NOTES ON SOME SPECIES OF COLURA
(LEJEUNEACEAE, JUNGERMANNIOPSIDA),
WITH DESCRIPTION OF COLURA CATARACTARUM
FROM MADAGASCAR

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Examination of about one hundred unidentified Colura specimens resulted in new distributional data of eleven uncommon species, *C. australiensis*, *C. bicornis*, *C. calyptrifolia*, *C. crispiloba*, *C. cristata*, *C. heimii*, *C. humbertii*, *C. imperfecta*, *C. obesa*, *C. rhynchophora*, *C. saroltae* and a new species of sect. Colura from Madagascar, *C. cataractarum*.

Key words: Africa, Australia, endemism, Fiji, Madagascar, Mascarenes, new species, phytogeography

INTRODUCTION

During the past decades I accumulated nearly one hundred unidentified specimens of the liverwort genus *Colura* (Dumort.) Dumort. (Lejeuneaceae) from different parts of the world, mostly from East Africa, Australia and the Fiji Islands, collected by myself, my wife and my colleagues. The identification of the material resulted in a large number of range extensions and recognition of a new species of section *Colura*, *C. cataractarum* Pócs, from Madagascar. In this paper new localities and range extensions of eleven uncommon species as well as the description of the new species are presented.

RANGE EXTENSIONS

In the present enumeration the first two digits of locality numbers refer to the year of collection, while the letters mark the different species within the same locality. The novelty of the records was mostly established using Ah-Peng and Bardat (2005) and Ah-Peng et al. (2010a, b) for Réunion, Grolle (1995) and Marline et al. (2012) for Madagascar and the Mascarenes, McCarthy (2003) for Australia, Söderström et al. (2011) for Fiji and Wigginton (2018) for continental Africa.

*Colura australiensis* Ast, Rev. Bryol. Lichénol. 22: 260 (1954) (Figs 1–3, 24) – Australia: Queensland, Cape Tribulation, Daintree National Park, ‘Botanical
Figs 1–8. – Figs 1–3. *Colura australiensis* Ast (from Pócs & Streimann 9990/C): 1 = habit, ventral view; 2 = valve; 3 = broken underleaf. – Fig. 4. *Colura bicorns* Ast, habit (from Pócs, Szabó & 9872/AA). – Fig. 5. *Colura calyptrifolia* (Hook.) Dumort., habit with sporophyte (from Pócs, Szabó & Ranairojaona 9851/AE). – Fig. 6. *Colura humbertii* Ast, habit (from S. & T. Pócs 9890/DB). – Fig. 7. *Colura crispiloba* Ast, lobe apex with lobule sac (from S. & T. Pócs 03269/I). – Fig. 8. *Colura saroltae* Pócs, habit, ventral view (from Kis & Pócs 9124/S).
NOTES ON SOME SPECIES OF COLURA (LEJEUNEACEAE, JUNGERMANNIOPSIDA) 395

Circuit’ along Noah Creek, on bark in mangrove forest at 1–2 m elevation, with Colura streimannii Pócs (Pócs 2015), T. Pócs, H. Streimann 9990/C (CANB, EGR). A species of sect. Harmophyllum, previously known only from the type locality on Mt Bellenden Ker in Queensland, from the Solomon Islands (Pócs 2013) and from New Caledonia (Hürllimann 1987).

Colura bicorns Ast, Rev. Bryol. Lichénol. 25: 272 (1957) (Figs 4, 23) – Madagascar, Toamasina Prov., epiphyllous in lowland rainforest at the N side of Fandrarazana River Estuary at 2–3 m elev., S. & T. Pócs, A. Szabó 9872/AA (EGR, TAN). Since the description of this peculiar Madagascan species of sect. Glotta with a forked sac apex (Jovet-Ast 1956) from the Moramanga-Andasibé road, only one further locality had become known, from Andringitra National Park (Pócs 1995). The species seems to prefer very wet, waterlogged rainforests.

Colura calyptrifolia (Hook.) Dumort., Recueil d’Observ. Jungerm., p. 12 (1835) (Fig. 5) – Madagascar, Antananarivo Prov., on Erica twig in a heath on the summit at the N end of Lake Mantasoa, near Anjorozo village, at 1,500 m elev., T. Pócs, A. Szabó, R. Ranaivojaona 9851/AE (EGR); Toamasina Prov. Maromizaha Forest S of Andasibe National Park. Epiphyllous in a mossy cloud forest on the summit ridge of Mt Maromizaha, at 1,080–1,214 m elev., S. & T. Pócs 9890/DB (EGR, TAN). This widespread, pantropical-oceanic temperate species of sect. Colura was not previously known from Madagascar (see map in Gradstein et al. 1984).

