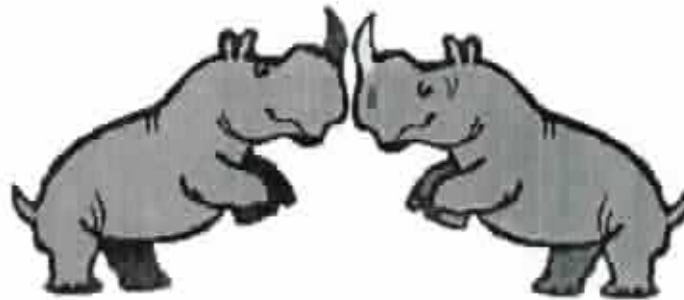


**Evaluation of *ex-situ* and *in-situ* projects conducted by SOS Rhino
in Sabah, Malaysia**

Plans and recommendations



Tanjung

Gelugob

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1. INTRODUCTION:

The Sumatra rhino is one of the rarest and most threatened mammals. Only 300 Sumatran rhinos are left in the wild and seven in captivity. Besides being hunted for their horns, the Sumatra rhino is losing its rainforest habitat in Malaysia and Indonesia because of deforestation. The Borneo subspecies of the Sumatran rhino, *Dicerorhinus sumatrensis harrissoni* is the rarest of the three subspecies. The latest estimate is that there are about 32 animals left in Tabin Wildlife Reserve and possibly a few animals in the Danum Valley area, and two Sumatra rhinos in captivity in Sepilok.

SOS Rhino Borneo is undertaking several actions to protect the remaining Sumatran rhinos in Borneo. The SOS Rhino team is conducting monthly surveys in Tabin Wildlife Reserve to patrol the area, and to gather information about the current rhino distribution. In addition, SOS Rhino is conducting a community outreach program which will help to improve protection of the northern boundary of Tabin Wildlife Reserve. Until April 2003, SOS Rhino was also involved in captive breeding of Sumatran rhinos in Sepilok. Since then no further work was conducted in this field. The recent death of five captive Sumatran rhinos in the Sungai Dusun conservation center in Selangor, Malaysia urge to undertake action in captive breeding before the last remaining captive populations disappear.

I was invited by SOS Rhino to familiarize with the *ex-situ* and *in-situ* work conducted by SOS rhino in Sabah. During my visit I evaluated the possibilities to conduct an intensive breeding project in Sepilok and I investigated in the possibilities to improve research of the free ranging Sumatran rhinos in Tabin Wildlife Reserve.

The Table below gives an overview of the places visited, the time spent at each location and a short description of the work conducted since my arrival in Sabah on the 1. November 2003.

Table 1:

dates	places	short description of work conducted
1. November 2003	arrival in KK	
3. - 5. Nov.	SOS rhino office in KK	meeting with Wildlife Department, meet Datuk Karim and John Lo from Cariota's Borneo, check files on computer
6. - 9. Nov.	Sepilok	meet Dr. Rosa and Dr. Sen, check laboratory, check the rhinos and enclosures
10. - 11	Sabahmas, Tanjung Utik	meet Mr. Ooi and Mr. Simon Geg at Sabahmas Oil Palm Plantation
12. - 14. Nov.	Tanjung Utik, Tabin	check equipment, develop new system for photo trap camera, train staff
15. - 16. Nov	Lahad Datu	pick up volunteer in Lahad Datu and Sabahmas
18. - 24. Nov.	Survey Tabin	put up camera traps, follow rhino tracks, collect food samples, take plaster cast imprint of footprint, together with volunteers.
25. - 27	Tanjung Utik+ Lahad Datu	meeting with Mr. Ooi and Mr. Simon Geh from Sabahmas
28. - 11. Dec	KK SOS rhino office	writing report, meeting with Wildlife Department and the Secretary of Research and Internal Affairs, Chief Minister Dept.
20. Dec	flight back to Germany	

