Warm Weather Giants

New study delves into the relationship between climate and size in the Sabre-Tooth Cat

Survival of the fittest. It is the underlying concept of natural selection, and the theory of evolution as a whole. The individuals best suited to their environment survive, procreate, and pass down their advantageous genes to future generations. Yet one factor that often is overlooked in this process is the dynamic nature of the environment. Climate change can cause dramatic shifts in an environment's characteristics, completely changing the necessary skills and traits needed to survive. What was once an advantageous set of genes can quickly (in terms of an evolutionary time-scale) become a death sentence when they are present in an ill-suited setting. As we enter an era of dramatic and rapid warming of the planet, one can't help but wonder how the world's wildlife will change with their surroundings.

When considering the future, it is often helpful to consult the past. Life on Earth is billions of years old, and has seen massive changes to the planet's conditions. If we want to know more about how rapid climate change affects species, we must investigate the changes seen in prehistoric species in eras with an unsettled climate.

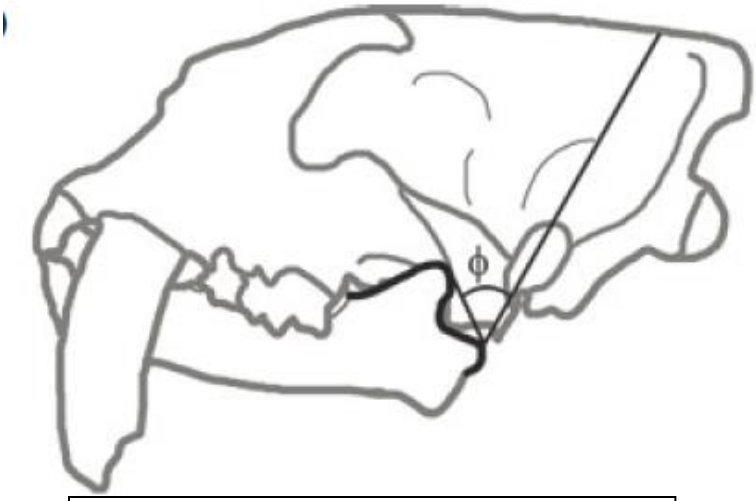
"The Pleistocene period is really an ideal period to study," says Dr. Julie Meachen from Des Moines University in Iowa. "It is recent enough that we have very good climate records with large swings in the conditions, and also have a well preserved fossil record from the tar pits."

Dr. Meachen is an expert on Smilodon Fatalis, more commonly known as the Sabre Toothed Cat, which existed during the Pleistocene period. She has written numerous papers on the sabre-tooth's morphology, including her most recent paper published in the April 2014 issue of the Journal of Evolutionary Biology, which focused on the size and shape of the cats' mandibles in comparison to the climate change. She has worked extensively at the Rancho La Brea tar pits, which has an extensive collection of fossils from a range of dates within the Pleistocene period. By using the radiocarbon dates from individual tar pit where Smilodon fossils were found, the mandibles can be associated to a specific climate via dated climate records.

While it seems data on the size and shape of an extinct species mandible would have limited use, it is actually much more informative than you might expect. Although the size of the jaw itself indicates an individual cat's size, because we cannot say at what age the cat died, this is of limited value on its own. However, analyzing the size of the jaw's gape and the shape of the teeth, the size of prey can be established along

with the method of killing using. When all these factors are combined, it is possible to determine which age of fossils corresponded to the bulkier, more muscular cats.

Dr.Meachen was able to establish that the Smilodons from time periods associated with warmer climates were the largest in size, had the largest jaw gape, and the most extreme upper canines. This result is actually contrary to the general correlation between size and climate, or Bergmann's rule. This rule is based on the idea that in cold climates, a higher volume to surface area ratio would be advantageous in order to limit the effect cold would have on the individual. However, for Smilodons it would seem there are more important factors driving the evolution of the species, likely being prey selection, prey availability, and competition with other high level carnivores. This is not completely unexpected, as many modern day predators also contradict Bergmann's rule, with their size more directly linked to the size of their prey. This is hinted to be the case for Smilodons as well, as larger cat's also had a larger jaw gape, and thus could fit their jaws around larger prey.



Using the skulls of Smilodon Fatalis, a measurement of the coronoid process and condylar process (the bolded area on the jaw) allowed for a measurement of the jaw gape angle.

This change in diet the cat's is measurable by detecting and comparing the isotopes of nitrogen and carbon in the fossils themselves. This, along with improved fossil dating, is a big part of Dr.Meachen's future work: "[the pits] were dated in the 2000's, but new methods allow for impurities to be filtered out much better, giving better dating of the fossils. You can actually conduct isotope testing at the same time without extra cost…I have a proposal in the works to study this."

While it is impossible to perfectly predict what the species will look like in the future, by understanding the evolutionary mechanisms of the past, we give ourselves a clearer view of what may be around the corner. With the committed work of evolutionary biologists such as Dr.Meachen, this view is getting clearer with each passing day.