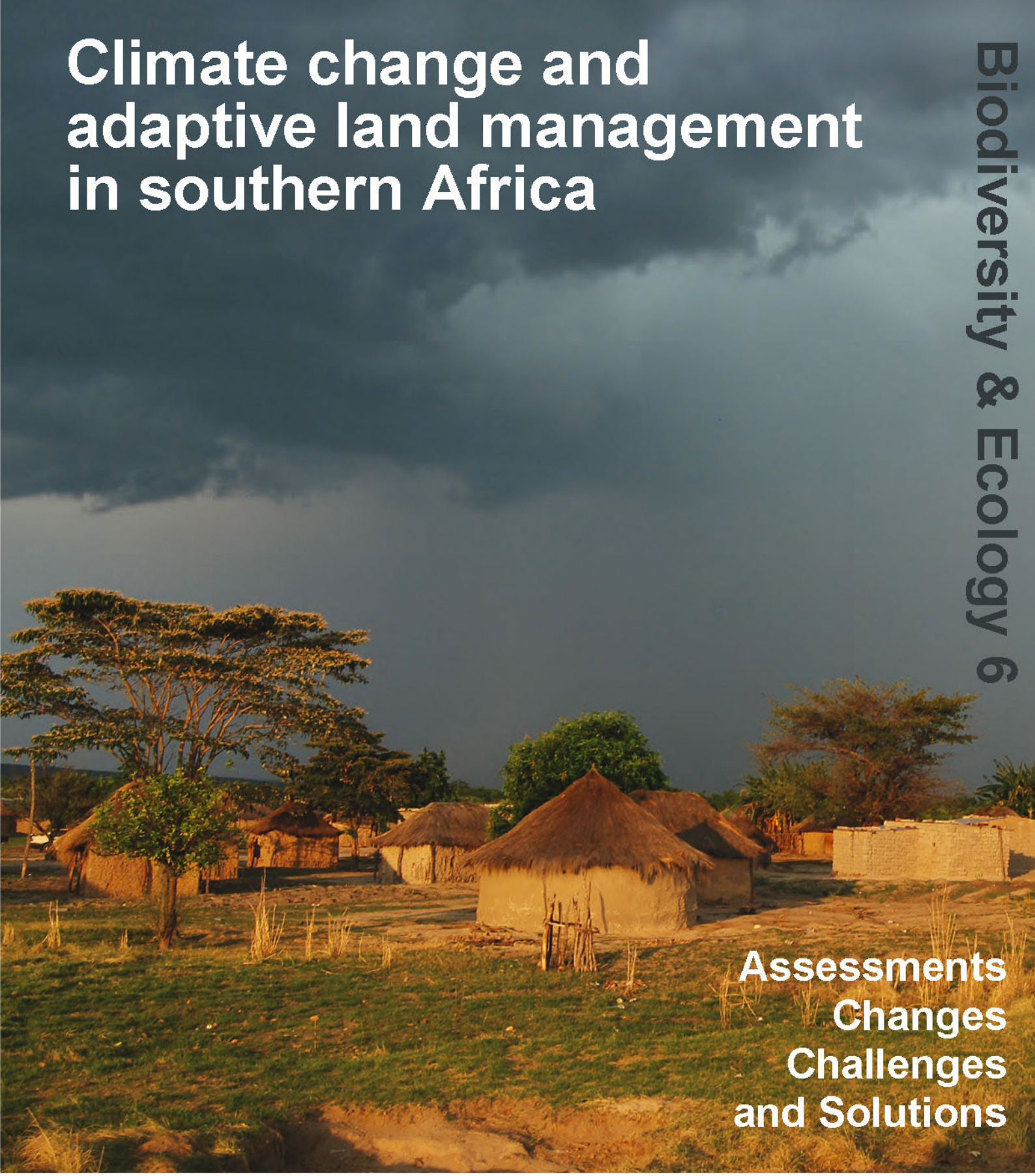
Climate change and adaptive land management in southern Africa

Biodiversity & Ecology 6



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Climate change and adaptive land management in southern Africa

Assessments, changes, challenges, and solutions

Edited by

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BIOTABase — a unique software to handle complex biodiversity observation data and environmental data

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While there are a number of software programmes that offer storage and handling of species data of biocoenoses, a software programme dedicated to handling complex observation data recorded within time series has so far been lacking. Within SASSCAL 1.0, the software BIOTABase has now been developed to make a new dimension of data handling and analysis possible.

Which observation data need to be stored for biodiversity monitoring?

There are many very different approaches to monitoring biodiversity (Proença et al., 2017). Therefore, it is unlikely that a single software will be able to address the needs of all. However, perhaps the approaches that use intensive ground base monitoring (Proença et al., 2017) bring about the most complex and diverse data. BIOTABase (Muche et al., 2012) has been developed to satisfy the needs of just such an intense biodiversity observation scheme (i.e., the SASSCAL observation network).

