Diversity, ecology and specificity in Antarctic lichens

project number	P 26638 Einzelprojekte
project lead	Ulrike Waltraut RUPRECHT
decision board	2014/03/02

project details

university / research place	Paris-Lodron-Universität Salzburg
institute	FB Ökologie und Evolution
Link	web project lead
lifetime	2014/07/01-2019/03/31
grants awarded	353,010.00 €
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UNIVERSITÄT SALZBURG

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Organisms inhabiting climatically extreme regions are sensitive to changes in environmental conditions. Current climate warming, for instance, forces cold-adapted lichens to shift their natural geographic distributions, which may cause changes in the interactions between fungal (mycobiont) and algal partner (photobiont) that form the lichen symbiosis. Especially, in lichens the independently distributed symbiotic partners show varying degrees of specialisation to each other. They are requiring different climatic conditions which can be defined by the size of their ecological niche. Accordingly, lichens are ideal model systems to study the effects of climate warming on species interactions and diversity.

This project aimed at gaining more insights in the aspects of myco-/photobiont interactions of saxicolous lecideoid lichens in climatically extreme environments of Continental, Maritime Antarctica and Subantarctic areas in southern South America. The terrestrial vegetation communities in these regions are dominated by lichens, which act as vegetation forming pioneer-organisms.

The goals of this project were (1) to reveal the identity and geographic distribution of the mycobiont and photobiont species; (2) to quantify the extent of specificity between these symbiotic partners and how this relates to their environmental niche breadth; (3) to generate area-covering climate (BIOCLIM) variables for the Antarctic continent that were not available before; and (4) to construct genealogical trees of Antarctic and South-American myco- and photobionts in global context. Altogether 700 lichen specimen were investigated, 500 for Antarctica and 200 for the subantarctic areas in southern South America.

The results showed a surprisingly high diversity of these lichens and their independently distributed symbiotic partner, especially for southern South America, but also with a smaller amount for Antarctica. Several endemic species and locally differentiated subgroups of globally distributed species point to different separating events such as geographic isolation, limited distribution by the Antarctic Circumpolar Current system and regional glacier refugia. The generalist myco- and photobionts are by far the most widespread group and occur frequently. However, species specialised to specific climatic conditions are more likely to be present in smaller numbers. This supports the assumption that highly specific species with a small ecological niche are more endangered than generalists.

The diverging patterns of dispersal and their causes of this cosmopolitan group of lichens are still under-researched. They are very sensitive to environmental changes, and consequently can be used as a powerful indicator. Therefore, it is important to create larger data sets along the assumed distribution routes such as high mountain ranges worldwide. With these data it will be possible to better understand colonization and dispersal events and the impact of climate change on the symbiotic relationship of this so far quite overlooked group of crustose lichens.

A follow-up project has already been submitted to ensure the necessary further work on this topic.

>> Review on the final report of the project

Publications and links:

Wagner, M., Brunauer, G., Bathke, A.C., Cary, S.C., Fuchs, R., Sancho, L.G., Türk, R., **Ruprecht, U.** (2021) Macroclimatic conditions as main drivers for symbiotic association patterns in lecideoid lichens along the Transantarctic Mountains, Ross Sea region, Antarctica. ***Scientific Reports***. https://doi.org/10.1038/s41598-021-02940-6

Lagostina, E., Andreev, M., Dal Grande, F., Grewe, F., Lorenz, A., Lumbsch, H.T., Rozzi, R., **Ruprecht, U.**, Sancho, L.G., Søchting, U., Scur, M., Wirtz, N., Printzen, C. (2021) Effects of dispersal strategy and migration history on genetic diversity and population structure of Antarctic lichens. ***Journal of Biogeography***. https://doi.org/10.1111/jbi.14101

Wagner, M., Bathke, A.C., Cary. C., Junker R.R., Trutschnig, W., **Ruprecht, U.** (2020) Myco- and photobiont associations in crustose lichens in the McMurdo Dry Valleys (Antarctica) reveal high differentiation along an elevational gradient. ***Polar Biology***: 43: 1987-1983. https://doi.org/10.1007/s00300-020-02754-8

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Muggia, L., Nelsen, M.P., Kirika P.M., Barreno, E., Beck, A, Lindgren, H., Lumbsch, H.T., Leavitt, S.D. Trebouxia working group (2020) Formally described species woefully underrepresent phylogenetic diversity in the predominant lichen photobiont genus Trebouxia (Trebouxiophyceae, Chlorophyta): Impetus for developing an integrated taxonomy. ***Molecular Phylogenetics and Evolution*** 149:106821. https://doi.org/10.1016/j.ympev.2020.106821
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Wagner, M., Trutschnig, W., Bathke, A. & **Ruprecht, U.** (2018) BIOCLIM variables and newly calculated climate zones for Antarctica. ***Theoretical and applied climatology*** 131, 1397-1425. https://doi.org/10.1007/s00704-017-2053-5

Ruprecht, U. & Junker, R.R. (2017) Climate niche expansion due to generalization in species associations in lichens. Abstract. - In: Werth, S. & Obermayer, W. (editors). Lichen Genomics Workshop II. Institute of Plant Sciences, University of Graz, Austria. 2–5 November 2017. - ***Fritschiana*** (Graz) 85: 39–40. - ISSN 1024-0306.

Ruprecht, U., Søchting, U. & Türk, R. (2016) *Porpidia navarina*, a new endemic species from Isla Navarino – Southern Tierra del Fuego (Chile). – in Festschrift Josef Hafellner, eds. Mayrhofer, H. & Muggia, L. ***Herzogia*** 29 (2) Teil 1, 596-609. https://doi.org/10.13158/heia.29.2.2016.596

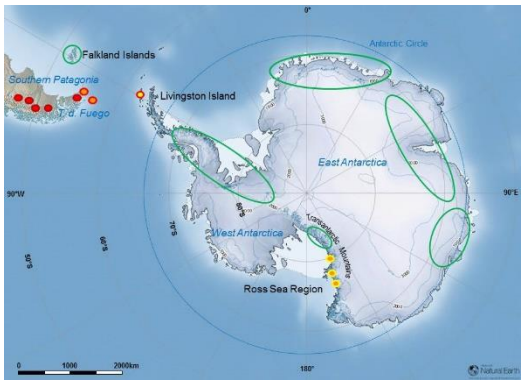
BIOCLIM Antarctica

Research Stays

Marker and primermaps

Ulrike Ruprecht (PI)

Monika Zacharias (Wagner; PhD-student)

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