2. Investigation in intensive breeding project in Sepilok (ex-situ program):

2.1 Meeting with Wildlife Department officers in KK and in Sepilok:

- On the 3rd of November Dr. Edwin and myself attended a meeting with the Director of the Wildlife Department, Mr. Patrik Mahidi Andau, with his Deputy Director and his officers. In the meeting we discussed about the plans of SOS Rhino to conduct a 3 month intensive breeding program in Sepilok. The Wildlife Department agreed on the plans on the condition, that we discuss the plans with Dr. Rosa and get her response. In addition, I gave

a short summary of the research I have done on white rhinos in South Africa and we discussed about conservation projects in South Africa.

- In Sepilok we meet Dr. Rosa the vet in charge and discussed about our plans. Following the meeting, she send a letter to the Wildlife Department in which she gave a strong recommendation for SOS rhino to assist Wildlife Department staff.
- In a second meeting with Patrick Mahidi Andau on the 4th of December, the plans of intensive breeding in Sepilok were finalized. As a result of the meeting SOS Rhino got a letter of support from Patrick Andau for the Sepilok project. In addition, he wrote a letter to SOS Rhino in which he recommended that I conduct the work in Sepilok as a field scientist of SOS Rhino in cooperation with Dr. Rosa.

2.1.1 Summary:

All parties involved in the project are informed about the breeding project and support our plans.

2.2 Equipment in Sepilok:

2.2.1 SOS rhino office:

Dr. Rosa made a copy of the keys for the SOS rhino office which she passed on to me. The office is still in good shape. It just needs some cleaning. However, the toilets and the kitchen needs to be fixed so that they can be used for the project.

2.2.2 Laboratory and ultrasound machine:

The laboratory has not been used for a long time. Everything is very dirty, some of the equipment is rusty and some cables were chewed on by rats. In the Appendix (Table 1) you find a listing of the equipment which is working and not working. The ultrasound machine is working. I have checked it together with Dr. Rosa. However, at the moment we do not know how to save images on the memory card. I would recommend to get in contact with practicing gynecologists in Sabah as there might be someone using the same ultrasound machine (EUB-905) and to contact Hitachi to solve this problem.

2.3 Rhino enclosures:

According to Dr. Rosa the rhinos are released into the small enclosure on a rotational, daily basis. The large enclosure has not been used since a long time. The small enclosure needs to be fixed before we start breeding the animals. It has got a wallow which is extremely steep and there is a high risk that the animal will fall into the wallow during mating.

The large enclosure needs to be fixed as well. At the moment it is not possible to walk on top of the enclosure (picture 1 see Appendix). The broken parts are important for observations of the animals and to get quick access to the animals during mating. Dr. Rosa took measurements and calculated the amount of material needed to fix it. A picture drawn by herself and pictures taken by myself from the fence are attached to the Appendix (picture 1-2). We will send Mr. Lee the contractor from SOS Rhino to have a look at it and to calculate the costs involved to fix it.

2.4 Condition of the rhinos:

The rhinos were kept in the night stalls during both my visits. The condition of the animals was fairly well. They had no external wounds on the body or their feet (see Appendix picture 3 and 4). What I have noticed however was a clouded condition of their eyes which is most probably due to the light intensity which is still pretty high in the enclosures. As a future plan, I would recommend to put up some nets on top of the enclosure or some roofs made out of leaves as used to built the chalets in Tabin, to prevent sunlight coming in.

Silih the keeper of the rhinos mentioned to us that he saw vulva discharge on the 6th of December, an indication that the rhino was in estrous. During our visit Gelugob was laying most of the time on her side - next to Tanjung's enclosure - and made a lot of noises. Dr. Edwin and I agreed that this was another sign that she was in estrous. With this date in mind (6th of December) we have a baseline data on her estrus cycle.

No work has been conducted with the animals since February 2003. The animals therefore need to be reconditioned before blood samples and ultrasound analysis can be conducted.

