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GERHARD WAGENITZ, FRANK H. HELLWIG, GERALD PAROLLY & LUDWIG MARTINS

Two new species of *Centaurea (Compositae, Cardueae)* from Turkey

Abstract

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Two new species of *Centaurea* collected by R. Ulrich in southern Anatolia are described, mapped and illustrated. *C. ulrichiorum* is apparently very isolated and cannot be assigned to any of the known sections; molecular data place it in a clade comprising, e.g., the sections *Jacea* and *Acrolophus*. *C. werneri* is a member of *C.* sect. *Acrolophus* with affinities to species of the Balkans.

Key words: angiosperms, *Asteraceae,* Anatolia, ITS, ETS, systematics, endemism.

Introduction

Centaurea L. is one of the largest genera in the flora of Turkey. This holds true even if the new, revised system is accepted that excludes *Rhaponticoides* Vaill., *Psephellus* Cass. and *Cyanus* Mill. (Wagenitz & Hellwig 2000, Greuter 2003). Since the last revision for the Flora of Turkey (Wagenitz 1975a) the following new species of *Centaurea* s.l. have been added (literature citations are given for the newly described species):

Centaurea amplifolia Boiss. & Heldr. ≡ *Rhaponticoides amplifolia* (Boiss. & Heldr.) M. V. Agab. & Greuter

C. (sect. *Phalolepis* (Cass.) DC.?) *antalyense* A. Duran & H. Duman in Ann. Bot. Fenn. 39: 45. 2002

C. (sect. *Cheirolepis* (Boiss.) O. Hoffm.) *cankiriense* A. Duran & H. Duman in Ann. Bot. Fenn. 39: 43. 2002

C. (sect. *Acrolophus* (Cass.) DC.) *cariensiformis* Hub.-Mor. in Bauhinia 7: 179. 1982

C. hadimensis Wagenitz & al. in Willdenowia 28: 157. 1998 ≡ *Psephellus* (sect. *Psephelloidei* (Boiss.) Wagenitz & Hellwig) *hadimensis* (Wagenitz & al.) Wagenitz

C. iconiensis Hub.-Mor. in Bauhinia 7: 77. 1981 ≡ *Rhaponticoides iconiensis* (Hub.-Mor.) M. V. Agab. & Greuter

C. mykalea Hub.-Mor. in Bauhinia 6: 370. 1979 ≡ *Rhaponticoides mykalea* (Hub.-Mor.) M. V. Agab. & Greuter

C. (sect. *Acrolophus* (Cass.) DC.) *nydeggeri* Hub.-Mor. in Bauhinia 6: 285. 1978

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C. (sect. *Acrocentron* (Cass.) DC.) *rechingeri* Phitos

C. yildizii Civelek & al. in Bot. J. Linn. Soc. 143: 207-212. 2003 ≡ *Psephellus* (sect. *Psephelloidei* (Boiss.) Wagenitz & Hellwig) *yildizii* (Civelek & al.) Greuter

C. (sect. *Acrolophus* (Cass.) DC.) *yozgatensis* Wagenitz in Ann. Naturhist. Mus. Wien 98 B: 176. 1997

Several species only known from the type collection before 1975 have been recollected in the meantime, the most spectacular findings being *Centaurea foliosa* Boiss. & Kotschy (Wagenitz & Hellwig 1997), *C. taochia* Sosn. (Nydegger-Hügli 2000) and *C. leptophylla* (K. Koch) Tchich. (Nydegger-Hügli 2002).

At the beginning, the flora of Turkey was mainly explored by botanists from Central and W Europe. This period ended with the monumental "Flora of Turkey and the East Aegean Islands", edited, directed and for a substantial part authored by the British botanist Peter Davis (Davis 1965-85, Davis & al. 1988). This gave a strong impetus to Turkish botanists from different, often newly founded universities as can be seen in many papers of recent times (see, e.g., Güner & al. 2000). However, there are still collectors from Central Europe detecting new species, including, e.g., the Swiss collector Max Nydegger-Hügli and the German pharmacist Robert Ulrich, both with a keen eye for rare and new species. To Ulrich, who was especially active in S Anatolia (for his discoveries see Kilian & Parolly 2002, Parolly & Kilian 2003, Parolly & Nordt 2002, 2004, 2005, Parolly & Scholz 2004, Parolly & al. 2005), we also owe the material of two remarkable new *Centaurea* species together with valuable indications on their sites, phenology and conservation status.

