

Impressions from the 4th EDGG Research Expedition to Sicily: community composition and diversity of Mediterranean grasslands

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We report on the 4th EDGG Research Expedition, conducted on the Italian island of Sicily in spring 2012. A group of 14 scientists from five countries studied the variety of the dry grassland vegetation using standardised sampling procedures (nested-plot series and phytosociological relevés of 10-m² plots). All terricolous plants superficially present in the plots were sampled, including perennial and annual vascular plants, bryophytes, and lichens. The data will be used for analyses of scale-dependent diversity patterns and species-area relationships, as well as for studying vegetation-environment relationships and performing phytosociological classification. Later, the data will be entered in public vegetation-plot databases. The fact that scientists from different phytosociological schools participated in the expedition, gave rise to important methodological discussions, which we briefly highlight in this report.

Keywords: biodiversity; bryophyte; lichen; nested plot; vascular plant; vegetation classification; vegetation-plot database.

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Introduction

The fourth EDGG Research Expedition took place in Sicily, right at the center of the Mediterranean Region, from 29 March to 5 April 2012. The event was organised by Riccardo Guarino (University of Palermo), Gian Pietro Giusso del Galdo (University of Catania), and Jürgen Dengler (EDGG Expedition Coordinator, Lüneburg, Germany). The aim of the expedition was the investigation of biodiversity patterns in the thermo-Mediterranean annual and perennial dry grasslands, with specific reference to environmental factors and spatial scales. In addition, one day was spent on Mt. Etna, for data-sampling along a transect on the NE flank of the mountain, from the thermo-Mediterranean belt up to the timber line (for an overview of the landscapes studied, see Guarino 2011).

An international team of 14 scientists from five countries (Czech Republic, Germany, Italy, Latvia, Poland) intensively studied a wide variety of dry grassland types on different substrata. Local students interested in

vegetation and/or field botany were invited to participate for as many days as was convenient to them.

While Galvánek et al. (in press) already briefly reported from the expedition, we will give some more details here



The expedition crew with the EDGG logo. This is not a coastal dune, but a "mountain dune" made of H₂O at Mt. Etna. Photo: J. Dengler, 03.04.2012

and use the opportunity of this full-colour journal to illustrate the beauty of the Sicilian grasslands and their plants with some plates.



Mediterranean picnic amidst the dry grasslands in the Sciare di Mazara. Photo: J. Dengler, 29.03.2012

Methods

We applied standardised sampling approaches, as proposed by Dengler (2009) and as applied in previous EDGG Expeditions (Dengler et al. 2009, in press) to allow large-scale comparisons and syntheses. We collected a set of 21 biodiversity plots (i.e. nested-plot series 0.0001, 0.001, 0.01, 0.1, 1, 10, and 100 m²) and 67 phytosociological relevés (10 m²; including those from the corners of the biodiversity plots). In both plot types, we recorded all terricolous components of the vegetation according to the vertical projection (shoot presence or any-part system; see Dengler 2008), including perennial and annual vascular plants as well as bryophytes and lichens. Only saxicolous cryptogams were excluded from sampling due to logistic constraints (we otherwise would have needed to take many stones with us to determine the cryptogams on them). In contrast with the traditional phytosociological approach, we did not use the 7-scale or 9-scale cover-abundance values, but directly estimated percentage coverage of the plants. This avoids mathematical problems when analysing with a mixed scale and allowing better differentiation at the lower end of the scale, where in dry grasslands the majority of plants are found (it is certainly something different if a species is occurring with 1% or only 0.01% cover). Slope, aspect, and microrelief were measured in the field, and the soil depth and its variability determined with a pointed iron pole, 12.5 mm in diameter and 80 cm in length. Mixed soil samples were collected from all 67 10-m² plots. They will be used to determine texture class, pH, C and N content, and possibly other relevant parameters.

Plant species were mostly determined in the field; specimens of species that were not confidently determined in situ were collected and mostly identified during the evenings, where we had arranged working space in our accommodations with many floras, stereo microscopes, microscopes, etc. Vascular plants were mainly identified using Flora Europaea (Tutin et al. 1968–1993), Flora d'Italia (Pignatti 1982), and the still unpublished interactive identification tool for the planned second edition of the latter (Guarino et al. 2011).

Bryophytes and lichens were determined using various floras, most prominently Frey et al. (2006). We also commenced entering the data already during the expedition.

Those plant samples that could not be determined to species during the expedition were taken by the specialists in our team for later determination, namely the vascular plants by R. Guarino, and the cryptogams by C. Dolnik and I. Bruchmann. Several expedition members are presently finishing data entry and standardise taxonomic concepts, while Ł. Kozub has taken all the soil samples for analyses in the laboratory of his department. This shows that also the analytical part of the expedition is a highly collaborative enterprise.

