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A NEW SPECIES OF *CENTAUREA* (ASTERACEAE) FROM TURKEY

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Abstract

A new species of *Centaurea* (Asteraceae) from Turkey is described and illustrated. *Centaurea nallihanense* Uysal & Hamzaoğlu occurs on stony slopes of corrupted oak openings in the Province of Ankara in Central Anatolia. It seems to be similar to *C.* sect. *Ptosimopappus* but related to the *Cheirolepis-Pseudoseridia* complex. Diagnostic characters of similar taxa are provided and a comprehensive discussion is held on the basis of molecular and karyological data. The geographical distribution of the new species is mapped. The chromosome number of *C. nallihanense*, $2n = 2x = 18$, counted in root tips, is also reported and illustrated. Its karyotype formula is 6m+3sm. The karyotype of *C. nallihanense* consists of mainly metacentric chromosomes with the length ranging from 1.113 to 1.771 µm, and the total haploid chromosome length of 12.909 µm. Also, the ITS gene region of the new species is amplified and sequenced to compare with the relatives and to identify the taxonomical position of the new species within *Centaurea*.

Key words: chromosome number, Compositae, Centaureinae, endemic, ITS, karyotype, taxonomy, Turkey

Introduction

An important and relatively large genus in the flora of Turkey, *Centaurea* Linnaeus (1753: 909) currently comprises circa 250 species distributed across Eurasia, especially in Irano-Turanian and Mediterranean Regions (Susanna & García-Jacas 2007). A broad redefinition of *Centaurea* (Asteraceae) has taken place in recent years, thanks to the generalized use of molecular, caryological and biochemical methods (Romaschenko *et al.* 2004; Uysal *et al.* 2009, 2010; García-Jacas *et al.* 2006; Hilpold *et al.* 2014a). Comparison of DNA sequences finally allowed for the delineation of a monophyletic genus, *Centaurea* s. str. (García-Jacas *et al.* 2000, 2001; Wagenitz & Hellwig 2000). This new definition, however, does not change the important fact that Turkey is the main centre of the *Centaurea* diversity (Wagenitz 1986). *Centaurea* is one of the large genus having highest rates of endemism in Turkey. According to latest reports, in Turkey the genus is represented by 198 taxa, of which 109 are endemic (Uysal 2012; Köse & Alan 2013; Bancheva *et al.* 2014; Yüzbaşıoğlu *et al.* 2015; Uysal *et al.* 2015), so that the endemism rate is about 55 %.

In 2011, the second author collected some interesting plant specimens from the Nallıhan (Ankara) province during an expedition undertaken for floristic studies. One of the collections belonged to the genus *Centaurea*. The collection had a very characteristic stem branching, involucre, leaves and achenes and was identified as a presumably new species.

The specimens belonging to this new species were mainly similar to species of the *Cheirolepis-Pseudoseridia* complex (Uysal *et al.* 2005) in terms of general morphology at the first glance. However, their appendages were fairly reduced and the median phyllaries had only very narrow border without distinct teeth or cilia, as in *C.* sect. *Ptosimopappus* Hoffmann (1893: 329). Because of the appendage morphology, we thought that the specimens could be related with a species within *C.* sect. *Ptosimopappus*. After detailed comparisons, we realized that the specimens cannot be positioned within *C.* sect. *Ptosimopappus* because of the presence of distinct inner pappus. To take a final decision about its taxonomical position, we applied an analysis of the ITS gene region (rDNA) and we concluded that we found a new *Centaurea* species from the *Cheirolepis-Pseudoseridia* complex.

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Material and Methods

The material of the new species was compared with herbarium specimens of *Centaurea* in E, ERCIYES, G, GAZI, HUB and KNYA (acronyms follow Thiers 2016).

The morphology of the specimens was examined under a stereobinocular microscope. These comparisons demonstrated that our specimens could represent a species new to science from the *Cheirolepis-Pseudoseridia* complex. Many plants of this new species were used for the description. The specimens were examined and compared with specimens of the closely related taxa: *C. drabifolia* subsp. *floccosa*, *C. kotschyi*, *C. aksoyii*, *C. ptosimopappa*, and *C. ptosimopappoides*.

Mature seeds were selected and periodically germinated for chromosomal analyses. Chromosome counts were made on somatic metaphases using the squash technique. The mature achenes were germinated and root primer meristems were used to create metaphase plates.

Total genomic DNA was extracted by the 2X CTAB method as previously described by Doyle & Doyle (1987) and modified by Soltis *et al.* (1991) and Cullings (1992) from silica gel-dried leaves collected in nature from type localities of *Centaurea nallihanense*, *C. aksoyii*, *Rhaponticoides mykalea*, *Psephellus hadimensis*. Double-stranded DNA from the ITS region was amplified using ITS1 as the forward primer and ITS4 as the reverse primer (White *et al.* 1990). The amplification protocol included a hot start at 94 ºC for 2 min followed by 72 ºC for 5 min, during which the polymerase (Fermentas) was added. Next, 30 cycles of amplification were performed under the following conditions: 94 ºC for 1 min 30 s, 57 ºC for 2 min, and 72 ºC for 3 min with an additional extension step of 15 min at 72 ºC. The PCR products were purified using the QIAquick PCR Purification Kit. Both strands were sequenced with ITS1 as the forward primer and ITS4 as the reverse primer. Direct sequencing of the amplified DNA segments was performed using the Big Dye Terminator Cycle Sequencing v3.1 (Macrogen, Korea) following the manufacturer's protocol and analysed on an ABI PRISM 3730 DNA Analyser (PE Biosystems).