Colura crispiloba Ast, Cryptog. Bryol. Lichénol. 4(3): 205 (1983) (Figs 7, 24) – Australia, Queensland, there are several new localities: Atherton Tableland, Cardwell Range, E slope of Mt Fisher 9 km N of Ravenshoo, at 940–1,000 m elev. Epiphyllous in disturbed rainforest, Pócs, Streimann 99114/AK. This place is not far from its type locality in Karrima State Forest. Paluma Range: McClelland’s Lookout at the E side of the village and also in the garden of A. & W. Cairns in Paluma village, in the opening of a rainforest rich in epiphytes, at 900 m alt., on bark, T. Pócs 9976/A (CANB, EGR); S. & T. Pócs 01109/W (BRI, EGR). Main Coast Range, Mt Lewis W of Rumula, SW slope of the summit at 951 m elev., on decaying twigs, S. & T. Pócs 01085/F (EGR, BRI). A new Fiji locality: Viti Levu Island, SW ridge of Mt Tamanivi (Mt Victoria), at 800 m elev., epiphyllous in cloud forest, S. & T. Pócs 03269/J (EGR). According to our present knowledge this is an Australasian–Pacific species restricted to Queensland and to Viti Levu in the Fiji Islands (Jovet-Ast 1983, Pócs and Streimann 2006, Pócs and Eggers 2007).

Colura cristata Ast., Rev. Bryol. Lichénol. 22(3): 291 (1954) – Fiji Islands, Viti Levu Island, coral Coast, near Nabukavesi village 10 km N of Lombau, epiphyllous in wet lowland rainforest, S & T. Pócs 03261/CD (EGR). A rare species of section Harmophyllum, known only from Borneo, Java and from the Kadavu Island of Fiji.
Colura heimii Ast, Rev. Bryol. Lichénol. 22(3): 275 (1954) (Fig. 9) – Two additions to the Réunion localities: SSW slope of Piton de la Fournaise volcano, along the trail from Gite Basse vallée to Puis Ramond and to Piton Larde, 720–1,250 m elev., on bark, G. Kis 9605/C, 9652/CQ (EGR, REU). In Mauritius the species was known from 1–2 localities only (Jovet-Ast 1976). Mauritius: Black River Gorges Nat. Park, N slope of Mt Cocotte, 710 m, on twig, D., S. & T. Pócs, D. Florins 9665/B (EGR, NAI). Tanzania, Morogoro District, Nguru Mts, which is part of the Crystalline Eastern Arc range: Watershed between Chogowale and Divue headwaters, 6 km SSE of Maskati Mission, at 1,960 m elev. On bamboo stems in montane rainforest dominated by Schefflera volkensii, Afrocrania volkensii and Podocarpus, T. Pócs, G. Kis 9129/W (EGR); Bamboo

Figs 9–14. – Figs 9–10. Colura heimii Ast (from Pócs & Kis 9129/W): 9 = habit, ventral view; 10 = underleaf. – Fig. 11. Colura imperfecta Steph., habit, dorsal view (from Pócs & Streimann 99117/AN). – Fig. 12. Colura rhynchophora Ast, habit with perianth (from S. & T. Pócs 03148/BB). – Fig. 13. Colura obesa Ast, leaf, ventral view (from Pócs 6889/CF). – Fig. 14. Heteroscyphus grandistipus (Steph.) Schiffn., underleaf, ventral view (from Pócs 9473/AF)
NOTES ON SOME SPECIES OF COLURA (LEJEUNEACEAE, JUNGERMANNIOPSIDA)

(Sinarundinaria alpina) forest with scattered Ocotea usambarensis trees, on the S slope of Mt Kwakungwi, 7 km SE of Maskati, at 1,970–2,000 m, on bamboo stem, T. Pócs, G. Kis 9135/AF and 9137/E (EGR); Dry elfin forest on the rocky top of Mt Kwakungwi, at 2,100 m, on tree bark, G. Kis, T. Pócs 9140/O and BQ (EGR). Jovet-Ast (1954, 1958, 1976) has published it and we also found it from several localities in Madagascar, where it seems to be widespread. Not so common in the island of Réunion, where it became known from 7 localities (Ah Peng et al. 2012) and was known only from 1–2 localities in Mauritius (Jovet-Ast 1976). It became known also from the Comoro Islands: Mayotte (Pócs 2010). More surprising is its discovery in continental Africa (Tanzania).

