Predicting the distribution of creatures great and small

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In studying how animals change size as they evolve, biologists have unearthed several interesting patterns. For instance, most species are small, but the largest members of a taxonomic group -- such as the great white shark, the Komodo dragon, or the African elephant – are often thousands or millions of times bigger than the typical species. Now for the first time two SFI researchers explain these patterns within an elegant statistical framework.

"The agreement between our model and real-world data is surprisingly close," says SFI Postdoctoral Fellow Aaron Clauset, who, along with SFI Professor Douglas Erwin, presented the findings in a July 18 *Science* paper.

In Clauset and Erwin's model, descendant species are close in size to their ancestors, but with some amount of random variation. But, this variation is constrained, first by a hard limit on how small a species can become, due to physiological constraints, and second by a soft limit on how large a species can become before becoming extinct. After millions of virtual years of new species evolving and old species becoming extinct, the model reaches an equilibrium in which the tendency of species to grow larger is offset by their tendency to become extinct more quickly.

By using fossil data on extinct mammals from up to 60 million years ago to specify the form of the model, the researchers showed that this evolutionary process accurately reproduces the diversity of 4,000

mammal species from the last 50,000 years.

"The model is remarkably compact, " says Aaron. "It also omits many traditional ideas from evolution and ecology, such as population dynamics or species interactions, yet makes very accurate predictions."

Because species size is fundamentally related to so many other characteristics like metabolism, life span and habitat, the researchers' simple evolutionary model offers support to idea that some aspects of evolutionary and ecological theory can be unified.

Source: Santa Fe Institute