Is a saber-tooth cat's roar worse than it's bite?

September 21 2016, by Sarah Gibson

Credit: La Brea Tar Pits Museum

Is a saber-tooth cat's roar worse than it's bite? Maybe…. if it's cold outside.

When the climate changes, organisms change with it. Environmental stresses can impact an organism by limiting ideal living conditions and/or decreasing prey, or can even cause favorable conditions that allow a population to flourish. These changes can be observed over time, whether it is a decrease/increase in numbers in a population, size of

individuals, mortality rates, changes in morphology, etc.

But, sometimes changes are occurring that might not be so outwardly obvious. Especially when you are working with fossils, where a lot of data is inherently missing. Then it's time for researchers to get clever and think of ways to examine morphology that might not be readily available to the naked eye, which is exactly one what group of researchers—Wendy J. Binder and Kassaundra S. Cervantes from Loyola Marymount University, and Julie A. Meachen from Des Moines University—decided to do in a study recently published in *PLOS ONE*. The study examines the cortical bone density in many specimens of the saber-tooth cat Smilodon fatalis from the La Brea Tar Pits in order to test the strength of these cat's bites through time.

The fossil record is fantastic for observing such changes to a population, and tied in with evidence from the geological record, paleontologists can infer ancient climates and their impacts on the organisms that inhabited the planet.

Credit: Charles Robert Knight – The Jesse Earl Hyde Collection, Case Western Reserve University (CWRU) Department of Geological Sciences, Public

Paleontologists that work with the La Brea Tar Pits in southern California are especially lucky; they have 30,000 years worth of deposits to comb through, allowing them to examine in great detail the changes that have occurred to thousands of individual animals in response to ecological and environmental changes over time.

For those who might be unfamiliar with La Brea, the site is a natural trap, in which naturally-formed asphalt has seeped up from underneath the ground for tens of thousands of years—and in fact still is seeping today. Animals ventured in, either because they mistook it for water or just didn't see the tar when covered by leaves and debris, and became stuck in the mire, eventually dying. A single large and tasty mammoth carcass can attract dozens of predators to scavenge on it, not realizing they were approaching their own demise, hence a larger concentration of predators compared to prey at natural trap sites such as La Brea. The tar also helps preserve the fossils, giving them their characteristic dark brown hue.

Binder and her colleagues set out to learn what they could about Smilodon, its feeding habits and jaw strength, and the idea to measure jaw strength via cortical bone thickness came to them through discussions.

"It's always a challenge to figure out how to learn more about an extinct species, especially one that is well-known," Binder says. "The idea has been used in extant species as a way to try to indirectly look at jaw strength based upon beam theory. I have been collecting data on a number of carnivores over the years, but havn't put it together for publication yet. The idea of applying this to Smilodon was a result of a

conversation Julie Meachen and I had in which we were talking about some of our work on Smilodon and what we wanted to do next, and when I brought this up we decided this would be an interesting area to pursue. I then started working with my undergraduate research student Kassi [Cervantes] to collect the data."

Smilodon fatalis on display in Japan. Credit: Momotarou2012 (Own work) [CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0), via Wikimedia Commons

