CHAPTER 15

BREEDING MANAGEMENT OF THE SNOW LEOPARD AT NEW YORK ZOOLOGICAL PARK

James *Doherty and Dan Wharton*

Since 1966, the Bronx Zoo has produced 48 snow leopard cubs. Some of the cubs born in the last several years are the great-great-grandchildren of the Bronx's male Sherpa (Bronx 16) born in 1966.

These five generations have all been bred and reared in the Zoological Park's Lion House which opened in 1903. Equipped with many wire-mesh cages, the Lion House is not a pretty facility by today's standards. Like many zoo buildings of its age, it contains exhibits that were designed more for visitor viewing than for total appreciation of large felines in ecological context. Fortunately, the cages are relatively large, contiguous and airy (if uninteresting) and dens are secluded. In short, the facilities have proven adequate, given thoughtful management to the species in them. Rieger (1978) has given general guidelines for housing, care and feeding of snow leopards. These aspects of snow leopard husbandry will not be dealt with in this paper. Instead we will focus primarily on management and manipulation for cub production.

HOUSING OF MALE AND FEMALE ADULTS

Male-female compatibility is a significant consideration in many species breeding programs. Among snow leopard breeders, the compatibility question has led to two basic but different techniques in breeding management: (1) the first involves establishment of permanent similar-aged, monogamous pairs usually before sexual maturity, while (2) the alternative involves management of adults as solitary individuals with annual introduction and re-introduction of selected animals prior to estrus.

The first technique involving monogamous pairings has several advantages in that the increased sociality of immature animals makes introductions rather uneventful, and once established, monogamous pairs require little manipulation. It is well known in captivity that at least a few snow leopard males are tolerant of young. This, plus the references to adult pairs in the wild hunting cooperatively (Dang. 1967), have led some to propose that perhaps snow leopards may have a capacity for pair bonding (Freeman. 1978). Recent field data, so far. has not supported this hypothesis (Jackson, 1987); however, it is clear that monogamy can work in captivity as far as compatibility is concerned.

In regard to cub production, monogamy appears not to be the ideal strategy. Rleger's (1980) analysis of studbook data correlating breeding unit size with offspring per individual showed dramatically better cub production among the larger breeding units or non-monogamous arrangements. It is also interesting to note that several institutions—New York, Helsinki. Oklahoma, and Lincoln Park—with highly successful breeding programs do not keep males and females together continuously (Turner. 1980: Koivisto. et al.. 1977; Kitchener, et al.. 1975). An interesting question that remains open Is whether or not monogamous pairs might do as well as those managed as temporary pairs if provided some sort of sensory contact with conspecifics other than themselves. Monogamous pairings often consist of the only snow

leopards In the collection. The Bronx collection today usually consists of 15 to 20 snow leopards.

The use of the temporary pairing strategy for cub production reopens the compatibility concern each year. Compatibly for mating, however, has not yet been a significant problem in the New York collection. Since 1971. prospective matings are decided upon in late fall and the appropriate males and females are placed in adjoining enclosures at this time.

In early January, wire mesh doors are substituted for solid doors so that visual and tactile contact between the animals is added to the olfactory and auditory contact of the previous few weeks. Mutual interest is generally low at this time. By late January, when mutual interest begins to increase, the introductory door Is opened and the animals are allowed to be together for a few minutes to an hour each day (usually in the morning). All pairs are watched but pairs that have not mated previously are watched closely. All introductions are accomplished with den doors closed to prevent hiding (and potential for unobservable aggression) during introduction periods. The door between the two enclosures is left open so that animals can choose to remain in familiar surrounding or explore the potential mate's area. Water hoses with pressure nozzles are kept within easy reach in case of serious fighting, as a strong blast of cold water Is effective in interrupting an aggressive encounter.

Although slaps, growls and threatening postures are no* uncommon during these early introductions (even among previously mated pairs), the need to resort to quick separation of the animals has been infrequent.

ESTROUS CYCLES

In New York, first estrus of the season occurs consistently in mid-February. Records here show matings occurring in February, March, April, May and June with one female experiencing four estrous periods in one year (Bronx 18 in 1973} all four of which elicited copulation by the male (Bronx 16) but none resulted In a pregnancy. Another female (Bronx 15), was observed to mate in June in two separate years approximately three and half weeks after giving birth to stillborn litters. Neither of these June matings resulted in additional litters. There are unpublished anecdotes of postpartum estrus with similar intervals between birth and estrus (about 24 days) among managers of other snow leopard collections.

