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Estimation of the status of representative populations of *Sideritis scardica* G r i s e b. in the Rhodopi Mts

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Abstract. Representative populations of *Sideritis scardica* were studied from all Rhodopean locations, in which the species manifested itself as a calciphyte, inhabiting open places predominantly of southern exposition, on shallow eroded terrains. Five associations were described with the participation of *Sideritis scardica*, one dominated by this species. A comparative estimation of the populations from Rhodopean locations showed them with a similar capacity for regeneration and development. Anthropogenic impact is crucial for the destiny of this rare species.

Key words: *Sideritis scardica* Griseb., rare species, population.

Introduction

Sidertis scardica is a perennial herbaceous plant with tracing roots and a powerful root system. Genus *Sideritis* belongs to tribe *Stachydeae*, subtribe *Marrubiae* of family *Lamiaceae*, and *Sidertis scardica* G r i s e b. species was referred to Empedoclia (R a f i n.) B e n t h. division (H a l a e s y 1902). P a p a n i c o l a u & K o k k n i (1982) offered a more detailed taxonomic revision of that division. Chromosomal complement of the investigated species of division Empedoclia, including of *Sidertis scardica*, is 2n = 32 (K o z u h a r o v & K u z m a n o v 1965; M a r k o v a & G o r a n o v a 1994), although in some materials chromosomal complements of 2n = 32 + 0 – 2B and 2n = 30 have been discovered (S t r i d & T a n 1991). A s s e n o v & G a n c h e v (1978) gave a morphological characteristic of the species.

The plant is reproduced mainly by seeds, but under cultivation vegetative reproduction is possible by rhizome division (E v s t a t i e v a & al. 1990). There has been no evidence of spontaneous vegetative reproduction.

The generic name *Sideritis* originated from the Greek word sideros (iron), related to the ability of plants of that genus to heal wounds of cold steel, a property known already in the 16th century (U z e p c h u k 1954). The generic epithet scardica reflected the locality of material for which the species of Grisebah was described for the first time, namely Mt Scardo in Macedonia.

The area of distribution of *Sidertis scardica* is closely linked to the Balkan Peninsula. The species is a Balkan endemic encountered in Southwest Albania, Greece, Macedonia, and Bulgaria (H e y w o o d & T u t i n 1972; A s s e n o v 1989; S t r i d & T a n 1991).

Data on chorology of this species for Bulgaria were provided by S t o j a n o v & al. (1924; 1933), S t o j a n o v & al. (1967), A s s e n o v (1989), E v s t a t i e v a & al. (1990) and G a n c h e v (1995).

Sidertis scardica arouses considerable interest as a medicinal plant and in spite of being entered in the list of protected plants, is object of intensive exploitation. Along these lines the negative changes in the resource potential and reproduction capacities of the species have determined it as one of the most threatened components of the Bulgarian spontaneous flora.

The aim of this research was to study the ecological conditions in the natural habitats of *Sidertis scardica* on the territory of Rhodopi Mts, to analyze the status of its populations in that region and to assess the anthropogenic impact on them.

Object of study

Sidertis scardica in Bulgaria is generally distributed in Mt Slavyanka, the Pirin and Rhodopi Mts (Fig. 1). In the Rhodopes its distribution is concentrated in three points: Dobrostan, Moursalitza and Trigrad region. This research was carried out in sample plots of the above mentioned Rhodopean locations.

Moursalitza Ridge is an independent morpological unit, with a radially flowing river-valley network and a broad, flat crest at 1800-2000 m a.s.l. Climate in the area

