Merging DNA metabarcoding and ecological network analysis to understand and build resilient ecosystems

FAPESP WEEK LONDON

Darren Evans, Newcastle University

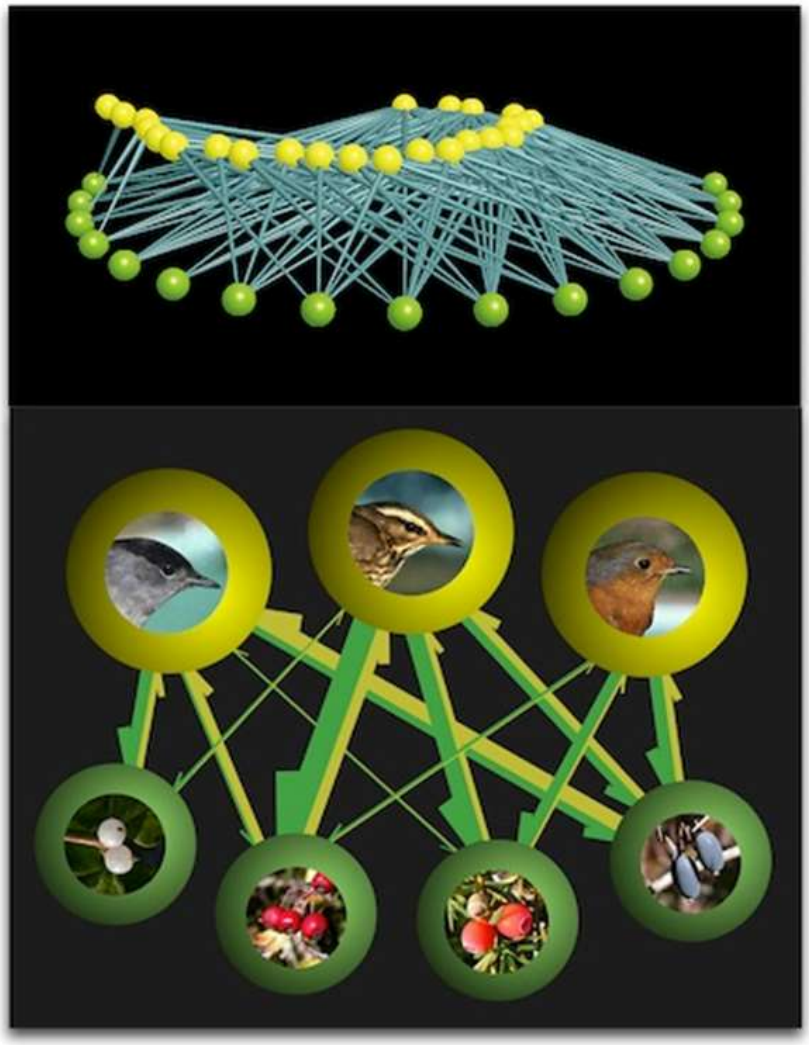
Newcastle University

FAPESP SÃO PAULO RESEARCH FOUNDATION

UK-BR Year of Science and Innovation

GREAT

Ecological networks provide a framework for understanding and managing biodiversity and ecosystem functioning



