

NORMAL PHYSIOLOGICAL PARAMETERS
AND MORBIDITY AND MORTALITY ASSOCIATED WITH CAPTURE, TRANSLOCATION
AND LONG-TERM HOLDING OF FREE-RANGING BLACK RHINOCEROS

Mike Kock and Pete Morkel

TAPE 3A 007

Kock: We are not going to talk very much about physiological data. If things are normal, they are normal. The data is in the literature. I know that their normals are being established in this country as well. I think there are far more important things, including management, that we would like to present to you. You are probably wondering why I put this picture up of elephant. Most of you have not visited Zimbabwe--you must come visit. We might not be able to show you any rhino, but we can certainly show you some elephants. After the rhino, I think the elephant is going to be the next creature. I think we have lost 52 elephants in a six week period this year from poachers, so much for *the CITES ban*.

I want to fill you in on some historical information on black rhino. Pete [Morkel] is going to jump in as he sees fit to correct me and keep me honest. Just to remind you that we are talking about free-living black rhino in a country where the decline had been *amazing*, in fact dramatic. When we started our dehorning operations a couple years ago... In fact, last year in January we thought we had about 2,000 black rhino. We have probably about 250 black rhino now. Of course, the reason for this decline is illegal hunting. I think that the one thing we are aware of more and more now with the decline is the need for us to have a rapport with people in *ex situ* situations. It is vital, because our need is becoming much greater now for intensive management. And I think that sharing of knowledge and information and some of the problems we are having now are very similar to some of the problems you are seeing in the captive situation.

Of course the demand for rhino horn is still there, despite the CITES ban. We just found out this last Monday that despite dehorning, the poachers are getting approximately \$250 US dollars for a horn stump. And if they manage to find a rhino with a large horn they might get something like \$10,000 US dollars. I am not sure if that sounds very high, but the demand is still there for horn.

In Zimbabwe we have a natural background in conservation strategy which we have been trying to implement and maintain for the last few years, and in many cases, not very well. Just to remind you, the most important thing for conserving black rhino, as far as we are concerned, is *in situ* protection. And that in Zimbabwe includes protection on Parks and Wildlife estate land, which we are doing dismally, and protection in the conservancies in which Raoul [du Toit] is very much involved in. So far, we do far better in the conservancies than we are doing on national parks land.

Objective two is capture and translocation. We will go into some of the methods, because I know some of you are not very familiar with the way we operate and how we catch rhino and some of the work

we are doing. I think it is very important that we show you, because I think there is a lot of key information that might help us in unraveling some of the mysteries of diseases of rhino.

Objective three is *in situ* captive management. This is our support for places like White Oak with black rhino gathered from Zimbabwe. In fact, it is nice to see that animal in such good shape. Of course, rhino in Australia as well. And this is something that will continue. In fact, I was thinking last night that the female that is out in the paddock here [at White Oak] would be dead today if it was not kept. The *Chewore* Safari Area where these rhino all came from, there is no rhino left now, *there was approximately 150 or so*. It is devoid of rhino now, which is pretty bad. We do have some programs in Zimbabwe for doing some *in situ* captive breeding. *Ex situ* is of course what I just mentioned.

Just some historical information... I think as Raoul [du Toit] emphasized yesterday, and I think it is something that we are becoming more and more aware of, is monitoring of rhino. If we go back and look at some of the historical aspects of rhino translocation in Zimbabwe, the documentation and monitoring has actually been very very poor. It is far better now for example at the conservancies, and we find it true at Parks and Wildlife stations. Raoul [du Toit] has been floating photo ID files around and case histories, so we know everything about each rhino.

To give you an example of some of the historical information that really worries us... In Hwange National Park for example, we did dehorning. We accrued about 146 helicopter hours in this national park here last year dehorning. We based ourselves at a pan called 051 pan where in 1984 or 1986, approximately 45 black rhino were translocated from the Zambezi Valley. Now all of these animals would have had ear notches and in some instances ear tags. In that time we worked in the area, we found two rhino that had evidence that they might have been from the Zambezi Valley population. My big question was where were the 40+ animals? There is no doubt there were probably some old animals that had had some mortality, but there is no doubt in my mind that there probably was a high mortality rate that was not documented. I think as we have looked over the years now, we have a black rhino mortality rate that is unacceptably high for long-term survival of the black rhino. This why this sort of workshop I think is vital to try and find some clues. We have ideas, but we really do not have the answers.

The one thing that has happened in the last couple of years, is this crisis management program of dehorning. I think that the one thing that it has enabled us to do particularly with chemical immobilization methods, is we have been able to refine them. We have done well over 300 black rhinos in the last two years and probably 160 white rhino. We have modified drug dosages and I will go through some of the techniques.

This rhino horn, when we got it off, the front horn weighed eight kilograms. So the black market price is about \$2,000 US dollars. That black rhino is dead now from poaching.

As far as rhino capture, I am going to briefly go through some of the techniques. Most of the capture is done by using a fixed-wing [aircraft] and helicopter. We have trackers on the ground. It is much

more efficient. You can catch rhino by darting them on the ground, but it is a lot more work. The darting is done from the helicopter, it does not always work, sometimes it is difficult.

The one thing when we got involved with the black rhino in 1988 to 1989... Basically, we needed to identify some area where as veterinarians we were able to influence the management of rhino. And I think it was crucial. It is like Raoul [du Toit] mentioned yesterday, we call it "adaptive management," a term we are using more and more now. Adaptive management is a goal oriented philosophy. In other words, you set yourself up some goals; it is almost like an experiment, then at the end you look at it and see whether it has worked. It is something you have to do when you cannot carry out a laboratory experiment under controlled conditions.

