Factors Influencing the Well-Being and Longevity of Captive Female Orangutans

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Abstract I examined factors affecting the health and mortality of female orangutans in captivity and identified specific aspects of husbandry that appear to be critical to long-term survival in captivity. There are certain high-hazard events in the life of a captive female orangutan, including birth and parturition. Other than the short periods of high hazard, and perhaps of more significance to long-term survival, the major factors that appeared to influence long-term health and mortality included primiparous age, interbirth interval, rearing type, and weight.

Keywords captivity · female · orangutan · zoo

Introduction

Mortality of orangutans (*Pongo pygmaeus* and *P. abelii*) is a life history parameter that varies according to age and environment. Galdikas (1995) estimated that, in the wild, orangutan infant mortality is low, and that most individuals live for ≥40 yr; more recent information from Singleton *et al.* (2004) indicates an even longer lifespan. In captivity, where the potential lifespan is 50–60 yr, 80% of orangutans die at <25 yr and 90% at <30 yr (Cocks 1998). I identified aspects of husbandry that appear to be critical to long-term survival of female orangutans, considering the following key variables:

- Primiparous age: In the wild, menarche (first menstruation) for orangutans usually does not occur until 12 yr. There appears to be a period of infertility after the onset of menarche, and wild females on average do not give birth to their first offspring until 15 yr (Galdikas, *pers. comm.*). Some female orangutans enter menarche as early as 7 yr, with pregnancy and birth of their first offspring occurring shortly thereafter (Cocks 1998).
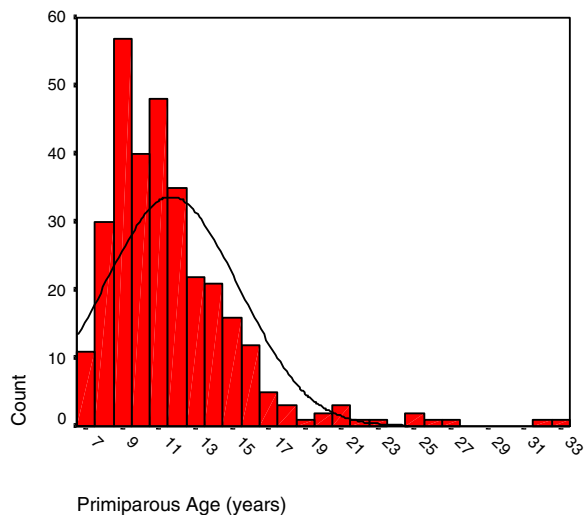
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Table I Summary statistics for the captive population

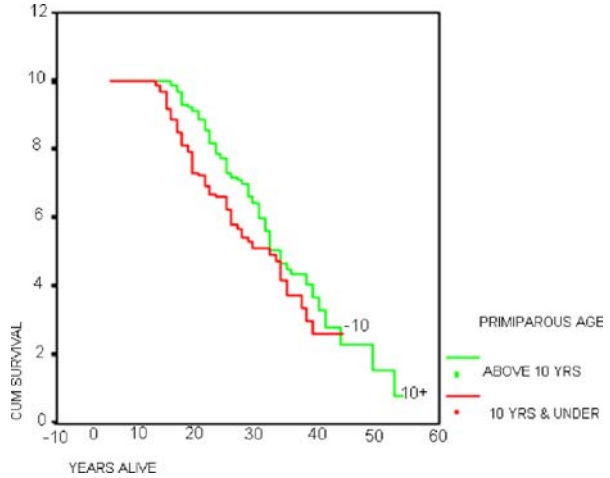| Prognostic indicators	Results
Overall survival	Mean life span = 13 yr
Adult survival	Mean life span after infancy (0–5 years) = 18 yr
Infant rejection	38% of captive females rejected infants
Stereotyped behavior	11% of captive individuals were reported to have stereotyped behaviors
Postnatal death	21% of female orangutans die ≤30 d of giving birth

