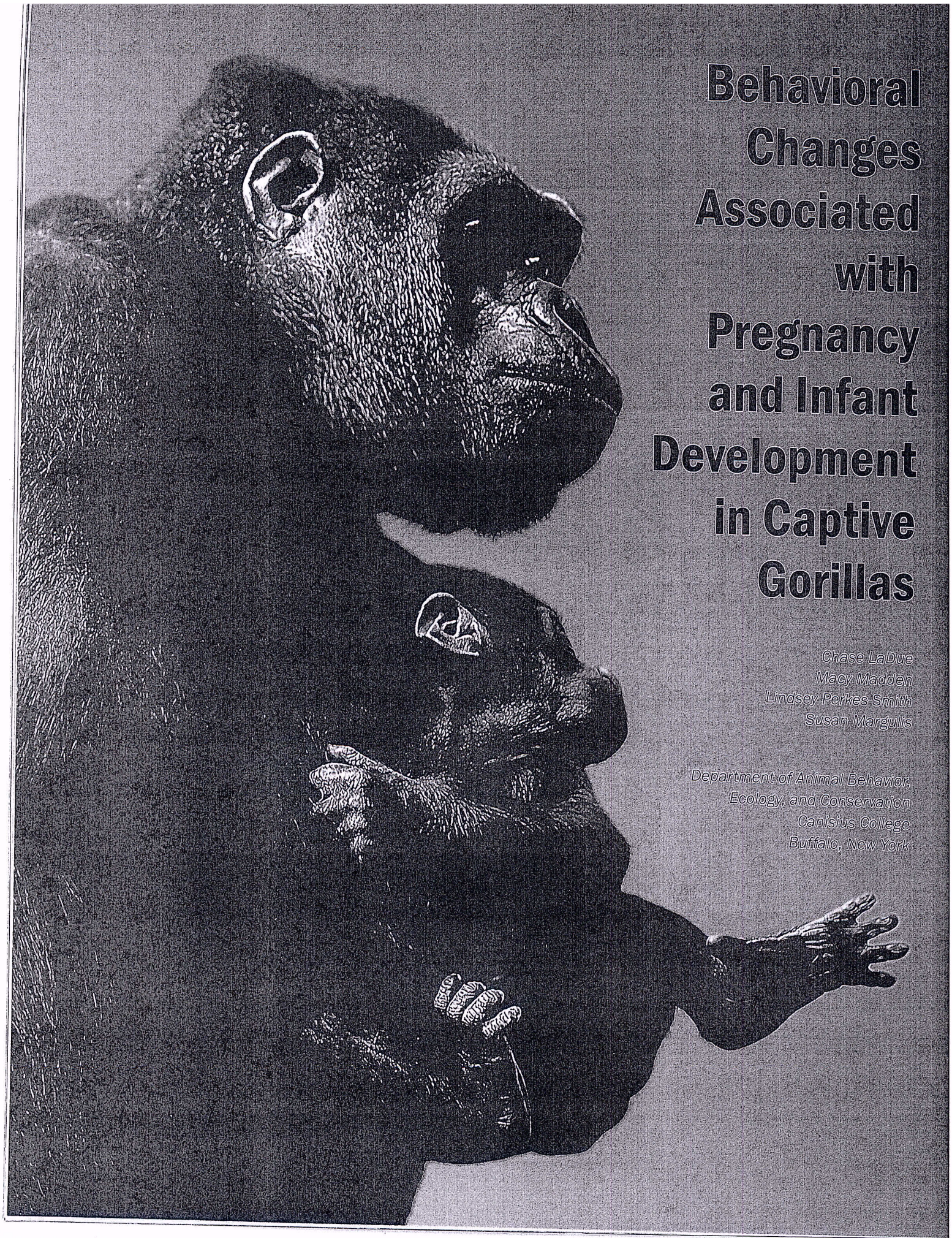


Behavioral Changes Associated with Pregnancy and Infant Development in Captive Gorillas

Chase LaDue
Macy Madden
Lindsey Perkes-Smith
Susan Margulis

Department of Animal Behavior, Ecology, and Conservation
Canisius College
Buffalo, New York

INTRODUCTION

As conditions in captivity improve, and our understanding of reproductive biology becomes greater, the prevalence of successful primate births continues to increase, and certainly, gorillas are no exception (Hosey 2005, Snowdon 1989). In 2010, there were 21 successful western lowland gorilla (*Gorilla gorilla gorilla*) births internationally in zoos, six of which were in the United States (Wilms 2011). Nonetheless, our base of knowledge is still growing, and although it is common for detailed veterinary information to be recorded upon each birth, changes in behavior over extended periods of time—in regards to both mothers and their infants—are rarely documented systematically or objectively.