Credit (plus previous image): Pedro Jordano

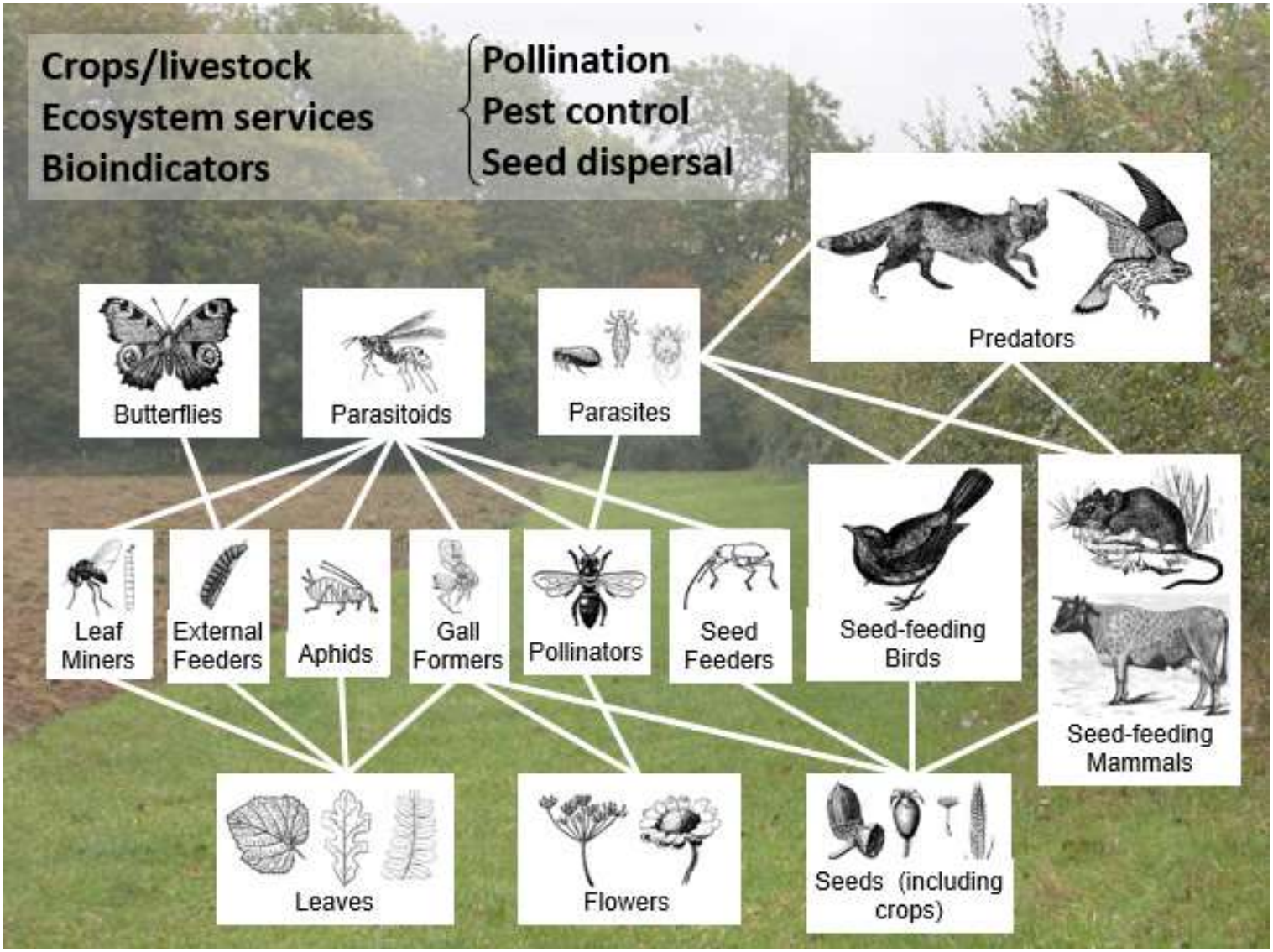
FAPESP WEEK LONDON

FAPESP SÃO PAULO RESEARCH FOUNDATION

UK-BR Year of Science and Innovation

GREAT

Scaling up networks to build resilience into agriculture and forestry systems



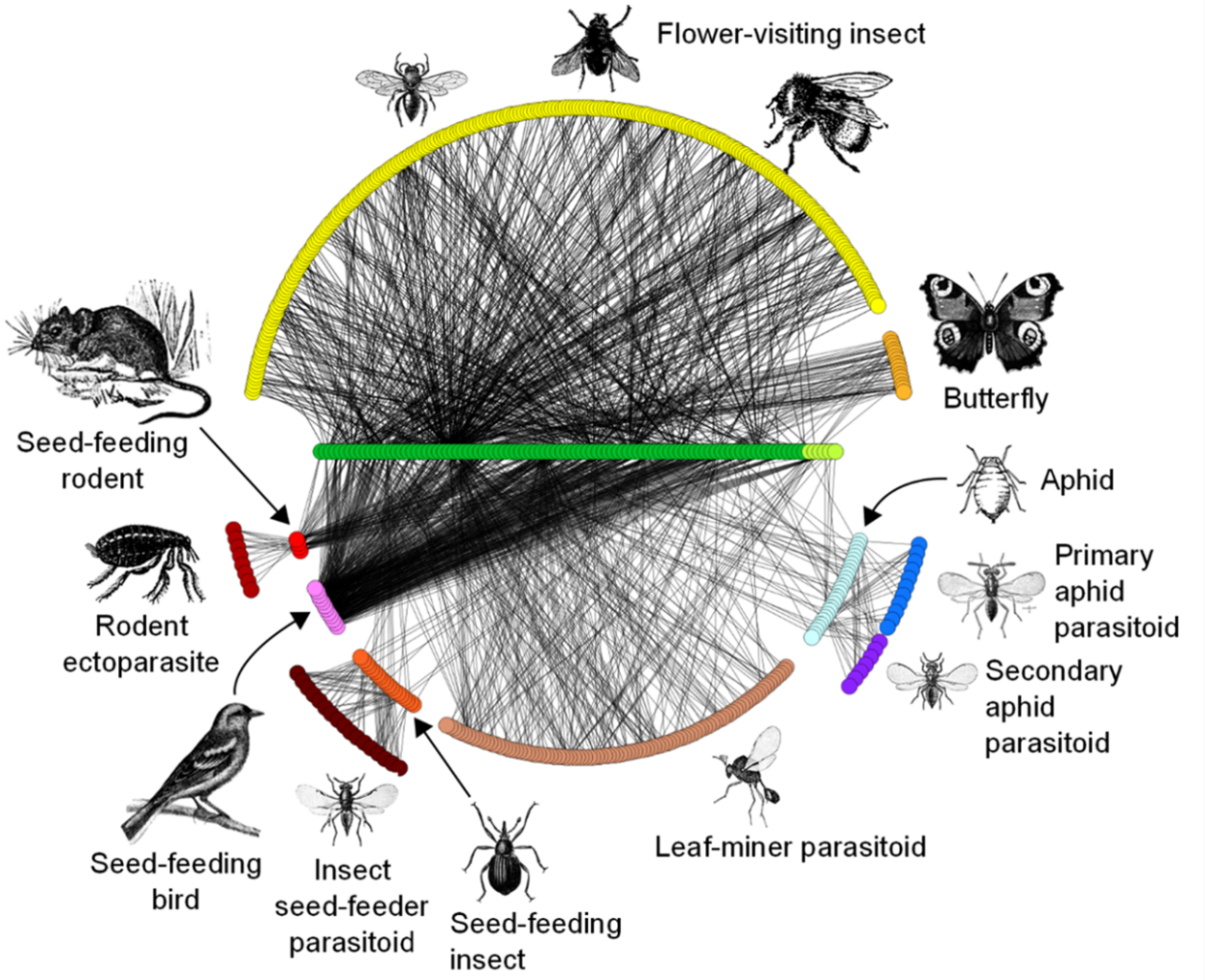
FAPESP WEEK LONDON

FAPESP SÃO PAULO RESEARCH FOUNDATION

UK-BR Year of Science and Innovation

GREAT

Examining the ‘robustness’ of the Norwood Farm network



Pocock, Evans & Memmott (2012) *Science*
Evans, Pocock & Memmott (2013) *Ecology Letters*

Applying the state-of-the-art in network ecology

- ✓ Select sensitive groups for conservation and assessment as **bioindicators**?
- ✓ Some plants are disproportionately **important** in this network of networks - targets for local restoration?
- ✓ Habitat loss scenarios using genetic algorithm identified disproportionately important habitats - targets for landscape **restoration**?