2.5. Previous breeding activities in Sepilok:

The first breeding attempt was made by Dr. Edwin Bosi in October 1995. Based on behavior observations, male and female mated successfully without any injuries. Pregnancy however lasted for about three months only. In April 2001 Dr. Cheong was recruited by SOS Rhino to manage the *ex-situ* program. He joined the animals in two separate occasions, on the 15th of July 2001 and on the 24th of October 2001, based on hormonal progesterone profiles taken every three days. These attempts failed as the female was badly injured by bites of the male. Dr. Cheong resigned in January 2002. In July 2002, his work was taken over by Dr. Symphorosa Sipangku. Dr. Rosa has attempt mixing the rhinos in October 2002. This attempt failed. According to Dr. Edwin, the failure of Dr. Cheong and Dr. Rosa was due to a lack of behavior observations. Dr. Symphorosa Sipangku resigned from SOS rhino in May 2003. She is now the vet in charge for the Wildlife Department in Sepilok.

2.5.1 Summary: Successful mating was obtained by intensive behavior observations.

2.6. Intended breeding activities in Sepilok:

After studying Dr. Cheong's paper I would like to propose my work schedule as below. In contrast to Dr. Cheong's work, I will put more emphasize on behavior observations and combine the observations with hormone analysis (progesterone and oestrogen concentrations).

Gelugob (E):

planned analysis	frequency	persons involved
ultrasound analysis	weekly	Dr. Rosa and myself (Dr. Edwin)
behavior observations	daily	myself and SOS rhino employees
body weight	daily	myself, WD staff or SOS rhino staff
weigh amount of food	daily	myself, WD staff or SOS rhino staff
blood collection	1-2 times per week	Dr. Rosa and myself
fecal collection	daily	myself, WD staff or SOS rhino staff
record vocalization	daily	myself

Tanjung (Γ):

planned analysis	frequency	persons involved
ultrasound analysis	once per month	Dr. Rosa

behavior observations	daily	myself and SOS rhino staff
body weight	daily	myself, WD staff or SOS rhino staff
weigh amount of food	daily	myself, WD staff or SOS rhino staff
semen collection	weekly	Dr. Rosa, Dr. Edwin
blood collection	weekly	Dr. Rosa and myself
fecal collection	daily	myself, WD staff and SOS rhino staff
record vocalization	daily	myself

2.6.1 Hormone concentrations:

The hormone concentration of both male and female will be monitored continuously to insure that they are both reproductive active. The main focus however will be on the female. Following Dr. Cheong's report, I will monitor progesterone and estrogen concentrations to establish the estrus cycle of the female. I plan to collect two blood samples per week. To monitor the testicular activity, I will collect one blood sample per week from Tanjung and establish the testosterone concentrations. The samples will be stored in liquid nitrogen to prevent any damage during power cut off. The samples will be sent on a weekly basis to Dr. Harun at the University Putra Malaysia in Kuala Lumpur, Malaysia via parcel service. His laboratory has done the previous hormone analysis for Dr. Cheong and Dr. Rosa. I also plan to collect fecal samples of both male and female on a daily basis. The samples will be used as a back up if the female or male develop irregular hormone patterns. The samples will be stored in Methanol or frozen, depending on the requirements of the laboratory. I will contact Muhammad Agil whether he can assist with the analysis. We worked together at the German Primate Institute in Germany and I know he has a lot of experiences with fecal analysis. He is currently establishing a laboratory with Prof. Keith Hodges from the German Primate Institute, in Indonesia.

2.6.2 Ultrasound analysis:

Ultrasound analysis of the genital track will be conducted weekly. Dr. Edwin offered to assist at the beginning of the project. Initially I will learn the ultrasound analysis from Dr. Rosa and Dr. Edwin. He mentioned that you will come over during the project to countercheck on our analysis. Thus more elaborate training will be obtained from you. We would also like to send

the images to countercheck on our analysis, but at the moment there is no possibility for us to save the images (see 1.4.2).

