Ecologists Say Metabolism Accounts for Why Natural Selection Favors Only Some Species

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(PhysOrg.com) -- Why are some species of plants and animals favored by natural selection? And why does natural selection not favor other species similarly?

According to a UC Riverside-led research team, the answer lies in the rate of metabolism of a species – how fast a species consumes energy, per unit mass, per unit time.

The researchers studied 3006 species, the largest number of species ever analyzed in a single study. The species list encompasses much of the range of biological diversity on Earth – from bacteria to elephants, and algae to sapling trees.

To the researchers' surprise, they found the mean metabolic rate of the species at rest fell on a narrow range of values – 0.3 to 9 Watts per kilogram.

"This narrow range is in dramatic contrast to the 20 orders of magnitude difference in the body mass of the species we studied," said Bai-Lian Li, a professor of ecology at UC Riverside, who led the study along with two colleagues. "At physiological rest, the biosphere appears to run, on average, predominantly at the optimal rate defined by this narrow range of values. This remarkable phenomenon is likely associated with the pervasive biochemical universality of living matter, and could provide us with clues to understanding how life is organized."

Study results appear in the Nov. 4 issue of the *Proceedings of the National Academy of Sciences.*

According to Li, the metabolic optimum explains the ubiquitous and seemingly unrelated features of life organization we see all around us – complex adaptations such as animal breathing and flat, green leaves.

"Organisms whose designs fit the physiological window have been favored by natural selection across all of life's major kingdoms," he said. "This observed, narrow range might therefore be considered as the preferred, optimal range for the functioning of living matter as a whole."

Unlike the genetic code and protein composition, metabolic rate cannot be inherited from a common ancestor. Rather, a particular range of metabolic rates is maintained by natural selection.

"Species had to invent diverse tricks to remain near the metabolic optimum, from which the progressive evolutionary increase in body size – from prokaryotes to largest vertebrates and plants – was continually taking them away," Li said.

He was joined in the study by co-leaders Anastassia M. Makarieva and Victor G. Gorshkov of the Russian Academy of Sciences, St. Petersburg. Their co-authors on the research paper are Steven L. Chown of Stellenbosch University, South Africa; Peter B. Reich of the University of Minnesota, St. Paul; and Valery M. Gavrilov of Moscow State University, Russia.

Provided by University of California - Riverside