

JUBULA HUTCHINSIAE SUBSP. CAUCASICA KONSTANT. & VILNET (MARCHANTIOPHYTA: JUBULACEAE) – NEW FOR THE BRYOPHYTE FLORA OF IRAN AND TURKEY

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Abstract. *Jubula hutchinsiae* (Hook.) Dumort. forms a complex of notoriously difficult intraspecific taxa, recorded from Southwest Asia as *J. hutchinsiae* subsp. *javanica* (Steph.) Verd. A re-examination of the Iranian and Turkish records indicates that they belong to the recently described *J. hutchinsiae* subsp. *caucasica* Konstant. and Vilnet, which seem to be restricted to the broadleaved deciduous forests of the Euxine-Caucasian-Hyrcanian floral province.

Key words: Bryoflora, Euxine-Caucasian-Hyrcanian floral province, liverworts, phytogeography.

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INTRODUCTION

Despite the monograph of Guerke (1978), there has long been great confusion about assignment of the highly polymorphic *Jubula* Dumort. species recorded from Southwest Asia and the Caucasus. The first records of this taxon date back to Brotherus (1892), who reported the genus from Georgia (Caucasus) as *Frullania hutchinsiae* (Hook.) Nees var. *integrifolia* (Nees) Lindb. Later on, records from Southwest Asia and the Caucasus area were named either as *Jubula hutchinsiae* (Hook.) Dumort. subsp. *pennsylvanica* Verd. [*J. pennsylvanica* (Steph.) A. Evans (Zerov 1953)] or more often as *J. hutchinsiae* subsp. *javanica* (Steph.) Verd. (cf. Kürschner & Frey 2011). As Guerke (1978) treated *J. hutchinsiae* subsp. *pennsylvanica* as a strictly East-American endemic, most authors followed this phytogeographical concept and listed all records from Southwest Asian to the present under the East-Asian *J. hutchinsiae* subsp. *javanica*, even though most of the specimens lack any serration of the leaf lobes and underleaves typical for *J. hutchinsiae* subsp. *javanica*, thus more resembling *J. hutchinsiae* subsp. *pennsylvanica*. Only in the Caucasus Mts have such specimens with entire leaf lobes been referred to *J. hutchinsiae* subsp. *pennsyl-*

vanica (Zerov 1953; Duda 1982). The confusion is deepened, as specimens with entire leaf lobes and underleaves also were known from *J. hutchinsiae* subsp. *javanica*, and named *J. hutchinsiae* var. *integrifolia* S. Hattori. The latter taxon, however, deserves no taxonomic recognition in the view of most authors (Frey *et al.* 2006; Guerke 1978; Kürschner & Frey 2011; Paton 1999).

The classification within (sub)tropical *J. hutchinsiae* subsp. *javanica* is supported additionally by the floral history of the area and the phytogeographical concept of ‘Indo-Malesian relict species’, as indicated by many vascular plants that survived the strong Pleistocene climatic changes in forest refuges along the eastern Black Sea and Caspian Sea coasts (Euxine-Colchic-Hyrcanian relict forests; cf. Zohary 1973). By this view, *J. hutchinsiae* subsp. *javanica* represents a nice example for these phytogeographical relationships within the bryophytes.

Just recently, Konstantinova and Vilnet (2011) described a new subspecies in the *Jubula hutchinsiae* complex of the Russian western Caucasus mountains (Republic of Adygea). Based on ITS1-2, nrDNA, *trnL-F* and *trnG* cpDNA

sequences and some morphological characters it turned out that all specimens from the Russian Caucasus area belong to an own taxon, named *J. hutchinsiae* subsp. *caucasica*, which evolved in the perhumid, subtropical Colchic lowland forests. It is also confirmed for Georgia (Adjara, Mtirala National Park and Jochostskali area east of Batumi; Kürschner *et al.* 2013). Therefore it can be expected that most records in the area belong to this new taxon and are hidden until now under the East-Asian *J. hutchinsiae* subsp. *javanica* (cf. Kürschner & Frey 2011) as already stated by Konstantinova and Vilnet (2011). A re-examination of the Iranian (Frey & Kürschner 1983) and Turkish records confirmed this view.