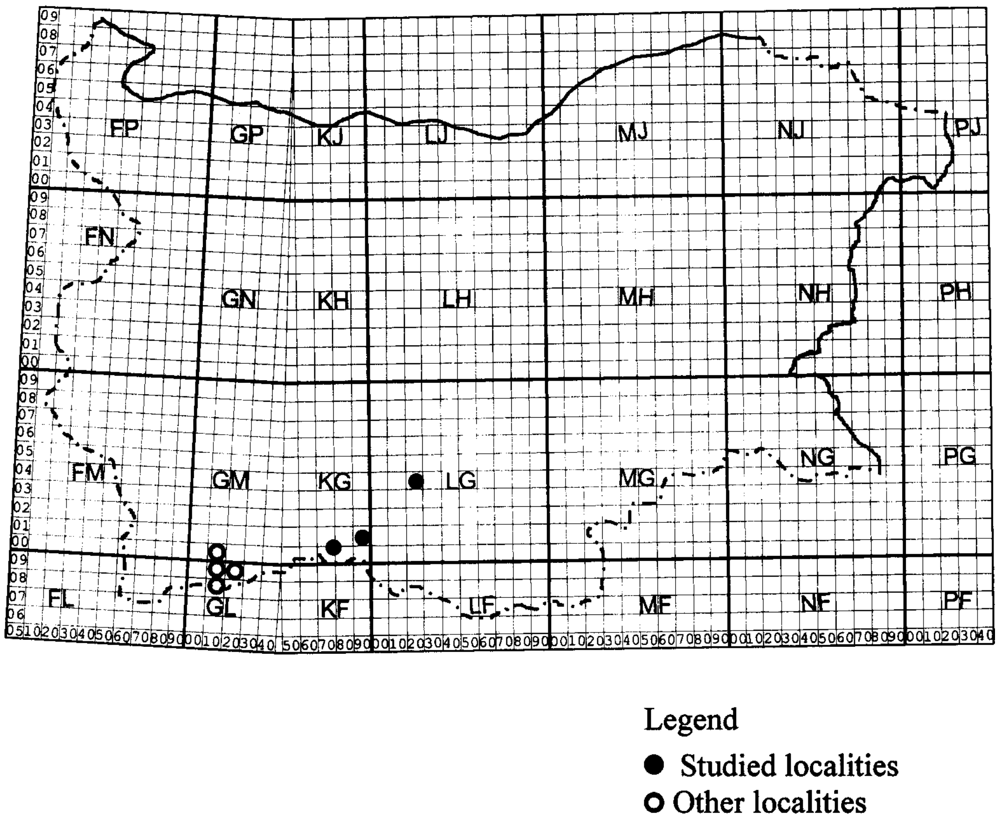


Fig. 1. Distribution of *Sideritis scardica* G r i s e b. in Bulgaria

is transitory from Mild Continental to Continental Mediterranean, with two equally distinct maximums and two minimums in the regime of rainfalls. The average annual tempreature is 5-8°C (S a b e v & S t a n e v 1963; T i s h k o v 1982). According to the same authors, the total annual temperatures in the period of active vegetation vary between 2300-1200°C, with a descending trend in terms of altitude. The total annual rainfalls are between 900 and 1200 mm. Days under snow cover amount to 80-100 an year. Westerly and northwesterly winds prevail, as well as southern winds in the cold half of the year.

A specific cahracteristic of Moursalitza is the spacious cavern-water basin set in the deeply karstified marble massif.

The soil cover is comparatively homogeneous. Cambisols prevail, with a thin to medium humus layer, medium to very stony. Along the crest local patches of rendzinas and umbric cambisols are scattered, occasionally combined with modic cambisols (N i n o v & I o l e v s k i 1982).

The region of Trigrad lies in the southeastern part of the Veliyshko-Videnishki Divide of the Western Rhodopes. It is cahracteristic with thick-layer marble lithogenic formations of karst nature. Corrosion and erosion processes and a strongly fissured carbonate substrate preconditioned the deep karstification of the region. The deep canyon beds of rivers Bouinovska, Trigradska and Moutlenska are particularly impressive in the upper reaches of river Vucha. The relief is varied, strongly rugged by the dense and deeply hatched network of valleys. The climate is Transitory Continental (T i s h k o v, 1982). Annual rainfalls total 900 mm. The region has two equally distinct maximums (May-June and November-December) and two minimums (February and August) in the annual rainfalls. The possible duration of snow cover is 145 days, with 80 days under snow cover. The average annual temperature is 6.5°C. The average July temperature is 15.4°C, and the average January temperature is – 2.8°C (V e l e v, 1990). Soil cover in the region mainly consists of cambisols, with rendzinas, umbric and modic cambisols along the mountain ridge.

The northern part of Western Rhodopes houses the large plato-like Dobrostan mountain massif. Its northern slopes are waterless and karstic, while the southern and western represent a bare karstified wall, with the rocky peak Chervenata Stena (1508 m) towering above it.

Climate in the region is Transitory Continental, with two maximums of the rainfall: spring-summer and autumn-winter. The average continual temperature is 7-9°C (S a b e v & S t a n e v 1963; T i s h k o v 1982). A characterisitc feature of the Dobrostan Massif is the good water supply, both on the surface and underground. Soils are represented mainly by the brown forest mountain type passing into humus carbonate (rendzinas) on marble-formed terrains (N i n o v & I o l e v s k i 1982).

Selected sample plots of the natural habitats of *Sideritis scardica* in the Rhodopes were chosen for an object of study: 1) crest sections of Moursalitza Ridge; 2) a plato-like elevation to the west of Trigrad, as most typical of habitats in the region located between Chaleto locality to the south of Trigrad, Tourlata between Zhrebovo and Kesten villages, and the region of Yagodina; 3) close to the Martziganitza chalet (Slivov Dol locality), Dobrostan.

Methods of research

Field observations were carried out in 5 sample plots 400 m^2 in size. Three of the plots were on the territory of Moursalitza Ridge: one above Trigrad village and another close to Martziganitza chalet. Within the framework of each plot the following investigations were carried out: phytocoenotic characteristics on the principle of dominance (S h e n n i k o v 1964), the number of specimens of this species, the number of vegetative branchings (modules) and respectively the generative shoots of each specimen, as well as the number of flowers in one cluster. The length of generative shoots and the length of inflorescences were also measured.

Soil samples from the surface soil layer (20 cm) were analyzed potentiometrically for pH; by the method of Tuerin for humus content, and with a modification of Keldal's classic method (scorching with sulphuric acid and hydrogen peroxide).

The area of the populations was calculated on the basis of local forestry maps and 1:25000 topographic maps and their plotting on graph paper.

Field studies were carried out in the 1996-1998 period.

Taxonomy of the species was determined after the Flora of Bulgaria, vol. 1-10, and A n d r e e v & al. (1992).

Results

1. Ecological conditions in the natural habitats of the species

The investigated habitats were situated at altitudes of 1200 m up to 1900 m. The population of Dobrostan Massif was the lowest situated, while that of Moursalitza was at the highest altitude. This corresponded to data from literature (A s s e n o v 1989; G a n c h e v 1995) on the vertical distribution of species and at the same time confirmed the locality close to Martziganitza chalet as the lower boundary of vertical distribution of the plant in Bulgaria.

