Research explains how ecosystems survive in a constantly changing world

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Ecological networks may struggle to survive the systematic changes our planet is undergoing, according to researchers from Queen Mary, University of London.

A huge range of interactions exist in nature: from predatory and herbivorous relationships, such as a fox killing a mouse; to more reciprocal relationships, such as the pollination of flowers by insects. Darwin called this mass of complex interactions a ‘tangled bank’.

Writing in the journal *Nature*, Dr Jose Montoya and collaborators have found that Darwin's tangled bank exhibits simple and complex patterns, or relationships, which are affected by changes such as the addition or removal of a species.

His research has shown that ecological networks, although often complex, have well-defined patterns in their interactions, which have evolved to absorb natural changes in the environment. For example, if a disaster wipes out an entire species, other species within the network can usually compensate, according to their abundance and position in the web, thus restoring the network.

But if just a few 'keystone' species are systematically removed from the network, the ecosystem become more unstable and can collapse. Species with many connections to other species may be such keystones: for example, if a prey species is wiped out, many species may lose their only prey source and hence they will become extinct. These findings are a

fundamental to understand the stability and fragility of ecosystems, and may alter the predictions of impeding extinction rates.

Montoya explains: “By understanding how species interact within ecological networks, we can understand how species survive. Every species is closely linked to every other, either directly or indirectly. Every disturbance in the ecosystem moves quickly through a food web, buffeting every other species. But how do species persist in this ‘noisy’ world? And which species will still persist in the extensively modified and increasingly species-poor world we are creating for them?”

Although superficial similarities exist to those patterns found in non-ecological systems, such as networks of interacting computers, genes or humans, ecological networks are unlike any other. The assembly of ecological networks follows unique rules, with the processes of predation, competition and reciprocity constraining them in different ways.

“Our knowledge of the structure of ecological networks is still incomplete in important areas including sub-webs that make up larger webs, and reciprocal specialization, such as the flower insect relationship,” Montoya continues. “But as humans continue to exert such a profound effect on the planet, further research is vital to understanding which species can survive changes in their environment, and which are more vulnerable to extinction, which is taking place hundreds or thousands of times as fast as normal.”

Source: Queen Mary, University of London

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