Molecular phylogenetic analysis

For nrDNA sequence analyses, DNA was extracted from dry material, and the internal transcribed spacers (ITS-1 and ITS-2) and the 3' portion of the external transcribed spacer (ETS) were amplified and sequenced as described in detail by Martins & Hellwig (2005). The PCR of ITS-1 failed for *Centaurea stenolepis, C. deusta* and *C. alba* subsp. *latronum*. A list of the species included in the molecular phylogenetic analysis with their voucher data and GenBank accession numbers is given in the appendix. The alignment of the sequences was performed manually. It is available on request from L. Martins. The data set (1043 characters, 213 thereof parsimony-informative) was analysed with both Maximum Parsimony (MP) and Bayesian Inference of Phylogeny (BI). The MP analysis was performed using PAUP* 4.0b10 (Swofford 2000) by a heuristic search with 10 random addition sequence replicates, TBR branch swapping and the MulTrees option in function. Gaps were treated as missing data. Branch support was evaluated by means of a bootstrap analysis with 1000 replicates and by a decay analysis using AutoDecay (Eriksson & Wikström 1995). For the Bayesian analysis, the GTR+I+G model of nucleotide substitution was selected by the Akaike Information Criterion (AIC) as implemented in Modeltest version 3.5 (Posada & Crandall 1998). Bayesian analysis was done with MrBayes version 3.0B4 (Huelsenbeck & Ronquist 2001) with the following settings: number of substitution types = 6, rates = invgamma (i.e., GTR+I+G model), 4 Monte Carlo Markov chains (MCMC) for 2 000 000 generations, trees sampled every 100th generation, and 500 trees discarded as burn-in.

Results

Centaurea ulrichiorum Wagenitz, Hellwig & Parolly, **sp. nov.**
Holotype: Turkey, C4 Antalya, NE Demirtaş (Richtung Pass), 950 m, steiler Erdhang, Exp. W, 7.9.2001, *R. Ulrich 1/25* (GOET) – Fig. 1-2.

Planta elata, perennis, 50-80 cm alta, a basi valde ramosa ramis suberectis iterum ramosis, 4-6 capitula gerentibus. *Caulis* et folia glandulis sessilibus et pilis brevibus dense obsita, asperula, pilis longis interdum immixta. *Folia* inferiora lyrata, petiolata, segmentibus utrinque 1-4, media subovalia, apice acuta et mucrone minimo cartilagineo plusminusve distincto terminata, basi 1-2

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Fig. 1. *Centaurea ulrichiorum* – holotype specimen (GOET).

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Fig. 2. *Centaurea ulrichiorum* – capitulum. – From the holotype; scale bar = 10 mm.

lobis minutis provisa, sessilia; c. 2 × 4 cm, superiora sensim minora, indivisa. *Capitula* in parte basali ramorum saepe fere sessilia, caetera ad apice ramorum 2-10 cm longorum. *Involucrum* ovoideum, (10-)11-13(-14) × 8-10 mm; *appendices* phyllorum partem basalem earum pro parte obtegentes, non decurrentes, stramineae vel dilute brunneae, anguste triangulares, utrinque ciliis 5-6, 1.5-2 mm longis tenuibus provisae, interdum basi auriculatae, spinulo 1-1.5 mm longo vix validiore terminatae. *Flores* purpurei, marginales non radiantes; *tubus antherarum* florum hermaphroditum apice leviter curvatus. *Achaenia* 3.2-4 mm longa, grisea, cicatrice parva. *Pappus* 2.5-3.5 mm longus, setae scabrae ab externis ad series penultima elongatae, pappus internus c. 0.5 mm longus.

Erect perennial with a somewhat bushy, wiry appearance, 50-80 cm tall, arising from a weakly branched root-stock; remains of stems and leaf bases of the previous year present. *Branches* up to 20, all ± equalling in length, rigid, virgately and repeatedly branched, angled, leafy throughout, up to 4 mm in diam. at base. Stems and leaves with a dense, somewhat heteromorphic indumentum consisting of yellowish, sessile glands and long, white, evanescent hairs scattered among a dense cover (especially on leaves) of stiff, weakly hooked hairs, 0.1-0.2 mm long. *Basal leaves* including petiole 4-15 × 1-2.5 cm, lyrate with 1-4 unequally large segments, terminal segments largest, about $^1/_5$-$^1/_3$ of the total leaf length, often shallowly and irregularly dentate, the 4-6 teeth ending in cartilaginous mucros, apex acute, petiole up to 8 cm long. *Median stem leaves* sessile, ovate to obovate in outline, c. 3-5 × 1-1.5(-2) cm, with 1-3 small lobes, margin of terminal lobe indistinctly dentate or entire, apex acute or obtuse, often with a cartilaginous mucro; upper stem leaves increasingly smaller, entire. *Capitula* up to 10 per branch, those at base of the branches partly subsessile, the upper on 2-12 cm long peduncles and solitary, or occasionally clustered and then one capitulum subsessile. *Involucre* ovoid, (10-)11-13(-14) × 8-10 mm.

