1.1 About the Sumatran Rhinoceros

The Sumatran rhinoceros (*Dicerorhinus sumatrensis*) belongs to the family Rhinocerotidae. The family Rhinocerotidae consists of five species of heavy land mammals found in the world today. They are characterized by a long nasal "horn" or "horns" which are not true horns but formed of a mass of compacted hair. Two rhinoceros species, the Black rhinoceros (*Diceros bicornis*) and the White rhinoceros (*Ceratotherium simum*) are found in Africa while the other three, the Javan rhinoceros (*Rhinoceros sondaicus*), the Indian rhinoceros (*Rhinoceros unicornis*) and the Sumatran rhinoceros are found in Asia. The Asian species are of the rarest mammals in the world with the Javan and the Sumatran being in imminent danger of extinction.

The Sumatran rhinoceros is also known as the Lesser Two-horned rhinoceros. It is the smallest and hairiest living rhinoceros in the world. It is also a solitary animal with a home range of about 15 to 30 km^2. The average shoulder height and body length of these animals is about 112.7cm and 291.5cm respectively. Its frontal horn is often so inconspicuous that it appears to be single. However, the nasal horn is generally short, the record from a well-authenticated specimen being 381mm. The average body weight of the Sumatran rhinoceros is about 600kg. This rhinoceros is also characterized with two distinct folds on its body, which makes the animal's body looks like it is being segmented into three parts.

The Sumatran rhinoceros was historically found from the Indian subcontinent to Burma, Thailand, Indo-China, Malay Peninsula, Sumatra and Borneo Island. By 1960, the species is extinct in most of its ranges in India and Burma. The animal is now confined to scattered habitats in Thailand, Peninsular Malaysia, Sumatra, Sabah and Sarawak. In Peninsular Malaysia, the viable Sumatran rhinoceros populations can only be found in four main areas, Taman Negara, Endau Rompin, Belum and Selama in Perak..

The estimated number of Sumatran rhinoceros in Peninsular Malaysia in 1999 is 43 to 52 animals. This estimate has reduced by about 60% since the 1993 survey. This factor must be taken seriously despite acknowledging the fact that it is only an estimated number. The decreasing number of this

species is attributed to several factors. The first factor is that the animal's habitat is slowly disappearing. The extensive habitat destruction from logging to forest clearance for agriculture and development purposes has greatly reduced the amount of habitat suitable for the animal. The second factor also deals with the habitat destruction whereby the animals are isolated into small islands of pocketed forest, which prevents them from meeting each other to mate. Poaching of these endangered species is also a factor contributing to the declining numbers. The animal is poached for its horn, hide and blood for many centuries. Contrary to popular belief, rhino horn is not mainly used as an aphrodisiac but as cure to illnesses such as headaches, high fever and asthma. The low number of the species coupled with their solitary behaviour and long gestation period (15 months) hampers the survivability of the species in the wild.

Sumatran rhinoceros that are forced out from their habitat into plantations, villages and timber camps are very vulnerable to poachers. From 1984 to 1994, the Department of Wildlife and National Parks rescued eleven Sumatran rhinoceros from these unnatural habitats. In addition, there were ten recorded cases of the Sumatran rhinoceros carcasses found who fell prey to unscrupulous hunters that killed them for their horns. The rescued animals were taken to Zoo Melaka and later, in 1991 to the Sumatran Rhinoceros Conservation Centre in the Sungai Dusun Wildlife Reserve, Selangor.

1.2 The Rhinoceros Conservation Center

The Rhinoceros Conservation Centre (RCC) is where all the ex situ conservation work of the Sumatran rhinoceros is carried out. It is situated within the Sungai Dusun Wildlife Reserve (SDWR), located at the northern tip of Selangor and comes under the jurisdiction of the Department of Wildlife and National Parks (DWNP). The size of the reserve is 10 400 acres and bordered by two rivers, Sungai Dusun in the south and Sungai Tengi in the north which are connected by a canal. The center could be accessed by roads from Tanjung Malim, Perak (29km) in the east, Sungai Besar, Selangor

(50km) in the west and Batang Berjuntai, Selangor via Felda Sungai Tengi in the south.

