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Novelties in the moss flora of Oman, Saudi Arabia and Yemen, including the most outstanding *Vesicularia montagnei* (Bél.) Broth. (Hypnaceae)

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Abstract – Based on former collections from Oman, Saudi Arabia and Yemen, supplemented by a small collection from Yemen by E. Schröder in 1988-1989, new records of ten mosses are given for the Arabian Peninsula. New to the Peninsula are *Bryum alpinum* With. and *Vesicularia montagnei* (Bél.) Broth., the latter new for Southwest Asia and a major range extension. *Vesicularia montagnei* belongs to a number of xeric Palaeotropical elements with an Arabian-Southeast Asian distribution pattern that reach their western-most limit on the Arabian Peninsula and the Socotra archipelago. These Palaeotropical species are mostly concentrated in the xerotropical relict forests of the border mountains, and indicate a common Tertiary floral history of South Arabia and Southeast Asia.

Arabian Peninsula / Bryophyta / distribution patterns / floral history / mosses

INTRODUCTION

Collections of bryophytes from the Arabian Peninsula (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen) still are a rarity and those from Yemen are at present, due to the political circumstances, nearly impossible to obtain. Therefore any collection from this region, however small, is highly welcome as a contribution to our knowledge of species and their distribution. Additionally, such collections demonstrate the regrettable lack of knowledge of bryophyte diversity in these countries. There is enormous variation in the bryophyte flora of the Arabian Peninsula and its diversity across the different countries. At present, no records are known from Bahrain and Qatar; however, four liverworts and 24 mosses are recorded from Kuwait, 16 liverworts and 44 mosses from Oman, 28 liverworts and 114 mosses from Saudi Arabia, six liverworts and 44 mosses from the United Arab Emirates, and 37 liverworts, 100 mosses and one hornwort from Yemen (excluding the Socotra archipelago) (Kürschner & Frey, 2011).

The relatively low number of species in some of these countries is understandable if one takes into consideration that extensive areas forming a major part of these countries have strongly xeric climatic conditions with an

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annual rainfall of less than 100 (50) mm. Many taxa are strictly confined to the monsoon-influenced mountainous western and southern xerotropical woodlands and forests of the Peninsula (Kürschner; 2003).

An additional eleven records of ten moss species are here reported for the first time in the following territories: Oman (one species), Saudi Arabia (four species), and Yemen (six species). Of these, the most interesting is the record of *Vesicularia montagnei* (Bél.) Broth., a xerotropical genus and species new to South-west Asia, representing a remarkable range extension to the Arabian Peninsula.

MATERIAL

The collections date back to 1983 (W. Frey and H. Kürschner, Oman), 1984 and 1988 (W. Frey and H. Kürschner, Saudi Arabia), 2001 (H. Kürschner, Yemen), 2009 and 2013 (H. Kürschner, Saudi Arabia) and are supplemented by a small collection made by E. Schröder in 1988 and 1989 from Yemen (herb. E. Walsemann; B). The latter collections are concentrated on four sites which are located in the western escarpment mountains (Haraz Mts.) and highlands west of Sana'a. The site localities given on the labels are in German and are often incomplete, lacking the names of provinces and/or the larger villages/towns in the adjacent area. However, with the help of a Yemeni gazetteer most of them can be located and, with one exception, the names of the provinces and geographical coordinates can be given. They refer to:

- Amran province: Kawkaban plateau north-west of Sana'a, near Shibam, *ca* 15°30'N; 43°54'E
- Al-Mahwit province: Mahwit area, c. 15°29'N; 43°31'E
- Al-Mahwit province: Jabal Milhan area, c. 15°23'N; 43°21'E
- Wadi Makdoral, near Säl(k)? Aiyun (an unidentificable locality).

For clarity, we have included Schröder's site localities in his original German text in the treatment which follows.

The voucher specimens are kept at B, with duplicates in the herb. H. Kürschner (Berlin). The nomenclature of species follows Kürschner & Frey (2011).

RESULTS

Brachytheciaceae

Oxyrrhynchium speciosum (Brid.) Warnst.

YEMEN: Nordhang des Kawkaban-Massif, etwa 500 m Luftlinie südlich von Bayt Shass, 2780 m, Sandstein (Tanila Sandsteinfazies), Nord-Seite von Blöcken und Lesesteinmauern, z. T. quellnass, 31/05/1989, *coll. E. Schröder* (herb. E. Walsemann, B).