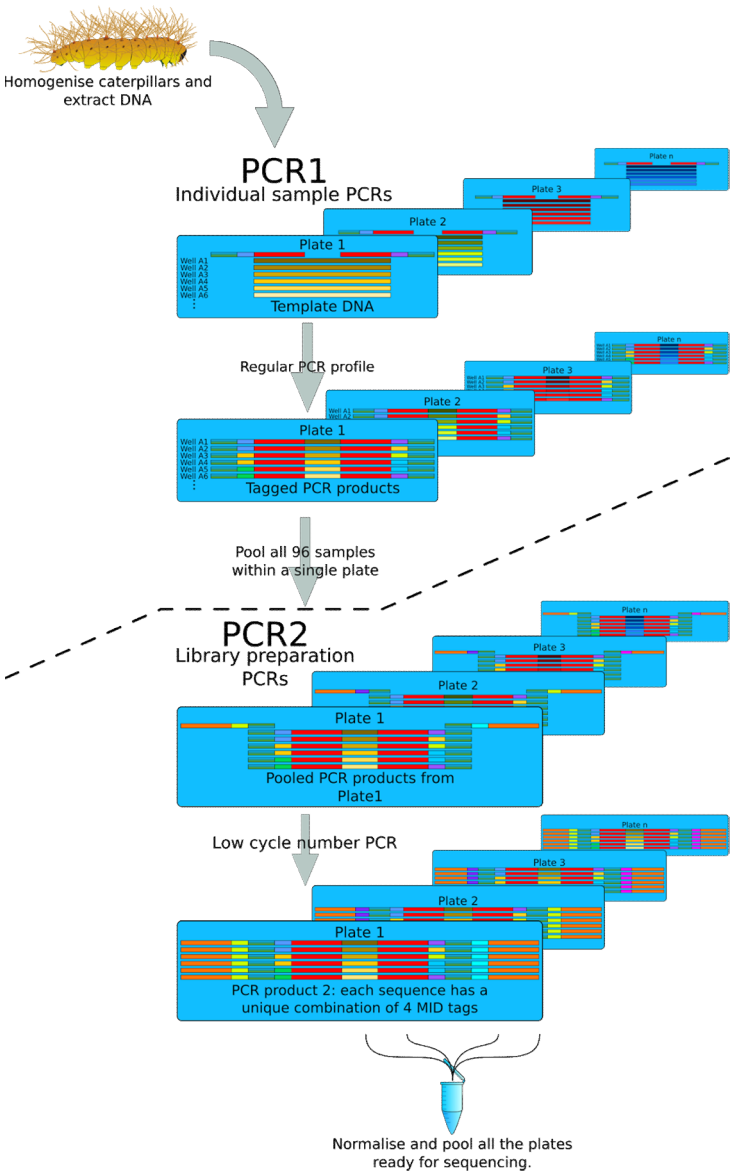
FAPESP WEEK LONDON

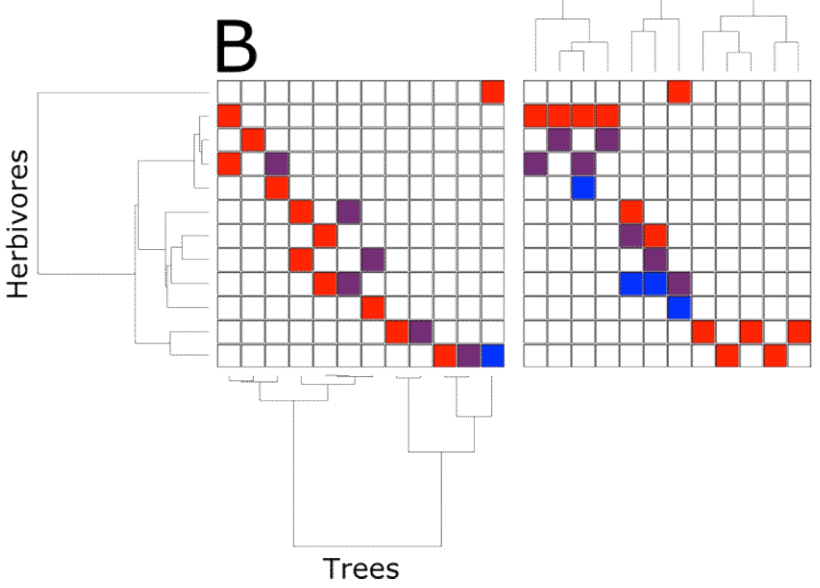
FAPESP SÃO PAULO RESEARCH FOUNDATION

UK-BR Year of Science and Innovation

GREAT