So I mentioned we looked at the management of the rhino and consulted with colleagues like Pete Morkel. And we decided that the area we could influence was first of all, the chemical immobilization. We could take chemical immobilization methods, evaluate them and improve them. We can talk a little bit about that.

When we first got involved with chemical immobilization in 1988, for a variety of reasons individuals who were involved in game capture then were not veterinarians, but they were very competent and they were actually pioneers in what they did. We were talking about extended down times following the stress from immobilization, and so we decided to try and improve this. You can see from 1988 through 1990 to 1991, the induction time, in other words, the down time, we improved it dramatically. We average an induction time of between three and four minutes now with our black rhino. And we are talking about an animal that goes down 500 meters of darting them and there is no doubt of the reduction of stress and a better animal. This is a picture of a rhino actually in Pete's [Morkel] neck of the woods, in Namibia being immobilized. Obviously, with immobilization in a free-ranging situation, it is a lot more difficult because of the type of terrain the rhinos live in, it is very rugged country.

Just to give you an idea of some of the ways we assessed whether our immobilizations were less stressful is done with some of the parameters. I was actually quite surprised. As you know, LDH [(lactic dehydrogenase)] is a muscle enzyme. It is not specifically muscle. You can see with the different combinations, we used etorphine, M99. This is our product from xylazine. We then introduced Hyalase, which is hyaluronidase, which increased absorption time. You can see between 1990 to 1991, we see a reduction in muscle enzymes, which indicates obviously there is less exertion.

R. Kock: Why is there a difference? Is 1991 a good year?

M. Kock: No, I think the explanation for this improvement is experience. Improved technique, I suspect. We improved it from here because we introduced new drug combinations. The only way I can explain this improvement, even in induction time, is that we got better at it. Better dart placement, better team work.

Blyde: What were the number of animals that...

M. Kock: I think this is about 14 and 20.

Blumer: Is there a decrease in 104? You increased your M99 dose a bit...

M. Kock: Yes, and what we did, and I think this is something that Pete [Morkel] might mention... The old pioneers who evolved in rhino capture in Zimbabwe are very scared about using high doses of narcotic drugs. My philosophy and Pete's [Morkel] philosophy is that high doses are better because you got better knock down time. In fact, people like Ed 108 were using about 1.75 mg of etorphine. We use up to 4.0 mg with much better knockdown time. When Pete [Morkel] was doing a lot of immobilizations, he was using Azaperone; and I believed that M99/xylazine *produced a good* knockdown time. Pete [Morkel] started using xylazine and Pete, you reckon one minute was knocked off down time?

Morkel: Sure.

M. Kock: Just by using xylazine. Why it is, obviously we do not really know. And then the addition of Hyalase, there is no doubt that Hyalase has made a difference. So basically, you have got a much less stressed animal. I think that is very important, because at least we know that in that phase of management of rhino we are doing our best to reduce stress. And hopefully, that would affect long-term survival.

The other thing our immobilizations have enabled us to do with dehorning, is we have immobilized over a dozen young calves with their mothers for dehorning. Under a field situation where you have got predators and very rough country, it is actually quite a challenge to immobilize these animals. What we do... The other thing we have been using particularly with these 121 combinations, is using Naltrexone to reverse it. We reverse the calf about 20 seconds ahead of the mother. The calf wakes up, and the mother is still lying there, so the calf does not get upset and run off, it stays next to mom. Then mom stands up and 122. You have to be very careful. You do not want to be close to that animal when that young calf wakes up, because when it wakes up, it is a bit disoriented and it thinks you are its mother and it comes after you. And its mother stands up, and you have got a problem! This is an example. Just about a month ago, we immobilized both these animals again to put a radio collar on the mother. The nice thing about that was that this calf here was twice the size as here. It actually survived its mother being dehorned.

This sort of information of course is really valuable for us, but also for sharing our knowledge with people working in the captive situation. In fact, having people from the west who are interested in rhino coming out to Zimbabwe and assisting us, and not only carrying out some of their own research projects, but also seeing some of the techniques we have.

So basically we have just looked at immobilization, and I have given you an idea of some of the things we did to improve immobilization. I think one of the most 132 things for me after we did this was for one of the scouts to come up and said it was a real pleasure to work with us with rhino, because they did not have to chase rhino all day and get bruised from roping them. We would knock them down quickly and we worked good together.

Now, the other area that we looked at where we could improve management of rhinos is boma confinement. What that basically means is when we catch the rhinos, and we are going to translocate them, we transport them either in crates or a sled in lateral recumbency. In Namibia they do it by crate, in Zimbabwe we sled mostly, although we do a lot more crating lately. So boma management was a crucial area where there were definitely problems. The way we looked at it was short-term boma management and then we looked at long-term, and then long-term survival. And some of the problems that occurred with boma management were: design of the bomas, trauma in the bomas with the rhino, and also general management, general animal husbandry, which basically means feeding and caring for those animals. The other thing I think was crucial is how long animals stay in bomas. When I first got involved with rhino with Raoul du Toit, we were talking about individuals catching these rhinos and moving them two days after their deport, and we had mortalities associated with that. What we looked at was improved boma design, that is something we worked on. I will show you some of our latest bomas. Improved nutrition, I think this is an absolute key. And hopefully after this workshop we will collaborate on it, I think we are having more talks on that tomorrow. As Raoul [du Toit] said and as Pete [Morkel] will say as well, I think nutrition will turn out to be a key. We have modified that as much as we can. I think with some individuals here who are experts in nutrition and the formulation of better cube formulations, I think is absolutely essential.

