Zoo Biology 2:253–257 (1983)

Managerial Strategies in the Captive Propagation of Endangered Species

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A captive propagation manager, committed to the welfare of captive populations of exotic animals, must often make decisions that are risky to individual animals. Innovative decisions that place animals at risk are essential to the progress of captive propagation. Such decisions must be grounded thoroughly on peer consultation, the scientific and zoo literature, and where possible on original applied research targeted specifically to the procedure in question. The management of two closely spaced births in a gorilla group is provided as an example.

The birth-to-death ratio is proposed and illustrated as a quantitative index of the quality of captive propagation programs and their managers.

Key words: captive propagation, curator, endangered species, gorilla, hand-rearing, mother-rearing, primate, zoo

INTRODUCTION

A captive propagation manager must often make policies, implement programs, and take specific actions that may potentially be harmful to animals. While no curator or propagation manager would willfully inflict injury or illness, certain risks must be taken if there is to be progress in captive propagation. Examples include the design of an innovative captive habitat, preparing and allowing females to raise their offspring, and immobilization of adults for intensive fertility evaluation, semen collection, and artificial insemination. There is presently no quantitative measure to evaluate a specific risk or to rate the overall quality of a propagation program and its managers. These issues need consideration and investigation just as surely as the more technical aspects of propagation biology.

RISKY DECISIONS

Our knowledge of the management and husbandry of endangered animals is often too imprecise to say with certainty that a decision involves no danger to the welfare of the animals involved. In such cases the risk must first be acknowledged; ignoring or denying the risk thwarts input that might improve the procedure. There

Received for publication 1983; accepted February 19, 1983.

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must be full and open discussion with all parties qualified through their knowledge, experience, or justified interest. Curatorial and veterinary colleagues, and keepers, within and outside the home institution, must be involved. Questionnaire surveys, such as one conducted recently on gorilla birth management by Satterfield and Kiser [unpublished], are often appropriate for reviewing the experiences of others facing comparable situations. The relevant scientific and zoo literature must be consulted. The administrative officer who would have to handle public reaction and media inquiries in the event of failure should join the discussion and prepare a response. There should be a written plan that details the responsibilities and authority of all personnel involved in the procedure, and responses to all foreseeable contingencies. Rehearsals are often appropriate.

In my experience, the most effective preparation is to design and conduct research that is targeted specifically to the procedure and its risks. At Brookfield Zoo, I trained a cadre of volunteers in behavioral research methodology and then involved them in a research program designed to provide data that would inform the management of two impending gorilla births. Our subjects were "Samson," a 19-year-old male on loan from the Buffalo Zoo, and two females, "Alpha" and "Babs." Samson had never sired offspring and as an adult had never seen a gorilla infant. Alpha was 20, and had had several infants. Indeed, one of her infants was Babs, who was 7 yr old when we began our research and who had lived continually with Alpha since birth. The trio had been living together for about a year at the onset of our study. Both Alpha and Babs were known to be pregnant by Samson. Based on copulation dates and the appearance of positive reactions on urine pregnancy tests, we calculated that Babs was about 3 months pregnant and Alpha about 1 month pregnant when our research began. I was hopeful that we could keep the group intact for the births. Fossey [1978] and Stewart [1977] had reported that wild mountain-gorilla females remain spatially and socially integrated with their groups during and after births. I reasoned that an expectant female might be sufficiently stressed by separation from her group to interfere with maternal behavior. I wanted to avoid hand-rearing, since sustained captive propagation necessitates maternal competence. Hand-rearing the multitude of infants that would result from a successful propagation program would simply be too costly and impractical. Additionally, many mammals and birds, when deprived of conspecific maternal contact and normal sensory stimulation as infants, are likely to be socially and sexually deficient as adults [eg, Harlow and Harlow, 1965; Hess, 1963].

