EVIDENCE THAT THE SABER-TOOTH DID NOT INCREASE THE LIFESPAN OF THE CARNIVORA SPECIES

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ABSTRACT: There are many extant species from the Carnivora order, however, none of them are considered saber-toothed. It is examples like this that contribute to the mystery of extinction and speciation. To evaluate this example and to see if there is a correlation between having saber-teeth and their extinction, the hypothesis tested is that non-saber-toothed species of Carnivora on average survived longer than saber-toothed species. Using the data from the Paleobiology Database, all species and genera from the order of Carnivora were downloaded. The average lifespan of saber-toothed and non-saber-toothed species were compared. The results indicated there was a statistical significance between the average lifespans and that the research hypothesis was supported. On average non-saber-toothed species existed longer than saber-toothed species of Carnivora. Reasons include the lack of evidence indicating the usefulness of the saber-tooth over the smaller and stronger conical tooth.

Introduction

The saber-tooth is an elongated canine tooth with a feature assumed to be useful in killing prey. It is a question as to why there are no extant saber-toothed Carnivora. This paper compares the average lifespan of saber-toothed and non-saber-toothed Carnivora species and uses the previous studies to evaluate why there may be a difference. The saber-toothed species existed primarily in North America and Asia (Van Valkenburgh, 2007). The first of the saber-toothed species, Nimravids, existed from the Eocene through the Miocene, and then the saber-toothed felids took over from the Miocene until the major Pleistocene extinction (Meachen-Samuels, 2011). While the order of Carnivora continued following this major extinction event, it was the end of the saber-tooth for Carnivora species. It is important to understand how evolution occurs and to evaluate extinction events. From studying extinction researchers can better understand global ecology across time (Raup, 1991). It is assumed that extinction or evolution occurs if that species was in some way inferior as a natural process for adaptation (Raup, 1991). So, what contributed to the saber-toothed Carnivora species extinction and why?

In this paper, the hypothesis tested was that on average, the age of non-saber-toothed Carnivora species exceeded saber-toothed species. The results will provide a direction for discussion of why saber-toothed Carnivora species no longer exists.

Materials and Methods

The data was downloaded from the Paleobiology Database on 19 October 2017 using the Order name “Carnivora”. All the data provided by the Paleobiology Database was downloaded and winnowed to focus only on genus and species. The average lifespan of each species was calculated using the excel average function of the maximum and minimum ages of the fossils. Data was then differentiated based on the species

containing saber-teeth or conical teeth. Identifying which species contained saber-teeth was done by referencing Sabretoothed Carnivores and the Killing of Large Prey by K. Anderson, et al. (2011). Once data was organized, the average age for each sample (saber-toothed and non-saber-toothed) was calculated as well as the standard deviation. A level of significance was placed at 0.05 as this test is not high risk. A p-value was calculated within Excel using a one-tailed t-test. The one-tailed test was used because the hypothesis states the non-saber-toothed species average lifespan will exceed saber-toothed species. From here, the graph for the mean age with error bars set to the standard deviation was created as shown in Figure 1.

Results

The one-tailed t-test was used because the research hypothesis predicted non-saber-toothed Carnivora species to have a higher average age than saber-toothed species. The test performed supports the research hypothesis that species of non-saber-toothed Carnivora survived longer than saber-toothed Carnivora. The data analysis provided a p-value of 0.04. This result indicates that the possibility of getting these results by random chance if the statistical null hypothesis is .04; therefore, the research hypothesis is accepted. Figure 1 shows the one-tailed t-test graph of average age for non-saber-toothed Carnivora species and the average age for saber-toothed Carnivora species with error bars set using the standard deviation for the data. According to the data, the mean age for non-saber-toothed Carnivora was 5.68 million years compared to the mean age for saber-toothed Carnivora being 4.95 million years.