RESULTS

MORPHOLOGY. Katagiri *et al.* (2010) showed that *J. hutchinsiae* subsp. *javanica* can be separated from *J. hutchinsiae* subsp. *pennsylvanica* by (mostly) serrate leaf lobules, small and short male branches and thick-walled medulla cells in stem cross-section. By contrast, the new *J. hutchinsiae* subsp. *caucasica* has entire leaf lobules, large and long male branches and thin-walled medulla cells, thus much more resembling *J. hutchinsiae* subsp. *pennsylvanica* morphologically. The latter is clearly separated by the molecular data and in addition by some (weak) morphological differences which can be summarized as follows (cf. Konstantinova & Vilnet 2011):

– *J. hutchinsiae* subsp. *caucasica* – small leaf lobes; sinus of bracts with slightly to non-reflexed margins; underleaves only shortly decurrent (decurrent part < width of stem); a distinct small-celled zone on the stem between the decurrent underleaf lobes.

– *J. hutchinsiae* subsp. *pennsylvanica* – larger leaf lobes; sinus of bracts with strongly reflexed margins; underleaves long decurrent (decurrent part > width of stem); lack of a distinct small-celled zone on the stem between the decurrent underleaf lobes.

A re-examination of the known Iranian records (Frey & Kürschner 1983) and some Turkish sam-

ples from eastern Karadeniz Dağları close to the Georgian border shows that the samples fit well in the morphological concept given by Konstantinova and Vilnet (2011) and therefore belong to this recently described new Euxine-Caucasian-Hyrcanian taxon.

***Jubula hutchinsiae* (Hook.) Dumort. subsp. *caucasica* Konstant. & Vilnet**

New to Iran and Turkey (Fig. 1).

SPECIMENS EXAMINED: IRAN. MAZANDARAN: Alborz Mts, 12 km south of Abas Abad, 36°37'17.9"N, 51°06'8.1"E, Caspian (Hyrcanian) lowland forest dominated by *Fagus orientalis* and *Parrotia persica*, 400 m, on wet rock, 6 June 1977, O. Braune & H. Kürschner 77-51 (Frey & Kürschner 1983 as *J. hutchinsiae* subsp. *javanica*); ditto – 36°35'53.9"N, 51°07'58.4"E, 700 m, on wet rock, 6 June 1977, O. Braune & H. Kürschner 77-61 (Frey & Kürschner 1983 as *J. hutchinsiae* subsp. *javanica*). TURKEY. TRABZON: Karadeniz Dağları, 12 km south of Of, near Çumarpazarı, 40°49'21"N, 40°16'06"E, 130 m, on rock near waterfall in Euxine lowland forest, 22 June 2011, M. Kırmacı & H. Kürschner 11-135; Rize: Karadeniz Dağları, İkizdere, near Şimşirliköyü, 40°48'31.8"N, 40°29'41.2"E, 960 m, on wet rock in Euxine lowland forest dominated by *Fagus orientalis*, 16 Sept. 2004, H. Kürschner & G. Parolly 04-983; ditto – between Çayelı and Kaptanpaşa, near Yeşiltepe, 40°58'01"N, 40°47'44.9"E, 430 m, Euxine lowland forest, on wet rock beneath *Rhododendron ponticum* scrub, 23 June 2011, M. Kırmacı & H. Kürschner 11-146.

PHYTOGEOGRAPHY AND ECOLOGY. *Jubula hutchinsiae* subsp. *caucasica* belongs to a small group of partly endemic saxicolous and corticolous species that survived and evolved under subtropical climate conditions in the forests of the eastern Black Sea coast, the lower parts of the Caucasus Mts and the southern Caspian Sea area (Fig. 1). This florogenetic entity can be combined into a Euxine-Caucasian-Hyrcanian floral province of the large Euro-Siberian region [Frey 1980; Pontic province of the Euro-Siberian region (West Euro-Siberian subregion) *sensu* Zohary 1973 p. 81]. To the present day this area is densely covered by hygro-thermophytic and mesophytic broadleaved deciduous lowland and montane forests dominated by *Fagus orientalis* Lipsky (Fig. 1), and associated

