

ECOLOGY OF THE CRYOSPHERE (MB162P30)

Marek Stibal, Jakub Žárský & international guest lecturers

The aim of this course is to introduce the cryosphere as an important and rapidly changing yet relatively unknown part of the Earth's system and a biome that contains distinct ecosystems and communities. Emphasis will be placed on recent and/or current research by the lecturers. This course will be principally focused on ecosystem-scale processes within the cryosphere and is complementary to the courses Winter Ecology and Polar Ecology. The course will be in English.

1. **Introduction to the cryosphere** Cryosphere as part of the Earth's system • The icy biome • The past, present & future of the cryosphere
2. **Physics and chemistry of snow** Phases of water • Latent and sensible heat • The process of freezing • Ice crystal formation • Nucleation agents • Preferential melting
3. **Snow ecology** Limits of metabolism in snow ecosystems • Survival strategies in microbes • Aquaporines • Metabolic rates at low temperatures • Nutrient dynamics in snow packs • Spatiotemporal relevance for biogeochemical cycling
4. **Glaciers and ice sheets** (guest lecture by Jacob Yde, Sogndal University) Formation of glacial ice • Glacier types • Glacier hydrology • History of glaciation • Glaciers as landscape architects
5. **Glacier ecology: The supraglacial ecosystem** Energy and nutrient sources for glacier surfaces • Cryoconite holes • Surface ice • Supraglacial lakes • Real world example: Ice algae and albedo feedback on the Greenland ice sheet
6. **Glacier ecology: The subglacial ecosystem** Energy and nutrient sources for glacier beds • Basal ice • Subglacial sediments • Subglacial lakes • Real world example: The bed of the Antarctic ice sheet as a methane reservoir
7. **Glacier ecology: The englacial ecosystem** Limitations for life within glacial ice • Ice cores as past climate proxies

8. **Glacier ecology: Glacial ecosystems in the warming world** Transition to proglacial ecosystems • Ecological succession of deglaciated land • Export of organisms and nutrients from glaciers to downstream ecosystems • Real world example: Export of microbial activity from beneath the Greenland ice sheet
9. **Lake ice ecology** (guest lecture by Birgit Sattler, University of Innsbruck – to be confirmed)
10. **Sea ice** Formation of sea ice • Energy and nutrient sources for sea ice • Diatoms as major primary producers in the sea ice environment
11. **Permafrost ecology** Energy and nutrient sources for permafrost • Permafrost thawing and greenhouse gas release • Real world example: Seasonal change in the microbial community in the active layer of permafrost in Svalbard
12. **The future of the cryosphere** Global climate change and its impact on the cryosphere, or Are we losing the cryosphere for good?

Literature

- Anesio A.M., Laybourn-Parry J. (2012) Glaciers and ice sheets as a biome. *Trends Ecol. Evol.* 27, 219–225.
- Boetius A. et al. (2015) Microbial ecology of the cryosphere: sea ice and glacial habitats. *Nat. Rev. Microbiol.* 13, 677–690.
- Hodson A. J. et al. (2008) Glacial ecosystems. *Ecol. Monogr.* 78, 41–67.
- Jansson J. K, Taş N. (2014) The microbial ecology of permafrost. *Nat. Rev. Microbiol.* 12, 414–425.
- Jones H. G. et al. (2011) *Snow Ecology. An Interdisciplinary Examination of Snow-Covered Ecosystems*. Cambridge University Press.
- Laybourn-Parry J., Tranter M., Hodson A. J. (2012) *The Ecology of Snow and Ice Environments*. Oxford University Press.
- Stibal M., Šabacká M., Žárský J. (2012) Biological processes on glacier and ice sheet surfaces. *Nat. Geosci.* 5, 771–774.