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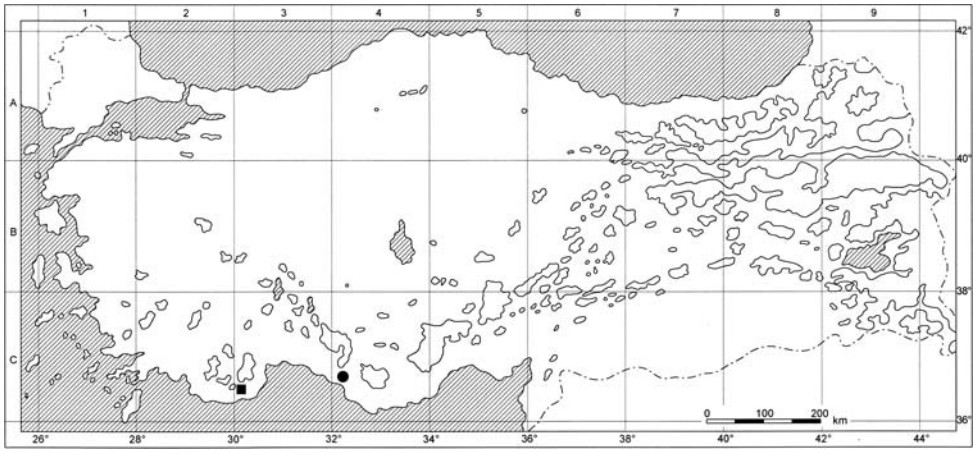


Fig. 3. Map of Turkey with the distribution of *Centaurea werneri* (■) and *C. ulrichiorum* (●).

Phyllaries firm, straw-coloured, glabrous, especially the inner ones in the upper part with indistinct elevated nerves; *appendages* moderately imbricate, not decurrent, in flower pale brown with a green centre, in fruit straw-coloured, narrowly triangular, occasionally auriculate at base, with 5-6(-7) distinctly verruculose 1.5-2 mm long cilia on either side and a weak, 1-1.5 mm long terminal spinule. *Receptacular bristles* 6-8 mm long. *Flowers* uniformly dark purplish violet, marginal ones not radiant; *corolla tube* c. 10 mm long; *anther tube* of hermaphroditic flowers faintly curved. *Achenes* elliptic, laterally compressed, 3.2-4 mm long, grey and yellowish striate, shining, with a very loose sericeous indumentum, hilum small. *Pappus* persistent, double, multiseriate, innermost bristles of outer pappus up to 2.5-3.5 mm, scabrous, inner pappus c. 0.5 mm long.

Additional specimens seen (paratypes). – TURKEY: C4 ANTALYA: NE Demirtaş (Richtung Pass), 950 m, steiler Erdhang, Exp. W, 24.10.2001, *R. Ulrich 1/25a & b* (herb. Parolly [consisting of two basal leaves and dissected capitulum]); ibid., 3.7.2003, *R. Ulrich 3/33* (herb. Parolly [in flower]); ibid., 13.11.2003, *R. Ulrich 3/33a* (herb. Parolly [in fruit]).

Eponymy. – The plant is named in honour of its discoverers, the German pharmacist Robert Ulrich, plant enthusiast with a tremendous knowledge of the flora of S Anatolia, and his wife Gertrud.

Systematic position and phylogeny. – When the authors saw this specimen, it was their immediate impression that it represents a new species. On closer inspection it became clear that the species does not fit into any of the known sections of *Centaurea*. The well differentiated (not decurrent) appendages are known from *C.* sect. *Jacea* (Mill.) DC., sect. *Cynaroides* Boiss. ex Walp. and several yellow-flowered sections in Turkey such as *C.* sect. *Cheirolepis,* sect. *Pseudoseridia* Wagenitz*,* sect. *Pteracantha* Wagenitz, but none of these has a combination of characters corresponding to the new species. Besides the habit and the nearly oval median stem leaves with small lobes at the base, the indumentum of the new species is particularly noteworthy. Stem and leaves have a dense indumentum of very short stiff hairs, which make them slightly rough on touch, and additional long hairs, which are very unevenly distributed.

Analysis of the molecular data set (Fig. 4) comprising DNA sequences from the nuclear genome (ITS and ETS) of the nuclear ribosomal repeat shows that on the basis of 213 parsimony-informative characters *Centaurea ulrichiorum* is nested in a monophyletic group (99 % bootstrap support, posterior probability = 1 and Bremer support value = 12) that also encompasses *C. benedicta* (L.) L. (= *Cnicus benedictus* L.), *C. stenolepis* A. Kern. and *C. inexpectata*

