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BRIEF REPORT

Chimpanzee (*Pan troglodytes)* Birth Patterns and Human Presence in Zoological Settings

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In response to work demonstrating a negative correlation between human staff activity and parturition in laboratory-managed primates, this study examined the distribution of 231 captive chimpanzee (*Pan troglodytes*) births that occurred in accredited American zoological institutions by the day of the week on which the birth was discovered. We hypothesized that if chimpanzee parturition patterns displayed sensitivity to human presence, then fewer births per day would be reported during the weekend period, when the visitor density was high, as compared with the lower density working week. Analyses indicated that chimpanzee births were randomly distributed throughout the week. In the context of the questionable sensitivity of primate parturition to external influence, results suggest that variations in human presence do not affect the fine-level timing of birth in chimpanzees managed in a zoological setting. Am. J. Primatol. 70:703–706, 2008.

Key words: chimpanzee; *Pan troglodytes*; day of birth; parturition; captivity; visitor effect

INTRODUCTION

At the moment of birth, maternal and infant fitness is affected by a range of ecological variables: predation, availability and quality of food resources, social and environmental factors, and the energetic cost of delivery [Bicca-Marques & Gomes, 2005; De Lathouwers & Van Elsacker, 2005; Whittle et al., 2001]. Sensitivity to these factors has shaped patterns of parturition in which birth is synchronized with periods of (1) high food availability and (2) low conspecific and predator activity levels [Alford et al., 1992; Bicca-Marques & Gomes, 2005; Chism et al., 1978; McGrew & McLuckie, 1984; Schino & Troisi, 2005].

These shaping forces are substantially altered in captivity: food resources are consistently available, predation threats are eliminated, and other environmental factors are stabilized [De Lathouwers & Van Elsacker, 2005; Hosey, 2005]; however, some species-typical patterns of birth timing persist across captive context, including the tendency for diurnal and nocturnal primates to give birth during the night and day, respectively [Bicca-Marques & Gomes, 2005]. In examining this consistency, investigators have questioned whether a unique factor in captivity —presence of and interactions with humans—affects the timing of the birthing process on a secondary, fine-grained level, beyond these circadian-related rhythms [Cook et al., 2003; McGrew & McLuckie, 1984]. In support of this potential influence, human activity has been associated with a range of behavioral and physiological effects on captive primates [Davis et al., 2005; Hosey, 2000, 2005; Lambeth et al., 1997; Mitchell et al., 1992; Wells, 2005]. Many of these reports link human presence to an increase in arousal, as indicated by increased levels of activity [Chamove et al., 1988; Mitchell et al., 1992; Wells, 2005] and agonism, often with an accompanying decrease in conspecific affiliation [Chamove et al., 1988; Wells, 2005] and an increase in cortisol levels [Davis et al., 2005].

To assess whether these apparent effects extend to parturition, McGrew and McLuckie [1984] and Alford et al. [1992] examined the distribution of captive primate births over the course of the week, postulating that primates respond to human-associated stimuli in captivity by suppressing components of the parturition process to effectively delay birth. Consistent with this hypothesis, in two laboratory populations of callitrichidae (common marmosets, *Callithrix j. jacchus* and cotton top tamarins, *Saguinus o. oedipus*), McGrew and McLuckie found a

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greater occurrence of births during the period of low human activity on the weekend (Friday–Sunday) compared with the working week (Monday–Thursday). However, this ''weekend effect'' diminished among larger, similarly managed populations of the same species, suggesting that the birth distribution may have been skewed by the low number of births examined. Alford et al. followed with an analysis of birth timing among a cross-institution population of laboratory chimpanzees. In three of the five populations exposed to a large differential in weekly staff activity, significantly more births occurred during the low-activity weekend (Sunday–Monday) as compared with the week (Tuesday–Saturday). The fewest births occurred in the late week, which the authors suggested is associated with an accumulation of arousal over consecutive days of exposure to human presence. Although Alford et al. interpreted these findings as indicative of a captive-based, species-wide phenomenon, several management or site-related factors may have exerted wide-ranging effects on the timing of birth events. For instance, the reported separation of some of the pregnant subjects from the social group may have changed ambient arousal levels and the nature of interaction with human staff that in turn affected perinatal physiology.

Alford et al. [1992] advocated a similar analysis on birth patterns in the zoological environment, where visitor presence provides the critical weekly variation in human exposure. This study addresses this question by assessing the distribution of 20 years of recorded chimpanzee births occurring in zoos accredited by the Association of Zoos and Aquariums (AZA). Contrary to the weekly cycles of staff presence in the previous laboratory settings, management activity in the zoological context remains relatively consistent throughout the week, whereas visitor density demonstrates a predictable increase during the weekend period. If chimpanzee parturition exhibited sensitivity to human activity, then fewer births per day were expected during the weekend, as compared with the weekday period; conversely, the null hypothesis predicted a random distribution of births across days of the week. These findings have the potential to further describe the effect of human visitors on captive primates, inform captive management protocols, and hold implications for conservation breeding programs that seek to optimize conditions under which successful births may occur.