- Interbirth interval: In the wild, female orangutans have an interbirth interval of 6–8 yr. The period of postpartum amenorrhea (5–7 yr) appears to correspond to the period of nursing (Galdikas and Wood 1990). Owing to human rearing of infants in zoos and the practice of housing males and females in the same enclosure, the interbirth interval of captive females is usually <6–8 yr (Cocks 1998).
- Sterilization: Sterilization is often a practical way to limit the reproductive potential of captive male and female orangutans.
- Rearing situation: Captive orangutans can be either human or mother reared (Cocks 1998).
- Adult female weight: On average, wild females weigh *ca.* 38 kg and males 86 kg (Markham and Groves 1990). The mass of captive orangutans usually exceeds the mass of wild orangutans (Cocks 1998).

I tested the effects of the aforementioned variables on the health and survival of captive female orangutans. I looked for a statistical relationship between the variables and the following prognostic indicators:

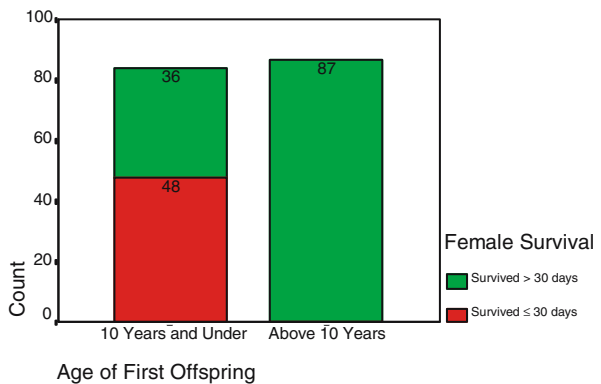**Fig. 1** Primiparous ages for female orangutans.

SD = 3.71, mean = 11.7, and *N* = 314.00
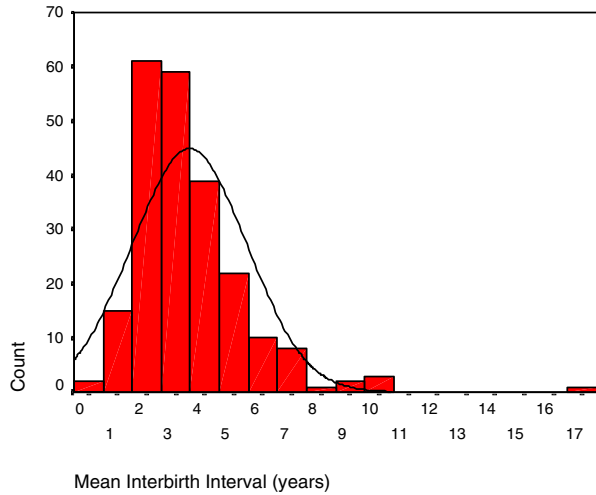
Fig. 2 Cumulative survival vs. primiparous age.

- Overall survival or longevity is a precise and impartial indicator of the success of captive husbandry practices.
- The factors affecting infant mortality may be different from the ones affecting overall survival and therefore can provide another indicator of the success of captive husbandry practices.
- Infant rejection by female orangutans is another indicator of the success of captive husbandry practices, and is an undesirable outcome. Infant rejection increases the cost to the zoo and affects the quality of life for both mother and offspring.
- Stereotyped behavior is an indicator of poor mental fitness of captive individuals.
- The factors affecting maternal death may be markedly different from the ones affecting overall survival. The subset of orangutan mortality —defined here as death ≤30 d after giving birth— therefore can provide another indicator of the success of captive husbandry.

Fig. 3 Maternal survival vs. primiparous ages.