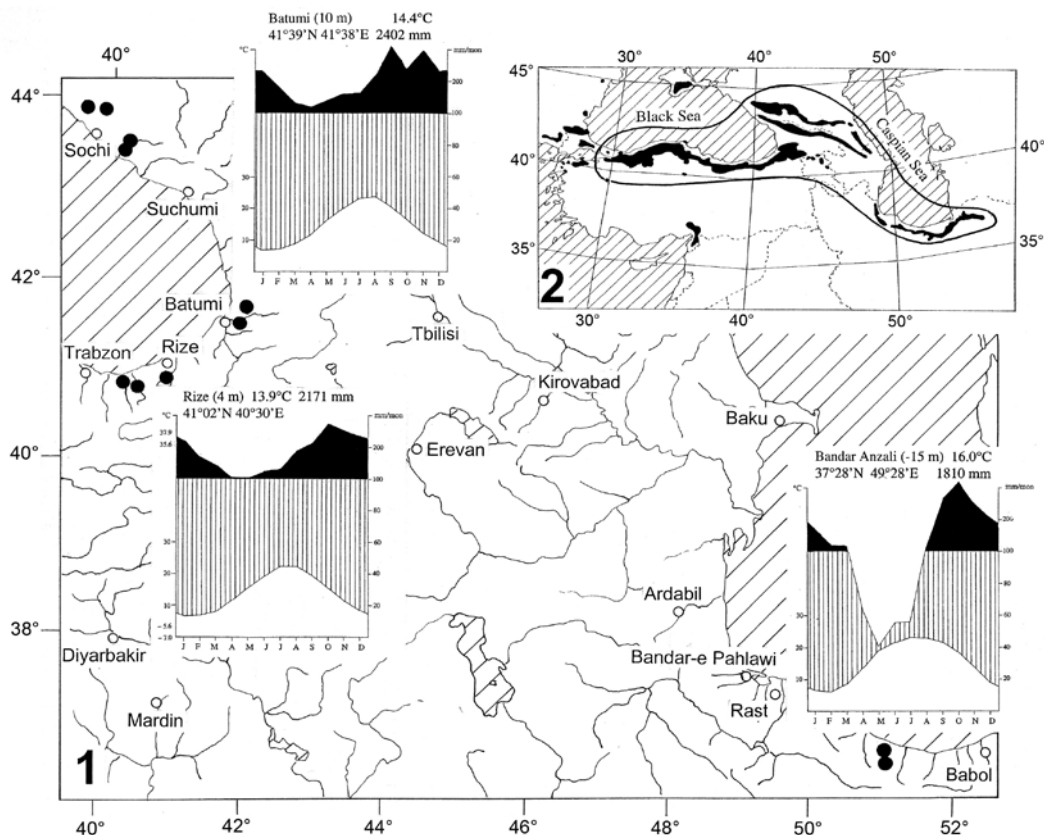
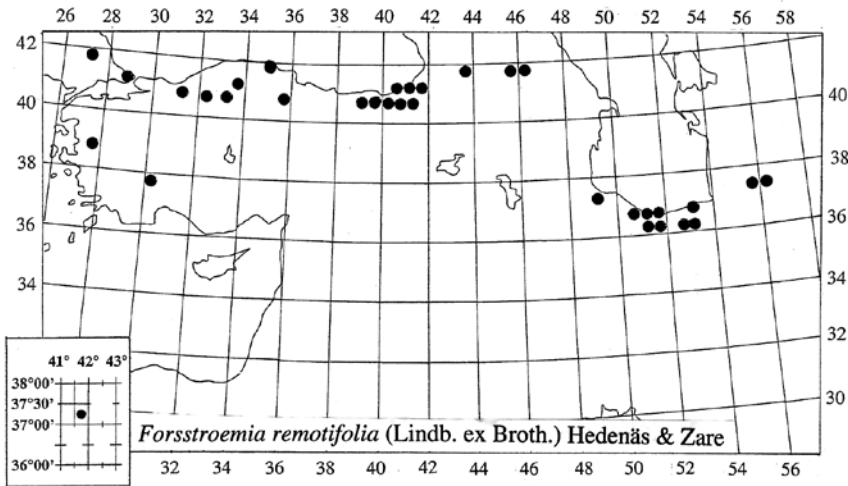
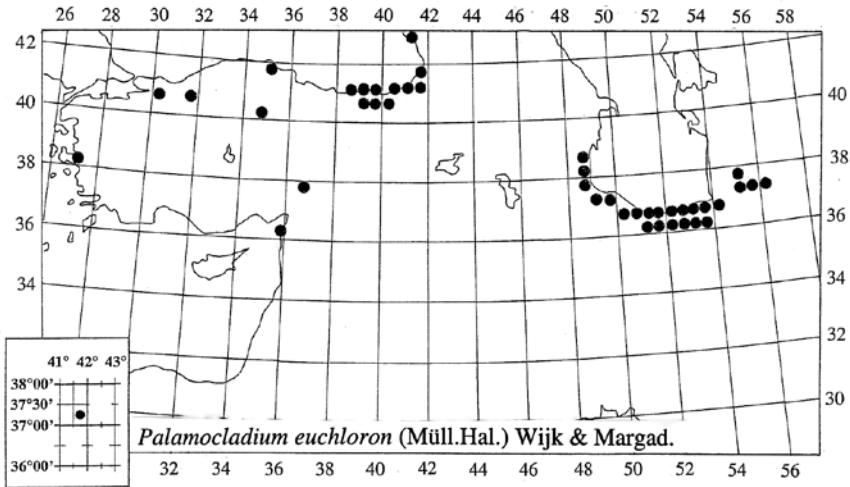
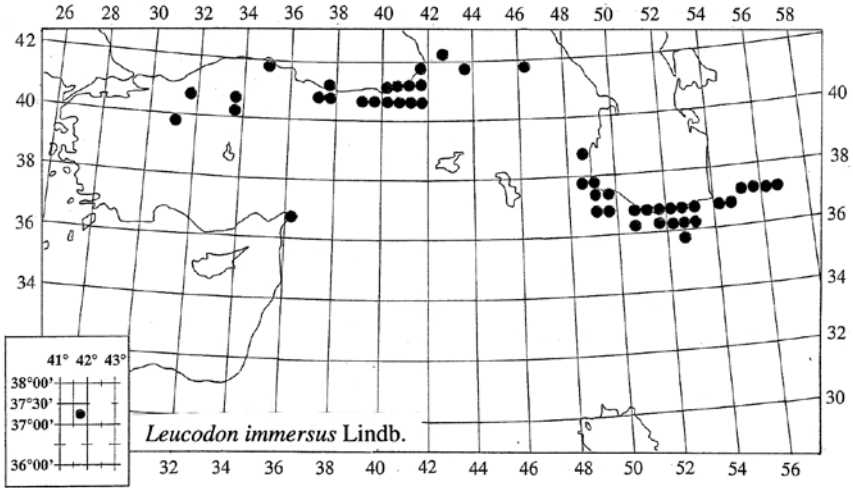


