Galanthus samothracicus (*Amaryllidaceae*) from the island of Samothraki, northeastern Greece

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Abstract. *Galanthus samothracicus* (*Amaryllidaceae*) is fully described, illustrated by photographs, and mapped according to its distribution in three localities on the North Aegean island of Samothraki in northeastern Greece. It is believed to be a local endemic, related to *G. nivalis* which is not known in the Aegean. The morphological differences between *G. samothracicus* and *G. nivalis* are provided and the genome size in *G. samothracicus* and some other taxa belonging to *Galanthus* series *Galanthus* are presented here for the first time.

Key words: endemic species, *Galanthus* (*Amaryllidaceae*), genome sizes, Greece, Samothraki

Introduction

During floristic explorations by B. Biel on the island of Samothraki on 11 April 2006, a few plants of a *Galanthus* in fruit were discovered. The locality was to the northwest of the village of Makrilies, in a *Platanus* alluvial forest on the banks of the Xiropotamos river on the southwest of the island. Return visits to the area in February 2009 and 2011 yielded gatherings from nine separate populations. Five other areas near Xiropotamos, nine places near the village of Therma and three near Anomeria on the northeastern coast of the island were also searched (Fig. 1). The localities were in the lowland area between the coast and the foothills of Mt Fengari. Herbarium vouchers were prepared from nine of the largest populations in the three different localities and plants taken for cultivation at Copenhagen Botanic Garden and the private garden of Biel at Höchberg, Germany. All measurements, colours and other details given in the description are based on living material examined in the wild or in cultivation. The plants were surprisingly frost-hardy in cultivation, surviving temperatures down to –20 °C.

Fig. 1. Distribution of *G. samothracicus* in Greece.

Description of species

Galanthus samothracicus Kit Tan & Biel in Phytol. Balcan. 19(3): 377-378 (2013). Figs. 1-5.

Type: GREECE. Nomos Evrou, Eparchia Samothrakis: NE of Therma, gravelly sand along the banks of the Tsivdogianni stream, 20 m a.s.l., 40°29'N, 25°36' E, 10 February 2011, *ca*. 10,000 plants observed, *Biel* 11.046 (**holotype** C; **isotypes** ATH, herb. Biel).

Perennial. Bulb subglobose to ellipsoid, 2–2.5 × 1.5–2 cm; outer tunics thin, chartaceous, greyish-brown. Basal sheath tubular, 2–5 × 0.3–0.7 cm, whitish. Vernation applanate. Leaves basal, 2–3, produced in winter and spring, linear-oblanceolate, slightly broader in the middle to upper third, (9.0–) 16–25 (–34) × 0.4–1.2 cm, erect, recurving at maturity; apex subacute to obtuse, white-tipped; upper and lower surfaces glaucous to subglaucous, becoming green at maturity; upper surface shallowly depressed-concave, with faint or hardly visible pale green median stripe; smooth and with conspicuous midrib beneath, margins slightly subrevolute. Scape 1 (–2), erect in flower, (7.0–) 16–31 cm long, longer than leaves, subterete, green. Spathe *ca.* 3.5 × 0.4 cm, translucent, membranous. Pedicel (15–)20–40(–50) mm long. Flowers solitary, 1 per scape, nodding, slightly fragrant. Outer perianth segments with claw of 1/3 length, obovate-elliptic, (16–) 20–26 × 6.0–9.0 mm, white. Inner perianth segments smaller, more than half the length of outer segments, obovate, (8–)11–12 ×4–6 (–8.5) mm, white, striped dark green on inner face; each segment with a sinus and single apical broad green mark on the outer face, mark usually enlarged in the lobes on either side of the sinus. Anthers basifixed, yellow, apiculate, dehiscing by terminal pore. Ovary trilocular, 5–6 × *ca*. 5 mm at anthesis, dark green; stigma capitate. Capsule 3-valved, obovoid, rounded-angular, (6–) 9.0–14.5 × 6.0–10.5 mm. Seeds strophiolate, asymmetrically oblong-ovoid, 2.2–3.6 × 1.3–1.6 mm; testa reticulate-areolate, turning dark brown at maturity. *Chromosome number*: 2*n* = 24.

The size and shape of the outer perianth segments, and whether they are shortly clawed or, as flowers mature, with a claw of moderate length, varies; likewise the size and shape of the green apical markings on the inner segments but they are always broad and not narrow V- or U-shaped arcs (Fig. 3).

