

Gagea spathacea (Liliaceae) on the Black Sea slope of the Caucasus

ILIJA TIMUKHIN¹, BORIS TUNIYEV¹, IGOR G. LEVICHEV²

¹ Sochi National Park, Moskovskaya
str. 21, Sochi 354000, Krasnodarsky krai, Russia
(timukhin77@mail.ru; btuniyev@mail.ru)

² Komarov Botanical Institute of the Russian Academy of Sciences
Prof. Popov str. 2, Saint Petersburg 197376, Russia.
(ilevichev@yandex.ru)

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La Gagea spathacea (Liliaceae) sulla pendice del Caucaso sul Mar Nero – Nel Caucaso, vicino a Soci, si trova una piccola popolazione di *Gagea spathacea* (Hayne) Salisb., molto distante da tutti gli habitat di questa specie in Europa. Si dà una descrizione delle condizioni ambientali, del numero di individui e del motivo della loro scarsità. La popolazione è composta da singole piante giovanili e da pochi esemplari in fiore, che non producono semi, essendo la riproduzione esclusivamente vegetativa.

Key words: Caucasus, critically endangered (CR) species, *Gagea spathacea*, distribution, Sochi (Krasnodar Region, Russia).

A small population of *Gagea spathacea* (Hayne) Salisb. (Fig. 1-3) has been unexpectedly found east of Sochi, between the Mzymta and Psou Rivers (Fig. 4), during the inspection of the route of a new highway and monorail that is being built for the 2014 Winter Olympic Games. Till now *G. spathacea* was known only from Europe (Meusel et al., 1965; Henker, 2005; Schnittler et al., 2009; Bertoldi et al. 2009). Its presence in the western Colchis floristic region (Asia), far from its main distribution within central and southeastern Europe, is of great biogeographical interest (Fig. 5).

The plants occur in a moist deciduous forest at altitudes between 260 and 300 m above sea level, near the limestone massif Akhshtyr, in the vicinity of the village Kazachiy Brod (Cossack Ford), Adler region of Sochi (Krasnodar Territory). As a protective measure, in Fig. 4 the wider area is circled, but purposefully, the exact locality is not mapped. The population extends over a NW to NNW hillside sloping 10° to

20° (Fig. 6), in an area of trapezoidal shape measuring 60 × 80 m, confined at its lower edge by a dirt road (Fig. 7), cut by cattle trails, and with tangles of fallen trees and clumps of a blackberry species. We estimated the number of mainly juvenile individuals of *Gagea spathacea* to about 4,000 - 5,000.

The soil of the locality is more than a meter deep (Fig. 7), heavy and moist, without any rubble or gravel. It can be classified as brown forest soil with a superficial layer of humus. The surface is rough, covered with grass and fallen debris, and shows traces of hoofs. The area is not flooded, but at the base of the slopes there are some springs, indicating a humid but well drained soil.

There is a dense forest cover of alder (*Alnus barbata* C.A. Mey.) with single trees of *Acer campestre* L., *Pyrus caucasica* Fed. and *Carpinus betulus* L., with a crown density of up to 85-90 % in summertime, and trees up to 25 m tall; a distinct shrub layer with *Corylus avellana* L., *Rubus caucasicus* Focke, *R. hirtus* Waldst. & Kit.,

