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A new species of *Halocnemum* M.Bieb. (Amaranthaceae) from southern Turkey

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Halocnemum yurdakulolii Yaprak is described as the second species of the previously monotypic genus *Halocnemum*. The species is endemic to the Göksu Delta in southern Turkey. The main morphological characteristics that separate *H. yurdakulolii* from *H. strobilaceum* (Pall.) M.Bieb. are growth form and spike morphology. Apart from these morphological differences, the species show a clear genetic differentiation. © 2008 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2008, **158**, 716–721.

ADDITIONAL KEYWORDS: Chenopodiaceae – endemic – Göksu Delta – *Halocnemum strobilaceum* – *Halocnemum yurdakulolii* – halophyte – Silifke.

INTRODUCTION

Halocnemum M.Bieb. belongs to Amaranthaceae subfamily Salicornioideae. In its current circumscription it is monotypic and represented by *Halocnemum strobilaceum* M.Bieb. only. The distribution area ranges from South Europe and North Africa to Asia and Mongolia (Jalas & Suominen, 1980; Freitag, 1991). *Halocnemum* is easily recognized in Salicornioideae by its characteristic glomerulate short shoots consisting of few scale-like leaves and tepals that are only fused at the base (Ulbrich, 1934: fig. 208A–G). According to molecular data, the closest relative of *Halocnemum* is the monotypic Eurasian genus *Halostachys*. The two genera share the morphological traits of free bracts with connate opposite leaves and articulated stems (Kadereit, Mucina & Freitag, 2006). Apparently, *H. strobilaceum* has only little economic value. It is sometimes grazed by camel and sheep and used as a source of potash and as fuel by nomadic tribes (Iljin, 1936).

In this paper, a second species of *Halocnemum* is described. *Halocnemum yurdakulolii* Yaprak was discovered during field studies on Turkish Salicornioideae in the Göksu Delta in 2004. The correct placement in *Halocnemum* is tested by molecular evidence. Seed morphology of both species is studied using scanning electron microscopy.

MATERIAL AND METHODS

PLANT MATERIAL STUDIED

Specimens from the only locality of *H. yurdakulolii* collected in three different years and months were included in this study (Appendix). Thirty three specimens of *H. strobilaceum* from 21 different localities in Turkey were also included. The appendix provides the voucher information for all specimens studied.

SCANNING ELECTRON MICROSCOPY

Micromorphological features of the seed testa were observed by scanning electron microscopy. The seeds were coated with gold and photographed using a scanning electron microscope JSM-6060.

SEQUENCING

Two internal transcribed spacer (ITS) sequences were generated according to the procedures used in Kadereit *et al*. (2006). The samples sequenced were *A. E. Yaprak 2004–108* for *H. strobilaceum* and *A. E. Yaprak 2003–116* for *H. yurdakulolii*. The sequences were aligned to the data sets of Salicornioideae