To our knowledge, only one other study has assessed the behavioral changes associated with pregnancy in captive gorillas: Meder (1986) conducted a study which compared the physical and activity changes of five gorillas over fourteen pregnancies at two German institutions. In terms of behavior, it appears that female social activity decreases within the first three months of pregnancy. Additionally, the author suggested that behavioral, and not physical, changes are the most reliable signal in determining gorilla pregnancy. This is especially relevant to all zoos housing female gorillas, as it illustrates that inexpensive behavioral records can be taken in order to reliably identify pregnancy.

One of the methods through which zoo personnel can observe and review behavior is behavioral monitoring, a process by which observers objectively measure and record an animal's behavior on a regular basis (Watters et al. 2009). In doing so, a behavioral baseline is established, and the effects of any environmental changes can be analyzed accordingly. Observations made by keepers or other observers do not necessarily have to occur frequently; regular, shorter observations can provide a behavioral baseline and, over time, portray an accurate and quantitative picture of behavior. When applied to zoo animals, behavioral monitoring can be a valuable tool for keepers, curators, researchers, and others, because it allows for an evaluation of an animal's behavioral response to environmental changes, such as births, deaths, transfers, and exhibit changes.

The purpose of this project was to systematically characterize the behavioral changes in a captive female gorilla before, during, and after pregnancy, and to track the behavioral development of her infant over time. By documenting the behavioral progression of both mother and infant, each pregnancy and birth can be compared with other institutions holding gorillas in order to establish norms of behavior and development. There are few published studies on the effects that pregnancy and motherhood have on a gorilla's behavior, so an additional goal of the project was to contribute to a growing pool of practical knowledge (Beck 1984, Clift and Martin 1978, Hoff et al. 1981). In the current study, the mother had never given birth before, so any information could potentially be used for future offspring, and this would certainly be beneficial for the institution and researchers alike.

In 2009, an undergraduate research team from Canisius College (Buffalo, New York) began collecting behavioral data on a captive troop of gorillas at the Buffalo Zoological Gardens for a behavioral monitoring database. One of the gorillas ("Sidney," SB# 1449) became pregnant in February 2010 and gave birth to a female offspring ("Amari," SB# 2029) on October 8, 2010. Our baseline data gave us the opportunity to quantify changes in both mother and infant behavior. At the time of submission, and to our best awareness, this is the only study that simultaneously examines behavioral changes in both a mother gorilla and her infant. In regards to the mother, we expected to observe differences in activity budget and sociality due to pregnancy and motherhood. For the infant, we expected to note a progressive increase in independence, accompanied by changes in overall activity budget.

METHODS

Behavioral data were collected from September 2009 through the first year of Amari's life, until November 2011. At the time of pregnancy, Sidney was 12-years-old, and shared an enclosure with an adult male silverback ("Koga," SB# 967, 22 years) and two adult females ("Becky," SB# 778, 28-years; and "Lily," SB# 1575, 9-years). Becky passed away in March 2011 and so was excluded from analysis. Observation sessions were conducted three to seven times weekly, with each animal observed through focal animal scan sampling for twenty minutes during normal visitor hours at public areas. Scans during each session were one minute apart, and at each scan, behavior, location, and social distance were recorded. All data were collected using trained student observers with EthoTrak behavioral monitoring system programmed on handheld PDAs.

In order to assess any behavioral changes from Sidney, we separated data into three periods: pre-pregnancy (September 2009 through January 2010), pregnancy (February 2010 until October 8, 2010), and post-birth (October 8, 2010 through October 2011). To gauge Sidney's interest in other gorillas across the three periods, all instances of approach between two animals were recorded, along with which gorilla initiated the approach and which was the recipient of an approach. As an additional measure, with each behavior scan, a "neighbor," if present, was recorded; any individual within one meter of the focal animal was considered a neighbor. To evaluate Amari's behavior, the first year of life was divided into quarters for analysis. As with her mother, approach behaviors and neighbor data were recorded as an indication of Amari's growing independence from Sidney. We used an ANOVA (with a comparison of means) to statistically evaluate neighbors, Kruskal-Wallis tests for activity budgets, and chi-square tests for approach behavior.