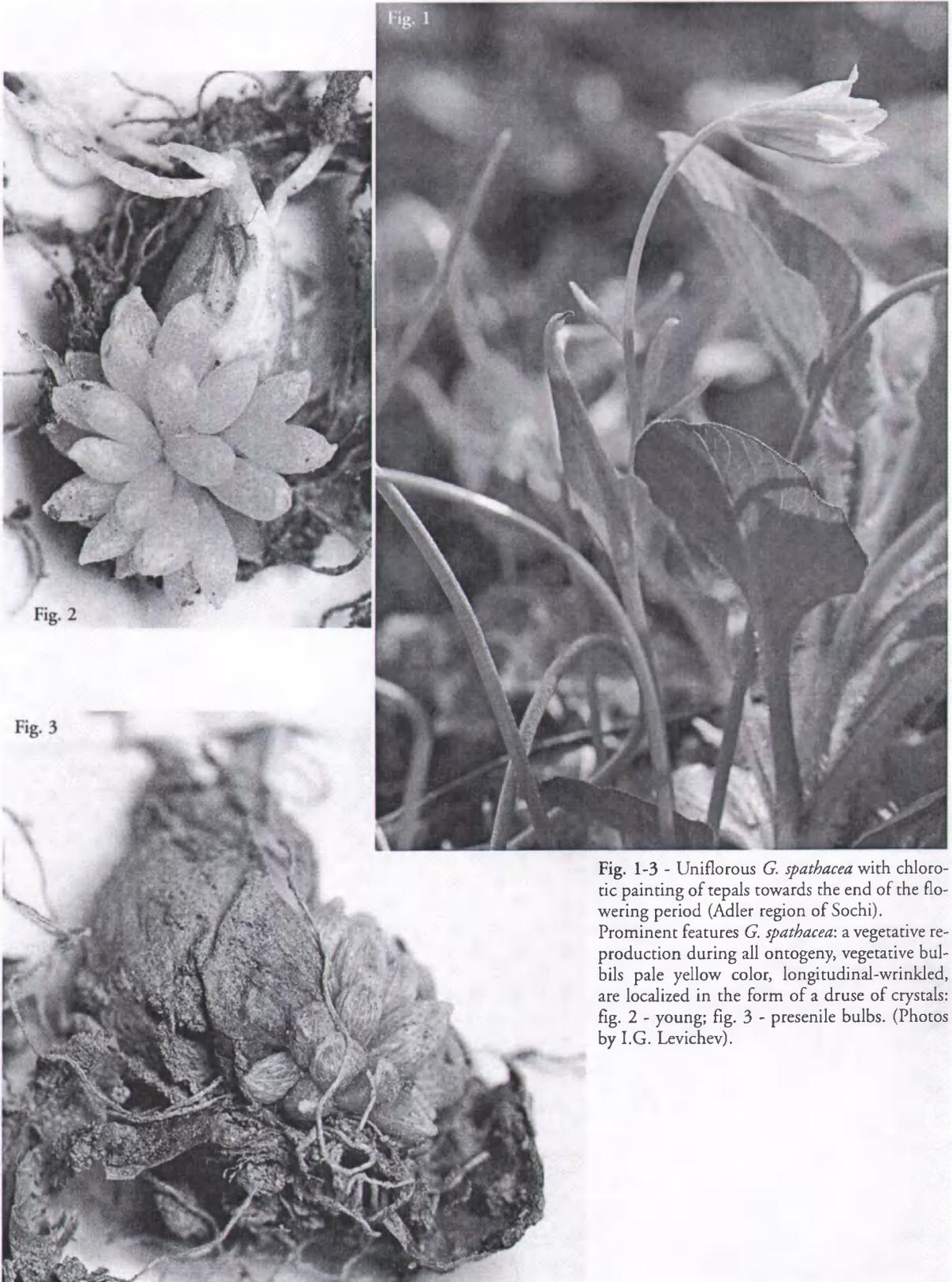


Fig. 1-3 - Uniflorous *G. spathacea* with chlorotic painting of tepals towards the end of the flowering period (Adler region of Sochi). Prominent features *G. spathacea*: a vegetative reproduction during all ontogeny, vegetative bulbils pale yellow color, longitudinal-wrinkled, are localized in the form of a druse of crystals: fig. 2 - young; fig. 3 - presentile bulbils. (Photos by I.G. Levichev).