Complete ITS gene sequences from 8 taxa were included in this study, representing *Centaurea* and two outgroup taxa from *Psephellus* and *Rhaponticoides*. Sequences of some similar species were obtained via the NCBI (National Centre for Biotechnology Information) GenBank, whereas sequences of *Centaurea nallihanense*, *C. drabifolia* subsp. *floccosa*, *C. aksoyii*, *Rhaponticoides mykalea*, *Psephellus hadimensis* were new (Table 4).

Nucleotide sequences were edited using Bioedit v7.0.5.3 (Hall 1999) and aligned visually by sequential pairwise comparison (Swofford & Olsen 1990). The ITS matrix has an aligned length of 615 bp. Parsimony analysis of the ITS dataset involved heuristic searches conducted with PAUP v4.0b10 (Swofford 2002) using TBR branch swapping with character states specified as unordered and unweighted. Bootstrap analyses (BS) (Felsenstein 1985) were performed using 1000 replicates of heuristic search with the default options. Internodes with BS ≥ 75 % were considered statistically significant. For the strict consensus tree consistency index (CI) and retention index (RI) are given, excluding uninformative characters.

Bayesian analyses were started with random starting trees and were run for 1×10^6 generations in two independent runs of four Metropolis-coupled chains. We recorded one out of every 1000 generations, examination of run output for convergence (standard deviation of split frequencies nearing 0.001) removal of the first 1000 samples (20%) as burn-in after visual examination of likelihood score plots. The stationary of the runs and the convergence between the runs were checked with Tracer v.1.5.0 (Rambaut & Drummond 2007). Internodes with posterior probabilities P≥ 0.95 were considered statistically significant.

Results

Description of the new species

Centaurea nallihanense Uysal & Hamzaoğlu, **sp. nov.** (Figs 1, 2 and 3)

Type:—TURKEY. B2 Ankara, Nallihan, Osmanköy–Yenice arası, Taşlı yamaçlar, Meşe açıklıkları 395 m, 40º04′39" N, 30º53'41" E, 10 July 2011, *Hamzaoğlu 6120* (holotype KNYA).

Planta perennis, basi lignosa. Caules erecti, subsimplices, ad 25–60 cm alti, griseo-tomentosi. Folia albo- vel griseotomentosa, basalia inferioraque brevipetiolata, indivisa. Involucrum oblongum, 15–20 mm longum, 9–13 mm latum. Involucri phylla lanceolata,

appendicibus satis reductis, anguste triangularibus, mucrone terminali 0.1–0.3(–0.5) mm longo. Flores flavi, marginales steriles radiantes, hermaphroditi. Achenia lanceolata ad ovoideo, 5–6 mm longa, 2–2.3 mm lata. Pappus cremeo-brunneus, persistens, biseriatus, exterior e setis scabris brevissimis 0.5–0.8 mm longis, interior e setis 4.5–5.5 mm longis.