The other thing that is a major constraint I think for the rhino involved with boma confinement is trauma, fighting between bomas with rhinos knocking horns off. And there is no doubt that horn loss is a risk factor for mortality long-term. So how do we prevent that? Well, now we are dehorning most rhinos, so that is taking care of that. We did start clipping horns. And I think what we have done is, we have started using these long-acting *indurids*, these long-acting tranquilizers, these human drugs. I have a little concern, and I think this is something we need to discuss at this meeting. Some people have been asking with the red blood cell problems of the rhino, whether some of these tranquilizers might possibly be contributing to some of the problems. Looking at the literature, I do not see anything to indicate that. This Clopixol-Acuphase is a pretty innocuous drug, it lasts for three days. But, I think it is something that we should think about. There is no doubt that these long-acting tranquilizers have been a major major breakthrough. Not only in the wildlife industry, from a different point of view in southern Africa, but particularly in quieting these animals down. What we do is we catch them and we most often give them Clopixol-Acuphase which lasts three days, and it is amazing how quiet the animals are. It has made a big difference

R. Kock: Mike, can we maybe stop a few minutes to discuss this? Has anybody with captive zoo animals done any detailed stuff on these chaps on these drugs? I ask that really because I have been using the dose that Mike [Kock] suggests and Pete [Morkel] and so on. I am not convinced it is enough to produce a dramatic effect. You see, because it depends on the individual, some are quieter than others anyway. We have had animals which were naturally very very aggressive and these drugs did not seem to

make a whole lot of difference, particularly in the 174 phase the first day. So, I think what is needed is some detailed substance controlled studies. To see at what doses and so on you do get a response in activity.

Jessup: Some of those drugs are not available in the United States, there are only a few people who can have them. I do not know whether there is any real numbers.

R. Kock: It would be very helpful.

Blumer: In this country the only thing that is available is haldoperidol, which is the shortest acting of all of them. There is only a few of us who are using them, and I have not had to use them at all on rhinos. I know that in terms of all the other hoofstock, the dosages that I have from the folks in southern Africa are right on. It has just dramatically improved our ability to manage zebras, and some of the more aggressive and flighty antelope. But really, pretty much by the time the rhinos get here they are settled down enough that we do not have to use them. There is just one thing, there are some, when we get on to these hepatopathies... There are some references in the literature about some neuroleptics, and none of these are mentioned, but it is US literature and these are not US drugs, that relates some hepatopathies to chronic use of these drugs. These are basically human antipsychotic drugs and so 190 were long-term.

Jessup: 191: Although *Prothethazine* has been used for a number of years in veterinary medicine, I do not know of any hepatopathy associated with this class of drugs, either in people or mammals. Although these particular compounds and their carriers like that have not really been extensively studied. The major drug itself has been used pretty extensively in a variety of mammal species and man.

M. Kock: I think you are quite right, we tend to be very cautious because these are long-acting tranquilizers, so that we do not overdose. I suspect we are underdosing.

Morkel: I think the important point Richard [Kock] made is that they are very individualistic and there is a lot of variation between different animals and one must manage them accordingly, must have some 199 quality to see each one's characteristics and manage them accordingly. I must admit, I am on the side of caution with these long-acting tranquilizers. I would rather at this stage make up with good management, rather than go too high with tranquilizers. I think our aim is to slowly keep on improving. Let us perhaps get people here to look at these things. But, let's not be too dependent on these long-acting tranquilizers. I think good management will take us very far.

Miller: I think a side point is that the ones that are available in the US are very limited, as Evan [Blumer] said, haldoperidol. We pretty much advise against those particular ones, because they are used in horses. *Linprone*, a *paraleptic*, has been associated with hallucinations and some crazy hyperexcitability behavior, and so we have not had access to it for years. That is not the report of haldoperidol, but we suggest that perhaps should not be used *until there is more* usage on it because *the ones* available here. We do not have the history like you have with Trilafon or some of the other 213 that work.

M. Kock: Sure, I think what Pete [Morkel] says as well, is absolutely essential, the management. We have used the 214 operation 214. We tranquilize most of the animals that were then moved to the conservancies. There is no doubt that it makes a difference. There is one young calf for example that was lost. There was some concern that we overdosed it, but I suspect we underdosed it. But, what was crucial was the management for that animal at the release site in the bomas. You have got to have experienced people there and know how to deal with situations. This little guy 219 *from an infectious* nasal bone and Nancy will probably mention it.

There is no doubt with the shipment that came to the states 220 talk to people. I remember with the ten animals that came here, I think as the plane landed in Houston we had a problem with one animal. During the entire journey to Frankfurt and across, these animals were just *sleepy*. And there is no doubt of their value, but I have a little feeling about it, whether there is a problem with wanting to tranquilize them. I think what would happen now is as Pete [Morkel] said, better management. And if you pick up an animal that is fractious, he is *going to tell you pretty often*. You go to immobilize an animal from the helicopter and the female turns around, passes and jumps at the helicopter, you know it is probably going to be a problem when you have it in the boma. So you have to use your judgment.

Hyalase, as I say, we use Hyalase routinely now. No doubt it makes a difference. We use it routinely for 228. It is simple, you just add it to your drug.

