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Research Article

Genus Bison Has the Biggest Sex-Related Difference in Longevity among Mammals

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Abstract

Longevity has become of great interest to researchers in past years. In genus Bison, only limited and statistically not relevant data concerning longevity has been presented until today. The objective of this study was to describe the longevity of American bison and lowland and lowland-Caucasian line of European bison. The median lifespan of European bison is 3.54 years (n=1206) and American bison 3.31 years (n=2912). The median lifespan of female European bison 6.01 years (n=600) exceeds more than two times the median lifespan of male 2.71 years (n=606). Similarly, the median lifespan of female American bison 6.64 years (n=1612) exceeds more than three times the median lifespan of male 2.12 years (n=1300). These differences represent the biggest sex-related differences in the longevity among mammals. The reason for the huge sex-related difference is associated with high mortality of young male calves under the age of 2 years in American bison and under the age of 4 years in European bison. This study can serve as a base for further research in longevity and its genetic background.

Keywords: American bison; European bison; Median longevity; Lifespan; Sex differences

Abbreviations: L: Lowland Line of European Bison; LC: Lowland-Caucasian Line of European Bison

Introduction

The genus Bison is a representative of large even-toed ungulates. The first members appeared at the beginning of the Pleistocene in India and China. Bison has later spread from Asia to Europe and America. Archaeological evidence shows that two bison species, the steppe bison (B. priscus) and the woodland bison (B. schoetensacki), existed in Europe from the Middle Pleistocene. Only two bison species have survived until today: American bison (B. bison) and European bison (B. bonasus), known also as a wisent. It was assumed, that these closely related species are derived from the extinct long-horned steppe bison. However, a recent study has found out that the woodland bison is a sister species of European bison, which excludes the steppe bison being a direct ancestor of European bison [1].

The European bison genome reflects a common descent, where the nuclear genome is closely related to that of American bison [2-4], in agreement with morphological evidence and the fact that the two bison species can produce completely fertile hybrid offspring. On the other hand, the mitochondrial genome of European bison is similar to aurochs (Bos primigenius) and cattle (Bos taurus) genome rather than to the American bison genome [2,5,6]. In general, several morphological and behavioural traits, which distinguished European bison from its American relative, have been found. Adult individuals of European bison have smaller body length, less body hair [7] and are mixed feeders combining browsing and grazing [8-10], whereas American bison is primarily grazer [11].

European bison went through a severe population bottleneck and became extinct in the wild at the beginning of 20th century. The descendants of just 12 animals out of the 54 remaining European bison living in captivity at the beginning of the 1920s were involved in species restoration. Two genetic lines of European bison has been diversified: the lowland line (L), and the hybrid lowland-Caucasian line (LC) [12]. The lowland line of European bison originates from only seven founders. Approximately 80% of the genes in the contemporary population come from just two founders. The average inbreeding level in the L line of European bison is almost 50% and 28% in the LC line [12].

In North America, American bison includes two subspecies: the plains bison (B. bison bison) and the wood bison (B. bison athabascae). Similarly, as European bison, American bison went through a population bottleneck too. The plains bison has been saved from extinction, especially thanks to ranchers. However, today's population of plains bison comes from less than 100 founders [13].

Once almost wiped out from existence, the mighty bison has recovered to become a symbol of pride for the American

and European conservation efforts. Both species have been extensively studied from the evolutionary [1,14,15], genetic [16-19], behavioural [8,20] and conservation [21,22] point of view. Interestingly, only limited and statistically not evaluated data of longevity has been presented in bison species until today. European bison is estimated to live up to 27 years in the wild [23] and up to 28 years [24,25] in captivity. American bison is estimated to live up to 25 years in the wild [23] with a record of more than 33.5 years old individual living in captivity [24]. The objective of this study is to describe the longevity of European (L and LC line) and American bison using the statistically significant data and to compare the sex-related differences in the longevity.

Materials and Methods

Data of 1206 deceased European bison were obtained from the European Bison Pedigree Book (www.bpn.com.pl). Recorded data were the line, sex, date of birth and date of death. Data of 2912 deceased American bison were obtained from the information system for zoological gardens ZIMS (www.species360.org). Recorded data were sex, date of birth and date of death. Lifespans specific for European bison (L and LC line) and for American bison were reported using median. Median lifespan of both lines of European bison, American bison and sex-related differences in lifespan were compared using Mann-Whitney U test [26].

Results and Discussion

For the first time, we described the median lifespan of European bison and American bison. Median lifespan was determined to 3.54 years in European bison and to 3.31 years in American bison. Median lifespan of the European bison L and LC line was determined to 3.58 years and 3.51 years, respectively. Data are summarized in Table 1. Median lifespan of the European bison L line and the European bison LC line did not differ statistically using Mann-Whitney U test (p=0.7667). These data confirmed that no difference in the longevity exists between L and LC line of European bison. However, the median lifespan was lower than expected. Low median lifespan is influenced by high mortality of young animals under the age of four years inspite of the fact that very high mortality of young animals is rare in mammals. Moreover, we found highly significant differences in the longevity between the sex in European bison as well as in American bison. Median lifespan of female European bison (6.01 years) exceeded more than two times median lifespan of male (2.71 years), see Table 1 and Figure 1. The difference between both sexes was statistically proved (p<0.001). Similar differences in sex-related lifespan were found in L and LC line of European bison Table 1.