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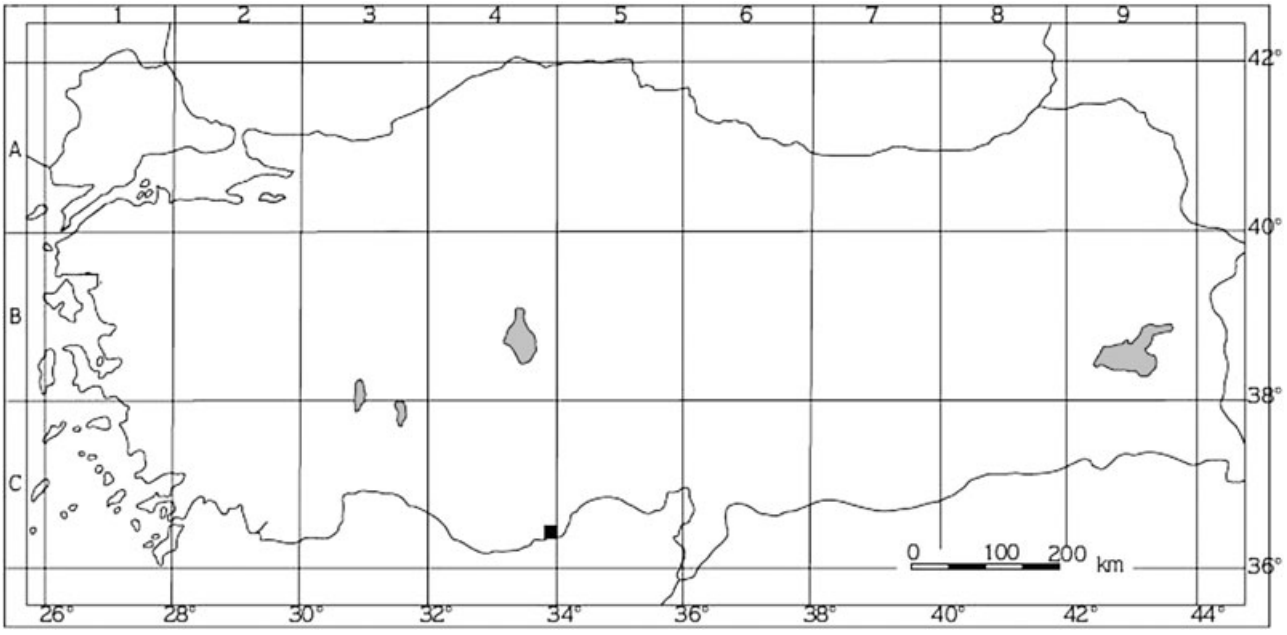

Figure 1. Distribution of *Halocnemum yurdakulolii* in Turkey (only known from the type locality).

presented in Kadereit *et al*. (2006) and analysed with maximum parsimony (MP) accordingly.

DESCRIPTION OF THE NEW SPECIES

HALOCNEMUM YURDAKULOLII YAPRAK SP. NOV.

Type: Turkey, C 5 Mersin: Silifke, Göksu Delta, edge of the Paradeniz Lagoon, hypersaline flats in coastal lagoons, sea level, 4.xi.2004 A. E. YAPRAK 2004–116. (holotype ANK; isotype GAZI, KAS, MJG).

Diagnosis: Affinis *H. strobilaceo* sed planta erecta vel ascendens, ad 150 cm alta; spicis omnibus ± aequalibus longitudine circiter 4–5 mm, testa seminis secus raphidem evidenter papillosa (non laevi vel infirme papillosa) differt (compare Figs 2 and 3, and Figs 4–7, respectively).

Description: Jointed, richly branched, fleshy shrub (Fig. 8B), sub-erect to ascending, 100–150 cm, glabrous, pale yellowish green, with long branches and short thick, globular branchlets (Fig. 8A); internodes short, cylindrical, *c*. 1.5 mm long, leaves obovate, ±obtuse, with scarious margins, connate at base; often subtending short, sterile globular, bud-like branches, with four rows of short, rounded sessile, leaves; flowers, mostly in threes, somewhat immersed in the axis of inflorescence, mostly perfect and some of them male or female, arranged in short, dense lateral and terminal spicate inflorescence; inflorescences ±equal in size, 4–5 × 3–4 mm, sessile, opposite, globular (Fig. 2); perianth lobes 3, united at the base; perianth *c*. 1.5 mm long, membranous, inflexed at tip, membranous and not appendaged in fruit; stamen 1; ovary with a thick style and 2 subulate stigmatic lobes (Fig. 1); bracts of flower clusters reniform sub-orbicular (Fig. 8E–G); seed vertical *c*. 0.7–1 mm long, compressed, brown, obscurely papillose along the raphe (Figs 5, 7, 8C, D).

Phenology: Flowering: late September to November; fruiting: November to December.

Habitat and ecology: Halocnemum yurdakulolii grows on hypersaline flats in coastal lagoons. It is associated with *Arthrocnemum macrostachyum* (Moric.) Bunge ex Ung.-Sternb. and *Sarcocornia perennis* (Miller) A.J.Scott (all Salicornioideae, Chenopodiaceae).

