

# *Hedysarum grandiflorum* subsp. *bulgaricum* (Leguminosae) and *Biarum ditschianum* (Araceae), two new records for the Greek flora

Theophanis Constantinidis

Department of Ecology & Systematics, Faculty of Biology, National & Kapodistrian University of Athens, Panepistimiopolis, 157 03 Athens, Greece, e-mail: constgr@biol.uoa.gr

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**Abstract.** *Hedysarum grandiflorum* subsp. *bulgaricum* has been recently found on Mt. Gerania in central Greece. Given that the three earlier known Greek species of *Hedysarum* have been transferred to *Sulla*, *H. grandiflorum* subsp. *bulgaricum* is the only representative of the genus in the Greek flora and a rare plant. *Biarum ditschianum*, considered earlier a Turkish endemic species, was found on the Island of Megisti (Kastellorizo) in the south-easternmost part of Greece. This is the only insular population of the species known so far. Keys to the genera *Hedysarum*, *Sulla* and *Biarum* in Greece are provided, together with distribution maps of the two new taxa and notes on their population structure.

**Key words:** *Biarum*, chorology, conservation, distribution, Greece, *Hedysarum*

## Introduction

With over 6000 species and subspecies, the Greek flora is rich and diverse. New taxa are still described from various regions (e.g. Bergmeier 2010; Phitos & al. 2011; Kalpoutzakis & al. 2012) and new floristic records are not uncommon in the country, even in areas considered well investigated floristically (e.g. Crete, Bergmeier 2011). Fieldwork in regions close to the borders may be particularly fruitful with respect to new records of plant species harboured by the adjacent countries. Furthermore, critical revisions of certain plant groups may occasionally change species concepts, thus adding to or withdrawing taxa from the Greek flora.

*Hedysarum* L. (Leguminosae) was known to comprise three species in Greece, two out of which are annuals (*H. glomeratum* F. Dietr., *H. spinosissimum* L.) and one is perennial (*H. coronarium* L.). The latter is probably an allochthonous species from the western and central parts of the Mediterranean region, record-

ed with certainty in Greece from the Ionian island of Kefallinia and close to Arachova, Sterea Ellas. Regardless of its origin, the population on Kefallinia seems to be well-established. Recently, Choi & Ohashi (2003) have transferred the members of *H.* sect. *Spinossissima* (older sect. *Hedysarum*), where all the Greek plants belong, to the resurrected genus *Sulla* Medik. *Sulla* included the traditional type of the genus *Hedysarum* but a recent proposal to conserve the name *Hedysarum* with a conserved type not belonging to *Sulla* (Choi & Ohashi 1998) has been recommended for formal adoption (Brummitt 2000). As a consequence, no *Hedysarum* s. str. has remained in the Greek flora and the discovery of *Hedysarum grandiflorum* Pall. subsp. *bulgaricum* Kožuharov presented here is technically a reappearance of the genus in Greece.

*Biarum* Schott (Araceae) is a genus of small geophytes comprising 21 species and six subspecies (Boyce 2008a) distributed in semi-arid and seasonally dry areas of South Europe, North Africa, Near and

Middle East. So far, five species have been known to grow in Greece: *B. davisii* Turrill, *B. fraasianum* N.E. Br., *B. marmarisense* (P.C. Boyce) P.C. Boyce, *B. rholospadix* K. Koch (syn.: *B. spruneri* Boiss.), and *B. tenuifolium* (L.) Schott (Athanasίου & Yannitsaros 1995; Boyce 2008b). The latter includes four subspecies, i.e. subsp. *abbreviatum* (Schott) K. Richt., subsp. *idomenaeum* P.C. Boyce & K. Athanasίου, subsp. *tenuifolium*, and subsp. *zeleborii* (Schott) P.C. Boyce. *B. fraasianum* is still somewhat enigmatic the least known species of them all recorded from its classical locality ('*in campis Thebaicis*' of Viotia Prefecture, Sterea Ellas) and Peloponnisos (Boyce 2008b). With the discovery of *B. ditschianum* Bogner & P.C. Boyce presented here, the genus is now represented by six species in the Greek flora.

## Material and methods

*Hedysarum grandiflorum* subsp. *bulgaricum* and *Biarum ditschianum* were collected in the field and herbarium vouchers are kept in ATHU. Data about the habitats, populations and risks are based on field observations. Four tubers of *B. ditschianum* have been kept in cultivation, in order to examine the species' life cycle. All characters and measurements in the description of the two taxa refer to Greek material and were made on living plants (particularly in *Biarum*) or dry specimens. High resolution photographs of the *Hedysarum grandiflorum* subsp. *bulgaricum* type specimen have been seen (SOM!) and the material of *H. grandiflorum* kept in B has been consulted.

