

DESCRIPTION OF A NEW *ALLIUM* SPECIES FROM SYMI ISLAND, (SE AEGEAN, GREECE): *ALLIUM CARLSTROEMI* SP. NOV. (AMARYLLIDACEAE)

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Abstract

Allium carlstroemi, a new species of *Allium* sect. *Codonoprasum* from the Aegean Island of Symi (SE Aegean, Greece) is described. It is a spring-flowering species and shows close morphological relationships with *A. stamineum*, a species with a distribution limited to SW-Turkey, and with other taxa belonging to the *A. stamineum* group. Morphology, ecology and relationships to other species belonging to *A.* sect. *Codonoprasum*, distributed in the E Mediterranean area, are also examined.

Introduction

Symi Island belongs to the Dodecanese Archipelago. It is located between Rhodes and the Turkish coast (Datça Peninsula, Muğla Province) from which it is only 5 km. Symi has a surface area of 58 km² and is mainly composed of Mesozoic limestone (Carlström 1987), which makes up the high coastal cliffs and the deep inlets. The geological nature of the rock outcropping gives rise to very interesting chasmophytic flora characterized by many rare and endemic species. Information concerning the vascular flora of Symi is given by Rechinger (1944), Davis (1965-1985), Davis et al. (1988), Carlström (1987), Keitel & Remm (1991), Strid (2016), Galanos (2016), Burton & Tan (2017, 2018), Cattaneo & Grano (2017, 2018, 2019) and Galanos & Tzanoudakis (2017, 2019). On the island of Symi, 12 *Allium* species occur. Two new single-island endemics have recently been described for Symi, *Allium symiacum* Galanos & Tzanoudakis (2017:109) and *Allium panormitisi* Galanos & Tzanoudakis (2019: 198). Both these taxa are autumn-flowering and belong to *A.* sect. *Codonoprasum* Reichenb. Another autumn-flowering species belonging to sect. *Codonoprasum*, *Allium archeotrichon* Brullo, Pavone & Salmeri (1999: 42), is a SE-Aegean endemic also occurring on Rhodes and Tilos (Galanos 2016). The *Allium* species here described is a member of the *A.* sect. *Codonoprasum* and differs from the aforementioned taxa since is a spring-flowering species. Material of this new species was previously collected by Carlström in 1982 and referred to *A. stamineum* Boissier (Boissier 1859: 119). However, the comparison between the material concerned and the species related to *A. stamineum* s. l., also in light of the latest studies on this group (Brullo et al. 2007), showed remarkable differences, and led me to the conclusion that it is a new species.

Allium carlstroemi sp. nov. from Symi Island, Greece



HERBARIUM CRISTINA CATTANEO - ROMA
Nome: ALLIUM CARLSTRÖMI
Località: NANOJ BAY, SYMI ISLAND
NOKOS DODEKANISOU, EPARCHIA RODOU
N _____ E _____ ALT. _____
Legit: C. CATTANEO
Determinavit: C. CATTANEO
Note: LIMESTONE ROCKS
Numero: 644 Date: 27/04/2018

Fig. 1. *Allium carlstroemi* Cattaneo sp. nov., holotype.

Materials and methods

The morphological study was based on four specimens collected in April 2018 on the site of Nanou Bay, during botanical research carried out on Symi, and on five samples collected by Carlström at the same site in May 1982. The latter ones, preserved at LD Herbarium, were attributed by Carlström to *Allium stamineum*. By comparing Lund's material and the new collected material, a correspondence was found. In light of recent studies that have limited the area of *A. stamineum* to south-western Anatolia (Brullo et al. 2007), a review and re-evaluation of the taxonomic identity of the population of Nanou Bay is proposed. The measurements of the material were made on exsiccata. The comparison of *Allium carlstroemi* with the other related taxa was based on data derived from the available literature (Karavokyrou & Tzanoudakis 1994, Brullo et al. 1996, 2001, 2007, Koçyiğit et al. 2016a).