Blumer: Just one other point. I have entered into some discussions with the folks at the FDA Center for Veterinary Medicine. We are talking about an investigation with opportunities for Trilafon, especially through our friend *Dugle* providing some of these substances, particularly these newer ones. So there may be an opportunity to do that in this country and there certainly is in the UK right now.

M. Kock: OK, boma design... I think this is absolutely essential. And the more we have our backs against the wall in the free-ranging situation, then we have got to start intensively managing the animals. More importantly, it is important for us to carry out animal husbandry at a top level. These are bomas which are just being completed in 237, which is one of the parks we are *carrying as an intensive* 238. Basically, some of the design changes we have made I will go through now.

Our design in Zimbabwe is *not* that we have bomas in a row. This is actually sort of our treatment boma. Animals all flow to here, then they run down through the gates to the bomas. Some of the crucial things we have done... Basically we have increased the sizes to eight meters by eight meters; in fact, those bomas you saw were ten meters by ten meters, and I think that is essential. Before we got involved, the bomas were sometimes only five meters by five meters, quite small. We have added cube troughs, shade areas, and the other crucial thing we have done also is add *buffer* steel gates. As you can just see, this is a boma design. This is a steel gate here where the rhinos are brought in. We have got a cube trough, a water trough, and this is for uploading a rhino into a crate or pre-releasing it into the bush.

I think this is actually the key--how you manage the animals in the bomas. The one thing we introduced as well... Before, you had to clammer up the side of the boma to look in. If you fell in there you came up very very quickly! So what we did is we just built these cat walks. It just made things so much better for the guys who are feeding the rhinos, for us as veterinarians to go in there, or anyone to just evaluate the rhinos. We just walk on the cat walk. Of course the rhinos get used to you, and you can evaluate them much much easier.

The other addition was these steel gates, rather than pole gates. The pole gates you drop into two pieces of *chopped off* wood. The rhinos obviously do not like you when you drop these poles in there, and they try and knock those poles out as fast as you can get them in. So steel gates definitely were a nice improvement. And you can see. I think this is one of the rhinos in the states now and you can see him moving down the bomas to his particular boma.

Let us just talk a bit about boma management and some of the problems and things like tipping the horns, dehorning and using long-acting tranquilizers. This was a major problem when we first got involved in it. And I tell you we have almost eliminated it now. Very rarely do we have problems of this magnitude. And what that animal did, was basically in a fraction of a second, knock us out of the boma and knock his horn off completely. And what you are leaving there is an exposed germinal layer that is very vulnerable to trauma. These animals get into a situation where they are particularly aggressive, and I do not think they feel pain very much. And they can go ahead and smash this nasal bone area until they do damage. This is an example of one that unfortunately eventually died. But, we treated her 266. She just went totally bonkers and smashed her nasal bone and there was a nice big hole that went into her nasal cavity and she 268. You can see a little bit of horn regrowth there. So that is a problem as I said. Dehorning, horn tipping, and use of long-acting tranquilizers has virtually eliminated the problem of horn loss.

Now, the other thing that I think is absolutely vital, and this is something that Raoul [du Toit] is rather interested in, is that in conservancies where we are monitoring rhinos very closely, we are body scoring them. We are teaching the individuals who are custodians of those rhinos to also evaluate their body condition whenever they see them. Some of the things we have developed... We have a body score system of one to five. Basically, if an animal is four or five, we *release* 277. Between three and four, we are a little concerned. As Raoul [du Toit] said yesterday, you will find an animal's habitat is vital. Those animals that are on marginal habitats or there is a high density of rhino and the habitat can not support it, we will consistently find them close to three and sometimes below three. From a veterinarian's point of view, we like to keep the rhinos in the boma from two to three weeks. As Pete [Morkel] has said, you have a week of loss of condition; a week of adaptation; and then there is the third week if you are managing them properly, of a regaining of the condition that was lost. If the body score is around three, it is a fair condition, but we need to evaluate these rhino more carefully. I will show you some of the techniques we use. A body score of two or one is obviously something to be concerned about.

Sadler: Just quickly, can you tell us what the key factors are? Are you going to go through these?

M. Kock: Yes. This is probably a two, maybe a little below. This is a wild caught animal with a large calf. She is obviously just towards the end of the dry season, so she was under indeed a lot more stress. She actually survived, remarkably. We put her out, and I am not quite sure where she is now in the conservancies. But that is a two, and I would be very concerned about that animal, and obviously you would manage her very carefully, and do not release that animal into the bush. You pull it up and when it gets to three or three and a half, then you evaluate it. Remarkably, this animal's blood parameters are relatively normal. Its protein was low, but everything else was relatively normal. It was just basically just a nutritional problem.

Munson: Mike, what was the protein? Was this albumin or total protein, do you remember?

M. Kock: Total protein and albumin. I can not remember what they were, but they were 68 or 70, somewhere in there.

Munson: And do these guys have skin lesions?

M. Kock: Yes, they have the filarial lesions, which is under the neck.

Munson: But not the pressure points and other ones?

M. Kock: No, I have only seen one black rhino that came from the wild with ulcers or skin lesions. I think Nancy has got some examples from that animal from a couple years ago.

