Diversity changes of soil-growing lichens along the BIOTA Southern Africa transect – data gathering, maintenance and analysis

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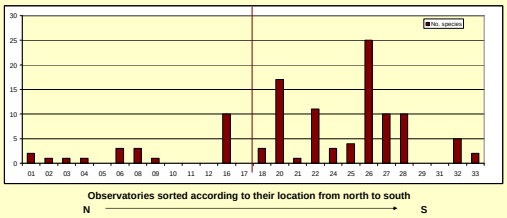
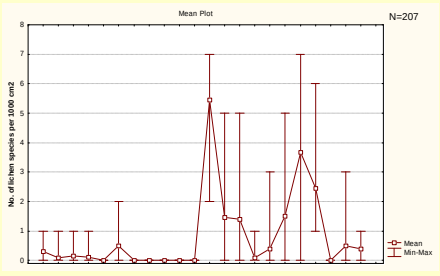
Introduction

The BIOTA subproject S04 is focused on the gathering and processing of data on lichen diversity in Southern Africa. WP 01 is dedicated to the assessment of soil-growing lichen diversity and the exploration of diversity changes due to different abiotic and biotic factors. Furthermore, the indicative value of lichens and lichen communities is investigated, in order to develop a long-term monitoring strategy. WP 02 focuses on the development of a Java-based database client ("Diversity Navigator") for maintenance and analysis of biodiversity data. The gathering, storage, management and analysis of data on lichen diversity is presented. PostgreSQL was selected as database system because it is open source and compilations exist for all major platforms. Some major specifications of the database client are: 1) Data entry and maintenance by table grid views and data forms; 2) Data validation, e.g. taxon names by parser functions; 3) Content data transfer between SQL databases of different types; 4) Queries on content data distributed in databases that are located on different servers under different domains; 5) Script generation for the statistical processing of data matrices (e.g., with the statistics package *R*) and data visualization with the Geographic Information System GRASS as web service.

Diversity of soil-growing lichens at transect level

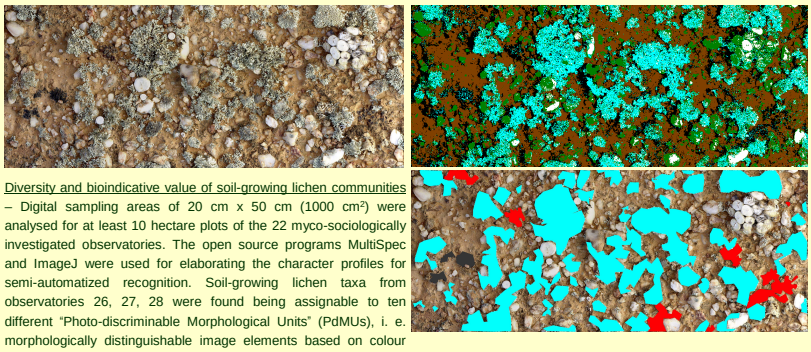


General diversity of soil-growing lichens at the different observatories along the transect – Hotspots of diversity are found in the observatories of the winter rain area, especially Numees (20), Soebatsfontein (22), Goedehop (26), Ratelgat (27) and Moedverloren (28), and the observatory 16 placed in the Namib desert, with maximal values of 25 species/km². Much less taxa or no lichen taxa are found in observatories of the summer rain area and in the one characterized by a Fynbos vegetation.

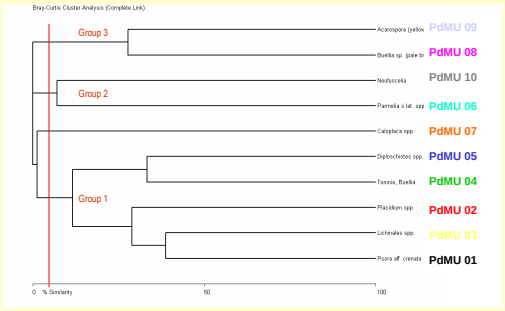


Average diversity of soil-growing lichens in the plots investigated by vegetation relevés according to ranking (at least 10 hectare plots / observatory) – Similar patterns of diversity results from the analysis, with higher diversity at same observatories as listed above. The average lichen diversity and maximum values, however, are significantly lower in comparison to the entire diversity of soil-growing lichens at the respective observatories.

