to be expanded to approximately 90 km-2. This larger size would also grant the animals potentially a greater diversity of habitats to survive the rigours of drought conditions and the effects of possible fires.

The primary goal of rhino conservation should be to maximize the breeding potential of its populations. Population growth is potentially constrained at the upper limit by ecological

factors (EMPCC), while at the lower limit it is affected by the founder population size and its associated demographic and genetic (inbreeding depression) problems, and its greater susceptibility to stochastic (droughts, disease) catastrophes. Thus, minimum founder populations (mFP) should consist of at least 10 animals, but preferably between 16 - 20 (Foose, Lacy, Brett & Seal 1992). Furthermore, so as not to negatively affect the breeding potential of the population the maximum founder populations (MFP) should not exceed 50% of the EMPCC (Emslie 1993). Thus, in the case Mkomazi the MFP should not exceed 10 animals.

As the founder population of Addo arose from four adults (Hall-Martin & Penzhorn 1977), less than the recommended minimum of 10 individuals necessary to reduce a rapid loss of genetic heterozygosity (Foose, Lacy, Brett & Seal 1992), it may be worth while considering obtaining an extra three or four animals from elsewhere for incorporation into the Mkomazi population.

It should be stressed that the EMPCC figure must not be taken for more than an estimate. The actual value constantly changes given the unpredictable factors such as climate, fire, disease etc. Thus the vegetation and demography of the rhino population should be constantly monitored to track their impact on the environment, and the population's response to these changes.

Score: P.
Reservations & recommendations: The recommended EMPCC density for the sanctuary is 0.45 rhinos km-2 or a total of 20 animals. The recommended number of founders should be about 10 animals. Consideration for obtaining 3 - 4 extra animals over and above the Addo animals should be considered. The rhino population's performance, body conditions, behaviour and impact on the vegetation should be constantly monitored to reassess the recommended EMPCC.

g. Veterinary considerations.

Disease is not an important factor in rhino mortality in southern (Emslie 1993) or East Africa (Foose, Lacy, Brett & Seal 1992). Deaths resulting from starvation and from complications associated with translocation are more common.

Trypanosomiasis (known as 'trips'), caused by Trypanosoma vivax and T. brucei, is endemic in black rhinos in East Africa and is the only disease of potential concern. During the early translocations of rhinos in East Africa, trips accounted for 8.5 % of rhino mortalities (McCulloch & Achard 1969). However, recent translocations of animals from 'non-trips' to 'trips' areas have been very successful as the animals were maintained in good body condition throughout their captive period (Brett pers comm.). As biting flies, such as the tsetse fly Glossina pallidipes which act as the vector for the Trypanosoma organism, can potentially be a problem for rhinos (Parsons & Sheldrick 1964), the fly populations should be kept in check around the bomas, thus reducing the chance of this disease occurring.

Although rhinos have succumbed to anthrax it is not considered an important factor.

Score: P.
Reservations & recommendations: The nutrition, comfort and hygiene of the bomaed animals must be closely monitored to reduce the chances of a disease out-break. The sighting of the bomas is of crucial importance with respect to water supply, access, shade, breeze, drainage, security and release position.

h. Availability of water and effect of fire.

Although rhinos can go without drinking for 4 - 5 days, they are still dependent upon surface drinking water (Owen-Smith 1988). The limited and isolated supplies of permanent water points, particularly in the dry seasons, is a major factor influencing the herbivore biomass and movement patterns in MGR (Harris 1972).

As neither natural permanent water holes nor viable boreholes exist (as of yet) within the sanctuary, water has to be piped into the reserve from a combination of natural fountains, storage dams, and boreholes situated at the base of Kisiwani Mountain, just outside the reserve (Fitzjohn pers comm.). Logistic problems, at this stage would restrict the water to the larger southern side of the sanctuary but attention should be given to providing it on the northern side. Provision should also be made for water outside the sanctuary, preferably a distance from the sanctuary fence, to reduce any chances of elephants breaking in.

Fire is an important component of the Mkomazi system, maintaining the balance between bushed and wooded grasslands (Harris 1972). This has however been upset in the recent past as fire was extensively used by the Wakawave, Wapare and Maasai cattle herders as a management tool to stimulate grass growth in lean periods. With the removal of the cattle herders, and limited game populations in the reserve, there is the possibility of a build up of excessive plant biomass which could result in extensive hot fires. These could be dangerous to the animals in the confined sanctuary situation but of advantage with respect to top burning the larger Acacias and creating more scub ideal for black rhino. Therefore in addition to a perpheral fire-break, there should be some internal ones to prevent the whole sanctuary burning down.

Score: P-.
Reservations & recommendations: Extra water supplies should be provided, if possible, through constructing catchment dams at the base of the Hafino hill. Failing that water should be piped from the present reserves to the northern side of the sanctuary.

The construction of internal fire-breaks should prevent the entire sanctuary burning down.

Conclusions

The majority of criteria discussed above were allocated a standard to good rating. The only factor around which a little anxiety existed was the availability of sufficient and well distributed water supplies. Using the subjective scoring system employed in the habitat evaluation workshop in Foose, Lacy, Brett & Seal (1992), the habitat within the Mkomazi sanctuary scored a total of 36 points, comparable with that of Lewa Downs, Nakuru, Ol Jogi

and Aberdares-Salient. This should be viewed with caution given that such scoring techniques are always open to question.

Given the above environmental, ecological and socio-political facts surrounding Mkomazi and the proposals concerning the establishment of a rhino sanctuary, it is our opinion that Mkomazi Game Reserve offers an acceptable setting for establishing such a sanctuary. However, attention should be given to addressing the long-term security in the form of government support for the reserve and sanctuary once established. If maximizing the long-term productivity of rhinos is the ultimate goal of this sanctuary and other such schemes in Tanzania, the EEPCC of 20 animals in Mkomazi is slightly on the small side and should ideally be increased to hold a minimum of 40 animals. This would entail increasing the sanctuary to around 80 km2. This expansion is not of immediate concern but in the event that it is considered, it would offer the ideal opportunity to introduce extra animals from outside the Addo population. Although the Mkomazi sanctuary offers promise, this report does not necessarily detract from the appropriateness of other areas. Rather, in the event the sanctaury materialises it should ideally become one of a number such sanctuaries so as to get the Tanzanian rhino conservation programme back on track.

Acknowledgements and references

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