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On the genus *Sternbergia* (Amaryllidaceae) in Iraq

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Abstract

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Sternbergia is a genus containing mostly remarkable autumn flowering taxa within Amaryllidaceae. Its distribution ranges from the Mediterranean region through the Irano-Anatolian region to Caucasus and Central Asia. In *Flora of Iraq*, the information about the occurrence, habitat, and distribution of its species is outdated or incomplete. The main aim of this study has been to contribute with new data from the field in order to update its status in the Kurdistan Region. Botanical field surveys were mostly carried out between 2013 and 2015 in autumn and spring. The main result of this study has been the occurrence of 3 species of *Sternbergia*: *S. colchiciflora*, which is reported in this study for the first time for the Kurdistan Region and therefore for Iraq; *S. clusiana*, which has been rediscovered in Iraq; and *S. vernalis*, which has been found again in the Berwarya Mountains, after being considered a lost species in Iraq over the last 80 years. These 3 observed species occur in the mountains of Amadiya District, making this area the richest territory for *Sternbergia* in the country. Due to certain factors that currently threaten their natural habitats, they are rare species and could be regarded as potentially endangered at regional level according to the IUCN criteria.

Keywords: Flora of Iraq, Irano-Anatolian, Kurdistan Region, new record, *S. clusiana*, *S. colchiciflora*, *S. vernalis*.

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INTRODUCTION

The genus *Sternbergia* Waldst. & Kit. belongs to the family Amaryllidaceae and is one of the most remarkable autumn flowering genera. According to recent phylogenetical studies, it has been reported as a «brother» genus to *Narcissus* L., within an clade of Amaryllidaceae (Meerow & al., 1999; Meerow & Snijman, 2006; Gage & al., 2011). *Sternbergia* was first described by Waldstein & Kitaibel (1803-1805), and dedicated to the memory of the Hungarian botanist Count Caspar von Sternberg (1761-1838). This genus comprises mostly autumn flowering species with a wine glass shape and a long perianth tube. From a taxonomical perspective, all species of *Sternbergia* may be easily separated from other bulbous genera —v.gr., *Colchicum* and *Crocus*— because they produce true bulbs

Resumen

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Sternbergia contiene, sobre todo, extraordinarios táxones con floración otoñal de las amarilidáceas. Su distribución abarca desde la región mediterránea, a través de la región irano-anatólica, hasta el Cáucaso y el Asia central. En la *Flora de Iraq*, la información sobre la presencia, el hábitat y la distribución de sus especies está obsoleta o incompleta. El principal objetivo de este trabajo ha sido contribuir con datos nuevos tomados en el campo a actualizar su estatus en la Región del Kurdistán. Las expediciones botánicas al campo fueron llevadas a cabo entre los años 2013 y 2015, durante el otoño y la primavera. El principal resultado de este estudio ha sido la localización de 3 especies de *Sternbergia*: *S. colchiciflora*, que ha sido citada por primera vez en este estudio para la región del Kurdistán y, por tanto, para Iraq; *S. clusiana*, que ha sido redescubierta en Iraq; y *S. vernalis*, que se ha encontrado de nuevo en las Montañas Berwarya, después de que se haya considerado extinta en Iraq durante los últimos 80 años. Estas 3 especies viven en las montañas del distrito de Amadia y hacen de esta área el territorio más rico en especies de *Sternbergia* del país. Debido a ciertos factores que amenazan actualmente sus hábitats naturales, estas especies son raras y podrían ser consideradas potencialmente amenazadas a nivel regional de acuerdo con los criterios de la UICN.

Palabras clave: Flora de Iraq, irano-anatólico, nueva cita, Región del Kurdistán, *S. clusiana*, *S. colchiciflora*, *S. vernalis*.

and have one style with inferior ovary and generally bright yellow flowers —except the white spring flowering *S. candida*—. *Narcissus cavanillesii* Barra & G. López, due to its rudimentary corona, was formerly considered as a separate genus —*Braxireon* Raf., *Carregnoa* Boiss., etc.— morphologically related to *Sternbergia* (Aedo & al., 2013), being eventually named *S. exigua* (Schousb.) Ker Gawl. Within *Sternbergia*, the cultivation of *S. lutea* (L.) Spreng. is well-known as a garden plant that produces flowers in autumn when other plants have finished their flowering period.

