Zoo Biology 29:1–6 (2010)

BRIEF REPORT

First Report of Captive New Guinea Dingo (*Canis dingo hallstromi*) Den-Digging and Parental Behavior

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New Guinea dingoes (NGDs) (*Canis dingo hallstromi*; Troughton [1957] Proc Roy Soc new South Wells 1955–1956:93–94) have been kept in zoos since 1956. Almost nothing is known of their wild behavior. These observations of a captive pair are the first documentation of natal den-digging and parental behavior for this taxon. The main den, excavated near the top of a 1.5 m hill, consisted of a rounded chamber about 50.8 cm deep, with an entrance about 30.5 cm high and 40.6 cm wide. The dam frequently moved the pups from the natal den to secondary locations for short periods during the day and then back to the den, starting when the pups were 2 weeks old. When the pups were between 5 and 12 weeks of age, both parents regularly regurgitated for them. The sire expressed escalating threat behavior toward the male pup starting when the pup was 5 months old, and the female began threatening the female pups at about 6 months of age. Rejection of same-sex offspring is usual for captive NGDs as the next breeding season approaches. Zoo Biol 29:1–6, 2010. © 2010 Wiley-Liss, Inc.

Keywords: dog; canid; natal den; maternal behavior

The New Guinea dingo [*Canis dingo hallstromi* (NGD); Troughton, 1957] or the New Guinea singing dog is a wild dog of purportedly Asian origin [Savolainen et al., 2002; vonHolt et al., 2010], endemic to the mountains of New Guinea [Bulmer, 2001; Koler-Matznick et al., 2003, 2007]. Recent DNA studies provide evidence that the

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Received 20 September 2010; Revised 18 October 2010; Accepted 2 November 2010

DOI 10.1002/zoo.20370
Published online in Wiley Online Library (wileyonlinelibrary.com).

NGD is a unique evolutionary unit very closely related to the Australian dingo (*Canis dingo dingo*) [Savolinen et al., 2004; vonHolt et al., 2010]. Small numbers of NGDs have been kept in zoos worldwide, starting in 1956 [Troughton, 1957]. In the last two decades, some have also been kept by private parties in North America. Currently, the estimated world captive population is about 200 specimens, all descended from no more than 8 founders [Koler-Matznick et al., 2003, 2007]. The NGD annual breeding season begins in July in all latitudes as far south as Australia (no NGDs have been kept in South America or Africa). The NGD has not been studied in the wild, and parental behavior of captive NGDs in semi-natural conditions has not been previously described. The observations presented here may lead to insights for better captive management of this canid and promote further behavioral study.

METHODS

The observations in this report were gathered ad lib over a 9-month period, between September 2003 and June 2004, by various persons during routine care of the NGDs, during daily socialization of the pups to humans, and on occasions when escorted guests visited the NGD enclosure. Behavior observation notes were recorded intermittently according to time availability and documented at irregular intervals with photographs and video.

Subjects

The captive-bred subjects, a 4-year-old female NGD (ISIS no. 100190 AIKEN SRP) and her 3-year-old mate (ISIS NO. 100192 AIKEN SRP), were permanent residents at a private wild animal facility, the Conservator's Center (Burlington, NC). The female's only known previous litter was whelped before acquisition, and information about the enclosure and her behavior with that litter is not available. The subjects were maintained on a diet of dog kibble, supplemented with raw meat and bones. The subjects' care and maintenance were in compliance with the Animal Behavior Society's Guidelines for the Treatment of Animals Used in Behavioral Research and Teaching and the regulations of the US Department of Agriculture.

Study Area

The Conservator's Center is in the temperate zone, and the observations took place at the subjects' customary pen, an approximately 13.7 m × 13.7 m (187.7 m^2) enclosure of chain link fencing with natural sandy loam, clay soil, and grass substrate. There was an elevated hill area of about 2.5 m in diameter and 1.5 m height near the enclosure's center. Furniture in the enclosure included a weather-proof, free-standing wooden shelter approximately 76 cm × 122 cm. Also present, resting on the surface in a low-lying area, was an empty semi-rigid plastic pool approximately 0.3 m deep and 1 m diameter.

RESULTS

Den-Digging Behavior

Before whelping, both parents used the wooden shelter for sleeping, and the male continued to do so throughout the observation period. On September 17, 2003, 7 days before whelping, the female began digging a variety of shallow depressions in several locations across the enclosure. The male was not observed participating in

den digging. On September 20, the day before whelping, the female dug five larger holes or dens. Ignoring the shelter, she gave birth on September 21 in a den (D1), which she excavated under the edge of the empty plastic pool. There were five pups (two males and three females), an average number for NGDs [Koler-Matznick et al., 2003]. One male pup was either stillborn or died shortly after birth. When the surviving pups (one male and three females) were 2 days old, this birth den began flooding during a severe rain storm. The dam moved the pups into a second previously completed den (D2). D2 was located near the top of the north side of the 1.5 m hill, giving it better drainage than D1. D2 consisted of a simple rounded chamber of about 50.8 cm deep, with an entrance of about 30.5 cm high and 40.6 cm wide (Figs. 1, 2). Den three (D3), on the opposite of the hill from D2, was the same general size and shape as D2. Den four (D4) was similar but in a shady area. Den five (D5), on the southern exposure of a smaller rise than D2, was not completed until 17 days after the birth. The following year, the rise in which she excavated D2 had eroded away and the female whelped and raised her last litter (subject was spayed after her third litter) in the wooden shelter.