OK, I think this is nutritional. But what I think the thing that one has to be aware of when you catch an animal like this, it is really compromised. You talk about long-term survival and all these unknowns that contribute to the disease problems you have in rhino, these animals are probably more prone. For example, we did not give this animal long-acting tranquilizers. And then again, you have an animal like this, which is a free-ranging bull, and what score would you give that one? Six, yeah! But that animal is in pretty decent shape. Now what we are looking at... It is a young bull, so you knock off the classic bull neck, like Raoul [du Toit] showed us on the slide yesterday. But he has got a nice neck and his spine is not very prominent and points of his pelvis are pretty smooth with muscle and that. That animal is in good condition. If you have got an animal on your ranch like that and you monitor it and he stays like that, or maybe goes down to a four during the season, then you are doing all right. It is really critical that we get into this habit. I think in the captive situation also we should get into a scoring situation. I would give the White Oak black rhino a score of four and a half probably. I would not dare give it a lower score!

The other thing we tried to do that I think was a good idea, but the practicalities of dealing with it... We looked at four blood parameters, and worked out what we considered to be normal and then what we considered to be a normal number, and below that we would consider that abnormal. For example, we would look at three of these parameters. If they were all above a grade point, we would say that the animal that had a score of three or three and a half could be released. If any of these parameters were below that point, we would say even though the score was three or three and a half, we need to try and keep it for a

couple more weeks and pull it up. The blood cell count of four or greater was good, hemoglobin of 14 or greater, PCV of plus 35, total protein of over 7... It was a nice idea, I think if we had more time to do it we would, *in anticipation honestly* of immobilizing animals and getting samples, and particularly running in the bush... It is something to think of.

The other thing I think of as far as boma management [is nutrition]. I think I might just ask Pete [Morkel] just to talk about this, because he knows quite a bit about browse and stuff like that. Could you talk a bit about nutrition and nutritional management in the boma?

Morkel: I think this is probably by far, our biggest problem. We have tended to be too slack with the nutrition of the animals in the boma. Certainly as far as browse goes, I think what I did find was that we need a good diversity, we need an adequate amount, how the browse is presented is really important, and then as far as supplementation. Browse amount... We had the idea [that if] you chuck in a little browse, it will be adequate. But, if you see how they browse in the wild, they do not come to a bush and feed it up. They are very choosy, they just take a few nibbles here and there and then move on to the next bush. We have certainly found you can not give too much in the boma. Diversity is important. We found we would be happy to supply at least five or six different types of browse, a good amount of each. It is very interesting how they will take one or two species for a few days, go off those species and go for another species or another selection of species. They are very individualistic, they certainly do not all go for the same thing. How it is presented, I think that is very important. Just to fetch your browse, keep it in the sun all day and chuck it in in the evening after it is wilted, and put it in a position where they just push it around or something, is not good enough. We like to cut the browse fresh, try and feed it fresh. If you do have to try and keep it, keep it under shade, preferably moisten it.

M. Kock: I think the other thing we are finding, and I think Raoul [du Toit] is going to talk about it later on today, is these phytochemicals, the plant defense mechanisms. My concern with managing these rhinos, is when the crew goes out to cut browse for these rhinos, they are invariably cutting in stands. Historically, they tended to cut one stand day after day after day. Research has shown that we draw some from the giraffe. When the giraffe browses on acacia, within twelve meters away an acacia will increase its tannin levels I think over 100%, and it becomes unpalatable, and obviously the giraffe move on. I wonder how much the browse that we are cutting next to the browse we cut the previous day is high in tannins? I think our sort of philosophy now is that we cut one stand, then move maybe 100 meters away, and not come back to that other stand for a few days. Pete [Morkel], Raoul [du Toit], do you want to make any comments about it?

du Toit: I think it is very complicated issue you know 375 situation is. There is some skepticism about this transmission of tannins in plants and what it boils down to is 377*. It is a strong possibility, but there certainly is some skepticism on the part of some people. But, I think common sense is to do exactly as you said. Another would be to prevent doing that quite apart from the possibility of elevated tannin

action through feet *treading* on the browse 383. The other reason why browse quality within a particular species varies lead to the substrate. You know there is a lot of nutritional variation in the quality of browse according to the quality of the soil and so on it is growing on. So it makes things in terms of *volume and diversity in the diet, I can emphasize to vary your cutting sites*.

R. Kock: Mike can I just add, the *tannin* situation, we do not need to 390, our main concentration is on browse. And the 391 of timing is always more evidently clear when you get the early shoot to get the really absolute maximum nutrition from the browse. The other interesting thing is to hang the browse, rather than putting on the ground, that reduces trampling.

M. Kock: Well this was hung, but the rhinos....

R. Kock: I think browse is the key. I think in captivity too, whatever we synthesize. If browse is available, I am sure that is the best thing.

Morkel: I think it is the best thing, but then one really must be very careful about how much you give, the diversity, etc. I think people have been generally much too slack in the past. We cut one species, we leave it the whole day in the sun, and we put it in and think it is just as well. That is just not good enough.

M. Kock: You know, I think that this is an absolute key, because just like Eric Miller quoted Rick [Kock] yesterday, that white rhino are grazers and we give them grass, and black rhino are browser and we give them grass. I think, not being a nutritionist, but definitely this is a key. Now, what we do in Zimbabwe is we realize that browse is vital. I think one of our mistakes in the past is keeping rhinos in areas where there is definitely no live browse. I think cubes are very important. These rhino get on with their cubes, if they like it they eat eight kilograms a day. I definitely think it helps their body condition.

Blumer: Talking about cubes as a supplement... One of the things that I know Bill [Sadler] and some of you all have been talking about, is that in this country we have stepped back a little bit and actually gone and analyzed some of the cubes that we have been feeding and thought contained certain things. We have been surprised, and in some cases shocked, at what was actually in those cubes. I do not know whether the situation in southern Africa would present a better situation, or a worse situation. If they are more likely to substitute something that maybe should not be in there, or less likely to. But, we are finding things like cottonseed that should not be in there, corn and starches at levels that perhaps a browser can not handle. I think that some of these issues need to be looked at and hopefully translated to you guys.