Vegetation types studied

Most of our plots fell into the *Lygeo-Stipetea* class. The most frequently recorded vegetation-types were the perennial grasslands occurring on limestones (*Avenulo-Ampelodesmion mauritanici*) and on clay (*Moricandio-Lygeion sparti*). On Mt. Etna, some semi-ruderal stands with *Bromo-Oryzopsis miliceae* vegetation were also surveyed.

As concerns the annual dry grasslands, we sampled both *Tuberarietea* and *Stipo-Trachynietea* vegetation, occurring either on sand (*Alkanno-Maresion nanae*) or on alkaline substrata (*Trachynion distachyae* and *Sedo-Ctenopsis gypsophilae*).

We found that the species richness of the studied vegetation types ranged from poor (grey dunes) to rich (mostly grazed inland sites on limestone). Already our raw data allow to state that nowhere were these stands as rich in species rich as the temperate and hemiboreal dry grasslands in Transylvania, the White Carpathians, Estonia, or Öland (Dengler et al. 2009, in press a, Wilson et al. in press). While some stands were clearly dominated by annual plants, those with an upper layer of perennial grasses e.g. *Ampelodesmos mauritanicus* or *Lygeum spartum*, always had a significant number of annual vascular plants in the gaps between the grass tussocks. In the majority of communities, bryophytes and lichens clearly contributed to community assembly, a fact that is commonly overlooked (or at least not recorded) in present-day phytosociological literature from the Mediterranean region (while J. Braun-Blanquet himself



Long working days require a good food supply: traditional dinner in the Agroturismo at the foothills of Mt. Etna, where we stayed two nights (Photo: J. Dengler, 02.04.2012).

mostly recorded the cryptogams not only in his Central European but also his Southern European relevés).

Methodological reflections and discussion

For all the grasslands studied, we discussed aspects and options for their conservation. The dune grasslands in particular are highly endangered due to massive touristic development at the sites and due to inappropriate measures for sand dune stabilizing (planting of exotic tree and shrub species, e.g. *Acacia* spp., *Eucalyptus* spp.). At other sites, however, grasslands are vulnerable to shrub encroachment due to the cessation of management by grazing. On the other hand, we also encountered overgrazed pastures, dominated now mostly by spiny (e.g. *Cynara cardunculus*, *Galactites tomentosus*) and poisonous species (*Euphorbia* spp.).

The expedition also was a good framework to bring vegetation ecologists with different backgrounds together, resulting in intensive discussions during the expedition and hopefully initiating continued international cooperation in the future. Discussions in the field were mostly related to the following themes, that might be further discussed in joint papers: (1) pros and cons of our all-inclusive approach of temperate and boreal phytosociologists to the sampling approach of present-day Mediterranean phytosociologists, who traditionally do not consider annual and perennial as belonging to the same vegetation unit, even if they share a common physical space in the same plot, (2) differences in the vegetation between temperate and Mediterranean dry grasslands, (3) relevance of the non-vascular flora and differences in the bryophyte/lichen composition between Sicilian and Central European grasslands and (4) degree of naturalness of the communities found.

Using the data

Once the data are ready for analysis, we intend to use them for one or several joint publications analysing the compositional and diversity patterns in the Sicilian dry grasslands and their dependence on environmental factors (soils, climate). Of particular interest will be two aspects:

(1) Evaluation of validity of the traditional phytosociological classification of Mediterranean grasslands when all plants that co-occur in the plots are considered and not only pre-defined guilds.

(2) Comparison of the diversity patterns and species-area functions with those found in previously studied temperate and hemiboreal grasslands.

We plan to prepare a first paper for the series Dry grasslands in ...: preliminary overview on biodiversity, ecology and syntaxonomy, which has recently been started in *Tuexenia* with a study based on the data from the 1st EDGG Research Expedition (Dengler et al. in press a). After such an initial publication, we also envisage large-scale comparisons with other species-area data from the Mediterranean and sub-Mediterranean regions of Europe, e.g. from the 5th EDGG Research Expedition in Northern Greece (May 2012) or published data (e.g. De Bello et al. 2007).

In addition to creating a dataset of scale-dependent

diversity patterns of vascular plants, bryophytes and lichens, the collected data can be used for inventory, monitoring, and targeting restoration of the biodiversity of the region. Once published, all samples will be available for researchers, government agencies, conservation organizations, and whoever is interested to learn more about the Sicilian dry grasslands. Our datasets will be included in two vegetation-plot databases registered in the Global Index of Vegetation-Plot Databases (GIVD; www.givd.info; see Dengler et al. 2011): (1) the Database Species-Area Relationships in Palaearctic Grasslands (GIVD-ID EU-00-003; Dengler et al. in press b) and (2) VegItaly (GIVD-ID EU-IT-001; Venanzoni et al. in press).