The habitats of *Sideritis scardica* in the Rhodopes occupied open slopes and crest stretches, chiefly with southern exposition and an incline of 5-30°. These preferences of the plant were explained by the species requirement for longer periods of light, relatively higher temperatures and a characteristic drought resistance. Occasional specimens were found in places with northern exposition, but it should be pointed out that in such places they were always discovered close to the mountain trails, so that their presence there could be explained by artificial distribution by the people collecting the plant.

Ecologically, the plant belongs to the group of heliophilous calciphylic xerophytes (G a n c h e v 1995), because it inhabits open, grassy terrains, expressly calcareous, in the middle and upper mountain belt. According to R a u n k i e r's (1907) classification, the species belongs to hemicryptophytes.

Observations in all Rhodopean locations have shown that *Sideritis scardica* inhabits dry, sunny, grassy, and stony terrains, solely on a calcareous rock base. That is why a number of its morphological characteristics relate to its adaptation to permanently scanty humidity typical of the karst massives, namely a powerful root system and profuse hairiness.

Tracing down the sensitivity of *Sideritis scardica* to the light factor has shown the plant's attachment to open terrains, related to the heliophyllous nature of the species. Parallel with this, specimens of *Sideritis scardica* in the juniper-dominated coenoses showed aptitude for development under or in close proximity to the juniper bushes. Probably the species thus manifested certain tolerance of shading. Similar relative resistance to shading was also observed in the Dobrostan location, where we discovered successfully developing specimens along the line of the upper forest boundary. Such specimens developed larger tufts, bigger leaf laminae, higher flower-bearing stalks, and a greater number of modules. Along with this, they had a lesser number of generative shoots and difficulties in having their seeds ripen. We had two explanations for these facts: 1) Past deforestation has created favourable conditions for the settling of *Sideritis scardica*. After a gradual restoration of the forest, single specimens remained under its canopy, but their slow dying out could be foretold. 2) The species has found a better refuge and was better sheltered under the juniper bushes than in the open terrains, owing to which an increasing number of specimens have been encountered in such places. Furthermore, the soil cover in such places was thicker and of higher humidity and this favoured germination of seeds and successful development of the young plants.

All Rhodopean locations of *Sideritis scardica* were on eroded terrains, with soils of the rendzina type, neutral to slightly alkaline, shallow, stony or broken out by up to 50-60% of basic rock outcrops. All analyses made showed a relatively high content of humus and total nitrogen (Table 1).

Table 1. Chemical composition of the soil in the localities of *Sideritis scardica* G r i s e b. in the Rhodopes

Locality	Humus (%)	Total N (%)	pH
Moursalitza	14.32	0.78	7.6
Trigrad	7.28	0.37	7.4
Dobrostan	11.60	0.58	7.2

2. Phytocoenotic characteristics of *Sideritis scardica* G r i s e b

Our investigations have shown that in the studied regions the species took part in five associations described by the principle of dominance. Only in one of them it played a subdominant role, while in the rest was an accompanying species.

Association *Juniperus sibirica* was described in the region of Moursalitza on 15.07.1996, at 1820 m a.s.l., on a slope with southern expostion and 25° incline. The soils were shallow, stony, with 15% of rock outcrops, the basic rock was marble. Species composition: *Picea abies* (L.) K a r s t +, *Juniperus sibirica* B u r g s d. 70%, *Rubus idaeus* L. +, *Bromus riparius* R e h m. 1 II, *Festuca valesiaca* S c h l e i c h ex G a n d. 2 III, *Dactylis glomerata* L. 1 I, *Koeleria eriostachya* P a n c. 1 II, *Poa media* S c h u r. 1 I, *Poa alpina* L. 1 II, *Festuca nigrescens* L a m. 1 I, *Anthoxanthum odoratum* L. 1 I, *Agrostis capillaris* L. 1 I, *Bellardiochloa violacea*

C h i o v. 1 I, *Brachypodium sylvaticum* (H u d s.) P.B. 1 I, *Carex caryophyllea* L a t o u r r. 1 III, *Carex kitaibeliana* D e g. ex B e c h 1 II, *Luzula sudetica* (W i l l d.) DC 1 I, *Trifolium heldreichianum* H a u s s k n. 1 I, *Trifolium alpestre* L. 1 I, *Lotus corniculatus* L. 1 I, *Rhodax canus* (L.) F u s s 2 III, *Potentilla ternata* C. K o c h. 1 II, *Asperula cynanchica* L. 1 I, *Centaurea rhenana* B o r e a u. 1 I, *Euphorbia barrelieri* ssp. *thessala* (F o r m.) B o r n m. 2 III, *Euphorbia amygdaloides* L. 1 III, *Scleranthus neglectus* L. 1 III, *Galium album* M i l l. 1 I, *Thymus vandasii* V e l. 1 I, *Teucrium montanum* L. 1 I, *Acinos alpinus* M i l l. 1 I, *Hieracium pilosella* L. 1 I, *Sedum album* L. 1 I, *Sedum acre* L. 1 I, *Matricaria caucasica* (W i l l d.) P o i r. 1 I, *Hypericum linarioides* B o s s e 1 II, *Sideritis scardica* G r i s e b. 2 III, *Trinia glauca* ssp. *carniolica* (A. K e r n. ex J a n c h.) H. W o l f f 1 I, *Polygala comosa* S c h u h r. 1 I, *Fragaria vesca* L. 1 I, *Plantago media* L. 1 I, *Campanula persicifolia* L. 1 I, *Digitalis viridiflora* L i n d l. 1 I, *Achillea millefolium* L. 1 I, *Alchemilla flabellata* B u s e r 1 I, *Jasione laevis* ssp. *orbiculata* (G r s b. ex V e l.) T u t i n 1 I, *Sempervivum marmoreum* G r s b. 1 I, *Armeria rumelica* B o i s s. 1 I, *Paronychia kapela* (H a c q.) A. K e r n. 1 I, *Dianthus petraeus* W. et K. 1 I, *Cruciata laevipes* O p i z. 1 II, *Veronica chamaedrys* L. 1 II, *Geum urbanum* L. 1 I, *Viola tricolor* L. 1 I, *Myosotis laxa* ssp. *caespitosa* (C. S c h u l t z.) H y l l. ex N o r t h. 1 I, *Ranunculus sartorianus* B o i s s. et H e l d r. 1 I, *Herniaria glabra* L. 1 I, *Thesium alpinum* L. 1 I, *Draba lasiocarpa* R o c h. 1 I, *Tortella tortuosa* (H e d w.) L i m p r. 1 I.