Results

Allium carlstroemi Cattaneo sp. nov. – Fig.1-4.

Holotype: Greece, Nomos Dodekanisou, Symi Island, Nanou Bay 36°34'44.6"N, 27°50'29.4"E, c. 338 m, 27 April 2018 [Cattaneo, RO-HG (*s.n.*), Herbarium of the Department of Environmental Biology, Sapienza University of Rome].

Diagnosis: Species ad sectionem *Codonoprasum Allii* generis pertinens. *Allio stamineo* similis sed scapo minore, spathae valvis inflorescentia brevioribus vel aequilongis, tepalis purpureis, floribus compluribus, pedicellis longioribus, filamentis staminorum plane purpureis, annulo minore, stylo longiore, ovario basi stipitato, capsula minore, differt.

Description: Bulbils absent. Bulb ovoid 0.8 × 1.35 cm, with outer tunics coriaceous, dark brown and the inner ones membranous and whitish. Scape glabrous, greenish-red/purplish, somewhat flexuous, 5-14 cm long and 1 mm wide, covered by leaf sheaths for 1/4 of its length. Leaves 3, sometimes slightly rough, semi-cylindrical, costate, up 18 cm long and 0.8 mm wide. Spathe persistent, with two unequal valves equalling or slightly shorter than the umbel, the larger 6-nerved 1.35-2.4 cm



Fig. 2. *Allium carlstroemi* Cattaneo sp. nov., holotype, inflorescence.



Fig. 3. *Allium carlstroemi* Cattaneo sp. nov., holotype, inflorescence.

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Fig. 4. *Allium carlstroemi* Cattaneo sp. nov., Nanou Bay, Symi Island, 27.IV. 2018.

long, the smaller 5-nerved, 0.95-2 cm long, lanceolate at the base and ending in a filiform appendage. Inflorescence lax, fastigiate, 3-5.5 cm wide, 6-44 flowered, pedicels purplish, unequal, flexuous, 1.7-37 mm long. Perigon conical campanulate, with equal tepals glassy purplish-mauve, oblong and rounded at apex 4 mm long, 2 mm wide. Stamens simple, slightly exserted, with purplish filaments, subulate, 4.5 mm long, connate at base into an annulus ca. 1.5 mm high; anthers yellow, ellipsoid, rounded at apex, 0.5×0.2 mm. Ovary subglobose, slightly rugose, greenish, stipitate, $1.5-2 \times 1$ mm. Style white 5.5-6 mm long. Capsule trivalved, globose, brown, slightly throttled at base $2.5-3 \times 1.8-2$ mm. Seeds blackish.

Additional specimen examined: Island of Symi, Nanou Bay, 8 May 1982, *Carlström* (LD 1251969).

Phenology: Its flowering time falls between the end of April and mid-May. Fruiting time unknown.

Ecology and distribution: *Allium carlstroemi* occurs in partially shaded sites in the underwood of conifer woodlands dominated by *Cupressus sempervirens* f. *horizontalis* (Mill.) Loudon and *Pinus brutia* Ten., in limestone-rich soils resulting from the rock outcroppings. So far, it has only been found in this area of Symi (Dodecanese, Greece).

Etymology: The name of the new species is dedicated to A. Carlström who previously studied the vascular flora of the SE Aegean Islands and SW Turkey.

