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Beta lomatogona, a new addition to the flora of Cyprus

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Abstract. – *Beta lomatogona* is recorded in Cyprus for the first time. A morphological description and information on its taxonomy, distribution and ecology, as well as floristic status are provided. It should be characterised as "Critically Endangered".

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Introduction

The genus *Beta* L., *Patellifolia* A. J. Scott & al. included, comprises at least ten species in four sections, however this uncertainty of being able to specify the exact number results from different taxonomic concepts. Traditionally, only one taxon of the genus, *B. vulgaris* subsp. *maritima* (L.) Arcang., has been accepted to occur in Cyprus, due to the fact that Meikle's (1985) treatment is based on a very broad view of the problematic group. Later, Letschert (1993) demonstrated that *B. vulgaris* s. l. in Cyprus consists of three taxa, namely *B. vulgaris* subsp. *maritima*, *B. adanensis* Pamukç. and *B. macrocarpa* Guss. and indeed their occurrence has been confirmed recently (Hand 2018). All these taxa belong to section *Beta*.

In addition to the above-mentioned taxa, another beet species, *B. lomatogona* Fisch. & C. A. Mey., belonging to section *Corollinae* Ulbr. was found in a small streambed, at an altitude of 1665 m, in the Troodos National Forest Park, phytogeographical division 2 (sensu Meikle 1977, 1985).

Taxonomy

B. lomatogona forms together with *B. macrorhiza* Steven and *B. corolliflora* Sossim. ex Buttler the section *Corollinae* of *Beta*. The species are distributed in the western part of the Irano-Turanian Region (Oriental-Turanian Floristic Region in the terminology of Meusel & al. 1965). The supposed evolution centre is located in historical Armenia comprising parts of the present-day states of Turkey (eastern Anatolia) and adjacent areas in Armenia (western provinces Aragatsotn, Shirak, Ararat) and Iran (Azerbaijan). The plants are cold-resistant, long-living perennials with a stout taproot up to 2 m long. Old plants produce several caudicles each giving rise to an ample panicle.

The first two species mentioned are diploid (n = 9), whereas *B. corolliflora* is tetraploid. Characteristically the species are self-sterile. Additionally, apomictic hybrids are not infrequent. In Anatolia yet unnamed tetra- and pentaploids of the combination *B. lomatogona* × *corolliflora* are widespread. Another apomict, the hexaploid *B. trigyna* Waldst. & Kit. occurs in south-eastern Europe but has not been observed in Anatolia.

Description based on Cypriot material

Perennial herb with erect or rarely decumbent stems, 45–80(–100) cm long; taproot long-living, woody, dark-brown, in old plants apically with several caudicles giving rise to small groups of inflorescences (Fig. 1). **Stems** leafy, usually unbranched in the lower part, prominently sulcate, the ridges of ribs usually stained crimson especially towards the base, glabrous or sub-glabrous with scattered hairs. **Leaves** alternate, entire, slightly thick and fleshy, ovate to rhomboid, deltoid or lanceolate, glabrous or with scattered hairs; margin entire, flat or slightly undulate; apex acute. Basal leaves forming a more or less loose rosette; lamina 5–15 × 2.8–5.5 cm; petiole 5.0–20.5 cm long, canaliculate above, distally narrowly winged by the decurrent lamina and coloured towards the base. Stem leaves oblong-lanceolate, progressively smaller upwards with considerably shorter petiole or sessile. **Inflorescences** richly branched panicles, narrow at first with short branches but becoming wider with spreading branches in mature plants. Branches elongate, spiciform, bracteate, leafless almost to the base. **Bracts** resembling stem leaves but considerably smaller, the lower ones about 2.5 × 0.5 cm diminishing upwards. Bracteoles three, linear, the central about 3 mm long, the two lateral smaller 1.2–1.5 mm long. **Flowers** solitary, sessile, densely arranged along the inflorescence branches and becoming more widely spaced by the beginning of fruiting (Fig. 2). Perianth segments 5, 2.5–3.0 mm long, oblong, erect forward pointing, yellowish-white to greenish with membranous fimbriately toothed whitish margins, strongly keeled and distally hooded, becoming green in fruit. Stamens 5. Stigmas usually 4 or occasionally 3, about 1.5 mm long. Ovary semi-inferior. **Ripe fruits** 5-sided, pericarp hard and silicified, crowned by the persistent, shrunken and convergent perianth segments. Seeds blackish-brown, strongly rugose, about 2.5 × 3.2 mm.

