Project Update: June 2009

The projects aims are threefold (progress in achieving each aim is documented below):

(1) To test the utility of a new rapid field-based pregnancy assay for monitoring the reproductive performance of large free-ranging populations of rhinoceros.

We successfully installed horn-implant transmitters into 7 adult female black rhinos in October/ November 2008, 3 less than originally envisaged. Ezemvelo KZN Wildlife (EKZNW) Game Capture were forced to quick release 2 females before we could insert radio-transmitters due to unforeseen complications during sedation. Nevertheless, the 7 new adult female black rhinos, together with the 7 females installed with radio-transmitters during 2007/08, means that we now have a cohort of 14, only 3 less than the 17 we initially envisaged.

During horn-implant installation we collected a single blood sample and rectal fecal sample from each of the 7 adult female black rhinos. In addition, we were able to collect blood and rectal fecal samples from the 2 quick released adult females and give us a total of 16 blood and rectal fecal samples (including the 7 samples collected in 2007-08).

Roan D. Plotz and a Zulu tracker, Mr. Bom Ndwandwe, continue to monitor all 14 adult females using radio-telemetry. They have already collected almost a hundred fecal samples, at approximately monthly intervals over 12-months, for 7 adult female black rhino and are actively monitoring and collecting samples for the remaining 7. We have also collected 10 fecal samples from fortuitously sighted female black rhinos associating with our radio-transmittered females and will continue to obtain additional fecal samples in this way in order to increase overall sample size.

We have adapted methods from MacDonald *et al.* (2008) for black rhino fecal pregnancy analysis to our field setting. Part of these adaptations included us securing the use of a well-ventilated cabin at Hluhluwe-iMfolozi Park (HiP) Research Center, Hilltop, complete with refrigerator, to serve as a semi-sterile laboratory space to conduct our fecal pregnancy tests. All necessary equipment has been purchased and set up in the cabin in preparation for pregnancy analysis. As outlined in MacDonald *et al.* (2008), all already collected fecal samples have been stored in 8 oz. closable plastic containers, correctly labeled and frozen. We have extracted 6 hormone controls from black rhino fecal samples of known pregnancy status (via blood test) that will be used as our pregnancy indicators (MacDonald *et al.* 2008). We have recently analyzed 80 fecal samples, however results from our first attempt were inconclusive and we were able to trace the problem back to the incorrect mixing of chemicals. Hence, the next step is to remix necessary chemicals and then re-analyze all of the fecal samples we have collected thus far. We plan to have all 16 blood samples analyzed for pregnancy independently by a local veterinary clinic and will use these results to determine the accuracy of free-ranging black rhino fecal pregnancy analysis.

Our final step will be the compilation of a detailed report for HiP management that will outline the utility of this pregnancy detecting technique once all samples are collected, correctly analysed and the accuracy of pregnancy analysis is established by comparisons with the blood samples (post July 2009). We have reached a local audience by publishing an article in *Aardvark*, the newsletter of the Zoological Society of Southern Africa, in order to highlight our project and the potential benefits of black rhino fecal pregnancy analysis (See Plotz *et al.* 2008 - Appendix I).

(2) To train local Zulu field-rangers and management to incorporate pregnancy testing into long-term monitoring of the strategic Hluhluwe-iMfolozi donor population of black rhinoceros.

We have trained a Zulu field ranger, Mr. Bom Ndwandwe in the procedures for correct collection and storing of black rhino fecal samples. We are currently organizing a time with HiP management where we can demonstrate the procedures of pregnancy analysis in our field lab. We have already written a black rhino fecal collection protocol (sent to the former Head Regional Ecologist of HiP, Ms. Sue Van Rensburg) to aid HiP field rangers in the collection and storage of black rhino fecal samples. After we have collected and analysed all fecal samples and demonstrated to HiP management how to conduct pregnancy assays, we will write a training and protocol manual that HiP management may use to incorporate as part of an ongoing monitoring technique for black rhino in HiP. We have also contributed 30+ closable plastic containers to the three Section Rangers in iMfolozi Game Reserve in an attempt to facilitate fecal collection by field rangers over a wider area. Extra glass jars for pregnancy analysis have been contributed and once we complete our project in HiP we will contribute necessary equipment for pregnancy analysis. Reports and peer-reviewed manuscripts will follow after completion of training manuals.