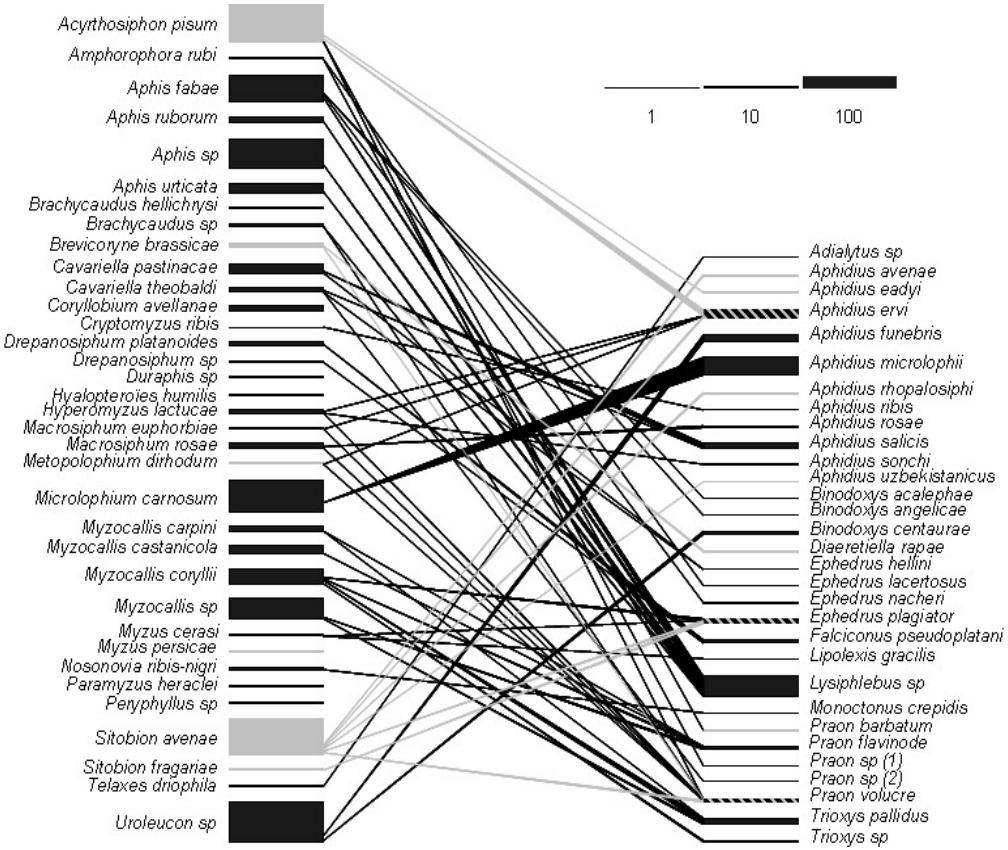
Environmental DNA/metabarcoding is revolutionising our ability to rapidly create large, phylogentically-structured networks in poorly studied regions