Fig. 1. 1 – Distribution of *Jubula hutchinsiae* subsp. *caucasica* Konstant. & Vilnet in the Caucasus and Southwest Asia (records near Sochi after Konstantinova & Vilnet 2011; records near Batumi after Kürschner *et al.* 2013; Turkish and Iranian records *hoc loco*; climate diagrams after Alex 1984). 2 – Euxine-Caucasian-Hyrcanian floral province *sensu* Frey 1980, and distribution of *Fagus orientalis* Lipsky (based on EUFORGEN Networks, <http://www.euforgen.org>).

with substantial components of evergreen shrub in the understorey. These forests are sometimes considered warm-temperate rainforests (Nakhutshvili *et al.* 2010) which harbor a great number of relicts of Arcto-Tertiary and palaeotropical Indo-Malesian origin. Here they survived *in situ* the Tertiary aridization and the glaciations during the Pleistocene. Examples of vascular plants indicating these relationships, which began to spread from Southeast Asia in the Cretaceous, reaching Europe in the early Tertiary, include *Acer cappadocicum* Gled., *Albizia julibrissin* Durazz., *Alnus subcordata* C. A. Mey., *Buxus* spp., *Danae racemosa* (L.) Moench, *Dioscorea caucasica* Lipsky, *Diospyros lotus* L., *Fagus orientalis* Lipsky, *Ficus colchica* Grossh., *Gleditsia caspica* Desf., *Hedera colchica*