A day or two before estrus, some mounting without copulation may occur. An introduction of an hour or so without copulation is consistently a sign that full estrus has not yet arrived. Once copulation begins, animals are left together for four to eight hours per day during the working hours of the zoo staff. Rieger (1980) noted that copulation among snow leopards is more frequent at night and wondered if induced ovulation wotild be hampered by non-access of mates at night. Our experience would suggest that several hours during the day is sufficient stimulation.

Mating pairs are introduced every day until copulation ceases for two full days. Estrus, as exhibited by copulatory behavior, lasts from four to eight days, usually five or six. Rieger (1984) reported a mean estrus duration of 4.4 days. Reintroduction begins again about three weeks later and continues for a week or more until estrus begins again or until it is clear that estrus will not occur again (indicating probable pregnancy). At that point, usually in April, no further Introductions of males and females are made. Dens are fully prepared for expected births at least a month before the due date (approximately 100 days after copulation commences), usually with video monitors mounted and operational at this time. Most females will show an increase in

girth in the last trimester of pregnancy, although females carrying a single cub may not. Behavioral changes including increased interest In the den box are often noted a few days before birth although this is not consistent either.

ROTATION STRATEGY

The above summarizes the usual procedures for mating snow leopards at New York Zoological Park since the 1970's. However, in earlier days, the first breeding pair (Copenhagen 9 and Bronx 15) were kept together continuously except during an unusual period when mateless females from other collections were sent for "stud service" by Copenhagen 9. The following case histories illustrate the use of a rotation strategy for impregnating more than one female by a single male.

In 1967. Oklahoma City 2 Tanya arrived on January 31 and was first introduced to Copenhagen 9 Bowser on March 28. Bowser and his resident mate, Bronx 15 Miss Bronx Zoo, were observed breeding February 27 to March 1 and again on April 2 and 3 after rotations between the two females began. During this time, the male and female were kept together 24 hours per day, which may explain why breeding behavior was observed for fewer days than it is now when mating is closely monitored and pairs never remain together overnight. Tanya was observed mating with Bowser on April 18 and 19 only and was not reintroduced to Bowser after April 28. On June 13, Tanya was returned to Oklahoma City where she gave birth to two healthy cubs on July 27.

Bronx 15 mated for a third and last time for the season with Bowser May 17-19 but she did not produce cubs in 1967. She had produced two healthy cubs, which were handreared. the previous year.

Encouraged by the success of 1967. Tanya was returned to the Bronx Zoo for a second time on February 15, 1968. Only a single day of mating with Bowser was observed, on March 13, the day of the first introduction. Bowser was again moved back and forth between the two females every week or so. No further introductions to Tanya occurred after April 20 and she was returned to Oklahoma on April 30. On June 21, Tanya again gave birth to two healthy cubs. Bronx 15 was observed mating with Bowser February 4 through 6, prior to Tanya's arrival. Two stillborn cubs were born to Bronx 15 on May 14 and 16. On June 8. Bowser and Bronx 15 were observed mating again but as noted elsewhere in this paper, no cubs resulted.

In 1969 and in 1970 Bowser was rotated to three females. The Milwaukee County Zoo, without a male, sent female Milwaukee 2 Smiley in the late spring. 1968 to be mated with Bowser in 1969. Oklahoma City Zoo sent Tanya for a third year, and plans were made to breed Bronx 15 as usual. A schedule was planned for rotation of the male among all three females. Assuming that estrus would occur in February, March and April in each of the three females at three to four week intervals, it was estimated that Bowser would be present for one estrous period per female if he were rotated to each of them at approximately five-day intervals. Bowser and Bronx 15 were housed together almost continuously until the rotation began and had been observed mating February 16 and 17. It was considered important to continue Bronx 15's exposure to the male since pregnancy was not assured.

Beginning February 26. 1969. Bowser was placed with Tanya. On March 3, he moved on to Milwaukee 2. On March 7. he was returned to Bronx 15. The cycle continued in this order with Bowser being moved on March 11. 15. 19, 23. 27. 30, April 4, 8, 12, and 17. On

April 17, Milwaukee 2 was returned to Milwaukee. Tanya was returned to Oklahoma City on May 12.

No matings were observed during the rotation period; however, on June 11, 1969, Milwaukee 2 gave birth to two healthy cubs indicating that mating probably took place during the March 3-7 period. Oklahoma City's Tanya did not produce cubs that year, and Bronx 15. the resident female, gave birth on May 27 to two cubs but they lived for only four days.

In 1970, the Bronx Zoo had two resident females it wished to breed to Bowser in addition to Tanya, Oklahoma City 2 who was to be bred for the fourth and last time. The latter arrived February 17 and was introduced to Bowser February 25. Mating was observed beginning the next day through March 1. A similar schedule of rotation to that of the previous year was followed to accommodate the three females. Bronx 18 Mitzi was bred March 27 and 28 and produced a single stillborn cub on July 7. Tanya once again produced no cubs, returning to Oklahoma City on April 29. Bronx 15, who was not observed mating in 1970, produced a litter of three on May 14, Indicating that mating had taken place in early February before the rotation schedule began.

