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EDITORIAL

Editorial: Structure and function of plants in extreme environments

Andreas Holzinger

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This issue "Structure and function of plants in extreme environments" is dedicated to Prof. Cornelius Lütz, Head of the Institute of Botany, University of Innsbruck, Austria. The dedication is to celebrate his 65th birthday on August 6th, 2010.

Prof. Lütz was born in Cologne, Germany, finished his secondary education in 1966, and started his studies in Biology at the University of Cologne in 1967 after his army service. In 1974, he received a Doctoral Degree from the University of Cologne where he started his scientific career as Research Assistant in the research fields of membrane physiology, cytology, and ecophysiology. In 1982, he received the *venia legendi* in "Botany". In 1986, he became chair of Botany IV at the University of Düsseldorf before moving to the GSF Research Center for Environment and Health, Neuherberg, Germany (now Helmholtz Zentrum München, German Research Center for Environmental Health) in 1987. At the GSF, he was responsible for the scientific coordination of the governmental large scale environmental simulation unit. His research there focused on the effects of air pollutants and UV on various plant species including alpine plants by means of stress physiological and ultrastructural techniques. During this position, he taught at the Ludwig-Maximilans-University of Munich as an adjunct Professor. In 1999, he followed a call of the Leopold-Franzens University of Innsbruck, Austria, for a Full Professorship (Succession of Prof. Larcher). In Innsbruck, he took the opportunity to focus on studies of plants from extreme environments such as the Austrian Alps and both polar regions. The studies covered algae directly living in snow and ice and vascular plants. Physiological and ultrastructural aspects of adaptation to the extreme environments were investigated. In keeping with his great interest in plants directly grown and collected in the field, research expeditions took Prof. Lütz to Spitsbergen and the maritime Antarctic. The combination of studying naturally grown field material in extreme habitats with sophisticated laboratory studies were a central goal in Prof. Lütz' research. "Nature is the best laboratory in search for survival strategies" is often stated by him. He has published about 100 original publications and book chapters and is recently editing a book on "Plants in Alpine Regions: Cell Physiology of Adaptation and Survival strategies" by Springer. He has been a very active academic teacher. Over his career, he supervised more than 40 Diploma and Doctoral students. He has carried out numerous collaborations with researchers from around the world. He has been an extremely helpful and inspiring colleague to all who have worked with him.

This issue of Protoplasma covers different aspects of plants either naturally or experimentally exposed to extreme conditions. The authors contributing to this issue are either colleagues or former colleagues, coworkers, and friends of Prof. Lütz. The stresses applied range from desiccation, freezing, osmotic stress, heavy metal exposure, and excess UV irradiation to pathogen stress. The contributions cover a wide range of organisms spanning green algae to bryophytes to vascular plants from extreme habitats. Most of the studies investigate plants collected in their natural habitats exposed to the different factors. Plants have astonishing abilities to adapt to their environment. For example, green algae, regularly exposed to desiccation, have developed the ability to produce the C5-polyol ribitol, functioning as an osmotically regulating solute to reduce water loss as

A. Holzinger (✉)
Department of Physiology and Cell Physiology of Alpine Plants,
University of Innsbruck,
Sternwartestrasse 15,
6020 Innsbruck, Austria
e-mail: Andreas.Holzinger@uibk.ac.at

demonstrated by Gustavs et al. in this issue. Another aspect of desiccation, the alteration of the ultrastructure in field collected moist versus desiccated samples of the green alga *Zygogonium ericetorum* from the Austrian Alps, is shown by Holzinger et al. A detailed analysis of pectin-like carbohydrates is demonstrated in the acid pond-inhabiting green alga *Netrium digitus* by Eder and Lütz-Meindl. *Oocardium stratum*, a green alga living in tuff springs, is an extreme organism in the sense as these cells have the ability to form tubular structures of calcite, in which to live, as shown by Rott et al. Osmoregulation is an important key for survival of plants exposed to changing water conditions. Plasmolysis effects on cell wall deposition are shown by Volgger et al. in this issue. Water may also be withdrawn from the protoplast by extracellular freezing. The effects of freezing cytorrhysis are demonstrated in the peat moss *Sphagnum capillifolium* by Buchner and Neuner. Remias et al. demonstrate one of the most extreme adaptations with a publication on *Chloromonas nivalis*, a snow alga living directly on snow fields in the Austrian Alps.

Moreover, this issue covers papers on heavy metal effects in plants. Cadmium-induced changes in the glutathione content of *Cucurbita pepo* are investigated by Kolb et al. Differences in gene expression of two ecotypes of the metal hyper-accumulator *Thlaspi caerulescens* are described (Pleßl et al.) by the group of Dr. Ernst, a former colleague of Prof. Lütz in the Helmholtz Zentrum, Munich. The same working group contributes a paper on the model plant *Arabidopsis thaliana*. In this study, the photosynthetically active radiation modulation on UV-dependent flavonoid metabolites is demonstrated (Götz et al.). Another study is dealing with UV effects in a field collected green alga, *Urospora penicilliformis* (Roleda et al.). This alga was sampled in the arctic at Spitsbergen (79°N). The northernmost research settlement, Ny Alesund, has been visited by Prof. Lütz several times—the presented work demonstrates a considerably resilient species, inhabiting the middle to upper intertidal zones of the Arctic sea. A flowering plant of the Alps, *Ranunculus galcialis*, is investigated concerning its success in reproduction at its high altitude distribution limit (Wagner et al.). Several studies of this special issue are dealing with conifers forming the alpine timberline. The aspects investigated range from an ultrastructural study on the changes of organelles during drought stress in *Picea abies* (Zellnig et al.), over effects of *Chrysomyxa rhododendri* infection on needle tissue in *P. abies* (Mayr et al.), to reduced frost resistance of *P. abies* needles during sprouting that are likely linked to cytological changes (Beikircher and Neuner).

With the broad range of papers in this special issue, all the contributors wish to congratulate Prof. Lütz on his 65th birthday. Despite his retirement from official duties as Professor at the University of Innsbruck, we are sure, his work will carry on! We wish him all the best!

Figure: Prof. Cornelius Lütz at an expedition to King George Island, Antarctica, 2009.