The geographical distribution of *Sternbergia* extends around the whole Mediterranean region and throughout the Irano-Anatolian region to the Caucasus and Central Asia. According to recent taxonomic revisions, this genus consists of 7 (Mathew, 1983), 8 (Artelari & Kamari, 1991;

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Govaerts & al., 2007) or 9 species (Pasche & Kerndorff, 2002). Turkey is particularly the richest territory and accounts for 7 recorded species (Gage & al., 2011). These different numbers of species highlight the complexity of species delimitation in *Sternbergia*, especially within *S. lutea* complex. For some authors, the lack of phylogenetic resolution (Gage & al., 2011), combined with the absence of morphological characters with diagnostic value (Gage & Wilkin, 2008), supports the idea that both *S. sicula* and *S. greuteriana* are conspecific with *S. lutea*, forming a species complex. For other authors, the morphology based on stable criteria—verified in natural, as well as in cultivated specimens (Kamari & Artelari, 1990; Pasche & Kerndorff, 2002; Peruzzi & al., 2008; Tison & Delaigue, 2010)—justify the recognition of 3 species in the complex.

From 1950 to the seventies, P. Wendelbo explored the Middle East and reported 4 species of *Sternbergia* in *Flora of Iraq* (Wendelbo, 1985). Unfortunately, during his botanical explorations throughout the Iraqi territory, he did not collect any species of *Sternbergia* and he only reported the presence of the genus by means of references from previously published works. In addition, the scarce botanical information about habitat and distribution makes sometime difficult to ascertain the presence or absence of its taxa. In *Flora of Iraq*, 3 species, namely *S. clusiana*, *S. lutea*, and *S. vernalis*, were considered very rare—“only found once”—and missed over the last 30 or 50 years. Moreover, the presence of a fourth species, *S. pulchella*, in Iraq is still dubious since it was based on a collection made 185 years ago in an imprecise locality—“between Aleppo and Mosul”—, and because the species has not been collected again outside Syria and Lebanon, from where it is considered endemic (Mouterde, 1966).

There have been very few floristic studies that recently have attempted to update *Flora of Iraq* (but see Shahbaz, 2006; Shahbaz & al., 2015). Particularly, there have been no regular floristic studies on the geophytes, except in Orchidaceae (Véla & al., 2013; Youssef & al., 2015).

The main aim of this study is therefore to contribute to the knowledge of the genus *Sternbergia* with new data from natural populations in order to update its status in the Kurdistan Region and to shed light on some of the historical localities known by the literature, as well as on the current threat status of its species and the proper strategies for their conservation.

MATERIAL AND METHODS

The taxonomical identification of the species of *Sternbergia* was carried out both in the field and at the laboratory—College of Agriculture, University of Duhok—. Initially, the identification process followed Wendelbo (1970, 1985), and then it has been systematically verified according to the successive published taxonomic revisions of this genus (Feinbrun & Stearn, 1953; Mathew, 1983; Artelari & Kamari, 1991; Pasche & Kerndorff, 2002).

Botanical field surveys and observations have been carried out only in Duhok Governorate. *Sternbergia* specimens were collected during our botanical investigation surveys between 2013 and 2015, with particular focus on both autumn and spring. All specimens collected were kept at the Herbarium of College of Agriculture—DPUH, University of the Duhok.

Our exploration area in the mountains of Duhok Governorate is included in a tetragon demarcated by Duhok, Zaxo, Barzan, and Kani-Massi—former “Ain Nuni” according to *Flora of Iraq*—, where we collected in 3 different localities: Beduhê near “Ain-Nuni” northward of the Mateen Mountain, and Banka and Mergué in the western and eastern parts of the Mateen Mountain respectively (Fig. 1). The main landscape features of the study area are characterised by a mixture of hills, cultivated plains, deep valleys, and mountain chains which are generally extending from west to east. Most of the vegetation community structure is represented by open oak forests on mountain slopes and dominated by the following tree species: *Quercus*



Fig. 1. Localities of *Sternbergia* in the Duhok governorate, Kurdistan Region.