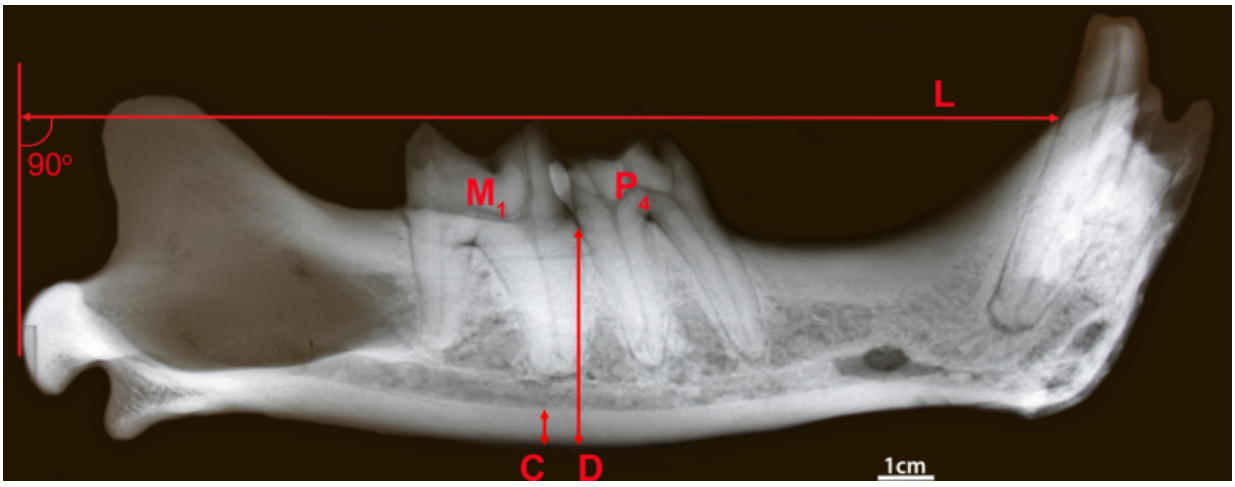
The team used 102 dentary samples from five pits at La Brea, ranging in age from 13,000 years to 40,000 years ago. Each dentary was scanned using a portable x-ray machine to produce radiographs, that the team could then use to measure the thickness in various areas of the dentaries.

What the team learned from this exercise was interesting. One of the pits, Pit 61/67, contains the largest and most robust dentaries of

Smilodon fatalis. This pit is also the youngest, ~13–14,000 Kypb, just prior to the late Pleistocene megafaunal extinction event at approximately 12,000 Kypb. The results of Binder et al. (2016) suggests that Smilodon fatalis were healthy and thriving prior to the extinction event. The large mandibles of these individuals suggest they were able to feed on large prey. All of this evidence suggests that prior to the extinction event, the climate and environment were suitable, even ideal, for these animals to thrive in.

However, pit 13 tells another story. Pit 13 ranges in age from 17–18.5 Kypb, older than the previously mentioned Pit 61/67, and a time that coincides with the last glacial maximum in North America. Smilodon fatalis dentaries from this site have the lowest thickness measurments of cortical bone. Less cortical bone in the dentary means less bite strength, and so Smilodon from this time period wouldn have had to likely subsist on softer foods and less strong prey if it were to survive. The reduction in cortical bone could be related to malnutrition. Binder et al. (2016) suggests that these individuals, in conjunction with colder temperatures, could have been under greater environmental stresses. Perhaps the cold limited vegetation, which limited primary consumers, which impacted predators and caused periods of nutritional stress and deficits, slowing development and affecting the health of saber-tooth cats during this time period.

What about other predators from La Brea? For example, do dire wolves display similarities in dietary stress or health?



An example of a Smilodon x-ray radiograph. Credit: Binder et al. (2016)

"There is evidence that dire wolves were under strong selection pressure at the time of Pit 13, but then rebounded, growing larger, with less tooth wear and breakage in Pit 61/67 right before their extinction," Binder told me. "We don't have similar [dentary] data from dire wolves at this point, but the trends in dire wolves and sabertooth cats aren't always the same."

This study is a great example of how changes to morphology of an organism could be related to external stresses, such as changes in climate/environment. Similar studies could also be performed on other carnivores at La Brea, as well as other natural trap sites where a similar sample of organisms can be obtained.

And let's hope that the data we learn about the health of animals under environmental stress can be applied to conserving the fauna we are lucky to still have around today, before they, too, are extinct.

More information: Wendy J. Binder et al. Measures of Relative Dentary Strength in Rancho La Brea Smilodon fatalis over Time, *PLOS*

ONE (2016). DOI: 10.1371/journal.pone.0162270