Closing remarks and acknowledgements

Lodging was carefully selected by the local organizers in order to relish a wide variety of different food and drink items that make Sicily well known around the world for its very Mediterranean dietary habits. So diversity was not only present in flora, vegetation, and landscapes, among the nationalities and scientific backgrounds of the participants but also in the food and beverages.

All participants feel extremely grateful to the Sicilian Institutions (Botanical Depts. of the Universities of Catania and Palermo) who supported the expedition by making freely available for the whole event a van and a Land Rover to travel around. These two powerful vehicles would not have driven such a long way, nor would the standard of the lodging have been so good without the financial support of Forum Plinianum, a scientific association chaired by Prof. Sandro Pignatti, which is gratefully acknowledged. Finally, we thank Stephen Venn for improving our English language usage.

References

- de Bello, F., Lepš, J., Sebastià, M.-T. (2007): Grazing effects on the species-area relationship: Variation along a climatic gradient in NE Spain. – *Journal of Vegetation Science* 18: 25–34.
- Dengler, J. (2008): Pitfalls in small-scale species-area sampling and analysis. – *Folia Geobotanica* 43: 269–287.



Visit at the Botanical Garden in Palermo at the last evening. Prof. Werner Greuter, a leading specialist of the Mediterranean flora, is showing us his working space in the Herbarium Mediterraneum Panormitanum. Photo: J. Dengler, 04.04.2012

- Dengler, J. (2009): A flexible, multi-scale approach for standardised recording of plant species richness patterns. – *Ecological Indicators* 9: 1169–1178.
- Dengler, J., Ruprecht, E., Szabó, A., Turtureanu, D., Beldean, M., Uğurlu, E., Pedashenko, H., Dolnik, C., Jones, A. (2009): EDGG cooperation on syntaxonomy and biodiversity of *Festuco-Brometea* communities in Transylvania (Romania): report and preliminary results. – *Bulletin of the European Dry Grassland Group* 4: 13–19.
- Dengler, J., Jansen, F., Glöckler, F., Peet, R.K., De Cáceres, M., Chytrý, M., Ewald, J., Oldeland, J., Finckh, M., Lopez-Gonzalez, G., Mucina, L., Rodwell, J.S., Schaminée, J.H.J., Spencer, N. (2011): The Global Index of Vegetation-Plot Databases (GIVD): a new resource for vegetation science. – *Journal of Vegetation Science* 22: 582–597.
- Dengler, J., Becker, T., Ruprecht, E., Szabó, A., Becker, U., Beldean, M., Bita-Nicolae, C., Dolnik, C., Goia, I., Peyrat, J., Sutcliffe, L.M.E., Turtureanu, P.D., Uğurlu, E.: (in press a) *Festuco-Brometea* communities of the Transylvanian Plateau (Romania) – a preliminary overview on syntaxonomy, ecology, and biodiversity. – *Tuexenia* 32.
- Dengler, J., Todorova, S., Becker, T., Boch, S., Chytrý, M., Diekmann, M., Dolnik, C., Dupré, C., Giusso del Galdo, G.P., Guarino, R., Jeschke, M., Kiehl, K., Kuzemko, A., Löbel, S., Otýpková, Z., Pedashenko, H., Peet, R.K., Ruprecht, E., Szabó, A., Tsiripidis, I., Vassilev, K. (in press b): Database Species-Area Relationships in Palaeartic Grasslands. – In: Dengler, J., Oldeland, J., Jansen, F., Chytrý, M., Ewald, J., Finckh, M., Glöckler, F., Lopez-Gonzalez, G., Peet, R.K., Schaminée, J.H.J. (Eds.): *Vegetation databases for the 21st century*. – *Biodiversity & Ecology* 4.
- Frey, W., Frahm, J.-P., Fischer, E., Lobin, W. (2006): *The liverworts, mosses and ferns of Europe*. – XV + 512 pp., Harley, Colchester, Essex.
- Galvánek, D., Becker, T., Dengler, J. (in press): Biodiversity, syntaxonomy, and management – Editorial to the 7th *Dry Grassland Special Feature* (with a bibliometrical evaluation of the series). – *Tuexenia* 32.
- Guarino, R. (2011): Green landscapes of Sicily. – *Bulletin of the European Dry Grassland Group* 13: 21–25.
- Guarino, R., Addamiano, S., La Rosa, M., Pignatti, S. (2010): "Flora Italiana Digitale": An Interactive identification tool for the Flora of Italy. – In: Nimis P.L. & Vignes Lebbe R. (Eds.): *Tools for identifying biodiversity: progress and problems*: 157–162.
- Pignatti, S. (1982): *Flora d'Italia*. Vols. 1–3. – Edagricole, Bologna
- Tutin, T.G., Burges, N.A., Chater, A.O., Edmondson, J.R., Heywood, V.H., Moore, D.M., Valentine, D.H., Walters, S.M., Webb, D.A. (1968–1993): *Flora Europaea*. Vols. 1–5. – Cambridge University Press, Cambridge.
- Venanzoni, R., Landucci, F., Panfili, E., Gigante, D. (in press): Towards the Italian national vegetation database: Vegitaly. – In: Dengler, J., Oldeland, J., Jansen, F., Chytrý, M., Ewald, J., Finckh, M., Glöckler, F., Lopez-Gonzalez, G., Peet, R.K., Schaminée, J.H.J. (Eds.): *Vegetation databases for the 21st century*. – *Biodiversity & Ecology* 4.
- Wilson, J.B., Peet, R.K., Dengler, J., Pärtel, M. (in press): Plant species richness: the world records. – *Journal of Vegetation Science*. DOI: 10.1111/j.1654-1103.2012.01400.x.

