

Perinatal maternal and neonatal behaviour in the captive reticulated giraffe

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A captive reticulated giraffe was observed constantly for three weeks prior to, and periodically for 90 days subsequent to, the birth of her calf. Extensive observations were made of the birth sequence, feeding, drinking, sleeping and one instance of an infant distress call, as well as observations of the initiation of maternal behaviour (including licking, nursing, placentophagia, and what appeared to be helping the calf to stand, guiding the calf's movements, and attempts to respond to the calf's distress call).

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'n Kameelperdkoei in gevangeskap is onafgebroke vir drie weke voor en periodiek vir 90 dae na die geboorte van haar kalf dopgehou. Noukeurige waarnemings is gedoen van die geboorteproses, die voeding, soog, slaap en, op een geleentheid, van die noodroep van die kalf. Verdere waarnemings is ook gedoen ten opsigte van die aanvang van moedergedrag insluitend die lek en oppas van die kalf, verwydering van die plasente, optrede wat voorgekom het as hulp aan die kalf om te staan, stuur van die kalf in sy bewegings en reaksie op die noodroep van die kalf.

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At 16h10 (EDT on 7 August, at the Buffalo Zoological Gardens Buffalo, New York), a reticulated giraffe, *Giraffa camelopardalis reticulata*, gave birth to a female calf that was approximately 162 cm tall and weighed between 34 and 45 kg. The mother had been the subject of an around-the-clock observation for 21 days prior to delivery. In addition to almost constant visual observation, seven hours of videotape recordings were made during that period, on her behaviour and external physical characteristics.

The mother, a 4.5 m tall, nine year-old multipara, and her only surviving offspring, a three year-old nullipara, occupied adjacent stalls in the Buffalo Zoo's giraffe house (the male having died two or three months after copulation). Both giraffes were let into a yard in fine weather for about six to seven hours per day, but during the last three weeks of pregnancy, access to the yard was restricted to two to three hours per day. Food (alfalfa and grain) was provided only indoors. The giraffe house was closed to the public during the last three weeks of pregnancy, to facilitate observation and to avoid undue disturbances, such as those that had seemed to result in the death by abandonment of the mother's previous calf.

External physical characteristics

The mother's abdomen was extremely large (about 30% wider than the pelvis) at -21 days (Day 0 = day of delivery), although symmetrical. The weight of the foetus was sufficient to cause the spine to sag, producing a pronounced dorsal pelvic ridge. The size and shape of the abdomen was not constant over the last three weeks, and changed, not in a constantly increasing fashion, but unpredictably as the foetus apparently changed position. On Day -20, we noted that the bulge of the giraffe's abdomen appeared larger on her left side, but on Days -18 through -1, the bulge appeared greater on the right side. The depth of the abdomen (dorso-ventral plane) also changed over the last three weeks: the lateral dimension of the abdomen increased noticeably beginning on Day -14, this increase persisting until Day -12, when the abdomen appeared more pronounced in the dorso-ventral dimension. On Day -8, the dimensions of the abdomen

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changed again, so as to increase the laterality and decrease the ventrality of the bulge. In general, the size of the abdomen appeared to have decreased around Day -14, but that was probably due to the change in the position of the foetus. We began to observe trains of what appeared to be foetal kicks on Day -19, consisting of sharp, outward-directed thrusts against the side of the mother's abdomen, accompanied by contraction of the abdominal muscles and a slight rotation of the pelvis resulting in an immediate subtle, downward deflection of the caudal edge of the pelvis. Trains of kicks, consisting of from one to eight kicks, and lasting for perhaps 15 minutes were observed only once or twice a day until Day 0, and on some days not at all. The kicks came most often between 00h30 and 03h30, but kick sequences were observed at all times of day. On Day 0, long trains of kicks were observed almost hourly from 01h00 to 04h00.