Table 1. List of the species of *Sternbergia* in *Flora of Iraq*, modified and completed after Wendelbo (1985) [MAM = Amadiya District (mountains of Duhok Governorate); FNI = Nineveh District (lowlands, eastern side of the Tigris River); FUJ = Upper Jazira District (western side of the Tigris River)].

Species	Flowering period	Habitat	Distribution
<i>S. clusiana</i>	Oct-Dec	Steppe plains and hills, rocky mountainside; 400-1100 m a.s.l.	Very rare in Iraq. Only found twice, in the moist steppe zone and in the middle forest zone of Iraq: FUJ, nr. Tal Afar, <i>Anon. s. n.</i> ; MAM, Mateen Mountain, <i>S. Youssef s. n.</i>
<i>S. colchiciflora</i>	Oct	Rocky mountainside; 1600-1700 m a.s.l.	Extremely rare in Iraq. Only found once recently in the middle forest zone of Iraq: MAM, Mateen Mountain, <i>S. Youssef s. n.</i>
<i>S. pulchella</i>	Aug-Sep (?)	Not known, elsewhere on dry hillsides.	Doubtful in Iraq, as the only specimen collected over 215 years ago was found whether in Iraq (FUJ?) or in Syria “between Aleppo and Mosul” by <i>Olivier & Bruguere s. n.</i> Wendelbo noted “It has not been found again within our borders in spite of the many botanists who have passed along this route suggests that Olivier’s gathering was probably made in Syria”.
<i>S. lutea</i>	Oct	Not recorded; probably 400-500 m a.s.l. (?). Possibly cultivated in gardens.	Very rare (even doubtful) in Iraq. Only found once around 80 years ago near the Turkish frontier in the moist steppe zone: MAM/FNI, nr. Zakho, <i>G. Reed in Rogers 387</i> . Wendelbo noted “only one rather poor specimen which I have, with some doubt, referred to this species”. Furthermore, the presence of this steno-Mediterranean species outside the Mediterranean is surprising, except considering it was cultivated or escaped.
<i>S. vernalis</i>	Feb-Mar	Rocky mountainside; 1200-1400 m a.s.l.	Very rare in Iraq. Only found twice, not far from the Turkish frontier, in the middle forest zone: MAM, Amadiya, <i>Guest 1237</i> ; near Beduhê, <i>S. Youssef s. n.</i>

aegilops L. [*Quercus ithaburensis* subsp. *macrolepis* (Kotschy) Hedge & Yalt.], *Quercus aegilops* and *Quercus infectoria* Olivier, and *Quercus infectoria* and *Quercus libani* Olivier, in low, middle, and high mountains, respectively. These forest steppes harbour a dense ground covering of annual herbaceous vegetation dominated by species of the families Poaceae and Fabaceae. The mountain summits are barren and rocky, and their passage is often blocked by the snow during winter. The subalpine zone is characterised by the dominance of shrubs or dwarf thorn-cushion vegetation —v.gr., *Astragalus* spp., *Onobrychis* spp., *Daphne acuminata* Stocks, and *Lonicera arborea* Boiss.

RESULTS

Identification key for the Iraqi species of *Sternbergia*

The botanical status of the 5 historically reported Iraqi species of *Sternbergia* is updated in Table 1 on the basis of the *Flora of Iraq* (Wendelbo, 1985) and our recent findings. As well, we also provide here a new species key —modified and completed after Wendelbo(1985):