Etymology: The species is named in honour of the eminent Turkish Botanist Prof. Dr Ender Yurdakulol.

Distribution and proposed conservation status: Halocnemum yurdakulolii is, to date, endemic to Göksu Delta Içel-Silifke, South Anatolia (Fig. 1) and belongs to the Mediterranean element of the Turkish Flora. *Halocnemum yurdakulolii* is known only from a single population at the type locality and from an area of approximately 40 000 m^2. The number of individuals is approximately 1000–1500. Therefore, it should be regarded as belonging to the World Conservation Union (IUCN) endangered (EN) threat cat-

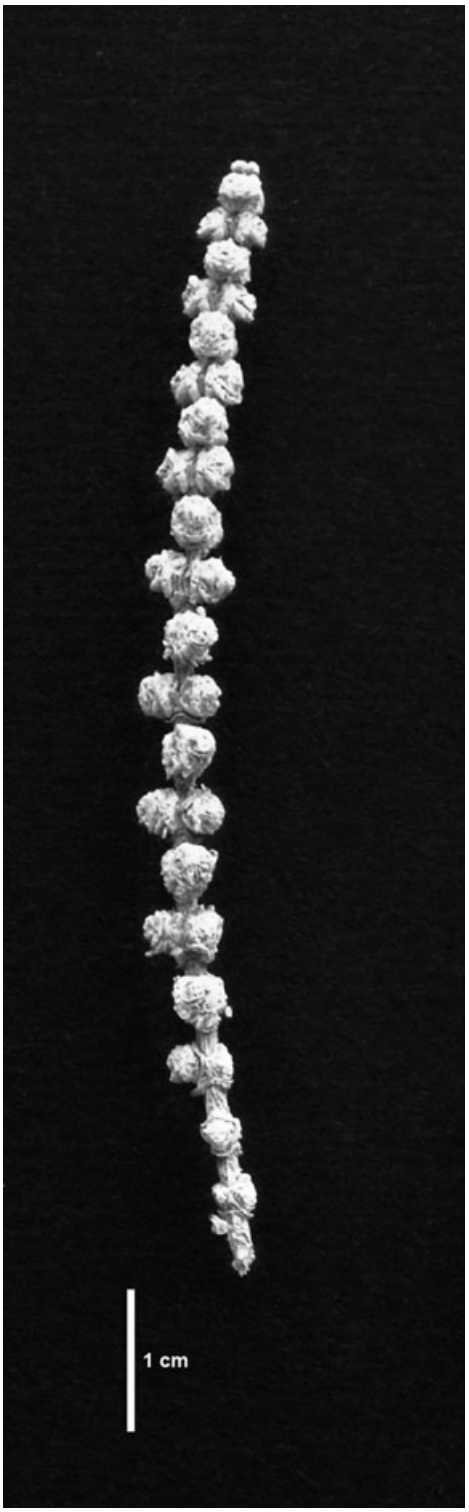

Figure 2. Branchlet of *Halocnemum yurdakulolii* (taken from specimen A. E. Yaprak 2004–116, see Appendix S1) showing the characteristic globular spikes.