Taxonomic relationships

A series of morphological features as the presence of two unequal spathe valves with at least one of them longer than the pedicels, the lax and fastigiate inflorescence, the simple filaments, and the absence of conspicuous nectaries suggest the inclusion *Allium carlstroemi* within *A.* sect. *Codonoprasum* (Zahariadi 1975, Galanos & Tzanoudakis 2017, 2019). Nevertheless, the presence of spathe valves shorter or equalling the umbel, would lead to include *A. carlstroemi* within *A.* sect. *Scorodon* Koch. However, this section is characterized by ovary with distinct nectariferous pores, which are absent in *A. carlstroemi*. For this reason, it is more likely to include *A. carlstroemi* within *A.* sect. *Codonoprasum*, which also comprises several species with spathe valves shorter or equalling the umbel as *A. brachyspathum* Brullo, Pavone & Salmeri (13: 414), an endemic species from Karpathos Island, and *A. lefkarensis* Brullo, Pavone & Salmeri (45: 248), an endemic species from Cyprus. Both these taxa differ from *A. carlstroemi* from an ecological point of view and in several morphological features. The former flowers in August and occurs in calcareous rocky places with *Sarcopoterium spinosum* (L). Spach phrygana at an altitude of 1000 m. It is well distinct from *A. carlstroemi* by the few-flowered inflorescence, the colour of tepals (white-greenish to white-pinkish) and style length (2 mm long). The latter has a flowering time in early summer and occurs in xeric garrigues at an altitude of 0-850 m. It differs from *A. carlstroemi* in having a bigger size, unequal, greenish tepals with purple striae. Within *A.* sect. *Codonoprasum*, *A. carlstroemi* shows close relationships with *A. stamineum* group, which is chiefly characterized by spathe of which at

least one valve is longer than the pedicels and by the absence of stipitate ovary. The speciation centre of this group is the Anatolian Peninsula (Brullo et al. 2007). Currently this group is known to include 20 distinct taxa marked by considerable heterogeneity and morphological diversity. They are distributed in the eastern Mediterranean area (Balkan Peninsula, Aegean Islands, Anatolia, Cyprus, Syria, Lebanon, Israel and N. Egypt), while few species reach the Irano-Turanian (Iran and Iraq) and Adriatic territories (Croatia and Italy) (Brullo et al. 2007, Giusso del Galdo et al. 2015). All members of this group flower in late spring or early summer. Although *A. carlstroemi* has spathe valves shorter or equalling the umbel and stipitate ovary, shares several features with this group (Tab.1): leaf sheaths up ½ of total stem length; tepals 4 mm long, purplish and pruinose similarly to *A. cyprium* Brullo, Pavone & Salmeri (1993: 280) and *A. daninianum* Brullo, Pavone & Salmeri (1996: 239); stamens exerted from perigon with simple filaments; style 5 mm long as in *A. dodecanesi* Karavokyrou & Tzanoudakis (1994: 141); ovary with inconspicuous nectaries. Within the *A. stamineum* group, *A. carlstroemi* shows remarkable affinities especially with *A. stamineum* s. str., an endemic of SW Anatolia for the following features: outer tunics dark-brown, inner one whitish; stem glabrous, green-purplish; leaves costate; spathe persistent with two unequal and nerved valves; inflorescence lax and fastigiate; pedicels unequal; perigon conical-campanulate with tepals equal, oblong-elliptical and rounded at apex; subulate stamen filaments; anthers ellipsoid, yellow; ovary subglobose, greenish and rugose. Despite the common features, *A. carlstroemi* differs from *A. stamineum* s. str. in several morphological characters (see Table 1) and flowering time, which is April-May in *A. carlstroemi* whereas occurs later in *A. stamineum* (June-July). Furthermore, from an ecological point of view, *A. carlstroemi* grows on limestone outcrops in the understory of conifer woodland with *Cupressus sempervirens* and *Pinus brutia*, whereas *A. stamineum* occurs in meadows and shrub communities. Brullo et al. (2007) refer to *A. stamineum* s. str. as an exclusive species of the SW Anatolia. Therefore, previous records of *A. stamineum* from Kalymnos, Lesbos (Karavokyrou & Tzanoudakis 1991), Amorgos, Euboea, Rhodes, and Symi (Rechinger 1944, Carlström 1987) should be re-examined in the light of recent studies. Considering the presence of stipitate ovary *A. carlstroemi* could be compared with *A. flavum* L., from which however it differs for the smaller size, the colour of tepals, the spathe valves much shorter and the stamens not too much exerted. Moreover, this species occurs in different kind of environments as woodlands and scrub, grasslands, and high mountain vegetation. The spring flowering joins *A. carlstroemi* with two other species: *A. dodecanesi* Karavokyrou & Tzanoudakis (1994: 141) a range-restricted species from Dodecanese Archipelago and *A. candargyi* Karavokyrou & Tzanoudakis (1994: 142) an endemic species from Lesbos and Kalymnos Islands. Despite the fact that the former shares many features with *A. carlstroemi* (bulb size, number and length of leaves, perigon with equal tepals 4-5 mm long, stamens 5 mm long, inflorescence with ca. 40 flowers, style 5 mm long), including the habitat type consisting of rocky areas and *Pinus* forest, it differs in the tepal colour greenish-white tinged with pink-purple, and in the non-stipitate ovary. The similarity to *A. candargyi* is seen mainly in: the bulb size, the equal tepals (4-5 mm long), the stamens not too much exerted, the stipitate ovary, the spathe valves only slightly exceeding the umbel and the occurrence on limestone rocks. *A. candargyi* however differs in the white-pinkish perigon, in its shorter style and in the more heterogeneous habitat consisting of limestone rocks, phrygana and macchie. In some extent *A. carlstroemi* shows remarkable affinities with *Allium tchihatschewii* subsp. *dumanii* (Koyuncu & Koçyiğit) Yild., (2016b: 14) and *A. armenum* Boiss. & Kotschy (1882: 254). Both these species belong to sect. *Codonoprasum* (Koçyiğit et al. 2016a) and have an eastern Turkish distribution. The former occurs in the Küçükyeşil area at an altitude of 2300 m, the latter in north-east Turkey at an altitude of 1500-2800 m. *Allium tchihatschewii* subsp. *dumanii* and *A. armenum* display several common features with *A. carlstroemi*: spathe valves shorter than or equalling the umbel, inflorescence lax and globose, perigon campanulate, tepals violet-purplish, ovary ovoid-globose.

