

Observation of mother-perpetrated infanticide in golden takins (*Budorcas taxicolor bedfordi*)

DEAR EDITOR,

Infanticide by unrelated individuals is widely reported in the animal kingdom; however, little is known about cases perpetrated by a parent, particularly the mother. This article reports on three cases of mother-initiated infanticide in Qinling golden takins (*Budorcas taxicolor bedfordi*) from video and camera images. Based on previous reports in other animals, we propose that the infanticide events observed in golden takins were related to the parental manipulation mechanism – i.e., killing an unhealthy infant to allow the mother to invest more care in potentially healthy offspring, and gain more fruitful reproductive opportunities. This appears to be an evolutionary-based selection strategy, whereby a species can prosper and succeed under the challenges of natural selection. However, further studies on both captive and wild populations are required to answer the various questions raised from our observations.

Among animals, particularly mammals, infanticide is more commonly performed by males and females that are unfamiliar with or unrelated to the target infant (Breed & Moore, 2016). However, parent-perpetrated infanticide has also been reported across different mammalian taxa (Hrdy, 1977; Sicotte et al., 2007). Infanticide by unrelated individuals appears to be primarily stimulated by sexual selection and the establishment of new kingship (Hrdy, 1979; van Schaik & Janson, 2000); however, little is known about those cases perpetrated by a parent, especially mothers (Blumstein, 2000; Digby, 2000). Several hypotheses related to the mechanism of infanticide have been proposed (Digby, 2000; Hrdy, 1979), including: (1) exploitation: killing an infant for nutritional gain or other use (Steiner, 1972); (2) resource competition: killing an infant due to limitations of food or other natural resources (Hrdy, 1979; Takahata, 1985); (3) sexual selection: killing an infant to gain new opportunities for reproductive benefits, particularly

mothers (Hrdy, 1979); and (4) parental manipulation: killing a weakened or abnormal infant to reduce maternal burden or increase reproductive success for either the father or mother (Hrdy, 1979). Nevertheless, mother-initiated infanticide remains an interesting and puzzling biological issue (Hausfater & Hardy, 1984). Here, we report on three cases of mother-initiated infanticide in captive Qinling golden takins from the Research Center of the Qinling Giant Panda, located on the northern slopes of the Qinling Mountains, Shaanxi Province, China. In addition, we discuss which hypothesized mechanism best explains the occurrence of such behavior in the cases observed in captive takins.

From 2008 to 2019, we recorded 29 captive takin births in total. Among these births, 26 newborns were deemed healthy and exhibited typical post-birth behavior, with an average time to stand after birth of 23 min and 43 s. However, the remaining three newborns exhibited abnormal behavior and failed to stand up, leading to mother-perpetrated death 46–53 min after birth. Specifically, on 23 May 2019, a pregnant female (N-022) began to show signs of labor and imminent birth: i.e., pacing and low vocalizations, with increased interest (sniffing) and approach from subadults within the same enclosure. A white viscous liquid was observed around the vaginal opening of the parturient (Figure 1A). The neonate forelimbs were seen 1 min later (Figure 1B), followed by the head, trunk, and hindlimbs after another 4 min (Figure 1C). Following the birth, N-022 began licking the mucus from the male infant (Figure 1D) and tried to help him stand up many times using her nose (Figure

Received: 20 February 2020; Accepted: 01 June 2020; Online: 11 June 2020

Foundation items: This study was supported by the Key Program of the National Natural Science Foundation of China (31730104), National Natural Science Foundation of China (31572278, 31801981), Strategic Priority Research Program of the Chinese Academy of Sciences (XDB31020302), National Key Program of Research and Development, Ministry of Science and Technology (2016YFC0503200), Special Foundation of Shaanxi Academy of Sciences, China (2016K-20, 2018K-16-04), One Institute One Brand Foundation of Shaanxi Academy of Sciences (2020k-01), Shaanxi Key Research and Development Program (2018PT-04), and Innovation Capability Support Program of Shaanxi (2020KJXX-008)
DOI: 10.24272/j.issn.2095-8137.2020.041

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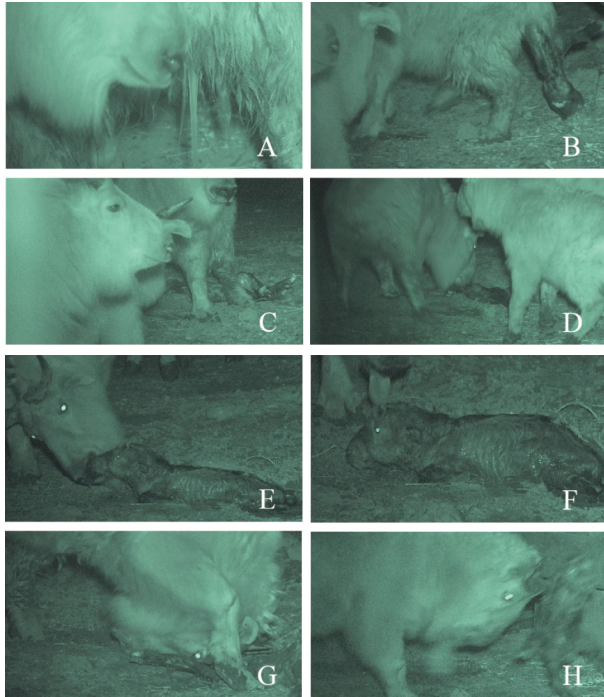


Figure 1 Birthing process and mother-perpetrated infanticide

A: Rupture of amniotic fluid; B, C: Birthing process; D, E: Mother licked mucus from male infant and tried to help him stand up. F: Infant remained on ground and failed to stand up; G, H: Mother attacked infant, leading to its death.

