

Brief Report

Milk Intake and Development in a Newborn Captive African Elephant (*Loxodonta africana*)

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In August 2003 the San Diego Zoo's Wild Animal Park (WAP) and the Lowry Park Zoo, under the auspices of the AZA's Elephant SSP and a USFWS permit, imported 3.8 African elephants (*Loxodonta africana*) from the Kingdom of Swaziland. When they were captured, transrectal ultrasound examinations revealed that one nulliparous cow was approximately 10 months pregnant. At the time of their arrival (August 2003), all of the animals were estimated to be approximately 13 years old and were thought to be nulliparous. Based on the ultrasound examination results and the average African elephant gestation period, parturition was predicted to be 20 February 2004. In this report, we provide the first detailed data about nursing activity around the clock and newborn calf development, describe maternal and neonatal nighttime activity budgets, and explore maternal weight changes during suckling and lactation. The newborn calf suckled significantly more at night than during the day, but suckled for only about 2 hr per 24-hr period. Regression analysis revealed that through the first 3 months of life the calf gained 0.385 kg/day while it suckled on a regular basis. We compare our findings with published information on wild elephants, and conclude that although the growth rate is reduced compared to hand-reared elephant calves, the suckling patterns are almost identical to those reported for wild calves. Zoo Biol 24:275–281, 2005. © 2005 Wiley-Liss, Inc.

Key words: activity budget; nursing; primiparity; growth; elephant

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INTRODUCTION

Although elephants (*Loxodonta africana* and *Elephas maximus*) have the longest gestation period of all land animals, their calves are relatively small when they are born (i.e., only about 3.5–4% of maternal mass) [Benedict, 1936; Moss, 1988; Spinage, 1994]. Birth is not a prolonged process and has been timed at less than 12 min [Moss, 1988]. Although the calves weigh about 100 kg at birth [Eltringham, 1997; Shoshani, 1992], their relatively diminutive size hampers recognition of pregnancy in the cows by human observation, and thus few data are available regarding the pre- and postparturition behavior of dams. Some cows develop enlarged breasts during late gestation, and some appear lethargic prior to parturition [Moss, 1988]. In the wild, some cows appear to isolate themselves from the herd prior to giving birth [Moss, 1988], but in general the behavior of preparturient cows is not distinct from that of nonpregnant cows [Spinage, 1994]. Given that elephants in the wild ingest about 170 kg of food per day, live in herds of about a dozen animals, move together between food sources, and sleep less than 5 hr per 24-hr period [Estes, 1991], one might expect that cows would minimize changes to their time budgets prior to parturition.

Elephant cows sometimes assist newborn calves in standing [Berg, 1987; Moss, 1988]. Prior to their first suckling bout, calves must be able to balance on all four limbs, and first nursing has been recorded at about 2–3 hr postparturition in captivity [Berg, 1987] and at 1.5–4 hr postparturition in the wild [Moss, 1988]. In the wild, calves feed exclusively on maternal milk for the first 3 months of life [Lee and Moss, 1986], but the actual amount of milk ingested, and the relationship to infant growth are unknown. Male calves probably have a greater intake and grow faster than female calves [Lee and Moss, 1986].

The San Diego Zoo's Wild Animal Park imported a group (1.6) of African elephants from Swaziland in August 2003. Before the animals arrived and were habituated to the facilities, one of the cows was determined to be pregnant, so we initiated a program to document the behavior of the cow and her calf. In this report, we provide the first detailed data about nursing activity and newborn calf development, describe the maternal and neonatal nighttime activity budgets, and explore weight changes in the cow and calf during the initial weeks of the calf's life.

MATERIALS AND METHODS

Study Site and Subjects

The San Diego Zoo's Wild Animal Park (Escondido, CA), under the auspices of the American Zoo and Aquarium Association's African Elephant Species Survival Program and a United States Fish and Wildlife Service permit, imported seven African elephants from the Kingdom of Swaziland. The animals were scheduled for culling because of overpopulation, habitat destruction, and their threat to critically endangered species such as black rhino (*Diceros bicornis minor*) in the reserves. All of the cows were nulliparous and estimated to be 12–13 years old. Transrectal ultrasound examinations at the time of their capture in Swaziland revealed that one female, Ndlulamitsi, was approximately 10 months pregnant (Hildebrandt, personal communication).