## Results and discussion

***Hedysarum grandiflorum* Pall. subsp. *bulgaricum*** Kožuharov, Fl. RP Bulg. 6: 557 (1976) (Fig. 1).

Perennial plant, acaulescent or with short stems up to 4(–8) cm covered with a few remnants of old petioles and stipules, forming a single or a few rosettes of leaves. Stipules membranous, triangular to quadrangular, often bifid, connate and sheathing stem and petioles, sericeous, 7–11 mm long. Leaves 6–15 cm long, imparipinnate, with 3–5 pairs of leaflets; leaflets 8–21 × 6–17 mm, ovate to oblong-elliptic, with sparse silvery hairs, particularly along the midrib and margins on upper surface, and dense, silvery, ad-



Fig. 1. *Hedysarum grandiflorum* subsp. *bulgaricum* in its natural habitat. A: Plant in flower, growing in an opening of *Pinus halepensis* woodland. B: Detail of the inflorescence.

pressed sericeous hairs beneath. Peduncle 5–15 cm long, straight or arcuate, with white adpressed and longer ascending or spreading hairs. Inflorescence 15–35-flowered, bracts lanceolate, 11–15 mm long, bracteoles subulate, shorter than calyx. Calyx campanulate; tube subglabrous, green tinged red, teeth narrowly lanceolate to subulate, with spreading hairs, 5–7 times as long as tube, often with a red-purplish hue. Corolla cream, ochre-yellow or pink (occasion-

ally two-coloured), standard obovate, emarginate, 16–20 mm long, as long as keel or somewhat longer; wings c. 10 mm long, c. half as long as keel. Ovary narrowly oblong, with a strip of thick hairs dorsally and ventrally. Fruit 1–3-segmented, usually spinulose and veined.

The Greek population of *Hedysarum grandiflorum* was first discovered in fruit, during a visit to Mt. Gerania (Southeast Sterea Ellas) in 2008 (see map of Fig. 2). Flowering material was collected in 2009 and the label details are as follows:



Fig. 2. Distribution map of *Hedysarum grandiflorum* subsp. *bulgaricum* in Bulgaria and Greece (red circles), and *Biarum ditschianum* in Turkey and Greece (red squares).

Nomos Korinthias, Eparchia Korinthias, Mt. Gerania. At the foothills of the mountain, c. 8.0–8.5 km NW of Agii Theodori town towards the Agios Nikolaos Monastery and Kiafa Beka. At roadsides, in sparse *Pinus halepensis* forest and margins of olive groves. Marl. Alt. 420–450 m, Lat. 37°58'N, Long. 23°05'E, 12 April 2009, Constantinidis 12347 & Iliadis (ATHU).

When not in flower or fruit, *Hedysarum grandiflorum* has a vegetative resemblance to *Astragalus spruneri* Boiss. and even *Ebenus sibthorpii* DC., both growing in its surroundings and in other localities as well, on the southern slopes of Mt. Gerania. This may be the reason the plant has remained unnoticed, although the area was visited twice in the past (Constantinidis 1997).

Two subspecies of *Hedysarum grandiflorum* are currently accepted: subsp. *grandiflorum*, a more robust plant with leaflets 20–30(35) × 12–15(20) mm and corolla 20–25 mm long (Fedchenko 1948), and subsp. *bulgaricum*, described with leaflets (10)12–15(18) × (7)10–12 mm and corolla 15–18 mm long (Kožuharov 1976). The type specimen of the latter kept in SOM (photo!) matches the Greek plants in most respects. Some of the morphological differences found in the Greek population (see description) should complement the taxon's variability rather than support the recognition of an independent entity, despite the long distance that separates the Greek population from the Bulgarian ones. On the other hand, the specimens of *H. grandiflorum* subsp. *grandiflorum* seen in Berlin (B) exhibit a noteworthy variation in quantitative characters (e.g. plant size, dimensions of leaflets and flower). A revision of the species' morphology within its whole geographical distribution would therefore be welcome and discrimination characters, if found, would further support the recognition of two subspecies in *H. grandiflorum*.