Association *Juniperus sibirica – Sideritis scardica* was described in the region of Moursalitza on 16.07.1996, at 1800 m a.s.l., on a slope with southern exposition and 25° incline. The soils were shallow, stony, with 70% of rock outcrops and strong surface erosion. The basic rock was marble. Species composition: *Picea abies* (L.) K a r s t. +, *Juniperus sibirica* B u r g s d. 30%, *Bromus riparius* R e h m. 1 II, *Festuca nigrescens* L a m. 1 II, *Dactylis glomerata* L. 1 I, *Koeleria eriostachya* P a n c. 1 II, *Poa alpina* L. 1 II, *Bellardiochloa violacea* (B e l l.) C h i o v. 1 I, *Sesleria coerulans* F r i v. 2 III, *Carex caryophyllea* L a t o u r r. 1 II, *Carex kitaibeliana* D e g. ex B e c h. 2 III, *Carex digitata* L. 1 I, *Trifolium heldreichianum* H a u s s k n. 1 II, *Trifolium badium* ssp. *badium* (V e l.) K o z. 1 I, *Lotus corniculatus* L. 1 I, *Onobrychis montana* DC 1 II, *Rhodax canus* (L.) F u s s 1 II, *Potentilla ternata* C. K o c h. 1 II, *Dianthus petraeus* W. et K. 1 II, *Polygala vulgaris* L. 1 I, *Saxifraga sempervirens* C. K o c h. 1 I, *Anthylis montana* ssp. *jaquinii* (A. K e r n) H a y. 1 II, *Galium album* M i l l. 1 I, *Thymus vandasii* V e l. 1 II, *Thymus stoyanovii* D e g. 1 II, *Teucrium montanum* L. 1 II, *Sedum album* L. 1 I, *Sedum ochroleucum* C h a i x. 1 II, *Matricaria caucasica* (W i l l d.) P o i r. 1 I, *Hypericum linarioides* B o s s e 1 I, *Sideritis scardica* G r i s e b. 2 III, *Trinia glauca* ssp. *carniolica* (A. K e r n. ex J a n c h.) H. W o l f f 1 I, *Muscari botryoides* (L.) M i l l. 1 I, *Veronica spicata* L. 1 I, *Plantago subulata* L. 1 I, *Theucrium chamaedrys* L. 1 I, *Primula veris* ssp. *canescens* (O p i z.) H a y. ex L u d i 1 I, *Carum graecum* B o i s s. et H e l d r. 1 II, *Jasione laevis* ssp. *orbiculata* (G r s b. ex V e l.) T u t i n 1 II, *Ranunculus sartorianus* B o i s s. et H e l d r. 1 I, *Armeria rumelica* B o i s s. 1 I, *Paronychia kapela* (H a c q.) A. K e r n. 1 I, *Dianthus petraeus* W. et K. 1 I, *Cruciata laevipes* O p i z. 1 II, *Veronica austriaca* L. 1 I, *Petkovia orphanidea* (B o i s s.) S t e f. 1 II, *Draba aizoides* L. 1 I, *Draba lasiocarpa* R o c h. 1 I, *Tortella tortuosa* (H e d w.) L i p r. 1 I, *Cetraria islandica* (L.) A c h. 1 I, *Cladonia rangiferina* Hoff. 1 I.

Association *Koeleria eriostachya – Carex caryophyllea – Rhodax canus* was described on Moursalitza on 17.07.1996, at 1800 m a.s.l., on a slope with southeastern exposition and an incline of 10°. The soils were strongly eroded, shallow, stony, with nearly homogeneously distributed 30% of basic rock outcrops. The basic rock was marble.

