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Reproduction, growth and parental care in Crab-eating foxes

Cerdocyon thous

at the National Zoological Park, Washington

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The Crab-eating fox *Cerdocyon thous* is a small canid with a wide distribution in South America. In nature, they are most often observed in pairs and they form long-term pair bonds in captivity (Kleiman & Brady, 1978). Little has been published on their breeding habits and captive management (Coimbra Filho, 1966) and when, in 1975, the National Zoological Park's Conservation and Research Center initiated a long-term investigation into the breeding habits and social behaviour of South American canids, they were one of the species included. The following report summarises information on the reproduction, behaviour and physical development of three pairs of captive Crab-eating foxes and their 18 offspring during the period January 1976 to the end of February 1977.

MAINTENANCE

Each pair of foxes is housed in a 1·2 × 2·4 m indoor den with an adjoining 9 × 5 m outdoor yard and access to a 2·5 × 3·6 m indoor run during the winter months. Pregnant ♀♀ are provided with a nestbox with a transparent top and the dens are illuminated with red light which permits observations, through a small hole in the den ceiling, of the parents and young without disturbing them.

The animals are each fed 300 g of Nebraska Brand feline diet daily with an occasional mouse or oxtail. The food ration of lactating ♀♀ is increased according to demand.

REPRODUCTIVE BEHAVIOUR

Crab-eating foxes become sexually mature during the first year. The appearance of raised-leg urinations, which are common to both sexes, indicates the onset of sexual maturity. The ♂♂, like other canids, raise the hind leg back and outwards. Females raise the hind leg forward and rotate the rump slightly towards the marking site. Young ♂♂ begin scent-marking (using the raised-leg posture) at five months of age, but only one ♂ in each litter does so. This was observed regardless of whether the father was present or absent during the rearing and it is possible that the young ♂ which first establishes the behaviour might inhibit it in other ♂ siblings. Females have not been observed to develop the raised-leg posture until eight months of age. This sexual dimorphism might be due to an inhibitory influence of the mother on her daughters or might be a physiological difference similar to that described for Red foxes *Vulpes vulpes* (Storm *et al.*, 1976).

Two ♀ siblings, captured as pups, came into oestrus at an estimated age of nine months and

LITTER NO.	♀	DATE OF LAST OBSERVED COPULATION	DATE OF PARTURITION	GESTATION PERIOD	LITTER SIZE	NO. REARED	COMMENTS
1	1	8 Jan 1976	8 Mar 1976	59	2.1	2.1	$♀_1$ 9 months old when mated
	2	6 Jan 1976					
	3	9 Jan 1976					
2	2	?	25 Jun 1976	?	2.2	2.2	
3	1	25 Aug 1976	23 Oct 1976	59	1.4	0.3	one ♀ hand-reared from day 30 on
4	3	2 Dec 1976	23 Jan 1977	52	5.1	5.1	sired by ♂ from litter 1
5	2	1 Jan 1977	24 Feb 1977	54	?		killed at birth (possibly by young of previous litter (2))

Table 1. Data on three breeding ♀ Crab-eating foxes *Cerdocyon thous* at the National Zoological Park, Washington.

one ($♀_1$ Table 1) became pregnant and successfully reared her young. However, young ♀♀ left with the family did not show a noticeable oestrous period at nine months. Young ♂♂ are capable of breeding in the first year. A captive-born ♂ (from the first litter) sired a litter (4) at nine months, and six-month-old ♂♂ showed interest and attempted to mount their mother when she came into oestrus.

The animals in the study group bred twice a year with approximately an eight month inter-birth interval (Table 1). Two oestrous periods in one year is a rare, but not unique, condition in wild canids (Kleiman, 1968; van Lawick & van Lawick-Goodall, 1971; Kleiman & Brady, 1978). In Venezuela, pregnant foxes have been found during most seasons (E. Mondolfi, pers. comm.), although on the llanos, young appear mainly in February and March (J. Eisenberg, pers. comm.).

Copulatory behaviour in the Crab-eating fox was similar to that described for other canids (Kleiman, 1968; Ewer, 1973). Copulations were observed over a three-day period. Copulatory ties lasted from five to eight minutes and the pair stood back to back while tied. The average gestation period, calculated from the last observed copulation, was 56 days but there was considerable variation (Table 1).

PARENTAL BEHAVIOUR

Pregnant ♀♀ remained close to the den as parturition approached. The ♂♂ remained with their mates at birth without conflict. However, one ♀ whose pair-mate was removed before parturition reared the litter alone (litter 1). Females did not attempt to exclude their mates from the den at birth and ♂♂ generally slept in front of the nest-box. They frequently poked the muzzle into the nestbox and sniffed the ♀ and pups. If the pups were handled and a foreign scent was present, the ♂ would enter the box and sniff each pup. Both parents growled and barked at keepers who entered the outside yard during the early rearing period.