The elephants were housed in a 1.3-ha outdoor enclosure containing trees, rocks, shade structures, grass, dirt, watering areas, and two indoor areas containing multiple stalls. Because the elephants had received effective training, it was easy to weigh them daily, with minimal intervention. Weights were obtained to the nearest 2.0 kg while the elephants were stationary on the scale (Pennsylvania Scale Company, load limit 9,000 kg, serviced monthly by the San Diego Scale Company). During the study period, the adult elephants were fed legume grass (*Pennisetum purpureum*), Bermuda grass (*Cynodon dactylon*), Sudan grass (*Sorghum vulgare*), alfalfa (*Medicago sativa*), various species of browse, and herbivore supplement pellet.

Observations and Data Collection

We recorded nighttime activity budgets, nursing frequency and duration, and weight changes in both the dam and the calf. Budgetary and time constraints precluded us from systematically collecting activity-budget data over a 24-hr period. Since the animal-care staff monitored the elephants during the day, the time-budget data were collected at night. Thirteen volunteers collected data.

Instantaneous scan samples [Altmann, 1974] of behavior were recoded every minute during 30-min sessions. Time-budget data were collected in three observation shifts: 1800–2200 hr, 2200–0200 hr, and 0200–0600 hr. Data were collected in 30-min sessions separated by 15 min. The observers began to collect data 15 min after their shift began, and waited 15 min between sessions. Each observer completed a total of five observation sessions, resulting in 15 samples per night. The recorded behaviors were subdivided into the following categories:

1. Move: pace, sway, walk, run.
2. Feed: eat food, drink.
3. Explore: play with object, explore environment, throw feces.
4. Solitary: dust bath, trunk to anogenital area, trunk to body, trunk to temporal gland.
5. Affiliative: touch elephant in yard, touch elephant in other yard, urine test by Ndlulamitsi, urine test by female, urine test by male (flehmen).
6. Aggressive: threat by Ndlulamitsi, threat to Ndlulamitsi, contact by Ndlulamitsi, contact with Ndlulamitsi.
7. Rest: stand, lean, lie down.
8. Miscellaneous: urinate, defecate, vocalize, etc.

For analysis purposes, we combined “explore” and “solitary” into a single category of “solitary,” and we combined “affiliative” and “aggressive” into a single category of “social.”

The animal-care staff and research volunteers collected nursing data 24 hr a day, 7 days per week, for the first 5 weeks of the calf’s life. The recorded information included the identity of the observer, date, time of day, duration of nursing, and teat selection. Therefore, we report only on activity budgets at night, and nursing behavior throughout the 24-hr day. When we report the mean, we also give the standard deviation (SD) and sample size. Statistical analyses were conducted with the use of SPSS 11.0 for Windows.

RESULTS

Although a parturition date was predicted and the pregnant cow's preparturition endocrinology was monitored via urine assay, the dam's exact stage of gestation at the start of the study was unknown, so we were able to record preparturition behavior for only 1 week. A male calf, Vus'musi, was born in an outdoor enclosure on 23 February 2004 at ~0935 hr following a short labor. The timing and duration of labor were based on the observations that at 0930 hr Ndlulamitsi was still pregnant, and when she was next observed at 0940 hr she was standing next to the calf. The placenta was expelled at 1157 hr. Forty minutes after the calf emerged, Vus'musi attempted to stand with maternal assistance and was upright 16 min later. Two hours postpartum, he made his first attempt to suckle, with initial nursing occurring at 1542 hr. His first nursing bout was only 10 sec in duration.

When Vus'musi was first weighed, at 2 days of age, he weighed 104 kg. The first postparturition weight obtained from Ndlulamitsi was when her calf was 3 days old and she weighed 2,198 kg. The placental weight (including mucus but not amniotic fluid) was approximately 15 kg. Therefore, the calf weight was approximately 4.7% of the maternal weight at birth. In the days immediately after the birth, although Vus'musi regularly nursed, he sustained a slight weight loss followed by a steady weight gain (Fig. 1). Weight was significantly correlated with day of life ($r^2 = 0.965$, $P < 0.001$; $Y = 0.385x + 102.5$ kg). By 23 May 2004, Vus'musi's weight had increased to 136 kg, while his mother's weight had decreased to 2,156 kg. Hence, over the first 3 months of life the cow lost an average of 0.47 kg/day while lactating.

Nursing occurred around the clock, with Vus'musi spending about 2 hr per every 24-hr period suckling. However, the amount of time spent suckling was significantly greater at night (1800–0600 hr) than during the day (0600–1800 hr) (63.27 ± 14.70 vs. 55.13 ± 17.81 min; paired $t = 2.340$, $df = 32$, $P = 0.026$). Over the first 33 days of life, each nursing bout averaged 1 min, 16 sec (± 19 sec), with the calf suckling an average of 101 (± 33.9) times per 24-hr period. During the first month of life the calf gained 12 kg, or 12% in body weight. The total amount of time spent nursing on a daily basis is shown in Fig. 2. The percentage of time spent nursing at night was significantly correlated with the actual amount of time spent on the nipple ($r = 0.681$, $n = 14$, $P = 0.007$), which indicates the reliability of our point sampling method for constructing time budgets.