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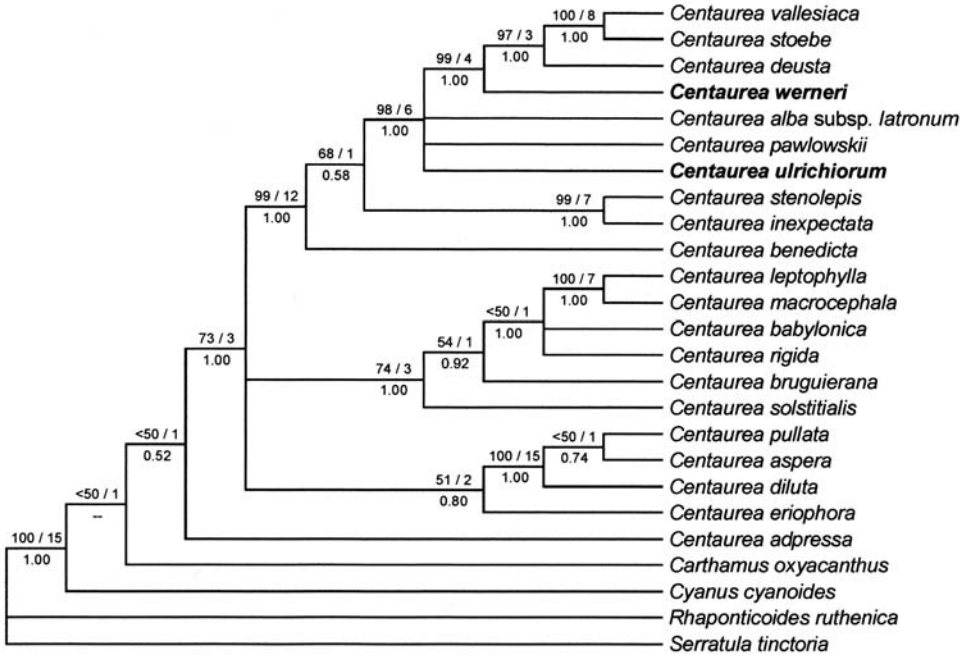


Fig. 4. Strict consensus tree of the 12 most parsimonious trees from the Maximum Parsimony analysis based on nrDNA ETS and ITS sequence data. Bootstrap percentages and decay indices (Bremer support) are given above branches. For those clades that are identical in the Bayesian Phylogenetic Analysis based on the same data posterior probabilities are given below branches.

Wagenitz from *C.* sect. *Jacea* and all representatives of *C.* sect. *Acrolophus* s.l. (including sect. *Willkommia* Blanca and sect. *Phalolepis*). Garcia-Jacas & al. (2000) found the same close relationship between *C.* sect. *Phalolepis* and sect. *Jacea,* and the former genus *Cnicus* L.

Due to limited species sampling, the sister group of *Centaurea ulrichiorum* cannot be defined. However, the strong statistical support for the monophylum that besides of *C. ulrichiorum* contains only members of *C.* sect. *Acrolophus* s.l. leaves little doubt about the sectional affinity of the newly described species. The basal position of *C. ulrichiorum* within this section may support the idea that it retained some plesiomorphic features of its common ancestor with either *C. benedicta* or *C.* sect. *Jacea*. The slightly curved anther tube reminds of the pronouncedly curved tube in *C. benedicta.* Knowledge of the chromosome number of *C. ulrichiorum* would provide further evidence of its sectional affiliation.

Site ecology and phenology. – *Centaurea ulrichiorum* grows on an earthy, partly unstable, fairly barren and strongly eroded slope merging into a bank below a *Pinus brutia* Ten. forest at 950 m. The few associated species include some scattered individuals of *Sideritis argyrea* P. H. Davis (an endemic of the Isaurian Taurus), *Peucedanum isauricum* Parolly & Nordt, another local endemic recently discovered by R. Ulrich and described from here (Parolly & Nordt 2004), and *Silene rigidula* Sm. in the drier mid-slope as well as more frequently *Chrysophthalmum dichotomum* Boiss. & Heldr. at the lower and damper margin. *C. ulrichiorum* flowers from early July till mid October, with an assumed peak of flowering in August. Ripe fruits date from November and may not be obtained earlier than at the end of September.

Distribution and recommended IUCN threat category. – *Centaurea ulrichiorum* is hitherto only recorded from its type locality near Demirtaş in the western Central Taurus (Fig. 3). The local

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population consists of two major stocks, each with more than 20 flowering shoots, and some 40 younger, smaller individuals, most of them at vegetative stage. A careful search by the Ulrichs over three years failed to detect more plants or additional localities. Fruit-set was copious, but the achenes were heavily infested by insects. R. Ulrich noted in November 2003 that the softer parts of more than 90 % of all fruits were eaten up. Moreover, the only known locality of the new species is situated along a road and is therefore directly threatened by any road widening. The known data support the view that *C. ulrichiorum* is among the rarest plant species of Turkey and facing an uncertain future. Its classification as "Critically Endangered" (CR) according to criterion C of the IUCN Red List Categories (IUCN 2001) is thus inevitable.

Centaurea (sect. *Acrolophus*) ***werneri*** Wagenitz, Hellwig & Parolly, **sp. nov.**
Holotype: Turkey, C3 Antalaya, Finike - Korkuteli, N Finike, 440 m, senkrechte Kalkfelsen, SE-Exposition, 29.4.2004, *R. Ulrich 4/1* (GOET; isotypes: B, GOET) – Fig. 5-7.

Species affinis *C. wettsteinii* Degen & Dörfl. a qua differt foliis basalibus distincte lyratis et ciliis appendicorum utrinque 6-7.