#### Key to species of *Hedysarum* and *Sulla* in Greece.

1. Perennial; leaflets 2–5 pairs, each leaflet usually wider than 7 mm ..... 2.
- Annual; leaflets 4–11 pairs; each leaflet up to 7 mm wide ..... 3.
2. Acaulescent or stems shorter than 8 cm; calyx teeth 5–7 times as long as tube; corolla 15–21 mm long ..... *Hedysarum grandiflorum* subsp. *bulgaricum*
- Stems 15–75 cm long; calyx tube somewhat shorter to equalling teeth; corolla 10–15 mm long ..... *Sulla coronaria*
3. Corolla 7–12 mm, up to 2 times as long as calyx; standard indistinctly emarginate, apiculate ..... *Sulla spinosissima*
- Corolla 12–19 mm, 2.5–5 times as long as calyx; standard emarginate, slender point indistinct ..... *Sulla glomerata*

**Phenology.** In Greece, *Hedysarum grandiflorum* subsp. *bulgaricum* is at the peak of its flowering period in the middle of April, with blooming ending around early May. Then the corolla withers but remains persistent and covers the fruit until fruit detachment. Ripe fruits are found in June and July, but presumably they are not dispersed before the rains of autumn.



Dispersion may refer to either the intact fruit as a whole or to fruit segments and is facilitated by temporal and shallow but forceful surface floods following a heavy rain. Indeed, a few plants of *Hedysarum* found c. 1–2 km south of the main population were growing in dry ditches that drain rain water in autumn and winter. The phenology of the Greek population is different from that of the Bulgarian ones: the latter flower in June and July and show mature fruits during July and August (Kozhuharov 2006), perhaps because of growing 3–5 latitudinal degrees to the north.

**Distribution.** *Hedysarum grandiflorum* is known from Ukraine, Russia, Kazakhstan, Romania, Bulgaria (Fedchenko 1948, GRIN 1998, Euro+Med 2006), and its new locality in Greece. *H. grandiflorum* subsp. *bulgaricum* was previously considered a Bulgarian endemic, distributed in the Danubian Plain (near the towns of Plevna and Levski, Novo Selo village, between Svishtov and Pavlikeni) and the Eastern Rhodopes (Kozhuharov 2006). The Greek population grows on the southern slopes of Mt. Gerania, Central Greece, at a linear distance of about 480 km to the south-southwest of the nearest Bulgarian locality (Fig. 2).

**Notes on habitat and population size.** In Greece, *Hedysarum grandiflorum* subsp. *bulgaricum* grows in openings of rather dense macchia vegetation and in sparse *Pinus halepensis* forest, usually on eroded hillsides, road cuts, and on the margins of an olive grove. The substrate has a sedimentary origin and is composed of white friable marl, occasionally enriched with gravel. Predominating woody species in the area include *Anthyllis hermanniae*, *Arbutus unedo*, *Cistus creticus*, *C. parviflorus*, *Globularia alypum*, *Erica manipuliflora*, *Phillyrea latifolia*, *Pistacia lentiscus*, *Quercus coccifera*, and *Satureja thymbra*. The main population was found at an altitude of 460–480 m above sea level, with scattered plants recorded down to c. 350 m.

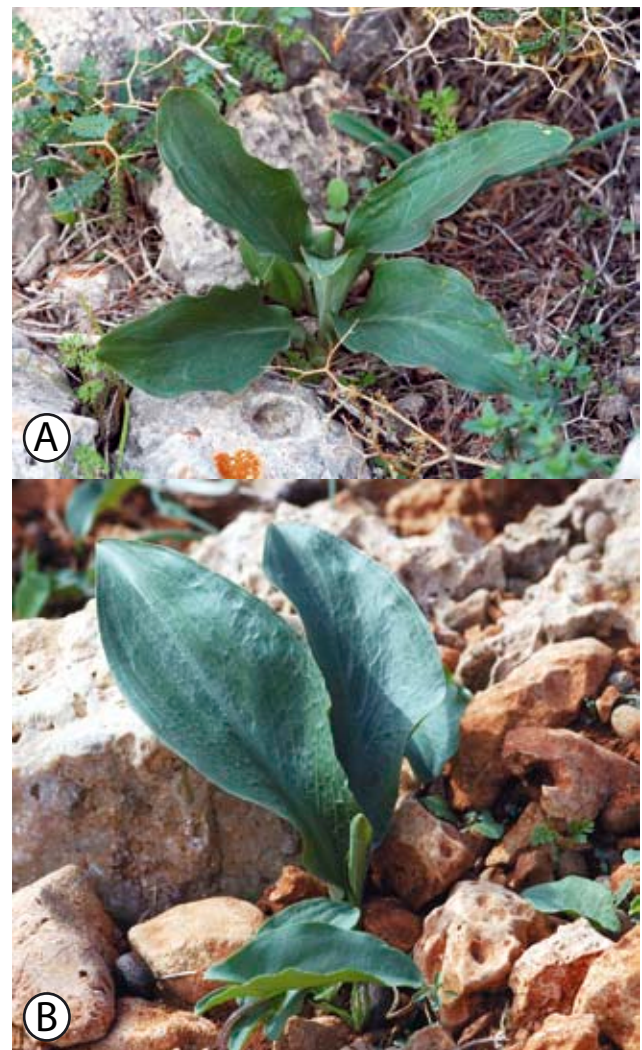
This only known Greek population is composed of c. 250 mature individuals forming two groups of plants at a distance of 700–1000 m. A few plants were also found in shallow ditches, up to 2 km to the south of the main locality.