1. Perianth tube almost as long as the segments, directly emerging from the soil 2
1. Perianth tube half of the segments or shorter (flower upon an epigeous scape) 4
2. Dwarf flowers together with the leaves; segments of perianth linear and less than 1.5 cm long *S. pulchella*
2. Conspicuous flowers emerging before the leaves; segments of perianth more than 2 cm long 3
3. Segments of perianth oblong-ovate, more than 3.5 × 1 cm; leaves 8 mm wide or more *S. clusiana*
3. Segments of perianth lanceolate-linear, less than 3.5 × 0.5 cm; leaves 5mm wide or less *S. colchiciflora*
4. Flowering in autumn, before or together with the leaves; ovary sessile *S. lutea*
4. Flowering in spring, together with the leaves; ovary stipitate *S. vernalis*

Updating information on three of Iraqi species of *Sternbergia* collected in Amadiya District

Three species of *Sternbergia* were collected in the studied area. One of them, *S. colchiciflora*, is considered here as a new record for the Iraqi flora (Wendelbo, 1985) as well as a confirmation for the Iranian-Iraqi Zagros, where it was considered doubtful (Wendelbo, 1970). The 2 other species, *S. clusiana* and *S. vernalis*, are considered very rare and were only found once, more than half a century ago (Wendelbo, 1985). We below provide a species key for the species discuss the current status of these species in the Kurdistan Region, provide photographs of living plants, and claim the emergency needs for their conservation:

1. *S. colchiciflora* Waldst. & Kit. [*Amaryllis etnensis* Raf.; *S. etnensis* (Raf.) Guss.; *S. dalmatica* Herb.; *S. colchiciflora* var. *dalmatica* (Herb.) Herb.; *S. colchiciflora* var. *etnensis* (Raf.) Rouy]. Fig. 2.

Observations.—At a global scale, *S. colchiciflora* occurs over a very wide area in southern Europe, the Mediterranean region, and



Fig. 2. *Sternbergia colchiciflora*: a, b, “Banka” locality in the western Mateen Mountain, photo by S. Youssef, 15 Oct 2015; c, cultivation, photo by E. Vêla, 5 Feb 2017.

western Asia: from Spain and Morocco westward, throughout Algeria, France, Italy, the Balkans, Hungary, Crete, Turkey, Syria, Lebanon, Israel, and eastward to Iranian-Iraqi Zagros and the Caucasus (Mathew, 1983, 1984; Fernández Alonso, 1986; Morales & Castillo, 2004; Debussche & al., 2006; Peruzzi & al. 2008; Frignani & al., 2009; Dobignard & Chatelain 2010-2013). For the Iraqi part of the *Flora Iranica* area according to Wendelbo (1970) "*Sternbergia colchiciflora* Waldst & Kit. is reported by Bornmuller, Verb. Zool. Bot. Ges. Wien 60: 177 (1910), from M. Qareh Dagh: Ali Bolaghi, leg. KNAPP."; and added "I have not seen the material and hesitate to take up the species as it has never been found in adjacent areas". *Sternbergia colchiciflora* was definitely illustrated without doubt in this study for the first time in the Iraqi Kurdistan Region and therefore as a confirmed record for the flora of Iraq and the whole Iranian-Iraqi Zagros (Wendelbo, 1970, 1985).

On the 15th October 2015, during a botanical exploration in the upper part of the western Mateen Mountain —around Banka village (37° 9' 1" N, 43° 12' 50" E; Fig. 1), Amadiya District—, a very small population in a very restricted area was found at 1671 m a.s.l., near the top of the mountain where the climate is characterised by a cold and snowy winter —2 or 3 months at least—. The observed population had only 3 flowered individuals in a surface of about 100 m², in an open, calcareous, and rocky habitat dominated by oak trees with a dense groundcover of herbaceous plants, as well as many other bulbous species such as *Allium* sp., *Eremurus* sp., *Gagea* sp., *Colchicum* sp., *Crocus* sp., *Ornithogalum* sp., *Muscari* sp., and *Tulipa* sp.. The vegetation community structure was characterised by the occurrence of some sparse young oak trees of *Quercus infectoria* in presence of some other trees and shrubs such as *Juniperus oxycedrus* L., *Crataegus azarolus* L., *Acer monspessulanum* L., and *Daphne acuminata*.