saplings of *Carpinus betulus* and *Alnus barbata*, and some woody climbers (*Lonicera caprifolium* L. and *Smilax excelsa* L.); and a herbaceous layer dominated by *Luzula forsteri* (Sm.) DC., associated with *Fragaria vesca* L., *Ficaria verna* Huds., *Scilla bifolia* L., *S. monanthos* K. Koch, *Dentaria quinquefolia* M. Bieb., *D. bulbifera* L., *Cardamine tenera* S. G. Gmel. ex C. A. Mey., *Ajuga reptans* L., *Gagea spathacea*, *G. lutea* (L.) Ker-Gawl., *Galeobdolon luteum* Huds., *Trachystemon orientalis* (L.) G. Don f., *Doronicum orientale* Hoffm., *Ranunculus grandiflorus* C. A. Mey., *Paeonia caucasica* (Schipcz.) Schipcz., *Oplismenus undulatifolius* (Ard.) Roem. & Schult., *Symphytum grandiflorum* DC., *Sanicula europaea* L., *Paris incompleta* M. Bieb., and the ferns *Matteuccia struthiopteris* (L.) Tod. and *Phyllitis scolopendrium* (L.) Newman. In spring, *G. spathacea* does not form a continuous colony, although its juvenile specimens can reach significant numbers in the herb layer: in large areas we could not find any or only scattered individuals.

A count of individuals of *G. spathacea* in seven plots of one meter square (both under canopy and in open places) yielded a total of 648 plants, but only 4 in the

generative stage: 196 juvenile; 120 juv.; 84 juv.; 76 juv. + 1 gen.; 73 juv. + 2 gen.; 64 juv.; 31 juv. + 1 gen. In general, plants in flower were rare and mostly still young: almost 30 were counted in 2008 but only 7 in 2009. Most plants were single-flowered, but a few with two flowers were seen. Each flower is open for 4-9 days, then its colour quickly fades and it blends with the surrounding vegetation, becoming difficult to spot. Further searches during the flowering season, on adjacent slopes and in other gorges with similar ecological conditions, were unsuccessful.

Despite the low accessibility of the locality, there is human impact regularly. It is crossed by two logging roads and suffers increasingly from wood-cutting by local people. A high-voltage power line runs close by, and pastures with livestock as well as an artificial lake frequented by vacationers are not far.

The plants can be assigned unquestionably to *Gagea spathacea*, being completely identical to those found in Europe (Fig. 1-3). In view of to their remoteness and strong isolation from the main range of the species we initially assumed that they might deserve recognition as a separate infraspecific taxon, being smaller than usual,