From the beginning of our observation period, the mother's vulva was considerably more swollen and puffy than that of her nulliparous daughter. A slight mucous discharge occurred on the morning of Day -21, but no additional discharges were seen until the morning of Day 0. The vulva appeared less swollen on Day -19, on Days -14 through -12, and on Days -6 through -3. During those periods when the vulva was reduced in size, it appeared less turgid and somewhat wrinkled. When maximally swollen, the labia appeared slightly peeled back away from the midline, exposing a little of the pink inner surface of the labia.

The udder and teats were less prominent than expected, and were only a little larger, relatively, than those of the nulliparous daughter. No change in their appearance was observed over the last three weeks of pregnancy.

Behavioural observations

The only relatively consistent changes in behaviour that we observed as parturition approached were those related to feeding and drinking. Each day the mother's food hopper was filled at approximately 15h00. During the first week of observation she would generally finish the previous day's bale of alfalfa at about 03h00 - 04h00. Her appetite seemed somewhat depressed from the evening of Day -14 until the afternoon of Day -8, at which time she began to consume her alfalfa at a faster rate than she did during the first week of observation. On Days -7, -6, and -5, she finished her previous day's food at around 01h00; on Days -4 through -1, the day's food was finished by 22h30. On Day 0, however, she had not finished the food presented on Day -1, by the time of delivery, although she was observed to eat throughout Day 0. Davis (1949) also observed that less food was consumed on the day of delivery.

Drinking was only observed about once a day prior to Day 0, and consisted of a two to three minute drink that usually occurred at around 02h00, or around 19h00. In contrast, on Day 0 the mother was observed to take four long drinks (three to four minutes) between 01h30 and 03h30, and another at 11h30. Robinson, Gribble, Page and Jones (1965) also reported elevated drinking on Day 0.

Sleeping, resting, cud-chewing, and grooming behaviours appeared normal, and did not change either quantitatively or qualitatively during the three weeks of observation. It should be noted, however, that from the evening of Day +1 until delivery, the mother only rested in

lying-down position for about one hour, beginning at about 04h00 on Day 0; this was in contrast to the four to five hours per night that both giraffes were observed to remain down (Kristal & Noonan, 1979).

One behaviour seen occasionally during the three weeks was one we came to call "bearing-down." The first observation of bearing-down was made on Day -19. It occurred once at 02h00 and once at 19h30. We observed bearing-down again on Day -17, Day -13, Day -10, Day -8, Day -4, and then several times during delivery. The behaviour consisted of a rigid stance with the neck held at about 45° above horizontal with the head pointing forward, the rear legs slightly spread but without a crouch, tail up, and a slight lordosis of the spine. The abdominal muscles appeared to contract and cud was not chewed during the pose nor were faeces or urine expelled. The entire episode lasted, on the average, for about 15 seconds.

Observations during parturition

The evening of Day -1, was uneventful; no changes in the giraffe's appearance or behaviour were observed. However, at about 00h30 on Day 0, the mother began to receive long trains of foetal kicks, as mentioned above. The period from 01h00 to 03h00 was also marked by frequent drinking, but feeding was not above normal. The labia appeared large and swollen, but flaccid, and from 01h00 on, flopped open when she walked. When the labia opened, they simply split at the midline as would a longitudinally split hollow sphere that is compressed at the poles. During this early period, when the labia did open, we were able to see into the vagina for a distance of about 3-5 cm. A mucous vaginal discharge began at about 03h00 and continued, increasing in quantity and decreasing in viscosity, until delivery. She did not urinate from 02h00 until delivery; defaecation occurred with normal frequency throughout Day 0.