The centre is headed by a senior wildlife veterinarian, and assisted by a contract veterinarian and seven rangers (5 DWNP staff and 2 contract labourers). Two males and five female Sumatran rhinoceroses are managed at the centre. Three of these animals were originally from this reserve. It is interesting to note that the SRCC possesses most (50%) of the world's captive Sumatran rhinoceros population. The world's captive Sumatran rhinoceros population is shown in Table 1.

The rhinoceroses are kept in a pie shaped enclosure with ten night stalls and seven paddocks. A natural enclosure of 10 acres in size was built in 1996 and now houses a pair of the Sumatran rhinoceros for breeding purposes. Another 100 acres of natural enclosure was just completed and a pair of rhinoceros will be released into the enclosure by the end of year 2000. Besides the enclosures, an interpretive center and a campsite has also been completed. The center is expected to function fully as a Sumatran rhinoceros research center and nature education center by the middle of year 2001.

The main objective of this center is to breed the endangered Sumatran rhinoceros. The "gene-pool" concept is used here, where the animals are released into their natural habitat, which in this case, is the 10-acre and 100-acre enclosure, to allow it to breed on its own. This concept also satisfy one more of the center's objective, which is to return the animals to the wild, but under close security to protect it from poachers.

To date the Government of Malaysia have spent in excess of **RM5,000.000** for the infrastructure and operating costs including staff salaries, feed costs and maintanence.

Table 1: World Captive Population and Location of Sumatran Rhinoceros

Breeding facility	Studbook number	Name	Sex	Capture or Birth (Year)
Cincinnati Zoo and Botanical Garden, Cincinnati, USA	27	Rapunzel	Female	1989
	28	Ipuh	Male	1990
	29	Emi	Female	1991
Sumatran Rhino Sanctuary, Way Kambas, Lampung, Indonesia	4	Torgamba	Male	1985
	32	Bina	Female	1991
Sepilok Orang Utan Rehabilitation Centre, Sandakan, Sabah, Malaysia	38	Tanjung	Male	1993
	40	Gologob	Female	1994
Sungai Dusun Rhino Conservation Centre, Selangor, Malaysia	7	Rima	Female	1986
	13	Panjang	Female	1987
	15	Minah (Captive born)	Female	23/5/1987
	19	Mas Merah	Female	1987
	20	Shah	Male	1988
	23	Seputih	Female	1988
	39	Ara	Male	1994
	1	Jeram	Female	1984

Source: International Studbook for Sumatran Rhinoceros, 31 October 1999

Likewise, the RCC's other objectives are to be the center for research and reference of the Sumatran rhinoceros worldwide and to educate the public on nature conservation. The RCC team and local researchers are currently carrying out research on reproduction, behavior and habitat utilization of the Sumatran rhinoceros. The public, especially school children are taught about the importance of nature and the Sumatran rhinoceros is used as the flagship species to stress the point. With plentiful of natural resources, this center is used as a "living classroom" for the school children to have hands-on experience on what they have learnt.

The Sumatran rhinoceros conservation efforts worldwide concentrate on the captive breeding of this animal. The RCC is in liaison with the other centres mentioned earlier where information is shared among centres on the latest development in Sumatran rhinoceros research.

2.1 Management and Husbandry of Sumatran Rhinoceros

In a captive facility, a very important component of the conservation work is to manage the animals and make sure that they are healthy. If the animals are not well taken care of, then, other conservation work cannot be carried out.

The eight rhinoceroses in the center follow a daily routine of being let out to the yard in the morning and then they are kept back in the night stalls in the evening. The rhinoceros that is in the 10-acre enclosure does not follow this routine as it is allowed to remain in the enclosure day and night till it is time for another rhinoceros turn to enjoy this big enclosure.