Diversity of soil-growing lichens at observatory level (example 26, 27, 28)

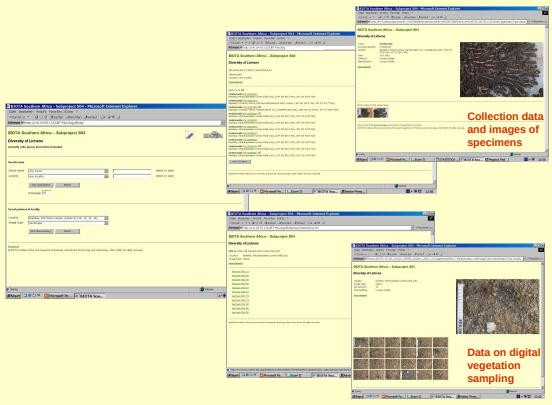


Diversity and bioindicative value of soil-growing lichen communities – Digital sampling areas of 20 cm x 50 cm (1000 cm²) were analysed for at least 10 hectare plots of the 22 myco-sociologically investigated observatories. The open source programs MultiSpec and ImageJ were used for elaborating the character profiles for semi-automatized recognition. Soil-growing lichen taxa from observatories 26, 27, 28 were found being assignable to ten different "Photo-discriminable Morphological Units" (PdMUs), i. e. morphologically distinguishable image elements based on colour and shape of the thalli or elements of the thalli. The character profiles for an automatized recognition of such "PdMUs" could also be applied for analyzing soil surfaces in plots of other observatories in the winter rain area.



Several PdMUs frequently occur together, forming characteristic "assemblages" or "communities". *Psora* aff. *crenata* being represented by "PdMU 01" is often associated with *Placidium* species (PdMU 02) and species belonging to the *Lichinales* (PdMU 03), but less frequently with the whitish grey thalli of *Toninia* spp. and *Buellia* spp. (PdMU 04) or *Diploschistes* sp. (PdMU 05). The taxa of group 1 have mostly a squamulose growth habit, and are wide-spread and common throughout arid to semi-arid areas of the World. Group 2, formed by PdMU 06 and 10, is characterized by foliose members of the *Parmeliaceae*. These taxa are known from semi-arid areas of Australia to be indicative for low disturbance, since they are strongly associated with stable soil surfaces. Group 3, formed by crustose *Acarospora* and *Buellia* species is most probably associated with particular soil conditions.

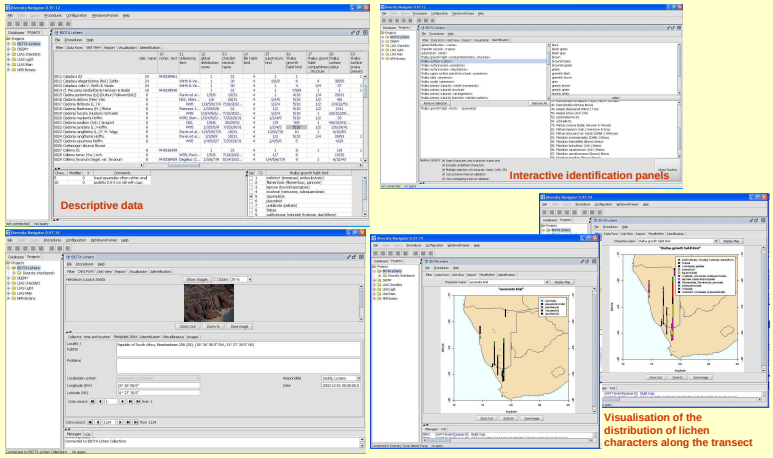
Web clients for database query with information on specimen and observation data



Observation and collection data together with image files of lichen samples and of the monitored soil surfaces are stored in applications of the Diversity Workbench database suite, to be accessed by several web clients. For maintenance, such data may be queried and edited remotely by a Java database client ('*Diversity Navigator*').

Descriptive data on ecological, morpho-anatomical and chemical characters of soil lichen taxa can be maintained remotely and are used for dynamical visualization of character state distributions along the BIOTA Southern Africa transect as well as for the purpose of online identification of taxa.

Database client *Diversity Navigator*



Perspectives for the III BIOTA phase

Long-term monitoring of soil-growing lichen diversity changes along the BIOTA Southern Africa transect:

- routine digital photography of lichen communities (can partly be carried out by paraecologists)
- remote lichen vegetation resp. soil crust image processing (via server-based and local applications) and online data analysis (via rich client software and local applications)

Development of an online (and local) e-Learning system for biodiversity data, referring to organisms studied in the BIOTA observatories

Modularization of the Java-based rich client "Diversity Navigator" and implementation of the functional components in a Java/Eclipse-based framework. Implementation of further functionality for flexible adaptation to databases of different data structures of the various BIOTA Africa subprojects.

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