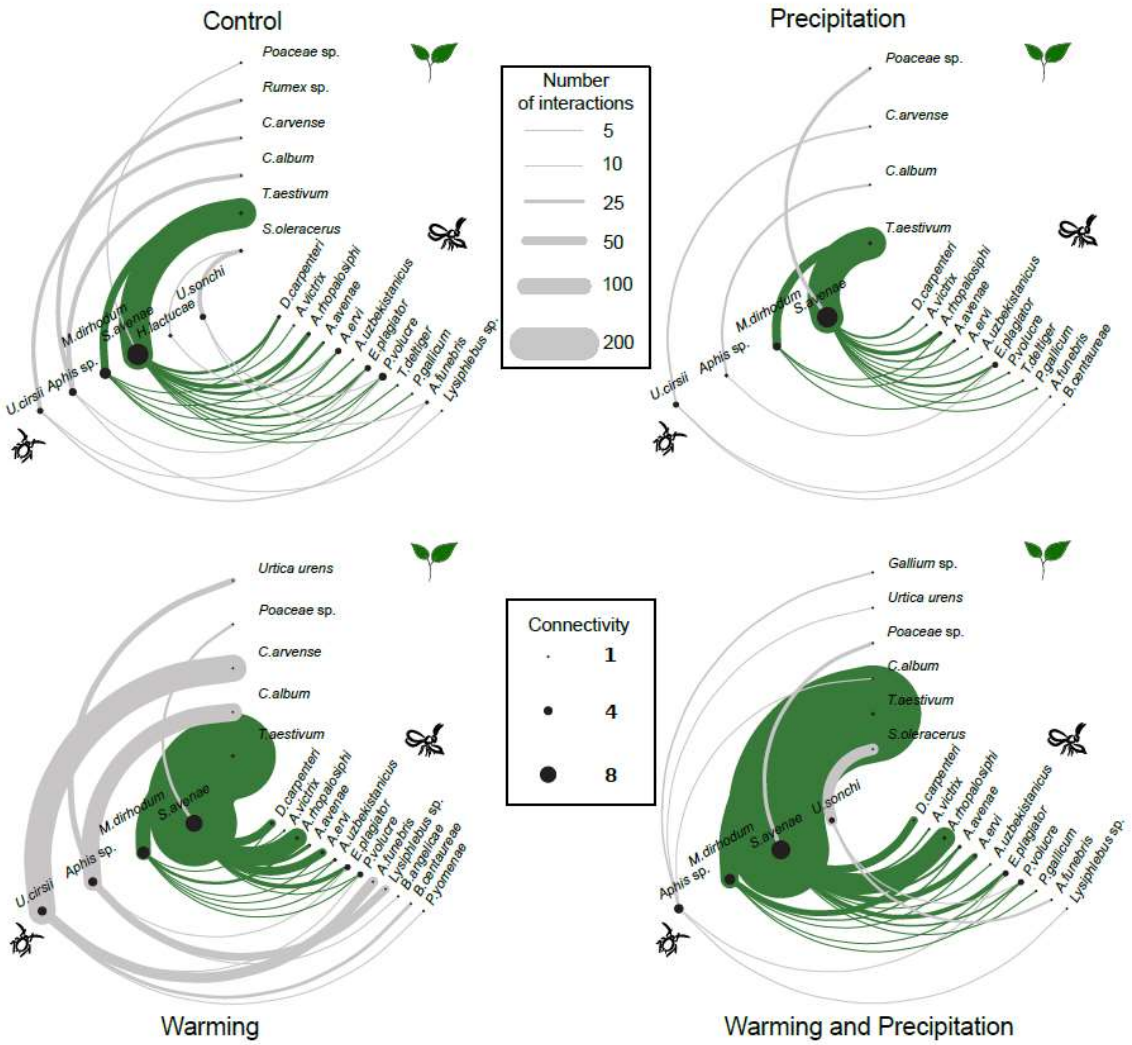
Evans et al. (2016) *Functional Ecology*

Merging DNA-metabarcoding and ecological network analysis to enhance ecosystem service provision: soils, pollination and pest control



Derocles *et al.* 2014. *Molecular Ecology*; Derocles *et al.* 2015. PLOS ONE; Bennett *et al.* 2013. PLOS ONE; Bennett *et al.* 2018. *Functional Ecology*; Macgregor *et al*. 2018. *Ecological Entomology*.