New to Yemen. Previously known from the Arabian Peninsula only from Saudi Arabia (Asir Mts: Jabal Shada, Raidah escarpment, Abha area) (Kürschner, 1989). As in Saudi Arabia, the species prefers wet, shaded earthy banks in Yemen, but grows also on damp stones and terrace walls. It closely resembles *O. hans* from which it differs by the breeding system (autoicous), the distant and complanate branch leaves, the coarsely toothed leaf margins and the longer mid-leaf cells.

Bryaceae

Bryum alpinum With.

YEMEN: Nordhang des Kawkaban-Massif, etwa 500 m Luftlinie südlich von Bayt Shass, 2780 m, Sandstein (Tanila Sandsteinfazies), Nord-Seite von Blöcken und Lesesteinmauern, z. T. quellnass, 31/05/1989, *coll. E. Schröder* (herb. E. Walsemann, B).

New to the Arabian Peninsula and Yemen. The closest locality is on the Sinai Peninsula (El-Saadawi *et al*., 1999). The species is easily recognised by the purplish red, metallic sheen and leaves with vermicular cells. From the physiognomically similar *B. mildeanum* it can be distinguished by the very incrassate upper laminal cells.

Bryum funkii Schwägr.

SAUDI ARABIA: Tabuk. Midian Mts., Jebel al-Lawz, west of Umm Nakhaila, 28°38'N; 35°17'E, 700 m, in rock crevices near a waterfall, 06/03/1988, *coll. W. Frey & H. Kürschner* (88-127).
YEMEN: Al Mahwit-Provinz. Al-Marat, ca. 3.5 km nordwestlich von al-Mahwit, 1820 m, nordost-exponierter Steilhang im Sandstein der Amran-Schichtenfolge, mit starker Verwitterung und Quellwasseraustritt, 06/1988, *coll. E. Schröder* (herb. E. Walsemann, B); Wadi Makdoral, Quellfassung Sälh(k) Aiyun (H 17066/R 3464), 1580 m, nordwest-exponierter Sandsteinhang mit Bodenbildung in Klüften, dicke, Feinerde durchsetzte Polster, 22/10/1989, *coll. E. Schröder* (herb. E. Walsemann, B).

New to Yemen. Recorded from the United Arab Emirates (Jebel Hafit) (Kürschner & Frey, 2011).

Cratoneuraceae

Cratoneuron filicinum (Hedw.) Spruce

YEMEN: Nordhang des Kawkaban-Massif, etwa 500 m Luftlinie südlich von Bayt Shass, 2780 m, Sandstein (Tanila Sandsteinfazies), Nord-Seite von Blöcken und Lesesteinmauern, z. T. quellnass, 31/05/1989, *coll. E. Schröder* (herb. E. Walsemann, B).

New to Yemen. Previously known in the Arabian Peninsula only from Saudi Arabia (Asir Mts: Raidah escarpment, southwest of Abha) (Frey & Kürschner, 1988), where it grows beneath shady rock boulders and rocks with dripping and seeping water.

Hypnaceae

Vesicularia montagnei (Bél.) Broth.

YEMEN: Jas(b)al Milhan-Gebirge, West-Hang (H 16993/R 3234), 1420 m, schattiger Quellaustritt (Ausgangsgestein: Granit/Porphyr), 19/09/1989, *coll. E. Schröder* (herb. E. Walsemann, B).

The genus *Vesicularia* is easily recognised by its dimorphic leaves with the dorsal and lateral leaves tending to be larger, spreading to secund and somewhat asymmetric and the ventral leaves being rather small and more or less appressed. Additionally, the areolation of all leaves consists of short and broad, lax, oblong-hexagonal to oblong-rhomboidal cells. Most species exhibit a remarkable phenotypic plasticity and hence there are many species described in this genus. The plants from Yemen have rounded to suborbicular, shortly acuminate lateral leaves and in this character they fit within the concept of the palaeotropical *V. montagnei*, as treated by various authors (cf. Gangulee, 1980; Noguchi, 1994;

