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Symposium 9. Bryofloristics and Bryotaxonomy

(Secretary: Rosa María Ros)

- Introductory lecture by the Secretary

Advances in the Mediterranean bryology according to molecular data: present and future

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With the development of molecular techniques it became possible to study many unresolved questions of bryophyte biology. Among them are the phylogenetic relationships of bryophytes at all levels, which in many cases could not be completely resolved based on morphological techniques alone. The great advantage of molecular methods, especially those based on DNA, is the virtually unlimited number of characters that can be studied and that there is a relatively solid theoretical framework to understand the evolutionary changes (although not free of problems). On the contrary, the number of morphological characters is often limited and the relative importance of for example sporophytic versus gametophytic characters and the sequence of evolutionary changes is often a matter of scientific controversies. One of the general tendencies that are becoming increasingly clear is that in many cases the sporophyte characters have been given too much importance when establishing genus separations. DNA sequence data support for example the conclusions of Zander who came to the conclusion that there exists a reduction series in the sporophyte of typical species of the genus *Tortula* leading to forms of species traditionally included in the genus *Pottia*. The same is true in the case of the genera *Weissia*, *Hymenostomum* and *Astomum*.

Sometimes the new data are not accepted due to practical problems. Some of the characters traditionally used to define taxa are easy to recognize as the cleistocarpous capsule of *Astomum*. It is often quite difficult or even impossible to find morphological characters that are easy to recognize and define a monophyletic group as defined by the molecular data. One possibility would be to admit paraphyletic (but never polyphyletic) taxa although this point of view is not shared by the majority of the scientist who work at present in the field of molecular systematics of plants.

Another field where the molecular data lead to new insights is the field of bryophyte biogeography. Many bryophytes have a very broad distribution, contrasting with the situation of vascular plants. Bryophytes that prefer a Mediterranean climate are often found in more than one zone with that type of climate. Traditionally this was interpreted by many bryologists as a result of the high phylogenetic age of the moss species that did exist before the continents separated in the present form. In almost all cases studied so far this point of view is not supported by molecular data. Generally the sequence divergence between samples with origin in different continents is quite low. In some cases this has been interpreted as a result of a very low rate of sequence change in bryophytes. But in studies where data of other species of higher taxonomic rank like genus or family are available, there are no indications of a reduced level of sequence evolution in bryophytes. Additionally, independent evidence suggests that the predominant direction of winds best explains the distribution pattern of bryophytes and

pteridophytes in the Southern Hemisphere. In some cases the accidental distribution of bryophytes by human actions cannot be excluded, but many of the studied species are not closely ligated to environments heavily influenced by human action.

- Marko Sabovljević

Peculiarities of the Balkan bryophyte flora

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The bryophytes of the Balkan Peninsula is still very poorly known, and the region of SE Europe is bryologically the less investigated area in Europe. Lately there is high activity in bryophyte investigation and data of regional bryoflora constantly increase. However, the intensive further investigation in regional bryophytes is urgently needed to approach, and lot remains to be done, to achieve the level of knowledge of some other European regions.

At present, bryophyte flora in the region of SE Europe counts 5 hornwort, 267 liverwort and 897 moss species. It comprises 59.9 % and 69.4 of European hepatic and moss flora, respectively.

The most rich territories in hepatic species are Romania (197) following by Bulgaria (170) and Slovenia (167). The lowest hepatic species records were done in Turkey in Europe (27), Macedonia, FYR (69) and Albania (91). Similarly the moss flora counts most species in Romania (747) following with Slovenia (637) Bulgaria (558) and Serbia (553). The numbers take into consideration only widely accepted species (not unknown, doubtful or underspecific taxa).

Many species described from the region still remain to investigate and solve. Here are some examples *Encalypta serbica* in Serbia, *Funaria maireana* in Greece, *Tortula montenegrina* in Montenegro, *Fissidens kosaninii* in Croatia, *Entodon transsilvanicum* and *Funaria transsilvanica* in Romania, etc. The presence of some taxa previously published without herbaria, still wait for confirmation, like for example *Sphagnum recurvum* complex, recently considered as tree different taxa.

Recently, quite many new taxa are described from the regions, but it is not clear weather it should be treated as country or regional endemics and what taxonomical rank they should have. For example, *Dicranum transsilvanicum* from Romania or *Cinclidotus confertus* from Greece.