For clarity, the events during delivery are presented in time-check fashion:

- 15h15 - Mother is pacing. A strand of mucous hangs from the labia, which are now open to a width of about 2 cm (and as much as 5 cm when she walked). The tip of the amnion, about 10 cm inside the vagina, is visible.
- 15h25 - Mother continues to pace. The amnion is visible just inside the vagina; it appears black.
- 15h27 - Mother continues to pace, and defaecates with tail out straight. Continues holding tail out after defaecation. The sac begins to emerge; it now appears opalescent.
- 15h28 - Mother stops pacing only long enough to turn and lick the sac. The tips of the infant's hooves are now visible.
- 15h29 - Front hooves entirely visible in the sac. Mother licks sac again.
- 15h30-15h39 - Mother continues to pace, foetus continues to emerge. During this period, mother licks the sac four or five times. Almost colourless fluid courses down the outside of the sac. About

- 30-40 cm of the calf's forelegs have now emerged. About a litre of fluid is visible in the bottom of the sac.
- 15h41 - Mother bears down.
 - 15h42 - Licks sac (usually turned to the right to do so, but not every time).
 - 15h45 - Mother is standing with hind legs apart. Calf's nose begins to emerge. Bottom of sac hangs about 50 cm below labia.
 - 15h48 - Mother defaecates. Calf's snout clearly visible, fluid coming from nostrils. Calf's head is on the left side of its legs, rather than on top of them (i.e., calf's head is on right side of mother's vagina). Mother licks sac.
 - 15h48-15h59 - Pacing continued. Mother bears down and defaecates, showing deep breathing and rhythmic abdominal heaving. She is holding her head lower than usual during bearing-down.
 - 16h00-16h04 - The calf's head emerges fully; mother bears down hard. As soon as the head is completely out, the mouth begins to open. During this gaping, clear fluid runs out of the calf's mouth. Mother paces when not bearing-down.
 - 16h05 - Sac ruptures. Mother turns and sniffs the fluid that fell to the floor.
 - 16h07 - More foetal mouth movement. Mother bears down, the calf is pushed out another 30 cm, but slips back 4 or 5. The neck of the calf is clearly visible.
 - 16h08 - Mother increases the rate of pacing. The emerging calf begins to sway to and fro as a result of the increased pacing. The calf's shoulders clear the vagina.
 - 16h09 - Mother bears down then resumes rapid pacing. The calf's front hooves are about 15 cm from the floor. Calf emerges now at a rate of about 4 or 5 cm per second. Calf is still swaying behind mother.
 - 16h10 - While mother is pacing rapidly, calf falls to the floor. Right side of the neck and shoulder contact the floor first. Allantoic sac ruptures and bloody fluid is evacuated pouring onto the floor near the calf (not directly on the calf as reported by Davis, 1949). Mother turns to the right and directs her attention to her calf.
 - 16h11 - Mother steps to calf and begins licking her. She continues to evacuate bloody fluid. Calf begins to try to raise her head.

The pacing which this female performed almost continuously throughout the delivery is apparently typical of giraffe births (Davis, 1949, van Aarde, 1976) but does not always occur (Lightfoot, 1975).

Observations after parturition

From the moment of delivery until the calf was able to remain in a standing position (16h54) the mother

constantly attended to the calf except for four or five minutes she spent drinking. From 16h54 to 18h30, the mother drank periodically for a total of about 20 minutes, which contrasted sharply with the four to six minutes per day typically observed. She continued to evacuate large amounts of bloody fluid from her vagina for about two hours after delivery.

For the first 10-15 minutes after delivery, the mother alternated between licking the calf and pulling the amniotic membranes from the calf and eating them. By 16h15 the calf's head and neck were raised from the ground. Whenever the mother licked the calf's head or neck, the calf seemed to push back reflexively against the mother's tongue or face. Later, this reflexive pushing, on the part of the calf, was directed against any part of the mother's body (usually the legs).

When the mother repositioned her feet near the preambulatory calf, she carefully placed her hooves very close to the calf, and often exerted only enough downward pressure to determine whether any part of the calf was underneath her hoof. If so, she raised and lowered the hoof while moving it back gradually, until the calf was no longer underneath. Twice, the mother placed herself over the calf in such a way that her udder was immediately above the calf's upturned face, but even when the calf was able to hold her entire neck erect, she was not able to reach the udder without standing.

