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Abstract: It is no shocking revelation to any animal keeper that cheetahs (*Acinonyx jubatus*) are very difficult to breed in captivity. Many cat species reproduce poorly in zoos, but cheetahs seem to have more challenges, ranging from poor genetic variability and gamete malformation to behavior nuances that complicate husbandry practices. At the Smithsonian's National Zoological Park (SNZP) we have been trying hard to overcome these obstacles and breed cheetahs. Although we cannot control their genetic situation we can manipulate our management to increase the potential for creating optimum breeding conditions.

Breeding Management Strategy for Cheetahs (*Acinonyx jubatus*) at the Smithsonian's National Zoological Park

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It is no shocking revelation to any animal keeper that cheetahs (*Acinonyx jubatus*) are very difficult to breed in captivity. Many cat species reproduce poorly in zoos, but cheetahs seem to have more challenges, ranging from poor genetic variability and gamete malformation to behavior nuances that complicate husbandry practices. At the Smithsonian's National Zoological Park (SNZP) we have been trying hard to overcome these obstacles and breed cheetahs. Although we cannot control their genetic situation we can manipulate our management to increase the potential for creating optimum breeding conditions.

In order to successfully explain how we manage our cats, it is necessary to describe how our yards and holding areas are set up. We have three cheetah exhibit yards that are visible to the visiting public. The largest yard (Yard 2) is 2,144 square meters, the neighboring yard (Yard 1) is 584 square meters, and the third yard (Yard 8) is 822 square meters. There are no visual barriers between Yards 1 and 2. Only a 2.1-meter high chain-link fence separates these yards so cats in either yard can have direct fence-to-fence contact with each other. Yards 1 and 8 are adjacent but separated by a fence and a four-foot wide patch of bamboo. Reed fencing attached to the fence in Yard 8 adds to the visual barrier. Because of the bamboo and reed fencing, the cats in Yards 1 and 8 have limited visual access to each other.

The off-exhibit holding area consists of a series of runways that connect to indoor housing (night houses) and outdoor holding yards. The night houses are eight individual adjoining rooms (the smallest is 1.75 meters x 3.5 meters while the largest is 2.3 meters x 3.5 meters). These rooms were designed primarily for short-term occupancy during severe weather, and can also be used to visually isolate cats from one another during breeding management. Lastly, there is an additional 349 square meters of space divided into eight outdoor holding yards for the cheetahs (see diagram of the NZP cheetah facility).

We have spent a considerable amount of time talking with keepers and managers at other cheetah breeding facilities and learning their breeding strategies. We have adjusted methods that have proven successful to fit our facility and hope that the information in this paper may prove beneficial in a similar manner to other institutions interested in breeding cheetahs. In 1999, the Species Survival Plan (SSP[®]) recommended that we breed cheetahs at SNZP. The process that we use to introduce an intended male and female for natural breeding is lengthy and difficult, but has resulted in nine successful copulations, one of which produced the first cheetah litter in SNZP's history (born November 23, 2004).

Males that were raised in coalitions live together, but we also house single males. All of our adult females are kept solitary in an attempt to repro-



First Cheetah Litter Born at NZP
(photo by Jessie Cohen, NZP photographer)

duce their natural social organization. We also make an effort to keep females as far apart from other females as possible due to the potential of estrus cycles being shut down (Wielebnowski et al., 2002). An important factor in breeding cheetahs is determining when a female is in estrus. Female cheetahs come into estrus roughly every 14 for a period of + / - two days (Brown et al., 2001). We conduct “investigations” to establish when a female is in estrus.

Investigations begin by moving the target female into Yard 1 and leaving her there for a minimum of two days. She is then moved into a night house where she is visually isolated from the other cats, particularly the males. A male or coalition of males is then given access to her empty yard to explore and his reactions are observed closely. The main responses we look for from the male are chirping, yelping, stuttering, running and an erection. If there is no response from the male within 30 minutes to an hour, he is moved out of her yard and another eligible male (one who is recommended by the SSP[®] to breed with that female) is moved into the yard. This process is continued until all eligible males have investigated the target female’s yard. Investigations will be conducted for one month or until males show a response. If no males react to her within a month’s time, then the possibility that she is not cycling needs to be explored. If any combination of the desired behaviors is observed, we assume that the female is cycling and continue with the next step of the breeding process.