One hundred and fourteen moss (12.7%) and 44 (16.2%) hepatic species are know from only one of 11 regional territories. The further picture can be drawn further with the species recorded in only two of 11 territories: mosses 149 (16.9%) and hepatics 57 (20.95%).

Taking into consideration that Balkan Peninsula comprise almost all European zoniomes in its vertical and horizontal profile, plus the proximity of Asia and Africa, it can be expected that the number of new species will be recorded with further investigations. Also, the distribution data of already known taxa will increase.

- Juana María González-Mancebo

Evaluation of the Mediterranean component in the bryophyte flora of the Canary Islands

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The Canary Islands are situated in the subtropical zone between 27–30° N and 13–17° E, within the southern limit of the European-Asiatic Mediterranean area. These islands have very heterogeneous landscapes in very small territory (over 7500 km²). Different vegetation types and Mediterranean bioclimatic belts are present in relation to topography and island altitude, reaching until five different bioclimatic belts in the highest island (Tenerife). In this small territory there is high bryophyte richness according to the last update of the list. The bryophyte species composition and therefore of its chorological spectre change much between islands and bioclimatic belts.

The analysis of the world distribution of the bryophytes from Canary Islands illustrates about the representation of the Mediterranean component into this archipelago. Twenty-six percent of the species have a Mediterranean affinity in a wide sense (including both Mediterranean and Mediterranean-temperate species), being the largest distribution type in the Canaries. In spite that the oceanic conditions in this archipelago, the oceanic component (including suboceanic species) includes only eighteen percent of the species. Very few species (6%) represent the Oceanic-Mediterranean element (species confined to the Mediterranean zone and the Atlantic fringe of Europe and more rarely Africa or North America)

The proportion of species with Mediterranean affinity increases from west to east. This element varies from 12-14% in the western islands (Hierro, Palma, Gomera and Tenerife) to 17-22% in the eastern islands of Gran Canaria, Fuerteventura and Lanzarote. Eighty percent of the Mediterranean species from Canaries occurs in Gran Canaria, the highest eastern island. The proportion of Mediterranean species varies also depending on the bioclimatic belts present in this archipelago. The arid Inframediterranean bioclimatic belt has the highest proportion of Mediterranean species (50%), while laurel forest situated in the humid Thermomediterranean belt has the lowest one. Destruction of laurel forest represents an increment in Mediterranean species and a diminishing of the oceanic and endemic components, especially in the proportion of liverworts. As usually occurs in Mediterranean countries, the Mediterranean component in the Canaries has higher representation of mosses (76 %) than hornworts and liverworts.

Despite high representation of the Inframediterranean bioclimatic belt in the Canary Islands, many of the Mediterranean species (28%) have a very restricted distribution in this archipelago. The rarity of these species seems to be highly related to the geographical position of the Canaries, in the west-southern limit of the Euroasiatic-Mediterranean region.

- Harald Kürschner

Bryoflora and bryovegetation of South Arabia and Socotra Island

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South Arabia and Socotra Island harbours some outstanding palaeo-African refuge areas, characterized by various xero-tropical and semi-evergreen Afromontane forests. Typical for these forests, which requires a certain amount of rainfall, fog and dew /summer monsoon rainfall), is a rich bryophyte flora, strongly dominated by *taxa* of xero-tropical origin. Most spectacular –beside terrestrial and saxicolous bryophytes– are epiphytes that densely festoon the trunks and twigs. They concentrate mainly in the western, south-western and southern escarpment mountains of the Arabian Peninsula and Socotra island. Examples are given from

- Jabal Arays (*Sterculia africana* subsp. *arabica* woodland) with a terrestrial *Riccietum jovet-astii* - *argenteolimbatæ* in the undestorey, which mainly consist of riccioid and marchantioid, drought-tolerant liverworts.

- the endemic *Anogeissus dhofarica* forests (*Hybantho duræ*-*Anogeissetum dhofaricæ* Kürschner et al., 2004) of al-Mahra/Yemen and Dhofar/Oman (terrestrial bryophyte synusium)

- the western and south-western escarpment mountains of mainland Arabia (epiphytic *Leptodonto-Leucodontetum schweinfurthii*, *Orthotricho-Fabronietum socotranae*), and

- Socotra island (epiphytic *Lejeuneo rhodesiae*-*Sematophylletum socotrense*, dominated by pleurocarpous mosses and liverworts; saxicolous *Grimmietum commutatae-campestris*, geographical race of the endemic *Schlotheimia balfourii*).

