

Press release – 18 February 2021

Taking inspiration from financial markets to step up the functionality of ecosystems

Do financial markets have anything to teach us about managing ecosystems? An international research team headed by INRAE and CNRS has come up with a unique methodology for studying how the distribution of resources between species (their biomass) affects the way ecosystems work. Is it worth banking on a high-performing, star species, or better to distribute resources evenly between several species to maximise the benefits of biodiversity? Their findings, published in the 10 February issue of PNAS, show that the best way to get the most out of ecosystems is to distribute resources evenly among species.

In this study, researchers analysed how the distribution of resources between species (their biomass) impacts bigger biogeochemical¹ cycles and the breakdown of the litter layer (plant detritus) and organic matter of soils. Is it better to use one type of species to the detriment of others, or on the contrary favour ecosystems where resources are distributed evenly between species to get the most out of biodiversity? To answer this question, the researchers looked to methods used by economists, and notably investors in financial markets. Investors can either bet all their money on one company on the stock market or make smaller investments in different sectors to minimise risk.

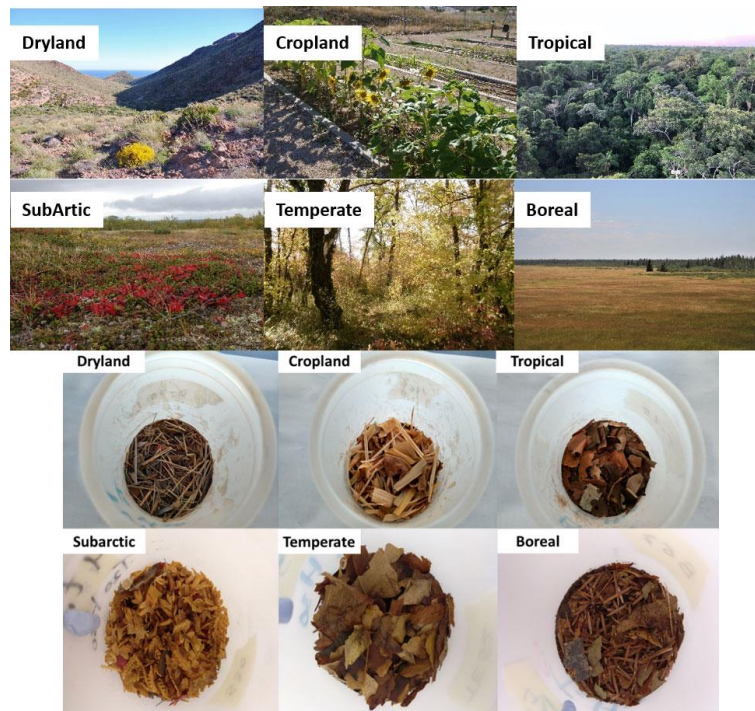
How to invest in an ecosystem

To test their hypotheses, the researchers reconstructed 570 miniature ecosystems from leaf litter from more than 90 species from six different ecological environments, ranging from tropical forests to arctic tundra to a myriad of cultivated crops (see photo below). In each ecosystem, they varied the biomass available for each species (the resource) to “manipulate” different facets of biodiversity:

- Dominance of species: the equivalent in economics is the business sector
- Distribution of resources: should we invest in a host of very different companies (varieties of species), or focus on one business in particular (favour a dominant area)?
- Scarcity of species: should we set aside some investment money for a few start-ups that are starting to gain traction?
- Functional equitability: should investments be evenly distributed or is it better to opt for an international holding company?

¹A biogeochemical cycle is the natural pathway by which chemical elements, e.g. C, N or P, enter environments like the soil, atmosphere, water or living tissue that are part of the biosphere.

The researchers then monitored, in controlled conditions, how the ecosystems responded by measuring several ecosystem functions such as the breakdown of the litter layer, respiration of soil and the abundance of microbial diversity in soil.



Miniature ecosystems made up of detritus from different plant species and soils used to study the positive effects of biodiversity on how terrestrial ecosystems function. Photography by Hans Cornelissen, Luca Deschamps, Nicolas Gross, Rubén Milla, Norma Salinas, Sonia Ruiz and Pablo García Palacios.

Distribute evenly to boost the functionality of ecosystems

The study showed that an even distribution of resources between species improves the recycling of the litter layer and nutrients, which are key factors of soil fertility. Even distribution also promotes the microbial diversity of soils while curbing the spread of disease to plants. Lastly, the study points to the important role of species that have rare morphological and physiological properties. For example, in an ecosystem dominated by plant species with tough leaves, a small fragment of a more tender leaf allows microbes in the soil to get the energy they need to trigger the breakdown of the litter layer and allow the ecosystem to function better. In the six ecosystems studied – each very different from each other – the results show the importance of even distribution between different plant species and the presence of rare species, suggesting the findings can be applied to different ecological contexts. Therefore, to maximise the functioning of ecosystems, it is better to both distribute investments evenly and avoid forming a handful of big companies (dominating species) that would gobble up all investments, and to promote the emergence of a few start-ups that could have potentially beneficial effects on the entire ecosystem.

The current biodiversity crisis caused by human activity is one of the most pressing challenges the world faces today, according to international agencies such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the FAO. The crisis has spurred a plethora of studies that show the importance of biodiversity in the functioning of ecosystems and the services they provide, including soil fertility, regulating climate, and food production. This study proposes using that knowledge to manage ecosystems and agricultural systems

thanks to the identification of species combinations that maximise the functioning of ecosystems and curb the spread of pathogens.

Reference

Le Bagousse-Pinguet Y., Gross N., Saiz H., Maestre F.T., Maire, V. Deschamps L., Cornelissen, H., Dacal. M., Ruiz S., Asensio-Mansilla S., Gozalo B., Ochoa V., Milla R., Singh B., Garcia Izquierdo C., Garcia-Palacios P. *Functional rarity and evenness are key facets of biodiversity to boost multifunctionality*. PNAS(2021) DOI: [10.1073/pnas.2019355118](https://doi.org/10.1073/pnas.2019355118)

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