Table 1: Median lifespan of american and european bison.

Species	n(all)	n(M)	n(F)	Median(all)	Median(M)	Median(F)
A bison	2912	1300	1612	3.31	2.12	6.64
E bison	1206	606	600	3.54	2.71	6.01
E bison L	298	144	154	3.58	2.95	5.98
E bison LC	908	462	116	3.51	2.62	6.01

Abbreviations: A. bison: American Bison; E. bison: European Bison; n: Number of Animals; M: Male; F: Female; L: Lowland line; LC: Lowland-Caucasian line.

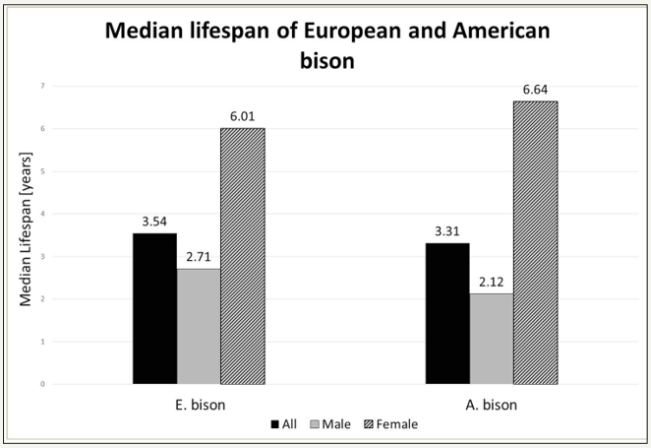

Figure 1: Median lifespan of European bison and American bison. E. bison: European Bison; A. bison: American Bison.

Median lifespan of female American bison (6.64 years) exceeded more than three times median lifespan of male (2.12 years), see Table 1 and Figure 1. The difference between both sexes was statistically proved (p<0.001). The reason for the biggest difference connected to sex in American and European bison among mammals is associated with the facts that mortality of young European bison males under the age of four years is substantially higher than mortality of young females of the same age and, similarly, mortality of young American bison males under the age of two years is substantially higher than mortality of young females of the same age. Among mammals, a difference like this has not been described yet. Generally, in most mammalian species including human, females live longer than males [27,28]. The biggest known difference in longevity between sexes among mammals has been described in short-finned pilot whale, where females live nearly twice as long as males [29], whereas only a small effect of sex was observed on canine longevity [30] and no sex-related difference in the longevity was found in Cane Corso dogs [31].

In our study, mortality of European bison (L and LC line) and American bison at the different age was evaluated. Results are summarized in Figure 2. Mortality of young European bison males (L and LC line) under the age of four years was higher than mortality of young females of the same age, see Figure 2A, 2B & 2C. Similarly, mortality of young American bison males under the age of two years was higher than mortality of young females of the

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same age, see Figure 2D. The cause of higher young male mortality could be linked to high inbreeding level. In the European bison L line, inbreeding level is almost 50%, whereas in the European bison LC line the level is 28% [12]. It is not clear if high inbreeding levels negatively influenced mortality of young males because inbreeding level of American bison is probably much lower than inbreeding level of European bison, but the mortality of young males of American bison is also very high. This is going to be the main topic of our further research.

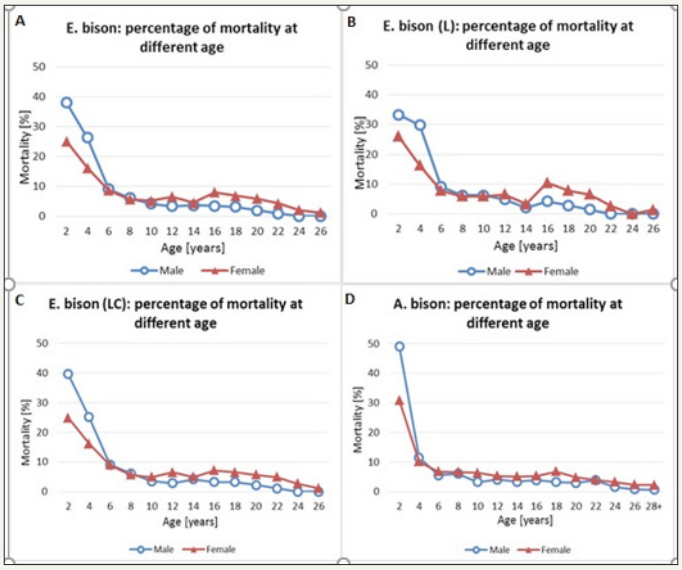

Figure 2: Percentage of mortality at different age. A. bison: American Bison; E. bison: European Bison; L: Lowland line; LC: Lowland-Caucasian line.

Conclusion

The median lifespan of European and American bison was determined for the first time. The median lifespan of female European bison exceeded more than two times the median lifespan of male. Similar finding was found in American bison, where the median lifespan of female exceeded more than three times the median lifespan of male. These differences in the longevities represent the biggest sex-related differences in the longevity among mammals. The reason of the difference is associated with the facts that mortality of young American bison males as well as European bison males is significantly higher than mortality of young females. A detailed study of these differences using methods of molecular genetics may help to clarify the genetic factors linked to longevity.

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