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INCIDENCE OF INFANTICIDE AMONG CAPTIVE WILDLIFE IN SOME SELECTED ZOOS IN NIGERIA

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ABSTRACT

This study aimed at revealing the cause of infanticide among zoo collections and proffer strategies to mitigate its occurrence. Three zoos in Nigeria were studied using empirical data from 20-year Veterinary retrospective records and circumstances surrounding the occurrence. A total of 17 infanticide cases were reported from three zoos in Nigeria; 8 from UNILORIN Zoo, seven from UI Zoo and two from Kano Zoo. A total of 55 infants were found to have died during the 17 infanticide events. The Nile Crocodile accounted for the highest number of individual infant deaths, while the side-striped jackal accounted for the highest frequency of infanticide events. The occurrence was highest in carnivores, and major offenders were of maternal origins, accounting for 59% of all infanticides. Exploitation was observed as the major motive, either sole or combined with other motives. This study assessed scenarios surrounding maternal infanticide in different animal species and predisposing factors peri-occurrence. We also proposed possible solutions, especially in developing nations' zoo settings, where this occurrence is grossly under-reported and most often neglected. Correction of observed factors linked with infanticide led to the prevention of further occurrence of infanticide in the three zoos.

Keywords: Captive animals, Animal welfare, *Ex-situ* conservation, Zoos, Nigeria

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INTRODUCTION

Breeding programmes in zoos have been ongoing for many years, with the main objective of sustaining captive populations and providing individuals for reintroduction programmes (Baskett and Waples, 2013). However, many facilities lack the capacity to sustain these programmes (Tapley *et al.*, 2015). Infanticide is an overt aggressive behavior by a conspecific adult that results in the death of a newborn or young juvenile and occurs in a wide range of taxa that may provide an evolutionary benefit for the perpetrator (Tortato *et al.*, 2017). This phenomenon varies in type of occurrence where sometimes particular sex is incriminated like males (Pluháček and Bartoš, 2000), females (Mayuri, 2015), or among siblings (Salmon and Hehman, 2014), which is mostly due to resource competition, otherwise can occur from a different specie completely (Carrillo and Fuller, 2021).

Several explanations have been offered to explain infanticide's adaptive benefits (Ebensperger, 1998). The most well-known is the sexual selection hypothesis, which claims that infanticide is a reproductive strategy that enhances male fitness by increasing their chances of having children (Hrdy 1979). Another theory is the predation hypothesis, which states that offenders should consume the newborns they kill and that it should be more common among energy-stressed people of any gender (Ebensperger 1998). Infant consumption has been observed among carnivores (Latham and Boutin 2011). The adoption

avoidance theory suggests that infanticide prevents parental care from being misdirected to unrelated offspring (Balme and Hunter, 2013). Infanticide, according to non-adaptive interpretations, could be the outcome of human-caused environmental (e.g., habitat loss) or social (e.g. overpopulation) disturbance (social pathology hypothesis). The dispute over adaptive explanations for infanticide, notably the sexual selection theory, continues despite existing evidence supporting them (Balme and Hunter, 2013).

The incidence of infanticide is a poorly reported occurrence in zoos, especially in developing countries, which should not be so as it defeats one of the prime objectives of a zoological garden which is conservation, as premature loss of offspring limits parents' reproductive success and escalates costs in terms of investment already made in progeny. A dam can profit by modifying and occasionally reducing her investment in offspring according to environmental conditions to maximize her total fitness in altricial species. Infanticide by unknown males result in maternal investment loss, and maternal mechanisms to minimize these losses have evolved. (Gale *et al.*, 2012).

Relevant data such as the proportion of infant deaths caused by the dam, age of killer and offspring and husbandry routines are essential for the understanding of the phenomenon and are scarce in the wild (Braastad and Bakken 1993). However, an attempt was made to gather such relevant data in the present study. Scenarios in which infanticide occur alongside incidence rates per specie are very important data that would help prevent reoccurrence and improve conservation goals, especially in developing Nations.

MATERIALS AND METHODS

Study Area

Three zoos were profiled; University of Ilorin Zoological Garden (UNILORIN ZOO), Kano state Zoological Garden (KANO ZOO) and University of Ibadan Zoological Garden (UI ZOO). The zoos are among the most prominent zoos located in the north-central, northern and southern parts of Nigeria, respectively.

