LESS CAN BE MORE: CONSIDERING SEASONAL DIFFERENCES OF NEWBORN MORTALITY IN BREEDING REGIMES

MÜLLER DWH[1], MÜLLER SI[1], BINGAMAN LACKEY L[2], HAMMER C[3], HAMMER S[3], LEUS K[4], MEYER M[1], HATT JM[1], CLAUSS M[1]

[1]Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Winterthurer- str. 260, CH-8057 Zurich, SWITZERLAND; dmueller@vetclinics.uzh.ch
[2]International Species Information System (ISIS), 2600 Eagan Woods Drive, Suite 50, Eagan, MN 55121-1170 USA
[3]Al Wabra Wildlife Preservation, P.O. Box 44069, Doha; STATE OF QATAR
[4]Royal Zoological Society of Antwerp, Koningin Astridplein 26, 2018 Antwerp, BELGIUM and CBSG Europe, Copenhagen Zoo, Roskildevej 38, Postboks 2000 Frederiksberg, DENMARK

Summary

Although many ruminant species are seasonal breeders in the wild, they breed throughout the year in captivity. While seasonal differences in newborn mortality could be expected, breeding is usually not managed so that births in month of particularly high newborn mortality are prevented – maybe because the effect of an adapted breeding management on population development (reduced newborn mortality vs. prolonged interbirth interval) is unknown. We found distinct seasonal differences in newborn mortality of different gazelle species kept at 2 facilities (Al Wabra Wildlife Preservation and Zurich Zoo), and within the zoo meta-population of okapi (Okapia johnstoni). Using a model of the current zoo population of okapi, we demonstrate that seasonal breeding restrictions (preventing births from occurring in seasons of higher newborn mortality) would benefit both population growth and animal welfare.

Introduction

Newborn mortality in captive wild animal species is much higher than in any other age class (KIRKWOOD et al., 1987). As newborn animals that die within the first days of life suffer from hypothermia, diseases, injuries, or starvation prior to deaths (BENIRSCHKE et al., 1980), newborn mortality must be considered as an important animal welfare issue (MELLOR and STAFFORD, 2004). To address newborn mortality in the zoo, it is essential to identify reasons for neonate losses and factors affecting neonate mortality. Whereas the causes of neonate losses are rather unspecific (BENIRSCHKE et al., 1980), management related factors influencing newborn mortality - such as inbreeding and crowding - are described (RALLS et al., 1979; BESSELMANN et al., 2008; MÜLLER et al., 2009).

Materials and methods

We analysed seasonal differences of newborn mortality (proportion of newborns that died within the first ten days of life according to seasons) in several ungulate species that give birth all the year round (non-seasonal breeders) at 2 different facilities: Al Wabra Wildlife Preservation (AWWP: *Addax nasomaculatus, Oryx beisa, Gazella spekei, Litocranius walleri*) in the desert of Qatar, and the Zoo Zurich *(Oryx leucoryx, Antilope cervicapra)*, located at the Swiss plateau (temperate zone). Additionally, we analysed seasonal differences of newborn mortality in the okapi *(Okapia johnstoni)* zoo population using data of the international studbook, modelled a population model of the current female okapi population, and tested the effect of temporal breeding restrictions to prevent births from occurring in the season of higher newborn mortality.

Results and discussion

Whereas at AWWP newborn mortality of the 2 non-seasonal gazelles *(G. spekei, L. walleri)* was notably higher during summer (June to August: 52.8 % n = 67 births, September to May: 19.1 % n = 179 births; t-test: $p < 0.0001$; pattern in *A. nasomaculatus* and *O. beisa* was not significant), newborn mortality of *A. cervicapra* at Zoo Zurich was lowest in summer, but higher in winter and spring (June to August: 34.1 % n = 168 births, September to May: 52.7 % n = 202 births; t-test: $p = 0.01$; no pattern in *O. leucoryx*). Seasonal differences of newborn mortality are also documented for other zoo populations (KIRKWOOD et al., 1987; ASHER et al., 1999), but it is unknown how climate conditions (high and low temperatures, high rainfall, draughts, strong winds) influence newborn survival in captivity. Cold and wet weather conditions, or even photoperiodicity may result in a higher susceptibility to infectious diseases (reviewed in DOWELL, 2001), and high temperatures combined with draughts and a high solar radiation may cause heat stroke (WILSON and KRAUSMAN, 2008). Furthermore, the condition of the lactating, but also gestating mother have an important influence on newborn survival (WALLACE, 1948; THOMSON and THOMSON, 1949). However, if causes for an increased seasonal newborn mortality cannot be identified and addressed, newborn mortality can theoretically be reduced by an adapted breeding management, preventing births from occurring in seasons of higher newborn mortality. Such a management is only useful in non-seasonal breeding species (i.e. species that reproduce all the year round). The breeding regime would consist of temporal breeding restrictions that - besides a reduction of newborn mortality - will also result in a prolongation of the interbreeding interval.

In captive okapi, newborn mortality is 3 times higher during the coldest months of the year (January and February: 30.1 % n = 43 births, March to December 8.4 % n = 329 births; independent sample t-test: $p < 0.0001$) - thus, the okapi could theoretically benefit from seasonal breeding restrictions. According to our model, temporal breeding restrictions preventing births of okapi calves in January and February would not only reduce first-year mortality by 2.5 %, but would also lead to an additional increase of population size (almost 10 %), despite a prolongation of the average interbreeding interval. The example of the okapi might be special. The difference of newborn mortality between seasons is high, and 2 months breeding restrictions are short compared to the long gestation period in the okapi (14.4 months). Nevertheless, this analysis demonstrated that a captive population that reproduces throughout the year, but shows distinct differences of newborn mortality between seasons might benefit from a temporal restricted breeding management, not only in terms of animal welfare (less mortality) but also population growth.

Acknowledgements

We thank the Georg and Bertha Schwyzer-Winiker-Stiftung and the Vontobel-Stiftung for financial support, and the Zoo Zurich and especially Gabriela Hürlimann for the provision of stock data of the Zoo Zurich. A part of this project was carried out within the scope of the Zoo Research Camp 2008/ 2009, organised by Al Wabra Wildlife Preservation and the Clinic for Zoo Animals, Exotic Pets and Wildlife of the Vetsuisse Faculty, University of Zurich. We thank H.E. Sheikh Saoud Bin Mohammed

Bin Ali Al-Thani for his kind support, and the "Schweizerische Vereinigung für Wild, Zoo und Heimtiermedizin" for their additional financial support.

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