

Some factors influencing the mortality of European bison calves in captivity

Wanda Olech

Department of Animal Genetics and Conservation, Warsaw University of Life Sciences, Warsaw, Poland

Abstract: Thank to the individual registration of captive animals in the European Bison Pedigree Book it is possible to analyze different characteristics of the species. One interesting trait is viability, which can be expressed in different ways. In this work, survival up to the age of one month was chosen because it was assumed that the influence of humans on this trait is very small. There are some papers in which the relationship between inbreeding level and viability has been studied, and it has been proved that inbreeding depression is significant in the Lowland-Caucasian line. In this work, we present the value of mortality by dividing the calves into groups depending on the age of the dam and the number of calving. It was also found that the animals born in winter have a much higher mortality, but the percentage of these calves is very small.

Keywords: mortality, age of calving, season of birth, European bison

Introduction

The natural mortality of European bison in large and medium-sized free-ranging herds is low and is not a significant factor in population regulation (Pucek *et al.* 2004). In the years 1960–2004, the average natural mortality rate excluding sick animals was $2.8 \pm 1.3\%$ (Kraśńska & Kraśński 2004). Based on surveys conducted in the Polish part of the Białowieża Forest in the years 1952–2000, the main causes of European bison falls were injuries of various kinds (10.0%), followed by injuries caused by other wild animals (7.6%), diseases caused by parasites (9.6%), diseases of the foreskin (8.0%), poaching (6.0%), old age (6.4%) and others (17.1%). About 20.0% of cases were due to unknown causes (Kraśński, 1994). There are isolated cases where predation is the cause of death in European bison (Kaczor *et al.* 2019) or their close relatives, the American bison (Fuller *et al.* 2017).

Mortality in the *ex situ* population was higher than in the two *in situ* populations studied (Pucek *et al.* 1996; Daleszczyk 2009; Olech 2003). In the *ex situ* population, there is practically no difference in the mortality of calves of both

sexes, although Daleszczyk (2009) determined a low coefficient value (3.8%) for the herd in the Białowieża reserve. Pucek *et al.* (1996) found a higher mortality of females (8.82%) than males (8.30%) in the group of calves. The survival curve for the first year of life of the European bison population born in captivity until 2002 (Olech 2003) falls steeply in the first month and becomes flatter in the following months. In the first 30 days, 11.3% of European bison die, in each subsequent month less than 1% (Olech 2003). Due to this higher mortality rate, the first month of life is particularly important, which is why only mortality in this period was taken into account in the analyzes.

At 88.7%, the survival rate of European bison in the first month of life is high compared to other ungulate species (Ralls *et al.*, 1979). Ballou (1997) estimates the average survival rate of all species studied at around 60%, which is significantly lower. The survival rate of calves of the highly inbred Chillingham cattle up to the age of 30 days was 73% (Hall & Hall, 1988) and thus significantly lower than that of the European bison.

Olech (2023) investigated the effects of inbreeding on survival and differentiated between time of birth and year of birth, with time of birth being the most important. Compared to data on other species, the effect of inbreeding on mortality in European bison is very small. She showed that the degree of inbreeding has a significant effect on viability, but only in the Lowland-Caucasian line of European bison. She divided the animals into 3 groups, depending on the month of birth. The calves born between December and March had more than twice the mortality rate. Kalinowski and Hedrick (2001) found a similarly small effect in bighorn sheep, which they explained by the low variability of both traits.

In 2023, a high mortality rate of 17.6% was found in a Polish reserve (EBPB 2024). The aim of this work was to show the relationship between mortality and the age of the dams and the number of their calvings. Based on the value for the entire captive population, the case of the Polish herds in 2023 was discussed.

Material and methods

The material for the analysis consisted of data from the European Bison Pedigree Book (EBPB 1917–2024) born in the years 1946–2023. Important information for each individual is the year and month of birth, the age of the mother and her calving number, and information on whether it survived to one month of age. The frequency of survival of European bison was analyzed using generalized binary values, where the dependent variable is survival to one month of age (marked 1 for survived and 0 for dead at this age). It was assumed that in the case of maternal age and calving number, values up to 16

years were given in order to have a not too small number of cases. From the set of all European bison registered during this period (13,955 individuals), those that met the above criteria were selected, so that 12,512 animals were analyzed, of which 3,089 were from the LB line and 9,423 from the LC line. The number of individuals in this group that did not survive one month was 1,277, i.e. the average mortality rate was 10.2%.

The mortality of calves up to one month of age was analyzed in relation to the age of the mother, the number of calvings, the season and the year of birth. For each category, mortality was plotted as a percentage and trends were visualized using regression functions. The function with the highest coefficient of determination was selected.