2.6.3 Behavior observations:

Initially I will train the SOS Rhino staff to assist me with the observations. The observations will start after the blood collection and after the rhinos have been released in the large enclosures, the observations will end at dusk. I plan to monitor the male and female simultaneously. The main focus however will be on the female. We will keep the female in the large enclosure and monitor whether they show interest in each other. Therefore the enclosure will be divided into quadrants. Every 30 minutes we will record in which quadrant they are staying. This will give us the amount of time they spent in each quadrant. My expectation is that both of them spent more time close to the fence when she is in estrus. During this time they become more interested in each other. In addition we will look for signs of estrus, such as swollen vulva, mucoid discharge from the vagina, and restlessness. We will record how much time the male and female spend resting, walking, urinating, wallowing to measure whether they become more restless.

2.6.4 Semen collection:

Semen collection will be carried out in the afternoon. According to Dr. Cheong's report, Tanjung is than released into the small stall near the chute which allows easy handling and allows more time to spend with the female in the morning. Initially Dr. Edwin will train Dr. Rosa and myself to do the semen collection. Further training will be obtained from you. I will also get in contact with Mohammed Agil to learn more about his artificial vagina. I will check the semen for sperms and sperm motility and keep a record of it. Any sperm found will be stored in liquid nitrogen.

2.6.5 Nutrition:

The amount of food given each animal will be recorded every day and the animals will be weight at least once a week. According to Dr. Rosa this work is being conducted by the Wildlife Department staff but I haven't had a chance to see the records. I mentioned to Dr. Rosa that we have got food samples of Sumatran rhinos which were collected in Tabin. I will

ask the WD staff to collect some of these plants if they come across them to possibly improve the diet of the rhinos. I will keep a record on which plants the rhinos select during feeding.

2.6.6 Vocalization:

I would like to record the sounds of the animals, in addition to the behavior observations. I think this is a unique chance to correlate behavior observations, vocalization and hormonal data, which will be a good supplementation to the paper just being released by Muggenthaler et al. (2003). I try to organize a recorder from a friend of mine who did a study on communications in African rhinos. I plan to record the sound in the morning and in the evening while the animals are in their night stalls.

2.6.7 Mating:

The plan is to use the small enclosure for mating. The advantage is that the animals can be monitored and separated more easier. We will keep the male in the small enclosure and give the female the chance to visit him. The advantage is that we can monitor whether she comes close to the fence and has any intention to mate with him. However, the small enclosure is steep and according to Dr. Rosa it is more difficult for the male to find the right place for mating. I will investigate in this aspect during my time in Sepilok and will make further recommendations later on.

2.6.8 Stress hormone concentration

In addition to the work described above I would like to suggest a project which involves a single injection of 3 mg Synacthen ® Depot (equivalent to 300 I.E. ACTH) given to either Tanjung or Gelugob, preferably at the beginning or at the end of the 3 month period. The injection will stimulate the glucocorticoid secretion which will result in an increase of glucocorticoid metabolites in the feces. All feces before and after injection of the rhinos need to be collected over a period of a week and stored in methanol. This experiment is important to establish an adequate enzyme immunoassay to measure glucocorticoid concentrations in the feces. Once this method has been established it can be used to establish the stress involved in translocations of doomed rhinos or to establish the stress of rhinos in small isolated free

ranging populations such as in Danum Valley. The samples can be analyzed by myself or by Mohammed Agil in the German Primate Center.

2.6.9 Summary:

The work will be based on Dr. Cheong's work. The reproductive status of the female will be monitored using behavior observations in combination with progesterone and estrogen concentrations in the blood and feces in combination with ultrasound analysis. The reproductive status of the male will be monitored using behavior observations in combination with testosterone concentration in the blood and feces and semen analysis.