Distribution and site ecology

Endemic to the N Aegean island of Samothraki (Fig. 1). Flowering between January and February in Greece; flowering from mid-December to late February in cultivation, earlier than any other *Galanthus* species in northern Europe, including *G. nivalis* L. On Samothraki, it occurs in seasonally wet to damp places, near streams and springs, in humus-rich soil at altitudes from 5–80 (–100) m. Accompanying taxa noted during the early flowering season include *Anemone pavonina*, *Arum elongatum*, *Cardamine graeca*, *Crepis hellenica*, *Doronicum orientale*, *Erodium cicutarium*, *Erophila verna, Geranium pusillum*, *G. robertianum* subsp. *purpureum*, *G. rotundifolium*, *Hedera helix*, *Juncus effusus*, *Lamium garganicum* subsp. *striatum*, *L. purpureum*, *Leucojum aestivum*, *Luzula forsteri*, *Melanortocarya obtusifolia*, *Muscari neglectum*, *Ornithogalum* spp., *Ranunculus ficaria*, *Saxifraga hederacea*, *Scilla bifolia*, *Senecio vernalis*, *S. vulgaris*,

Fig. 2. *G. samothracicus* in their thousands at Therma, NE Samothraki (*locus classicus*).

Fig. 3. **a**, *G. samothracicus* (from Xiropotamos, SW Samothraki); **b**, *G. nivalis*: flowers with apical marking on inner perianth segment.

Sternbergia lutea, *Scandix pecten-veneris*, *Selaginella denticulata*, *Smilax excelsa*, *Taraxacum* spp., *Theligonum cynocrambe*, *Veronica cymbalaria* and *Viola odorata*. The species does not seem to be under any threat in its natural habitat (Fig. 2).

Affinities

Resembling *G. nivalis*, 'the common snowdrop', which is widely distributed between 100 and 1600 m in west and central Europe. *Galanthus nivalis* is naturalized in northern Europe and widespread in cultivation. It was thought to reach its southeastern border of distribution in NW Turkey but these records are erroneous and refer to the taxon described twelve years ago as the hybrid *G.* ×*valentinei* (J. Allen) Beck nothosubsp. *subplicatus* (N. Zeybek) A.P. Davis (Davis & al. 2001; Taşcı Margoz & al. 2013). The epithet *nivalis* pertains to snow, referring to the snow-like flower colour or to the association of this winter-flowering species with snow.

Fig. 4. **a**, *G. samothracicus* (from Xiropotamos); **b**, *G. nivalis*: plants and transverse leaf sections.

Galanthus samothracicus differs most conspicuously from *G. nivalis* by the somewhat shiny, smooth green leaves at maturity, the initial glaucous bloom disappearing with age. They are shallowly depressed-concave above (Fig. 4) and never with a distinct white median stripe. The margins are flat to slightly subrevolute, the capsule obovoid (Fig. 5) and the average seed size is smaller, being 2.2–3.6 × 1.3–1.6 mm instead of 3–5 × 2.2–2.8 mm, thus corresponding to different genome sizes. Its usual habitat is in wet to damp places, near springs and streams at low altitudes of 5–80 m. In *G. nivalis* the leaves remain glaucescent to dull-glaucous on both surfaces, with a pale glaucescent median upper stripe; they are shallowly depressed-concave to almost flat above, conspicuously ribbed beneath and subrevolute at the margins (Fig. 4); the capsule is ellipsoid-subglobose with larger, broadly ovoid seeds (Fig. 5). *G. nivalis* is absent in the area of *G. samothracicus*. The leaves used in the comparison (Fig. 4) originated from central Europe (Höchberg, Germany) where the plants were growing in N-exposed, rather dry meadows (area with *ca.* 650 mm annual precipitation).

From *G.* ×*valentinei* nothosubsp. *subplicatus*, *G. samothracicus* differs by its consistently applanate vernation, less revolute leaf margins, and inner perianth segments with always a single apical green mark and never with additional green markings at the base. *G.* ×*valentinei* nothosubsp. *subplicatus* from European Turkey (provinces of Kirklareli and Istanbul), is stated to be a hybrid between *G. nivalis* and *G. plicatus* M. Bieb. subsp. *byzantinus* (Baker) D.A. Webb (Davis & al. 2001), and to differ clearly from *G. nivalis* in their molecular sequences (Taşcı Margoz & al. 2013). *Galanthus plicatus* subsp. *byzantinus* would account for the plicate [explicative] leaves and the variable markings at the base of the inner perianth segments in the hybrid but the role of *G. nivalis* as a parent must be assumed, especially when it is not known whether *G. nivalis* occurs in NW Turkey.