M. Kock: You know, I think that with the problems with these rhino there are obviously certain key factors that are contributing to elevated mortality of these rhinos. Now where the key hole is and where we put the key in and unlock it, I do not know. But, things like this that you mention, you know this sort of thing we [should] go and discuss at this meeting to try and, just like the 426 try and determine where in this chain we can manage it.

Morkel: I think we always need to know in the spectrum of plants we feed... It is incredible, it is remarkable, the diversity of plants they will take. I think the chance of toxicity is very small. They really know what they want. We have given them a remarkable selection, things which certainly in Namibia, we never fed before. Things like 436, which one does not think is a great browse, yet they often enjoy it very much. I think a lot of diversity... Certainly we are not too worried about them taking something possibly toxic, they just seem to know what they can and can not take.

Sadler: Just to make one comment... I want to support your movement of cut. I do not know if tannins is the right thing to track, but after not I, but my wife taking an entire course of plant physiology... The amount of compounds that are produced by plants upon damage or with just one insect bite, and the level of compounds that raise in those plants to protect that plant from the next insect, are incredible. I would encourage you to continue to do your movement, because even if we do not track tannins properly, there are hundreds of compounds apparently these plants can produce upon injury, or damage, or drought, that clearly these animals must be able to detect. I would encourage you...

Dierenfeld: By the same token, just on mature vs. immature of any browse, most people seem to think the young growing are the most nutritious. It is dependent highly on the nutrients, that *I will be talking about*. And so there are at least a hundred different things we can categorize as nutrients. Some are in total opposition to each other. Of course you know Vitamin C is extremely high in young growing shoots, Vitamin E is very low, which is exact opposite in mature plants. That is some of the kind of stuff I am going to talk about.

M. Kock: OK, I just want to spend two or three minutes throwing in a “wobbly” into this talk, in saying that some of the problems that we have faced over the past few years with our rhino management... We have this political equation which I think is a major major factor in contributing to mortality with our rhino. I think there are some factors that we recognize, that we easily can deal with. The political angle, and Tom Foose will appreciate it, as well as some other people here... I think this is something that will come out of this meeting, because we are going to be talking about translocation of rhinos from an *in situ* situation to an *ex situ*. Dave Blyde is here from Australia, and several individuals who have received rhino over here. We need to discuss for example, the bomas that we built outside Harare, which I think we now recognize as a mistake. These are *clear* sided bomas, the rhinos should not have spent as much time as they did 470 *all that*, in these bomas. The animals we had there had unacceptably high mortality rates associated with these. People are talking about creosote, and I think this will obviously come out in the talks. I think the interesting thing was, this young male that died in Australia. Apparently its liver was absolutely normal. That animal was in those bomas for 18 months. We have had several animals in those bomas that we have had no problem for 18 months that are alive today and quite healthy. So there are some questions, why is it that those animals managed to survive the situation like that? I am sure Nancy will elaborate more on some of the pathological findings of these animals that died in the bomas.

The situation that developed with the boma was a political thing. I think we would not have left the animals in there for as long as we had. But, I think at this workshop you need to dissect what has happened with those animals in there. I think as far as capture goes, they were captured and caught in the wild, we put them in bomas. From that point onwards, until they got here and they died, I think there was something. In the workshops or whatever we [should] follow these animals. We give you some idea of what problems we had in managing them in Zimbabwe and then obviously the problems they incurred here. Because I am sure there are some key things in there that some minds can think about and hopefully we can have some answers why that is.

Translocation... The other thing we can look at and try and improve things with the black rhino is obviously when we move them from the bomas into the veldt. We have been doing a lot of that with Raoul [du Toit] at these conservancies. There are a number of very important aspects that we need to look at. We do use long-acting neuroleptics when we transport. The boma design at the translocation site... Some of the boma designs in these conservancies, they vary in design, but some of them are absolutely pit stops. Obviously it is very important for nutrition at the translocation site.

And, I think absolutely essential is improvement of long-term monitoring. We just can not afford to just put animals into the bush and then just release them and hope they are going to make it. There are so many variables, and if we can not document what happens to those animals long-term, then I think we have got a problem.

Just to talk about quickly, a few other medical problems that we see with rhinos we have to immobilize is snaring, this is an old snare wound here. The other interesting thing we have learned to do with our dehorning program to prevent us from following our rhino we just dehorned, is we notch the feet, with notches in the hooves. It really works excellent for the trackers, so they can pick up the notches so we do not spend five hours tracking the same animal again.

Just to show you the decline of the rhino, both black and white, associated with lead poisoning. This is the result of an AK47 bullet that went into the bone of a white rhino and then about six weeks after that we captured the animal to reunite it with its calf. And during the night, its leg shattered. All there was was a little entry wound, but massive osteomyelitis. It must have been terrible for that animal. It died immediately when it shattered.

Morkel: Mike just on that, what is interesting, we have had a couple fractures of the legs where the muscles, on the front legs particularly, are so powerful that even fractured they seem to be able to walk on them. The muscles protect to keep the bone together.