2.7 Requirements for breeding project:

2.7.1 Staff:

Dr. Edwin mentioned that two additional field assistants will be recruited to help me with the work. By reading Dr. Cheong's report, I realized that these additional employees are vital important for me to conduct the project. Dr. Cheong wrote that he tried to carry out blood and ultrasound analysis on the same day, in order to correlate the findings. But most of the time it was not possible, as by the time blood collection and processing was finished the Wildlife Department staff was out to collect food. He also mentioned that it was often very difficult to do any blood collection or ultrasound examination at all at times when one of the Wildlife Department staff was not on duty. The remaining two could not help him at all, as their priority was food collection. So in order to get the blood samples and ultrasound analysis I recommend that SOS rhino appoints two additional employees for the intensive study to help me handling and training the rhinos or to help the WD staff with food collection. These employees are also needed to help me with the behavior observations, as this takes a long time and is very tiring if conducted by one person only.

2.7.2 Accommodation:

Dr. Sen is still using his house in Sepilok, therefore there is no accommodation available were I could stay. Once he has moved out, Dr. Rosa can move into his place and I may be invited to join her. I spoke with Datuk John Lim, the owner of the Sepilok Jungle Resort in Sepilok

and he is very interested in the project. He is willing to assist by providing cheap accommodation for the period of more than three months. The rate for a room will be 30 RM per day. The actual rate is 80 RM. Datuk John is presently the Chairman of the Sandakan Tourism Committee. He is hoping that the rhino breeding project will increase the number of tourist visiting Sepilok. I would suggest to put up an information center at his accommodation with brochures, posters and T-shirts from SOS rhino and a box where tourist can donate money.

2.7.3 Equipment:

The main costs involved in the project will be: liquid nitrogen, courier service, a laptop and a stabilizer. It plan to send the blood samples once a week via courier to the laboratory. The weekly interval is very important in order to react as quick as possible to any changes in hormone concentrations. Unfortunately my laptop is very outdated, it hasn't got a battery anymore and the modem cant be connected to the Asian system. In order to compose monthly reports, to draw graphs and to e-mail them to Dr. Edwin and to you I would need a new laptop as there is no spare one available in Sepilok. A stabilizer is necessary in order to prevent any damage on the computer during power cut off or power fluctuations. A detailed budget will be prepared by Dr. Edwin.

3. In situ program in Tabin Wildlife Reserve:

3.1 The new camp and SOS rhino staff

I stayed 4 days at the new base camp named Tanjung Utik. The place is very beautiful situated at the river and it has a lot of potential for eco-tourism. I met the whole SOS rhino staff and I could observe their daily routine during the work and the performance of individual people. The SOS rhino staff was very productive during that time. They finished everything what Dr. Edwin asked them to built. At the time of my arrival, four chalets were finished, as well as a toilet and the kitchen. On my return from a 7 day survey, a jetty and a shower were built, a light was attached to the toilet and a sign was drawn with the SOS rhino emblem on it (see pictures 5-7 in the Appendix).

The current problem is however that none of the SOS rhino staff speaks proper English and that they are very shy to speak to a foreigner at all. This is a problem for new volunteers, as they don't have anybody to tell them what to do and what to expect in the rainforest and they do not have anybody to talk to in the camp. For this reason I started to teach English in the evenings. The guys liked this idea very much. They were very keen on attending the school and eager to learn. I noticed that each of them knows quite a lot of English, the only problem is that they are too shy to speak.

I investigated in the performance of the staff in setting up the camera traps. I asked them to form up in groups of two people and to set up the whole camera trap, which included programming of the Trailmaster. In the first trial all groups were not performing well. The connection between the tree and the receiver/transmitter were too loose, the cable connecting the camera and the transmitter was loose, the camera was not fixed properly. I showed them the weak parts and let them do it a second time. Each group was performing much better and again the staff were very eager to learn and to improve.

I also showed them how to establish the current position with the GPS and how to go back to a certain position indicated by the GPS. I set up a game in which they had to find an object which hidden at a certain GPS position. Some of them performed very well, however, I noticed that some of them had problems to walk in a certain compass direction. For this reason I trained them in how to use a compass as well.