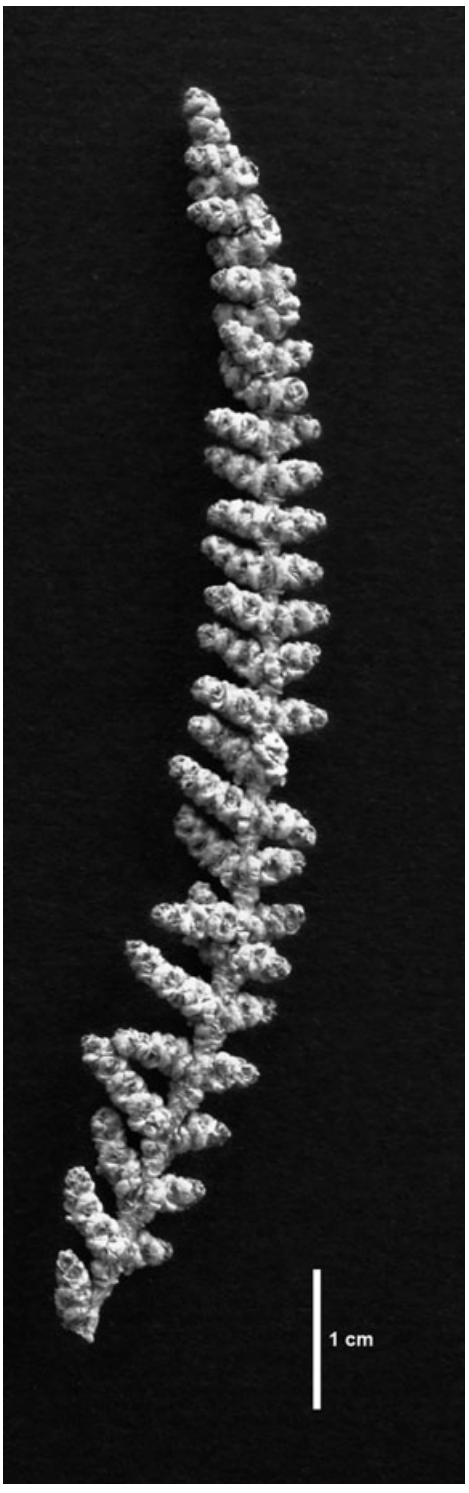

Figure 3. Branchlet of *Halocnemum strobilaceum* (taken from specimen A. E. Yaprak 2004–88, see Appendix S1) showing the globular to oblong spikes that are not equal in size.

KEY TO SPECIES OF *HALOCNEMUM*

1. Glaucous to yellowish green subshrubs, mostly 0.2–0.6 m high, with subglobular to cylindric spikes, spikes are not equal in size, 5–15 × 2–3 mm (Fig. 3), seed testa smooth to slightly papillose (Figs 4, 6).....***H. strobilaceum***
2. Pale yellowish green shrubs, 1.0–1.5 m high, with globular spikes, spikes ±equal in size, 4–5 × 3–4 mm (Fig. 2), seed testa papillose along the raphe (Figs 5, 7, 8C, D).....***H. yurdakulolii***

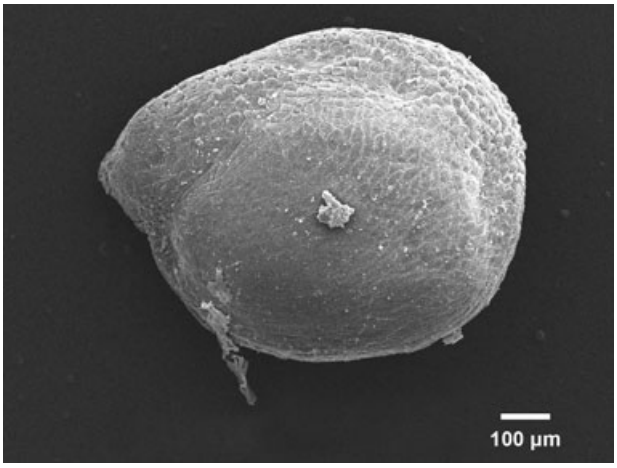

Figure 4. Seed of *Halocnemum strobilaceum* (taken from specimen A. E. Yaprak 2003–155, see Appendix S1).

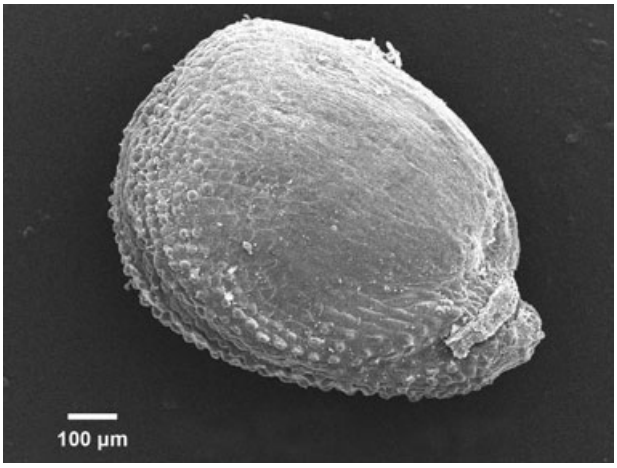

Figure 5. Seed of *Halocnemum yurdakulolii* (taken from specimen A. E. Yaprak 2003–116, see Appendix S1).

egory (IUCN, 2001). The area of known occurrence of this species is included in Göksu Delta Specially Protected Area (SPA) and is thus officially protected by Turkish law.