M. Kock: The other thing we are doing, and this is something to emphasize again, monitoring. Monitoring of the condition of animals constantly. We are at the moment, trying to develop a suitable radio collaring technique. Pete [Morkel] finally has this technique of using a stretchable material. The problem with the rhino and the anatomy, is that if you put a strip collar on, it can cut the ears off. So we have

developed this stretchable insert that goes on the rhino. You can see it here behind the ear. It stretches and does not cut the ear. So far it is working. It has enabled us to follow these rhinos on a daily basis and we have some really exciting monitoring projects that we are trying to develop for the few remaining rhino we have left in Zimbabwe. This is number seven, this is an animal at 535 National Park that we just recently knocked down to put a radio collar on. Always remember to remove your blindfold when you wake up 538.

The other thing also that has really revolutionized our work in the field, this is Jack Allen and Walter *Boist* from California, is pulse oximetry. We now have three pulse oximeters, Pete Morkel is very jealous. This is a mini pulse oximeter you can strap to your belt. We use it routinely now for black and white rhino immobilizations. To me it is the greatest advance in anesthesia, particularly in the field. You can relax once you have that established, you can just get on with your job. Particularly with white rhino when we have problems with immobilizations, we have been able to monitor anesthesia then. The recommendation is not to put it on the tail. Jack [Allen] and Walter [*Boist*], with this animal in fact, had that sticky tape and they said let's see what happens when you give the Naltrexone and we will sort of whip it off as the animal stands up. But, what they did not realize was that before the animal stood up, he cranked his tail down, and this bull disappeared across the bush with this pulse oximeter trailing behind him! It fortunately got snared on a tree. Now we use the ear, we attach it to the ear. It is a very very simple procedure. It really is a major major advance for us in field anesthesia.

Morkel: That is 562 you do not see that often, and that is just old age, running out of teeth. It does actually sometimes happen. They do live long enough to make it. Not that often though. 566*.

Montali: What is the estimate on the age?

Morkel: Between 35 and 40, that was our guess.

Stover: Can you age rhinos from their teeth, or from their skulls?

Morkel: Yes, very very easily.

R. Kock: 570 the front three and back.

Morkel: On that note, I recently fired up our local vet in *Okavango*. He has been making some extremely nice casts using the dental alginate and then putting that with plaster of paris. It is incredible, the definition he has got in black rhino. He is busy sorting it out now in white rhino as well. The aging of rhinos at capture is very important. It has been very much neglected in the past. Between moving animals which are much too old to be moved... We do not know what sort of age structure. I think it is something we should give a lot more attention in the future--using aging at capture. It is really not difficult.

Stover: *We would be interested in you looking at that skull from our male for 584.*

M. Kock: Pete [Morkel] and Raoul [du Toit] are the experts at aging.

Morkel: What is quite interesting here is that actually there is a sinus going through the root of that tooth into the nasal cavity, it was actually going from the 589 nasal cavity and out its nose.

Miller: On the wild skulls, have you seen much dental plaque or dental disease in younger animals?

Morkel: There is not a lot.

Miller: In the last year, we have lost two in captivity with massive plaque, which I suspect is diet related, but...

M. Kock: OK, let me just take two or three minutes to summarize. I think that basically from those of us who work in a free-ranging situation, I think as far as our ability to immobilize animals, we have developed a technique now that I think is the best we can. 599 modified slightly. I think we have definitely reduced stress associated with that, and I think that area is something we can feel confident that we are doing the best we can.

As far as the rhinos in bomas, a short-term situation, I think we recognize that the bomas have to be very well designed and very well built and that the management has to be 150%, no doubt about it. We can not afford to run out of food for a couple of days, which has happened when someone has dropped the order return of cubes. You have got to maintain a level of nutrition that is top of the range. There are some questions that we still need to address in that situation.

As far as long-term confinement and then release into the veldt or shipment overseas, I think there are a number of questions that need to be raised at this workshop. There are a number of keys that we need to try and unlock 615. I think if there can be something that comes out of this conference we can try and determine why we have had such a high mortality associated with *ex situ* translocation. Also in the situation in Zimbabwe, I think we need to think of and recognize some of the problems, for example in *Boldin* that we had. But historically, there is still mortalities that have occurred anything up to 12 months after translocation into some of these habitats. I think with some of the work that Raoul [du Toit] is doing and Pete [Morkel], we recognize that stocking density is very very important and the type of habitat they go into, and the time of year that you translocate them. I think that nutrition will definitely turn out to be probably one of the keys.

Morkel: I think that often we are looking for high tech solutions to low tech problems, and management is by far our biggest problem in Africa--management related problems. Classic diseases we actually see relatively little of.

Just one thing, on the increased dosages we are using, there is no doubt this is the way to go; but on the negative side, it does mean that obviously the higher your dose of opioid, the greater your chance of *central* depression. It is obviously important in old animals, pregnant animals and animals in poor condition. It does mean that the pressure is on to get to that animal as quickly as possible and then good monitoring. And yes, pulse oximetry is obviously worth a great deal, but I think one must always make use of your more basic monitoring techniques. And another thing which we have found, which is an absolute

must, is to use a low dose of nalorphine, 10, 15, 20 mg, just to improve the quality of respiration and improve the oxygenation; but without having a significant antagonist *opposite effect of the opioid*.

Jessup: Pete, are you routinely using doxipram?

Morkel: No, we have actually found that nalorphine, and it looks as though probably now *Ghucine*, are much better than Dopram. Dopram is always worth having along. It does have a response, but it is a very transient response. Nalorphine is a clear response and usually 10 to 15 mg nalorphine will improve that respiration for the entire duration the animal is down, 15 minutes, an hour, it will still be good after the nalorphine.