(K. Koch) K. Koch, *H. pastuchovii* Woronow, *Ilex colchica* Pojark., *I. spinigera* (Loes.) Loes., *Mespilus germanica* L., *Parrotia persica* C. A. Mey., *Prunus laurocerasus* L., *Pterocarya fraxinifolia* Spach, *Pyracantha coccinea* M. Roem., *Quercus castaneifolia* C. A. Mey., *Q. hartwissiana* Steven, *Q. pontica* C. Koch & K. Koch, *Q. robur* (Ten.) A. DC. subsp. *imeretina* Menitsky, *Rhododendron ponticum* L., *R. ungerii* Trautv. ex Regel, *Viburnum orientale* Pall. and *Zelkova carpinifolia* (Pall.) K. Koch. All this makes the whole area an outstanding and important Arcto-Tertiary refuge area (Probst 1981; Browicz 1989; Frey *et al.* 1999; Milne & Abbott 2002; Milne 2006).

The liverworts and mosses following this distributional pattern are few but include some



interesting saxicolous and corticolous taxa such as *Solenostoma caucasicum* (Váňa) Konstant., *S. handelii* (Schiffn.) Müll. Frib. (probably a Tertiary relict with exclaves on Crete, in Spain and in Japan), *S. lignicola* (Schiffn.) Váňa, Hentschel & J. Heinrichs, *S. subtilissimum* (Schiffn.) R. M. Schust., *Forsstroemia remotifolia* (Lindb. ex Broth.) Hedenäs & Zare [syn. *Pseudoleskeella laxiramea* (Schiffn.) Broth.], *Palamocladium euchloron* (Müll. Hal.) Wijk & Margad. and *Leucodon immersus* Lindb. (the latter two having a wider distribution and exclaves in the Amanos Mts, Turkey) (Fig. 2). They evolved in these relict forests, which are subjected to moist sea winds throughout the year, bringing high summer rainfall and hence lowering the risk of desiccation. Rainfall generally is very high, distributed throughout the whole year with heavy summer rains, amounting to more than 2000 mm/year in the Euxine and Colchic sectors of the area (e.g., Rize 2171 mm/year, Batumi 2402 mm/year; Fig. 1). Towards the east (Hyrcanian sector) and with distance from the sea, rainfall continuously decreases but still is high (e.g., Bandar Anzali 1810 mm/year), and the climate changes from perhumid to humid conditions. However, mild temperatures, high rainfall and permanent high atmospheric humidity, with damp and often foggy conditions, ensured the establishment of rich epiphytic bryophyte diversity throughout the Euxine-Caucasian-Hyrcanian area (Kürschner *et al.* 2012), and the evolution of taxa of humid northern (*Solenostoma* spp.) and (sub) tropical origin, such as *Jubula hutchinsiae* subsp. *caucasica*, *Forsstroemia remotifolia* or *Palamocladium euchloron*.