Morphologically, *S. colchiciflora* is characterised by its small flower, almost stemless, tiny shuttlecock-shaped, that appears in early autumn —September to November—. Its leaves are narrowly linear, usually twisted or spiralled, and appear long after the flowers. Approximately the flowering period ranges from 1 to 7 days. It has a narrow and long perianth with pale or bright yellow segments

that make it very easy to overlook among the dried vegetation during the autumn (Mathew, 1983). According to our field observations, the Iraqi plants show the same bright yellow perianth than the Hungarian ones —cf. Adam Gor photographs in <https://www.flickr.com/photos/charaxes14/9950422376/>—, which represent the typical material.

We can also confirm that *S. colchiciflora* is a very rare species in the Kurdistan Region, because of the low number of known locations —only one in Iraq—, the scarce occupied surface area —about 100 m²—, and the small size of the population —less than 5 flowered individuals—. Its presence in the Kurdistan Region is not surprising, because it was already known in the southeastern Turkey (Mathew, 1983, 1984) and historically collected on the Iranian side of the Iranian-Iraqi border (Wendelbo, 1970). Its short flowering period, small size, and small populations make it one of the most difficult species to be found in the field and may explain its rarity. The location is threatened by anthropogenic activities: the natural habitats are near the road that serves the oil field at the summit of the Mateen Mountain. Furthermore, the biological diversity in these habitats is negatively influenced by the over-harvesting of edible plants, and the construction of houses and villas by local people. Consequently, this rare species needs an urgent strategy for its biological conservation.

2. *S. clusiana* (Ker-Gawl.) Ker Gawl. ex Spreng. [*Amaryllis clusiana* Ker Gawl.; *S. stipitata* Boiss. & Hausskn.; *Oporanthus macranthus* J. Gay; *S. macrantha* (J. Gay) J. Gay ex Baker; *S. spaffordiana* Dinsm.]. Fig. 3.

Observations.—It is a common and widespread species in the eastern Mediterranean and the Irano-Anatolian mountains (Mathew, 1983, 1984), occurring in southern Turkey, Syria, Lebanon, Israel, Jordan, and throughout Iraq to Iran. *Sternbergia clusiana* has been considered as a lost species in the Iraqi territory for more than 60 years. It has been rediscovered in this study on a rocky steep slope at Mergué hamlet in the eastern Mateen Mountain —37° 3' 56" N, 43° 43' 54" E (Fig. 1). This population was not registered in *Flora of Iraq* (Wendelbo, 1985).



Fig. 3. *Sternbergia clusiana*: a, b, "Mergué" locality in the Mateen Mountain, photo by S. Youssef, 24 Oct 2015; c, *ibidem*, photo by S. Youssef, 4 Dec 2014; d, *ibidem*, photo by S. Youssef, 4 Apr 2015.

According to this flora, *S. clusiana* was very rare and found only once over 60 years at 400 m a.s.l. on moist plain steppes and hills near Tal Afar, in the upper Jazira District.

It is now known in the north-western mountains of the Kurdistan Region, situated precisely at 1042 m a.s.l. in the Mateen Mountain in Amadiya District. Currently, thanks to our field investigations on geophyte species on the 4th of December 2014, at least 100 individuals of *S. clusiana* were located on a surface area of several hectares. This species lives on the steep mountainside, with deep soil and in an open forest characterised by grassy clearings among oak trees —*Quercus infectoria* and *Q. aegilops*— and other shrubs —v.gr., *Juniperus oxycedrus*, *Crataegus azarolus*, *Rhus coriaria* L., *Pistacia khinjuk* Stocks, and *Prunus* spp.

Sternbergia clusiana is one of the species of the genus with largest flowers. It has a huge goblet-shaped flower produced in early autumn—from September to October— after the end of long, warm, and dry summers. The broad linear leaves are distinctive, flat and grey-green, and appear after the flowering season and grow during the spring (Mathew, 1983). We saw plants starting to flower at the end of October and finishing at early December. The bulbs were deeply embedded in the soil—20–30 cm.