(3) Determine whether the poor breeding performance of the HiP population is attributable most to poor conception rates, pregnancy termination, or depredation of young calves.

After we have completed the analysis of all of our 100+ fecal samples (Aim1), we will and are in the process of collating the results to determine the pregnancy rates and pre-natal calf losses of our 14 female black rhinos. RDP and Mr. Bom Ndwandwe have thus far successfully followed 4 out of 6 females through to the birth of their subsequent calf (Table 1: only 6 females as 1 was a sub-adult not yet or only near breeding age), which suggests that prenatal calf survival may not be severely limiting population performance. In addition, we will continue to monitor the 7 new female black rhinos as long as possible to obtain fecal samples for pregnancy analysis and follow calf survival and any subsequent new calf births. We will marry our results from prenatal pregnancy analysis with observations of postnatal calf survival rates to ascertain which life stage may be limiting population performance in HiP.

One of the most startling findings of our monitoring efforts thus far is the first documented incident of a black rhino calf that succumbed to wounds after an attempted lion predation incident The calf's wounds were consistent with an attack by at least 2 lions, and included recent tissue trauma to the ano-gential region, tail amputation to a third of its original length, claw marks to the rump and right posterior flank and two puncture wounds to the right neck region (Plotz & Linklater, *in press*). After sighting the severely injured calf with its mother, we increased our monitoring efforts in the surrounding area and managed to resight the calf's mother alone at 13 days and on three subsequent occasions post incident, thereby confirming the maternally dependent calf's death. This observation not only resolves the debate as to whether calf predation occurs, it is also the first direct link between tail amputation and calf predation and suggests that the numerous reported incidents of black rhino throughout Africa with tail and ear amputations, that is observed in 7.1% of some populations, as failed predation attempts. Moreover, preliminary analysis of data we have collected on predator densities in Masinda and Nqumeni Sections of HiP, indicate that the area in which the calf was attacked by lions, the Nqumeni area, has some of the highest densities of lion in HiP. Research from Tanzania shows that where high lion densities in Africa occur, black rhino calf recruitment can be severely limited (Amiyo *et al.* 2003). Hence, in an effort to highlight the importance of this incident and its potential implications for conservation management we have communicated our findings (with clear photographs) as a submitted manuscript and which has been recently accepted by the Journal of African Zoology (Plotz and Linklater, *in press*).

We have regularly measured the body condition of all 14 females over a 6 to 15-month period using Reuter and Adcock's (1998) body condition scoring system and continue to score the condition of the 7 new females in 2009. In addition, other than our cohort of females and calves, we have sighted and recorded the body condition of more than 60 identifiable male and female black rhino in Masinda, Nqumeni and Mbhuzane sections of HiP. This equates to 45% of all known black rhino in these sections and 27% of the entire known HiP black rhino population of 270. Preliminary results of body condition scores are appearing to suggest that resource limitation may not be significantly impacting on their condition and will help, we hope, resolve the debate about how best to explain and manage the poor performance of source populations.