RESULTS: SIDNEY

Figure 1 shows Sidney's activity budget across the three time periods (pre-pregnancy, pregnancy, and post-birth). The frequency of locomote and out-of-view behaviors differed significantly across the three time periods: Sidney locomoted progressively less following the pre-pregnancy period (Kruskal-Wallis test, $\chi^2 = 18.0524$, DF = 2, $P < 0.0001$), and she was out of view more during her pregnancy ($\chi^2 = 18.2290$, DF = 2, $P < 0.0001$).

Figure 1: Sidney's Activity Budget

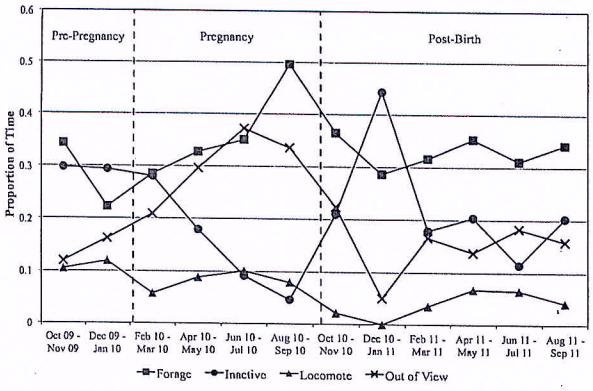


Figure 2 shows the approach behavior between Sidney and Koga (the silverback), with the proportion of interactions initiated by Sidney in white and Koga in black. Sidney was the initiator of significantly more approaches during the pre-pregnancy period ($\chi^2 = 6.231$, DF = 1, $P < 0.025$). However, significant differences in the initiation of approaches were not found in the subsequent time periods.

Figure 2: Approach Behavior, Sidney and Koga

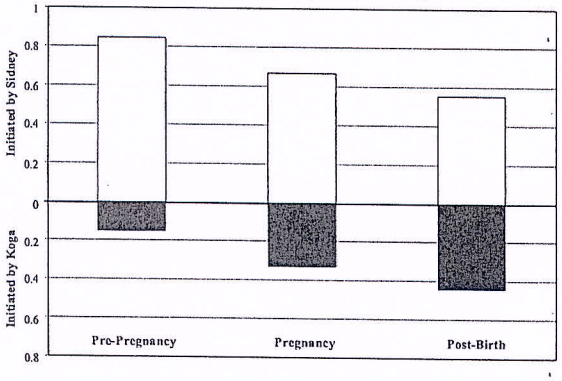
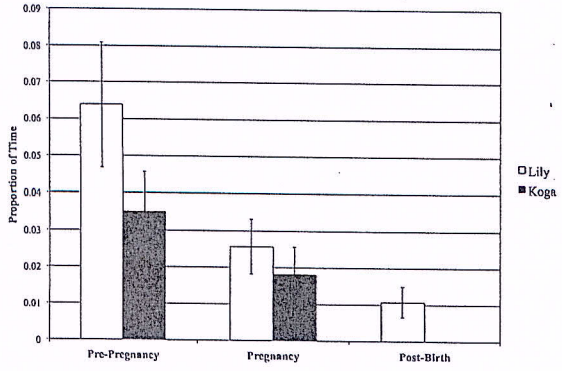


Figure 3 shows the frequency of neighbors to Sidney (Lily, adult female, in white, and Koga in black), with standard error bars. Statistical analyses showed that there was a significant decline in frequency with which Lily was a neighbor over the three time periods ($F = 7.083$, DF = 2, $P < 0.001$), but not with Koga. Sidney spent little time in close proximity to others.

Figure 3: Sidney's Neighbors, Lily and Koga



RESULTS: AMARI

Figure 4 illustrates the proportion of time that Amari spent as a neighbor to her mother. Black bars indicate proportion of time spent in contact with mother, gray bars show time spent within one meter of Sidney, and white bars designate time spent greater than one meter from Sidney. Statistical analysis indicated that she spent significantly less time in contact with Sidney during the fourth quarter (July 2011 through October 2011) ($F = 24.14$, DF = 3, $P < 0.0001$ with post hoc comparison of means, Duncan's multiple range test).