Twenty years Veterinary retrospective records were examined from these zoos, and scenarios/proper details were further gathered from Zoo curators. Dimensions of animal enclosures where infanticide occurred were measured.

Case groupings

We grouped cases based on various parameters, including:

- Offender - Maternal, Paternal, Sibling, Intraspecies, Interspecies, Human,
- Parity (Primer, Biparous and Multiparous);
- Class of infanticide- Exploitation, Resource competition, parental manipulation, Sexual selection, social pathology (based on classifications by Hrdy, 1979);

RESULTS

A total of 17 infanticide cases were reported from 3 zoos in Nigeria; 8 from UNILORIN Zoo, 7 from UI Zoo and 2 from Kano Zoo. A total of 55 infants were found to have died in our study (Table 1). The Nile Crocodile accounted for the highest number of individual infant deaths with 31 of 55 (56%) cases, while the side-striped jackal accounted for the highest frequency with 4 cases out of 17 (24%) incidences reported.

When the cases were categorized according to animal groups, 82% (14/17) were perpetrated by carnivores, while 6% (1/17) of the incidences were done by individuals belonging to a primate or ruminant groups. A majority of the infanticides were of maternal origin as this accounted for 10/17 of cases, followed by paternal 3/17, interspecies 2/17, Sibling 1/17 and both paternal/maternal 1/17 causes.

Exploitation was observed as the major motive, either as a sole motive or in combination with another motive, with an incidence rate of 10/17.

Enclosure Characteristics

All enclosures in our study lacked a separate nursing facility for the captive animals.

Table 1: Infanticide cases in three zoos in Nigeria with details on scenarios of occurrence

ZOO	Animal (Group)	Genus/ Species	Case Dist.	Offender	Parity	Age of infant	Enclosure dynamics	Class of Infanticide	Scenario
				UNILORIN ZOO					
1	Nile Crocodile (Reptile)	*Crocodylus niloticus*	20/20	Paternal/ Maternal	Primer	3-15 weeks	Pond- length 30ft, width 10ft avg depth 2ft, One dry enclosure of 20ft×30ft	Exploitation	Ate all infants due to hunger
2	Crested Porcupine (Rodent)	*Hystrix cristata*	1/4	Interspecies (Spotted hyena)	Biparous	2 weeks	3ft×4ft enclosure attached to Spotted hyena enclosure	Exploitation	Infant strayed into spotted hyena enclosure
3	Dorcas gazelle (Bovid)	*Gazella dorcas*	1/1	Paternal	Primer	4 days	6ft×6ft enclosure	Resource competition/Social pathology	Attacked and trampled by male
4	Nile Crocodile (Reptile)	*Crocodylus niloticus*	1/15	Paternal	Multiparous	20 weeks	Pond- length 30ft, width 10ft avg depth 2ft, One dry enclosure of 20ft×30ft	Resource competition	Older male fatally injured younger male
5	Spotted Hyena (Hyenid)	*Crocuta crocuta*	2/2	Maternal	Primer	2 weeks	Nursing dams never leave the inner enclosure 8ft×4feet	Exploitation/Social Pathology	Dam ate her young day after being handled by zoo staff
6	Olive Baboon (NHP)	*Papio anubis*	1/1	Interspecies (Chimpanzee)	Primer	2 months	4ft×4ft enclosure attached with a window into Chimpanzee habitat	Social Pathology	Male chimpanzee pulled the arm of the infant baboon through the enclosure
7	Spotted Hyena (Hyenid)	*Crocuta crocuta*	1/1	Maternal	Biparous	2 days	Nursing dams never leave the inner enclosure 8ft×4feet	Exploitation	Dam ate young before a rescue could take place
8	Spotted Hyena (Hyenid)	*Crocuta crocuta*	1/2	Maternal	Multiparous	3 months	Nursing dams never leave the inner enclosure 8ft×4feet	Resource competition	Fatally bitten by the dam during feeding
				UI ZOO					
9	African leopard (Feline)	*Panthera pardus*	1/1	Maternal	Primer	6 weeks	Inner; 8ft×4feet Outer 8ft×6ft	Exploitation	Scarcity of food and hunger
10	Striped Hyena (Hyenid)	*Hyaena hyaena*	1/3	Maternal	Primer	8 weeks	2 Inner rooms; 6ft×6feet each Outer 12ft×8ft	Parental manipulation	Runt killed
11	African lion (Feline)	*Panthera leo*	1/4	Sibling	Primer	6 months	Inner; 8ft×4feet Outer 8ft×6ft	Resource competition	Killed during feeding
12	Side-striped jackal (Canine)	*Lupella adustus*	3/3	Maternal	Primer	3 weeks	Inner; 8ft×4feet Outer 8ft×6ft.	Exploitation	
13	Nile Crocodile (Reptile)	*Crocodylus niloticus*	10/14	Parental	Primer	6-12 mths	Pond- length 50ft, width 6ft avg depth 2ft, two Islands of 12ft×12ft	Exploitation	Hunger, Were eaten one after the other over a period due to depletion of fish in the pond
14	Side-striped jackal (Canine)	*Lupella adustus*	4/4	Maternal	Primer	2 weeks	Inner; 8ft×4feet Outer 8ft×6ft.	Exploitation	
15	Side-striped jackal (Canine)	*Lupella adustus*	4/5	Maternal	Primer	2-3 weeks	Inner; 8ft×4feet Ouer 8ft×6ft.	Exploitation	Last one rescued and hand-raised
				KANO ZOO					
16	Common Genet (Viverrid)	*Genetta genetta*	1/2	Maternal	Primer	3 weeks	3ft×3feet cage with a height of 10ft	Exploitation	
17	Side-striped jackal (Canine)	*Lupella adustus*	2/3	Maternal	Biparous	2-3 weeks	Inner; 6ft×6feet Outer 15ft×10ft.	Social Pathology	Not eaten but fatally bitten

