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Theoretical Biology

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from March to June 2022
Born in 1980 in Madrid
Studied Physics at the Complutense University of Madrid and Biophysics at the Autonomous University of Madrid (UAM)

FELLOWSHIP
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ARBEITSVORHABEN

Disentangling the Building Blocks of Microbial Biodiversity: a Roadmap Towards Synthetic Ecology

Microbial communities are involved in a myriad of important functions that span a huge variety of processes, from biogeological cycles to human health. Therefore, challenges, such as climate change or antibiotic resistance, make understanding them – and, eventually, controlling them in their natural environment – an urgent task. This is the goal of the emerging field of synthetic ecology.
The control of complex consortia requires the development of an understanding of the relationship between each microbe and its community-level functioning and of how function persists over time in a stable way. However, this is a complex task, given the enormous biodiversity of the microbial world, the impossibility of cultivating most species, and the influence of environmental variability on their composition.
Microbes exchange metabolites as a result of their metabolic activity, and recent theoretical and experimental work points to a major role of metabolic interactions in the stability and functioning of microbial communities. Since it is frequent that some microbes supply what others need, these interactions help them buffer against fluctuations in the existing resources, and their division of labour makes them more efficient at functions like substrate degradation. For these reasons, I postulated that the formation of stable Metabolically Cohesive Consortia (MeCoCos) could be ubiquitous, and they may be the building blocks required to bridge the gap between what we can control (synthetic communities) and what we intend to understand (natural biodiversity).
My goal during this fellowship is to develop, with the help of computational models, more solid theoretical foundations for the definition of MeCoCos and to explore its scientific and philosophical consequences. Some questions of interest are: What environmental conditions favour the emergence of MeCoCos? Should MeCoCos be considered a new object of selection? Could Rosen's definition of life be extended to MeCoCos? Could MeCoCos play a role in the transition to multicellularity?

Recommended Reading

Pascual-García, Alberto, and Ugo Bastolla (2017). "Mutualism Supports Biodiversity When the Direct Competition is Weak." Nature Communications 8: 14326. https://doi.org/10.1038/ncomms14326.
Pascual-García, Alberto, and Thomas Bell (2020). "Community-Level Signatures of Ecological Succession in Natural Bacterial Communities." Nature Communications 11: 2386. https://doi.org/10.1038/s41467-020-16011-3.
Pascual-García, Alberto, Sebastian Bonhoeffer, and Thomas Bell (2020). "Metabolically Cohesive Microbial Consortia and Ecosystem Functioning." Philosophical Transactions of the Royal Society B 375: 20190245. https://doi.org/10.1098/rstb.2019.0245.

PUBLIKATIONEN AUS DER FELLOWBIBLIOTHEK

Pascual-García, Alberto (Cold Spring Harbor,2024)

A network optimisation condition uncovers the role of functional groups in the feasibility and dynamical stability of microbial model ecosystems

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1888598379

Pascual-García, Alberto (London,2020)

Community-level signatures of ecological succession in natural bacterial communities

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1800588321

Pascual-García, Alberto (London,2020)

Metabolically cohesive microbial consortia and ecosystem functioning

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Pascual-García, Alberto (San Francisco, California, US,2018)

A constructive approach to the epistemological problem of emergence in complex systems

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1800588909

Pascual-García, Alberto (London,2017)

Mutualism supports biodiversity when the direct competition is weak

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