Ndlulamitsi spent more time resting during the preparturition week than in the subsequent weeks, and spent much more time in social interactions following parturition (Fig. 3). Teat selection was random: Vus'musi suckled from the left teat 46% of the time ($n = 3376$ suckling bouts) and spent 48% of his nursing time at the left teat. On day 1 of life, only 35% of nursing attempts were successful, but his success rate climbed rapidly, and by day 3 of life he was nursing successfully for 87% of attempts.

DISCUSSION

Nighttime observations of Ndlulamitsi were insufficient for systematic analysis, but hinted at two trends. First, her general activity level was similar to that reported for African elephant cows of about the same age at Zoo Atlanta [Brockett et al., 1999].

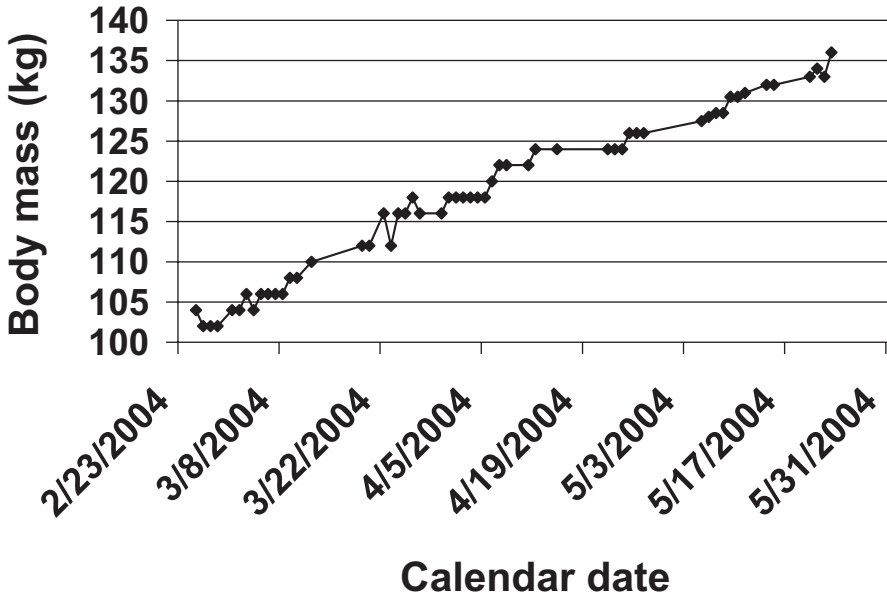


Fig. 1. Growth profile of Vus'musi. Birth date was 23 February 2004.

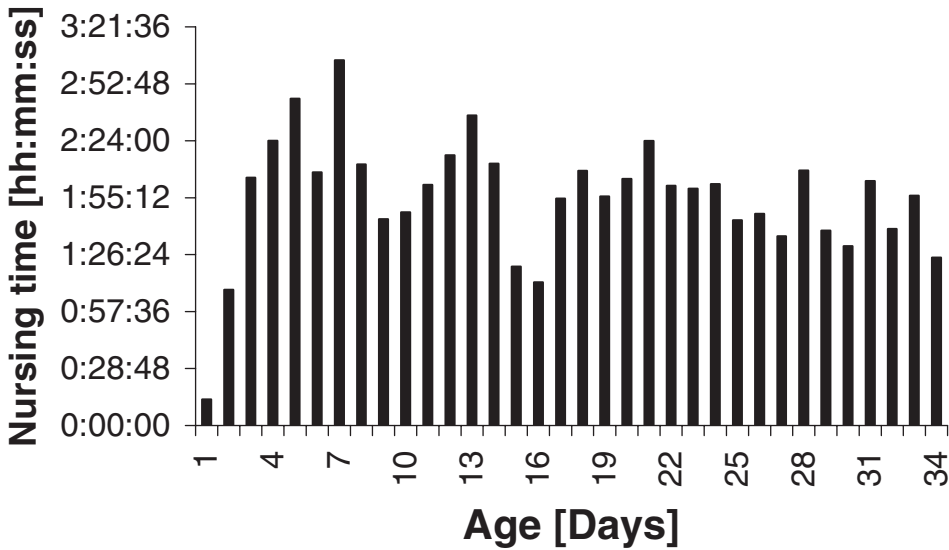


Fig. 2. Total amount of time spent nursing by Vus'musi. Data were recorded on a 24-hr basis, with day 1 being the first day of life.