3. *S. vernalis* (Mill.) Gorer & J.H. Harvey [*Amaryllis vernalis* Mill.; *Oporanthus fischerianus* Herb.; *S. fischeriana* (Herb.) Roem.]. Fig. 4.

Observations.—*Sternbergia vernalis* is one of the medium-size, spring-flowering species—beside to *S. candida* which has white flowers—. Its leaves are flat, shiny, green, and longitudinally twisted, and appear in spring, during the flowering period. It is a widespread species recorded from the eastern Mediterranean—Syria and Turkey— throughout the Irano-Anatolian region—Iraq, Iran, and Turkey—to Central Asia—Caucasus, Turkmenia, and Kashmir—. But it appears to occur only in widely separated colonies over this huge area (Mathew, 1983, 1984). It was also considered a lost species in Iraq for the last 80 years. We have found it once again, this time on the Berwarya Mountains in Amadiya District, about 2 km from the Turkish border.

Wendelbo (1985) reported the presence of one very rare population of this species at 1200 m a.s.l. in the middle forest zone of Amadiya District. Therefore, our finding of the 21th February 2014 is a confirmation of the historical presence of the species more than 80 years after. This population hosts about 100 individuals in 1000 m² near the village of Beduhê, in Kani-Massi Municipality—“Ain-Nuni” in *Flora of Iraq*—. The climatic conditions in these mountains are characterised by a cold and snowy winter, and occasionally the depth of snow can reach up to 1 m or more and remains about 1–3 months. It lives in damp mountainsides with deep soils. The vegetation structure is characterised by the dominance of herbaceous species surrounded by sparse *Quercus infectoria* trees and other trees or shrubs, such as *Amelanchier integrifolia* Boiss. &

Hohen., *Acer monspessulanum*, and *Daphne acuminata*. The presence of some dwarf thorn-cushion vegetation such as *Astragalus* sp., *Onobrychis* sp., and *Dianthus* sp. is also characteristic in this location.

In the Kurdistan Region, the rarity of *Sternbergia vernalis* may be due to their location, near the Turkish border, an under-investigated area by botanists. Recently, until 2014, the natural habitat of this species was threatened by the construction of the Beduhê Dam. Currently, this population is safe but located at less than 1 km from the dam, 100 m above the water level of the lake, and only 20 m from the new road track. Of course, we did not know the locality before the dam construction and we cannot assume that no population has been destroyed in a recent past.

DISCUSSION

Actually, the west part of the Kurdistan Region hosts all species of *Sternbergia* certainly known from Iraq. The 3 observed species only occur in the Amadiya District—mainly on the Mateen Mountain, a small territory benefiting of continental Mediterranean climate—, which is the richest territory for the genus in the country. This finding confirms as well that the centre of diversity of the genus *Sternbergia* expands from the eastern Mediterranean to the Irano-Anatolian region.

The Kurdistan Region of Iraq is a rich territory in terms of floristic diversity as a part of the Irano-Anatolian hotspot and hosts a number of rare, threatened, and endemic species. We have characterised their habitat, vegetation community structure, and population size, and estimated the environmental threats. Due to their rarity status, with many of their natural habitats under threat, *S. colchiciflora*, *S. clusiana*, and *S. vernalis* should be regarded as potentially endangered species at a regional level, but without precision about the threat level because of lacking information—DDreg, i.e., “Data Deficient regionally”—, according to the IUCN criteria (IUCN Species Survival Commission, 2001, 2003; IUCN Standards and Petitions Working Group, 2006). However, the small population of *S. fischeriana* occurring near the Beduhê Dam after its recent construction, suggests that it was probably more abundant before the dam and its natural habitat has been impacted by it. Since the Iraqi flora is one of the less documented in the Middle East region,



Fig. 4. *Sternbergia vernalis*: a, b, near the village of Beduhê on the Berwarya Mountain, photo by S. Youssef, 21 Feb 2014.

further new records and rediscovering historical localities of *Sternbergia* genus will be possible in future. The recent findings of this study highlight the real need to carry out further botanical explorations especially on rare or threatened species in order to document an Iraqi national biodiversity conservation strategy.

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