Results

Influence of the mother's age

The age of the mother has a very significant influence on the survival of the offspring. Calves from young females have a higher mortality rate, similar to older females (Fig. 1).

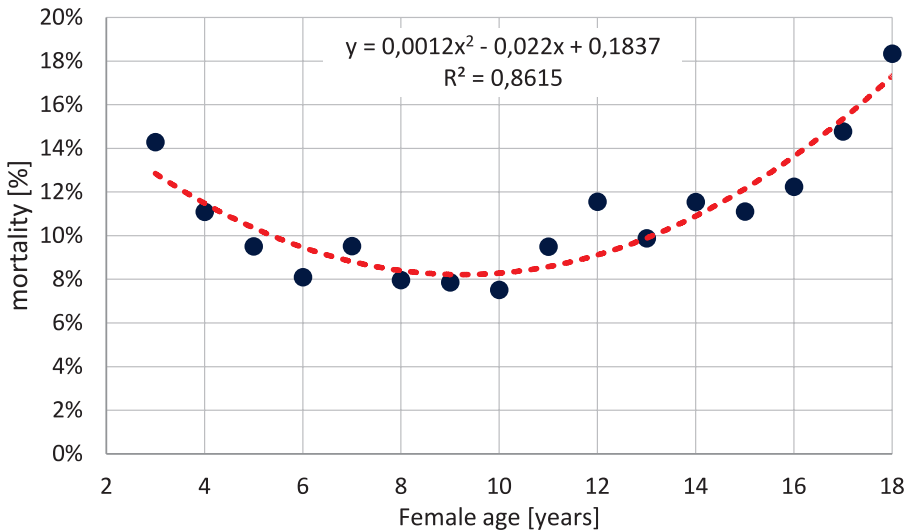


Figure 1. Mortality up to the first month of life depending on the age of the mother

The lowest mortality was observed in calves whose mothers were between 5 and 11 years old (Fig. 1). It should be noted that the proportion of calves whose mothers are between 5 and 11 years old is 62%, so calves at this age have a significant impact on the population as a whole. There are no differences

between the lines, the correlation coefficient between the mortality values in the maternal age classes is 0.56, which is high and indicates the same trend in the whole species.

Calving sequence number

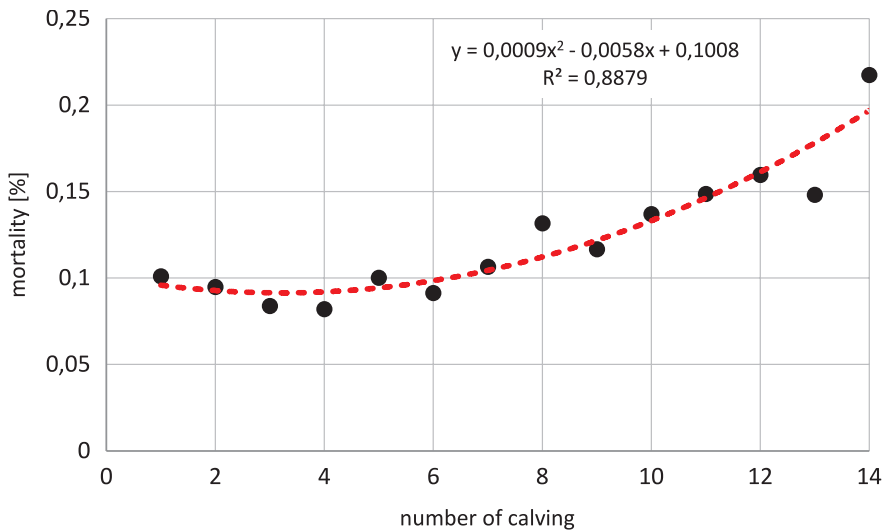


Figure 2: Mortality up to one month depending on the calving sequence number

The relationship between the calving sequence number and mortality is very similar to the relationship between the age of the cows. The data were presented up to the 14th calving, as the number of females was very low at higher values.

It can be seen that the mortality rate of calves from cows calving for the first time is slightly higher, then falls below 10% and slowly increases from the seventh calving onwards. Of course, the age of the cow and the number of calving are related, although when analyzing the age at which female European bison calve for the first time, it can be seen that only 1/3 of the first calvings occur at the age of 4 years (Fig. 3), i.e. at the age at which most cows in free-range herds calve for the first time (Kraśńska & Kraśński 2017). Kaczmarek-Okrój and Olech (2022) founded that in larger captive herds the age of first calving is equal to 4.5 years (SD=1,33), and the value depends very much of breeding center (Urošević 2022).

