

Three new species with two flowered spikelets in *Acantholimon* (Plumbaginaceae) from East Anatolia, Turkey

MUSA DOĞAN^{1*} and GALİP AKAYDIN²

¹Department of Biological Sciences, Middle East Technical University, 06531 Ankara, Turkey

²Department of Biology Education, Hacettepe University, 06532 Beytepe, Ankara, Turkey

Received May 2003; accepted for publication September 2003

Three new species, *Acantholimon bashkaleicum* sp. nov., *Acantholimon artosense* sp. nov. and *Acantholimon hoshapicum* sp. nov. (Plumbaginaceae) are described and illustrated. The species are all confined to B9/B10 Van Province in East Anatolia where they grow either on calcareous mountain slopes or on mountain steppes. Diagnostic morphological characteristics from the closely related species are given, along with a discussion dealing with their taxonomic relationships, and their conservation statuses are pointed out. A revised key to the *Acantholimon* species with heterophyllous leaves, two or more flowered and four or more bracteated spikelets is also provided. © 2004 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2004, 144, 497–505.

ADDITIONAL KEYWORDS: conservation – sect. *Acantholimon* – taxonomy.

INTRODUCTION

The genus *Acantholimon* Boiss. was described first by E. Boissier (1879) in his *Flora Orientalis* in which he recognized 74 species in the area. Recent estimates suggest that the genus comprises about 200 species worldwide and its main centre of diversity lies in the Irano-Turanian Phytogeographical Region. The genus has ecological and economic importance. Its ornamental importance with its coloured and long-lasting flowers is remarkable.

Bunge (1872) prepared the first monograph on the genus. Bokhari (1970, 1972a) carried out taxonomic studies on Plumbaginaceae in Turkey, where he recognized six genera (*Acantholimon* Boiss., *Limoniopsis* Lincz., *Limonium* Miller, *Armeria* Willd., *Goniolimon* Boiss. and *Plumbago* L.) in this family, and described six new species in *Acantholimon* (*A. confertiflorum*, *A. halophilum*, *A. reflexifolium*, *A. dianthifolium*, *A. hypochaerum* and *A. strigillosum*). Bokhari (1972b) also studied the stigma and the pollen types in *Acantholimon* and *Limoniopsis*. The first revision of *Acantholimon* in Turkey was made by Bokhari &

Edmondson (1982) for the *Flora of Turkey and the East Aegean Islands* (Vol. 7), in which they recognized 25 species and also indicated the possibility of finding more species either imperfectly known (two species) or doubtfully recorded (nine species). In a recent study a new subsection, *Halophiliceae* Muvaffak & Dogan, was recognized and published from Turkey (Muvaffak, Doğan & Bilgin, 2001).

The extensive field surveys and the laboratory studies conducted on *Acantholimon* in Turkey by us have revealed eight additional new species, namely *A. birandii* Dogan & Akaydin (Doğan & Akaydin, 2001), *A. avanosicum* Dogan & Akaydin (Doğan & Akaydin, 2002a), *A. anatolicum* Dogan & Akaydin (Doğan & Akaydin, 2002b), *A. karamanicum* Akaydin & Dogan (Akaydin & Doğan, 2002), *A. yildizelicum* Akaydin (Akaydin, 2002), *A. köycegizicum* Dogan & Akaydin, *A. göksunicum* Dogan & Akaydin (Doğan & Akaydin, 2003a) and *A. turcicum* Dogan & Akaydin (Doğan & Akaydin, 2003b).

METHODS

Since 2000, as a part of a revision of the genus *Acantholimon* in Turkey, we have carried out extensive

*Corresponding author. E-mail: doganm@metu.edu.tr

field surveys in Turkey and collected a large number of specimens. The specimens were pressed carefully and dried using standard techniques for further laboratory analysis (Davis & Heywood, 1973). In early July 2002, three local populations of *Acantholimon* were collected from B9/B10 Van Province in East Anatolia. The specimens all looked unfamiliar because of their heterophyllous leaves, 2-flowered and 4-bracteate spikelets. Because of their flower number, bracts shapes as well as bract number in each spikelet and spike types they appeared to be quite different from any of the species known in the Flora. However it gets close to *A. bracteatum* (Girard) Boiss. (including *A. capitatum* Sosn.) and *A. petuniiiflorum* Mobayen in the Flora.