Allium carlstroemi sp. nov. from Symi Island, Greece

Table 1. Morphological features of *Allium carlstroemi* compared with those of other related species of *Allium* sect. *Codonoprasum* reported for Greece and Turkey.

Features	<i>Allium carlstroemi</i>	<i>Allium stamineum</i>	<i>Allium brachyspathum</i>	<i>Allium dodecanesi</i>	<i>Allium candargyi</i>	<i>Allium armenum</i>	<i>Allium tchihatschewii</i> subsp. <i>dumanii</i>
Scape	5-14 cm	10-50 cm	6-25 cm	20-40 cm	8-20 cm	6-25 cm	3-10 cm
Leaf sheaths	1/4	1/2-2/3	1/2-2/3	1/2	1/2	1/3	1/2-2/3
Leaf indumentum	glabrous	glabrous	glabrous	glabrous	glabrous	scabrid	glabrous
Spathe valves	shorter valve 0.95-2 cm longer valve 1.3-2.4 cm	shorter valve 2.5-7 cm longer valve 5-12 cm	shorter valve 0.8-1.6 cm longer valve 1.2-2 cm	shorter valve 3.5-10 cm longer valve 8-20 cm	shorter valve 3-4.5 cm longer valve 3-5 cm	shorter valve 0.5-1.5 cm longer valve 1-2 cm	shorter valve 0.5-0.8 cm longer valve 0.6 – 1 cm
Inflorescence	lax, diffuse, 6-44 flowered	lax, diffuse, 10-25 flowered	lax, fastigiate 3-25 flowered	diffuse, 20-40 flowered	multiflowered	globose, 5-20 flowered	globose, 14-20 flowered
Perigon shape	campanulate	conical- campanulate	campanulate	obovate- campanulate	obovate- campanulate	campanulate	shortly campanulate
Tepal colour	purplish-mauve	greenish-yellow tinged with purple	white-greenish / white-pinkish	greenish-white tinged with pink- purple	white-pinkish tinged with purplish midrib	pinkish purple	purplish-mauve
Tepal length	4×2 mm	4.5-5.5×2-2.5 mm	5-2.2 mm	4-5×2 mm	4×1.5 mm	4-4.5×1.7-2 mm	2.5-3×0.8-1 mm
Stamens	slightly exserted, 4.5 mm	exserted, 4-6.5 mm	slightly exserted, 6.5 mm	exserted, 4.5-5 mm	slightly exserted, 4-4.5 mm	exserted, 4.5 mm	exserted, 3.5 mm
Style length	5.5-6 mm	1.5-2.5 mm	2 mm	5 mm	2.5 mm	4-4.5 mm	3-3.2 mm
Style colour	white	white	white	white	white	white	white
Ovary	subglobose stipitate	subglobose	cylindrical- obovoid	obovoid	subglobose stipitate	globose stipitate	ovoid-globose stipitate