Unfortunately I haven't had time to train the team in using the plastercast, as I had to go to Lahad Datu to pick up the volunteers. This showed to be a problem on the survey. Two out of three plastercasts imprints failed. The problem was: 1. the plastercast was not stored correctly and got wet, 2. there was no adequate container to mix the plastercast (see picture 8) 3. there mixture was not right. My team, Frans and Albert, had enough plastercast to take two imprints and we could improve the technique slightly which resulted in one plastercast imprint which we could transfer back to Tanjung Utik and KK.

3.1.1 Recommendations:

- In my opinion, the current SOS rhino team can work productively without permanent monitoring. I would however recommend to check on them on a two weeks or maximum 4 weeks basis.

- I would recommend to send one of the team to an English course. This would make communication between staff and volunteers much easier and I am sure SOS rhino work would profit from this. In general I would recommend to send Sarinus the leader to the English course. He is the oldest of the team and he has to interact most with the volunteers. However Sarinus has got some difficulties to speak and to remember English vocabulary and I would rather send Obop or Ahmed to the course as they have already got some knowledge in English.
- Training of the staff is very important and need to be followed up constantly in order to be able to use the equipment to its full extent. The staff is very willing and interested in working with the equipment, but at this stage they need to be supervised.
- Buy plastercast in 1 kg packages and put these packages in waterproofed bags to keep it as dry as possible.
- Train the people in taking plastercast imprints. Herefore it is necessary to simulate different soil conditions: dry, slightly wet or soaking wet soil.
- Use containers which are large enough to mix all the plastercast necessary for one imprint at once and make use of measuring cups. This will help to get the right water-plastercast mixture for the different soil conditions.
- Buy different plastercasts and find out which performs best under tropical conditions.

3.2 Equipment:

During my stay I check the equipment. At the moment there are 5 Cyber Tracker units working, 6 cameras, 16 cables, 12 tripods, 2 binocs, 2 multiple camera trigger, 13 Trailmaster, 22 transmitter, 5 GPS and 3 compass in the camp. The Cyber Tracker units can not be used at the moment, as the program is not on any of the palm units. I took all of them with to KK to put the program back on again.

I noticed that none of the equipment was stored in sealed boxes and that the silica gel was not used properly.

I spoke with Sarinus about the recent problems with the Trailmaster and the photo trap camera. He reported that most of the problems were caused by mice eating the cable. Another problem was that the box with the camera inside is not waterproof which caused a lot of damage to the camera. I came up with the idea of putting the cable into a hose to prevent it

from being eaten by the mouse. I also had the idea of putting the camera into the plastic wrapping used for the Cyber Tracker. It can be closed tight at the one end and is thus waterproof (see picture 9). I developed a system to fit the hose with the cable into the jacked to protect the whole system against rain and mice. We tested two sets during the survey at frequently used wallows. The survey was too short to test the set properly. The camera was built up for 24 hours only but during that time it worked well. The plastic wrapping did not obstruct the view and no water came into the camera (see picture 10). However, a longer survey is necessary to establish whether the camera is working properly.

3.2.1 Recommendations:

- For further improvements I would recommend to buy special waterproof bags for the cameras which have a special window for the lens or even better to use waterproof cameras.
- Put some silica gel into the plastic bag to reduce impact of water on the camera.
- Use rechargeable batteries and to buy a battery recharge which is at the same time discharging the battery to reduce the battery cost. This will guarantee a longer battery life.
- Buy a battery tester. At the moment the battery life can not be checked and I full batteries are often thrown away as nobody knows in what status they are.
- Dry all the equipment after the survey and put it in waterproof bags together with silica gel.