The specimens were cross-checked with the keys provided by Bokhari & Edmondson (1982), and the *Acantholimon* accounts given in various floras, such as *Flora Orientalis* (Boissier, 1879), *Flora Iranica* (Rechinger & Schiman-Czeika, 1974), *Flora Europaea* (Tutin *et al.*, 1972), *Flora of USSR* (Komarov, 1967) and *Flora of Syria, Palestine and Sinai* (Post, 1933).

The specimens were also then compared with the duplicates of Davis' specimens obtained from Edinburgh (E) as a gift, cited in *Flora of Turkey and the East Aegean Islands*. The Supplement to this (Davis, Mill & Tan, 1988) was also consulted. *Acantholimon* material either collected from the field by us or kept at Turkish herbaria (ANK, GAZI, HUB, ISTF and EGE) was examined. The types of Boissier cited in his *Flora Orientalis* were studied at the Boissier Collection in Jardine Botanic Garden, Geneva (G). The authorities are cited in accordance with *Authors of Plant Names* (Brummitt & Powell, 1992).

RESULTS

ACANTHOLIMON BASHKALEICUM DOĞAN & AKAYDIN SP. NOV. (FIGS 1,4)

Holotype: [Turkey B10 Van] Van- Hakkari road, around Başkale, on mountain slopes, 2100 m, 06.vii.2002, Doğan & Akaydin 7544 (holo. ANK).

Diagnosis: *Acantholimon bashkaleicum* sp. nov. *A. latifolio* Boiss. affinis sed foliis angustis (c. 1 mm latis) brevioribus 20–26 mm longis, scapis folia excedentibus 2–3-squamatis 7–9 mm longis, spicis 4–7 spiculis densissime compositis, spiculis 2-floralibus 14–15 mm longis, bracteis floralibus externis 6–7 mm longis ovato-lanceolatis hyalino-marginatis, bracteolis internis 7–10 mm longis, calycibus 12–15 mm longis, limbis albidis.

Description: Densely pulvinate pale-green shrublet, branches short and densely leafy. Leaves heterophyllous; spring leaves 10–15 × c. 1 mm; summer leaves

20–26 × c. 0.7 mm, linear-triquetrous, calcareous punctate, glaucous, rigid, ± erecto-patent, glabrous. Scapes exceeding leaves, unbranched with 2–3 scales, 7–9 cm. Scales shorter than internodes, c. 7–7.5 mm, lanceolate, acuminate to aristate, largely hyaline. Spikes densely distichous, terminal, with 4–7 spikelets. Spikelets 14–15 mm, 2-flowered. Bracts subequal–unequal glabrous, keeled; outer bract 6–7 mm, ovate to broadly lanceolate, obtuse, hyaline except veins; inner bracts 3–, 7–10 mm, obovate-elliptic, obtuse, cuspidate, hyaline except veins, equalling with calyx tube. Calyx infundibular, 12–13 mm, tube slightly pilose, veins glabrous; limb white, 10-lobed; veins reaching margins, not excurrent. Petals bright pink.

Phenology: Flowering June.

Ecology: This new species grows on sedimentary rocks on mountain steppes around Başkale (B10 Van) with *Astragalus aduncus* Willd., *A. ornithopodioides* Lam., *A. ponticus* Pall., *A. hirticalyx* Boiss., *A. macrourus* Fisch. & Mey., various grasses such as *Festuca sclerophylla* Boiss. ex Bisch., *F. valesiaca* Schleich. ex Gaudin, *Poa trivialis* L., *P. bulbosa* L., *P. nemoralis* L., *Stipa arabica* Trin. & Rupr., *Hordeum geniculatum* All., *H. bulbosum* L., and *Bromus tectorum* L. of the East Anatolian steppe.

Distribution: South-east Anatolia (B10 Van). Endemic. Ir.-Tur. element.

Status: This new species is known only from the type locality around Başkale (B10 Van), where it grows on mountain steppes on the road to Hakkari. It seems this endemic species is very rare and local. The populations seem to be small and threatened by excessive grazing. Therefore, it should be graded as Critically Endangered (**CR**) because of its local appearance and its small population size (IUCN, 2001).

Etymology: This new species is named after Başkale (B10 Van) from where it was collected for the first time.

ACANTHOLIMON ARTOSENSE DOĞAN & AKAYDIN SP. NOV. (FIGS 2, 4)

Holotype: [Turkey B9 Van] Gevaş, Artos Da., 2500 m, 05.vii.2002, Doğan & Akaydin 7532 (holo. ANK).

Diagnosis: *Acantholimon artosense* sp. nov. *A. bromifolio* Boiss. affinis sed foliis angustis (c. 1 mm latis), scapis brevioribus 8–10 mm longis



Figure 1. *Acantholimon bashkaleicum* sp. nov. A, habit. B, spikelet. C, outer bract. D–F, inner bracts. G, calyx.