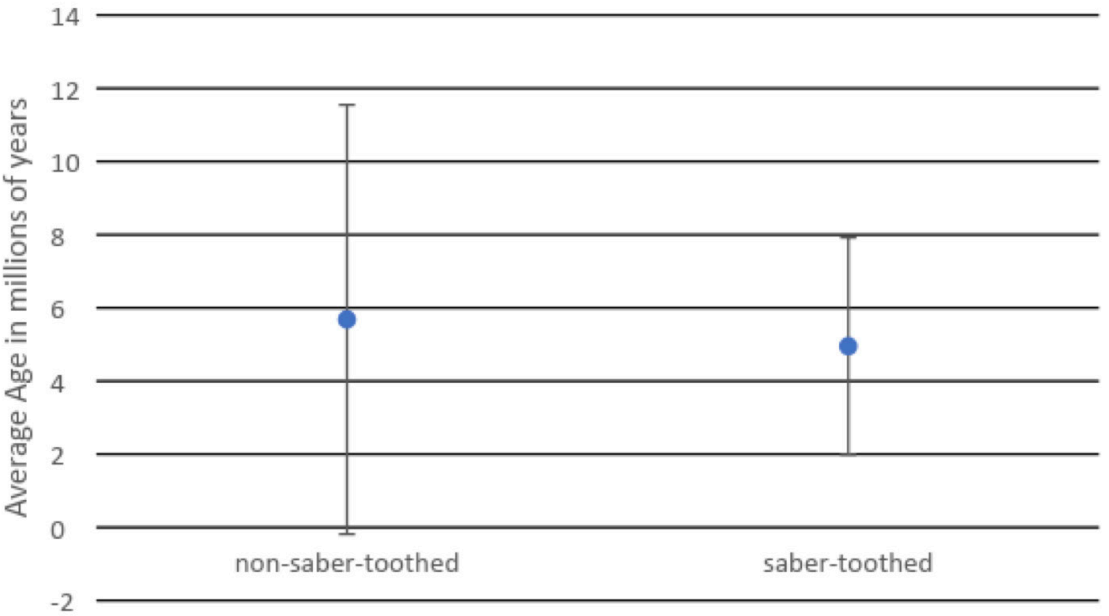

Figure 1: The difference in average age of non-saber-toothed Carnivora species versus saber-toothed Carnivora species is statistically significant.

Discussion

Based on the results of the one-tailed t-test, the research hypothesis is accepted that on average, non-saber-toothed Carnivora species had a longer lifespan than saber-toothed Carnivora species. While saber-teeth seem highly useful, they don't appear to be advantageous.

Hunting

Saber teeth were used for catching prey and assisting with a quick take down and are rather fragile (Meachen-Samuels 2011). According to Meachen-Samuels (2011), the round conical canines of extant cat species are used for a choke-hold method of killing prey (Meachen-Samuels, 2011). Their shorter, more compact tooth can withstand forces in all directions while the saber-tooth was subject to breaking (Meachen-Sameuls, 2011). This is supportive for why being a saber-tooth species did not ensure a longer lifespan. There was an idea tested that the upper body and forelimbs of the saber-toothed Carnivora had larger and stronger forelimbs in order to pin their prey (Meachen-Samuels, 2011). The results of this test did not support the idea that the forelimbs and saber-teeth were directly correlated. Meachen-Samuels (2011) suggests that the stronger upper body and forelimbs were likely a secondary adaptation due to the fragility of the saber teeth (Meachen-Samuels, 2011). Although there was a risk for breakage, the saber-teeth allowed the animal to increase their hunting range from the ability to take on larger prey relative to their body size (Van Valkenburgh, 2007). However, there is thought this may have contributed to their extinction (Antón, 2013). Due to the most recent major extinction event, the ice age of the Pleistocene, the food source for the saber-toothed Carnivora species died giving an advantage to non-saber-toothed Carnivora (Antón, 2013). This provides further evidence why non-saber-toothed Carnivora species survived longer than saber-toothed species.

Morphology

Dental features in animals can tell you a lot about the diet of the organism. They also allow you to assume the ecological niche for the species (Holliday and Steppan, 2003). Due to the elongated canines, it was imperative for the saber-toothed Carnivora to open their mouths wider (Van Valkenburgh, 2007). It was discovered that the anatomy of the skulls for these species were adjusted in comparison to present day cat-like Carnivora to accommodate their saber-teeth (Van Valkenburgh, 2007). The anatomical differences suggest that they could open their mouths larger, but they had a weaker bite (Van Valkenburgh, 2007). From the weakened bite and the increased size of teeth of the saber-tooth Carnivora came disadvantages to the saber-teeth, including a loss in biomechanical efficiency for the muscle systems and fragility of the teeth (Van Valkenburgh, 2007). This provides another example of what could have contributed to the shorter lifespan of the saber-toothed Carnivora species.

Limitations and future work

In comparison, less saber-toothed species of the order Carnivora existed than non-saber-toothed based on the Paleobiology database. Alternative results for this would be to focus on why non-saber-toothed species survived a longer time rather than why saber-tooth species survived a shorter time.

Because there are no extant saber-toothed species of Carnivora, the Paleobiology database was used to conduct this research which made the research dependent on the fossil record, creating a limitation on the sample size. While it would be more useful to have a larger sample size to increase the accuracy of the study and to gain more understanding on why saber-toothed Carnivora species on average did not survive as long as non-saber-toothed species, this is not an option. The only conclusion that can be made from this research is that the saber-teeth were not as advantageous as assumed and the more compact, smaller conical canines prove to be more useful for these carnivores.

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