Planta perennis. *Rhizoma* (caudex) crassum, tomentosum, cicatricibus foliorum et caulium obtectum, rosula foliorum terminatum, caulibus extrarosularibus. *Caulis* et folia plusminusve dense albo- vel griseotomentosa. *Folia rosulae* petiolata, lyrata, segmento terminali fere orbiculari vel late triangulari, 15-28 mm lato, indistincte denticulato, segmentibus lateralibus utrinque 4-5, basin versus minoribus, saepe basi lobulo parvo proviso. *Folia caulina* ovalia ad obovata, in petiolum latum angustata vel sessilia, inferiora interdum basi dentata vel lobata. *Caules* e basi foliorum rosularium ascendentes, arcuati, 10-15(-33) cm longi, 1-2(-3) capitula gerentes. *Involucrum* cupuliforme vel fere infundibuliforme, 15-16 mm longum, c. 8-10 mm latum. *Phylla* nervis elevatis longitudinaliter striata; *appendices* anguste triangulares, brunneae, ungues phyllorum pro parte obtegentes, utrinque ciliis albidis 6-7 3-3.5 mm longis ornatae, apice gracili 2-2.5 mm longa terminatae, basi margine hyalina decurrentes. *Flores marginales* radiantes, purpurei; *flores centrales* rosei (?, in sicco fere albidi), *tubus antherarum* apice purpurei. *Achaenia* 2.5 mm longa. *Pappus* 4 mm longus, duplex, series internae c. 1.5 mm longae.

Perennial plant with thick, tomentose root-stock surrounded by remains of leaf and stem bases and terminated by a leaf rosette. *Stems* several from the axils of the rosette leaves, ascending, arcuate, 10-15(-33) cm long, with 1-2(-3) capitula. Stems and leaves white to grey tomentose. *Rosette leaves* with a petiole 1.5-6 cm long, lamina lyrate, the terminal segment suborbicular or broadly triangular to ovate, entire or indistinctly denticulate, lateral segments (3-)4-5, obovate to elliptic, gradually smaller towards the base, often with a small lobe at the base giving the impression of an interruptedly lyrate leaf. *Cauline leaves* few, oval to obovate, 6-17 mm broad, ending in a minute mucro, sometimes with 1-2 lobes on either side, the lower ones narrowed into a broad petiole, the upper sessile. *Involucre* cup-shaped to funnel-shaped (at fruiting time), 15-16 mm long and c. 8-10 mm broad. *Phyllaries* glabrous, greenish, the inner ones distinctly striate by elevated nerves; *appendages* narrowly triangular, brownish, only partly concealing the bases, on either sides with 6-7 whitish cilia, 3-3.5 mm long and ending in a slender, 2-2.5 mm long spinule, decurrent on the phyllaries with a narrow hyaline border. *Marginal flowers* radiant, purple; *central flowers* rose-coloured (?, nearly white when dry); *anther tube* purple in the upper part. *Achenes* 2.5 mm long. *Pappus* double, 4 mm long, the inner series c. 1.5 mm long.

Additional specimen seen (paratype). – Turkey, C3 Antalya, Finike - Korkuteli, 400 m, senkrechte Kalkfelsen, W-exp., 11.6.2004, *R. Ulrich 4/5* (GOET).

Eponymy. – The species is named in honour of Werner Greuter, Director of the Botanic Garden and Botanical Museum Berlin-Dahlem, well-known as an excellent taxonomist with a long-standing interest in and dedication to the Greek flora.

Systematic position and phylogeny. – This new species belongs clearly to *Centaurea* sect. *Acrolophus,* the largest in the genus. The sectional classification is perfectly supported by the