The calf attempted to stand about 10 or 15 times between 16h25 and 16h54, but kept falling. She was frequently observed to lean against the mother's legs or neck, or to push with her hooves against the mother's hooves. She eventually rose successfully by employing the latter strategy. This same strategy was observed after birth in the wild (van Aarde, 1976). The mother almost constantly licked the calf during the calf's attempts at standing. Occasionally, the mother appeared to help the calf in her attempts to rise by positioning the rising calf between her foreleg and her head or neck while she was licking the calf.

The latency-to-stand for our calf was similar to latencies reported for other zoo (Davis, 1949; Innes, 1958) and wild (van Aarde, 1976) giraffe births, although shorter (Moss 1975) and longer (Lightfoot 1975) latencies have been indicated (for review see Dagg & Foster 1976). We feel that our calf would have stood alone much sooner if the straw-covered concrete floor of the pen had not become very slippery from the large amount of fluid evacuated by the mother.

Although the calf began searching for the teats before she successfully stood up, she did not find them for about 10 minutes after standing. She explored the mother's brisket and flank, and was even pushed, by the mother's head movements, at one point, toward the udder. The calf began butting and nursing unsuccessfully at about 17h10, and continued to do so periodically until 17h35, at which time her sucking sounds and swallowing indicated to us that she was having success. There was no teat preference; the calf alternated teats apparently randomly.

The afterbirth was gradually extruded over a period of 190 minutes, and was long enough to dangle to the floor before it was finally delivered. It was opalescent with 12-14 distinguishable placental cotyledons, each about 5-7 cm

diameter and containing hues of purple, brown, blue and red. It dropped to the floor at 18h26, and at 18h27 the mother took a bite of it. She spent one or two minutes chewing, and then drank some water. This sequence was repeated four or five times over the next 20 minutes with intermittent episodes of alfalfa-eating. She consumed only about one-third of the afterbirth. At 18h57, she picked up the entire placenta, which had been in the centre of the pen, and turned so that her head was over a corner of the pen. The placenta dropped (except for a small portion that remained in her mouth) into the deep straw in the corner, and was not attended to again. Incomplete or even absent placentophagia may not be unusual for giraffes (Dagg & Foster 1976; Lightfoot 1975), although the extent to which captivity affects this behaviour is unclear.

The most striking maternal behaviour that the mother manifested for the first two hours after the calf began to ambulate was herding, the stimulation and guidance of the calf's movements. When the calf was not nursing, the mother frequently kept the calf in front of her, and with her knees bumped and directed the calf. Lightfoot (1975) reporting on a birth in the wild, mentioned similar nudges of the calf by the mother.

On two occasions, at 18h47 and at 19h46, the calf approached the water trough while the mother was drinking. Both times, the mother stopped drinking and gently bumped the calf away from the trough. This is interesting since Langman (1977) reported that infant giraffes in the wild are not brought to water holes when their mothers go for drinks.

When the calf's attempts to stand up caused her to move across the pen to a location in which she was visible to the older daughter in the adjacent pen, the young adult began showing signs of agitation. Initially she would only stand on the furthest side of her pen, and continually readjusted her position so that she stood broadside to the calf; her tail was curled up and over her back, and slightly to the side facing the calf. Her head and ears were erect and directed steadily at the calf. The absence of nasal hissing and the broadside stance made it clear that this was not typical "approach-investigation" (Langman 1977). The young adult female approached the partition between the pens at 17h35 (almost 1.5 h after delivery), but she still kept her tail curled. At 19h00 the young adult and the calf nuzzled and licked each other's face through the bars separating the pens. Dagg (1970) and Moss (1975) described similar nose-to-nose greetings among young giraffes in calving pools. The mother showed no particular reaction; this is noteworthy, since Langman (1977) stated that the mother keeps her calf away from other giraffes during the first one to three weeks postpartum, and Dagg & Foster (1976) and Moss (1975) both reporting the observations of Mejia, stated that mothers in the wild drive away other giraffes if they approach the newborn.

Although the mother apparently did not respond to the approach of her three year old daughter, we did observe two behaviours on Day 0 which may have been protective in nature. (a) The mother herded her calf away whenever she came close to our observation post just outside the front of the pen. (b) When we attempted to manoeuvre closer to the calf for a better look, the mother placed herself between us and the calf.