Colura humbertii Ast, Rev. Bryol. Lichénol. 22(3): 251 (1954) (Figs 6, 25) – Réunion: Le Grand Brule on the E slope of Piton de la Fournaise. On lava flow of the 1931 eruption above the “Vierge au Parasol”, at 50–350 m elev. On dead fern petiole in secondary Agauria-Casuarina-Erica bushes, E. Kónya, T. Pócs 9630/ZB (EGR). Tanzania: Nguru Mountains, on twigs in ericaceous heath of Kwasenjunga rock SE of Maskati Mission, at 2,010 m elev., G. Kis, T. Pócs 9111/AX (EGR, NAI). It differs from C. tenuicornis (A. Evans) Steph. not only by the short obtuse, conical perianth horns but also the much wider, inflated lower part of lobule very quickly tapering into the half leaf long, narrow sac in contrast to the gradually narrowing sac of C. tenuicornis. It was known as an endemic of Madagascar and the Mascarene Islands. Jovet-Ast (1954) described it from Madagascar but later (1958) published it also from 3 localities in Réunion and Jones (1979) from Mauritius, but new for continental Africa.

Colura imperfecta Steph., Sp. Hepat. 5: 938 (1916) (Fig. 11) – Australia, Queensland edge of Atherton Tableland, Wooronooran Nat. Park, Henrietta Creek, 33 km WSW of Innisfail town, along the Palmerston Highway, epiphyllous in lowland rainforest with scattered Agathis robusta trees, at 375 m elev. T. Pócs, H. Streimann 9911/AN (CANB, EGR). A Malesian–Melanesian species distributed from the Malay Peninsula through New Guinea to the Solomon Islands. New to Australia.

Colura obesa Ast., Rev. Bryol. Lichénol. 22(2–3): 273 (1954) (Fig. 13) – New localities in Réunion: S slope of Piton de la Fournaise volcano from Basse Vallée at 930–1,300 m elevation, on twigs in mossy and in elfin forests, T. Pócs 9602/DD, 9612/DA (EGR). Tanzania, Uluguru Mts, summit and NE ridge of Bondwa Peak, 1,600–2,120 m elev. on leaves and on bark, T. Pócs 6889/CF, T. Pócs, M. Crosby 6844/GE (EGR, NAI). It is quite widespread in Madagascar (Jovet-Ast 1954), but had only one known locality in Réunion Island (Ah-Peng et al. 2012). After recording it from São Tomé and from Príncipe Island at very low altitudes, Pócs in Pócs et al. (2015: 57–59) discussed in details, supported by microphotos and a comparative table, its synonymy with the sympatric C. benoistii Ast. The present records are new to mainland Africa. The illustration of Jones (1979: 388, fig. 1/c) intends to depict C. dusenii Steph. This drawing

Acta Bot. Hung. 62, 2020

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Acta Bot. Hung. 62, 2020

398

PÓCS, T.

exactly matches the drawing of the type of C. obesa Ast, provided by Jovet-Ast (1954: 274, fig. 44/4) and Pócs et al. (2015: 57, figs 3C–D), but not the illustration of C. dusenii in Jones (1958: 62, fig. 3/D). The latter corresponds better to the figure of C. dusenii provided by Jovet-Ast (1954: 275, fig. 45). Therefore, I suppose that several records of C. dusenii of Jones from continental West Africa apply also to C. obesa.

Colura rhynchophora Ast, Rev. Bryol. Lichénol. 17(1–4): 27 (1948) (Fig. 12) – Dominican Republic, prov. La Vega. Cordillera Central, Constanza, between El Convento and Valle Nuevo, epiphyllous on fern leaves in wet, mossy Pinus occidentalis forest at 2,040 m elev. S. & T. Pócs 03148/BB (EGR). A Caribbean species known from Guadeloupe (Jovet-Ast 1954), Cuba (Mustelier Martínez 2005), Jamaica (Schäfer-Verwimp and van Melick 2016), Dominica (Schäfer-Verwimp 1999), Martinique, Guyana, Suriname (Gradstein 1997), and Costa Rica (Eggers in Eggers et al. 2004). New to the Island of Hispaniola.