Fig. 4 Mean interbirth intervals for female orangutans.
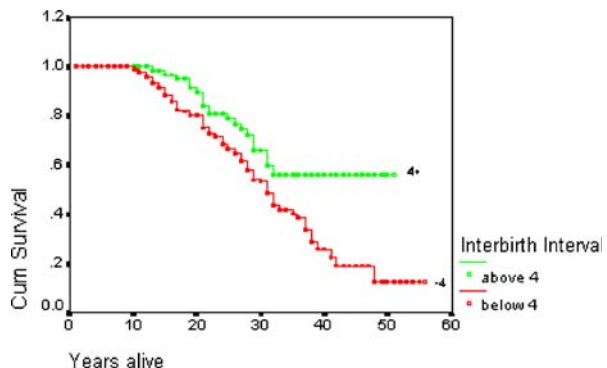

SD = 1.98, mean = 3.5, and *N* = 223.00

Materials and Methods

I transcribed details of the 1975 captive orangutans (1002 females) listed in the International Studbook (Perkins 1994) from a hard copy to a computer file. I restricted the information to the period 1945–1994. I did not use data for years before 1943 to avoid including deaths that were a direct consequence of World War II.
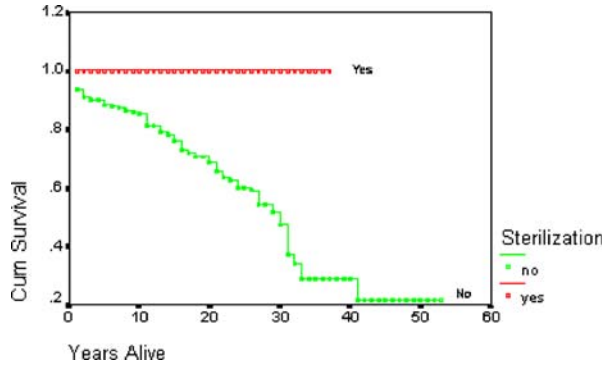
I developed a survey with the assistance of Dr. Douglas Paton of Curtin University's Psychology Department while referring to Fowler (1988) and Ford (1990). I sent the survey to 214 international institutions listed in the studbook as holding or having held orangutans. The data analyzed below thus came from the studbook and the survey.

I extracted a series of variables from the data that related to well-being. I further subdivided variables into those with indicative power —prognostic indicators— and those with a predicted relationship to the prognostic indicators.

Fig. 5 Cumulative survival vs. mean interbirth interval.

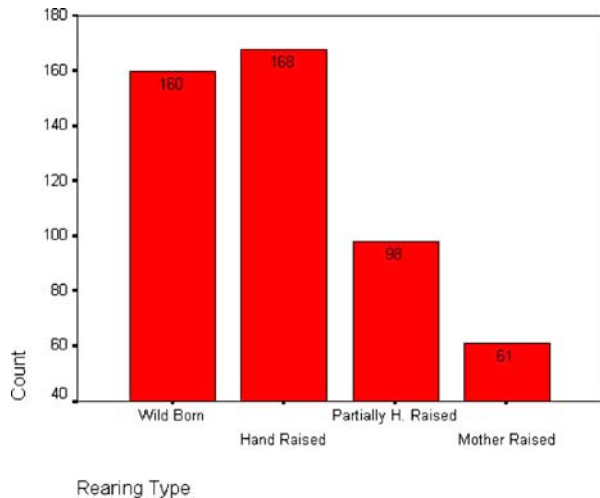Fig. 6 Cumulative survival for females vs. sterilization.

I used SPSS (6.0) for Windows to analyze the studbook data. Because censored (living individuals) and uncensored (dead individuals) data were present, for the analysis platform I used life tables, which analyze the probability of survival and death over fixed intervals of time. I used the Wilcoxon (Gehan) test statistic for survival variables and the Kendall and Spearman correlation coefficients for categorical variables. I set a significance level of .05 for all tests. I also used the Kaplan-Meir and Cox regressions on the same data, as they allow control of the effect of 1 variable on another. However, the regressions gave the same overall results. Descriptive statistics contain an overview of the prognostic indicators (Table I).
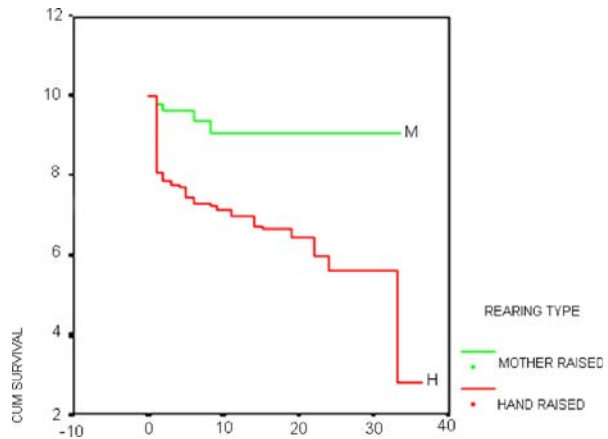
Results