(?densis), spicis 8–10 (?16) spiculis abbreviati-congestis compositis, spiculis 2-floralibus 12–13 mm longis, bracteis floralibus externis brevioribus 9–10 mm longis glabrescentibus hyalino-marginatis, bracteolis internis 3 aequilongis 8–9 mm longis hyalinis, calycis limbis 6–7 mm diametro, nervis limbi marginem attingentibus.

Description: Densely pulvinate shrublet, branches short and densely leafy. Leaves heterophyllous; spring leaves 13–20 × 1.5–2 mm; summer leaves 25–40 × 0.8–1.2 mm, linear-triangular, pale green, sparsely calcareous punctate, lower leaves spreading. Scapes simple, longer than leaves, 8–10 cm, 3–4 scaled. Scales shorter than internodes, c. 8–10 mm,

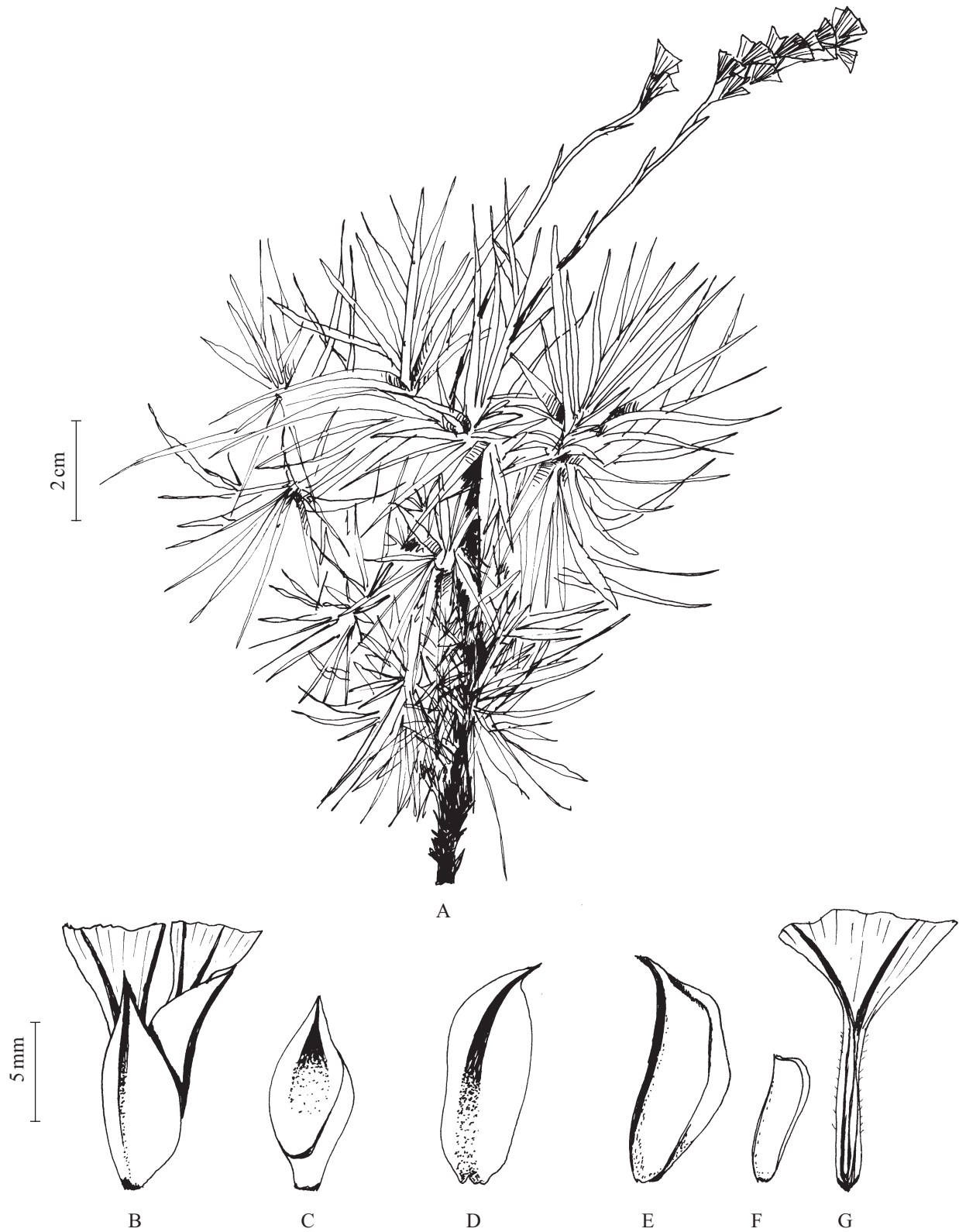


Figure 2. *Acantholimon artosense* sp. nov. A, habit. B, spikelet. C, outer bract. D–F, inner bracts. G, calyx.

