A case of programmed cheetah *Acinonyx jubatus* breeding

TED A. BENZON[1] & RICHARD F. SMITH[2]
[1]*Hogle Zoological Gardens, Salt Lake City, Utah 84110, and* [2]*Department of Psychology, University of Utah, USA*

Until recently, breeding in captive cheetahs *Acinonyx jubatus* has occurred more by accident than through planned parenthood. However, a cheetah was born on 5 November 1973 at the Hogle Zoo as the result of behavioural analysis, careful planning and co-operation from the animals concerned. This report describes our role in eliciting the reproductive behaviour which led to the birth.

In a previous paper we made the observation that one significant difference in the condition of cheetahs in the wild and those kept in captivity is that whilst in zoos the sexes are generally housed together or within visual and/or olfactory contact, in the wild ♀♀ spend most of their time in isolation and ♂♂ travel in hunting groups (*3*). The fact of social interaction amongst ♂ cheetahs and the probable existence of an aggressively maintained dominance hierarchy within the ♂ group led us to the hypothesis that this aggressive behaviour – and the ♀'s awareness of it – is a necessary prerequisite for the stimulation of receptivity and possible post-copulatory reflex ovulation. That ♀ observation of aggressive interactions within the ♂ hierarchy may excite and direct reproductive behaviour has been known in other species. While it has not been proven in cheetahs, the theory is supported by published reports where breeding has resulted following ♀ isolation and has been accompanied by aggressive interactions (see *3*).

Our first problem was to demonstrate the existence of a ♂ dominance hierarchy within the captive environment. Given this situation, we reasoned that it would be a relatively simple matter to fulfil and test the second requirement for simulating the conditions operative in the wild, that of pre-oestrus isolation of the ♀ and her sudden exposure to inter-♂ aggression. Having identified the hierarchy, we

would also be able to control, and if necessary intensify, the aggression by the appropriate movement of animals, such as, for example, removal of the dominant ♂ and his replacement just before the ♀'s oestrus.

Studies towards this end were conducted in 1972 at Hogle Zoo in Salt Lake City and their results seemed to confirm that a clearly defined dominance hierarchy did exist among the three ♂ cheetahs kept there (*3*). Two of them ($♂_1$, $♂_2$) had been captured as young adults in 1971, while the third ($♂_3$) was trapped as an infant and raised in captivity by humans. The ♀♀ had both been trapped as young adults in 1971; two tame ♀♀ used in the earlier investigation were not studied in the follow-up. A much weaker hierarchy observed amongst the ♀♀ was not considered to have any adaptive function.

ENCLOSURE

In early June 1973 a 753 m² enclosure affording a wide view of the Salt Lake Valley was completed (Fig. 1). One of the factors believed to encourage ♀ receptivity is a view of the surrounding landscape (see *3*). As shown, the animals can be shifted to any one of three sections of the enclosure. Of special interest are the culverts. These are of two sizes, those in the two smaller areas being 2·4 m long and 60 cm in diameter, while in the larger section they are 1·2 m long and 1·2 m in diameter. All the culverts are closed at one end and covered with soil to form a semi-natural cave. The enclosures are bare except for a few bushes and two small trees in the larger one. The small enclosures are roofed with fine wiremesh some 4·6 m above the ground.

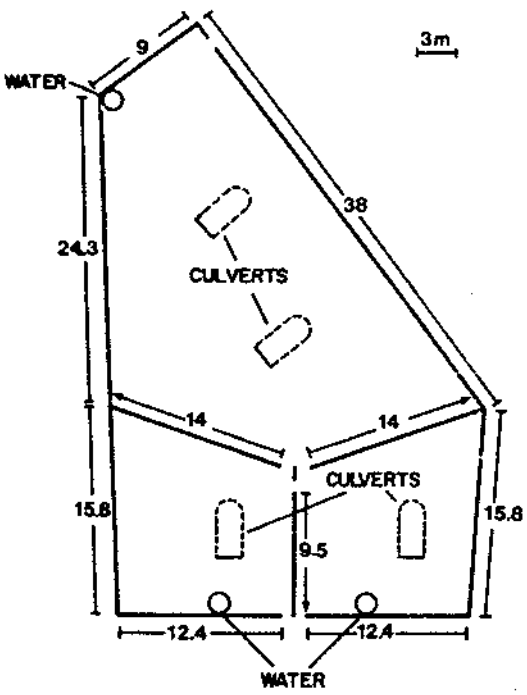

Fig. 1. Outdoor cheetah enclosure at Hogle Zoo, Salt Lake City. Access routes between cages are indicated by breaks in the solid lines.

EXPERIMENTAL PROCEDURE

As previously described (*3*), the sexes had been segregated at opposite ends of the feline building from December 1972 to July 1973. On 6 July the ♂♂ were moved to the outside enclosure, the ♀♀ remaining indoors. Towards the end of the month, we began to note various subtle alterations – such as increased general activity and intensified mutual grooming – in their behaviour. We were not certain whether or not these changes were indicative of oestrus, but as they took place at the appropriate time of year (*5*), we decided to introduce the ♀♀ into the ♂ enclosure. Because the ♂ group had exhibited a high level of aggression since being outside, we thought it unnecessary to further stimulate this by removing and then returning the dominant animal.

The senior author conducted observations for three one-hour periods a day. Once ♂♂ and ♀♀ were together, he kept watch for five minutes every half hour and continuously during the three hours before dusk. The animals were fed once in the evening, and water was available *ad lib* in the three positions shown in Fig. 1.