The phytogeographical analyses of these communities clearly demonstrate the strong tropical, mainly Afromontane influence in the bryophyte flora of southern Arabia, which is unexpected and unknown to many bryologists. Together with the forests and woodlands these tropical *taxa* are unique relicts of a former widely distributed Tertiary xero-tropical flora. The aridisation of the entire region in the late Tertiary changed the situation, and the formerly common palaeo-African vegetation was fragmented, isolated and restricted to isolated, monsoon-affected refuge areas where these relicts survived. Today, they link southern Arabia with East Africa and South-east Asia.

•Adnan Erdağ

A case report on bryofloristical researches in Turkey.

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Increasing attention had been paid to bryofloristic of Turkey in the last 20 years and resulted a number of new floristic additions and discoveries. Turkey is well known by its highly diversified flowering plants and many new *taxa* had been determined from country during the last century. Cryptogamic plants, especially bryophytes were relatively neglected parts of a plant diversity of Turkey. Till to date, more than 700 mosses, nearly 170 liverworts and 3 hornworts were recorded to be found in Turkey. Ongoing research activities will possibly increase the number of Turkish bryophyte *taxa* in near future.

In fact Turkish bryology was established by European scientists in early 19th century, these pioneer botanists sometimes were bryologists (e.g. Müller, 1829) or only collectors of bryophytes beside flowering plants (e.g. Tchihatcheff, 1860).

Having Ph D and M Sc academic programmes in Bryology was the most significant development in Turkish bryology since 1985 because of training native bryologists for expected bryoflora of Turkey. Today, more than 5 Turkish universities have MSc or Ph D students in field of bryology.

Present study describes a short history of Turkish bryology and development of bryofloristical researches in the country in relation with the phyto-diversity potential of the country.

POSTER SESSION

B. I/1

The genus *Orthotrichum* in bryoflora of Montenegro

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The moss flora of Montenegro includes 569 species. The genus *Orthotrichum* Hedw. consists of 14 species and 5 varieties and these are: *O. anomalum* Hedw., *O. anomalum* Hedw. var. *saxatile* (Brid.) Milde, *O. affine* Schrad. ex Brid., *O. alpestre* Bruch & Schimp., *O. cupulatum* Hoffm. ex Brid., *O. cupulatum* Hoffm. ex Brid. var. *sardagnanum* (Vent.) Vent., *O. cupulatum* Hoffm. ex Brid. var. *baldaccii* (Bott. & Vent.) Piccioli, *O. diaphanum* Schrad. ex Brid., *O. lyellii* Hook. & Taylor, *O. pallens* Bruch ex Brid., *O. patens* Bruch ex Brid., *O. pumilum* Sw. ex anon., *O. rupestre* Schleich. ex Schwägr., *O. rupestre* Schleisch. ex Schwaegr. var. *franzonianum* (De Not.) Vent., *O. speciosum* Nees, *O. stramineum* Hornsch. ex Brid., *O. striatum* Hedw., *O. striatum* Hedw. var. *rotae* De Not. i *O. tenellum* Bruch ex Brid.. The species *Orthotrichum tenellum* has been recorded for the first time in the mosses flora of Montenegro.

B. I/2

Data about some Macaronesian endemisms

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The Macaronesian region is widely known as an area especially rich in endemic species. Some of these species have a wide distribution in this region, but other ones are rare, restricted to just one locality on an island or to a few localities on different islands of one or several archipelagos. For these restricted species a relictual distribution or recent differentiation have been proposed.

Recent molecular studies based on DNA sequences have allowed to clarify the taxonomical status and biogeographical affinities of some Macaronesian endemisms. The data obtained are different depending on the species.

Platyhypnidium torrenticola, known from only one locality in the Canary Islands, has been compared with the most closely related species, *P. riparioides*. The nrITS sequences are identical with the majority of the European and African sequences of *P. riparioides*. It is concluded that the morphological characters used to segregate both species are within the variability of *P. riparioides* and that both names correspond to the same species.