Food is given 2-3 times per day, in the morning, afternoon and the final feeding in the evening, for the animals to munch through the night. In addition, supplemental vitamins and minerals are provided daily in the drinking water. Below is the proportion and the type of food given to each rhinoceros at the RCC:

Table 2: Daily requirement of individual captive Sumatran Rhinoceros at RCC

Type of Food	Weight (kg)
Horse Pellet (Cargill (M), Sdn. Bhd.)	3.0
Fruits Banana, papaya and jackfruit	3.0
Vegetable Sweet potato	1.0
Leaves Nangka (*Artocarpus rigidis*) Pulai (*Alstonia specilata*) Mahang (*Macaranga triloba & M. gigantea*) Kelompang (*Ficus variegata & F. glossolariodos*)	40.0-50.0

To ensure that the rhinoceroses are healthy, they are dewormed once every four months. Besides, each rhinoceros' yard must have a wallow for the animal to take a mud bath in, as it is known that rhinoceros that do not wallow will succumb to skin problems.

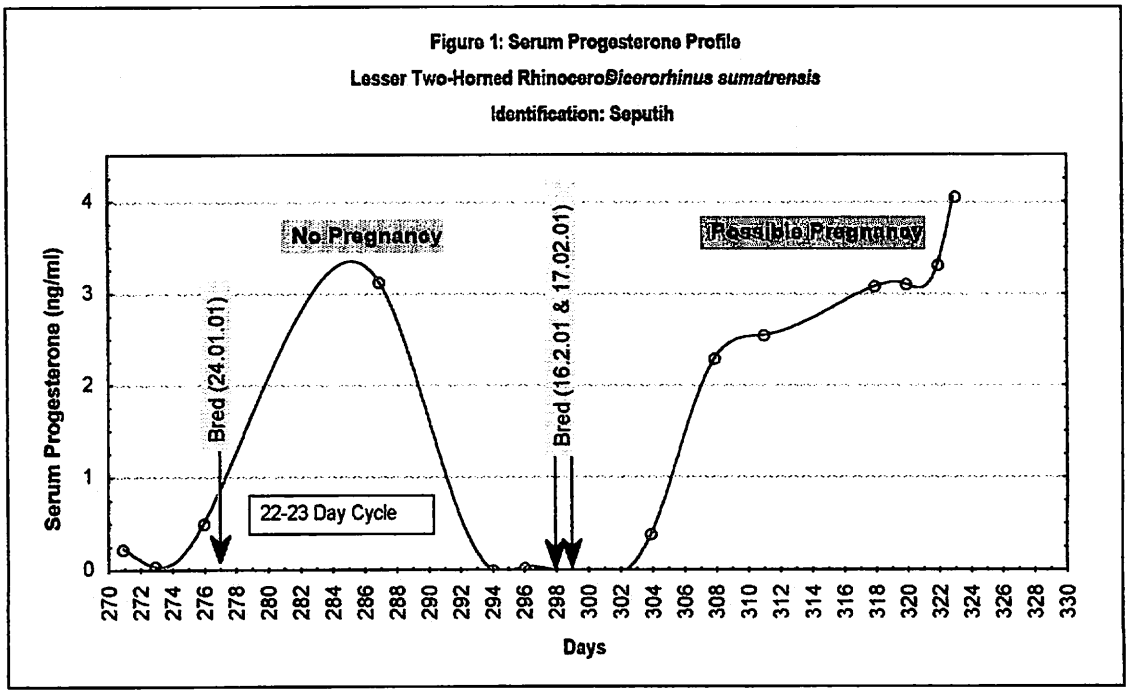
2.2 The Captive Breeding Program

There is only one Sumatran rhinoceros born in captivity in the 20th century. The calf was born in 1987 in Zoo Melaka, DWNP. Our Prime Minister Y.A.B. Datuk Seri Dr. Mahathir Mohamad named this female calf Minah. However, Minah's mother bred in the wild and was already pregnant when she was captured by the Department of Wildlife and National Parks. She gave birth after 496 days in captivity. Since then, no other births were recorded in captivity in the whole world.