lanceolate, aristate. Spikes 2.5–5 cm unbranched densely distichous, with 8–16 spikelets. Spikelets 12–13 mm, 2-flowered, 2 × longer than internodes. Bracts glabrous; outer bract 9–10 mm, ovate to broadly lanceolate, acute-cuspidate, largely hyaline margin, longer than inner bracts and calyx tube; inner bracts 3–, 8–9 mm, oblong-lanceolate, obtuse, cuspidate, with broadly hyaline margins or hyaline except for veins. Calyx infundibular, 11–13 mm, tube and veins pilose up to middle of limb; limb white, ±10-lobed, 6–7 mm in diameter; veins reaching margins. Petals bright pink.

Phenology: Flowering June.

Ecology: This new species grows on calcareous slopes of Artos Mountain above Gevaş (B9 Van) with *Astragalus barbatus* Lam., *A. onobrychis* L., *A. cylindraceus* DC. (endemic), *A. gevashensis* Chamb. & Matthews (endemic) and various grasses, such as *Festuca pratensis* Huds., *F. arundinacea* Schreb. ssp. *arundinacea*, *Poa pratensis* L., *P. nemoralis* L., *P. bulbosa* L., *Stipa arabica* Trin. & Rupr., *S. lessingiana* Trin. & Rupr., *Hordeum bulbosum* L., *Bromus scoparius* L., *B. tectorum* L., *B. danthoniae* Trin. of the East Anatolian steppe.

Distribution: East Anatolia (B9 Van). Endemic. Ir.-Tur. element.

Status: This new species is known only from the type locality at 2500 m above Gevaş in Van. The populations seem to be small and scattered on Artos Mountain, where excessive grazing and erosion are threatening the species. Therefore, it should be graded as Critically Endangered (**CR**) because of its very local distribution and small population size (IUCN, 2001).

Etymology: This new species is named after Artos Mountain in Gevaş (B9 Van) from where it was collected for the first time.

***ACANTHOLIMON HOSHAPICUM* DOĞAN & AKAYDIN
SP. NOV. (FIGS 3,4)**

Holotype: [Turkey B9 Van] Gürpınar–Başkale road, around Hoşap (Guzelsu), 2050 m, 06.vii.2002, Doğan & Akaydın 7540 (holo. ANK).

Diagnosis: *Acantholimon hoshapicum* sp. nov. *A. latifolium* Boiss. affinis sed foliis angustis (1–1.5 mm latis), scapis brevioribus 9–13 mm longis 3-squamatis, spicis laxis interruptis 3–5 cm longis 6–12 spiculis

compositis, spiculis 11–17 mm longis, bracteis floralibus externis brevioribus (7–10 mm longis) hyalinomarginatis, calycibus 13–14 mm longitudine, limbis abidis 4–5 mm diametro.

Description: Densely pulvinate shrublet. Leaves heterophyllous; spring leaves 13–20 × c. 1.5 mm; summer leaves 25–35 × 1–1.5 mm, linear-triquetrous, pale green, margins scabrid. Scapes much longer than leaves, 9–13 cm, 3- scaled. Scales shorter than internodes, 10–12 mm, lanceolate-acuminate, hyaline. Spikes simple, 3–5 cm, interrupted terminal with 6–12 spikelets. Spikelets 11–14 mm, 2-flowered, 4-bracteate. Bracts subequal, glabrous, keeled; outer bract 7–10 mm, equalling with calyx tube, ovate to broadly lanceolate, acuminate, largely hyaline margin; inner bracts 3–, 8–11 mm, longer than calyx tube, oblong to elliptic, obtuse, with broadly hyaline margins. Calyx infundibular, 13–14 mm, tube 6–7 mm, tube and veins pilose up to middle of limb; limb white, 7–10 mm in diameter, 10-lobed, lobes acute–obtuse; veins excurrent. Petals bright pink.

Phenology: Flowering June.