Cub Hatima and mother Tumai at NZP

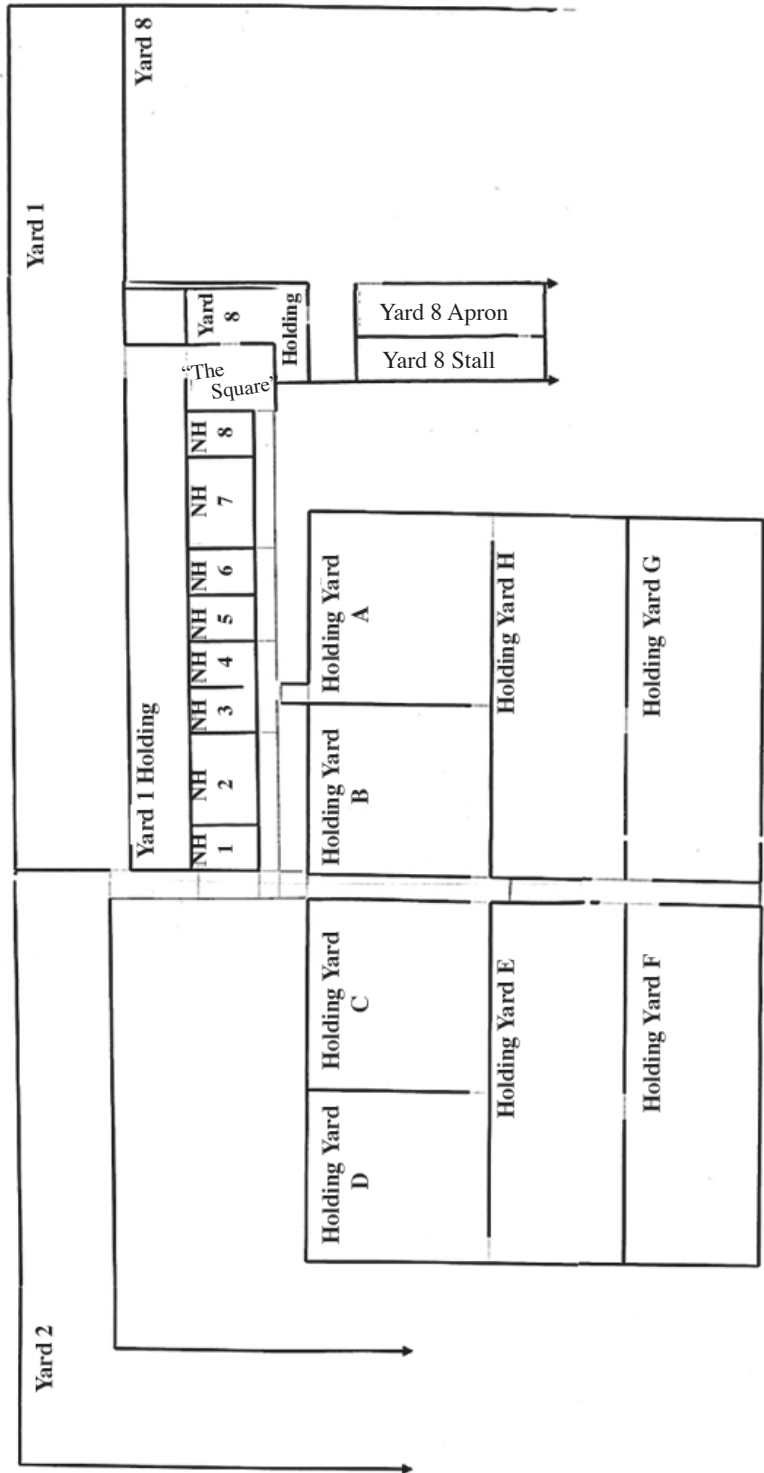
(photo by Jessie Cohen, NZP photographer)

In the next step, we shift the female into the adjacent Yard 2 so he can see her, and observe the reactions of both cats. Ideally, his behaviors should intensify and hers should include some combination of the following: tail flagging, rolling or head rubbing objects (particularly the fence near the male, allowing him to groom her). If she does not respond with any of these positive behaviors or avoids or acts aggressively towards the male, then the investigation with this specific male is discontinued and may be tried again the next day. A different male

may be tried to see if she responds more favorably to him. If she responds positively to the male, she is shifted back into the night house or holding yards to prepare for a breeding introduction. Note that when she is shifted out of Yard 2 and is no longer visible to the male, his vocalizations and running should grow even more intense.