In the Cincinnati Zoo and Botanical Garden, Cincinnati, USA, a female Sumatran rhinoceros is pregnant and should give birth within the next few months.

The breeding program started with the acquisition of a male through an exchange program with Indonesia in the mid-1980s. However, due to lack of understanding of the physiology and behavior of the Sumatran rhinoceros, most of the breeding introductions resulted in severe aggression by the male rhinoceros towards the female. In addition, the male that was acquired from Indonesia had a very severe chronic foot problem due to a cable snare that he sustained prior to being captured. The male subsequently died the following year. The post mortem showed a complete fracture of the second metacarpus of the affected feet and severe soft tissue injuries. This relates significantly to the problems he had during breeding. In 1988, the first male Sumatran rhinoceros (Identification: Shah) was captured in a pitfall trap in Sungai Dusun, Selangor by DWNP. However, the male was about 2 ½ years of age at the time of capture. Sexual maturity in rhinoceros occurs at about six years of age. In the early 1990's Shah was put to test with the females at the centre on a daily basis. Breeding introductions were carried out in a small 1/8-acre pie-shaped enclosure at RCC built in 1991. Although Shah mounted

the females, he only manages to obtain an erection but no copulation. Severe aggression was seen during some of the breeding introductions with wounds (cuts and punctures) inflicted on the females, some measuring more than 30cm long and 10cm deep. Due to the aggression, he was put on hold and efforts to acquire more information on the breeding physiology were undertaken via ultrasonography (ultrasound) and hormonal measurement. In 1994, a mature male (Identification: Ara) was captured in a logged area in Johor and brought to the center. In 1995 with the completion of the ¼-acre and 10-acre enclosures at the center, breeding introductions were carried out using the new male. Several females were tried out in different length of time ranging from a daily introduction to permanent pairing for several months. At one time, two females were put in together with Ara. Observations were carried out routinely and documented in a database sheet. Only one mating was observed with a female from Pahang (Identification: Seputih) but it did not result in a pregnancy. Despite the failure to get a pregnancy, the breeding introductions were continued. In 2000, it was discussed and decided at the Asian Rhino Specialist Group (AsRSG) meeting, that the breeding profiles (serum progesterone profiles) of the females should be tabulated and that breeding introduction should correspond to the time of estrus as indicated by this profile. In April, 2000, a collaborative effort was carried out with experts from the Theriogenology Laboratory, Veterinary Faculty, Universiti Putra Malaysia (UPM), DWNP and AsRSG to uptake this task of getting the serum progesterone profiles of all the female Sumatran rhinoceros at the center. Funding for the analysis was provided by the International Rhino Foundation, USA. The rhinoceros were bled twice weekly and the serum samples were sent to the laboratory for the analysis. The first successful breeding based on these serum progesterone profiles occurred on 19th October 2000 but did not resulted in a pregnancy. Subsequently, 10 more breeding were observed, involving three females. Although there were no pregnancies, efforts are being made to breed them regularly using the P4 levels as accurate guide.



2.5 Fund Raising

In an effort to conserve this species, the Department of Wildlife and National Parks and PATA Malaysia Chapter established a Malaysian Rhinoceros Trust Fund on June 5th 2000. The fund was established to enhance awareness among the travel industry on nature conservation in the country and to generate funds for the stewardship of this species.

Money collected for the trust fund will be used for rhinoceros conservation like the training of the keepers and management of the center. However, the money will not only be used for *ex situ* conservation but also *in situ* conservation, like the patrolling of rhinoceros habitat in the forest.

