

# Theoretical research offers explanation as to why some animals shrink over time

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The mystery behind why Alaskan horses, cryptodiran turtles and island lizards shrank over time may have been solved in a new study.

The new theoretical research proposes that animal size over time

depends on two key ecological factors: the intensity of direct competition for resources between [species](#), and the risk of extinction from the environment.

Using computer models simulating evolution, the study, published in *Communications Biology*, identifies why some species gradually get smaller, as indicated by fossil records.

Dr. Shovonlal Roy, an ecosystem modeler from the University of Reading who led the research, said, "Just like how we try to adapt to hot or [cold weather](#) depending on where we live, our research shows animal size can get bigger or smaller over long periods depending on the habitat or environment.

"In places and times where there's lots of competition between different species for food and shelter, animal sizes often get smaller as the species spread out and adapt to the distribution of resources and competitors. For example, small horses that lived in Alaska during the Ice Age rapidly shrank due to changes in the climate and vegetation.

"Where direct competition is less, sizes tend to get bigger, even though being really big and few in number can make animals more vulnerable to dying out—such as what happened with the dinosaurs. Changes in ecological factors help explain why [fossil records](#) shows such confusing mixes of size evolution patterns, with some lineages shrinking over time and others growing."

## **Cope's rule**

The research team carried out their study by challenging the contradictions [fossil evidence](#) posed to "Cope's rule." Cope's rule refers to the tendency for certain animal groups to evolve larger body sizes over thousands and millions of years.

The rule is named after Edward Cope, a 19th-century paleontologist who was credited with having first noticed this pattern in the fossil record. For example, early horse ancestors were small dog-sized animals that increased in size over evolutionary time, ultimately producing the modern horse.

However, fossil evidence shows remarkably conflicting trends, with increased size in some groups but decreased size in others.

## Evolutionary pressure

Using computer models simulating evolution, the study identified three distinct patterns of body-size change emerging under different conditions:

- Gradual size increase over time: This happens when competition between species is determined mostly by their relative body sizes rather than niche differences. For example, several genera of marine animal species (e.g. invertebrates) gradually [increased in size over millions of years](#).
- Size increase followed by extinctions: Here the largest animals recurrently go extinct, opening opportunities for other species to take their place and evolve even bigger bodies, continuing the cycle. Mass extinctions hit large-bodied apex predators hardest. Very [large mammals](#) and birds are particularly [vulnerable to extinction](#)—for example, dinosaurs and giant flying reptiles.
- Gradual size decrease over time: The simulations also predicted the opposite of Cope's rule: species shrinking over [time](#). This happens when competition is high and there is a degree of overlap in habitat and [resource use](#). As species evolve apart into distinct niches, they face evolutionary pressure to reduce in size.

Decline in size was previously reported for [vertebrates](#), [bony fish](#), [cryptodiran turtles](#), [Alaskan Pleistocene horses](#), and [island lizards](#)

**More information:** Ecological determinants of Cope's rule and its inverse, *Communications Biology* (2024). [DOI: 10.1038/s42003-023-05375-z](#)

Provided by University of Reading

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