Early Breeding of Females

I calculated female primiparous age for the 314 orangutans Perkins (1994) described in the International Studbook (Fig. 1). Female orangutans have their first offspring
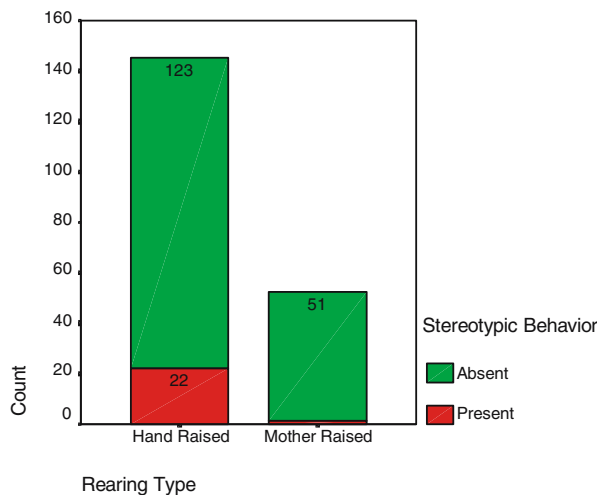
Fig. 7 Numbers of orangutans vs. rearing type.

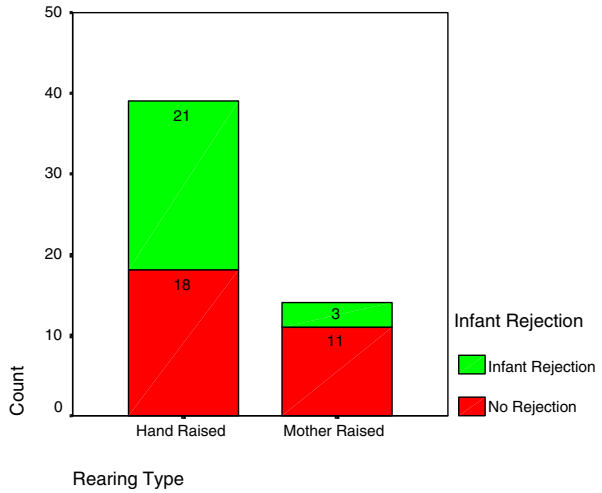Fig. 8 Cumulative infant sur-
vival (0–5 yr) vs. rearing type.

at 7–33 yr, with most females producing their first infants at 9–13 yr. To make the analysis clearer, I divided observations into 2 categories, ≤10 yr and ≥10 yr. I made the division on the basis of the mean age of 11.7 yr for captive females, which is close to the lower range of 12 yr for wild females (Galdikas 1978). Females that birth their first offspring at >10 yr appear to have a higher survival rate than the ones having their first offspring at <10 yr (Fig. 2; $p=.0026$, df=1).

Between the 2 categories of primiparous ages, there appears to be a difference in the occurrence of maternal death (Fig. 3; $p≤.000$, df=1). Fifty-seven percent of females that had their first offspring at ≤10 yr died ≤30 d of giving birth. There is no instance of maternal death in the >10-yr age group.

Fig. 9 Occurrence of stereo-
typed behavior in different rear-
ing types.

Fig. 10 Occurrence of infant rejection in orangutans for different rearing types.