Fig. 5. **a**, *Galanthus samothracicus* (from Anomeria, E Samothraki); **b**, *G. nivalis*: fruits and seeds.

The morphological differences between the two species are summarized in Table 1. With the inclusion of *G. samothracicus*, 21 species are recognized in the genus.

In February 2009 we misidentified the plants along the Tsivdogianni stream as *G. reginae-olgae* Orph., a taxon included in the same *Galanthus* series, and because they were spring-flowering, we referred them to subsp. *vernalis* Kamari. *Galanthus reginae-olgae* subsp. *reginae-olgae* had recently been reported from the Bistrica valley, Delvina district in S Albania (Shuka & al. 2011). It was flowering from October to November (without leaves) in shaded, mixed deciduous and evergreen woodland and scrub (*Castanea sativa*, *Fraxinus angustifolius*, *Paliurus spina-christi*, *Quercus coccifera*, *Q. ilex, Phlomis*, *Ruscus*). It is known from the Peloponnese where it flowers without leaves or with leaves 1–15 cm long, in the western part of mainland Greece and the island of Kerkira, but is absent from F.Y.R. Macedonia (pers. comm. V. Matevski, Skopje). Other collections in S Albania refer to *G. reginae-olgae* subsp. *vernalis*; in the wild and in cultivation, they flowered in January to March, together with leaves. Populations of the latter taxon from lower altitudes, e.g., 300–400 m in the Kardhiqi valley and near Picari village, flower in January whereas those from higher altitudes of 800–1200 m in Gjirokastra district (Mt Picari, Mt Murgana, Çajupi Pass) and Vlora district (Llogara Pass), flower from February to March, depending on altitude and

Table 1. Comparison of morphological characters in *Galanthus samothracicus* and *G. nivalis*.

Characters	*G. samothracicus*	*G. nivalis*
Upper leaf surface at maturity	shiny dark green	glaucescent, not shiny
Upper median stripe	not conspicuous, same colour as rest of leaf	visible
Upper leaf surface in transverse section	shallowly depressed-concave	flat to shallowly depressed-concave
Leaf vernation	applanate	applanate
Leaf margin	flat to slightly subrevolute	subrevolute
Inner perianth segments	usually more than half the length of outer perianth segment	half or less than half the length of outer perianth segment
Apical marking	single, U-shaped or solid broad band	single V-shaped with narrow connecting arc below sinus
Length of pedicel (mm)	(15–)20–40 (–50)	12–30
Capsule shape and size (mm)	obovoid, (6–)9.0–14.5 × 6.0–10.5	ellipsoid-subglobose, 12–15 ×10–16
Seed shape	asymmetrically oblong-ovoid	broadly ovoid
Seed size (mm)	2.2–3.6 × 1.3–1.6	3–5 × 2.2–2.8

exposition. The degree of leaf development at flowering time has often been used as a taxonomic character separating the two subspecies but as seen in the Peloponnese, there are various degrees of development and the character is not constant.

Genome size

The total nuclear DNA amount was assessed by flow cytometry according to Marie & Brown (1993). *Triticum aestivum* L. cv. 'Chinese Spring' (2C = 30.9 pg and 43.7 % GC) was used as an internal standard.

Three populations of *G. samothracicus* from three different localities were investigated for their genome size. One population of *G. nivalis,* four populations of *G. reginae-olgae* subsp. *reginae-olgae* from different localities and three populations of *G. reginae-olgae* subsp. *vernalis* also from different localities were assessed and the data tabulated (Table 2). For *G. samothracicus* the DNA content ranged from 2C = 51.42 to 52.72 pg, revealing slight variations within the sampled populations. The genome size of *G. samothracicus* is the smallest in *Galanthus* series *Galanthus* and differs to some extent from those of the other species (see Table 2). The values for 2C DNA in *G. reginae-olgae* subsp. *reginae-olgae* ranged from 64.65 to 66.64 pg and from 62.73 to 65.93 pg in *G. reginae-olgae* subsp. *vernalis,* which reveals, and at the same time supports, the small differences between the two subspecies. Zonneveld & al. (2003) obtained higher values for the two subspecies of *G. reginae-olgae*, 70.1–76.6 pg and 70.1–80.2 pg respectively. Our value for *G. nivalis* was higher (2C = 85.54 pg) than that obtained by Zonneveld & al. (2003) (70.1–74.2 pg); this was probably due to the different origins of the material sampled. Zonneveld & al. (2003) also reported values for a triploid *G. nivalis* (2C = 105.3 pg), for the putative hybrid *G.* ×*valentinei* nothosubsp. *subplicatus* (2C=54.4 pg) and for *G. plicatus* (54.9–56.1 pg). The value for *G.* ×*valentinei* nothosubsp. *subplicatus* cited in the work of Çelen (2005) was taken directly from Zonneveld & al. (2003). According to our results, genome size does not support the hypothesis that *G* ×*valentinei* nothosubsp. *subplicatus* is a hybrid between *G. nivalis* (2C ~ 70pg) and *G. plicatus* (2C ~ 55pg). If this had been the case, *G* ×*valentinei* nothosubsp. *subplicatus* should have 2C ~ 62 pg and not 54 pg as stated in Zonneveld & al. (2003).