The species composition included: *Picea abies* (L.) Karst. +, *Juniperus sibirica* Burgsd. +, *Koeleria eriostachya* Panc. 2 III, *Sesleria coerulans* Friv. 2 III, *Poa alpina* L. 1 III, *Bromus riparius* Rehm. 1 III, *Phleum montanum* C. Koch. 1 I, *Carex caryophyllea* Latourr. 2 III, *Carex kitaibeliana* Deg. ex Bech. 2 III, *Onobrychis montana* DC 1 III, *Anthyllis montana* ssp. *jacquinii* (A. Kern.) Hay. 1 I, *Medicago minima* (L.) Bart. 1 I, *Rhodax canus* (L.) Fuss. 3 IV, *Paronychia kapela* (Hacq.) A. Kern. 1 I, *Petkovia orphanidea* (Boiss.) Stef. 1 III, *Minuartia verna* (L.) Hiern. 1 II, *Jasione laevis* ssp. *orbiculata* (Grsb. ex Vel.) Tutin 2 III, *Thymus stojanovii* Deg. 1 I, *Thymus vandasii* Vel. 2 III, *Potentilla ternata* C. Koch. 1 III, *Sideritis scardica* Grsb. 2 III, *Plantago media* L. 1 I, *Centaurea rhenana* Boreau 1 I, *Hieracium pilosella* L. 1 I, *Trinia glauca* ssp. *carniolica* (A. Kern ex Janch.) H. Wolff. +, *Acinos alpinus* Mill. +, *Asperula cynanchica* L. 1 I.

Association *Bromus riparius* was described in the region of Trigrad on 23.07.1996, at 1600 m a.s.l., on a slope with southwestern exposition and an incline of 25°. The soils were shallow, stony, strongly eroded, with 25% of rock outcrops evenly distributed on the surface. The basic rock was marble. The species composition comprised: *Abies alba* ssp. *borisii-regis* (Mattf.) Koz. et N. Andr. +, *Juniperis communis* L. +, *Rosa bulgarica* Dimitrov. 2 II, *Bromus riparius* Rehm. 4 V, *Koeleria mitruschii* Ujh. 2 III, *Festuca valesiaca* Schleich. ex Gaud. 2 III, *Anthoxanthum odoratum* L. 1 I, *Briza media* L. 1 I, *Calamagrostis arundinacea* (L.) Roth. 1 I, *Poa alpina* L. 1 I, *Carex caryophyllea* Latourr. 2 II, *Onobrychis alba* (W. et K.) Desv. 1 II, *Trifolium heldreichianum* Hausskn. 1 I, *Trifolium repens* L. 1 I, *Trifolium pannonicum* Jacq. 1 I, *Anthyllis montana* ssp. *jacquinii* (A. Kern.) Hay. 1 I, *Rhodax canus* (L.) Fuss. 1 II, *Potentilla ternata* C. Koch. 2 II, *Potentilla argentea* L. 1 I, *Sideritis scardica* Grsb. 1 III, *Hieratium pilosella* L. 1 III, *Veronica austriaca* ssp. *jacquinii* (Baumg.) Maly 1 II, *Petkovia orphanidea* (Boiss.) Stef. 1 II, *Achillea clypeolata* S. et S. 1 II, *Teucrium montanum* L. 2 II, *Stachys recta* L. 1 I, *Euphorbia myrsinites* L. 1 I, *Euphorbia barrelieri* ssp. *thessala* (Form.) Bornm. 1 II, *Euphorbia cyparissias* L. 1 I, *Ajuga laxmannii* (L.) Benth. 1 I, *Ajuga chamaepitys* (L.) Schreb. 1 I, *Filago vulgaris* Lam. 1 I, *Asperula cynanchica* L. 1 I, *Hypericum linarioides* Bosse 1 I, *Teucrium chamaedrys* L. 1 I, *Sanguisorba officinalis* L. 1 I, *Achillea millefolium* L. 1 I, *Veronica verna* L. 1 I, *Verbascum longifolium* Ten. 1 I, *Scleranthus neglectus* Roch. ex Baumg. 1 I, *Sedum sartorianum* Boiss. 1 I, *Origanum vulgare* L. 1 I, *Achillea distans* ssp. *tanacetifolia* Janchen 1 I, *Hypericum perforatum* L. 1 I, *Campanula persicifolia* L. 1 I, *Polygala alpestris* Rchb. 1 I, *Eryngium campestre* L. 1 I, *Acinos alpinus* Mill. 1 I, *Morina persica* L. 1 I, *Silene italica* (L.) Pers. 1 I, *Galium album* L. 1 I, *Cerastium arvense* L. 1 I, *Knautia arvensis* (L.) Coult. +, *Primula veris* L. 1 I, *Thymus stojanovii* Deg. 1 I, *Trinia glauca* ssp. *carniolica* (A. Kern ex Janch.) H. Wolff. 1 I.