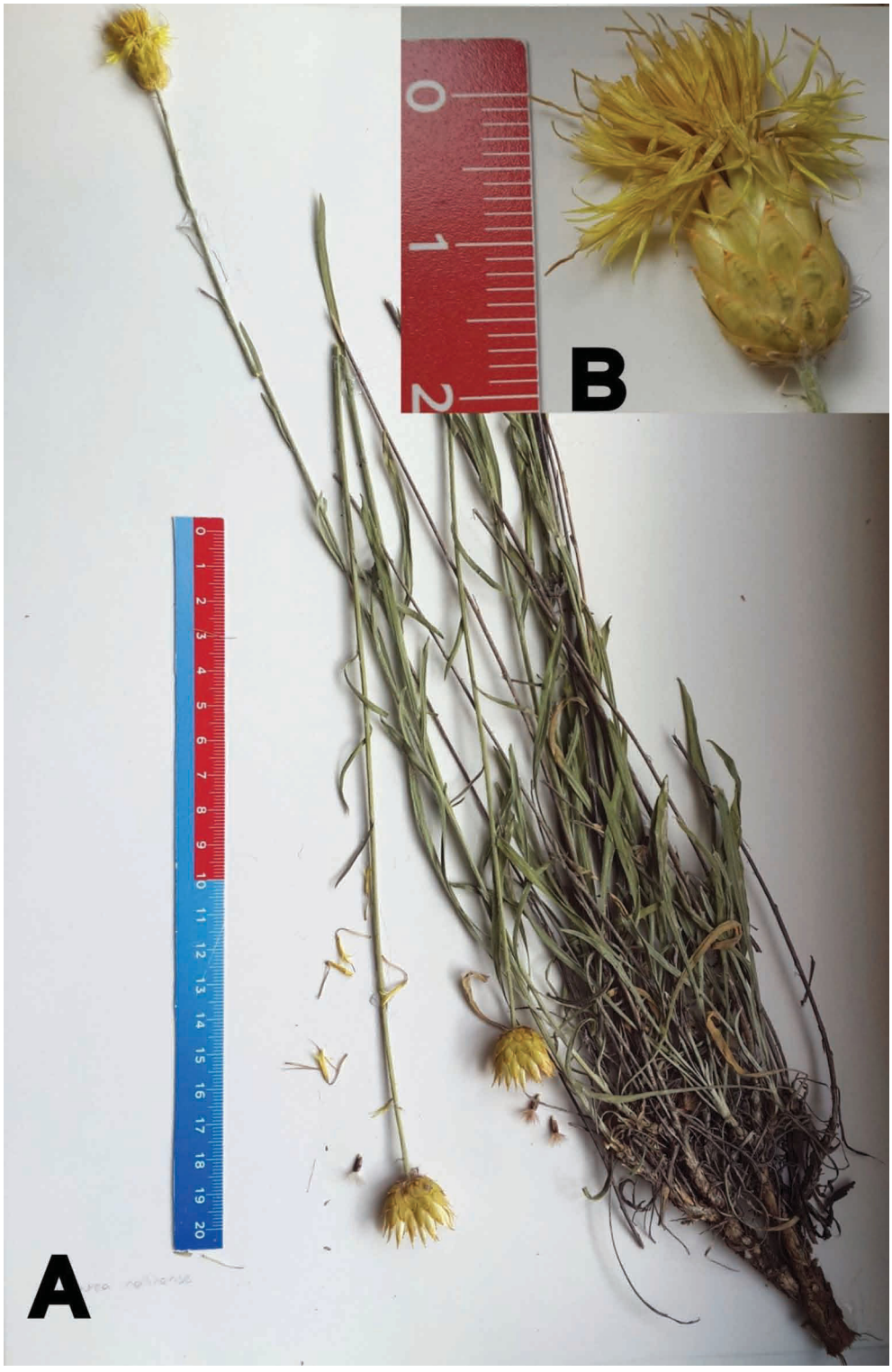

FIGURE 1. Holotype of *Centaurea nallihanense*. A: Habit; B: capitulum.

Perennial herbs with sterile shoots and a woody rootstock producing numerous stems. Stems simple, 20–60 cm tall, erect to ascending, slender, yellowish-green striate, floccose to tomentose and rarely glandular-punctate, ca 1.5 mm in diameter below. Leaves undivided, densely floccose or tomentose, sparsely glandular-punctate, entire and attenuate towards base; basal leaves linear, usually withered at fruiting, sessile, 4–12 × 0.1–0.5 cm; median and upper leaves similar to basal leaves but fairly reduced, linear to filiform, sessile, 2–12 × 0.1–0.4 cm, decreasing in size towards capitula, acute to acuminate. Capitula discoid and slim, solitary at the end of branches. Involucre 15–22 × 8–15

mm, glabrous, narrowly ovoid-oblong; outer phyllaries oblong-ovate, 2–3.5 × 1.5–2.5 mm; median phyllaries oblong-lanceolate, 4–10 × 2.5–4.5 mm; inner phyllaries linear to linear-lanceolate, 12–15 × 1–3 mm; appendages fairly reduced, minutely narrow triangular, thinly hyalineous decurrent along all margines, straw-coloured to creamish-brown in the centre, without cilia and ending in a very weak mucro 0.1–0.3(–0.5) mm long. Florets yellow, 18–20 mm long, longitutionally with reddish striae; corolla tube glabrous, 15–16 mm long, lobes 4–5 mm long, linear. Filaments 3–4 mm long, puberulent; anthers 7–8 mm long. Style 20–22 mm long, shaft 16–17 mm long, stigma 3.5–4 mm long, hairy at base. Achenes oblong-lanceolate, 5–6 mm long, brown or brownish-black, longitudinally irregular with yellow striae, smooth and shiny, glabrous; pappus biseriate, outer 4.5–5.5 mm long, scabrous, creamish-brown, inner 0.5–0.8 mm long, setaceous, creamish or light brown and yellowish-brown at base.

Note:—*Centaurea nallihanense* is a neoendemic species, which appears fairly nice because of its slim stems, capitulas and phyllaries without thorns. *Centaurea nallihanense* is mainly similar to *C. drabidolia* subsp. *floccosa* in a general way, but its appendages are fairly reduced and simple (not with distinct borders and ciliae). The capitula and appendages of the new species are similar to those in *C.* sect. *Ptosimopappus*, but the species can be easily distinguished with linear soft leaves and distinct inner pappus (vs. not firm lanceolate leaves and indistinct inner pappus).