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REFERENCES

- ALEX M. 1984. Klimadaten ausgewählter Stationen des Vorderen Orients. Beihefte zum Tübinger Atlas des Vorderen Orient, Reihe A (Naturwissenschaften). **14**. Ludwig Reichert Verlag, Wiesbaden.
- BROTHERUS V. 1892. Enumeratio muscorum Caucasi. *Acta Soc. Sci. Fenn.* **19**: 1–170.
- BROWICZ K. 1989. Chorology of the Euxinian and Hyrcanian element in the woody flora of Asia. *Pl. Syst. Evol.* **162**: 305–314.
- DUDA J. 1982. *Ad distributionem Hepaticarum in Caucaso notula*. *Novosti Sist. Nizsh. Rast.* **19**: 200–204.
- FREY W. 1980. Wald- und Gebüschverbreitung in Nordwest-Horasan (Nordiran). Beihefte zum Tübinger Atlas Vorderer Orient, Reihe A (Naturwissenschaften). **6**. Ludwig Reichert Verlag, Wiesbaden.
- FREY W. & KÜRSCHNER H. 1983. Contributions towards a bryophyte flora of Iran. New records from Iran. *Iranian J. Bot.* **2**: 13–19.
- FREY W., KÜRSCHNER H. & PROBST W. 1999. Flora and vegetation, including plant species and larger vegetation complexes in Persia. In: E. YARSHATER (ed.), *Encyclopaedia Iranica*. **10**(1): 46–63. Bibliotheca Persica Press, New York.
- FREY W., FRAHM J.-P., FISCHER E. & LOBIN W. 2006. The liverworts, mosses and ferns of Europe. (Edited by T. L. BLOCKEEL). Harley Books, Colchester.
- GUERKE W. R. 1978. A monograph of the genus *Jubula* Dumortier. *Bryophyt. Biblioth.* **17**: 1–118.
- KATAGIRI T., YAMAGUCHI T. & DEGUCHI H. 2010. Taxonomic studies on the liverwort *Jubula* Dumortier (Marchantiophyta: Jubulaceae) in Japan and Taiwan. *Hikobia* **15**: 463–472.
- KONSTANTINOVA N. A. & VILNET A. A. 2011. *Jubula hutchinsiae* subsp. *caucasica* subsp. nov. (Jubulaceae, Marchantiophyta) – a new taxon from the western Caucasus. *Arctoa* **20**: 227–238.
- KÜRSCHNER H. & FREY W. 2011. Liverworts, mosses and hornworts of Southwest Asia. Marchantiophyta, Bryophyta, Anthocerotophyta. *Bryophyt. Biblioth.* **139**: 1–240.
- KÜRSCHNER H., BATSATSASHVILI K. & PAROLLY G. 2013. Additions to the bryophyte flora of Georgia. *Herzogia* **26** (in press).
- KÜRSCHNER H., KIRMACI M., ERDAĞ A., BATSATSASHVILI K. & PAROLLY G. 2012. Ecology and life strategies of epiphytic bryophyte communities from the Arcto-Tertiary



Fig. 2. *Leucodon immersus*, *Palamocladium euchloron* and *Forsstroemia remotifolia*, three selected species with a mainly Euxine-Caucasian Hyrcanian distribution pattern.

- relict forests of the Black and Caspian Sea areas. *Nova Hedwigia* **94**: 31–65.
- MILNE R. I. 2006. Northern Hemisphere plant disjunctions: A window on Tertiary land bridges and climate change? *Ann. Bot.* **98**: 465–472.
- MILNE R. I. & ABBOTT R. J. 2002. The origin and evolution of Tertiary relict floras. *Advances Bot. Res.* **38**: 281–314.
- NAKHUTSRISHVILI G., ZAZANASHVILI N. & BATSATSASHVILI K. 2010. Regional profile: Colchic and Hyrcanic temperate rainforests of the Western Eurasian Caucasus. In: D. A. DELLA SALLA (ed.), *Temperate and boreal rainforests of the world*, pp. 214–221. Island Press, Washington DC.
- PATON J. A. 1999. The liverwort flora of the British Isles. Harley Books, Colchester.
- PROBST W. 1981. Zur Vegetationsgeschichte und Klimaentwicklung des Südkaspischen Waldgebietes (Nordiran). In: W. FREY & H.-P. UERPMANN (eds), *Beiträge zur Umweltgeschichte des Vorderen Orients*, pp. 26–39. Beihefte zum Tübinger Atlas Vorderer Orient, Reihe A (Naturwissenschaften). **8**. Ludwig Reichert Verlag, Wiesbaden.
- ZEROV D. K. 1953. The genus *Jubula* Dum. in the flora of the USSR. *Bot. Zhurn. (Kiev)* **10**: 85–90 (in Ukrainian).
- ZOHARY M. 1973. Geobotanical foundations of the Middle East. **1 & 2**. G. Fischer Verlag, Stuttgart.

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