**Threats.** Any thickening of the woody vegetation may pose a threat to the existence of the Greek pop-

ulation. Likewise, the use of herbicides to control the ground vegetation of the olive grove, or keep its margins clean, would damage an important part of the population. Particular care should be paid to construction works in the area of the subspecies: road widening or improvement would have a heavy impact on the population. *Hedysarum grandiflorum* (no subspecies assignment) has been characterized as Endangered (EN) in the Greek flora by Constantinidis (2009).

***Biarum ditschianum*** Bogner & P.C. Boyce, *Willdenowia* 18(2): 409 (1989) (Figs 3, 4).

Perennial, tuberous plant. Tuber depressed-globular, 2.5–3 × 1.5–2 cm, yellow-brown. Leaves 2–4, up to



**Fig. 3.** Leaves of *Biarum ditschianum* in its natural habitat on Megisti (Kastelorizo) Island. **A:** Plants growing on the slopes of Mounda Hill, among *Sarcopoterium spinosum*. **B:** Plants growing on the stony top of Mounda Hill, together with *Arisarum vulgare*. Photos taken on November 14<sup>th</sup>, 2010.

6 in cultivation, hysteranthous, surrounded by a few whitish membranaceous cataphylls at their base; petiole 6–20 cm × 1.3–3 mm, channelled, lamina of first leaves broadly spatulate to narrowly elliptic and of subsequent leaves linear-lanceolate to oblanceolate, 6–18 × 0.8–3.3 cm, up to 21 × 4.5 cm in cultivation, lateral veins clear, anastomosing, leaf base cuneate, apex acute to obtuse. Inflorescence enclosed by 5–6 whitish papery cataphylls at base, smelling strongly foetid. Spathe 3.5–5 cm long, tube 2.8–3 × 1.8–2 cm, greenish-white outside, dark reddish-purple inside, margins connate, limb much reduced, almost triangular, 1.8–2 × 1.8–2 cm, margins inrolled, greenish-white tinged purple outside, dark reddish-purple inside. Spadix 7–8 cm long, appendix yellow, stout, stipitate, subcylindrical, narrower at upper part and obtuse at apex, 4–4.5 cm × 7–10 mm, with a purplish-red zone at base covered with transparent white, filiform and deflexed hairs 1–2.5 long. Male flowers in an upper zone 4–5 × 7–9 mm, stamens subsessile, purple-red at apex. Sterile flowers absent. Female flowers at the bottom of inflorescence, arranged in a 2–2.5 mm high hemispherical cluster, bottle-shaped, purplish-red, style 1.2–1.3 long, purplish, stigma subcapitate, 0.6–0.5 mm in diameter, yellowish. Infructescence seen (*in situ*) but not measured in Greek material.

An interesting population of *Biarum* was found by the author during a joint visit with Roikos Thanopoulos to the northern parts of Megisti (or Kastellorizo) Island in April 2008. No inflorescence was noticed and a few tubers were collected for cultivation. The plant flowered in May 2011 (Fig. 4) and was immediately recognized as *B. ditschianum*, a rare Turkish species described 23 years ago (Bogner & Boyce 1989) and only known from a few localities of Southwest Anatolia (Turkey). The species is clearly distinct and its identification straightforward. Its discovery adds a new record to the Greek flora. Interestingly, the fresh inflorescence was detected in the garden by smell, not by sight! Immediately after spathe expansion a very foetid odour recalling a decaying animal corpse poured into the atmosphere and was stronger at noon. Following the smell was a very safe way to locate *B. ditschianum*, among other plants in the garden.