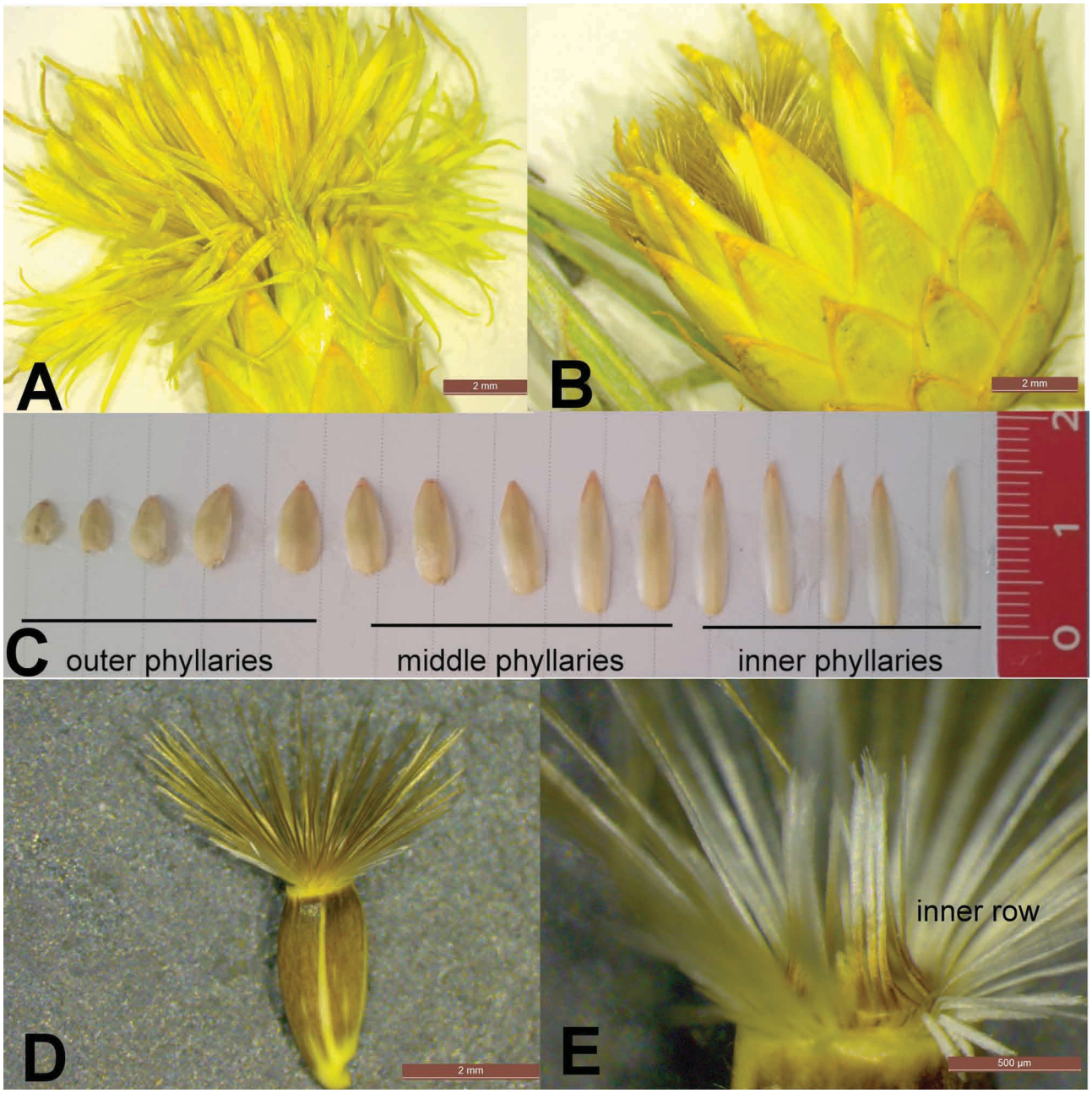

FIGURE 2. *Centaurea nallihanense*. A: Capitulum; B: Involucre; C: Phyllaries; D: Achene and pappus; E: Outer and inner series of pappus.