There were several cogent arguments for separating at least Babs from the group before she delivered. Samson, powerful, assertive, and inexperienced with infants, might purposely or accidentally harm the infant. Alpha would be in the third trimester of her own pregnancy when Babs delivered and might try to kidnap her daughter's infant. Finally, there is a common assumption that gorillas must learn maternal behavior by experience or imitation. Babs had observed no other gorillas being raised except herself, and had had only glimpses of two orangutans being mother-raised. If she proved to be incompetent as a mother, removal of the infant would be greatly complicated by the presence of the other two adults.

Our research program was designed to provide data that would be helpful in the formulation of birth management policy and decisions. We conducted 154.5 h of systematic observation during the 6 months that preceded the first birth. The setting was four large interconnected off-exhibit cages, each about 4 m $\times$ 3 m $\times$ 4 m, in "Tropic World," Brookfield Zoo's innovative primate complex.

Although there was little actual affiliative behavior, there was also little agonistic behavior. No biting was recorded. Not surprisingly, the strongest bond was between Alpha and Babs. For example, Alpha groomed Babs 11 times and Babs groomed Alpha 40 times; Samson groomed neither, was never groomed by Alpha, and was groomed by Babs only once. Alpha and Babs were observed to be in the same cage together in 59.6% of our scan samples; Alpha was found to be in the same cage with Samson in only 11.5% of the samples; and Babs was found in the same cage with him in 21.5% of the samples. Samson inflicted 41 "rough-ups" (a category of low-intensity aggressive behavior that includes slapping, poking, elbowing, punching, hair pulling, pushing, and holding) on Alpha and 36 rough-ups on Babs. In contrast, Alpha was roughed up by Babs only 14 times and Babs was roughed up by Alpha only twice.

The second strongest bond in the group was betwen Babs and Samson. As noted above, Babs was found to be in the same cage with Samson nearly twice as often as was Alpha. Samson was more aggressive toward Alpha than he was toward Babs, although this difference was not statistically significant. "Resting near," sitting or lying down within arm's reach of another individual for at least ten seconds, was used as a measure of social affinity. Samson rested near Babs 19 times but rested near Alpha only once. Babs rested near Samson 27 times while Alpha never rested near him. Alpha rested near Babs 93 times and Babs rested near Alpha 142 times, again demonstrating that the bond between mother and daughter was the strongest in the group. However, the rest-near data also demonstrate clearly that the bond between Samson and Babs was considerably stronger than the bond between Samson and Alpha. This reinforced our intuitive impression that Babs was the pivot point of the trio. Samson had severely bitten and beaten Alpha when they had first been introduced, and she seemed to avoid him subsequently. Babs had been spared such aggression, and had been the first to make affiliative contact with him.

Another significant finding was that when the trio was together, Babs was "dominant" over her mother. Specifically, as noted above, Babs roughed up Alpha 14 times while Alpha roughed up Babs only twice. Yet the keepers reported that when Samson was separated from the two females (as he was during the main feeding to insure that the females got sufficient food and that he didn't overeat), Alpha was able to take contested food from Babs, ie, Alpha was "dominant" over her daughter. This suggested that Alpha could kidnap Babs's baby if Samson were absent, but because of the tripartite dependent-rank relationship, the probability of kidnapping would be decreased if Samson were present. In general, the presence of the adult male decreases the frequency of aggressive interactions between gorilla females [Hoff et al, 1982].

Thus the overall cohesiveness of the group as well as its particular social structure indicated that keeping the group intact for the births was a justified risk and perhaps the preferred course of action. I should add that our reasoned confidence was strengthened by our intuitive impression of Samson's gentleness and good sense, and of Babs's and Alpha's social proficiency.

The gorillas had been introduced to their new exhibit in Tropic World 19 days before Babs delivered, and Samson had not yet begun to return reliably to the holding cages each evening. He was therefore not present for the first birth, but our reasoning guided his uneventful reintroduction to the group when the infant was 4 days old. Alpha had been intensely curious about Babs's baby but had not attempted to kidnap her. Alpha gave birth to her own healthy female infant 2 months later. Samson was present in the holding cages during this birth and was again a model of fatherhood.

