

SUMMARY

Diversity and phytogeography of the moss flora of southern Africa

by

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Philosophiae Doctor

According to the revised checklist prepared for this study, the moss flora of southern Africa consists of 503 species/infraspecific taxa in 204 genera and 54 families. The largest families and genera, and the most frequently collected and widely distributed taxa have been identified for the first time. This study also provides lists of (semi-) aquatic mosses and mosses endemic to the Flora of Southern Africa area. In keeping with results from other parts of the world, endemism is significantly lower in the mosses than the flowering plants of the region.

Mosses are concentrated in a zone the shape of a horseshoe along and below the Great Escarpment of southern Africa. The centres of moss diversity and endemism, formally described here for the first time, overlap in this zone to form 'hot-spots', which largely coincide with the 'hot-spots' described for vascular plants. Diversity and endemism is greatest along the eastern and southern parts of the escarpment, including the Cape Fold Mountains in the south-west. In southern Africa moss diversity and endemism are strongly correlated with habitat heterogeneity and

mean annual rainfall. The more heterogeneous the habitat and the higher the rainfall, the greater the diversity and higher the endemism.

The main objective of the present study was to delimit and formally describe bryogeographic regions and elements in the Flora of Southern Africa area. To achieve this goal three moss data sets, consisting of presence /absence data, were subjected to 1) classification using TWINSpan to detect patterns in the data, followed by 2) DCA ordination using DECORANA to compliment the TWINSpan classification and to describe gradients in the data. These gradients were then subjectively related to a range of environmental variables.

The numerical analyses of moss distributions resulted in the formal classification of grid squares into four bryogeographic or floristic Regions, the Zambebian, Afromontane, Karoo-Namib and Highlands regions, subdivided into eight Domains. The mosses were classified into four bryofloristic Elements, the Eastern Highlands, Cape, Afromontane Grassland and Afromontane Forest Elements, subdivided into eight Subelements. The Afromontane Region is the largest bryofloristic region in southern Africa and, as is shown for the first time, includes a large part of the former 'Cape Region'. The majority of southern African mosses (61%) belong to the Afromontane Forest Element. Compositional and distributional gradients in the moss flora of southern Africa are determined by the same set of environmental factors, identified in this study as precipitation (moisture) and temperature, acting independently and in combination.

The study is concluded with the suggestion that phytogeographic studies in southern Africa should be conducted more objectively than in the past and based on data sets that include the geographic distribution of all plants in the region.

OPSOMMING

Diversiteit en fitogeografie van die mosflora van Suider-Afrika

deur

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Volgens die hersiene kontrolelys wat opgestel is vir hierdie ondersoek, bestaan die mosflora van Suider-Afrika uit 503 spesies in 204 genusse en 54 families. Die grootste families en genusse, sowel as die taksons wat die meeste versamel word en die wydste versprei is, is vir die eerste keer uitgewys. Mosse wat endemies is tot die *Flora of Southern Africa* (FSA) gebied en (semi-) akwatiese mosse word vir die eerste keer gelys in hierdie ondersoek. In ooreenstemming met resultate vanuit ander wêrelddele is endemisme aansienlik laer in die mosse as in die vaatplante van die streek.

Mosse is gekonsentreer in die vorm van 'n hoefyster langs en benede die platorand van Suider-Afrika. Die sentrums van mosdiversiteit en endemisme, wat hier vir die eerste keer formeel beskryf word, oorvleuel in hierdie sone om 'hot-spots' te vorm wat grootliks ooreenstem met die 'hot-spots' wat beskryf is vir die vaatplante. Diversiteit is die hoogste langs die oostelike en suidelike dele van die platorand, insluitend die Kaapse plooiberge in die suidweste. Mosdiversiteit en endemisme is sterk gekorreleer met habitat-heterogeniteit en gemiddelde jaarlikse reënval. Hoe

meer heterogeen die habitat en hoe hoër die reënval, hoe meer spesies asook endemiese spesies is teenwoordig.

Die hoofdoelstelling van die huidige ondersoek was om briogeografiese streke en elemente in die FSA-gebied af te baken en formeel te beskryf. Om hierdie doelwit te bereik is die drie mosdata-stelle, bestaande uit teenwoordigheid/afwesigheid-data, onderwerp aan 1) 'n TWINSPAN-klassifikasie om patrone in die data op te spoor, en 2) 'n DECORANA-ordinasie om die TWINSPAN-klassifikasie te komplimenteer en om gradiente in die data te beskryf. Hierdie gradiente is toe subjektief in verband gebring met 'n reeks van omgewingsveranderlikes.

Die sukses wat behaal is met die numeriese analise van mosverspreidings het gelei tot die formele klassifikasie van ruite in vier briogeografiese streke, die *Zambezian*, *Afromontane*, *Karoo-Namib* en *Highlands*-streke, onderverdeel in agt domeine. Die mosse is geklassifiseer in vier briofloristiese elemente, die *Eastern Highlands*, *Cape*, *Afromontane Grassland* en *Afromontane Forest*-elemente, onderverdeel in agt subelemente. Die *Afromontane*-streek is die grootste briofloristiese streek in Suider-Afrika en sluit vir die eerste keer 'n groot gedeelte van die gewese *Cape*-streek in. Die meeste Suider-Afrikaanse mosse (61%) behoort tot die *Afromontane Forest*-element. Samestellings- en verspreidingsgradiente in die mosflora van Suider-Afrika word bepaal deur dieselfde stel omgewingsfaktore, in hierdie ondersoek geïdentifiseer as reënval (vog) en temperatuur, wat onafhanklik en in kombinasie optree.

Die ondersoek word afgesluit met die voorstel dat fitogeografiese ontledings in Suider-Afrika meer objektief moet geskied as in die verlede en gebaseer moet wees op data-stelle wat die geografiese verspreiding van alle plante in die streek insluit.