Ecology: This new species grows on dry mountain steppes at an altitude of 2050 m, around Hoşap between Gürpınar and Başkale where it grows with *Astragalus mollis* M. Bieb., *A. macrostachys* DC., *A. declinatus* Willd., *A. aureus* Willd., various grasses, such as *Festuca pratensis* Huds., *F. chalcophaea* V. I. Krecz. & Bobrov ssp. *chalcophaea*, *F. valesiaca* Schleich. ex Gaudin, *Poa trivialis* L., *P. pratensis* L., *P. bulbosa* L., *Stipa pontica* P. A. Smirn., *Hordeum geniculatum* All., *H. murinum* L., ssp. *glaucum* (Steud.) Tzvelev, *Bromus scoparius* L., and *B. cappadocicus* Boiss. & Bal., of the East Anatolian steppe.

Distribution: East Anatolia (B9 Van). Endemic. Ir.-Tur. element.

Status: This new species is known only from the type locality at 2050 m around Hoşap between Gürpınar and Başkale from where only two specimens were collected in 10 acres of land on the west side of the road. The populations seem to be small and under continuous threat of excessive grazing and erosion. Therefore, it should be graded as Critically Endangered (**CR**) because of its very local existence and small population size (IUCN, 2001).

Etymology: This new species is named after Hoşap (B9 Van) from where it appears to be a local and a distinct endemic species.



Figure 3. *Acantholimon hoshapicum* sp. nov. A, habit. B, spikelet. C, outer bract. D–F, inner bracts. G, calyx.

