New theory provides better basis for biodiversity conservation

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A mathematical model that provides a more effective basis for biodiversity conservation than existing frameworks has been developed by a researcher at the Hebrew University of Jerusalem.

The complexity of ecological systems, expressed in the large variation in morphology, physiology and behavior of individuals of different species, individuals of the same species, or even the same individual in different environments, makes the understanding of the mechanisms affecting the diversity of ecological communities extremely difficult.

As a consequence, most theories of biodiversity are either limited to a single mechanism, or rely on highly simplified and possibly unrealistic assumptions. Thus, after more than a century of intensive research on species diversity, the world still lacks a solid, theoretical foundation that can effectively guide decision makers.

What enables different species to coexist in nature? Why do some areas, such as the tropics, host huge numbers of species, while others can accommodate only a few? How is climate change expected to affect the diversity of natural ecosystems? What level of habitat destruction can ecological communities suffer, and according to what rules should we design nature reserves?

Taking into account that preserving biological diversity (biodiversity) is crucial for the health of the environment, answering such questions is now recognized as one of the greatest challenges for the 21st century.

In his Ph.D. thesis in the Department of Evolution, Systematics and Ecology at the Hebrew University, Omri Allouche developed, under the supervision of Prof. Ronen Kadmon, a new theory of species diversity that attempts to provide a more effective basis for biodiversity conservation. The heart of the theory is a [mathematical model](#) that predicts the number of species expected in an ecological community from properties of the species (e.g., rates of birth, death, and migration) and the environment (e.g., resource availability, [habitat loss](#), frequency of disturbances).

The generality of the model and its flexibility make it a highly effective tool for guiding conservation managers and policy makers. Interestingly, analyses of the model provide novel insights that often differ from common notions of conservationists. For example, in contrast to the intuition that improving habitat quality (e.g. by resource enrichment) should promote biodiversity, Allouche's theory predicts that resource enrichment can actually reduce biodiversity, a result supported by empirical studies.

Another example is the response of ecological communities to habitat loss, which is recognized as the largest threat to biodiversity. Often the response of an ecosystem to mild habitat loss is used to forecast expected responses to large-scale habitat loss. The theory predicts that such forecasts may be misleading, and that ecological communities may show a sudden biodiversity collapse prior to some critical level of habitat loss.

One aspect of particular importance for conservation planning is the prediction of biodiversity responses to global climate change. Most current models of biodiversity responses to climate change make the assumption that dispersal ability of species is unlimited. In his work - which has earned him a Barenholz Prize at the Hebrew University -- Allouche shows that this assumption significantly reduces the predictive

power of such models and can therefore lead to misleading conclusions.

Allouche believes that his contributions can improve the ability of conservation managers and policy makers to assess potential risks to biodiversity, to efficiently design nature reserves, to effectively identify and protect endangered species, and thus, to better conserve the diversity of ecological communities.

Provided by Hebrew University of Jerusalem