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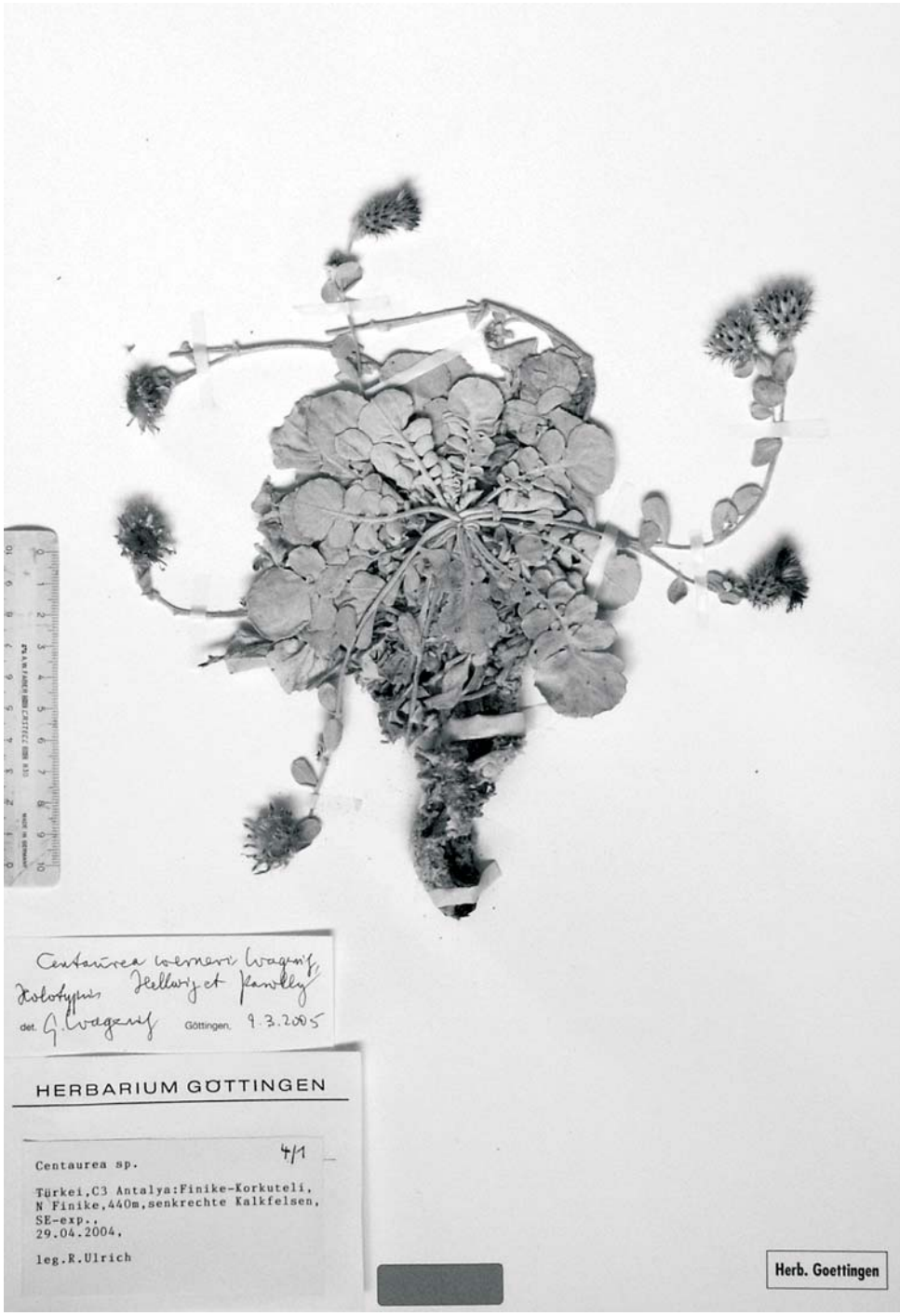


Fig. 5. *Centaurea werneri* – holotype specimen (GOET).

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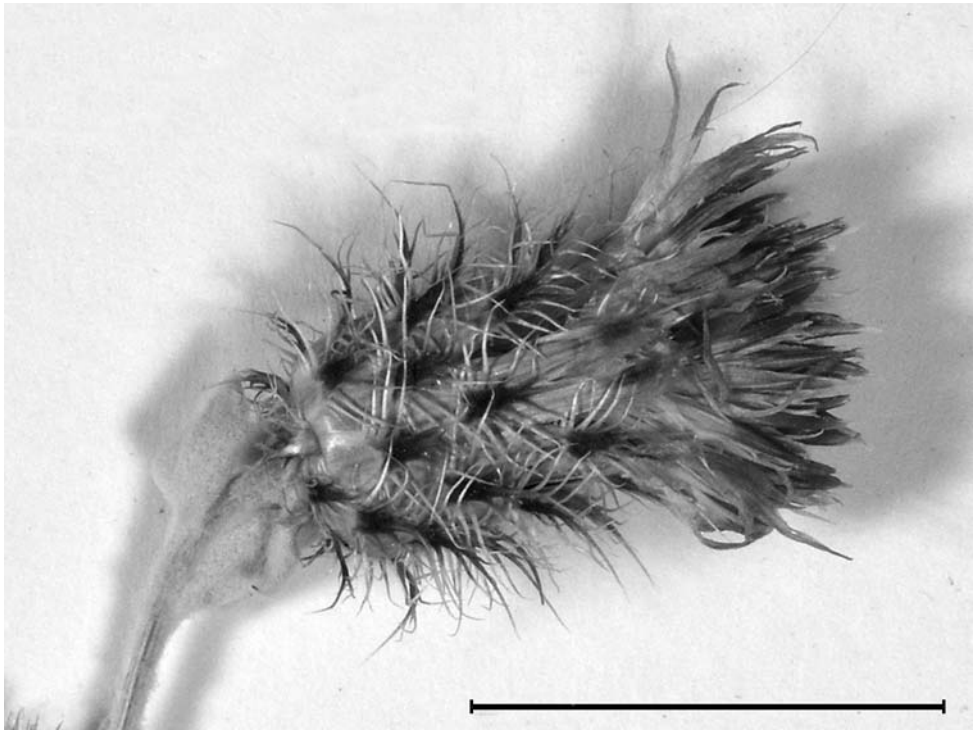