Additional material of *G. samothracicus* examined

Nomos Evrou, Eparchia Samothrakis, island of Samothraki.

Region of Therma: NE of Therma, large damp seasonally flooded area directly behind coastal barrier, with *Platanus* and *Alnus*, 3 m, 10.02.2009, *Biel* 09.043; E of Therma, gravelly sand along the banks of the Tsivdogianni stream, 50 m, 10.02.2009, *Biel* 09.048 (several thousand plants noted as *Galanthus reginae-olgae,*

Table 2. Nuclear DNA content of species belonging to *Galanthus* series *Galanthus*.

Taxon	Origin	2*n*	Our data 2C in pg[a] (sd)	Previously published data
G. samothracicus	Samothraki, Anomeria, Gr	24	52.72 (0.81)[b]	
	Samothraki, Therma, Gr	24	51.88 (0.66)	
	Samothraki, Xiropotamus, Gr	24	51.42 (1.47)	
G. reginae-olgae subsp. *reginae-olgae*	Bistrica valley, Al	24	64.65 (0.21)	70.10–76.6[c]
	Arkadias, Gortinias, Gr	24	65.86 (0.52)	
	Ilias, Mt Lapithas, Gr	24	65.86 (0.52)	
	Messinias, Mt Taigetos, Gr	24	66.64 (0.90)	
G. reginae-olgae subsp. *vernalis*	Llogara pass, Al	24	63.32 (0.46)	70.1–80.2[c]
	Mt Picari, Al	24	62.73 (1.48)	
	Ilias, Mt Minthi, Gr (loc 1.)	24	64.00	
	Ilias, Mt Minthi, Gr (loc. 2)	24	65.93 (1.98)	
G. nivalis	Bot. Garden, Copenhagen	24	85.54	
	various origins	24		70.1–74.2[c]
G. nivalis cultivars		36		105.30[c]
G. ×*valentinei* nothosubsp. *subplicatus*		24		54.4[c]
G. plicatus	various origins	24		54.9–56.1[c]

[a] 1 pg = 978 Mbp (Doležel & al. 2003)
[b] Mean value followed by the standard deviation (sd) in parentheses
[c] Zonneveld & al. (2003)

see Biel & Tan, Kit 2009: 119-120 and Fig. 2); NNE of Therma, coastal alluvial forest with *Platanus*, west of Tsivdogianni stream, 3 m, 10.02.2011, *Biel* 11.043; fenced meadow at Therma, above Platia stream, 80 m, 10.02.2011, *Biel* 11.048.

Region of Anomeria: Remboutsadika, SE of Anomeria, fenced pasture above Agistros stream, on granitic sand, 20–40 m, 12.02.2009, *Biel* 09.081; *loc. ibid*., 08.02.2011, *Biel* 11.020; Isomata, pasture adjacent to open *Quercus* woodland, 100 m, 08.02.2011, *Biel* 11.027.

Region of Xiropotamos: NW of Makrilies village, *Platanus* alluvial forest, on gravelly sand, 60–80 m, 11.04.2006, *Biel* 06.298 (as *G. elwesii*, see Biel & Tan, Kit 2006: 281); *loc. ibid*., 07.02.2011, *Biel* 11.006; on the east bank of Xiropotamos stream, with *Platanus*, 70 m, 09.02.2009, *Biel* 09.003; outside alluvial forest SW of Xiropotamos, 80 m, 09.02.2009, *Biel* 09.004 (*ca* 1000 plants observed); W of Xiropotamos, spring at foot of hill, with *Juglans*, 80 m, 07.02.2011, *Biel* 11.008.

All cited vouchers collected by Biel are provisionally kept in the private herbarium of B. Biel at Höchberg (herb. Biel); this excludes the type material.

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