We have to date collected over 240 GPS locations from our 14 radio-transmittered females in the Masinda and Nqumeni sections. Our team has also collected an additional 100+ GPS locations of black rhino in the Mbhuzane section (n=10). From these locations we have preliminary calculations of mean annual home range size of 7.20 km^2 in the Mbhuzane Section of HiP (n=10). These average home range sizes are 3-4 times smaller than the average annual home range size of 23 km^2 recently published by Reid et al. 2007 (Plotz., 2008; Plotz & Linklater. 2008, Appendix II, Plotz, 2009). Based on the fact that home range size has been used as a proxy for range condition, where larger home ranges indicate poor resource conditions, Reid *et al.* (2007) conclude that range condition is deteriorating and carrying capacity is reduced for black rhinoceros in HiP. Our measures confirm that Reid *et al.* (2007) estimates are probably inflated as they base their findings on a small number of locations recorded over ten years (i.e. 1-3 sightings per year by patrol guards) but then compare their estimates to historical studies with sighting frequencies over shorter periods. Hence, based on our analyzes of HiP home range sizes we will advocate that historical home range estimates for black rhino cannot be used to infer habitat deterioration (Linklater *et al.* submitted), especially as our recent findings show that there is no evidence of deteriorating range condition based on our home range sizes Plotz & Linklater, 2008, Appendix II; Plotz, 2009).

We have recorded over 180 browse abundance surveys for 10 of our adult females every time we sighted them, and this will help to determine what is preferred black rhino browse. We have also just completed 125-vegetation sampling points along transect lines over a 142 km^2 area in HiP. The information from this vegetation sampling will allow us to determine the abundance of preferred black rhino browse in an area that is one ninth of the entire Park (142 km^2 out of 960 km^2).

In summary, the large number of body scores, home range locations and vegetation surveys that we have collected will allow us to determine whether HiP's black rhino are resource limited. We will use all findings to write a report and additional manuscripts that outline what may be limiting this and other populations of black rhino.

Overall, most objectives are progressing as expected even though we are experiencing some delays in analyzing the over a hundred fecal samples. These delays are largely due to the time constraints of having to conduct ongoing field monitoring of our 14 radio-transmittered rhinos in order to meet all of our aims, but as field monitoring intensity decreases during 2009, we expect fecal analysis to gain momentum.

Project Impact

The project is targeted at testing the utility of a new rapid field-based pregnancy test to better monitor and manages black rhino. We have collected over a hundred fecal samples and our trial analysis of these samples has already highlighted some of the potential difficulties in conducting pregnancy assays in a field setting (e.g., incorrect mixing of chemicals). However, we will continue to collect and analyze all our samples to determine the utility of this technique for monitoring and managing black rhino. Our project is currently making a big impact in understanding what might be the limiting factors for poor population performance in HiP's black rhino population. The fact that we documented the first incident of calf predation by lion and together with our home range analysis which shows home range sizes significantly smaller than previously believed means we are already having a significant impact on managements understanding of the performance of HiP's black rhino population. Still longer term, once we have completed all pregnancy assays and analyzed all of our monitoring data, we will contribute knowledge that will help management better manage black rhino in HiP and elsewhere. We are at every opportunity informing relevant management groups about our findings and have attended a local symposium and rhino management group meetings (Plotz. 2008; Plotz & Linklater. 2008, Appendix III). The Rufford Small Grants has made an invaluable contribution to the impact that this project is having on assessing black rhino reproductive performance and we have acknowledged this in two submitted manuscripts thus far (Plotz *et al*., 2008; Plotz & Linklater, *in press*) and three oral presentations (Plotz, 2008; Plotz & Linklater, 2008; Plotz, 2009).

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APPENDIX I

Plotz, R., Linklater, W.L. & Kerley, G. (2008). The reproductive performance and ecology of black rhinoceros. *Aardvark* 20 (April): pp 3-4.
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The reproductive performance and ecology of black rhinoceros

Roan Plotz returned to Hluhluwe-iMfolozi Park (HiP) recently to begin a second field season investigating the causes of apparently poor breeding performance amongst the Park's black rhinoceros (*Diceros bicornis*) population. HiP is a strategically important population because it serves as a major source of individuals for ongoing meta-population management and range expansion and so maintaining or improving calving and survival rates is important to the recovery of this critically endangered species. Concerns have been raised that apparently long inter-calving intervals, increases in home range size, and a decline in population size might indicate deteriorating breeding rates. The reasons for poor breeding performance are not well understood but might be attributed to predation of young calves, particularly by spotted hyena and lion, or poor resource conditions for females such that pregnancy rates are poor.