The voucher of *Biarum ditschianum* consists of one inflorescence and two leaves, taken from cultivated plants. No further material was pressed in an effort

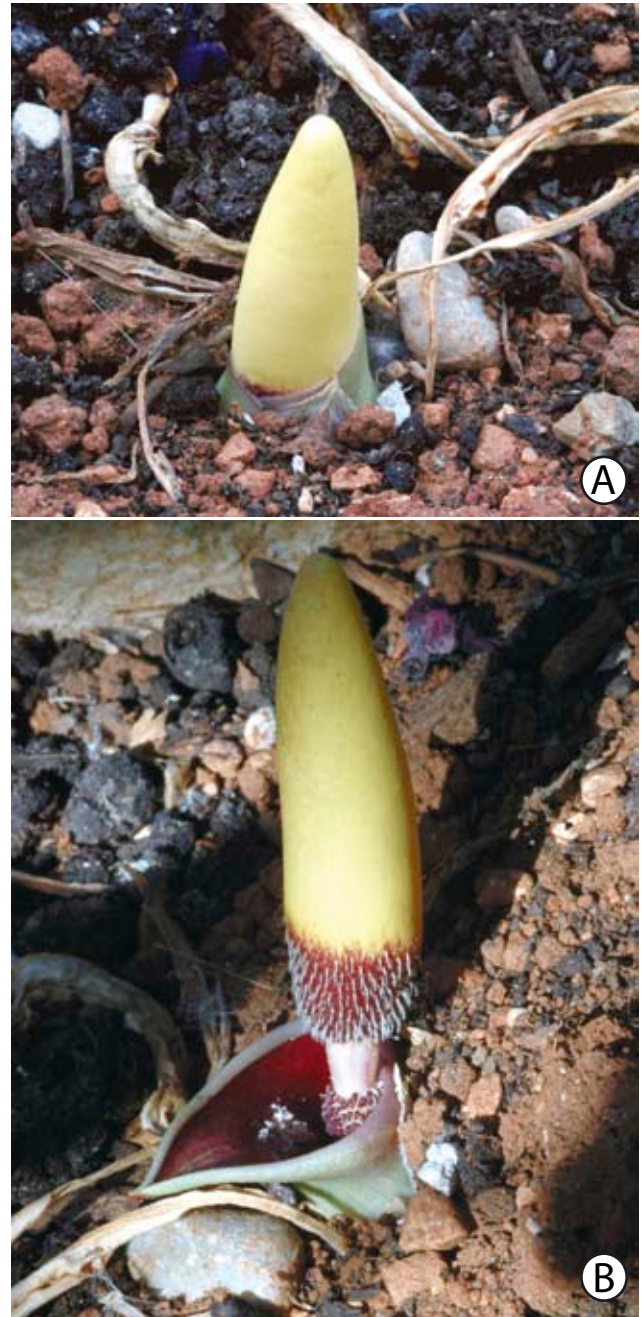


Fig. 4. The inflorescence of *Biarum ditschianum* in cultivation. **A:** Spathe and spadix expansion from the underground tuber. **B:** A fully developed inflorescence. Photos taken on May 20<sup>th</sup> and 21<sup>th</sup>, 2011.

to keep the intact plants in cultivation and propagate the species. Label details are as follows:

Nomos Dodekanisou, Eparchia Rodou, Megisti (Kastellorizo) Island. The upper parts and the top area of Mounda Hill, SW of Kastellorizo settlement. In open, stony places with a few *Daphne gnidioides*, *Euphorbia dendroides* and *Sarcopoterium spinosum*, on limestone. Alt. 180–200 m, Lat. 36°08'50'' N, Long. 23°05'00'' E, 21 May 2011, Constantinidis 12699 (cult., ATHU).