3.3 Survey:

We went on a 7 days survey in the rainforest, two volunteers from England, four people of the SOS rhino staff and myself. We went up to kilometer 32 to put up the photo trap cameras and to search for rhino tracks. It took us 3 days to reach the camp and two days to go back, so we had only 2 days to patrol the area around kilometer 32. At kilometer 32, we split up into two groups to check the different wallows. Both groups found tracks of rhinos at the wallow. The tracks were several days old. The cameras were set up at the wallows and removed the next day. During that time they were no rhinos or other animals visiting the wallow but both cameras were working well.

Our group (Franz, Albert, and a volunteer) measured the size of 30 different footprints (left and right hindfoot) of one individual. We followed these tracks for a distance of 3.8 km and collected several samples of food plants. During tracking we came across two dung heaps which were several days old. In Figure 1 you will find a map showing the three different wallows at km 32 and the route taken by the rhino. The brown squares indicate the position of the dung heaps.



Figure 1; Map showing the position of the 3 wallows at kilometer 32, the route the rhino has taken as well as the position of the dungheaps.

On our way back to Tanjung Utik we found a fresh rhino track (only a day old) just 1 hour away from the main river (Tabin river). The animal came from the main river and went into Tabin Wildlife. The animal was thus very close to human settlements.

3.3.1 Recommendations:

I would recommend SOS Rhino to erect a simple base camp at kilometer 32 (or at the mud vulcano) and to assign two or three people to stay permanently at this camp to do research. At the moment there is not enough time to patrol the area around kilometer 32 and to collect data. Most of the time is spend walking to get to the area.

I also noticed that the people including the staff are too exhausted to patrol the area properly once they have reached the camp and there is not enough time to patrol the area and to put up

the camera trap. The camera trap should at least stay for a week at one place. Only then there might be a chance to get a picture of a rhino visiting the wallow.

The team in the forest camp needs food and equipment. This can be provided on a regular basis by SOS Rhino staff (together with volunteers) walking into the forest. The advantage would be that intensive work could be done on-site. The camera could stay for a month or longer while people check it and exchange the films on a regular basis. Tracks of rhinos could be followed over a long distance enabling to identify individual home ranges, monitor feeding behavior, identify individuals and hopefully resulting in pictures of rhinos.

3.4. Potential research projects:

3.4.1 Identification of individual rhinos:

The identification of individual rhinos is very important. Once individual rhinos can be identified, the population density can be established more accurately and detailed data can be collected on sex ratio, social behavior, home range, feeding behavior and others. Individuals can be identified by several different methods: 1. through identification of footprints, 2. through pictures taken with the photo trap camera and 3. through DNA analysis of feces and hair. Each of these methods has got its advantages and disadvantages.

3.4.1.1 Identification using footprints:

The most data can be collected out of footprints because they are found on almost every survey. The current measurements taken however are not sufficient to identify individuals. At the moment, three different measurements are collected from the rhino footprint during a survey: the width of the 1. toe, the width between the toes, and the length of the foot. I investigated whether these measurements are sufficient to identify individuals. I compared all measurements collected in August 2003 and November 2003 from the left hindfoot at different locations (see Figure 2) using a Kruskal Wallis test.

The test revealed, that there is neither a significant difference between the measurements for the width of the 1. toe collected at different locations ($p = 0.06$ $H = 8.5$), nor between the measurements taken for the width between the toes ($p = 0.39$, $H = 4.165$) or the length of the foot ($p = 0.126$ $H = 7.06$). This indicates that the three measurements collected at the moment

are not sufficient for the identification of individual rhinos. It is therefore recommended to investigate into other methods to achieve greater success in this area.

