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| Dr Peter H. Thrall  Editor-in-Chief  *Ecology Letters* |  |
| **Emanuele Giacomuzzo**  Doctoral student  Phone +41 767908556  Emanuele.Giacomuzzo@uzh.ch |
| Zurich, XX INSERT DATE BEFORE SUBMITTING XX | |
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Dear Dr Peter H. Thrall,

We have enclosed our manuscript, ‘Ecosystem size mediates the effects of resource flows on biodiversity and ecosystem function at different scales’ to be considered for review as a Letter Article in *Ecology Letters*.

Ecosystem size and resource flows are key factors driving biodiversity and ecosystem function. Write here a phrase giving examples of how ecosystem size and resource flows affect biodiversity and function. However, whether and how ecosystem size and resource flows interact to affect biodiversity and ecosystem function has been largely overlooked. Consequently, write here what the consequences of not considering both ecosystem size and resource flows would entitle.

Here, we investigated how ecosystem size asymmetry affects biodiversity and function of two-patch meta-ecosystems connected through flows of non-living resources. We conducted a microcosm experiment, mimicking resource flows between ecosystems of different sizes, yet otherwise being identical, or between ecosystem of same sizes. **We show that meta-ecosystems with asymmetric ecosystem sizes had higher α- diversity but lower β-diversity and ecosystem function (total biomass) than their unconnected counterparts, while such an effect was not found for meta-ecosystems of identical patch sizes.** Add here the results at the local level.

**Our study stands as a significant contribution to the field of Ecology, as it advances our understanding of how flow of non-living resources influences the biodiversity and ecosystem function of networks made of multiple ecosystems.** Therefore, our manuscript addresses the urgent need for a better grasp of the mechanisms driving ecosystem function at different spatial scales (Gonzalez et al. 2020, *Ecol. Lett.*) and understanding what are the mechanisms by which changes in the size of ecosystem influence biodiversity (Riva & Fahrig, 2023, *Ecol. Lett.*). We believe *Ecology Letters* is the perfect outlet for this work, as it has been pushing the boundaries of non-living resource flows (e.g., Leroux & Loreau, 2008, Cole et al., 2006, Murakami & Nakano, 2002, *Ecol. Lett.*) and ecosystem size (e.g., Rybicki & Hanski 2013, Drakare et al., 2006, Crist & Veech, 2006, *Ecol. Lett.*).

We thank you for considering our manuscript for publication in *Ecology Letters*.

Best regards,

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Emanuele Giacomuzzo, Dr Tianna Peller, Dr Isabelle Gounand, and Dr Florian Altermatt

WHAT THE PROBLEM IS.

Recent research demonstrates the spatial flow of non-living resources (e.g., nutrients, detritus; herein, “resource flows”) between ecosystems can drive ecosystem dynamics and functions from local to meta-ecosystem scales (Gounand et al. 2014, Gülzow et al. 2019, *Am. Nat*.; Peller et al. 2022, *Ecol. Lett.*). In nature, resource flows can form networks comprised of many ecosystems, spatially coupled via resource flows (Jacquet et al. 2022, *Oikos*). Yet, the significance of resource flows for ecosystem function has primarily been understood by studying two-patch meta-ecosystems. Consequently, the broader resource flow network and its spatial structure have been largely overlooked, despite extensive theory demonstrating a critical influence of network structure on the dynamics of different types of ecological networks (e.g., dispersal networks; Holland & Hastings 2008, *Nature*; Zhang et al. 2021, *Ecol. Lett.*).

HOW WE FILL THE GAP, WITH THE MAJOR RESULT (THE NOVELTY AND KEY RESULTS IN BOLD)

We present a theory examining how the spatial structure of resource flow networks influences meta-ecosystem function (i.e., biomass production). With the objective of drawing generic predictions, we compare meta-ecosystem models with resource flow networks exhibiting homogeneous versus heterogeneous degree distributions, but otherwise equivalent characteristics. **We show meta-ecosystems with contrasting degree distributions of resource flows can exhibit strong differences in meta-ecosystem function, which arise through the scaling-up of nonlinear local processes.** Notably, however, we show that neither network structure consistently exhibits the greatest meta-ecosystem function. Rather, meta-ecosystem function depends on a combination of resource flow network structure, as well as the biotic (organism traits) and abiotic (resource flow rates) properties of the network.

WHAT YOUR IMPACT IS IN THE FIELD OF ECOLOGY AND WHY ECOLOGY LETTERS IS THE BEST AVENUE (E.G., ECOLOGY LETTERS HAVE BEEN AT THE FOREFRONT OF THIS FIELD, PUT EXAMPLES OF PAPERS THAT THEY PUBLISHED ON THE TOPIC).

**Our study represents a major advance in Ecology as it identifies a mechanism by which non-living resource flows can drive ecosystem function at landscape spatial scales.** In doing so, our manuscript answers urgent calls for an improved understanding of the drivers of ecosystem function across scales (Gonzalez et al. 2020, *Ecol. Lett.*), while simultaneously bridging gaps between the mechanistic field of meta-ecosystem ecology and the descriptive field of landscape ecology. We believe *The American Naturalist* is the perfect venue for this work because it has been at the forefront of developments on non-living resource flows (Loreau & Holt 2004, Gounand et al. 2014, Gülzow et al. 2019, *Am. Nat.*) and ecological networks (Andreazzi et al. 2017, Gauthier et al. 2021, Benadi et al. 2022, *Am. Nat.*).

There are a bunch of studies that look at the effects of size and resource flows. These are: Anderson et al. 2001, etc.. However, they miss the following things:

* No bidirectional
* No mechanisms