Short Interbirth Intervals

Using the studbook data, I calculated the interbirth interval for 223 orangutans (Fig. 4). I divided the observations into 2 categories: <4 yr and ≥4 yr on the basis of the average captive interbirth interval of 3.5 yr. Females with mean interbirth intervals >4 yr have a higher survival rate than those with mean interbirth interval of <4 yr (Fig. 5; $p=.0366$, df=1).

Fig. 11 Adult female weights.

SD = 24.90, mean = 69.5, and $N = 65.00$

Fig. 12 Survival vs. female weight.

Female Sterilization

I collected 238 responses for the survey question on female orangutan sterilization. Only 11 females (5%) were reportedly sterilized. There is a significantly higher death rate in unaltered females vs. sterilized females (Fig. 6; $p=.0171$, df=1).

Human Rearing

A total of 85 zoos responded to the survey questions about the rearing conditions of their orangutans (Fig. 7). There were 160 wild-born orangutans (33%), 168 human reared (34%), 98 partially human reared (20%), and 61 mother reared (13%). I collected data for the wild born and partially hand reared categories to exclude them reliably from the analysis, as they were both likely to be hybrids of the 2 other raising categories. I tested the relationships of human and mother reared categories to the prognostic indicators.

There appears to be a much higher survival rate for mother-raised than for human-raised infants (Fig. 8; $p\le.0000$, df=1). Also, the presence or absence of stereotyped behavior is related to rearing condition, with a 15% occurrence of stereotyped behavior in human-reared orangutans and only a 2% occurrence in mother-reared individuals (Fig. 9; $p=.038$, df=1).

The conditions under which a female orangutan was reared impacts on her maternal competence. Human-reared females showed a higher rate of infant rejection (54%) than did females that were mother reared (21%; Fig. 10; $p=.011$, df=1).

Adult Female Body Mass

A total of 85 zoos responded to the survey questions on the weights of 65 orangutans (Fig. 11). For analysis, I divided female weights into 3 categories. The first category included 22 adult females that by commonly accepted zoo standards were within a normal mass range (35–55 kg), the second category 28 overweight adult females (56–75 kg), and the third category 21 obese adult females (≥76 kg).

Adult female survival prospects dropped as mass increased (Fig. 12; $p=.0052$, df=1). Pairwise comparisons showed that only the 76–95 kg category had significantly different survival rates from the other 2 (lower) mass categories ($p=.0084$ for 35–55 kg and $p=.0532$ for 56–75 kg). There is no significant difference between the 35–55 kg and 56–75 kg categories ($p=.1937$). However, this may have been significant if higher numbers of females were involved in the analysis.

Discussion

Within 1 mo of parturition, captive female orangutans had a higher risk of death. Other factors that influence long-term health and mortality included primiparous age, interbirth interval, sterilization, rearing type, and adult body mass.

Female Reproductive History

The natural breeding timetable for wild female orangutans is to have the first offspring at *ca.* 15 yr and to continue to produce infants with an average interbirth interval of 8.5 yr. The rate of reproduction may be limited by such factors as dietary intake, body fat levels, and postpartum amenorrhea (Knott 1998).

Natural limits on reproduction are absent in the captive environment, which results in earlier first births and reduction in interbirth intervals, which is undesirable because both variables are strongly linked to reduced maternal survival rates. The results strongly suggest that early breeding of females is associated with complications during and shortly after the birth process. Though the reduction in interbirth intervals did not appear to have a significant effect on the frequency of maternal deaths, it did appear to affect survival rates significantly, possibly because of longer-term physiological stress placed on the female, rather than immediate problems associated with the births of their infants.

The increased survival rates of sterilized females may be related to the elimination of risks associated with the reproductive process. Twenty-one percent of captive females die ≤30 d of giving birth, which suggests the process is a hazardous event for captive female orangutans. It is important to study the range of normal behaviors that occur during the birth process. Once normal behaviors are determined, problems in captivity can be recognized and corrections attempted (Leuthold 1977). The absence of appropriate behaviors may indicate such problems as injury, illness, maternal rejection, or social dysfunction.