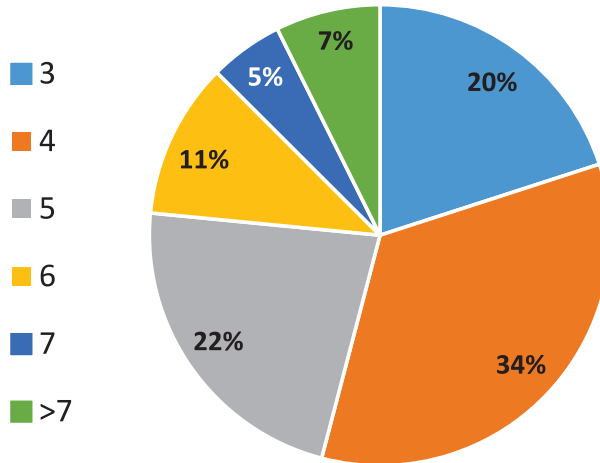


Figure 3. The distribution of cows age in first calving

The season of birth

The calving season of the European bison in our latitudes is from April to July. The vast majority of calves are born during these four months. It is true that the calving season is extended and for the entire population studied, 72.1% of calves were born in these four months, while Krasieński and Raczyński (1967) reported values of 82.3% for herds in enclosures. Calves born out of season have a significantly lower survival rate despite the care provided by the breeders (Fig. 4). Every third calf born in January-March does not survive 30 days, while calves born in May have the best survival rate.

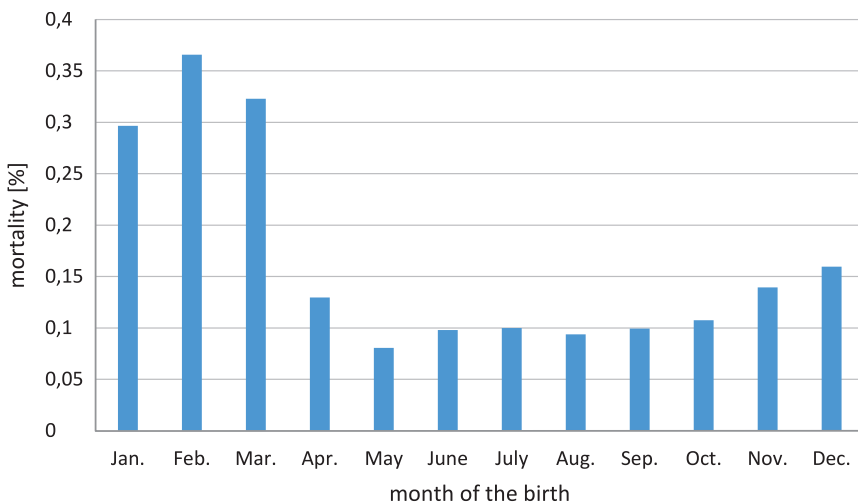


Figure 4. Mortality up to one month depending of the month of birth

Summary

Calf mortality depends on many factors, but the few that I have tried to emphasize, i.e. the age of the dam, the number of calving and the month of the year, have an influence on the development of this trait. Of course, other factors such as inbreeding, herd size, enclosure area or the role of the caretaker should also be included in the analyzes. Most likely, the size of the herd in which the calf is born is important for the correct behavior of the European bison. In addition, care by several cows reduces the risk of malnutrition if the mother has no milk.

Mortality up to one month in subsequent years is similar and there is no trend for this trait. However, the question has recently arisen as to whether the year 2023 in Poland was not something special in terms of the number of calves that died. Unfortunately, this year in our country stood out from other years, and the mortality of calves up to one month of age was as high as 17.6%, while the average for other countries in this age group was 8.2%. There are no specific reasons for this higher mortality, there is no difference between the Polish herds and the other countries in terms of the age of the cows or the number of calvings. All calves that did not survive in Poland were born in few herds at the right time of the year. This high value of mortality should be considered a coincidence and we should assume that Polish herds will not stand out in this respect in the coming years.

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Wybrane czynniki wpływające na śmiertelność cieląt żubra w hodowli ex situ

Streszczenie: Dzięki indywidualnej rejestracji zwierząt w Księdze Rodowodowej Żubrów możliwe jest analizowanie różnych cech gatunku. Jedną z interesujących cech jest żywotność, która może być wyrażana na różne sposoby. W tej pracy wybrano przeżywalność do wieku jednego miesiąca, ponieważ założono, że wpływ człowieka na tę cechę jest bardzo mały. Istnieje kilka prac, w których badano związek między poziomem inbredu a przeżywalnością i udowodniono, że depresja inbredowa jest istotna w linii nizinno-kaukaskiej. W tej pracy przedstawiamy wartość śmiertelności, dzieląc cielęta na grupy w zależności od wieku matki i numeru wycielenia. Stwierdzono również, że zwierzęta urodzone zimą mają znacznie wyższą śmiertelność, ale odsetek tych cieląt jest bardzo mały.