CONSERVATION EFFORTS AND THE RESULTS

3.1 On the Husbandry and Management

It should be known that the mortality rate of captive Sumatran rhinoceros was high in the 19th century. During that century, 55 Sumatran

rhinoceros were taken out of their forest into captivity and non-survive (Zainal Zahari, personal communication, 2000). Starting from 1984, eleven Sumatran rhinoceros were captured in Peninsular Malaysia. Three died while the rest are still living today (Zainal Zahari *et al.*, 2000). The first Sumatran rhinoceros that was captured in 1984 was a young male by the name of Erong. As no one knew the kind of food the rhinoceros eat at that time, Erong died of malnutrition. However, as information was gathered about the animal's biology, husbandry and nutrition, the mortality rate became lower. In actual fact, the center has zero mortality rate now.

3.2 On the Captive Breeding Programme

So far, the captive breeding of the Sumatran rhinoceros is not successful. There are no births of this endangered species in captivity. However, the Sumatran rhinoceros in Cincinnati Zoo is already pregnant and all four centers are awaiting the birth with much excitement. The team at the Sumatran Rhinoceros Conservation Center, in collaboration with the Faculty of Veterinary Medicine, UPM and the International Rhino Foundation are working hard to breed the animals. Hopefully, with the knowledge gained from the current research here, there will be a birth in the near future for this center. If efforts to breed the Sumatran rhinoceros naturally fail, then unnatural methods will be used. The rhinoceros will be bred using assisted reproductive technology, which includes estrus synchronization, estrus induction, semen collection, cryopreservation and artificial insemination.

3.3 On the Reference Centre for Sumatran Rhinoceros

More then 50 publications were generated from this center. The publications cover a wide range of subjects on the Sumatran rhinoceros like; nutrition, physiology, anatomy, disease, morphometrics, endocrinology, ultrasonography, parasitology, ethology, reproductive biology, molecular systematics and hematology. The reference center intends to share its

information of the Sumatran rhinoceros to anyone that wants to obtain good scientific facts on this species.

Four undergraduates and one master student from local universities have completed their thesis on the Sumatran rhinoceros in this center. Currently, three local master students are carrying out their research here. Two are from the Faculty of Veterinary Medicine, UPM while the third student is from the Faculty of Science and Technology, UKM. The center hopes to attract more students to do their research here in the coming years as to add to the growing information on the Sumatran rhinoceros.

3.4 On the Public Education and Awareness

This center is not fully open to the public. The reason is the Sumatran rhinoceros are very precious animals to the Department of Wildlife and National Parks as they are so rare and endangered. Visiting public would give some amount of stress to the animals and unknowingly, the visitors may feed the animals with unsuitable food or bring in diseases which could result in their death.

Notwithstanding, many people have heard of this center, especially from the international arena. The center can be found on the web site of the International Rhino Foundation. It is also slowly becoming famous in the national scene, through publicity from the newspapers and articles written in easy reading magazines like the Malaysian Naturalist. Hopefully, more personnel will be hired to aid the center in spreading public awareness and educating the people on the plight of the Sumatran rhinoceros once the interpretive center is fully opened.

3.5 On the Fund Raising

As the trust fund has just been set up, not much fund has been collected yet. However, film companies that film or photograph the rhinoceros and visitors who come to the center will usually give a small sum as a token for the guided tour of the center. This money will be put into the fund.

CONCLUSION

Like all conservation work, the main setback the Rhinoceros Conservation Center faces is lack of funds. Funds are needed for research work, equipment for the research, creation of public awareness and to fence up the whole of Sungai Dusun Wildlife Reserve. The Government has already contributed USD 2,000,000 towards the conservation of this species. Other contributors are the United Nations Development Programme and the International Rhino Foundation.

The Javan rhinoceros once existed in Peninsular Malaysia but became extinct in 1932. The last animal that was killed is now in the British Museum. History should not repeat itself with our last rhinoceros species, the Sumatran rhinoceros.....