Phylogenetic status: The ITS tree of Salicornioideae showed that *H. strobilaceum* and *H. yurdakulolii* form a monophyletic group with 15 synapomorphic substitutions. The ITS sequences of the two

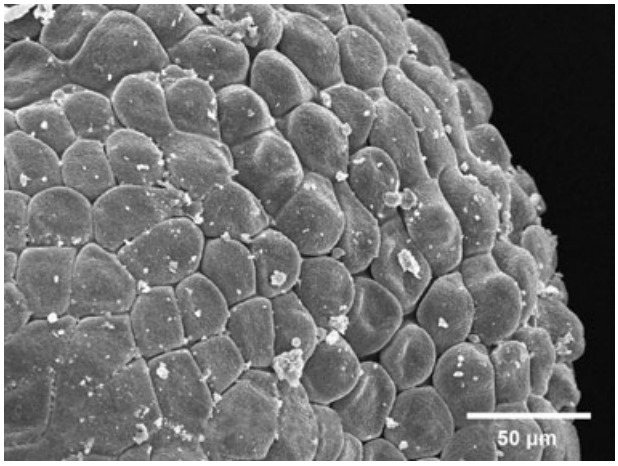

Figure 6. Scanning electron microscopy (SEM) picture of seed testa of *Halocnemum strobilaceum* (taken from specimen A. E. Yaprak 2003–155, see Appendix S1) showing the smooth to slightly papillose testa cells.

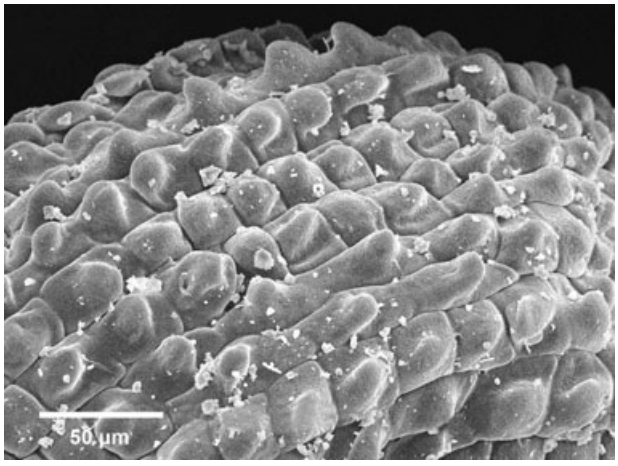

Figure 7. Scanning electron microscopy (SEM) pictures of seed testa of *Halocnemum yurdakulolii* (taken from specimen A. E. Yaprak 2003–116, see Appendix S1) showing papillose testa cells along the raphe.

species (represented by specimen *A. E. Yaprak 2004–108* for *H. strobilaceum* and specimen *A. E. Yaprak 2003–67* for *H. yurdakulolii*) differ by 25 substitutions. The sequences are deposited in GenBank: *H. strobilaceum*, *A. E. Yaprak 2004–108* EU195883 and *H. yurdakulolii*, *A. E. Yaprak 2003–67* EU195882.

Figure 8. *Halocnemum yurdakulolii* Yaprak sp. nov. A, branch with globular branchlets. B, richly branched major branch. C, seed (lateral view). D, seed (view from opposite the raphe). E–G, bract (E, top view; F, bottom view; G, dorsal view). Drawings made by Doris Franke (Mainz) from specimen A. E. Yaprak 2004–116 (isotype, MJG).

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:
Appendix. S1. Specimens examined of *Halocnemum strobilaceum* and *H. yurdakulolii.*

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