Symbionts and changing environment: Lichen diversity and photobiont associations in tropical mountain ecosystems

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African mountain ecosystems under global change: Linking biodiversity, biotic interactions and biogeochemical ecosystem processes.

Symbionts and changing environment: Lichen diversity and photobiont associations in tropical mountain ecosystems

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Epiphytes comprise a significant component of biodiversity and biomass in tropical forests. They are ecologically important in intercepting and retaining moisture, providing habitat and food for invertebrates, and contributing fixed nitrogen into the ecosystem. Lichens are mutualistic symbioses between lichen-forming fungi (mycobionts) and algae and/or cyanobacteria (photobionts). Most lichen mycobionts are specific in their photobiont choice and the local availability of compatible photobionts may limit their ability to disperse into new habitats.

The aims of this study are to 1) provide the first account of lichen symbiont diversity in tropical mountains, with focus on changes along topographic gradients, and 2) elucidate the effects of human induced environmental change to lichen symbiotic organisms, including the effects of expansion of agricultural and other disturbed ecosystems, and changing climate. The results will significantly improve our understanding of tropical biodiversity since so far very few studies with modern molecular methods have dealt with lichens of East Africa. We will also compare the lichen biota of Mt. Kilimanjaro to those of other East African mountains[1].

Lichens, bryophytes, and free-living cyanobacteria and green algae are recorded along a natural environmental gradient of the southern slope of Kilimanjaro, including all main ecosystem types. The sampling is focused on study plots established by the KiLi project[2]. The collected specimens will be studied microscopically, with chemical analyses, and DNA methods.

So far, we have sampled several plots within the natural savanna, maize fields, grassland, and Chagga homegardens (3–5 sampled plots per ecosystem type). The specimens have been studied microscopically. In all studied plots, lichens mainly occur epiphytically on shrubs and trees. The preliminary results show that clear differences exist in lichen biota between different ecosystem types. Lichen abundance seems to correlate primarily with presence/absence of woody plants, species composition with the climatic variables, and overall lichen diversity with substrate variability.

In savanna, small and adnate foliose lichens are well represented. Typical examples are various species of the family Physciaceae (e.g. *Physcia*, *Pyxine*, *Dirinaria*, and *Heterodermia* spp.). Additionally, several species of *Collema*, some parmelioid genera (*Bulbothrix*, *Parmotrem*a) and *Candelaria concolor* are frequent. In many places, the maize fields now replace the natural savanna. Due to the lack of woody plants, also epiphytic lichens are largely missing from these environments (three out of the four investigated plots did not have any macrolichens).

Both foliose and fruticose lichens are present in grassland habitats. Like in all other ecosystem types, the abundance of epiphytic lichens is largely dependent on the presence of woody plants and varies greatly between different study plots. Typical lichen families in these habitats are Parmeliaceae (e.g. *Parmotrema*, *Hypotrachyna*, *Usnea* spp.) and Physciaceae

[1] Kaasalainen et al. Photobiont-mediated cyanolichen guilds in a tropical biodiversity hotspot. Sci Rep (in review).
[2] https://www.kilimanjaro.biozentrum.uni-wuerzburg.de/Default.aspx

(e.g. *Heterodermia*, *Physcia*, *Pyxine*, *Dirinaria* spp.). Also, several species of *Ramalina* and *Teloschistes* are frequently found. (Fig. 1)

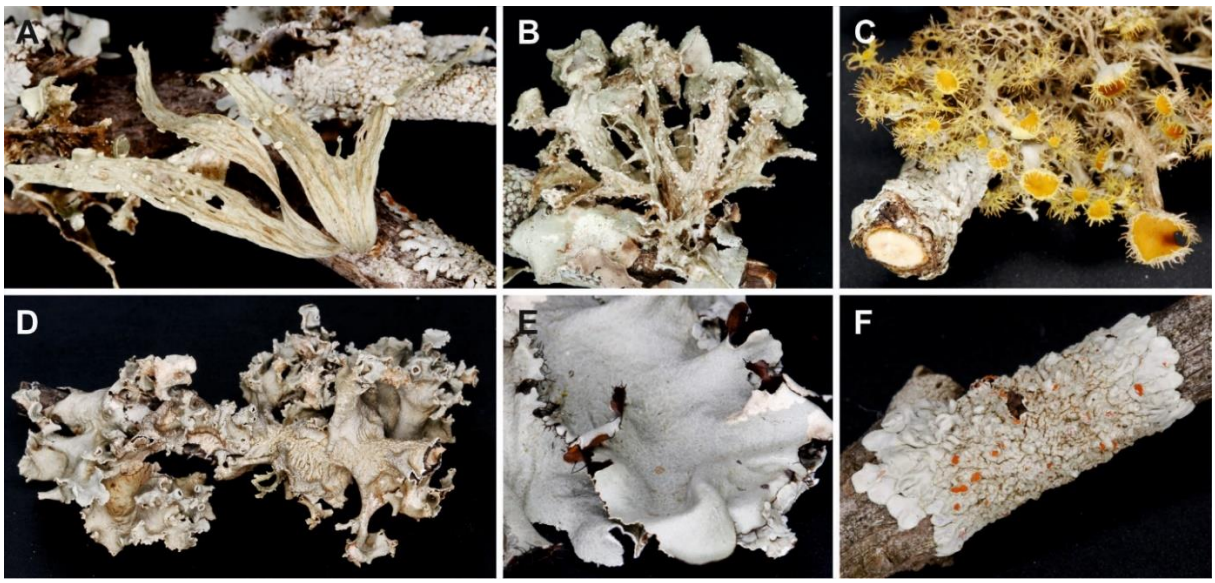

Figure 1. Lichens from grassland and Chagga homegarden habitats on Mt. Kilimanjaro. A) *Ramalina celastri*, B) *Ramalina africana*, C) *Teloschistes chrysophthalmus*, D) *Parmotrema* sp., E) *Parmotrema reticulatum*, and F) *Dirinaria coccinea*[3].

In the Chagga homegardens, foliose and fruticose lichens are abundant and diverse especially in the higher canopy. The most prominent families include Parmeliaceae (e.g. *Parmotrema*, *Hypotrachyna*, *Usnea*, and *Punctelia* spp.) and Physciaceae (e.g. *Heterodermia*, *Physcia*, and *Pyxine* spp.). Additionally, several species of *Ramalina* and *Teloschistes* are common, as well as many cyanolichens, including species of *Leptogium*, *Collema*, *Crocodia*, *Sticta*, *Lobaria*, and *Coccocarpia*. (Fig. 1)

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[3] Identification and naming based on Swinskow & Krog, 1988: Macrolichens of East Africa (British Museum, London).