Association *Juniperus oxycedrus – Koeleria obscura + Achillea clypeolata* was described in the Dobrostan Massif (near to Martziganitza challet) on 28.07.1996, at 1200 m a.s.l., on an southwestern slope with 5° incline. The soils were shallow, stony, strongly eroded, with a marble basic rock. The species composition included: *Pinus nigra* A r m. ssp. *palasiana* (L a m b.) H o l m b. +, *Quercus daleschampii* T e n. +, *Ostrya carpinifolia* S c o p. +, *Juniperus oxycedrus* L. 5%, *Koeleria obscura* (V e l.) K o z., P e t r., N e n. 3 V, *Festuca valesiaca* S c h l e i c h. ex G a u d. 3 V, *Poa alpina* L. 1 II, *Melica ciliata* L. 1 II, *Bromus riparius* R e h m. 1 I, *Achnatherum bromoides* (L.) B e a u v. 1 I, *Àstragalus depressus* L. 1 II, *Medicago lupulina* L. 1 I, *Trifolium heldreichianum* H a u s s k n. 1 I, *Achillea clypeolata* S. et S. 3 V, *Teucrium polium* L. 3 IV, *Euphorbia barrieleri* ssp. *thessala* (F o r m.) B o r n m 1 III, *Primula veris* L. 1 I, *Asperula cynanchica* L 1 II, *Veronica austriaca* L. 1 III, *Sideritis scardica* G r s b. 1 II, *Sideritis montana* L. 1 II, *Eryngium campestre* L. 1 II, *Teucrium montanum* L. 1 II, *Teucrium chamaedrys* L. 1 I, *Dianthus deltoides* L. 1 I, *Rhodax canus* (L.) F u s s. 1 II, *Sedum acre* L. 1 II, *Inula oculus-christi* L. 2 III, *Marrubium friwaldskyanum* B o i s s. 1 I, *Leonthodon crispus* V i l l. 1 II, *Asyneuma canescens* (W. et K.) G r s b. et S c h r e n k 1 I, *Digitalis lanata* L. 1 I, *Sedum album* L. 1 I, *Centaurea rhenana* L. 1 I, *Hypericum perforatum* L. 1 I, *Trachelium rumelianum* H a m p e 1 I, *Clematis vitalba* L. 1 I, *Haberlea rhodopensis* F r i v. 1 I, *Asplenium viride* H u d s. 1 I.

A general characteristic of these associations was their open horizontal structure and rich species composition. The greatest floristic abundance (64 species) was found in the association *Juniperus sibirica* in the Moursalitza region.

A comparative analysis of the three localities has shown that irrespective of similar in type habitats, the common elements in the described associations were few: 6 species. This testified to the ability of *Sideritis scardica* to associate with different plant species under conditions of poor competition between them.

Mention deserves the great conservational importance of communities with the participation of *Sideritis scardica*, housing besides it some other endemic or rare species for the flora of the country, such as *Abies alba* ssp. *borisii-regis*, *Morina persica*, *Haberlea rhodopensis*, *Trachelium rumelianum*, *Petkovia orphanidea*, *Rosa bulgarica*.

3. Evaluation of the status of populations of *Sideritis scardica* G r i s e b in the three Rhodopean locations

3.1. Comparative analysis of the three habitat types in the region of Moursalitza

The prevailing part of the population of *Sideritis scardica* in the region of Moursalitza was situated within the boundaries of Mougla Forestry Range. Its area amounted approximately to 882 ha. The population maintained highest numbers in sections 70 and 71 of the forest management plans of the Forestry and the area of the sections accounted for 2.7% of the total area of the habitats within the boundaries of this Forestry Range.

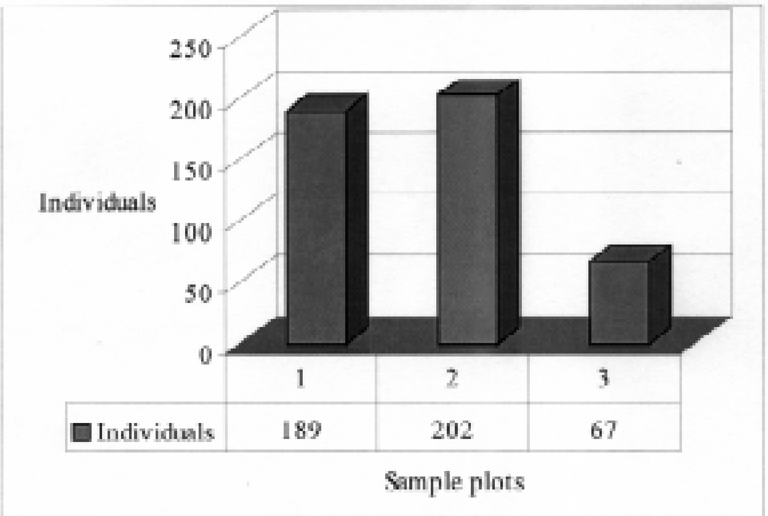
The locations along the Moursalitza Ridge could be referred to three types of habitats, according to their ecological specificities:

1) Terrains under Siberian juniper;
2) Stony and rocky terrains with over 50% of rocky outcrops;

3) Grassy stretches with shallow, stony and eroded soils.

Analysis of the number of specimens in the sample plots set in these types of habitats has shown that the populations maintained highest density on rocky terrains (Fig. 2). This, on the one hand, was due to the fact that such terrians were least accessible to anthropogenic interference, while on the other, the extreme conditions in such habitats made it possible for *Sideritis scardica* to develop under lesser competition.

Fig 2. Total number of individuals in the sample plots in Moursalitza



The number of modules per specimen and the number of generative modules respectively were taken as a criterion for good development. Differences in the development of vegetative modules between the Moursalitza plots reflected both the specificities of habitats and the degree of anthropogenic impact on them. The greatest number of modules (with greatest frequency) (Table 2) were formed by plants from the habitat dominated by *Juniperus sibirica*. The thicknes of soil substrate and the protective role of juniper bushes exercised a major influence in the case. In support of this one could compare the rocky terrain habitats, where the most frequently encountered number of vegetative modules registered four times lower values. The values of the third plot were close to those estabished in the communities of Siberian juniper.

With respect to formation of generative shoots all three plots showed considerably similar data. Concern has been aroused by the fact that in all three plots most frequently encountered were the specimens which did not form generative shoots, which testified to a poor reproduction capacity of the population in general. In our opinion this seriously threathens the seed reproduction of the popuation in the area.