Flowering period in Cyprus: (late May?–)June–July.

Illustrations: Fig. 1, 2; a more comprehensive photo documentation is to be found in the online checklist for Cyprus (Hand & al. 2011–).

Distribution and ecology in Cyprus

In Cyprus *B. lomatogona* has been found hitherto only at one location in the Troodos National Forest Park, which belongs to the phytogeographical division 2 (sensu Meikle 1977, 1985). The altitude of the area is around 1665 m, whereas the geological substrate is serpentine (serpentinized, tectonized harzburgite of the Troodos ophiolite). The plants grow in open, relatively moist streambeds with deep soil and shallow incline, which is surrounded by *Pinus nigra* subsp. *pallasiana* forest; the accompanying species are *Pteridium aquilinum*, *Poa pratensis* (Vulnerable), *Juncus heldreichianus*, *Silene vulgaris*, *Viola sieheana* and sporadically *Alyssum cypricum, Colchicum troodi, Ornithogalum chionophilum, Hypericum confertum* subsp. *stenobotrys, Rosa canina* and *Berberis cretica*, appearing mainly on the margins of the habitat.

Fig. 1: *Beta lomatogona*, Troodos National Forest Park, plant habit, 27.6.2017. – Charalambos S. Christodoulou.

Fig. 2: *Beta lomatogona*, Troodos National Forest Park, inflorescence with flowers and young fruits, 27.6.2017. – Charalambos S. Christodoulou.

Floristic status

B. lomatogona is a typical element of the Irano-Turanian flora (distribution map in Buttler 1977: 296), which occupies an area in west-east extension of more than 1600 km from south-western Anatolia (Elmalı area) to the mountains west of the Caspian Sea. The altitude ranges from 700–2330 m, with the species limited to the lower altitudinal belt of the high plateaus.

Disjunctions between this phytogeographical region and Cyprus are not common but can be found in species such as *Bongardia chrysogonum*, *Gundelia tournefortii*, *Lactuca undulata* and *Zosima absinthiifolia*. *B. lomatogona* also belongs to a group of taxa which are restricted in Cyprus to the higher elevations of the Troodos Mountains and which are more or less widespread in neighbouring countries such as Turkey but not necessarily limited to mountainous areas. This group comprises, e. g., *Agrimonia eupatoria*, *Campanula podocarpa*, *Chenopodium foliosum*, *Galium recurvum*, *Holosteum umbellatum*, *Myosotis pusilla* and *Sorbus graeca*. Overall, *B. lomatogona* shows a rather rare pattern of distribution type as regards its occurrence in Cyprus; but it is not unique.

A question of particular interest is the floristic status of *B. lomatogona* in Cyprus. Must the status be considered as being indigenous or introduced by man? To solve the question, if at all possible, there are two main aspects to look at: reproduction and chorology.

(1) As a self-sterile species, *B. lomatogona* is only able to build populations if at least two plants grow together at the site. However, rare exceptions are imaginable and have been observed in other species. If the self-incompatibility breaks down, be it by internal (mutation) or external causes (climate, viruses, feeding source), then occasional fruit set may be possible. The probability, however, is estimated to be very small. In favour of such an event are the longevity of the plant and its rich fruiting. Supposed one plant lives 50 years, has 5 caudicles and produces 100 fruits per inflorescence, the seed-set amounts to 25,000 seeds. At a probability of 0.1 ‰, 2–3 viable seeds may be produced.