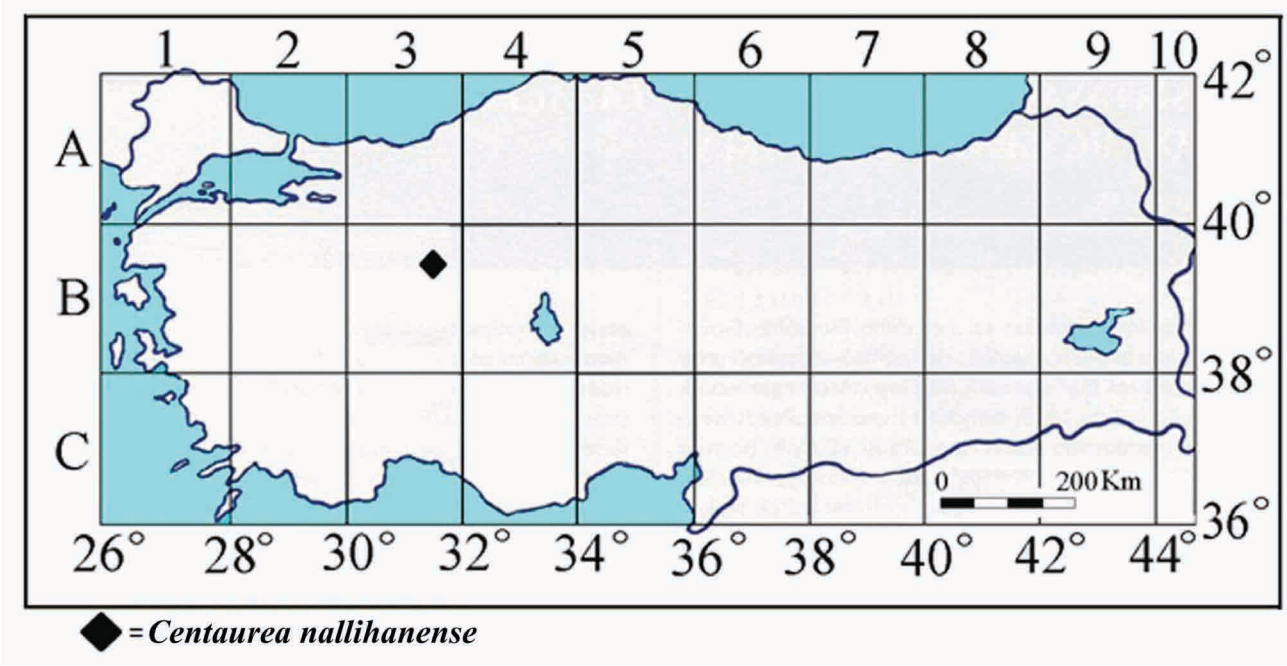

FIGURE 3. Distribution map of *Centaurea nallihanense.*

Karyology

The chromosome number of *Centaurea nallihanense* was found 2*n* = 18 in all metaphase plates examined (Fig. 4). The karyotype formula is 6m + 3sm. The new species is diploid; it has specific karyomorphological features and could be easily separated from the other species discussed here (Table 1, 2, 3). The karyotype of *C. nallihanense* consists of mainly metacentric chromosomes with the length ranging from 1.113 to 1.771 µm, and the total haploid chromosome length of 12.909 µm (Table 2). According to asymmetry indices (AI, A_1 and A_2), the karyotype of the new species consists of symmetric chromosomes with a lower level of chromosomal heterogeneity, with a CV_{CI} value below 10. Variations in the length of chromosomes are moderate within the species (CV_{CL} 13.02) (Table 3).

TABLE 1. Karyomorphological data of *Centaurea nallihanense.*

Chromosomes of *Centaurea nallihanense*	Mean length (µm)	Total length (µm)	Long arm (µm)	Short arm (µm)	Centromeric Index	Centromer position
1	1.771 (0.033)	3.541	0.697 (0.017)	1.073 (0.016)	0.394 (0.002)	m
2	1.613 (0.031)	3.226	0.565 (0.013)	1.048 (0.018)	0.35 (0.001)	sm
3	1.577 (0.003)	3.154	0.624 (0.005)	0.953 (0.002)	0.395 (0.002)	m
4	1.447 (0.005)	2.894	0.529 (0.005)	0.917 (0.01)	0.366 (0.004)	sm
5	1.423 (0.002)	2.846	0.582 (0.005)	0.841 (0.006)	0.409 (0.004)	m
6	1.371 (0.017)	2.743	0.628 (0.004)	0.743 (0.012)	0.458 (0.002)	m
7	1.341 (0.003)	2.681	0.55 (0.003)	0.79 (0.005)	0.411 (0.003)	m
8	1.253 (0.01)	2.507	0.448 (0.004)	0.806 (0.007)	0.357 (0)	sm
9	1.113 (0.045)	2.227	0.513 (0.022)	0.601 (0.023)	0.46 (0.001)	m

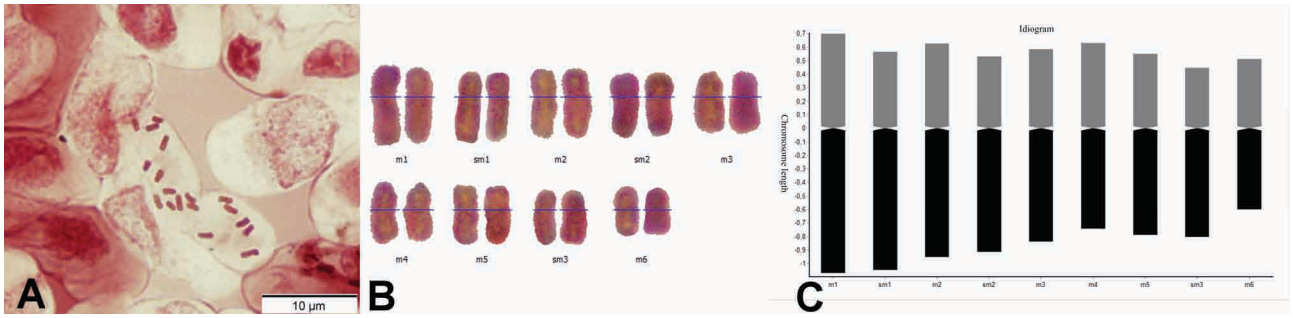

FIGURE 4. Karyomorphology of *Centaurea nallihanense*, with 2*n* = 18. A: Metaphase plate; B: Karyogram; C: Ideogram.

TABLE 2. Karyotype formula according to Levan *et al.* (1964) and characteristics of the studied *Centaurea nallihanense* PL—Ploidy level; R—Range; SC—shortest chromosome length; LC—longest chromosome length; p-mean—length of long short arm; q-mean—length of long arm; CL-mean—length of chromosome; TCL—total haploid complement length; CI-mean—centromeric index; m—metacentric; sm—submetacentric; SD—standard deviation.

Taxa	2n	x	Ploidy	R (SC-LC) (µm)	Ratio LC/ SC	p(µm) mean (±SD)	q(µm) mean (±SD)	CL (µm) mean (±SD)	TCL	CI mean (±SD)	CF
Centaurea nallihanense	18	9	2x	1.11–1.77	1.59	0.57 (±0.07)	0.86 (±0.14)	1.43 (±0.19)	12.909	40 (±0.04)	12m + 6sm

TABLE 3. Karyotypes of *Centaurea nallihanense* using different methods of evaluating karyotype asymmetry. A_1—intrachromosomal asymmetry index; A_2—interchromosomal asymmetry index; CV_{CL}—relative variation in chromosome length; CV_{CI}—relative variation in centromeric index; AI—karyotype asymmetry index; DI—dispersion index; Stebbins' types—classification of karyotypes in relation to their degree of asymmetry according to Stebbins (1971).