For the first three days after parturition ♀♀ generally left the den either to eat or eliminate although several did not take food for the first two or three days. The mothers spent most of the time sleeping or licking the pups; however, they all left the nestbox for an occasional walk around the den.

When returning to the nestbox or when changing position in the box, the ♀ avoided reclining directly on the pups. She would usually circle several times and reposition the pups by pushing with the muzzle, before lowering the head and shoulders to the ground and then gently sliding forward to lower the hind-quarters last. This usually resulted in the pups being positioned on the mother's ventral side.

Occasionally pups would be dragged out of the nestbox because they held on to the teats as the ♀ left the box. They were retrieved from the den floor by either parent when they whined. Both parents also licked the pups' anogenital region and ingested the excreta. The ♂ rarely entered the box to clean the pups but began cleaning them regularly around day 17 when they began to crawl out of the box. The parent would push the muzzle under the pup's belly and flip it on to its back so that the entire ventral area could be licked. As the pups grew older they attempted

to avoid the cleaning routine but the parents would chase, pin them with a foreleg and clean them. This behaviour decreased in frequency as the young foxes became efficient at escaping the adult's hold.

During the early stages of rearing the adults were fed in the outdoor yards. The ♂♂ were not observed carrying food to the ♀♀ but both parents were first seen transporting food to the young on day 16. Chunks of food were carried and dropped in the den rather than regurgitated. Adult ♀♀ cache food randomly throughout the yards using the muzzle to cover it with soil in a typical canid fashion.

A striking change in the ♀♀'s scent-marking behaviour occurred after the birth. They no longer marked the yards with raised-leg urinations nor were they observed to anal rub or rub the flanks against their mates' marks, all of which were commonly observed outside the rearing season. Neither did they cover the ♂♂'s marks during this period, although pairs of foxes generally mark the same spot in sequence (Kleiman & Brady, 1978). Scent-marking was resumed at *c.* 45 days after parturition and it is possible that the cessation of scent-marking might function to minimise attraction of predators to the whelping site.

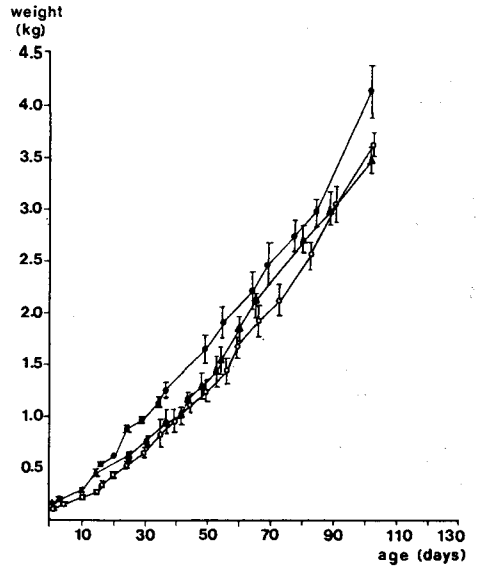

Fig. 1. Growth rates of three litters of Crab-eating foxes *Cerdocyon thous* reared by their mothers. Black circle=2.1; triangle=2.2; open circle=0.3 (1 removed for hand-rearing day 30). In each case, the symbol represents the mean litter weight while the vertical lines indicate the range in weights.

DEVELOPMENT OF PUPS

Crab-eating fox pups are born with the eyes and ears closed and without teeth. They weigh between 120–160 g and gain weight rapidly (Fig. 1). The natal coat is charcoal grey with a buff patch in the inguinal region. The first changes occur on day 14 when the eyes and ears open and the canine teeth begin to erupt. At this time the buff inner ear pinnae also become visible. The pelage begins to change colour around day 20 when the hair around the ears and eyes becomes grey. By day 25 the head is grey with a black muzzle and distinct black marks on the cheeks. The buff undercoat now extends from the chin to the anal region and down the inside of the flanks. By day 35 the entire coat is a lighter grey except for the paws, muzzle and tail which remain dark. The adult pelage is attained by day 45.

Body measurements and tooth eruption dates were recorded for three litters and are presented in Tables 2 and 3. The Crab-eating fox is similar to other canids (Ewer, 1973) in that it lacks upper and lower premolar 1 in its milk dentition and that the carnassials are the first cheek teeth to erupt. Although regular oral examination was discontinued on day 50, subsequent checks revealed that the foxes began to lose their milk teeth at about five months of age.

The development of the young may be divided into three periods (Ewer, 1973). The first is the early nesting stage when the young are completely dependent on the mother's milk for nutrition. In Crab-eating foxes this would correspond to the first 30 days after birth. The second period, a time of mixed nutritional dependency, lasts from day 30 to day 90 when the pups are completely weaned. Finally, there is a period of post-weaning dependency which lasts from day 90 to *c.* five months. In captivity the family unit may be extended beyond this date but in the wild is probably disbanded around this time.