Figure 4: Amari's Proximity to Sidney

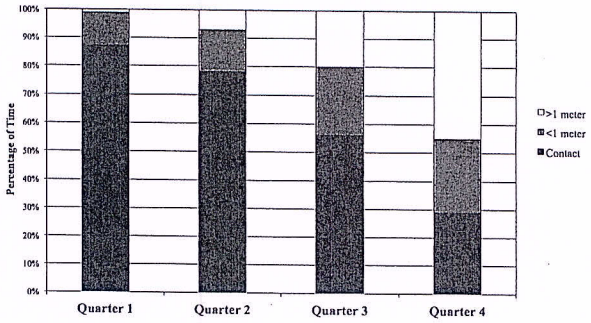


Figure 5 shows the activity budget for five principal behaviors throughout Amari's first year of life: being carried, foraging on solid food, locomoting, playing with objects, and suckling. Statistically significant differences were found for foraging, locomoting, and playing across the four periods, while differences between being carried and suckling were not statistically significant. Amari foraged significantly more as she began to develop throughout the year (Kruskal-Wallis test, $\chi^2 = 28.15$, DF = 3, $P < 0.0001$). She also increased independent movement as she aged ($\chi^2 = 28.84$, DF = 3, $P < 0.0001$). Lastly, Amari played significantly more as time went on ($\chi^2 = 32.61$, DF = 3, $P < 0.0001$). These behaviors occurred significantly more during the third and fourth quarters than during the first and second quarters (Duncan's multiple range test).

Figure 5: Amari's Activity Budget

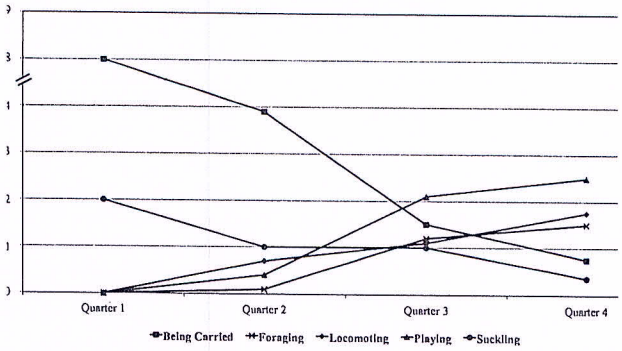


Figure 6: Approach Behavior, Amari and Sidney

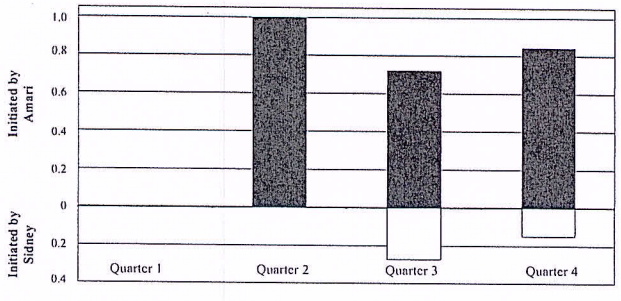


Figure 6 shows the relative frequencies with which Amari and Sidney initiated approaches to each other. Approaches initiated by Amari are shown in black, while white bars represent approaches initiated by Sidney. Amari initiated significantly more approaches in the fourth quarter, July 2011 through October 2011 ($\chi^2 = 7.14$, DF = 1, $P < 0.01$).

DISCUSSION

Our results suggest that Sidney's behavior changed during the course of her pregnancy. As expected, she locomoted less during her pregnancy and was out of view of the public more often. More than likely, Sidney was probably inactive while out of view, although we cannot confirm this with complete certainty. These results are in accordance with Meder's study (1986). The data also suggest that pregnancy and motherhood affected Sidney's social behavior: specifically, she interacted less with conspecifics after her pregnancy and following the birth of Amari. Before the pregnancy, Sidney initiated significantly more approach behaviors towards Koga (the silverback), but during and after the pregnancy, the two initiated about the same number of approaches. This is reasonable: females that are already pregnant should show no sexual interest in directly interacting with the silverback. Additionally, neighbor data show that Sidney spent progressively less time in close proximity to Koga during and after her pregnancy. Interestingly, she also spent less time in proximity to Lily, the other adult female in the group. This may be attributed to Sidney's protectiveness towards Amari. Unfortunately, we cannot compare social behavior in regards to another female conspecific to confirm or refute this. Nonetheless, the data indicate that Sidney engaged in less social activity following the pre-pregnancy period.