Babs as well as Alpha exhibited total maternal competence [Beck, 1982], and the group, which includes three generations of females, is still intact at this time.

The outcome is not always successful. An infant born into another gorilla trio under my curation was killed shortly after birth. In this case I had failed to study the social relationships between the three animals and had failed to monitor the birth properly. We must learn from our mistakes, and, painful as they are, we must publish and present them publicly so that others will not repeat them. The voluminous zoo literature carries accounts of successful exhibit design and management programs but errors and failures are rarely acknowledged. We should emulate the frankness of Chamove's account [1981] of both the strengths and weaknesses of the design of a primate facility.

Of course, a consistent pattern of misjudgment is unacceptable. Quantitative assessment of the long-term success of propagation programs and of the performance of propagation managers and curators is urgently needed. I favor annual computation of the ratio of births to deaths. For this purpose I include as a birth any infant that breathed, regardless of its longevity (for a full-term birth) or gestational age (for a premature birth). Stillbirths, whether premature or full term, are counted neither as births nor deaths but are reflected negatively by a decreased birth rate. Successful captive propagation demands a birth-to-death ratio equalling or exceeding 1.0.

Indeed, the birth-to-death ratio would be affected by the quality of the performance of a manager's or curator's associates, the adequacy of physical facilities, and numerous other factors, including luck. The ratio can be inflated by inclusion of "weed species" that are easy to maintain and propagate, and can be deflated by taking on a species that has been resistant to captive propagation. The ratio will also vary with the reproductive pattern of the species involved; it is bound to be higher for geese than for elephants. Despite these vicissitudes, comparison of the ratio for a series of years for the same manager/curator with that for analogous programs and curatorships in different institutions will provide a quantitative estimate of quality. I know of no precedent for absolute values for this evaluation. What is a good birth-to-death ratio for a reptile, bird, ungulate, or primate collection? In a decade, the ratio for the Brookfield Zoo primate collection increased from 0.82 to 3.60. The increase is gratifying, but is 3.60 average, good, or poor?

I strongly recommend that propagation managers calculate, compare, and evaluate birth-to-death ratios. The ratio is a quantitative tool for individual and institutional evaluation, and for expressing and upgrading the standards of the captive propagation profession. It is a useful variable for preoccupation/postoccupation studies of new exhibits, and for evaluation of new management policies and programs. It is easily understood by the paying visitors, taxpayers, donors, and funding agencies that support captive propagation programs and therefore have a right to accountability. A good overall ratio will additionally provide insulation from an isolated but dramatic failure of a risky procedure. Of course, the ratio should complement, not replace, conventional criteria, but we should no longer rely solely on subjective evaluation. There is a possibility that such hard evaluation might dampen innovation, but the ratio is as sensitive to unjustified conservatism as it is to unjustified risk. Our commitment is neither to tradition nor to innovation, but to the wisdom to blend the best of both.

CONCLUSIONS

1. Effective captive propagation often necessitates decisions that place individual animals at risk.
2. Risky decisions must be fully informed by peer consultation, the literature, and original applied research.
3. Annual computation of the ratio of births to death provides a quantitative index of the success of captive propagation programs and their managers.

ACKNOWLEDGMENTS

Primate keepers Dennis Houdek, Nancy Ludvigson, John Palis, Jan Rafert, Jan Ramer, Beate Rettberg, Carol Schifo, and Mark Warneke, and veterinarians Scott McDonald, Janis Ott, and Frank Wright provided advice and assistance in the recent management of gorillas at Brookfield Zoo. Minot Ortolani, Gerry Aquilina, and Allan Prowten demonstrated wisdom and skill in arranging to move Samson from the Buffalo Zoological Gardens to Brookfield. Frances Olson and Mary Nichols coordinated the efforts of more than 20 volunteers who participated in the gorilla research program. Robert Horwich first demonstrated the power of the birth-to-death ratio.

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