Pup health was generally good. However, two of the five pups from litter 3 died on day 5 from meningitis. Another pup from the same litter was

	LITTER 1 (2.1)					LITTER 2 (2.2)					LITTER 3 (0.3)				
DAY	TOTAL LENGTH	TAIL LENGTH	GIRTH	NECK	EARS	TOTAL LENGTH	TAIL LENGTH	GIRTH	NECK	EARS	TOTAL LENGTH	TAIL LENGTH	GIRTH	NECK	EARS
1						22	6	11	8	closed	22	6	10	8	closed
7						27	8	12	10	closed	23	6	12	9	closed
14						30	8	14	11	2	30	8	15	12	2
21	40	13	20	16		32	9	15	13	2	32	—	17	13	3
28	42	15	23	17		38	11	20	14	4	35	—	19	13	4
35	49	16	24	18		44	13	22	15	4	41	—	21	14	4
42	54	18	25	19		47	14	23	15	4	47		22	15	5
49	63	21	27	19		49	15	23	15	5	50		24	16	5
56	64	21	30	19		56	16	25	16	5	52		24	16	5
63	67	22	30	20		58	17	25	16	6	58		26	17	6
70	71	22	30	20		64	20	28	18	6					
77	73	24	30	22		68	21	28	18	6	64		28	18	6
84	76	24	31	22		70	22	29	19	6					
91	—	—				73	23	31	20	6	66		30	18	6
105	—	—				77	23	31	20	6	73		32	20	6

Table 2. Body measurements (in cm) of the first three litters shown on Table 1. The figures given are the average for each litter. One of the pups in litter 3 was hand-reared from day 30 after being removed for veterinary treatment.

UPPER JAW	(days)	LOWER JAW	(days)
i_1	22–26	i_1	20–26
i_2	20–23	i_2	20–23
i_3	17–23	i_3	18–23
c	14–16	c	14–16
pm_1		pm_1	
pm_2		pm_2	28–32
pm_3	30–35	pm_3	27–30
pm_4	20–25	pm_4	25–28
m_1		m_1	
m_2		m_2	
		m_3	

Table 3. The range in days of tooth eruption in the three litters of ten pups shown in Tables 1 and 2. Oral examination was discontinued after day 50.

born with splayed front and rear limbs. Although the pup moved with swimmerlike motions, it did not have difficulty in nursing. On day 30 it was removed and the limbs were taped together in the proper position by the veterinarian. After four days' restriction, the pup moved with a normal gait. Subsequent trial reintroductions to litter mates failed and it was hand-reared and later weaned on the feline diet.

PUP BEHAVIOUR

Suckling bouts were the pups' only major activity for the first two weeks of life. They were able to crawl but generally remained in contact with the mother. When she left the den, the pups moved into a pile, a behaviour which aids heat conservation and is observed in other canid species (Rheingold, 1963). As they grew older they constantly attempted to climb on top of each other which resulted in a period of scrambling and readjusting each time the pile was formed. The first observed interactions between litter mates occurred on day 13 during one of these periods. The pups mouthed each other's heads and attempted to stand on one another's backs. This mouthing later developed into biting to the muzzle, ears, cheeks and occasionally a limb or the tail. Muzzle wrestling and grappling appeared on day 17 and coincided with the development of walking. Both parents ignored these pup interactions.

The pups suckled at frequent intervals for the first 50 days, although they were first observed to take solid food on day 20. They left the den for various periods beginning on day 28, but did not venture outside regularly until day 45. Defaecation outside the den entrance was first observed on day 35.

The pups were efficient at begging and were able to extract even the choicest food item from their parents. With ears flattened laterally and tails wagging, they would crouch low to the

ground and approach the adult from the side. Although the parent usually fled, the pups, still in the begging posture, chased and nudged the corner of its mouth until the food was dropped. The same posture was used when attempting to suckle after day 50. As the pups grew older, the parents, especially the ♀, would punish them when they begged by grasping the pup's muzzle in the mouth and pinning it to the ground. The pup would whine, roll on its back and continue wagging its tail; a posture referred to as active submission (Schenkel, 1967).

Family units were left together until serious fights occurred. In one family (litter 1) where the adult ♂ was removed, serious fighting between two ♂♂ occurred when they were five months old. This coincided with the onset of raised-leg urinations by one of the pups, although the adult ♀ might have been in oestrus. In other litters, where the adult ♂ was present, no fighting occurred.

In another family group (litter 2) the adult ♀ came into oestrus and copulated solely with the adult ♂. Both ♂ juveniles showed interest and one son who used the raised-leg urination posture attempted to mount. The ♀ repelled him on all occasions. In this instance, the juveniles were left with the adult pair in order to observe whether they would assist the parents in rearing the new litter. The remains of the new litter were discovered on the morning of birth and it appeared that the juveniles had killed them.

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PRODUCT MENTIONED IN THE TEXT

Nebraska Brand Feline Food: manufactured by Central Nebraska Packing Co., North Platte, Nebraska 69101, USA.

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