CONCLUSION

The International Pedigree Book of Snow Leopards (Blomqvist, 1984) lists all known captive snow leopard births through 1983. Several collections other than Bronx have had more than one litter sired by the same male in the same year indicating that rotation of males in some form is feasible and can be accomplished with some regularity. We are not aware of other cases where females have been shipped in for breeding and shipped out again while pregnant.

Now armed with more knowledge on snow leopard breeding biology, a long history of reproductive performance in the Bronx Zoo and a method for pregnancy testing in snow leopards [Taylor et al., 1983), we believe that a rotation schedule described above Is not the best method for assuring multiple pregnancies In the same year from a single male. Although extant literature on the subject suggests that snow leopard estrous cycles are largely endogenous with light cycle functioning to some extent as a trigger for the onset of estrous (Freeman and Braden, 1977), recent experience with snow leopards in the southern hemisphere (Melbourne and Wellington Zoos, where breeding season for these cats is reversed) strongly suggests that estrous cycles are light cycle dependent. It appears to us (in considering 20 breeding seasons at the Bronx Zoo) that female snow leopards In a given location tend toward synchronization of estrous cycles, an observation compatible with light cycle dependency. Rieger (1984) observes that two females in the same cage are never synchronous although the interval between the end of the first female's estrus and the beginning of the second female's can be very few days.

The likelihood of estrus occurring at about the same time among females in the same collection, combined with the seasonally polyestrous nature of the snow leopard, suggests that a better strategy for mating two or more females with the same male is to concentrate on one female at a time beginning with the first expected estrous period. Cessation of copulation after several days duration is not only a good indicator of when to begin separation and introduction to the next female, but is also a fairly accurate indicator of pregnancy, particularly among proven breeders. In rotation mating, it is probably inadvisable to invest time in reintroduction of females which have already copulated successfully that season, especially if more than two females are

to be mated.

Postscript: The Bronx Zoo opened its Himalayan Highlands Exhibit in September 1986 [Doherty, 1987). This state-of-the-art facility presents three large naturalistic exhibits and is equipped with off-exhibit holding/breeding enclosures for 18 animals. Two litters of snow leopards were born in the new facility in June. 1987.

REFERENCES

Blomqvist, L. 1984. Register 4. *int. Fed. Book of Snow Leopards*^ 4:123-142.

Dang, H. 1967. The snow leopard and its prey *Cheetal.* 10(1): 72-74.

Doherty, J. 1987. The exhibition and management of snow leopards in the Himalayan Highlands Exhibit in the Bronx Zoo. *AAZPA Annual Conference.* Portland, Oregon (Proceeding in press).

Freeman. H. 1978. Social behavior In the snow leopard and its implications for captive management. *Int. Fed. Book of Snow Leopards*^ 1:71-77.

Freeman, H. and Braden, K. 1977. Zoo location factor in the reproductive behavior of captive snow leopards. Zooi. Garten., 47:3/4, 280- 288.

Jackson. R. 1987. Snow cats of Nepal's Langu Gorge. *Animal Kingdom,*. 4:44-53.

Kitchener. S.. Meritt, Jr., D.; Rosenthal. M. 1975. Observations on the breeding and the husbandry of snow leopards at the Lincoln Park Zoo. Chicago. *Int. Zoo Yearbook,* 15:212-222.

Koivisto. I; Wahlberg, C.: Muuronen, P. 1977. Breeding the snow leopard at Helsinki Zoo 1969-1976. *Int. Zoo Yearbook.* 17: 39-44.

Rieger. I. 1978. Management techniques of captive ounces, *Uncia uncia. Int. Fed. Book of Snow Leopards,* 1:50-70.

Rieger, I. 1980. Some difficulties in breeding ounces. L/ncia *uncia,* at zoological gardens. Jnt *Ped. Book of Snow Leopards,* 2: 76- 95.

Rieger, I. 1984. Oestrous timing in ounces *Uncia uncia,* Schreber (1775). *Int Ped. Book of Snow Leopards.* 4:99-103.

Taylor, D., Meuli. L., and Thau, R. 1984. Comparison of urinary steriods in the Siberian tiger and the snow leopard during estrus and pregnancy. *Biology of Reproduction* (Supplement 1). 30: 66 (abstract only).

Turner, L. 1980. Oklahoma City Zoo —Twenty-nine Snow Leopards. *Int. Ped. Book of Snow Leopards,* 2: 76-111.