In the following pages we present several plates of photos from the expedition. Unless otherwise stated their author is J. Dengler.

Page 16 - The participants at work

Page 17 - Plants of Sicily

Pages 18 and 19 - Dry grassland communities on Sicily

Page 20 - Bryophytes and lichens

Page 21 - Sicilian landscapes that host dry grasslands

Page 22 - The organisers and participants of the 4th EDGG Research Expedition in Sicily



The very first biodiversity plot in Sciare di Mazara



Determination of cryptogams



Biodiversity plot at Monte Cofano. Photo: I. Dembicz



The expedition vans at the south coast



Evening work after a plentiful dinner



Biodiversity plot from bird's eye view



Biodiversity plot in Bosco di Santo Pietro. Photo: T. Becker



Kilimanjaro? No, just a biodiversity plot at Mt. Etna in fog and rain. Photo: T. Becker



Moraea sisyrinchium
Photo: T. Becker



Tetragonolobus purpureus



Orchis italica



Orobanche sanguinea



Tuberaria villosissima



Orchis longicornu



Silene colorata



Astragalus caprinus



Convolvulus cneorum



Ophrys speculum



Lygeum spartum



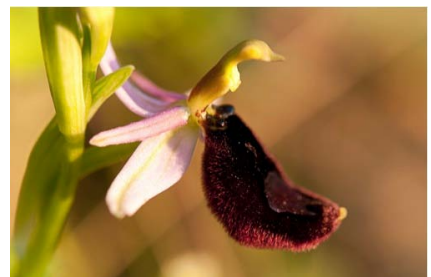
Asphodeline lutea



Anthyllis vulneraria subsp. maura



Chamaerops humilis



Ophrys bertolonii



Semi-ruderal, limestone grassland, Monte Cofano



Pasture over limestone, Monte Cofano



Ampelodesmus mauretanicus grassland, Monte Cofano



Annual grassland, Monte Cofano



Gypsum grassland, Marina de Siculiana



Sedum caeruleum community on gypsum rocks. Photo: T. Becker



Dry grassland on clay with Lygeum spartum, Monte San Nicola



Grey dune community, Torre Manfreda



Stipa capensis grassland, Torre Manfreda



Annual grassland on acid sands, Bosco di Santo Pietro



Annual grassland on acid sands with *Echium sabuleolum*, Bosco di Santo Pietro



Cryptogam-rich, perennial grassland on acid sands, Bosco di Santo Pietro



Thermophilous grassland with *Cenchrus ciliaris*, Capo Zafferano



Cladonia symphy carpia



Cladonia convoluta



Terricolous, crustose lichen on sand



Diploschistes sp., crustose lichen on sand



Cladonia rangiformis



Pleurochaete squarrosa



Stereocaulon vesuvianum



Bryum cf. torquescens



Sicily is a cultural landscape since Millennia: ancient Greek temple in Segesta



*Carboniferous rocks at Monte Cofano
Photo: I. Dembicz*



Gypsum badlands in Southern Sicily



Coastal dunes in SE Sicily



Pasture land on poor sands ("Cork oak savanna")



NE flank of Mt. Etna



Łukasz Kozub (PL)



Thomas Becker (DE)



Martin Rejžek (CZ)



Ieva Rove (LV)



Riccardo Guarino (IT)



Jürgen Dengler (DE)
Photo: Z. Kacki



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Gian Pietro Giusso del Galdo (IT)



Ines Bruchmann (DE)



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