



Research Article

Audit of Captive Breeding in a University Zoo Facility in Nigeria: Challenges and Prospects

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Abstract | Reports on captive breeding of zoo animals are scanty in literature especially in an African setting. The understanding of challenges and prospects of captive breeding will aid conservation of zoo animals especially those endangered. This report evaluates unaided, sporadic, captive breeding of zoo animals over a 10-year span. Clinical records of observed gestation or egg-laying, as well as successful or failed parturition or hatching of various species of captive animals were obtained. The animals included reptiles, amphibians, aves and mammals, with both sexes placed in the same enclosure with some degree of access to one another. Among mammals, survival rates of neonates ranged from 0% in Dorcas gazelles (*Gazella dorcas*; n=2) to 100% in Green monkeys (*Chlorocebus sabaeus*; n=2) and Patas monkeys (*Erythrocebus patas*; n=3), and crocodiles (*Crocodylus niloticus*; n=32). Muscovy ducks (*Cairina moschata*), black cobra (*Naja nigricollis*) and lions (*Panthera leo*) had survival rates of their hatchlings/neonates to be 83%, 95% and, 67% respectively. The challenges include absence of a pseudo-naturalistic environment, poor fostering ability and inadequate perinatal care. The prospects, if these challenges are addressed, are potentially humongous and rewarding. When appropriate management and health practices are put in place, wild animals in captivity can be successfully bred; thus, offering captive breeding as a veritable tool for conservation.

Editor | Muhammad Abubakar, National Veterinary Laboratories, Park Road, Islamabad, Pakistan.

Received | January 02, 2019; **Accepted** | February 28, 2019; **Published** | March 15, 2019

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Citation | Ogunsola, J., R.E. Antia, B.O. Emikpe and O.A. Morenikeji. 2019. Audit of captive breeding in a university zoo facility in Nigeria: Challenges and prospects. *Veterinary Sciences: Research and Reviews*, 5(1): 12-15.

DOI | <http://dx.doi.org/10.17582/journal.vsr/2019/5.1.12.15>

Keywords | Captive breeding, Conservation, Zoo animals, Nigeria

Introduction

Captive breeding is the process of breeding animals outside of their natural environment under restricted conditions in closed facilities. The choices of individual animals that are to be part of a captive breeding population are controlled by humans (Magin et al., 1994). Captive breeding may be carried out to produce animals for zoos, aquaria, research institutions, and other public facilities, and to increase captive population numbers of rare, threatened or endangered species (WWF, 2007).

Zoos and aquaria are principal institutions that hold ex situ populations of animal species for captive breeding purposes. Zoo facilities originated as avenues for public entertainment, and recently education. Zoos are beginning to assume conservation roles. Captive populations of animals can play a significant conservation role as demographic and genetic reservoirs, as sources from which new populations can be founded, and as last resort for species which have no immediate chance of survival in the wild. Captive breeding of mammals in zoos is promising for many of the best-known endangered species and

has succeeded in saving some from certain extinction (Magin et al., 1994).

Captive breeding has been met with several success rates as there are known limitations to captive breeding of mammals in zoos (Alroy, 2015). Interestingly, breeding success has been the most frequent indicator for measuring animal welfare in captivity (Clubb and Mason, 2007). Failure to reproduce in captivity has been consistently linked to stress from sustained confinement in sub-optimal conditions (Hua et al., 2015). Overall, if an enclosure does not provide an appropriate environment, the population will not have the physiological or behavioural capacity to breed, and the conservation objectives of the zoo will be compromised.

In many African settings, reports of captive breeding (Bertschinger et al., 2008) are scanty in literature. This may be a consequence of a relative paucity of zoos on the continent, despite the vast amount of wildlife. The University of Ibadan Zoological garden, one of Nigeria's foremost zoos was established over six decades ago as a Menagerie and became a full-fledged zoo in 1974 as its animal collections grew. The zoo boasts a vast array of animals comprising mammals, birds, reptiles and amphibians. The zoo aims to provide conservation, education and entertainment.

This retrospective study that spanned about a decade was then carried out to examine the possibility of breeding among zoo animals, and to determine how successful it was. It is thought that understanding the factors critical to the success of sporadic breeding is crucial to establishing a role of the zoo facility in conservation of threatened or endangered species.

Materials and Methods

Ethical statement

All necessary permits were obtained from the Animal Care Use and Research Ethics Committee (ACUREC) University of Ibadan, Nigeria.

Zoo facility

The study location was the University of Ibadan Zoological garden. The zoo boasts a vast array of animals comprising mammals, birds, reptiles and amphibians. The zoo aims to provide conservation, education and entertainment.

Animal

The animals studied included reptiles, amphibians, aves (birds) and mammals. Such animals had both sexes placed in the same enclosure with some degree of access to one another.

Assessment of breeding outcome

The outcome of the sporadic breeding was described as one of the following: failed (when both sexes of the same species were placed in same enclosure with unlimited access to each other for a decade without any sign of gestation); partial success (when either there was obvious gestation or egg-laying but there was no successful parturition (hatching) or the neonate/hatchling did not survive for at least 1 month); and successful (when there was successful parturition/hatching and the neonate/hatchling survived for more than 1 month).