METHODS

Subjects

Distribution of births was assessed among the 238 captive chimpanzees (*Pan troglodytes*) born in the 27 accredited American zoological institutions between 1985 and 2005 by using data from the 2006 North American Regional Studbook [Ross, 2006]. For each subject, studbook number and the date of discovery of birth (designated in the studbook as date of birth) were recorded. Twin (five sets) and triplet (one set) births were treated as single events, bringing the total number of births to 231. Subjects were maintained in a variety of social and caretaking contexts, but all institutions met the husbandry standards of the AZA as assessed in the accreditation process. This standardized accreditation process permits the assumption of comparable management settings and a consistent relationship between the day of birth and the day of its discovery in each subject institution.

Data Analysis

Records were sorted according to day of week within each of the 27 institutions of birth. To assess day-related clustering in the distribution of births, the week was divided into weekday and weekend periods. The weekend was defined as the period lasting from Saturday to Sunday, in accordance with increases in visitor levels. Weekday and weekend-day blocks were compared using the goodness-of-fit log likelihood test statistic (G).

RESULTS

Each of the 27 focal institutions recorded between 1 and 47 birth events. To assess population-wide trends, records were combined across institution regardless of differences in the size of each institutional sample. In this pooled set, births in the population were recorded on every day of the week and in every month of the year. Table I lists the number and frequency of births encompassed by the day groups as well as the G-value indicating the degree of similarity between the complementary groupings.

TABLE I. Daily and Weekly Distribution of Births

Day of week	Number of births (231 total)	Percent births	G-value (df = 1)	P[a]
Sunday	25	10.8	3.017	0.082
Monday	37	16.0	0.548	0.459
Tuesday	38	16.4	0.849	0.357
Wednesday	32	13.9	0.357	0.850
Thursday	26	11.3	1.847	0.174
Friday	34	14.7	0.035	0.851
Saturday	39	16.9	1.214	0.271
Saturday–Sunday	64	27.7	0.085	0.770
Monday–Friday	167	72.3		

[a]Each day is compared with the collection of remaining days in the week (df = 1).

In the day-group comparison (weekend vs. weekday), the number of births recorded as occurring during the weekend period was not significantly different from that expected in a random distribution.

To address potential variation in patterns of visitor activity, birth numbers were also compared within weekend/weekday-blocks and institution. Analyses again indicated a random distribution of births across the week and between weekday and weekend blocks in the 11 zoos reporting seven or more births.

DISCUSSION

The random distribution of births across days of the week indicates that the timing of chimpanzee parturition in zoological parks seems not to be affected by changes in visitor activity levels. It is possible that the contrast with the Alford et al. [1992] and McGrew and McLuckie [1984] findings may result from a complex of institution- and species-typical characteristics [Alford et al., 1992; Bicca-Marques & Gomes, 2005; Hosey, 2005; McGrew & McLuckie, 1984]. In the zoological setting, the behavioral and physiological effects of human exposure may be less pronounced than in a laboratory setting as a result of the lower differential in presence (with weekend visitor access) and the inclusion of secluded areas (with naturalistic elements and enrichment structures) from which humans (and conspecifics) are visually occluded [Hosey, 2000, 2005]. These factors may have also served to confound a clear relationship in the current data set, given the large time range of birth events and corresponding changes in zoological management [Davis et al., 2005; Hosey, 2005; Wells, 2005]. The absence of significant differences in birth distributions within institutions tempers this argument, but future analyses may include exhibit type (naturalistic vs. laboratory) and days of public access as additional variables.

In concert with these habitat-based factors, a high species-typical ''nervousness'' [Alford et al., 1992; McGrew & McLuckie, 1984] (i.e. disposition to arousal) may enhance reactivity to visitor presence. Such species may exhibit the most robust birth-timing sensitivities [Chamove et al., 1988; Hosey, 2000], a possibility suggested by McGrew and McLuckie [1984] in describing observed interspecies differences in birth distribution among the callitrichidae and a stump-tailed macaque (*Macaca arctoides*) population and supported in the current chimpanzee results. In this analysis, species-specific social and cognitive traits may differentiate chimpanzees from callitrichidae in the nature of the reaction to human presence [Wells, 2005] to suppress a significant response—perhaps involving parturition—in the former species. An examination of birth cycles in other, zoologically housed species is needed before the influence of setting and species traits in the two tamarin and marmoset species and chimpanzee populations studied can be fully addressed.

We also considered that an interaction between human-associated arousal and parturition might be expressed in terms of infant viability [Debyser, 1995; Newell-Morris et al., 1989]. Using the same data set, which included recorded dates of death, we assessed the association between length of infant survival and the day of week on which the individual was born (weekday vs. weekend). Supporting the general analysis, there was no relationship between the day of birth and survivability; in each survival category examined (1 day, 1 week, 2 weeks, 1 month, 3 months, 6 months, 1 year, 2 years) infants that survived were no more likely to be born on a weekday (or weekend) than those that did not survive to reach those specific benchmarks.

In sum, the observed random distribution of captive chimpanzee births, supported by the absence of a link between day of birth and survival, is consistent with previous work demonstrating a fine-grained control of birth timing by intrinsic factors including circadian rhythms [Cook et al., 2003; Reppert, 1988; Whittle et al., 2001], rather than by recurring captive-based stimuli such as levels of human activity. The relationship between human presence and parturition reported in other studies may be more likely to stem from interactions of facility- and species-specific characteristics, as those authors have suggested. However, though other dimensions of the reproductive process (e.g. mating and development) may be affected by specific components of the external environment, the current results suggest that the temporal patterns of chimpanzee parturition events do not seem to be directly associated with a single factor unique to the typical zoological environment, including one as salient as visitor activity.

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