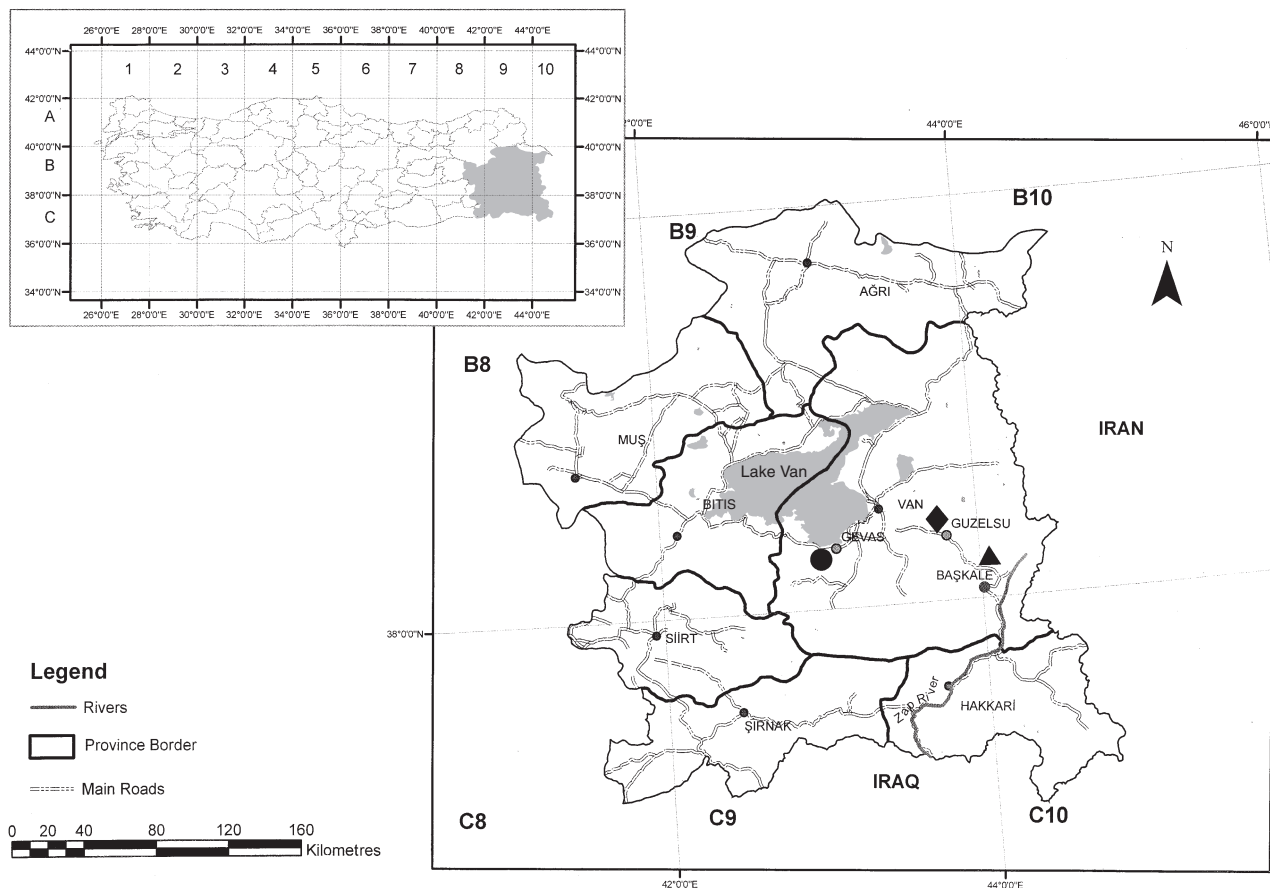


Figure 4. Distribution of (▲) *Acantholimon bashkaleicum* sp. nov., *A. artosense* sp. nov. (●) and *A. hoshapicum* sp. nov. (◆) in south-east Anatolia (Turkey).

A REVISED KEY TO TURKISH *ACANTHOLIMON* SPECIES WITH 2- OR MORE FLOWERED SPIKELETS

- 1. Calyx purple or brownish to light brown 2
- 2. Outer bract ± orbicular with very broadly hyaline margins to 5 mm wide; spikelets 2–5 flowered, 4–6 bracteate; calyx purple..... *bracteatum*
- 2. Outer bract ovate, with narrowly hyaline margins to 2 mm wide; spikelets (1–) 2–3 flowered, 2–4 bracteate; calyx brownish..... *petuniiflorum*
- 1. Calyx white or colourless..... 3
- 3. Inflorescence type a laxly to densely distichous spike 4
- 4. Spike densely distichous; outer bract longer (9–10 mm) than inner ones (8–9 mm); calyx veins reaching margin *artosense*
- 4. Spike laxly distichous; outer bract shorter (7–10 mm) than inner ones (8–11 mm); calyx veins excurrent..... *hoshapicum*
- 3. Inflorescence type densely terminal spike 5
- 5. Spikelets with 2-flowers; outer bract 6–7 mm; spike up to 1.5 cm in width *bashkaleicum*
- 5. Spikelets with at least 5 flowers; outer bract 10–11 mm; spike at least 2.5 cm in width..... *capitatum*

DISCUSSION

A. artosense, *A. hoshapicum* and *A. bashkaleicum* all exhibit heterophyllous leaves and 2-flowered spike-

lets, in which the bract number is four, and the outer bracts are broadly ovate. Vegetative and reproductive morphology have proved that the species are all in the sect. *Acantholimon* represented so far by

A. bracteatum and *A. petuniiflorum* in Turkey, both of which grow in south-east Anatolia where this new species are found.

In Table 1, *A. bracteatum*, *A. artosense*, *A. hoshapicum* and *A. bashkaleicum* are compared with each other on the basis of their habits, leaves, scapes, scales, spikes, spikelets, bracts, calyces, petals, flower-

ing times, habitat preferences, altitude ranges and phytogeographies.

A. bashkaleicum has a dense terminal capitate spike with 4–7 spikelets and rather erect patent rigid leaves with sharp aristate points at their tips. Because of its spike type it is close to *A. bracteatum* and *A. capitatum* in the key in the Flora but it can be dif-

Table 1. A comparison of *A. bracteatum*, *A. artosense*, *A. hoshapicum* and *A. bashkaleicum*