At Zoo Atlanta, females at night divided their time into resting (~55%), feeding (~38%), walking (~3%), and other activities (~3%), while at the Wild Animal Park, the periparturitional activity profile of Ndlulamitsi consisted of resting (55%), feeding (25%), walking (3%), and other activities (16%). However, other behaviors accounted for 2% of the nightly time budget during the preparturition phase. Second, the results

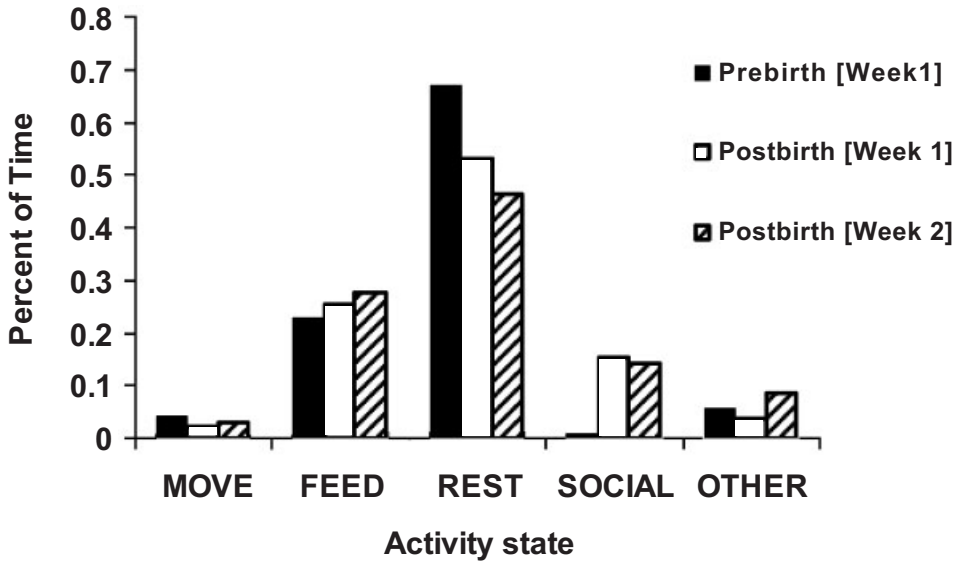


Fig. 3. Ndlulamitsi's nocturnal time budget. Data were recorded from 1800 to 0600 hr. See text for definitions of activity states.

agree with the suggestion that near-term cows in the wild are more "sedate" [Moss, 1988]. Between 1800 and 0600 hr, Ndlulamitsi spent 67% of the evening resting, and this fraction decreased in the 2 weeks following the birth of Vus'musi.

Although the calf was only 4.7% of maternal mass at birth, it grew to 5.5% of maternal mass by 5 weeks of age, and 6.3% of maternal mass at 3 months of age. It has been reported that hand-raised Asian elephants gain weight at approximately 1.0 kg/day over the first year of life [Reuther, 1969]; however, published findings regarding neonatal weight gain in African elephants are unavailable. During the first 3 months of the calf's life we documented a growth rate of 0.385 kg/day for this mother-reared African elephant. Although the calf sustained an initial weight drop, subsequent weight changes revealed a fairly steady increase in body mass.

Our findings can be directly compared with data obtained from wild African elephant calves. Lee and Moss [1986] found that male calves nurse for an average of 86 sec per bout, whereas we found that Vus'musi nursed for an average of 76 sec per bout. However, while Lee and Moss [1986] reported that males suckled about once every 37 min, we found that suckling occurred about once every 14 min. According to their data, calves spend an average of less than 10% of the day nursing during the first 3 months of life, and we were able to establish that Vus'musi suckled for about 8.3% of the 24-hr day. Therefore, although the growth rate of the calf was slower than that reported for hand-raised calves, the milk intake pattern was remarkably similar to that observed in young calves born in wild herds in Africa.

CONCLUSIONS

1. A nulliparous African elephant cow had an extremely rapid first parturition, and the calf stood less than 1 hr after birth.

2. Observations over consecutive 24-hr periods revealed that significantly more suckling occurred at night than during the day, with the calf nursing for about 2 hr during every 24-hr period.
3. The suckling pattern of African elephants in captivity is very similar to that reported for African elephants in the wild.
4. The growth rate of the calf during the first 3 months of life was 0.385 kg/day.

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