Because the future of the captive gorilla population is dependent upon continued breeding success, especially from genetically-unique individuals, it is critical that every birth be closely monitored.

Regarding Amari's behavior, there appeared to be a substantial behavioral shift after six months of age (between Quarters 2 and 3). Specifically, behaviors associated with a growing state of independence, such as foraging on solid food, locomoting, and playing, increased in occurrence as time progressed. Additionally, Amari spent time further away from her mother as time progressed. It should also be noted that after six months of age, Sidney initiated approaches to Amari, which had never been observed during the first six months of life. Therefore, the period around six months of age seems to be a significant milestone for a gorilla infant, characterized by growing independence from mother and an increase in the frequency of more active, individualistic behaviors.

Because the future of the captive gorilla population is dependent upon continued breeding success, especially from genetically-unique individuals, it is critical that every birth be closely monitored. We have shown that data obtained via behavioral monitoring are reliable indicators as to any changes in activity patterns, changes that may be more valid than any physical signs. We suggest that all institutions housing gorillas, and any other species of interest, should employ some form of behavioral monitoring. This method is an important tool for zoos, because it allows for the effects of any environmental changes to be compared against baseline data. While this project was conducted using a larger research team, a smaller group of keepers can certainly perform similar observations with fewer resources and less time commitments. Observation sessions need not happen more than once a week if time constraints are present, and behavioral observations recorded in daily keeper reports can also be useful to extract information through one-zero sampling (Powell 2008).

If nothing else, efforts to conduct behavioral monitoring during critical periods—such as during pregnancy or following a birth—should provide an institution with knowledge that can affect both the daily husbandry and long-term management of an individual. For instance, if a pregnant gorilla doesn't seem to be active progressively less, or if an infant does not show significant signs of independence after six months of age (both of which were found in this study), these could serve as an early warning of potential problems. These issues may not present themselves via physical signals, and it is in these instances that behavioral monitoring is crucial.

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Please send any correspondence to ApeResearchers@gmail.com.

REFERENCES

Beck, B.B. 1984. The Birth of a Lowland Gorilla in Captivity. *Primates* 25(3):378-383. Springer Science+Business Media, Berlin, Heidelberg, Germany.

Clift, J.P., and R.D. Martin. 1978. Monitoring of Pregnancy and Postnatal Behaviour in a Lowland Gorilla (*Gorilla gorilla gorilla)* at London Zoo. *International Zoo Yearbook* 18(1):165-173. Zoological Society of London, London, England, U.K.

Hoff, M.P., Nadler, R.D., and T.L. Maple. 1981. The Development of Infant Play in a Captive Group of Lowland Gorillas (*Gorilla gorilla gorilla*). *American Journal of Primatology* 1(1): 65-72. American Society of Primatologists, U.S.A.

Hosey, G.R. 2005. How Does the Zoo Environment Affect the Behaviour of Captive Primates? *Applied Animal Behaviour Science* 90(2):107-129. International Society for Applied Ethology, Penicuik, Midlothian, U.K.

Meder, A. 1986. Physical and Activity Changes Associated With Pregnancy in Captive Lowland Gorillas (*Gorilla gorilla gorilla*). *American Journal of Primatology* 11(2):111-116. American Society of Primatologists, U.S.A.

Powell, D. 2008. *Methods for Animal Behavior Research* [DVD]. Wildlife Conservation Society. New York, New York, U.S.A.

Snowdon, C.T. 1989. The Criteria for Successful Captive Propagation of Endangered Primates. *Zoo Biology*. Vol. 8, Issue Supplement: 149-161. Association of Zoos and Aquariums, Silver Spring, Maryland, U.S.A.

Watters, J.V., Margulis, S.W., and S. Atsalis. 2009. Behavioral Monitoring in Zoos and Aquariums: A Tool for Guiding Husbandry and Directing Research. *Zoo Biology* 28(1):35-48. Association of Zoos and Aquariums, Silver Spring, Maryland, U.S.A.

Wilms, T. 2011. *International Studbook for the Western Lowland Gorilla.* Frankford Zoo, Frankford, Germany.