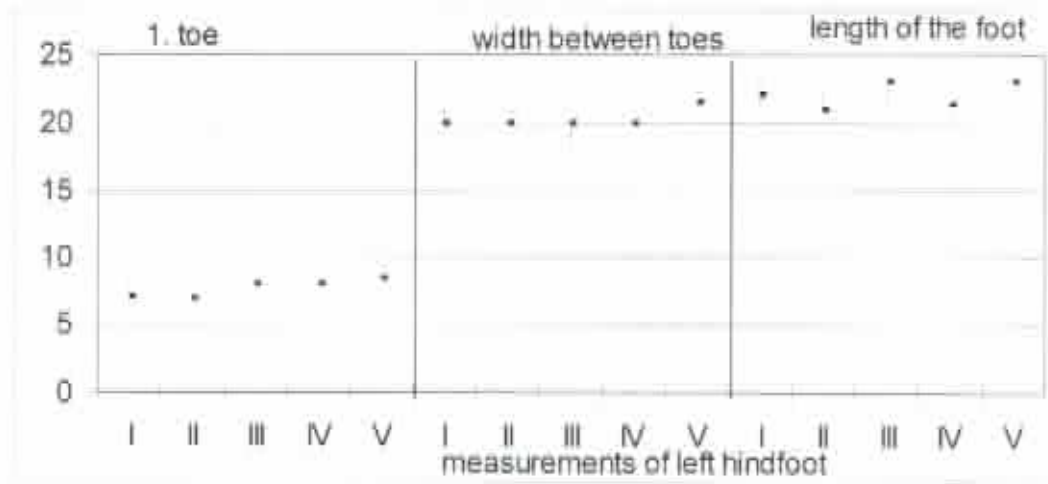


Figure 2; Comparison of measurements collected from left hindfoot at 5 different locations (median and interquartil range). The numbers indicate the different locations.

Plastercast imprints have been successfully used by N. van Strien (1986) to identify individuals. The SOS rhino team is collecting plastercasts during their surveys. However according to Dr. Edwin and the staff, the plastercast doesn't harden and can very often not be transported to the camp. I would therefore recommend to improve:

- dry keeping of plastercast
- use measuring cup for preparation of plaster cast and standard mixing tin
- train people in preparation of plastercast in different moisture conditions
- study existing plastercast imprints and try to identify characteristics in footprints
- take stereophotographs and use standard measurements developed by N. van Strien (1986)

Jewell et al. (2001) developed a footprint identification technique. It is based on digital pictures of footprints. They defined landmark points on the pictures and conduct discriminant analyses. The advantage of this method is, that there is no need for plastercast anymore. More footprints can be sampled without carrying a lot of plastercast into the forest. To develop this method I would recommend to get in touch with Zoe Jewell and Sky Alibhal.

3.4.1.2 Identification of individuals using DNA analysis:

I am cooperating with a laboratory in South Africa which is currently developing a method to conduct genetic fatherhood on white rhinos. They have got a high number of markers available: markers from rhinos, horses, and tapir which can be used for the genetic analysis of Sumatran rhinos. I will send hair samples from Gelugob and Tanjung to this laboratory to establish whether the current markers are sufficient to identify individuals. Once the necessary markers have been identified, a laboratory in Sabah can be set up which will do the genetic analysis from the samples collected in Tabin. They only need to buy the markers necessary for the genetic analysis of the Sumatran rhinos.

3.4.1.3 Identification of individuals using pictures collected by camera trap

see 3.2.1 and 3.3.1

3.4.2 Home range analysis:

The home range of individual rhinos can be established by following the footprints of an individual rhino. It requires good tracking skills and knowledge of individual footprints. During our survey I realized that some of the SOS rhino staff are extremely good in tracking (Franz) and I am convinced that he/they will quickly learn to identify individual rhinos once they are working intensively in one area. It is than only a question of time until enough data have been collected to establish the size of the home range of individual rhinos. Based on this it is possible to get an better estimate of the density of rhinos in Tabin. A distance can be calculated giving the likelihood that the tracks found in a certain area belong to the same or to different individuals.

3.4.3. Nutritional analysis:

A study of the feeding behavior of rhinos requires food samples of individual rhinos and samples of plants available in the Reserve. Out of these samples it can be established whether the rhino has selected particular plans for feeding or whether it just took the plants along its way. Once we know that rhinos are selecting particular plans it will also be possible to