However, *A. carlstroemi* differs from the former in having longer scape and leaves, more flowers, much longer pedicels, larger tepals, purplish filaments and yellow anthers. *Allium armenum* shows more similarities with *A. carlstroemi* in its lengths of scape, leaves and tepals, but differs in scabrid leaves, larger ovary and capsule, and shorter style. Finally, the flowering time for both Turkish species is between July and September. The careful study of the morphological features of the specimens concerned has led to the conclusion that *Allium carlstroemi* shows unique features, which distinctly differentiate it from *A. stamineum* s. str. and allied taxa. Spotted evidence assigns *A. carlstroemi* to *A. sect. Codonoprasum*, but the spring flowering and the presence of spathe valves shorter or equalling the umbel segregates it taxonomically from the aforesaid species. The discovery of another endemic species underlines the notable floristic richness of Symi Island despite its small size and its relatively recent insular isolation (Carlström 1987, Sfenthourakis & Triantis 2017, Cattaneo & Grano 2019).

Conclusion

Greece is regarded as an evolutionary centre of the genus *Allium* hosting more than 100 species, of which more than 50% are endemics (Stearn 1981, Tzanoudakis & Vosa 1988, Georghiou & Delipetrou 2010, Dimopoulos et al. 2013, Galanos & Tzanoudakis 2017, 2019). *Allium carlstroemi* is a spring-flowering species and is taxonomically well-distinguished from *A. symiacum* and *A. panormitisi*, two autumn-flowering species of the *A. sect. Codonoprasum* also strictly endemic to Symi. Both these taxa are considered floristic relics (Galanos & Tzanoudakis 2017, 2019) for morphological and ecological features (the apparent absence of dormancy in their life cycle). *Allium carlstroemi* seems to be the outcome of allopatric speciation resulting from geological and climatological events that repeatedly separated and connected Symi from the Anatolian mainland and from the other Aegean Islands during the Plio-Pleistocene (Carlström 1987, Steinbauer et al. 2016, Sfenthourakis & Triantis 2017, Cattaneo & Grano 2019). The dynamics of geology and climate can be powerful generators of biodiversity and climatological events can act as a species pump (Gillespie & Roderick 2014). Periodic isolation and connection dictate evolutionary outcome. Indeed, fluctuating sea levels and climate changes which led to repeated episodes of separation and reconnection among populations (and subsequent genetic reshuffling) may have accelerated genetic diversification processes. It is plausible that the definitive separation of Symi from the Turkish mainland would have led to separation from the ancestral population of *A. stamineum*, a species belonging to the continental Turkish flora, resulting in a gene flow interruption from the Anatolian populations of *A. stamineum*. This would have promoted microevolutive processes on the small population of *A. stamineum* present in Symi, the probable outcome of genetic drift processes triggered and favoured by the new taxon's colonization of small, suitable areas. However, further genetic studies are needed to better clarify the taxonomic relationships between *A. carlstroemi* and *A. stamineum*.

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Allium carlstroemi sp. nov. from Symi Island, Greece

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