The ♀♀ were released into the ♂ enclosure at 0830 hours on 31 July and almost immediately the ♂♂ forced one of them

into a culvert. There she remained, surrounded by ♂♂ and fighting them off if they approached too closely, for the next 30 hours. The second ♀ was completely ignored. When food was offered at 1800, she was the only animal to eat. The ♂♂ maintained their siege until 1445 on 1 August, when the beleaguered ♀ left the culvert and ran to one of the water pans, the ♂♂ in pursuit. Her sudden movement seemed to precipitate inter-♂ aggression and throughout that and the following two days the ♂♂ fought continuously. The ♀ also warded off an increasing number of approaches. By 3 August the aggression was becoming increasingly ritualized and closely resembled the 'mating circle' described by Eaton (5). The fighting took place in a circular formation, with the ♀ lying close by, watching. As no mating occurred during this display, we prefer to designate this phase of courtship behaviour as the 'fighting circle'.

On the evening of 3 August, $♂_2$ was injured in a fight. About an hour later $♂_1$ succeeded in approaching the ♀ and sniffing her genital area. The next day the fighting circle intensified and that evening, $♂_1$ tried on five occasions to mount the ♀. Each time the attempt was foiled, either by the ♀ or by the other ♂♂ attacking. During two of the mounts, $♂_2$ tried to mount $♂_1$. On 5 August, the fighting circle became even more violent. Male 1 continued to try to mount the ♀ and this time she did not resist. However, the attempts were still unsuccessful because of the attacks of the other ♂♂. As it appeared as if the ♀ was now fully receptive, and only $♂_1$ had tried to mate, we decided on the morning of the 6th to isolate the pair in the large enclosure. That evening they were constantly together and the ♂ was permitted to sniff the ♀'s genital region. The next evening he was allowed to mount on three occasions. By 8 August, however, his attentions had noticeably diminished and although the pair was left together in isolation until the 16th, we saw no further breeding activity. All the animals were then reunited and the post-oestrous ♀ attracted no more special interest. Two days later she was again segregated and kept in a private cage until a week after she had given birth.

In the second ♀, there were no signs of breeding behaviour until 17 September, when she began to respond to ♂ approaches with high-pitched vocalization and escape behaviour, and the next day $♂_1$ attempted to mount her. It should be noted that this ♀ had been left together with the ♂♂ throughout the experiment; this was done intentionally so as to determine whether pre-oestrus isolation is a necessary condition for the stimulation of ♀ reproductive activity. Escape behaviour increased during 19 September but there were no more attempts to mate. Despite a few bouts of inter-♂ fighting on the 20th, neither the ritualized siege nor the fighting circle developed. That evening $♂_1$ and $♀_2$ were isolated in one of the smaller enclosures, but no further breeding behaviour resulted.

BIRTH

The first ♀ gave birth to a ♂ cub on 5 November 1973. Identifying pregnancy visually in cheetahs is reported to be difficult but this has not been our experience, and three weeks before parturition there was general agreement amongst her keepers that this ♀ was pregnant. She also became increasingly aggressive towards the keepers both before and immediately after the birth. In other respects, however, her maternal behaviour was not well integrated. Although the cub was cleaned immediately after birth, it was not seen to suckle. It appeared as if the ♀ was assuming nursing posture, but at some distance from the cub. On the evening of 6 November it was thought best to remove it for hand-rearing. This unfortunately was not successful and the cub died, of unknown causes, the next day, some 37 hours after birth.

DISCUSSION

This second phase of our study has revealed two important conditions for the successful breeding of cheetahs in captivity: (1) the necessity for pre-oestrus isolation of the sexes, and (2) that exposure to the ♂ dominance hierarchy plays an active role in rousing the ♀s receptivity, and perhaps in stimulating reflex ovulation.

The differences in the treatment of the two ♀♀ supports the first argument. Female 1 entered oestrus immediately before her introduction to the ♂ group, while $♀_2$ was introduced about seven weeks before the onset of her oestrus. The reproductive activity involving $♀_1$ was highly developed, including the persistent 'suitor siege', followed by the elaborate 'fighting circle', and these ritualized behaviour patterns continued for several days. In the case of $♀_2$, breeding activity was limited to mildly intensified aggression and one single attempted mounting.

The two different treatments also underline the part played by inter-♂ aggression. There was considerable aggression surrounding the courtship of $♀_1$ and she became receptive (and pregnant); while in the presence of $♀_2$ little aggression took place and only limited sexual behaviour resulted. The dominant ♂ proved to be the leader in courtship and he was the only one permitted to mate. This phenomenon has been observed in many other species (*1*; *2*; *3*; *6*) and it is generally concluded that the ♂ hierarchy acts to ensure the strongest genetic background for the offspring.

REFERENCES

1. ALLEE, W. C., EMERSON, A. E., PARK, O., PARK, T. & SCHMIDT, K. P. (1949): *Principles of animal ecology.* Philadelphia: W. B. Saunders & Company.

2. BARNETT, S. A. (1967): *Instinct and intelligence: behavior of animals and man.* Englewood Cliffs: Prentice-Hall, Inc.

3. BENZON, T. A. & SMITH, R. R. (1974): Male dominance hierarchies and their possible effects upon breeding in cheetahs *Acinonyx jubatus. Int. Zoo Yb.* **14:** 174–179.

4. DETHIER, V. G. & STELLAR, E. (1961): *Animal behavior: its evolutionary and neurological basis.* Englewood Cliffs: Prentice-Hall, Inc.

5. EATON, R. L. (1973): *The world's cats* **1**:. Portland: Metropolitan Printing Company.

6. LORENZ, K. (1963): *On aggression.* New York: Harcourt, Brace & World, Inc.

Manuscript submitted 23 April 1974