Orthotrichum handiense is also restricted to one locality in the Canary Islands and it is a clearly defined species, both from a molecular and morphological points of view. It deserves specific status but its phylogenetic relationships within the genus are still unclear, because its isolated situation with respect to other European species of *Orthotrichum*.

Fissidens luisieri has a wide distribution in Macaronesia, being known from Canary Islands, Madeira and Azores. It is not a well defined species. At the moment morphological and molecular data do not allow a clear specific segregation from *F. serrulatus*.

Leucodon canariensis y *L. treleasei* also with a wide distribution in Macaronesia, are segregated by molecular data, in spite of their morphological affinities, also with respect to *L. sciuroides*, what has led to a great confusion in the identifications. *Leucodon treleasei* is more frequent in the dry parts of the islands and *L. canariensis* in the typical Macaronesian laurel forests.

B. I/3

The *Orthotrichum diaphanum* complex in the Southern Hemisphere

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Hyaline leaf awns are exceptional within the genus *Orthotrichum* Hedw., and only the widely distributed species *O. diaphanum* Schrad. ex Brid. has been considered to show this character after Lewinsky's taxonomical revisions (1993). Recently, other

species with sort hyaline leaf points from the Northern hemisphere have been added (Lara et al. 1999, Erdağ, et al. 2004).

During various collecting trips throughout the Southern Hemisphere, some *Orthotrichum* specimens with leaf awns and other gametophyte characters similar to those of *O. diaphanum*, but with a different peristome configuration, have been found. This led us to a reexamination of the material of *O. diaphanum* available in diverse herbaria, including type specimens of previously synonymized species.

Our study points to 1) the absence of *Orthotrichum diaphanum* in the Southern Hemisphere. Previous records correspond in fact to other species, sometimes already described and subsequently synonymized, sometimes representing new species; 2) the presence of 7 species with a hyaline leaf awn of variable length in this hemisphere: 4 in South Africa and 3 in southern South America.

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B. I/4

Patterns of variations in species composition in liverworts from the Mediterranean Region

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The liverwort flora (including hornworts) of the Mediterranean region includes 407 accepted species based on recent Hepatics and Anthocerotae checklist of the Mediterranean. There are rough differences between Mediterranean countries in both richness and species composition of liverworts. The analysis of the species distribution in 32 Mediterranean countries and islands, showed that 138 of the species (34%) have a restricted distribution (occurring only in 1, 2 or 3 countries). One hundred species (24%) occurs in 12-25% of the countries and 83 species (20%) occurs in 25-50% of them. Eighty-four species have been recorded in more than 50% of these Mediterranean countries, of which only 19 were in more than 75% of the countries.

Detrended correspondence analysis (DCA), similarity analysis and TWINSpan analysis revealed that differences in species composition from the Mediterranean

countries seem to be more influenced by their latitudinal position than by the longitudinal gradient, in spite of the larger area of the latter. This is mainly related to the highest species richness of the northern Mediterranean countries, compared to the poorest north-African ones.

Six groups of countries and islands were obtained at the third division level with TWINSpan analysis. The western group was formed by both the Macaronesian archipelago (Madeira and Canary Islands) and Portugal, a group highly influenced by the oceanic conditions. Northern countries were separated into a north-western group formed by Spain, France and Italy (the richest countries in liverworts) and a north-eastern group including Bosnia-Herzegovina, Bulgaria, Croatia, Serbia and Slovenia. The poorest group in species is formed by all southern and eastern countries (Egypt, Lebanon, Israel, Jordan, Libya, Syria, and Tunisia) and the islands of Balears, Cyprus, and Malta. The third TWINSpan level separates into this group the poorest countries of Egypt and Syria. Only the African countries of Morocco and Algeria are included in the last group formed by Albania, Corsica, Crete, Greece, Macedonia, Montenegro, Sardinia, Sicily, and Turkey.

Photograph taken in the Bryophyte Symposium. From right to left: Vicente Mazimpaka, Rosa María Ros, Ilana Herrnstadt, Adnan Erdağ, Juana María González-Mancebo, Harald Kürschner, Michele Aleffi, Toberta Tacchi, Marko Sabovljević and S. Dragičević.