Taxa	A_1	A_2	CV_{CL}	CV_{CI}	AI	DI	Stebbins
Centaurea nallihanense	0.326	0.13	13.023	9.402	1.224	5.17	4A

TABLE 4. Voucher specimens for the ITS study.

Taxa	Section	Voucher location	GenBank ITS	Author, year
Centaurea aksoyii	*Pseudoseridia*	Turkey. Between Sefaatli and Yerköy, Karanlıkdere valley, Adatepe, 39º 34' 28" N, 34º 40' 23" E, 850 m a.s.l., serpentine rocks, 6 July 2006, *Hamzaoğlu* & *Budak* 4167 (Bozok Univ. Herbarium)	KX158186	Uysal 2016
Centaurea drabifolia subsp. *floccosa*	*Cheirolepis*	Turkey. Kütahya Afyon arası, the sides of motorway 1100 m, 39º 14.094 N, 030º 07.046 E, 30 June 2004, *T. Uysal 583* (KNYA)	KX158187	Uysal 2016
Centaurea kotschyi	*Cheirolepis*	Iran. Mazaran: Chalus road, Azad-bar mountains between Gachsar and Valiabad, 01 August 1996, *García-Jacas, Maassoumi, Mozaffarian, Susanna 1617* & *Vallés* (BC)	DQ319127	García-Jacas *et al.* (2006)
Centuarea nallihanense	*Cheirolepis*	Turkey. B2 Ankara, Nallıhan, Osmanköy-Yenice arası, Taşlı yamaçlar, Meşe açıklıkları 395 m., 40º04'39" N, 30º53'41" E, 10 July 2011, *Hamzaoğlu 6120* (KNYA)	KX158188	Uysal 2016
Centaurea ptosimopappa	*Ptosimopappus*	Turkey. Seyhan-Hatay: Nur Dag, Gavur Dag, near Osmaniye 1000–1350 m, 11 October 1957, *Wagenitz & H. J. Beug* (B)	DQ319152	García-Jacas *et al.* (2006)
Centaurea ptosimopappoides	*Ptosimopappus*	Turkey. Adana: Adana-Karsanti, Pos Ormonlari, Ormanalti, 25 July 2002, *A. Savran* (BC)	DQ319153	García-Jacas *et al.* (2006)
Psephellus hadimensis		Turkey. Konya: Hadim-Gevne çayı kenarları, Orman açıklıkları, 1800 m, 16 July 2012, *K. Ertuğrul* 4697 & *T.Uysal* (KNYA)	KX158189	Uysal 2016
Rhaponticoides mykalea		Turkey. Aydın: Kuşadası, Davutlar yolu, 40m, 05 June 2011, *O. Tugay* 6710 & *H. Demirelma* (KNYA)	KX158190	Uysal 2016

Molecular and Phylogenetic analyses

Centaurea nallihanense and its relatives were placed in a single clade with a bootstrap value of BS: 100% and PP: 1·00. In this clade are firstly found *C. kotschyi* and *C. drabifolia subsp. floccosa* (*C.* sect. *Cheirolepis*) as well as *C. nallihanense*, which are grouped together with a moderate bootstrap support (BS: 64%) but a high posterior probability based on Bayesian Analyses (PP = 0.99). *Centaurea aksoyii* shows a close phylogenetic affinity to this clade with strong bootstrap and posterior probability values (BS: 99% PP: 1). *Centaurea ptosimopappoides* is connected externally with an agreeable parsimony value (68%), but high posterior probability (PP: 0.96). *Centaurea ptosimopappa* appears at a distant relation with this clade (BS: 100%, PP: 1). Therefore, we concluded that the new species is clearly related to the *Cheirolepis-Pseudoseridia* complex phylogenetically and positioned with *C. kotschyi* and *C. drabifolia* subsp. *floccosa.*

Discussion

The phyllaries and appendages within *Centaurea* were treated among the most useful diagnostic morphological features in the *Flora of Turkey* (Wagenitz 1975). Recently, bract characters (phyllaries and appendages) had been accepted to be relatively unreliable because of the frequent intermediate forms that exist between some sections (Wagenitz 1989; Wagenitz & Hellwig 1996; Hilpold *et al.* 2014b). As regards to these morphological variations and complications within *Centaurea*, it was expressed that these differences occurred within some sections, such as *C.* sect. *Melanoloma*, *C.* sect. *Seridia* and the *Cheirolepis-Pseudoseridia* complex (Ertuğrul *et al.* 2004; García-Jacas *et al.* 2006). Additionally, it was clarified by supporting molecular tools that morphology-based classifications reflected poorly the natural positions of species within *Centaurea* (Ochsmann 2000; García-Jacas *et al.* 2006; Suárez-Santiago *et al.* 2007; Hilpold *et al.* 2011). In such a case, we assume that any decision made about the taxonomical position of the new species would be unreliable if drawn only from the bract morphology. Considering modern improvements in the taxonomy of the genus, we thought that molecular markers would provide a stronger evidence together with morphological features for an informed decision on the taxonomical position of the new species.