Colura saroltiae Pócs, J. Bryol. 14(3): 497 (1987) (Figs 8, 24) – Tanzania, we have found new localities in the western part of Nguru Mts: on Erica twigs in the summit bush of Mafulumula Ridge, at 2,050 m, on twigs in the elfin forest at our campsite NE from Divue headwaters at 2,090 m elevation, G. Kis, T. Pócs 9124/ S, 9130/AP (EGR, NAI). This large and spectacular species preferring ericaceous twigs was hitherto known in Tanzania from the Kilimanjaro Mts (type), West Usambara Mts, E part of Nguru Mts, Rungwe Mts (Jones and Pócs 1987, Pócs 1991, Pócs 1994, Pócs and Váňa 2015); Kenya (Enroth et al. 2019, Pócs and Váňa 2015) and from Rwanda (Fischer 2013).

DESCRIPTION OF THE NEW SPECIES

Colura cataractarum Pócs, spec. nova (sect. Colura) (Figs 15–22)

Similar to Colura ochyrana Pócs from Peru (Pócs 2019) and C. junghuhniana Steph. from Java (Stephani 1916) in the hood-like lobule sac (other members of sect. Colura have narrowly elongate horns), but differing from both species in the wider (5–8 cells wide) underleaf lobes and short, triangular perianth horns (similar to those of C. calyptrifolia). The new species is furthermore separated from C. ochyrana by the obtuse apex of the lobular sac and from C. junghuhniana by the smooth leaf cells, without papillae.

Type: Madagascar, Prov. Fianarantsoa, Reg. Haute-Matsiatra, Andringitra Massif and National Park, on steadily irrigated granite rocks in the cataracts of the W tributary of Korokoro River, near Camp III, surrounded by mossy montane rainforest at 1,230 m elevation, 22° 12’ 40” S, 47° 00’ 00” E, T. Pócs, A. Szabó 9473/K, 22. Sept. 1994 (holotype: TAN; isotypes: G, GOET, EGR, MO, herb. Schäfer-Verwimp).
Plants in herbarium brownish yellow, creeping on the irrigated granite rock, forming a continuous mat. Stems ca 50 µm thick, adherent, irregularly branched, branches to 4 mm long. Leaves about 1 mm long, erecto-patent, spreading at an angle of 60–80° to the stem. Lobes about half of the lobule.

Figs 15–21. Colura cataractarum Pócs, sp. nov. (all from the type): 15 = habit, side view; 16 = lant with perianth, side view; 17 = leaves, side view; 18 = rhizoid bundles, side view; 19 = valve; 20 = lobe cells; 21 = underleaf

*Acta Bot. Hung.* 62, 2020
length, inflated, convolute, about 250 µm wide, auriculate at base. Lobules gradually widening above into a hood shaped sac, ca 200 µm wide at base and 500–600 µm long, with obtuse apex. Leaf cells irregular polygonal, ca 20 µm in diameter, somewhat elongate near the lobe margin, to 40 µm long, walls thin, without trigones and intermediate thickenings, outer wall smooth, on the sac mamillously protruding. Valves ca 75 × 65 µm, with 16–17 hyaline marginal and 11–12 median cells, of which the two basal ones are more or less triangular in shape. Underleaves

Fig. 22. András Szabó collecting *Colura cataractarum* at its type locality, from the irrigated granite rocks

Fig. 23. Endemic species of Madagascar. Star: *Colura cataractarum*, ring: *Colura bicornis*. (Here and later: black: known data, white: new records)
V-shaped, to 500 µm wide, with triangular lobes, 5–8 cells wide at their base, ending in a row of 1–2 rounded cells. Rhizoids colourless, unicellular, often ending up in short dichotomy. Gynoecia on very short side branches; female bracts with rounded apex, about 1/3 of the length of the perianth; perianth urn-shaped, up to 1.2 mm long, without horns 0.5 mm wide, with 5 horns, the horns broadly triangular, 100–200 µm long, nearly horizontally spreading; beak 1–2 cells (up to 6 µm) high, not emerging. Androecia not seen. Vegetative reproduction by gemmae from the perianth mouth.