Based primarily on the temperament of the cats involved, keepers determine where the breeding introduction will take place. Normally we use either Yard 1 or the holding yards. If cats are introduced together in Yard 1, two keepers will be in the yard with them ready to intervene if they get overly aggressive. The advantage of Yard 1 is that it is large enough that the cats have space to move around freely even with keepers standing in the yard with them. The yard is small enough that it is relatively easy to separate cats in the case of an emergency. The biggest problem with using this yard is that cats are sometimes distracted by the presence of zoo visitors. The holding yards offer us tremendous flexibility and ease for separating cats that become too aggressive. However, there is very little room for cats to move freely and though they have privacy from the public, in this setting keepers are not able to move away from them as we can in Yard 1 and can easily end up being a big distraction. In either case the female is always put into the introduction area first and then the male is allowed in with her. This gives the female the opportunity to avoid him if she is not interested in breeding.

NZP Cheetah Facility



When the male is introduced to the female, keepers watch the body language of both cats carefully. Is the male being aggressive (approaching the female with his head down and ears back) or solicitive (approaching her with his head up and stuttering)? Is the female running from him or is she walking with the potential of going lordotic? Keepers need to be very aware that some aggression is normal, but must be able to identify when the aggression level is becoming dangerous. For keepers with less experience putting cats together, it is always better to err on the side of caution. If it becomes apparent (this is a judgment call that can only be made by the keepers involved in the introduction) that the cats have little interest in breeding, then they are separated. If a breeding takes place, then the animals are separated at the first opportunity.



Mother Tumai and her four cubs play in the snow at NZP

(photo by Jessie Cohen, NZP photographer)

To conclude that a breeding has occurred, we look for key behaviors. In all instances where we have seen intromission and consider the copulation successful, we have noted several specific behaviors. The copulation lasts about 30 – 45 seconds. The male exhibited a flehmen response and hissed immediately after the female threw him off. The female immediately started rolling vigorously from side to side. These behaviors have also been documented at other facilities that have successfully bred cheetahs.



Cub Sanaa and four-year-old mother Tumai at NZP

(photo by Jessie Cohen, NZP photographer)

After the cheetahs have bred, we may attempt another breeding with the same pair of animals over the course of the next 24 hours. After that window we assume that the female is pregnant and we treat her as such, moving her to the maternity den and increasing her food amount

slightly every 30 days. It is not uncommon for cheetahs to go through false pregnancies after breeding. Since they are induced ovulators, when a female cheetah is bred and ovulation occurs, her body immediately goes into pregnancy mode. Her belly will get larger, she will begin to gain weight and in some cases even exhibit some maternal behavior. In a false pregnancy these changes cease abruptly 60 – 70 days after the breeding (Saffoe, 2005). In a true pregnancy they continue until she completes her three-month gestation.

Though we have had only one litter of cheetah cubs born at SNZP, we consider our breeding strategy successful. From 1999 to 2004 we had nine breedings. Six of these resulted in false pregnancies, all with females between the ages of seven and 12 years. The first time we implemented this strategy with a young female (four years old), she became pregnant and gave birth. This indicates that the biggest hurdle we were facing was the age of the females we were breeding. We are well aware that there are numerous factors that go into the success of breeding cheetahs at any facility. The strategy that we employ provides us with the optimum conditions by which to continue breeding these cats long into the future.



On 21 August 2004 Tumai, a four-year-old female, and Amadi, a 10-year-old male were introduced for breeding. After a 95-day gestation, Tumai gave birth to a litter of four healthy cubs on 23 November 2004. (photo by Jessie Cohen, NZP photographer, January 2005)

Cheetah Cub Fast Facts

- Cheetah cubs are born with long, grey fur. Some naturalists think that this mimics the Ratel (*Mellivora capensis*), a fierce relative of the badger that few animals dare attack.
- Cheetah cubs have a long mane on their neck and shoulders that disappears as they get older.