M. Kock: I think with white rhino you will see a 25% increase in oxygenation, just with nalorphine under anesthesia. The value 670.

Morkel: Certainly in the white rhino, the Dopram I think might in fact exasperate your sympathetic stimulation. It makes the muscle tremor worse, you get more shivering and shaking. I would stay away from Dopram particularly in white rhino.

Blyde: Pete, can you use that nalorphine routinely, rather than when you have got a problem?

Morkel: Routinely. In whites it is an absolute must, and in blacks it is definitely worth giving.

Jessup: If they do not get up on you?

Morkel: For 10 mg you will not get an animal up, except if it is a long procedure, 10, 15, maybe 20 mg you might risk an animal getting up; but usually it is fine.

Blyde: The same dose for white rhino?

Morkel: Yes. But, it is remarkable, even at low dose. Usually it is very successful every time. Occasionally if you are using a pulse oximeter, you might have to give a little bit more. But usually 10 to 15 mg is a very good reliable response.

Blyde: You give that i.v.?

Morkel: i.v.

Jessup?: Are you using Naltrexone after 694 for reversal?

Morkel: In black rhino Diprenorphine is fine, Naltrexone is even better and in white rhino Naltrexone definitely is the best.

M. Kock: It is a very consistent for reversal.

Morkel: You could also use a good dose of Nalorphine in white rhino. That is not too bad, it is not quite as good as Naltrexone.

Blumer: Mike, could you just speak a little moment more about some of the other alpha-2 agonists and how you have been playing with those--Detomidine and the options that gives for reversing those also? Instead of xylazine or even...

Morkel: Certainly in white rhino, Detomidine is definitely superior. It gives a much better quality anesthesia, much lower heart rate, much better muscle relaxation. There is no doubt about it, it is the drug

of choice to add with your opioid in white rhino. In black rhino I do not think it is a real advantage using Detomidine over xylazine. It looks as though you might have a slightly better quality of anesthesia. We have got sort of a gut feeling that it takes slightly longer with Detomidine in black rhino. But, Detomidine can be used. And then antidote with some of the newer alpha-2 antagonist like RX. There is probably not a big indication to antagonize it except in animals in poor neck, it is not a bad idea. It is certainly always a good thing to have an opportune antagonist with you.

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M. Kock: The black rhino that you wake up that have been under Eutorphine/Detomidine are very very clever at hiding their natural aggressiveness. Pete Morkel was actually part way up a sapling when a black rhino that had been reversed and was still under Detomidine, was sauntering along and happened to smell my colleague Dr. *Ackenson Grekels*, who was 004 Pete. He proceeded to destroy it totally, while Morkel was balancing. Eutorphine can be very dangerous. It lulls you into this false sense of security.

R. Kock: Mike, can I give a word of warning too? These alpha-2 *antagonist* will reverse eutorphine. So, if you give it too early and you think this reversal...

Jessup: Are you saying that RX will reverse eutorphine?

R. Kock: Has a reversal effect.

Jessup: Really, has that been documented?

R. Kock: It is only my experience. It has never been...

M. Kock: What dose of RX are you using?

R. Kock: A couple milligrams. You have got to be careful, because just recently I did that in a rhino 011.

Bolln: What is the normal oxygen saturation in the rhino? At what point in the pulse oximeter readings do you get concerned?

M. Kock: About 85 to 90%.

Bolln: Is normal?

M. Kock: We try and keep the pulse oximeter going until the rhinos sit up. It is always interesting, but it has gone up to 95%. I do not know what ours got up to! But, it is normal about 85%. Anything below... We have documented SaO₂ of 50% in white rhinos. You see a white rhino like that and take a blood sample and it is black, than you know you have got problems.

Jessup: Jack [?] feels pretty strongly that it is not just any absolute percentage, it is trend too. You need to take a couple of oximeter readings and see whether you are... Even at 85 or 80%, if it is going up you are in pretty good shape; but if it is going down and your oxygen saturation is dropping over time, you are in trouble.

Bolln: Most mammals run 95% or better just sitting there.

M. Kock: But, obviously we do not know what standing normal is. It is an incredibly sensitive machine. As the animal breaths, just doing that really is a joy to watch, and then we can always do that ourselves and make sure. It is embarrassing sometimes 027.

Morkel: Just on mortalities. Our mortalities are about 1 to 2% at the moment. As I see it, it is either drug related, too little. Now it is usually the case, we do say too little due to poor technique, poor darting. As a result the animal was only partially narcotized and it takes a long time, long induction. Good chance of it going into a ditch, 031, over a cliff, something like that, these accidental deaths which happen. And then on the other hand, too much, especially obviously the animal is poorly or pregnant, etc., and then your hypoxic problems related to that.

We also often end up catching animals we should not catch, and as a result we lose them. For example, just the other day in Namibia they did a cow with an extremely small calf. She really was in no need to do, she was not under a lot of risk. We lost that calf subsequently in the boma. So I think instead of doing good anesthetic risks, or good translocation risks, we sometimes through circumstances, are forced to do animals we should not be doing.

Kenny: Do you ever give supplemental oxygen or carry that in the field?

M. Kock: We tried it in the whites, we carried it. We had problems with the whites and then decided to carry oxygen and *never used it. We modified our protocol to start using oxygen.* It is pretty difficult in the field, you need a small one. You have limited helicopter room. But sure, I think in a captive situation...

Kenny: Are you saying that a pulse oximeter jump 10%, from 85 to 95 in just a minute or so, is just a 045?

M. Kock: *If you can do it, it is not 045.*

END