

Communications

Predicting the risk of failure in nature and business

15 September 2011

Newly published research has found that the old adage "only the good die young" rings true when it comes to the nature of co-operative networks in the ecological and economic worlds.

Recently appointed University of Canterbury academic Dr Daniel B. Stouffer (Biological Sciences), working with Brian Uzzi and Serguei Saavedra from Northwestern University in Illinois, United States, and Jordi Bascompte of Estación Biológica de Doñana in Seville, Spain, has found that the strongest contributors to the well-being and persistence of a mutualistic network – be it between plants and their pollinators, or between designers and contractors in the garment industry of New York – are the most likely to run the greatest risk of extinction or business failure.

Published in the journal *Nature* in a paper titled "Strong contributors to network persistence are the most vulnerable to extinction", the researchers found that different species or businesses made distinct contributions to the overall network structure – some contributed more and others less.

Dr Stouffer, a complex systems ecologist, said simulations of population dynamics found that the removal of these strong contributors had a greater detrimental effect on the network than the removal of weak contributors. Paradoxically, these strong contributors did not gain from contributing more but instead are the nodes most vulnerable to extinction.

While the researchers did not have a comprehensive theory on why this should happen, Dr Stouffer said "it seems similar to the idea of the 'tragedy of the commons' wherein some individuals are able to extract more from their community than they give, providing a competitive advantage".

Dr Stouffer said previous research by some of the paper's authors had characterised the architecture of the network of interactions between plants and their pollinators, looking at the community-level consequences of a global network pattern.

"Nevertheless, it remained unclear to what degree different species made distinct contributions to the overall network architecture. In our new paper, we start to unravel these distinctions at the level of individual species," he said.

"In addition, we explore the degree to which these results are generalisable across another type of mutualistic network. Specifically, we examine the dynamic patterns in the socio-economic network made up of designers and contractors in the New York garment industry."

Dr Stouffer said while the nature of the two systems were clearly different, in both the ecological and socio-economic scenarios "the networks depict co-operation between two types of nodes and the observed network architectures are quite similar, allowing for the possibility that they also exhibit similar behaviours at the node level".

"An advantage of the socio-economic data is that we know who interacted with whom during 15 years, allowing us to know precisely which companies stayed in business and which fell by the wayside. Crucially, we reach the exact same conclusions as before – those companies that made the greatest contribution to overall network architecture and persistence were those that had the greatest risk of failure."

Dr Stouffer said these findings had "strong implications" when attempting to understand the origin of participants make greater contributions to the collected good and how some nodes can improve their own survival at the expense of others.

"In ecology, it might be possible to predict the success of an invasive species as well as its effects on the overall welfare of the community. In socio-economic systems, we can identify those companies that undermine stable, long-term economic prosperity in the hope of better avoiding the systemic risk and failure that has recently plagued the financial sector."

"Furthermore, they suggest specific strategies to increase the overall persistence and success of these types of co-operative networks such as providing rewards to those nodes that contribute the most to the overall good."

The full paper can be found on the *Nature* website at <http://www.nature.com/nature/journal/vaop/ncurrent/full/nature10433.html>.

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