Parental Behavior

During rain showers, the dam placed her body across the D2 entrance, effectively preventing the rain from reaching the pups, intermittently rolling her body so her belly faced into the den allowing the pups to nurse. Over the next few days, between rain showers, she periodically left the pups to continue digging at the unused dens. She did not try to remodel D1. Except for occasions when the dam moved the pups, detailed below, the pups remained inside D2 until they became mobile at 3 weeks of age. They continued returning to D2 both for daytime naps and overnight until, at about 7 weeks of age, they could no longer all fit inside.

Beginning in their second week, during daylight hours, the female occasionally carried the pups by grasping them across their bodies and placed them together in one of the secondary dens. After they were mobile and until 5 weeks, the dam carried one or two and the others would then follow her back and forth from D2. After 5 weeks,

Fig. 1. The natal den (D2) entrance being measured. Pubs are 11 days old.

Fig. 2. Natal den (D2) location.

they were exploring the enclosure on their own, but occasionally she led them or "herded" them to a specific location by nudging them with her muzzle. D3 was never utilized. The female took the pups to the shaded D4 on sunny days. D5 was used as a sheltered sunning spot for the pups on windy days. Up to 5 weeks of age, the pups did not remain in these secondary locations for more than a few hours at a time.

After they were mobile at 3 weeks of age, the dam nursed the pups outside D2. Until the pups were about 6 weeks of age, she laid down for nursing sessions. The proportion of standing nursing increased to 100%, just before weaning. She continued to nurse them to about 10 weeks old. The dam, very shy of humans, remained attentively alert and within 7 m of visitors interacting with the pups. If the visitors stayed longer near the pups than the dam was comfortable with, she crept up next to them and gave inhibited nipping bites to the soles of their shoes.

The sire was not observed entering D2, merely sticking his nose into the den entrance occasionally. When humans approached the pups, he remained in close proximity and attended to interactions. When the pups were mobile, he began to interact directly with them and "supervised" when the pups approached people at the fences. He sometimes put himself between the pups and the visitors at the fence, although he was not observed attempting to move the pups back from the fence. The sire remained tolerant of the pups and interacted playfully with them until the approach of the next breeding season (see below).

Both parents regurgitated for the pups from about 5 to about 12 weeks of age. The parents were fed extra rations to compensate for this, and the pups also ate some of the rations directly. After the pups were 3 months old, the parents began avoiding

the pups' vigorous attempts to solicit regurgitation. This is consistent with previous observations, in that all captive NGD dams have been reported as regurgitating for their pups, and the few sires kept with their offspring have also been observed regurgitating for pups, starting at about 5 weeks of age, with regurgitation ending at about 3 months [Koler-Matznick et al., 2001].

When the male pup was 5 months old, the sire began harassing him with threat postures [see Koler-Matznick et al., 2001, for threat behavior definitions]. During the next month, the male pup spent an increasing amount of time under a low wooden platform, presumably to avoid his sire, so he was moved to another enclosure. Starting when the female pups were about 6 months of age, the dam began threatening them. The dam's threats escalated over the next 3 months, and the female pups were moved to another enclosure at 9 months of age. Rejection of same-sex offspring of the previous season during the pre-estrus period is common for NGDs [Koler-Matznick et al., 2001, 2003].

DISCUSSION

The design of this NGD den, with no entrance tunnel, differs significantly from the earthen excavated dens reported for captive coyotes (*Canis latrans*) and gray wolves (*Canis lupus*) [Ryon, 1977, 1986]. However, reports of wild wolf, coyote, and Australian dingo earthen natal dens vary from elaborate tunneled structures to shallow depressions under trees or brush, and often natural structures, such as hollow logs or rock caverns, are utilized [Althoff, 1980; Ballard and Dau, 1983; Corbett, 1995; Harrison and Gilbert, 1985; Mech, 1970; Murie, 1944; Thomson, 1992]. Interestingly, Ballard and Dau [1983], Harrison and Gilbert [1985], and Mech [1970] and Thomson [1992] report that, like the NGD in this report, Australian dingoes, wolves, and coyotes preferentially locate natal dens in elevated areas. The few dens reported for wild NGDs, which may or may not have been natal dens, were described as shallow chambers beneath rocks or large tree roots [Bino, 1996]. Comparable information is lacking for domestic dog natal dens.

There are references of wild canids moving pups from the natal den to secondary dens, presumably to avoid ectoparasite infestations, prevent attraction of predators, or after human disturbance [e.g., Geir, 1983; Harrison and Gilbert, 1985; Mech, 1970]. However, no reports of any canid moving nursing pups out of a natal den to a secondary location during the day, and then back to the natal den, were located. The temperature ranges in the period during which the dam moved the pups are: September, 27–14°C (average 21°C); October, 22–8°C (average 14°C). At these mild temperatures, the pups surely were not expressing physiological stress symptoms. This possible temperature modulation behavior with young pups could be a unique NGD behavioral adaptation or merely an idiosyncratic behavior of this individual dingo. The question is why a canid dam would expend energy repeatedly relocating pups from the natal den, thus possibly reducing her inclusive fitness, unless prompted to do so by their distress behaviors? Hopefully, there will be future opportunities to observe NGD natal den construction and the interesting maternal behavior of moving young pups back and forth from the den. Long-term field studies of wild NGD behavior are necessary to answer the questions raised by their captive behavior.

ACKNOWLEDGMENTS

We thank G. Webb who sponsored the NGDs at the Conservator's Center during these observations; D. Evans for collecting data; and B.C. Yates, I.L. Brisbin, Jr., and two anonymous reviewers for valuable comments. The subjects of this article were placed with the Conservator's Center through the assistance of the New Guinea Singing Dog Conservation Society's relocation endorsement service, and were part of the NGSDCS's planned conservation breeding program.

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