(2) The smallest distance from the population at the Troodos Mountains to a known locality with *B. lomatogona* in southern Anatolia is 260 km (Bozkır). Others further west and east are in a similar range: İrmasan geçidi 275 km, Ovacık 285 km, Gülek boğazı 315 km (see Buttler 1977). The actual distance between the south coast of Anatolia and the north coast of Cyprus across the Cilician Basin varies between 70 and 90 km. Four further geological and macroclimatic details are important in the context discussed here:

a) The genesis of the Troodos Massif occurred during the Turonian (92 million years BP) and is associated with volcanic activity at the bottom of the Tethys Ocean. In late Oligocene and the beginning of Miocene (25 million years BP) the uplift of Troodos started, which became more intensive in the Middle Miocene (15 million years BP). Meanwhile, during the Alpine Orogenesis (10 million years BP) the Pentadaktylos range has been uplifted in the north of Troodos

(Constantinou & Panagides 2013: 95–99, Hadjikyriakou 2017: 27). During this long period of time the island was never connected to the Eurasian mainland, but see c below (Geological Survey Department of the Republic of Cyprus 2018).

b) In the north, the island of Cyprus is separated from Anatolia by the Cilician Basin. The Basin is surrounded by steep coastal slopes, the sea floor reaching a maximum depth of more than 1400 m (Reinert-Ritz 2014).

c) A major event took place during the Messinian (7.25–5.33 million years BP), the so-called Messinian Salinity Crisis when the Mediterranean Sea desiccated leaving water only in the deepest basins (see, e. g., Roveri & al. 2014). With a maximum depth of c. 1400 m (maybe less during the Messinian), it is probable that the Cilician Basin was above sea level and a land bridge between Anatolia and Cyprus may have existed.

d) In the Pleistocene (2.59–0.0117 million years BP), during repetitive Glacial periods, sea level dropped as much as 100-120 m below the present sea level decreasing the distance between Anatolia and Cyprus by about 5 km in comparison to the present.

On the basis of the presented facts, the different migration possibilities of *B. lomatogona* into Cyprus can be examined. As usual in this context, three options are discussed: recent or historical introduction by man or natural area expansion. The possibilities are shown in Tab. 1.

Tab. 1: Probability of a vector for the dispersal of *Beta lomatogona* into Cyprus.

era / vector / years		abiotic/*nae*	animals		man
			birds	other	
Modern Age	1492–	–	+ [a]	?	(–) [c]
Middle Ages	476–1492	–	+	?	(+)
Ancient Times	776 BP–476	–	+	?	(+)
Prehistory	11.700–776 BP	–	+	?	?
Pleistocene	2.59–0.0117 my BP	–	?	?	–
Messinian	7.25–5.33 my BP	(+) [b]	?	?	–
L. Miocene	c. 20 my BP–	– [d]	–	–	–

my = million years, BP = before the present, *nae* = natural area expansion
probability: – impossible, (–) very low, (+) low, + possible, ? unpredictable
[a b c d] see the text

[a] The role of migratory birds may be a plausible explanation for the presence of *B. lomatogona* on Cyprus. If the hard, silicified and about 3 mm large seeds have been ingested, they may remain long enough in the bird's digestive system to be taken across the Cilician Basin. An important factor in this context is perhaps that the *Beta*

location is situated next to a spring with running water all the year round. In this respect, birds may be particularly attracted in the otherwise more or less dry landscape. Some seed-eating species, such as finches and buntings, are well known to overwinter in the upper Troodos and a few of them may be breeding birds from Turkey or migrating birds having stop-overs in Turkey. Various wintering species such as Brambling (*Fringilla montifringilla*) or Yellowhammer (*Emberiza citrinella*) are more or less restricted to the *Pinus nigra* zone in Troodos (Flint & Stewart 1992).
Even the plant may benefit from the diaspore transport by birds as the ingested fruit becomes scarified by the bird's digestive system, a process that facilitates germination. If the assumption is true, no time, however, is to be defined. The event may have taken place rather recently, as well as in the far past.