Simulated climate-warming affects farm plant-flower visitor and plant-aphid-parasitoid networks



Derocles *et al.* (2018) *Molecular Ecology.*
Moss *et al.* (2018) *PNAS. In prep.*

Future challenges: restoration of ecological function in forestry and agriculture using adaptive network models (ANM)

FAPESP WEEK LONDON

Trends in Ecology & Evolution

CellPress REVIEWS

Opinion

Adaptive Networks for Restoration Ecology

Rafael L.G. Raimundo,[1,2,*] Paulo R. Guimarães Jr,[2] and Darren M. Evans[3]

The urgent need to restore biodiversity and ecosystem functioning challenges ecology as a predictive science. Restoration ecology would benefit from evolutionary principles embedded within a framework that combines adaptive network models and the phylogenetic structure of ecological interactions. Adaptive network models capture feedbacks between trait evolution, species abundances, and interactions to explain resilience and functional diversity within communities. Phylogenetically-structured network data, increasingly available via next-generation sequencing, inform constraints affecting interaction rewiring. Combined, these approaches can predict eco-evolutionary changes triggered by community manipulation practices, such as translocations and eradications of invasive species. We discuss theoretical and methodological opportunities to bridge network models and data from restoration projects and propose how this can be applied to the functional restoration of ecological interactions.

Highlights

A network approach to restoration ecology recently emerged as a tool for integrating methodological and theoretical advances to support environmental management and decision-making.

Adaptive network models allow us to better understand and predict how both ecological and evolutionary processes shape biodiversity and ecosystem functioning.

In adaptive networks, the feedback between the macroscopic dynamics of interaction structure and the microscopic dynamics of population-level processes shapes interactions, abundances, and traits, hence influencing resilience and functional diversity.

Restoration Ecology: Developing the Application of Ecological Networks

With unprecedented biodiversity losses as a result of anthropogenic disturbance, restoration of many ecosystems is needed to re-establish the provision of valuable **ecosystem services**

FAPESP SÃO PAULO RESEARCH FOUNDATION

UK-BR Year of Science and Innovation

GREAT

Challenge-Led opportunities for UK-Brazil collaboration: Biodiversity engineering

FAPESP WEEK LONDON

Agência FAPESP NOTÍCIAS AGENDA VÍDEOS ASSINE

Ecossistemas poderão ser restaurados por meio da engenharia da biodiversidade

09 de janeiro de 2019

EN ES

Elton Alisson | **Agência FAPESP** – Muitos cientistas consideram que as atividades humanas começaram a ter, a partir do fim do século 18, um impacto tão significativo no clima e nos ecossistemas da Terra a ponto de der dado origem a uma época geológica que denominaram Antropoceno.

Pesquisadores avaliam que há condições teóricas, metodológicas e tecnológicas para manipular a composição de comunidades ecológicas e garantir a permanência das funções de um ecossistema (*Trochilus polytmus / foto: Sharp Photography - Wikimedia*)

As eliminações de espécies nesse período mais recente da história do planeta Terra podem rivalizar com as grandes extinções em massa registradas ao longo de outras eras geológicas. A fim de restaurar essa perda de biodiversidade e o funcionamento do ecossistema terrestre seria preciso aplicar, urgentemente, o conhecimento ecológico existente.

Um estudo de autoria de pesquisadores brasileiros e britânicos indicou que há condições teóricas, metodológicas e tecnológicas sem precedentes para enfrentar esse desafio.

Resultado de uma pesquisa **apoiada pela FAPESP** e de um pós-doutorado realizado com **Bolsa da FAPESP**, o trabalho teve resultados publicados na revista ***Trends in Ecology & Evolution***

FAPESP SÃO PAULO RESEARCH FOUNDATION

UK-BR Year of Science and Innovation

GREAT

From Newcastle. For the world.

darren.evans@ncl.ac.uk

(Funded by Royal Society, NERC and EU H2020)