At about 19h00 (about three hours after birth) the calf first attempted to gambol: she took a step with both front legs together, rocked forward, lifted both hind legs and brought them forward of the front legs, placed her weight on the hind legs and stepped out. She did not become proficient at this until the third or fourth try.

At 20h24 the calf fell down again, and rather than rising, fell asleep in the deep-sleep posture, with her head resting on her hip (Kristal & Noonan 1979).

From Day +2 to about Day +90, observations of the mother and calf were made only every two or three days by one of our students, Harriet Warne. The development of the infant proceeded apparently normally. Herding of the calf by the mother was not observed at all after Day 0, although following of the mother by the calf increased in frequency over the first few days. Nursing was only rarely observed after Day +25; only three of 12 observed attempts to nurse, after this time, were successful. When the calf approached the udder, the mother, more frequently than not, stepped away. This weaning age is comparable to those observed elsewhere (Foster & Dagg 1972), although Langman (1977) and Dagg & Foster (1976) indicated that nursing sometimes continues for months after birth.

Although the calf approached the water trough several times in the first several days, she did little more than touch her muzzle to the surface of the water. However, by Day +25, she had learned to drink water directly from the spout that filled the trough. By Day +35, the calf had acquired a drinking pattern identical to that of the adults: she now sipped water from the trough, keeping her head down for the duration of the drinking episode.

Between Days +21 and +35, the calf began eating alfalfa, and by Day +60, her feeding pattern was identical to that of the adults. Jaw movements similar to those of cud-chewing were observed as early as Day +21, but true rumination as indicated by apparent food boli moving upward in the oesophagus, was not verifiable by Day +60. Langman (1977) suggested that rumination begins at the age of 4-6 months.

What appeared to be a vocal distress call by the calf was observed on Day +90. The calf and the mother were separated briefly so that the former might receive a veterinary examination. The mother was let into the yard and the door was closed immediately behind her, trapping the calf inside the building. As the calf was captured, she began bleating and bellowing loudly. This was the only vocalisation that we heard from the giraffes, and it appears to correspond to the distress call of young giraffes as reported by Kettlitz (1961). As soon as the calf began to vocalise, the mother began bucking with her hind legs and kicking at the door with her forelegs, although she, herself, did not vocalise. She continued to buck and kick for five minutes, after which she only paced in front of the door in an agitated, alert manner.

When mother and calf were reunited, after a period of separation of about 20 minutes, the mother immediately began to nuzzle and lick the calf, who stood in the center of the pen. The mother then circled the pen several times, facing outward, before she relaxed and resumed feeding.

Conclusions

Our parturition observations indicated that there are few, if any, behavioural or physical changes during the last three weeks of pregnancy that can be used to predict the day of delivery. It may be that the change we observed in feeding (i.e., decreased feeding for a week followed by increased feeding for a week, followed by parturition), or the decrease in total sleep the night preceding birth may prove to be reliable predictors, but more observations are necessary. The changes that occurred in the 15 hours prior to the onset of labour are significant (drinking, foetal kicks, bearing down and pacing), and certainly seem to be good indices of impending delivery.

The delivery events were very similar to those described previously (Davis 1949; Robinson *et al.* 1965; Lightfoot 1975; van Aarde 1976; for review see Dagg & Foster 1976), although our observations have provided more detailed information on placentophagia, periparturient drinking, and immediately-postpartum maternal-infant behavioural interactions.

There is an apparent controversy regarding the intensity of the mother-infant bond in giraffes; whereas earlier reports suggested a weak bond (e.g. Innes, 1958) more recent, more detailed analyses (Langman, 1977) have begun to reveal a stronger and more complex mother-infant interaction. The mother we observed aided her calf in standing, oriented toward her, and stimulated and guided the movements of the calf. Also, although weaning took place about three to four weeks after birth, months later the mother responded with attempts to reach her young when it cried out. Our observations indicate that the mother-offspring relationship is extensive and intense.

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