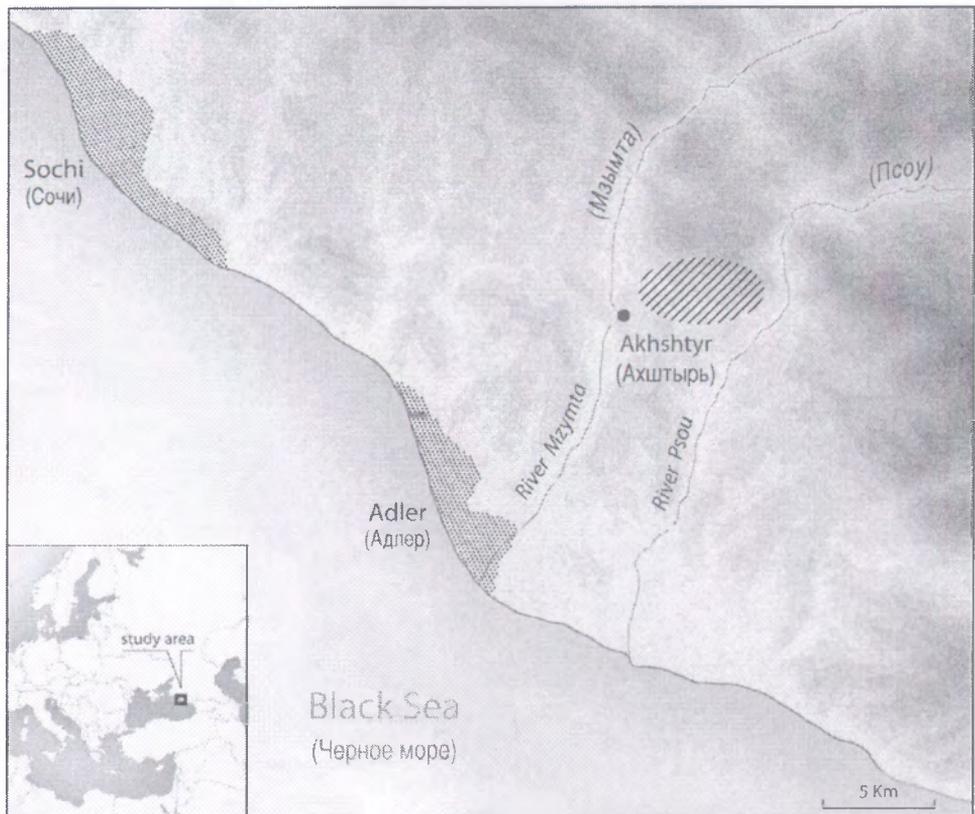


Fig. 4 - Area location of population *G. spathacea* (outline round) on slopes of Caucasus near Sochi. As a security measure the extensive area has been deliberately encircled but this is not a concrete place of the population.



Fig. 5 - Distribution *G. spathacea*: × the greatest density, \ many populations removed from each other, ☆ group populations, ● unique populations.

mostly single-flowered, never having more than two basal leaves, and showing perianth chlorosis. However, comparative morpho-biological and taxonomic analyses demonstrated that these deviations are not essential taxonomically, reflecting mainly the absence of older, fully mature individuals and the extraordinarily juvenile age structure of the population.

The apparent reduction in life expectancy is probably caused by ecological and anthropogenic factors. When large animals or humans cross the humid and steep slope, the top layer of the soil is easily removed, damaging or killing the plants. In addition, snails and slugs, which are common in the area, feed on the bulbs. Damage may also come from grazing, logging, tree fall, trunk skidding, recreational activities, the collecting of herbs and nuts, also from exceptional weather events and the natural growth restrictions (Schnittler et al., 2009). *Gagea spathacea* does not

form seeds and survives by vegetative reproduction only, resulting in clonal populations (Fig. 2-3). As has shown by the counts of individuals in seven plots, referred to above, vegetative renewal appears to be plentiful. The observed prevalence of juvenile individuals (of an estimated age of 3-5 years) is usually a symptom of alarming decline in population size.

There is a casual reference to an alleged occurrence of *Gagea spathacea* in Transcaucasia in the determination key in the Flora SSSR (Grossheim, 1935: 64), but it is obviously due to error, because it is contradicted by the distribution given in the main entry for this species (l.c: 70), which only concerns present-day Belarus. In previous and subsequent *Gagea* monographs (Terracciano, 1905, 1906; Pascher, 1907; Misczenko, 1912, 1913; Stroh, 1937; Uphof, 1958-60; Davlianidze, 1976; Levichev, 2006) *G. spathacea* is not recorded from the Caucasus Mts.



Fig. 6 - View of the alder forest with the population *G. spathacea*.



Fig. 7 - Dirt road at the lower edge of the population of *G. spathacea*. The fine-grained soil devoid of stones and rubble that has been accumulated over many millenia is well visible. (Photos by I.G. Levichev, 23.04.2009).

Most likely, the Caucasian population of *G. spathacea* represents a relic preserved by extraordinarily suitable circumstances. Doubtless, this unique and strongly isolated outpost demands the inclusion of *G. spathacea* in lists of protected species and Red books. As this is the single recorded occurrence of the species in the Caucasian region, Russia and Asia, it would qualify as "Critically Endangered, CR" in that area. Protection measures are necessary for the Caucasian population, like reintroduction, creation of reserves and sites for rejuvenation, or ex-situ propagation by bulb or even tis-

sue cultures, assisted by thorough research about the reproductive ability of this relict.

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Summary: We describe the conditions of growth, reproduction and plants numbers of an isolated population of *Gagea spathacea* (Hayne) Salisb. discovered in the Caucasus Mts., including its protection status and proposed measures of conservation.