The chromosome number determined had been reported before for many *Centaurea* species in several studies (Georgiadis & Phitos 1976; Phitos & Damboldt 1976; Romaschenko *et al.* 2004; Uysal 2008, 2009). Therefore, we reconfirmed that the *Jacea* group has usually a basic chromosome number of $x = 9$. According to our karyological comparisons among *C. nallihanense* and *C. ptosimopappa* (Koçyiğit & Bona 2013) as well as species of the *Cheirolepis-Pseudoseridia* complex (Uysal *et al.* 2009), the new species has specific karyomorphological features and is clearly different from its relatives karyologically (Tables 1–3). In previous publications, two different karyotype formulas had been reported for *C. ptosimopappa* by Koçyiğit & Bona (2013); however, their reports are not compatible with our results.

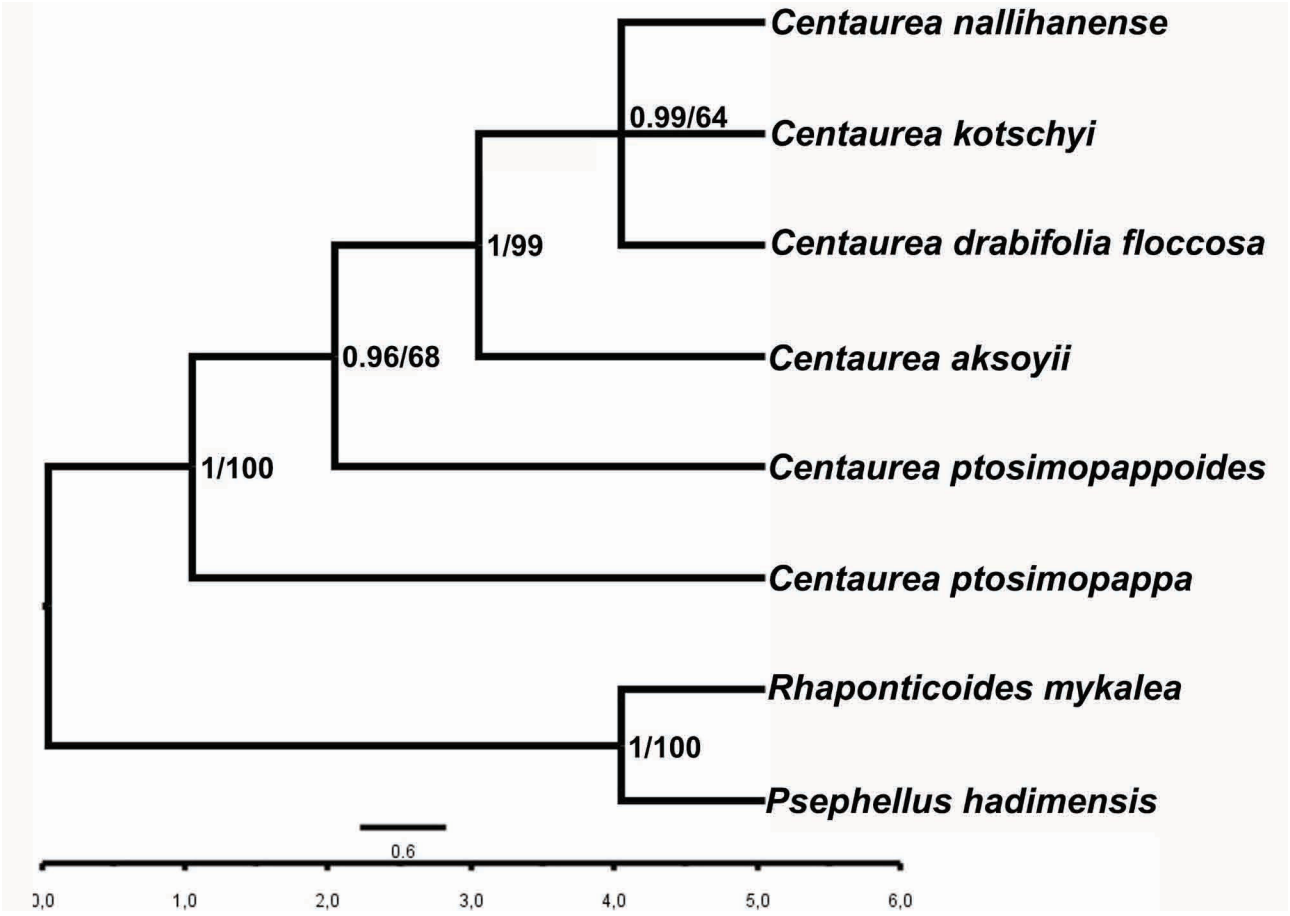

FIGURE 5. Majority rule consensus tree obtained from Bayesian analysis of the ITS data. First number on branches indicates Bayesian posterior probabilities, second number after slash indicates maximum parsimony bootstrap values (CI = 0.984; RI = 0.973; HI= 0,016).

When the appendages are ignored, *C. nallihanense* seems to be more associated with the *Cheirolepis-Pseudoseridia* complex in terms of its general appearance and fruit morphology. Furthermore, the present molecular results indicated

that *C. nallihanense* phylogenetically displays a closer relationship to the *Cheirolepis-Pseudoseridia* complex than to *C.* sect. *Ptosimopappus* (Fig. 5). In accordance with the molecular and karyological data, we determined that the new species is a member of *Cheirolepis-Pseudoseridia* complex.