	<i>A. bracteatum</i>	<i>A. artosense</i>	<i>A. hoshapicum</i>	<i>A. bashkaleicum</i>
Habit	Compactly pulvinate shrublet	Densely pulvinate shrublet	Densely pulvinate shrublet	Densely pulvinate shrublet
Leaves	Glabrous, narrowly lanceolate, plano triquetrous, margins scabrid	Glabrous, calcareous punctate, linear triquetrous, margins smooth	Glabrous, glaucous-green, linear triquetrous, margins scabrid	Glaucous, calcareous punctuate, linear triquetrous, rigid, margins smooth
Spring leaves	30 × 3 mm	13–20 × 1.5–2 mm	13–20 × c.1.5 mm	10–15 × c. 1 mm
Summer leaves	20–50 × 1.5–2.5 mm	25–40 × 0.8–1 mm	25–35 × 1–1.5 mm	20–26 × 0.7–1 mm
Scapes	Unbranched, equalling to exceeding leaves, 5–8 cm, 1–2 scaled	Unbranched, exceeding leaves, 8–10 cm, 3–4 scaled	Unbranched, exceeding leaves, 9–13 cm, 3 scaled	Unbranched, exceeding leaves, 7–9 cm, 2–3 scaled
Scales	9–11 mm, broadly ovate to orbicular, broadly hyaline margin	8–10 mm, lanceolate, aristate, broadly hyaline margin	10–12 mm, lanceolate, acuminate, hyaline	7–7.5 mm, lanceolate, acuminate, aristate, largely hyaline
Spike	Terminal-capitate, with 6–10 spikelets, 2–3 cm long	Densely distichous, terminal, with 8–16 spikelets, 2.5–5 cm long	Interrupted, terminal, with 6–12 spikelets, 3–5 cm long	Densely distichous, terminal, with 4–7 spikelets, 2–2.5 cm long
Spikelets	14–16 mm, 2–5 flowered, having 1 outer and 3–5 inner bracts	12–13 mm, 2-flowered, having 1 outer and 3 inner bracts	11–14 mm, 2-flowered, having 1 outer and 3 inner bracts	14–15 mm, 2-flowered, having 1 outer and 3 inner bracts
Bracts	Unequal, glabrous	Subequal, glabrous	Subequal, glabrous	Subequal to unequal, glabrous
Outer bract	8–12 mm, ovate to suborbicular, longer than inner bracts	9–10 mm, ovate to broadly lanceolate, longer than inner bracts	7–10 mm, ovate to broadly lanceolate, shorter than inner bracts	6–7 mm, obovate to broadly lanceolate, shorter than inner bracts
Inner bracts	7–8 mm, broadly obovate, hyaline except for base and vein	8–9 mm, oblong-lanceolate, margins broadly hyaline	8–11 mm, oblong to elliptic, margins broadly hyaline	7–10 mm, ovate-elliptic, hyaline except for vein
Calyx	11–12 mm, tube and veins pilose up to the limbs, lobes truncate, veins reaching margin, limb 5–6 mm in diameter	11–13 mm, tube and veins pilose up to middle of limbs, lobes obtuse, veins reaching margin, limb 6–7 mm in diameter	13–14 mm, tube and veins pilose up to middle of limbs, lobes acute-obtuse, veins excurrent, limb 7–10 mm in diameter	12–13 mm, tube slightly pilose, veins glabrous, lobes obtuse, veins reaching margin, limb 5–6 mm in diameter
Habitat	Rocky slopes, mountain steppe	Calcareous, mountain slopes	Sedimentary rocks	Sedimentary, mountain slopes
Altitude	1700–3100 m	2500 m	2050 m	2100 m
Flowering time	July–August	July	July	July
Phytogeography	Irano-Turanian	Irano-Turanian	Irano-Turanian	Irano-Turanian

ferentiated from both by its small floret number (only two), shorter outer bract (6–7 mm) and spike length (up to 1.5 cm). *A. bashkaleicum* can also be differentiated from *A. artosense* and *A. hoshapicum* by its smaller summer leaves (20–26 mm long) that are very sharp and erect patent, very short, densely terminal capitate spikes (2–2.5 cm long) with 4–7 spikelets, larger spikelets size (14–15 mm) and shorter outer bract (6–7 cm).

Although *A. artosense* and *A. hoshapicum* look similar at first glance, close examination proves that they are quite different. *A. artosense* has an interrupted dense distichous spike in which the outer bract is longer (9–10 mm) than inner ones (8–9 mm) and veins reaching the margin. *A. hoshapicum* has interrupted laxly distichous spikes, in which the outer one is shorter (7–10 mm) than the inner ones (8–10 mm) and the veins are attingentibus.

A. artosense grows on calcareous slopes on Artos Mountain above Gevaş at a height of 2500 m. The other species are mainly confined to high mountain steppes (the geology is predominantly sedimentary), where they grow at 2050–2100 m.

The centre of diversity of sect. *Acantholimon* appears to lie in the Irano-Turanian area. The species are mainly confined to mountain steppes above 2000 m and might have radiated in this area. In sect. *Acantholimon* there is a tendency to reduce the flower number in each spikelet, from 6–10 to 2 and the bract number from 4–6 to 4. This might have been the mechanism that gave rise to the early ancestors of the species, with one flower, three bracts and monomorphic leaves, grouped under sect. *Staticopsis*.

ACKNOWLEDGEMENTS

We wish to thank the Regius Keeper of the Royal Botanic Garden, Edinburgh (E) for making the duplicates of Davis' material of *Acantholimon* available as a gift to Professor Musa Doğan and providing herbarium facilities, and the Director of the Jardin Botanique (Geneva) for making their herbarium facilities available, the Scientific and Technical Research Council of Turkey (TUBITAK-TBAG 1781) for their financial assistance for the study and Mr A. Sargın from the Ministry of Forestry and Environment in Ankara for his drawings of the species. Thanks are also due to the following Turkish herbaria (ANK, GAZI, HUB, ISTF and EGE) for making their herbarium material available.