Information / data gathering

Data from the clinical and zoo keepers' records of observed gestation or egg-laying, as well as successful or failed parturition or hatching of various species of captive animals were obtained over a decade (2006 - 2015). Focused discussions and interviews with the zoo keepers (n=2 in each section) and attending veterinarians (n = 3) provided information which included circumstances surrounding parturition and care of the neonates or hatchlings as well as possible reasons for the failure, partial success or complete success of any observed breeding/mating.

Results and Discussion

The details of animals studied, number of observed gestations and/or egg-laying, the number of neonates and hatchlings produced, as well as the number of the neonates/hatchlings that survived for at least one month after parturition/hatching are presented in Table 1.

Zoo keepers attributed the absence of a naturalistic habitat as the most likely reason for 'failed breeding' because both sexes of the animals never showed signs of deteriorating health during the period of access to each other. Veterinarians suggested that the breeding soundness of these sexes were never assessed and that there was no examination carried out to determine if the animals were sterile or fertile in the first place. The main reason for not carrying out the breeding soundness examination was due to a lack

of facilities that can ensure restraint of these species. Inappropriate enclosure conditions, poor mothering/fostering ability of the dam and lack of adequate perinatal care were the three main reasons adjudged as contributory to partial success of any observed gestation/egg-laying.

Table 1: Record of sporadic captive breeding in a zoo facility in southwest Nigeria.

Animal	Observed gestations/eggs laid	Successful parturition/hatchlings	Number of surviving animals
Soft-shelled turtle	12	0	0
Crocodiles	32	32	32
Black cobra	38	36	36
Muscovy ducks	24	22	20
Dorcas gazelle	2	2	0
Donkey	2	2	1
Horses	6	5	5
Green monkey	2	2	2
Patas monkey	3	3	3
Lion	2	3	2
Stripped hyaenas*	0	0	0
Giant Eland*	0	0	0

*Both sexes placed together in same enclosure during the period under study.

Coordinated captive breeding programs in zoos have been adjudged as largely successful for mammals (Hayward, 2011) and in improving the status of 13 species on the IUCN Red list (Condey et al., 2011). The roles of zoos in ex situ conservation are well documented (Azevedo et al., 2011; Condey et al., 2011; Hua et al., 2015). Similar documented reports on captive breeding programs in Africa are scanty in the literature (Bertschinger et al., 2008). Captive breeding appears to be the only prescription to safeguard the future of threatened animals, as well as that of zoos and aquaria themselves (Condey et al., 2013).

Interestingly, a few mammals and virtually all the lower vertebrates (aves and reptiles) in this study had successful breeding outcomes. We suggest that this may be linked to the intense requirement for survival of a mammalian neonate when compared to the hatchlings of lower vertebrates. Mammals are expected to provide colostrum for their neonates in the early hours of life and when the dam is not able to provide colostrum, assisted feeding is almost always inevitable. However, the aquatic reptiles (e.g.

soft-shelled turtle) also had poor breeding outcomes. This may be due to the absence of a naturalistic environment. The study location may be unable to mimic the optimal thermal, saline conditions required by soft-shelled turtles.

Despite the successes recorded and prospects, there are known limitations to improved success rates of captive breeding programs (Alroy, 2015). In our view, the naturalistic habitat as well as intrinsic (poor fostering ability of the dam) and extrinsic (inadequate perinatal care) factors that bother on reproduction are the major challenges towards successful captive breeding in the zoo. Bertschinger et al., 2008 asserts that failed captive breeding in cheetahs could be related to a lack of genetic diversity. Hua et al. (2015) reports the naturalistic habitat, dietary husbandry, reproduction and disease control as problems in the successful captive breeding of pangolins. Marshall et al. (2016) found out that breeding success of Humboldt penguins is affected by husbandry and enclosure area.

The roles of appropriate equipment and expertise in ensuring the success of captive breeding can never be over-emphasized. With advanced reproductive technologies (Holt, 1994), breeding programs would have largely successful outcomes despite the animal species are outside of their natural habitat. There is a need for provision of equipment relevant to the detection of estrus, aiding successful insemination (even if it is artificial), monitoring of gestation in mammals and assisting parturition. The peri-parturient period is significant in the final outcome of breeding. The neonate may not be well-suited to the enclosure environment, and, some dams may lack the necessary fostering ability required to increase the chances of survival of the neonate. As much as 84.9% of losses in cheetah cubs occurred during the first month postpartum while 15.1% deaths occurred between 1 and 12 months of age (Bertschinger et al., 2008). This supports our finding that the perinatal period is critical in determining if the outcome of breeding would be a partial success or a complete one. There is therefore, a crucial need for training and re-training of zoo workers, animal handlers and attending veterinarians in the field of neonatal and perinatal care of wild life species.

We conclude that support for local captive breeding facilities in developing countries, in the areas of

provision of equipment and training of manpower should be increased. This could be achieved through collaborative ventures with captive breeding programmes in the developed world. This support is considered as a necessity in ensuring that zoos are strategically placed to fulfil the role of conservation.

Acknowledgements

The authors are grateful to the participating zoo keepers, curators and attending veterinarians.

Authors' Contributions

REA and BOE conceptualized the project. JO and OAM retrieved the records and conducted the focused group interactions. JO wrote the initial draft of the manuscript. All authors critically reviewed the manuscript.

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