Fig. 6. *Centaurea werneri* – capitulum. – From the holotype; scale bar = 15 mm.

molecular findings (Fig. 4). No satisfactory subdivision of this section exists and its limits are not clear either. Hayek (1901) named several taxa in sect. *Acrolophus* without rank and with short descriptions. Dostál (1976) elevated these to sections. They are, however, ill-defined. It is apparent that *C. werneri* is isolated among the Turkish species of *C.* sect. *Acrolophus.* The closest species is *C. wettsteinii* Degen & Dörfl. from FYR Makedonija. Both are chasmophytic perennials with undetermined growth, the flowering stems arising from the base of the rosette. Thus, an elongated monopodial rhizome is formed. Large lyrate rosette leaves are present at flowering time, whereas the leaves of the flowering stems are much smaller. The flowering stems are ascending with a few large capitula (compared to other members of the section); the involucre is 15-17 mm long, open at fruiting time; the pappus is longer than the achene. *C. wettsteinii* differs by the structure of the leaves: the basal ones are pinnatipartite (the terminal segment scarcely larger than the lateral) and the stem leaves are more divided. Furthermore, *C. wettsteinii* differs in having a larger number of lateral cilia on the appendages (up to 10). Taxonomic affinities between the flora of the Balkans and Turkey are relatively rare in the genus *Centaurea* (see Wagenitz 1975b).

Boissier (1875) was the first to observe the growth form in *Centaurea* as described above. In *C.* sect. *Cyanus* (now genus *Cyanus*) he distinguished "caules floriferi infrarosulares" and "caules floriferi e rosulae centro" in the conspectus of the genus. Stefanoff & Georgieff (1931) in their revision of *C.* sect. *Cyanus* (Mill.) Dumort. described a subsect. *Infrarosulares* Stef. & T. Georgiev on account of this character. The same difference can be observed in the sections *Acrolophus* and *Phalolepis*. Typical examples of the type with infrarosular stems from *C.* sect. *Acrolophus* are *C. yozgatensis* Wagenitz, *C. austro-anatolica* Hub.-Mor., *C. dichroa* Boiss. & Heldr., from *C.* sect. *Phalolepis C. ptarmicoides* Halácsy (= *C. ptarmicifolia* Hayek), *C. cadmea* Boiss., probably also *C. pawlowskii* Phitos & Damboldt and the recently described *C. leonidia*

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Fig. 7. *Centaurea werneri* in fruiting stage on the rocks near Finike. – Photograph by G. Ulrich, 11.6.2004.

Kalpoutzakis & Constantinidis. It must be admitted, however, that it is not always easy to distinguish between the two possibilities, especially if only herbarium material is available.

Further species allied to *Centaurea werneri* are *C. niederi* Heldr. and *C. heldreichii* Halácsy. At least in *C. niederi* the flowering stem arises from the centre of the rosette (see the excellent figure in Tan & Iatrou 2001: t. 95a). These species have already been discussed by Wagenitz (1989) hinting at their affinity although formally *C. niederi* belongs in section *Acrolophus* and *C. heldreichii* (like *C. leonidia*) in sect. *Phalolepis*. All these plants grow typically in limestone rock crevices and have a very restricted distribution area.

Site ecology and phenology. – *Centaurea werneri* is a typical chasmophyte of sunny, steep, nearly vertical or even projecting limestone cliffs at altitudes between 400 and 460 m. The exposure varies between SE, SW and W. There are very few associated species: *Amygdalus graecus* Lindl., *Dianthus* sp., *Eryngium glomeratum* Lam., *Euphorbia hierosolymitana* Boiss., *Hypericum hubermorathii* N. K. B. Robson and *Ptilostemon chamaepeuce* (L.) Less. *C. werneri* flowers in April and May, on 11 June 2004 all plants were fruiting.

Distribution and recommended IUCN threat category. – *Centaurea werneri* is so far only known from one locality near Finike (Fig. 3), where Ulrich noted c. 350 plants. It is not immediately threatened at this place due to the special habitat, but nevertheless belongs to the very rare species of Turkey. On account of the very restricted area and small population, it must be considered as "Vulnerable" according to criterion D (D1+2) of the IUCN Red List Categories (IUCN 2001).

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We cordially thank the pharmacist Mr Robert Ulrich (Tübingen, Germany) and his wife, Mrs Gertrud Ulrich, for providing us with specimens, precise field notes and photographs. Mrs Sybille Hourticolon (Göttingen) made the photographs of the herbarium specimens. The paper has certainly benefited from the corrections and comments of the reviewers T. Constantinidis and N. Kilian.

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Appendix – List of the species included in the molecular study with their voucher data and GenBank accession numbers.

Accession numbers for new sequences not included in earlier studies are given in bold face.