This SASSCAL biodiversity observation network (Jürgens et al., 2018) uses spatially fixed standardized observation sites in real landscapes that encompass many scales (1 km², 1 ha, 10 000 m², 1 000 m², 100 m², 10 m², 1 m²), relates to complex environmental data (including climate and land use), and observes a wide range of different organismic groups (algae, lichens, mosses, ferns, seed plants, animals) at different temporal scales (allowing time steps from daily to annual to many years). Figure 1 summarizes the typical characteristics schematically. All data, of course, shall be referenced within relevant systems (accepted taxonomic names, output data formats for modern analytical and statistic software). This is made possible by a well-thought-out design with multiple structures that can be accessed as *views*. The following views are used:

- ***Plots*:** contains all *invariable attributes of the observation* (e.g., georeferences of plot corners, altitude, slope, inclination and other topographical and relief information, geomorphology, landscape).
- ***Relevés*:** contains all information recorded *at a single time stamp* at a plot (see above), including not only lists of species recorded with numerical attributes (Fig. 2) but also environmental data.
- ***Species*:** contains the *single record of a species* within a relevé, with all relevant attributes such as abundance or cover values or growth form or single morphological and functional traits. Here, referenced lists of accepted species and synonyms are offered to make data entry efficient and correct. Even the fate of a single collected specimen sent to a specific museum collection is stored here. Species are linked to online catalogues of photographs.
- ***Habitats*:** contains all *general environmental information*, including geology and soil properties.
- ***Land uses*:** contains information on type and intensity of *land use*, stock composition, etc.
- ***Individuals*:** contains information generated from *individual-based* monitoring

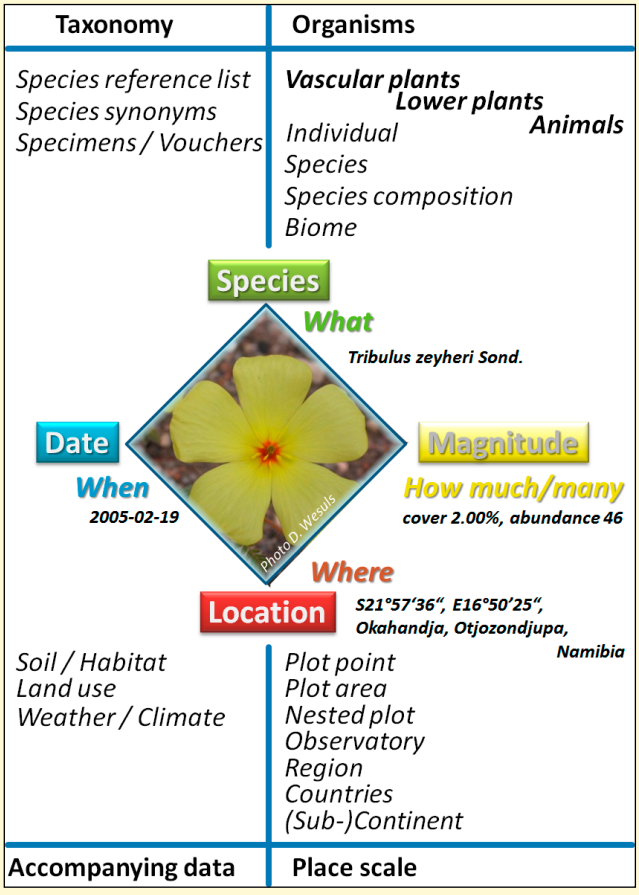

Figure 1: Attributes of a vegetation record.

Which functionalities are needed to explore observation data?

BIOTABase offers all needed tools for modern database management. Datasets can be filtered and selected based on complex combinations of features. Datasets can be split and merged, and there are interfaces allowing import and export to other data formats.

Many functions can be called using customized menus: data entry, data cleansing, lists, and cross-tables as well as interfaces to analytical tools.

Finally, vegetation ecologists can use functions to flexibly design the most diverse data queries and perform analyses directly from BIOTABase or transfer them via interfaces to expert systems. BIOTABase offers output and links to most analytical software currently in use, including Juice (Tichý, 2002), Turboveg (Hennekens & Schaminée, 2001), Google Earth (https://www.google.com/earth), ArcGIS (http://www.arcgis.com), QGIS (https://qgis.org), Saga-GIS (http://www.saga-gis.org), Ordinations and Cluster Programmes via R (https://www.r-project.org), and spreadsheet software such as MS Excel or database software such as MS Access, some of them with specific exchange formats, and others with CSV files or ODBC links.

The BIOTABase software can be downloaded free of charge from the SASSCAL website (http://www.sasscal.org/?page_id=1029) or the BIOTA AFRICA website (http://www.biota-africa/biotabase_ba.php).

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Vascular plant species name	Cover total	Abundance	Coll.-No.
Amellus microglossus	0.10	100	
Atriplex lindleyi ssp. inflata	3.00	20	
Atriplex semibaccata	10.00	1000	
Chenopodium album	8.00	200	
Dimorphotheca sinuata	0.01	1	
Drosanthemum hispidum	1.00	5	
Galenia sarcophylla	0.10	10	
Tribolium utriculosum	1.00	100	
Lycium oxycarpum	0.50	1	
Manochlamys albicans	0.10	1	
Mesembryanthemum guerichianum	5.00	40	
Mesembryanthemum hypertrophicum	30.00	1000	
Foveolina dichotoma	8.00	1000	
Oxalis pes-caprae	0.10	10	
Phyllobolus trichotomus	0.01	1	
Psilocaulon dinteri	3.00	15	
Tetragonia microptera	0.10	10	
Addition of items	70.02	3514	

Lower plant species name	Cover total	Abundance	Coll.-No.
Buellia sipmanii	0.10		
Caloplaca elegantissima	0.10		
Lecidella crystallina	0.10		
Neofuscelia dregeana	0.10		
Xanthomaculina walteri	0.10		
Addition of items	0.50		

Animal species name	Abundance	Coll.-No.
Anoplolepis steingroeveri		190 215
Hodotermes mossambicus		190 214
Ocymyrmex velox		190 216
Psammotermes allocerus		190 213

Figure 2: Relevé elements for vascular plants (example from Soebatsfontein), lower plants (example from Central Namib), and animals (example from the Kunene region).