DISCUSSION

Wolff (1997) suggested that there are variables that predict which individuals of a species will commit infanticide; these are: territorial females, altricial, non-mobile young and risk of predation are common to all that use this strategy, which is the case of many rodents and most terrestrial carnivores. Carnivores are most incriminated in this phenomenon (Harano and Kutsukake, 2018). In our study, sexual selection for male infanticide is more prevalent in primates (Balme and Hunter, 2013; Harano and Kutsukake, 2018). Although infanticide among herbivores has been previously reported, our report is significant because it involved a male, whereas most infanticides reported among herbivores involved females (Pluháček and Bartoš, 2000; Král *et al.*, 2019). Similarly, to herbivores, male infanticide has also been frequently reported in other animal groups, e.g., carnivores (Balme and Hunter, 2013) and rodents (Palombit, 2015). Birds are not left out in this phenomenon, as has been reported by Silva-e-silva, 2017, although they are difficult to witness and occur in a broad range of situations. Brood reduction due to food limitations and nesting birds losing their mate are common reasons birds engage in infanticide.

In well-studied populations, it is explicit that infanticide is not merely an aberration or a byproduct of other biological characteristics or conditions but represents an adaptive approach for males in some circumstances (Palombit, 2015). Following the sexual selection hypothesis, it has been postulated that infanticide by males will increase male reproductive success (Hare and Simmons, 2019). Killing other individuals' offspring may increase fitness by facilitating access to resources or enhancing breeding opportunities, and individuals belonging to some species may have developed counterstrategies to minimize the occurrence of these events, such as termination of pregnancy, defense mechanisms against intruders and territoriality (Ebensperger 1998).

Throughout the order Carnivora, there was a slight link between the origin of the female (if wild-caught or captive-born) and the type of infanticide: wild-caught females performed more passive infanticide, and captive-born performed more active infanticide (Norton and Whiteside, 2014). The entire females in our study were introduced into captivity from the wild. Parental (maternal and/or paternal) infanticide has different causes, especially in severe circumstances like starvation and threat of predation; mammals can respond by terminating or resorbing the fetus, abandoning, or eating them after birth ((Baskett and Waples, 2013; Reihl, 2016). Infanticide also allows the alteration of reproductive patterns at the expense of others, and parental investment can be suppressed at any stage between conception and weaning (Furness *et al.*, 2015).