Etymology: named for its occurrence on regularly irrigated rock surfaces in a cataract (Fig. 22). This habitat is very rare in the genus Colura and is otherwise known in the morphologically highly unusual C. irrorata (Spruce) Heinrichs, Y. Yu, Schäf.-Verw. et Pócs (= Myriocolea irrorata Spruce) (Gradstein et al. 2004).

DISCUSSION

Since the publication of World checklist of hornworts and liverworts (Söderström et al. 2016) four new species of Colura have been described, hence the total number of species in this genus, according to our present knowledge, is 86. The number may change in the future with synonymization and description of further species. A notable feature of the genus is that the greater part of the species is endemic, while several species are worldwide distributed or at least pantropical. This can be the result partly of their quick and steady evolvement since the Cretaceous (Feldberg et al. 2014, Wilson et al. 2007), partly of the ability of many species for vegetative reproduction by mass production of disciform gemmae. These develop in endo- or exogenous ways (Pócs 2012), usually at the upper end of the sacciform lobule and sometimes on the perianth. The gemmae might be more successful in long range dispersal than the large, protonemal spores attaining sometimes 100 µm in length in many species (Weiss 2001). The fully developed gemmae of different Colura species have the same diameter (80–100 µm), but being lighter and having much larger specific surface due to their shape (Zanten and Pócs 1981) they have a good chance to float in the air. Their survival ability is not yet experimentally checked. It is notable that the autoicous, worldwide distributed Colura calyptrifolia has relatively small, unicellular spores (Jovet-Ast 1954).

Examples of endemic species are the Melanesian endemics (Fig. 23) C. australiensis, C. crispiloba and C. vitiensis Eggers et Pócs (the latter reaching westwards to the Solomon Islands; Pócs 2013), and C. queenslandica B. Thiers, a narrow endemic of Queensland (Thiers 1987). Colura heimii and C. humbertii, hitherto considered endemic to Madagascar and the Mascarene Islands, have become known also from the Nguru Mts of Tanzania (Fig. 24). These two species are joining the group of more than 50 “Lemurian” elements (Pócs 1975, 1982, 1999,
Acta Bot. Hung. 62, 2020

2000, Tixier 1978) occurring in Madagascar and the crystalline Eastern Arc mountain range of mainland Africa, extending from southern Kenya to southern Tanzania.

The new species, *C. cataractarum*, represents a small group within section *Colura* characterised by the hood-like, relatively wide conical sac, approaching morphologically the sect. *Oidocorys*. In fact, these two sections, characterised by their valves with 2 triangular basal-median cells (Grolle and Zhu 2002), represent related, sister lineages within the subgenus *Colura*, separated from the sect. *Harmophylllum* (Heinrichs et al. 2012). *Colura cataractarum* seems to be a narrow endemic of Madagascar, similarly in distribution to *C. bicornis* (Fig. 22).

The Andringitra Massif, where the new species was found, is particularly rich in endemics compared with other Madagascar localities, and several new bryophyte taxa have recently been described from this area. Examples of rare taxa of this area include *Amazoopsis diplopoda* (Pócs) J. J.
NOTES ON SOME SPECIES OF COLURA (LEJEUNEACEAE, JUNGERMANNIOPSIDA) 403

Engel et G. L. Merr., Ceratolejeunea andringitrae Pócs, Cheilolejeunea cordigera (Steph.) Grolle, Colura bicornis Ast, Diplasiolejeunea andringitrae Schäfer-Verw., D. ornata Pócs et Schäfer-Verw., Otolejeunea moniliata Grolle in Tixier, Plagiochila angusta Lindemb., Serpotortella chenagonii (Ren. et Card.) Vitt et Zander and Heteroscyphus grandistipus (Steph.) Schiffn. (Fig. 14), the latter growing on tree-fern stems and decaying logs in mossy montane rainforest (Pócs 9473/AF, EGR, TAN). This species is new to Madagascar, hitherto being known only from Zimbabwe (Sim 1926) and Réunion (Ah-Peng et al. 2012). A good illustration of the species is available in the Icones of Stephani (1985: 1833).

As the new records of the Colura species have demonstrated, the ranges of the species of this large genus are still very imperfectly known. To obtain a more precise picture, many more specimens have to be studied by morphotaxonomic and molecular methods.

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