[b] It is generally believed that during the Messinian the non-flooded areas were covered by extensive and hostile salt steppes or deserts as the typical vegetation of plains. This statement must be questioned. The character of the Cilician Basin may have been that of a broad canyon bordered by steep slopes and with a central river draining towards the west. It is not plausible to assume that these slopes were totally covered by salt vegetation. Smaller or greater steppe patches may have been intercalated and served as stepping stones for the migration of non-halophytic species – like *B. lomatogona*.

[c] In Anatolia *B. lomatogona* grows chiefly in or along grain fields (Buttler 1977) and its distribution is intimately connected with traditional farming (harvest by hand, threshing on special threshing floors, winnowing by tossing chaff and grain into the air). By this method seeds of the wild beet are not separated from the grain seed and are brought back to the area sown. A good example is a voucher at FR, collected by O. Fiedler in 1963, with the note (translated from German): "cultivated from weed seed in Turkish barley from a silo at Emden, … sown 1955". Furthermore, with their deep reaching taproot the plants resist flat ploughing. For the population in Cyprus, agriculture does not seem relevant, at least not for the Modern Age. The (semi-)natural habitat is far away from cultivated land located at the highest parts of Troodos, which is scarcely inhabited. The situation in earlier eras may have been different, but the influence of man is also questionable.

[d] The arrival of *B. lomatogona* on Cyprus during the Miocene is most unlikely. There existed no land connection to Anatolia.

To sum up, *B. lomatogona* is an indigenous member of the Cypriot flora. As the arguments suggest, man most probably played no role in the establishment of the small Cypriot population.

A chorological detail has to be highlighted. In south-western Anatolia *B. lomatogona* penetrates into the South Anatolian Floristic Province, which is part of the Mediterranean Subregion (Meusel & al. 1965). The province is characterised by a less continental (less arid and hot) climate than the Irano-Turanian Region; steppes are found only on a small scale in limited areas. Cyprus also belongs to the Mediterranean Sub-

region. Thus, the presence of *B. lomatogona* on Cyprus is chorologically plausible and is not in contradiction to its occurrence outside the Irano-Turanian Region.

Conservation status

The species is known since 1991 growing in an area of less than a hectare, with no obvious change to its population or habitat. In view of the small geographical range (extent of occurrence and area of occupancy), the single location and the extent of the species' habitat (IUCN Standards and Petitions Subcommittee 2014), it can be characterised as Critically Endangered [CR; IUCN criteria: B1ab(iii)+2ab(iii)].

Specimens seen

Cyprus: Xylovrysi Troodos, moist grassy ground, 1665 m, 7.7.1991, *C. S. Christodoulou 1172* (CYP). – ibid., 7.7.1991, *C. S. Christodoulou in Hadjikyriakou 2771* (Hadjikyriakou pers. herb.); ibid., 23.6.2017, *G. N. Hadjikyriakou 7571* (Hadjikyriakou pers. herb.); ibid., 27.6.2017, *C. S. Christodoulou 6599* (B, CYP); ibid., 12.6.2018, *R. Hand 8983 & C. S. Christodoulou* (B).

Selected specimens from outside Cyprus (for an extensive list of specimens see Buttler 1977):

Turkey: Armenia turcica, Egin, Altikioei, in campis, 1.6.1890, *P. Sintenis, Iter Orient. 1890, 2451*, conf. K. P. Buttler 1972 (B). – Bithynia, Ad Bilečik, in declivitatibus vallis fluvii Kara-su, in vinetis derelictis prope stationem, 300–400 m, 19.5.1929, *J. Bornmüller, Iter Anatol. V, 14589*, conf. K. P. Buttler 1972 (B). – Phrygia, ad Akscheher, in campis, 1000 m, 14.6.1899, *J. Bornmüller, Iter Anatol. III, 5522* "*Beta intermedia*", det. K. P. Buttler 1972 (B).
Iran: Prov. Azerbaijan orient., 2–12 km w Zonuz, 1500–1700 m, 7.6.1971, *K. H. Rechinger, Iter Iran. VII, 41362*, det. K. P. Buttler 1971 (B).

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