Human Rearing

An orangutan, ideally, should not be human reared, given the increased occurrence of stereotyped behaviors and reduced survival rates. The techniques should be emergency measures used only when all else fails. Wild orangutans often do not nurse their infants until 48 h after birth. Zoos unaware of this behavior have in the past prematurely removed infants from the mother for human rearing. It is possible to condition even orangutans that have neglected or abused their offspring to care for

their young (Read and Meier 1996). For example, an adult female orangutan allowed a staff member to position an infant correctly on her nipple (Asano 1967). There have also been successful reintroductions of dams and infants after short periods of human rearing (Mehren and Rapley 1978). Researchers have trained dams that either cannot or will not nurse infants to present their infants for bottle feeding. The Monkey Jungle (Fontaine 1979) and the Audubon (Kennedy 1992), Toledo, and Brookfield Zoos have successfully used the techniques with orangutan dams or suitable surrogates.

Human rearing may be optimized to reduce the occurrence of stereotyped behaviors. Historically, infants were reared in isolated and sterile environments that provided for physical survival, but neglected their behavioral or psychological needs. Read and Meier (1996) state that human and ape social behavior may be similar enough that human-raised infants will learn much of what they need to know to fit into their group. It is clear from the increased occurrence of stereotyped behaviors in human-reared orangutans that the assumption is false, and there is a need to develop techniques that address all of the particular needs of the infant orangutan.

The dam-infant relationship forms the basis of nearly all social behavior in mammals. Maple (1980) linked the absence of conspecific mothering to deficiencies in both sexual and maternal behaviors in adults. Preferably, human-reared infants should have contact with other orangutans, especially adults, and they should live in mentally stimulating environments.

The orangutan mother is in constant physical contact with her infant for the first 12 mo of the infant's life, and for many years they are rarely separated by more than a few meters (Galdikas 1978). The close social and physical relationship between mother and offspring gives a secure base in which the infant can confidently explore its environment. Without the secure base, the infant becomes reluctant and fearful to initiate contact or explore novel situations and often exhibits stereotyped behaviors (Maple 1980). Jane Goodall (1990) has linked the presence of this close relationship during infancy with adult confidence and dominance in Gombe chimpanzees. Wild orangutans have the closest dam-infant contact of the great apes and produce the most independent adults (Galdikas 1995). Therefore the importance of constant contact with the surrogate mother may be the most important factor missing in the human rearing of orangutans. Human surrogates usually provide less social stimulation in both quantity and quality than orangutan dams (Maple 1980). Maple (1980) linked the presence of stereotyped behaviors in human-reared orangutans to the absence of sufficient stimulation, which the orangutan dam ordinarily provides as she grasps, hugs, rocks, and carries the infant. Fritz *et al.* (1985) implicated a decreased number of feed times and the associated reduction in body contact time as a cause of stereotyped behaviors such as digit sucking and body rocking in human-reared apes. The transition to the adult environment should be gradual.

Adult Female Body Mass

The factors that likely contribute to reduced survival rates in obese female orangutans are probably similar to those commonly known in humans. Interestingly,

no such relationship there is for obese adult male orangutans ($p=.6220$, df=1), suggesting that females are more susceptible to the problems associated with obesity (Cocks 1998).

Conclusions

- Captive female orangutans should not breed until they are 12–15 yr. Breeding at younger ages increases the risk of maternal death.
- Female orangutans should have interbirth intervals of ≥4 yr.
- The birth process is a high-hazard event for captive female orangutans and should be monitored with great care. Twenty-one percent of females die ≤30 d of giving birth.
- Researchers should avoid human rearing if at all possible to enhance longevity, decrease the presence of stereotyped behavior, and decrease the occurrence of infant rejection. If human rearing becomes necessary, it is important to maintain the naturalistic upbringing of the infant as closely as possible.
- Because they are more likely to reject their infants, researchers need to give human-reared females an extra opportunity to learn maternal behaviors.
- Captive female orangutans should not become obese, because it reduces overall survival.

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