The number of generative shoots depends on the vitality of specimens. Observations have shown (E v s t a t i e v a & al. 1990) that the number of vegetative and generative modules was in direct proportion to the age of the specimen, and

Table 2. Number of modules in the sample plots

Statistical data	Sample plots				
	Moursalitza			Trigrad	Dobrostan
	1	2	3		
Mean	35.65	19.89	20.61	24.56	15.80
Standard error	2.31	1.66	2.13	1.98	2.62
Median	25	13	16	18.5	10.5
Mode	16	4	14	14	2
Standard deviation	31.74	23.60	17.45	19.98	17.78
Sample variance	1007.60	557.02	304.39	399.20	315.98
Kurtosis	2.42	29.59	5.14	5.44	9.91
Skewness	1.46	4.32	2.10	2.09	2.68
Range	166	223	88	109	97
Minimum	1	1	2	2	2
Maximum	167	224	90	111	99
Sum	6737	4018	1381	2505	727
Count	189	202	67	102	46
Confidence level (95.0%)	4.56	3.27	4.26	3.92	5.28

thus specimens with more than 25–30 generative shoots were 4 to 5-year old. Probably in this case we had an ageing population. Our assumption was prompted by the limited opportunities for seed reproduction of the population, because of extensive collection of the generative shoots before the phase of seed production. The greatest number of generative shoots per specimen was registered in the plot dominated by Siberian juniper under the natural protection of *Juniperus sibirica*. In the plot in the community of Siberian juniper 18.85% of the vegetative branchings developed into reproductive organs, in the plot on rocky and stony terrain they accounted for 16.35%, while in the sample plot on eroded soil the percentage of generative shoots was 7.24.

Apparently the conditions of the habitat in the communities of Siberian juniper were most favourable for the formation of vegetative and generative shoots, as these two parameters showed the highest values (Tables 2 and 3).

3.2. A comparative evaluation of the habitats of Sideritis scardica in the Rhodopes.

At Moursalitza, Trigrad and Dobrostan the evaluation of populations was based on observtions of sample plots of equal area in the most typical habitats for the species: grassy communities on shallow, eroded soils. The specimens in the Dobrostan

Table 3. Number of generative shoots in the sample plots

Statistical data	Sample plots				
	Moursalitza			Trigrad	Dobrostan
	1	2	3		
Mean	7.56	3.25	2.38	4.46	5.86
Standard error	0.60	0.29	0.46	0.43	1.09
Median	5	2	1	3	4
Mode	0	0	1	0	4
Standard deviation	7.75	4.10	2.98	4.33	6.42
Sample variance	60.01	16.82	8.88	18.72	41.24
Kurtosis	4.61	8.24	7.65	1.05	5.45
Skewness	1.72	2.27	2.49	1.23	2.35
Range	49	29	15	18	28
Minimum	0	0	0	0	0
Maximum	49	29	15	18	28
Sum	1270	657	100	459	205
Count	168	202	42	103	35
Confidence level (95.0%)	1.18	0.57	0.93	0.85	2.21

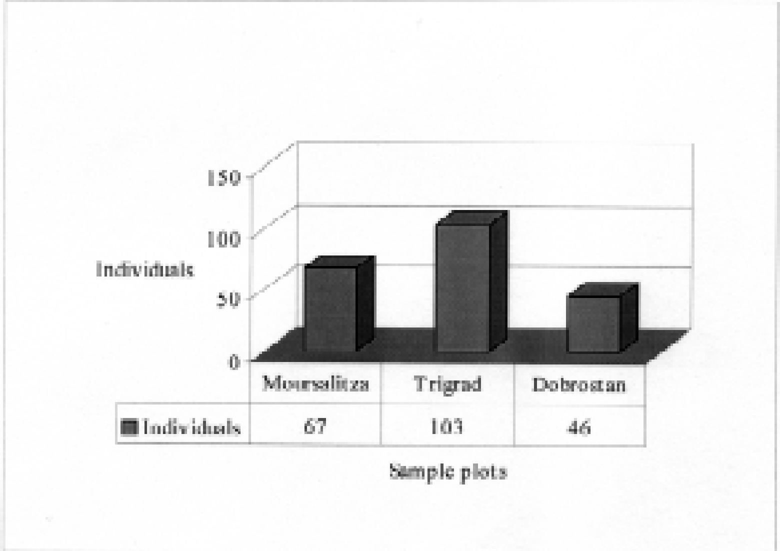
plot had the lowest density (Fig. 3), because the plants were strongest affected there by the unfavourable anthropogenic factor, as well as by the rapid climbing of the upper forest boundary, which reduced the area of habitats suitable for them.

The number of modules formed in the regions of Moursalitsa and Trigrad showed silimar values (Table 2), exceeding the numbers formed in the Dobrostan locality. Along with this, the maximum number of generative modules per specimen were registered in the region of Dobrostan and plants with 4 modules were most frequent there, which again was the highest value for that type of habitats in the Rhodopes (Table 3). In the region of Dobrostan the percentage of generative modules was highest with respect to the total number of modules: 28.20%, with 18.32% for Trigrad, and 7.24% for Moursalitza.

In all three locations it was established that over 60% the specimens form flower-bearing stalks, which testified to good natural opportunities for reproduction of the populations, as well as to the fact that *Sideritis scardica* had very suitable conditions for life in the Rhodopes.