Carthamus oxyacanthus M. Bieb. – Kyrgyzstan, Džalal-Abad oblast, 1 km E Taš-Kömür, 13.7. 2003, *Janßen 2034* (JE), AJ867985, AJ867986, AJ867987.

Centaurea adpressa Ledeb. – Kyrgyzstan, Ysyk-Köl oblast, between Bolšewik and Tört-Kül, 20.7.2003, *Martins 939* (JE), AJ867991, AJ867992, AJ867993

Centaurea alba subsp. *latronum* (Pau) Dostál – Spain, *Vicioso 881* (JE), **AM087172**, **AM087173**

Centaurea aspera subsp. *inermis* DC., cult. in the Botanical Garden Göttingen, voucher at JE, **AM087189**, **AM087190**, **AM087191**

Centaurea babylonica L. – Turkey, vil. İçel (Mersin), Gözne, 12.8.1994, *Hellwig & Kaya 60* (JE), **AM087617**, **AM087618**, **AM087619**

Centaurea benedicta (L.) L. (≡ *Cnicus benedictus* L.) – cult. in the Botanical Garden Göttingen, voucher at JE, **AM087159**, **AM087160**, **AM087161**

Centaurea bruguierana subsp. *belangeriana* (DC.) Bornm. – Iran, Fars, Borazjan, Amikhah, 26.4.1973, *Riazi 9326* (GOET), **AM087192**, **AM087193**, **AM087194**

Centaurea deusta subsp. *concolor* (DC.) Hayek – Croatia, Istria, 26.6.1999, *U. & W. Starmühler* (GOET), **AM087167**, **AM087168**

Centaurea diluta Aiton – Spain, 1997, *Lewejohann & Müller And-97-150* (JE), **AM087169**, **AM087170**, **AM087171**

Centaurea eriophora L. – Morocco, prov. Fes, 2 km SE Moulay-Yakoub (W of Fes), 30.4.1987, *Lippert 22982* (M), **AM087156**, **AM087157**, **AM087158**

Centaurea inexpectata Wagenitz – Turkey, vil. Zonguldak, 4.8.1962, *Davis & Coode 38440* (GOET), **AM087177**, **AM087178**, **AM087179**

Centaurea leptophylla (K. Koch) Tschich. – Turkey, vil. Çoruh, Sarigöl, 19.6.1988, *Nydegger 43398* (GOET), **AM087153**, **AM087154**, **AM087155**

Centaurea macrocephala Willd. – cult. in the Botanical Garden Göttingen, voucher at JE, **AM087162**, **AM087163**, **AM087164**

Centaurea pawlowskii Phitos & Damboldt – Greece, Pindus Mts, 18.7.1978, *Krendl* (GOET), **AM087174**, **AM087175**, **AM087176**

Centaurea pullata L. – cult. in the Botanical Garden Göttingen, voucher at JE, **AM087183**, **AM087184**, **AM087185**

Centaurea rigida Banks & Sol. – Turkey, vil. Mardin, 50 km W Cizre, 28.5.1983, *Sorger 83-10-2* (W), AJ867988, AJ867989, AJ867990

Centaurea solstitialis subsp. *carneola* (Boiss.) Wagenitz – Turkey, vil. İçel (Mersin), 5 km N of Erdemli on road to Güzeloluk, 26.7.1987, *Schroeder 12* (GOET), **AM087186**, **AM087187**, **AM087188**

Centaurea stenolepis A. Kern. – Turkey, vil. Bolu, 23.8.1973, *Holtz & al. 1309* (GOET), **AM087165**, **AM087166**

Centaurea stoebe subsp. *australis* (A. Kern.) Greuter – Hungary, Budapest, Budaörs, 14.8.1994, *Ochsmann CE0227* (herb. Ochsmann), AJ405128, AJ405097, AJ402894

Centaurea ulrichiorum Wagenitz & al. – holotype (GOET), AM087195, AM087196, AM087197

Centaurea vallesiaca (DC.) Jord. – Switzerland, Valais, E of Leuk, 31.8.1994, *Ochsmann CE0392B* (herb. Ochsmann) AF031060, AF031061, AF031056

Centaurea werneri Wagenitz & al. – holotype (GOET), **AM087180**, **AM087181**, **AM087182**

Cyanus cyanoides (Wahlenb.) Wagenitz & Greuter – Israel, Dovrat Emeq, 1993, *Leuschner* (GOET), AJ867997, AJ867998, AJ867999

Rhaponticoides ruthenica (Lam.) M. V. Agab. & Greuter – Kyrgyzstan, Džalal-Abad oblast, 4 km SE Arslanbob, 14.7.2003, *Martins & Janßen 1004* (JE), AJ868066, AJ868067, AJ868068

Serratula tinctoria L. subsp. *tinctoria* – Spain, prov. Cantabria, Armuero, 6.8.1981, *Sánchez-Mata* (JE), AJ868084, AJ868085, AJ868086

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