We began Roan's study last year by installing horn-implant transmitters in 7 adult female rhinos with the help of Ezemvelo KwaZulu-Natal Wildlife's Game Capture unit, and hope to install up to 13 more this year. Using radio telemetry, Roan is able to make frequent observations of each female to track her reproductive state, body condition, habitat use and quality, and interaction with other rhino. The ability to monitor the reproductive status of rhino in the field has been enhanced by the development of a rapid, inexpensive, and non-technical colour-change pregnancy test that uses dung, just like the modern human colour-change pregnancy test uses urine. The combination of radio telemetry and pregnancy testing technologies mean that regular samples of fresh dung can be used to measure pregnancy, pregnancy loss, and calving rates across the population and between seasons for the same females.

If pregnancy rates are poor and there is evidence for pregnancy loss, and these correspond to poor maternal body and range condition, then the population's breeding performance is probably resource limited. However, if pregnancy rates are high but there is significant calf loss that is unrelated to maternal condition and home range quality, then the evidence implicates other factors, perhaps predation, as limiting breeding performance. Whatever the result the outcome will assist in better managing the population because there is uncertainty about whether greater removals of black rhinoceros for translocation to other reserves will improve performance by reducing density. Field work for this study will be completed before the middle of 2009.

Roan Plotz: Ph.D. candidate in the Centre for Biodiversity and Restoration Biology at Victoria University of Wellington and advised by Wayne Linklater and Graham Kerley. Roan's work is currently supported by the US Fish & Wildlife Service, Rufford Small Grants, Australian Geographic Society, and Enkosini Conservation Trust.

Wayne Linklater: Centre for Biodiversity and Restoration Ecology, Victoria University of Wellington, New Zealand.

Graham Kerley: Centre for African Conservation Ecology, Nelson Mandela Metropolitan University, South Africa.
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APPENDIX II

Plotz, R.D. & Linklater, W.L. (2008). *Are black rhinoceros Diceros bicornis home range sizes in Hluhluwe-iMfolozi Park increasing in response to deteriorating range condition?* Ezemvelo KwaZulu-Natal Wildlife Conservation Symposium (Conservation in Practice), 25th to 27th November 2008. Queen Elizabeth Park, Pietermaritzburg, KwaZulu-Natal, South Africa.

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SYMPOSIUM ABSTRACT:

Are black rhinoceros *Diceros bicornis* home range sizes in Hluhluwe-iMfolozi Park increasing in response to deteriorating range conditions?

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Home range size in black rhinoceros is used as a proxy for range condition and to detect deterioration of ranges through time. Since Hluhluwe-iMfolozi Park (HiP) serves as a strategic source population for black rhinoceros range expansion, an accurate estimate of home range size is critical for management of the species. Reid *et al*. (2007) report a mean home range size of 23.07 km^2 for HiP, 54% larger than historical estimates (Emslie, 1999). Based on their findings they conclude deteriorating range condition and reduced carrying capacity for black rhinoceros in HiP. Unfortunately, Reid *et al*. (2007) estimates are based on a small number of locations recorded over ten years meaning their estimates may be inflated. Home ranges calculated using data gathered over 10 years where the sighting rate is extremely low (i.e. 1-3 sightings per year) but then compared to estimates over shorter periods with higher sighting frequencies (Emslie 1999) will inevitably lead to different sized home ranges. Lent and Fike (2003) have warned about the dangers of comparing black rhinoceros home range estimates using different sighting rates over varying periods of time and appropriately advocate for annual home ranges for inter-study comparison. We present preliminary data on a cohort of black rhinoceros (n = 10) with VHF radio transmitters that were regularly located in random stratified fashion to estimate annual home range size in HiP. Our findings from years 2004 – 2007 show annual mean home range sizes of 6.40 km^2, which are 72% smaller than the 23.07 km^2 estimates of Reid *et al*. (2007). Therefore, based on our findings, there is no evidence for deteriorating range condition.