1E). At the same time, other enclosure members approached N-022 and showed interest in the newborn by predominantly sniffing. After approximately 53 min, N-022 stopped licking her infant (Figure 1F) and instead initiated an attack towards him (Figure 1G). Using her head and horns, she tossed her infant into the air multiple times until he died, with prominent punctures in his belly. Other members surrounded N-022 but made no attempt to stop her attack (Figure 1H).

Our recorded images also showed two similar scenarios in the same enclosure. In June 2012, after giving birth, female N-004 was observed licking her female infant and trying to help her stand up many times. Approximately 47 min after birth, the infant still had not stood, despite repeated attempts to assist her by the mother. At this point, the mother displayed similar behavior as female N-022, attacking and killing her newborn. The third case was observed via video images recorded in May 2016. In that case, female N-025 was seen attacking her female infant ~51 min after birth, again after a failure to stand up. In general, the infanticide scenarios and processes observed among the adult females were highly similar between each other, thus warranting scientific report. These observations provide basic information for further studies on mother-perpetrated infanticide in different animal taxa.

As found in other animals, our observations indicate that mother-perpetrated infanticide occurs in golden takins. Thus, it would be interesting to clarify whether such events result from

pathological (Hrdy, 1979) or intrinsic parturient phenomena (Harvey & Lyles, 1985) or whether this could be an evolutionarily obtained characteristic (Rosenthal, 2018) in golden takins. Our sense is that it is unlikely such behavior is an isolated event rooted in pathologically ill parturients, but rather seems to be an instinctual reaction to the infants displaying developmental problems. All three cases showed apparently abnormal behavior of the newborn, i.e., a failure to stand up within the average time frame (23 min and 43 s). This failure appears to have triggered mothers' behavior, resulting in intentional killing, rather than accidental death. Interestingly, all three events were initiated and completed by the parturients alone; all other takins within the same enclosures watched the event but neither intervened nor assisted.

Although recent research suggests that infanticide is not directly modulated by kinship within a group, (Knott et al., 2019), parent-perpetrated infanticide remains relatively rare in mammals (Hausfater & Hardy, 1984). Of note, all three mothers who demonstrated infanticide behavior here had given birth at least three times before and successfully parented more than one infant after the infanticide episode. This implies that they were experienced in the successful delivery and raising of offspring and were therefore not suffering some form of pathology. Other members in the same herd did not participate in the actions. In addition, based on lineage relationship analysis (unpublished data, private communications), we found no kinship among the three mothers. We also did not observe any feeding on the dead newborns by any group member, and thus concluded that infanticide was not related to resource exploitation. Furthermore, all other takins living with the parturients were subadults during the reproductive process, and therefore we argue that these events were not related to reproductive suppression. Such a scenario is different from that reported in most non-human mammalian species (Hrdy, 1979; Takahata, 1985). Thus, the results of our observations raise an important question: why did these mothers kill their offspring? General consensus in previous studies suggests that such events can be caused by social conditions (e.g., social rank of males or females); resource scarcity, resulting in mothers killing their infants to defer or reduce parental investment (Fox, 1975; Williams, 1966); reproductive benefits, allowing a female to increase her future mating opportunities (Beehner & Lu, 2013; Wasser & Barash, 1983); and improving survival, whereby individuals improve their chances of survival under the principles and regulations of natural and/or sexual selection (Hrdy, 1979). However, our observations suggest that mother-initiated infanticide in takins may be driven by the direct health status of the infant under nursing investment pressure, whereby the mother selects and supports those who are healthy and have a better chance of survival. Our results indicate that takin mothers may kill a weakened or abnormal infant to reduce maternal burden, which most closely accords with the parental manipulation hypothesis. Therefore, we concluded that mother-perpetrated infanticide in takins may be a consequence of evolutionarily developed behavior under the

regulations and principles of natural selection, which improves breeding quality and reduces parental burden of unhealthy offspring (Hausfater & Hardy, 1984).

Nevertheless, our observations raise many questions, which require further research efforts. For example, studies comparing the impact of adult male presence at the scene may help elucidate whether takin fathers also perform infanticide on related infants. This may also help determine whether such an event is associated with sexual selection and/or social rank competition. Most importantly, comparisons with other takin species in the genus could help clarify whether this behavior is a unique characteristic of Qinling golden takins or a shared phenomenon with other clades – i.e., a phylogenetically developed trait in *Budorcas*.

SUPPLEMENTARY DATA

Supplementary data to this article can be found online.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

H.T.Z., W.Q.Z., and K.S.J. designed the study. H.T.Z., W.Q.Z., and X.W.W. conducted fieldwork; K.S.J. and X.X.B. collected and analyzed the data for the last decade; J.X.L., S.J.H. and H.J.S. conducted literature research; H.T.Z. drafted the manuscript; S.T.G., Y.H.L., R.L.P., and B.G.L. revised the manuscript. All authors read and approved the final version of the manuscript.

ACKNOWLEDGEMENTS

We thank the Research Center of the Qinling Giant Panda, Shaanxi Academy of Forestry and Shaanxi Louguantai Experimental Forest Farm, China, for permission to carry out this study. We greatly appreciate our assistants for indispensable support during this research, especially all teachers and students from the Primate Research Center of Northwest University, China.

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