Zhang Man-Xiang & Si He, 2005). According to Buck (1998), it is very likely that the oldest name for this species is *V. vesicularis* (Schwägr.) Broth. Notwithstanding the species concept, *V. montagnei* is widely distributed and known from South and East Asia to the Pacific area, eastwards from India and Sri Lanka. From Africa the species is unknown but considering that over 60 species have been described from this continent, it is very likely that some of them are conspecific with the *V. vesicularis/montagnei* complex. The discovery of this genus and species from Yemen represents a major range extension. Together with further xero-tropical species from the monsoon-influenced Arabian escarpment mountains such as *Chionoloma bombayense* (Müll.Hal.) Sollman*, Claopodium prionophyllum* (Müll.Hal.) Broth.*, Diaphanodon procumbens* (Müll.Hal.) Renauld *et* Cardot*, Papillaria crocea* (Hampe) A.Jaeger*, Splachnobryum aquaticum* Müll. Hal., and *Tuerckheimia svihlae* (E.B.Bartram) R.H.Zander, it belongs to a xeric Palaeotropical element with an Arabian-Southeast Asian distribution pattern that reaches its western limits in South Arabia and the Socotra archipelago (Kürschner, 2006). They are mostly found in the xerotropical relict forests and indicate a common floral history of South Arabia and Southeast Asia.

Mniaceae

Pohlia melanodon (Brid.) A.J. Shaw

SAUDI ARABIA: Tabuk. Tayma area, 30 km east of al-Kotayeb, Abu Mughayr area, Ain Alia spring, south-western border of the an-Nafud, 27°11'55.6''N; 39°20'10.7''E, 1030 m, on ground between dripping and seeping sandstones, 20/02/ 2009, *coll. H. Kürschner* (09-82).

New to Saudi Arabia. Known from Ru'us al-Jibal in the United Arab Emirates (Shabbara & El-Saadawi, 2001).

Pottiaceae

Didymodon cordatus Jur.

YEMEN: Hadhramout. Mukalla area, Kor Seiban, c. 6 km south-east of Bayn al-Jibal, 14°48'N; 48°49'E, on soil in a montane wadi covered by *Tarchonanthus camphoratus-Bauhinia ellenbeckii* woodland, 15/10/2001, *coll. H. Kürschner* (s.n.).

New to Yemen. Known from the Asir Mts. and Jabal Fayfa (Saudi Arabia), close to the Yemeni border (Frey & Kürschner, 1988).

Gyroweisia reflexa (Brid.) Schimp.

OMAN: Muscat. Batinah, Wady Aday, 10 km south of Muscat, 23°32'N; 58°31'E, 200 m, on soil, 13/02/1983, *coll. W. Frey & H. Kürschner* (83-52).

New to Oman. Known from Saudi Arabia and the United Arab Emirates (Shabbara & El-Saadawi, 2001; Kürschner & Frey, 2011). The few, small capsules show a well developed annulus and a rudimentary peristome. These characters distinguish the species from similar *Gymnostomum* spp. On the Arabian Peninsula, it grows in shady and weft clefts or beneath rock boulders close to periodically flooded runnels and small wadis.

Tortella inflexa (Bruch) Broth.

SAUDI ARABIA: Asir Mts., near al-Tawil, *ca* 50 km south of Kamish Mushayt, 18°05'N; 42°56'E, 2250 m, on soil in *Acacia origena-Juniperus procera* woodland, 27/03/1984, *coll. W. Frey & H. Kürschner* (84-258).

New to Saudi Arabia. Known from Yemen (Kürschner & Frey, 2011). Characterized by a subcucullate leaf apex as typical for some *Weissia* spp. The basal laminal cells, however, are rectangular, hyaline and ascend along the leaf margins.

Tortula viridifolia (Mitt.) Blockeel *et* A.J.E.Sm.

(*Pottia crinita* Bruch *et* Schimp.)

SAUDI ARABIA: Tabuk. Tayma area, 30 km east of al-Kotayeb, Abu Mughayr area, Ain Alia spring, south-western border of the an-Nafud, 27°11'55.24''N 39°19'26.9''E, 1030 m, on ground between dripping and seeping sandstones, 05/03/2013, *coll. H. Kürschner* (13-75).

New to Saudi Arabia. The closest locality is in the Dead Sea area in Jordan (El-Oqlah *et al*., 1988). The ± ovoid to ellipsoidal capsules, the rudimentary peristome and the granulate-papillose spores with 25-35 µm in diameter distinguish this species from other *Tortula* spp. (former *Pottia* spp.). In the Abu Mughayr area it grows in a shady and wet sandstone cliff near a spring that lowers the harsh, arid site conditions.

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