The generative shoots of plants from the various Rhodopean localities were different in size. They were the longest in specimens from Dobrostan population (Table 4). One of the reasons for this was the circumstance that most specimens developed on the periphery of the forest, where they were subject to partial shading.

Fig 3. Individuals in sample plots in the Rhodopes



Along with this, the high rainfalls typical of Dobrostan, as compared to Moursalitza, probably had their favourable impact in that plot. Inflorescences did not show any significant differences in length in the localities of Moursalitza and Trigrad, while in Dobrostan they were smaller (Table 4). The number of clusters per inflorescence varied in the different plots, the region of Moursalitza being the most favourable for the development of inflorescences. Our observations confirmed the literary data that one cluster contained 6 flowers (seldom more), while each flower formed 4 nutlets (A s s e n o v , 1989). Along with this, the top cluster did not always reach the fruit-bearing stage. On the basis of specimens and the average number of generative shoots in the sample plots, and taking into consideration the above characteristics pertaining to the number of flowers per cluster and the number of seeds per pod, a forecast of the seed production was made within the framework of sample plots in all three localities (Table 4). The registered number of specimens in the sample plots testified that such production actually seldom realized itself into mature plants.

Table 4. Metric characteristics of the generative shoots and seed production in the three Rhodopean localities

Characteristic	Moursalitza	Trigrad	Dobrostan
Average length of generative shoot (cm)	15.59±2.24	12.40±1.46	25.46±3.45
Average length of inflorescence (cm)	4.80±0.65	4.09±1.23	2.93±0.86
Number of clusters per inflorescence	7.08±0.81	4.64±0.79	3.86±1.24
Prognosticated seed production per 400m^2 (in number of seeds)	28056	36960	14976

4. Anthropogenic impact

Proclaiming *Sideritis scardica* in 1989 a protected species has practically had no effect, because the plant is still collected on a mass scale in all areas of its distribution in Bulgaria. This is the major factor threatening it. According to local population, both in Mougla village and in the region of Trigrad town and Kesten village, some 40-50 years ago the abundance of the plant was so great, that collection of flower-bearing stalks took place by mowing. Considering the great percentage of generative shoots collected in the phase of flowering, as well as the low germination of seeds (E v s t a t i e v a & al. 1990), the reduction of generative reproduction, reflecting on the total numbers of the populations of this species is easily explained.

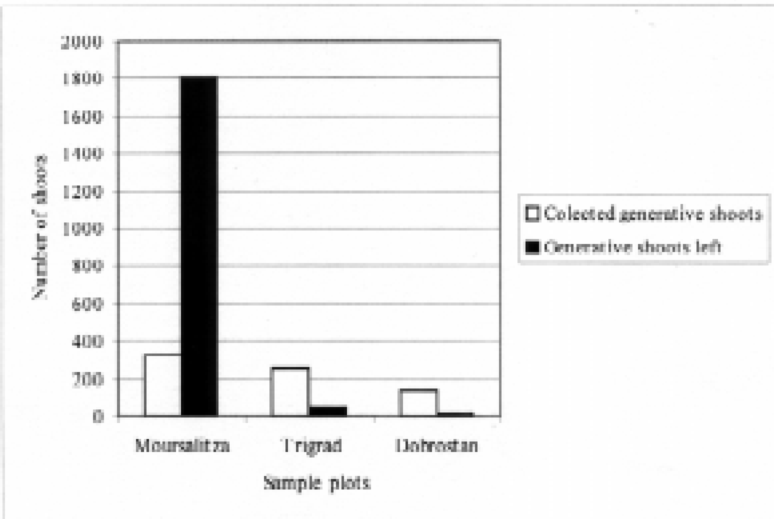
The anthropogenic impact in the localities under observation predetermines the distribution of specimens in the various types of habitats. Association of *Sideritis scardica* with bushes of *Juniperus sibirica* was observed, where the specimens of the former found shelter against trampling and collecting. Along with this, it should be pointed out that development of juniper bushes and increase of their density as a natural process in the successional development of vegetation above the upper timberline of the forest on Moursalitza Ridge would gradually push the specimens of *Sideritis scardica* out of that habitat.

According to local shepherds, when young and early in the spring the plants are also grazed by the cattle.

The indirect human impact takes expression in various economic activities practiced in the habitats of the species: grazing, plowing up of terrains, laying out of forest trails, and thus reducing the territories suitable for its habitats.

The deteriorated state of all populations however was chiefly due to uncontrolled collection of the plant for its herbal properties. In 1996 we registered the quantities of collected and left flower-bearing shoots in the different localities (Fig. 4) and the obtained results showed that only in the region of Moursalitza Ridge, where

Fig 4. Anthropogenic impact



an effective protection of the plant was organized by the Mougla Forestry Range that year, the left flower-bearing shoots made possible a successful generative reproduction.

Particular anxiety arouses the destiny of the population in the region of Dobrostan, where the destruction of the species has led to only few specimens left in the spring of 1999.

If this trend prevails, in a matter of several decades the populations of *Sideritis scardica* in the Rhodopes will reach critically low values for their survival.

Safekeeping this species for the Bulgarian flora is now partially ensured by its habitats within the boundaries of the Alibotoush Natural Reserve on Mt Slavyanka and in the protected Trigradsko Zhdrelo locality.

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