**Key to species and subspecies of *Biarum* in Greece.**

1. Spathe limb very short, almost triangular; spadix with recurved white hairs at base of appendix; sterile flowers absent ..... ***B. ditschianum***
  - Spathe limb well-developed; spadix without hairs at base of appendix; sterile flowers usually present above or below the male flower zone ..... 2
2. Sterile flowers present above the male and between the male and female flower zones ..... ***B. tenuifolium* (3)**
  - Sterile flowers absent above the male flower zone, usually present between the male and female flower zones ..... 6
3. Leaf lamina 13–40 cm long, spathe 11–27 cm long ..... 4
  - Leaf lamina 2.5–14 cm long, spathe 4–13 cm long ..... 5
4. Leaf lamina 10–17 mm wide; spadix appendix 10–40 cm × 2–4 mm ..... ***B. tenuifolium* subsp. *tenuifolium***
  - Leaf lamina 15–36 mm wide; spadix appendix 9–14 cm × 3–9 mm ..... ***B. tenuifolium* subsp. *zelebori***
5. Leaf lamina spatulate to lanceolate, usually erect, 6–21 mm wide, margins flat to slightly undulate ... ***B. tenuifolium* subsp. *abbreviatum***
  - Leaf lamina linear-oblong, usually adpressed to the ground, 2–9 mm wide, margins strongly undulate-crested ..... ***B. tenuifolium* subsp. *idomenaeum***
6. Spathe tube almost equal or longer than limb, enclosing a considerable part of the spadix; margins of spathe limb recurved ..... 7
  - Spathe tube shorter than limb, enclosing spadix at base; margins of spathe limb flat, undulate or in-rolled ..... 8
7. Spathe 4.5–7 cm long, spadix appendix 2.5–3.8 cm × 1–2 mm ..... ***B. davisii***
  - Spathe 7–9 cm long, spadix appendix 3.5–5 cm × 0.5–1.5 mm ..... ***B. marmarisense***
8. Sterile flowers thickened and rigid, often recurved and falcate; spathe limb usually 1–4 cm wide ..... ***B. rhopalospadix***
  - Sterile flowers filiform, straight or flexuous, not thickened; spathe limb usually 4–6 cm wide ..... ***B. fraasianum***

**Phenology.** *Biarum ditschianum* starts growing after the autumn rains, most probably in late October or

November. The plants on Megisti Island had already expanded leaves when visited on November 14th, 2010 and growth continued throughout winter. The first leaves were broadly spatulate to narrowly elliptic, with subsequent leaves being narrower and linear-lanceolate to oblanceolate, in full accordance with Bogner & Boyce (1989). This difference in leaf form is kept in cultivation. Depending on the spring rains and moisture availability, the leaves begin to wither around late April to May. Flowering has been observed only once in cultivation (May 2011), soon after the leaves faded. The inflorescence lasted for about 3 days and the foul smell is stronger around noon of the first day. Pollination is probably achieved by species of *Diptera* that were observed to visit the flowering plants in cultivation. From late May to the end of October or early November, i.e. for about 5–6 months, the Greek plants remain dormant subterraneously.

**Distribution.** *Biarum ditschianum* was so far considered a rare and local endemic species of South-west Anatolia (Turkey). The population on Megisti Island, apart from a new record for the Greek flora, is also the only insular one known so far. However, the population itself and the island of Megisti as a whole are not far away from the Turkish coast. Boyce (2008b) has mapped only two populations in Anatolia but more remain to be found, particularly in the Antalya Vilayet. The distribution of the species is shown in Fig. 2.

**Notes on habitat and population size.** Only one population of *Biarum ditschianum* has been found on Megisti Island, consisting of approximately 100 mature individuals. The plants grow away from any tourist activity or serious human interference; however, the area is grazed by goats. Their habitat is the stony substrate of a hillside and top, with some sparse *Daphne gnidioides*, *Euphorbia dendroides* and *Genista acanthoclada* shrubs. Other plants growing together include *Arisarum vulgare*, *Asphodelus ramosus*, *Colchicum stevenii*, *Cyclamen* sp., *Origanum onites*, *Sarcopoterium spinosum*, etc. A few young olive trees (*Olea europaea*) were observed in the area, obviously planted in the near past. Some *Biarum* plants were found in pockets of clay soil within limestone holes, as in Turkey (Bogner & Boyce 1989, Boyce 1998b) but most of them were growing in the *terra rossa* soil of the calcareous slope. The area of occupancy of the Greek population is less than 500 m<sup>2</sup>.

Boyce (1995, 2008b) records the species at an altitude of 30–120 m. The Greek population was found slightly higher, at 180–200 m above sea level.

**Threats.** The Greek population of *Biarum ditschianum* on Megisti Island is not under any immediate threat at the moment. Nevertheless, it consists of a small number of plants that are spread over a narrow strip of land. Members of *Biarum* are of horticultural interest and *B. ditschianum*, as a rare plant, may be highly desirable; therefore, this insular population needs to be safeguarded from any illegal collection. The cultivation of the species and the availability of tubers from specialized nurseries will relieve natural populations from collecting pressure. Grazing by goats does not seem to bring any serious harm to the population and may even contribute positively to its maintenance by keeping the vegetation open. Changes of land use should be avoided and in case of an absolute necessity, the population of *B. ditschianum* should be offered some protection.

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