A variety of infanticide forms have different aetiology and adaptive principles (Hrdy 1979), but its occurrence in captivity can be detrimental to the success of captive breeding programmes. Often, social pathology is considered common in artificially modified locations, e.g., zoos and urban areas (Isaksson, 2015). When animals are disturbed by noise, light, and/or odors, it is considered a major stressor and can result in erratic/zoochotic behaviors (Isaksson, 2015). In our study, captive female carnivores devour their offspring right after birth, e.g., in scenario 5 (Table 1). Peri-parturient and early nursing disorders bring about the neglect of litter or infanticide in many females (Teodorov *et al.*, 2016). During these periods, a strict hands-off policy could result in a higher survival rate, especially with younger, less experienced (primer) females, which should give birth in familiar surroundings; the male rather than the female should be moved to another location during parturition and early rearing. Although the timing and social structure of the concerned species must be taken into account, stress caused by isolation and restricted contact with herd members, as well as isolation during birth, have previously been suggested to cause stress-induced suppression of oxytocin production and thus dystocia (Hartley and Stanley, 2016). In zoos where elephant cows could give birth unchained and within the herd, it was a considerable reduction in maternal hostility (Hartley and Stanley, 2016). Elephants have a great need for proximity to and bodily touch with other elephants, especially during times of stress or uncertainty, so limiting contact possibilities could be a stressor. Therefore, exact species and social needs need to be considered when mitigating strategies for infanticide are being designed.

Zoochosis here can either be a predisposing factor or an outcome of infanticide. Across species lines, captivity creates, perpetuates, and exacerbates

distortions and obstructions to the ecological relationships that have crafted both bodies and instincts over evolutionary time in both human and nonhuman animals. The result in zoo animals is a variety of vices and self-harming behaviors known as zoochosis (Wilkins, 2020), thereby postulating social pathology to equal zoochosis in terms of the source rather than the outcome.

Lack of mothering experience plays a major role in infanticide. Researchers reported that the probability that a cub with a primer dam would be killed was 37% (Braastad and Bakken 1993). Therefore primers/primiparous animals should be observed more closely postpartum. In elephants (Hartley and Stanley, 2016), the importance of allo-mothering or past maternal experience on calf raising and mortality was demonstrated, with experienced mothers having a higher calf survival rate.

Felids require a secluded and quiet environment to have cubs, and mothers could be prone to neglect or eat cubs when disturbed or stressed (Balme and Hunter, 2013). Breeding or cubbing dens are an important aspect of designing an enclosure (Landa *et al.*, 2017). We observed bad enclosures and poor planning in many of the enclosures where infanticides occurred.

Infanticide in our study occurred in crocodiles that were over 5 months old; although this age for crocodiles is quite small and young, delayed infanticide in mammalian carnivores has been reported (Elliot *et al.*, 2014) where they discovered a previously unknown kind of indirect or "delayed infanticide" that might be increased in populations with a large off-take of resident adult men. Summarily, lion dispersal is closely linked to the arrival of new males, resulting in a higher mortality rate for male lions who disperse when still young. This phenomenon should be considered when introducing males to an enclosure where a female co-exists with a sub-adult. Adequate diet post parturition is recommended because hunger could cause a high incidence of exploitation by carnivore dams. As the decision to interrupt maternal investment depends on the mother's perception of resource availability, the welfare of the individual is crucial to successful breeding (Fennell, 2013). Infants should also be removed as they get older to avoid resource competition.

The high incidence of maternal infanticide in captive populations of carnivores suggests that females perceive captivity conditions as sub-optimal, which can seriously damage the output of adult individuals by ex-situ breeding programmes. This effect seems stronger in wild-caught females, unaccustomed to human manipulation than in tamer captive-bred ones (Curry *et al.*, 2015). Further study is needed, however, to assess exact optimum husbandry systems and housing conditions in target species prone to perpetrate maternal infanticide. This study assessed scenarios surrounding maternal infanticide in different animal species and predisposing factors peri-occurrence. We also proffered possible solutions, especially in developing nations' zoo settings where this occurrence is grossly under-reported and most often neglected. Correction of observed factors linked with infanticide led to the prevention of further occurrence of infanticide in the three zoos.

CONCLUSION

Infanticide frustrates ex situ conservation efforts. Most infanticides are linked to maternal and environmental factors. Female carnivores often devour their offspring right after birth. Adequate nutrition, avoiding artificial interference with normal parturition in wild captive animals and removing males from birthing enclosures reduce the infanticide incidence in zoo settings.

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