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Appendix: Additional specimens examined

Centaurea aksoyii Hamzaoğlu & Budak (2009: 27)
B5 Yozgat: between Sefaatli and Yerköy, Karanlıkdere valley, Adatepe, 39º 34’ 28” N, 34º 40’ 23” E, 850 m a.s.l., serpentine rocks, 06 July 2006, *Hamzaoğlu & Budak 4167* (holotype: Bozok Univ. Herbarium; isotypes: Bozok Univ. Herbarium!, ERCIYES Hb.,! GAZI!, ANK! and HUB!).

Centaurea drabifolia subsp. *floccosa* (Boissier 1875: 595) Wagenitz & Greuter in Greuter (2003: 54)
A3 Bolu: Bolu-Göynük, Sünet Gölü, 1200 m, 27 July 1988, *Nydegger 43901* (G!); **A4 Ankara:** Beynam Ormanı açıklıkları step, 1200 m, *Eyce 386* (KNYA!); Haymana Yenice karayolu, Yol kenarları, *T.Uysal 999* (KNYA); **A6 Tokat:** Tokat, 5th km, 14 June 1939, *Reese* (G!); **B2 Eskişehir:** Eskişehir- Kütahya Karayolu, Kütahya’ya 18 km Kala, yolun sağındaki yamaçlar, taşlık çakıllık alanlar, 910 m, 39º 33.362 N, 30º 03.881 E, 30 June 2004, *T. Uysal 580* (KNYA!); Kütahya Afyon arası, yol kenarları 1100 m, 39º 14.094 N, 30º 07.046 E, 30 June 2004, *T. Uysal 583* (KNYA!); Kütahya’dan Eskişehir’e 15th km, metamorfik kayalar üzerinde, 22 June 1962, *Dudley 36103* (E!) Bozhüyük’den Kütahya’ya 15 km kala, yolun sağındaki yamaçlar, 905 m, 39º 33. 400 N, 30º 03.842 E, 19 June 2003, *T.Uysal 501* (KNYA!); **B3 Kütahya:** (Phrygien)**:** Kütahya-Bozöyük, Bozöyük’ün 18 km kuzeyi, 900 m, 25 June 1954, *Huber-Morath* 12232 (G!); Kütahya-Gediz arası (Phrygien), Kütahya’nın 21 km güneyi, Göksuyu, taşlık-kayalık alanlar, 960 m, 14 June 1954, *Demiriz 12231* (G!); Kütahya- Afyon karayolu, İzmir yol ayrımı, beyaz taşlı tepe yamaçları 957 m. 39º 22.092 N, 030º 03.982 E, *T.Uysal 581* (KNYA!); **B6 Sivas:** Divriği, Dumlucadağ, 30 May 1968, *Baytop 12926* (E!); Sivas- Gürün arası, Gürün’e 1 km kala, 1350 m, 28 June 1953, *Huber-Morath 11967* (G!).

Centaurea kotschyi (Boissier & Heldreich in Boissier 1849: 107) Hayek (1921: 140)
C4 Konya: (Lectotype) ad radices montis Karadagh prope Larenda (Karaman), 22 June 1845, *Heldreich* (G!); **B4 Ankara:** Konya yolu 180. km, Yavşan stepi, 16 July 1953, *Rul.-Mun. 1501* (G!); **B5 Kayseri (Cappadocien):** İncesu-Develi, Eruptivegestein İncesu’yun 3 km güneyi, 1050 m, 17 June 1951, *Huber-Morath 10863* (G!); **Cappadocien:** July 1941, *Heilbronn* (G!); **Cappadocien:** Şarkışla-Kayseri arası, Şarkışla’nın 43 km güneyi, 1350 m, 05 July 1953, *Huber-Morath 11968* (G!); **Kırşehir:** Kayseri-Kırşehir arası, Kayseri’nin 60 km kuzeybatısı, 1180 m, 23.7.1958, *Huber-Morath 16039* (G!); **C3 Konya:** Konya-Beyşehir yolu, Apa barajına varmadan 1 km kala, yolun sağındaki dere yamaçları, 1455 m, 12 July 2003, *T.Uysal 503* (KNYA!); **C4 Konya:** Karapınar, Koruma-Araştırma alanı, 1800 m, 30 July 2003, *T.Uysal* 535 (KNYA!); ibid., *T.Uysal 536* (KNYA!); **Karaman:** Ayrancı Barajı, 1170 m, 28 July 1992, *Nydegger 46871* (G!).

Centaurea ptosimopappa Hayek (1901: 590)
C6 Osmaniye, Zorkum road, 1050 m, roadside, 05 July 2003, *A.Duran 6306 & M.Sağıroğlu* (KNYA!); **C6 Osmaniye**, between Zorkum, 300-400 m, roadside, 12 September 2003, *A.Duran 6344 & M. Sağıroğlu* (KNYA!).

Centaurea ptosimopappoides Wagenitz (1974: 225)
B5 Kayseri, Karpuzbaşı waterfall, Akdağ road, 8 km, 1000 m,stony places, forest openings, 18 July 2007, *A.Duran 7611* (KNYA!); **C5 Adana**, between Aladağ-Kızılçam, 890 m, under forest, 36S 755700D, 4189506K, 18 June 2010, *A.Duran 9042 & M.Öztürk* (KNYA!); **C5 Adana**, between Aladağ-Kızıldam, 672 m, under forest, 36S0713119, 4161938, 09 June 2007, *M.Dinç 2929* (KNYA!); Adana: Adana-Karsanti, Pos Ormonlari, Ormanalti, 25 July 2002, *A. Savran* (KNYA!).