REFERENCES

Akaydın G. 2002. A new species of *Acantholimon* Boiss. (*A. yildizelicum* sp. nov.) (Plumbaginaceae) from North Anatolia, Turkey. *Nordic Journal of Botany* **22** (5): in press.

- Akaydın G, Doğan M. 2002.** A new species of *Acantholimon* Boiss. (Plumbaginaceae) from Western Taurus Mountains of Turkey. *Israel Journal of Plant Sciences* **50**: 67–71.
- Boissier E. 1879.** *Flora Orientalis* 4: 823–854. Basel: Reg. Acad. Scient.
- Bokhari MH. 1970.** Materials for a *Flora of Turkey* XXII: *Plumbaginaceae*. *Notes of the Royal Botanic Garden, Edinburgh* **30**: 295–304.
- Bokhari MH. 1972a.** Synopsis of *Plumbaginaceae* in Turkey. *Notes of the Royal Botanic Garden, Edinburgh* **30**: 57–77.
- Bokhari MH. 1972b.** A brief review of stigma and pollen types in *Acantholimon* and *Limonium*. *Notes of the Royal Botanic Garden, Edinburgh* **32**: 79–84.
- Bokhari MH, Edmondson JR. 1982.** *Acantholimon* Boiss. In: Davis PH, ed. *Flora of Turkey and the East Aegean Islands*, Vol. 7. Edinburgh: Edinburgh University Press, 478–502.
- Brummitt RK, Powell CE, eds. 1992.** *Authors of plant names*. Kew, London: Royal Botanic Gardens.
- Bunge A. 1872.** *Die Gattung Acantholimon* Boiss. L'Academie Imperiale des Sciences de St.-Petersbourg, IIV. Serie 1–72.
- Davis PH, Heywood VH. 1973.** *Principles of angiosperm taxonomy*. Huntington, NY: Robert E. Kieger Publishing Co.
- Davis PH, Mill RR, Tan K. 1988.** *Acantholimon* Boiss. In: Davis PH, ed. *Flora of Turkey and the East Aegean Islands*, Vol. 10. Edinburgh: Edinburgh University Press, 212.
- Doğan M, Akaydın G. 2001.** A new species of *Acantholimon* Boiss. (*A. birandii* sp. nov.) (Plumbaginaceae) from the Central Anatolian Steppe in Turkey. *Nordic Journal of Botany* **21**: 481–484.
- Doğan M, Akaydın G. 2002a.** A new species of *Acantholimon* Boiss. (Plumbaginaceae) from Central Anatolia, Turkey. *Botanical Journal of the Linnean Society* **138**: 365–368.
- Doğan M, Akaydın G. 2002b.** A new species of *Acantholimon* Boiss. (Plumbaginaceae) from Ankara, Turkey. *Botanical Journal of the Linnean Society* **140**: 443–448.
- Doğan M, Akaydın G. 2003a.** Two new species of *Acantholimon* sect. *Staticopsis* (Plumbaginaceae) from Turkey. *Annales Botanici Fennici* **40**: 53–58.
- Doğan M, Akaydın G. 2003b.** An undescribed species of *Acantholimon* Boiss. sect. *Staticopsis* (Plumbaginaceae) from Turkey. *Israel Journal of Plant Sciences* **51**: 233–238.
- IUCN. 2001.** *Red List Categories: Version 3.1*. Prepared by the IUCN Species Survival Commission. Gland, Switzerland and Cambridge, UK: IUCN.
- Komarov VL, ed. 1967.** *Flora U.R.S.S.*, Vol. 18. (Engl. Transl.). Jerusalem: Israel Program for Scientific Translations.
- Muvaffak A, Doğan M, Bilgin CC. 2001.** Numerical taxonomic study of the genus *Acantholimon* Boiss. (*Plumbaginaceae*) in Ankara Province. *Israel Journal of Plant Sciences* **49**: 297–300.
- Post GE. 1933.** *Flora of Syria, Palestine and Sinai*. Beirut: American Press.
- Reichinger KH, Schiman-Czeika H. 1974.** *Flora Iranica: Plumbaginaceae*. Graz, Austria: Akademische Druck- u. Verlagsanstalt.
- Tutin TG, Heywood VH, Burges NA, Valentine DH. 1972.** *Flora Europaea*, 3. Cambridge, UK: Cambridge University Press.