

Bio-systematic study on the endemic *Silene oreosinaica* Chowdhuri from Sinai, Egypt

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Abstract

Silene oreosinaica is a rare, endemic plant species in Saint Catherine protectorate. It was collected for first time by Schimper in July 1835, and then it was collected in 1982 and 1983. Since this date, it could not be found and therefore there was no sufficient data about it. This paper aims to confirm the presence of *Silene oreosinaica* and gives sufficient data about its distribution, morphological description based on field observation, anatomical characteristics of stem and leaf, pollen grains and seed micromorphology.

Keywords: Anatomy, endemic, pollen grain, taxonomy, seed micromorphology, *Silene oreosinaica*.

Introduction

Silene L. is a large genus of a world-wide distribution, family "Caryophyllaceae" where it belongs to Subtribe Silenoideae. The annotation, description, typification, content and distribution of 44 sections of *Silene* that were proposed by Chowdhuri 1957 The genus includes about 700 species (Boshra and Farhad , 2014) and it has a great morphological variation (Abdel Bari, 1973). It is mainly distributed in north temperate regions especially around the Mediterranean and west Asia, but also it could be found in the tropical regions and South Africa (Abdul Ghafoor, 1978). However, the Mediterranean region hosts

the majority of the *Silene* species (Oxelmann et al., 1997).

The genus *Silene* L. is represented in Egypt by 29 species, 13 varieties and subspecies (Boluos, 2009); it is distributed all over Egypt especially in Sinai which includes 19 species. Saint Catherine protectorate as a part of Sinai includes 7 species (about 25% of Egyptian *Silene* spp.) namely *S. arabica* Boiss., *S. leucophylla* Boiss., *S. linearis* Decne., *S. odontopetala* Fenzl, subsp. *congesta* Boiss., *S. oreosinaica* Chowdhuri, *S. schimperiana* Boiss., and *S. villosa* Forssk., among of them, there are three endemic species which are *S. schimperiana*, *S. leucophylla* and *S. oreosinaica* according to Boluos (2009).

Silene oreosinaica is one of very rare, endangered, endemic species (Radford, 2011). It was collected for first time by Schimper in 1835 and then it was recollected in August 1982 from Wadi Feiran and Gabel Catherine of South Sinai. Cairo University staff collected the last sample in October 1983 from Gabel Catherine; Ein Shinar. Although several excursions had been undertaken to South Sinai, no sample of *S. oreosinaica* was collected since 1983.

According to Zahran et al (2015), *S. oreosinaica* had never been traced as a living sample. Therefore, the aims of the present study were to (1) determine the presence of this endemic taxon, *S. oreosinaica*, from Saint Catherine protected area in Sinai Peninsula and (2) characterize and document the data about its ecological distribution, seed morphology, anatomy and palynology of this species.

Materials and Methods

Thirty two sites were surveyed at Saint Catherine Protectorate addressing the distribution of *Silene* species. The endemic species *S. oreosinaica* was recorded in two sites only. The terminology used for morphological attributes follows Stearn (1973).

2-1 For anatomy

A segment of the middle third of a fresh leaf and the third internode were fixed in FAA (formalin: acetic acid: 70% ethanol [1:1:18, v/v]) for 48 hr. Dehydration is carried out by using a graded ethanol series (70%, 80%, 90%, 99.9%). Staining was carried out with safranin-fast green dyes for 24 hour and mounted with Canada balsam (Sass, 1961) in order to get permanent slide. The well-staining sections were photographed on camera were achieved using XSZ-N107 Research Microscope fitted with Premiere MA88-900 digital camera.

2-2 Epidermal Characters

The epidermal impressions were made with nail polish method. The two sides of the

leaf samples were painted with clear nail polish respectively. After the nail polish had dried thoroughly, a square of very clear strip was selected and was gently peeled from the leaf completely and attached to a clear plastic package tape piece, and then a leaf impression was made. The leaf impressions were taped to a clean glass slide respectively for observation under microscope. (Wei et al, 2006)

2-3 Seeds and pollen grains micromorphology

Seeds and pollen grains specimen were collected and coated with gold in a sputter coater. The photographic film was attached to a SEM-holder by means of double sided cello-tape examined and then it was photographed with Jeol JSM-6510 LV in the scanning electron microscope unit of Mansoura University, Egypt. The distribution map was drawn using ArcGIS 10.2.

Results and discussion

3-1 Systematic treatment

Silene oreosinaica Chowdhuri, Notes Roy. Bot. Gard. 22: 269 (1957); Hosny et al, Taecholomia, 14:15 (1992); Bolous, Flora of Egypt, 1:62 (1999); El-Hadidy, Flora aegyptiaca. 1: part 2, 131 (2000); Bolous, Flora of Egypt checklist 36 (2009).

Type: Sinai, in Rupium fissuris montis St. Catharinae; Schimper 352 (1835); (K, holotype).

3-2 Morphological characters

S. oreosinaica is a perennial species. It has a woody structure at the base. Stem is few, hairy, cylindrical, usually between 1 to 6 reach to 25 cm in height. Basal leaf is entire, symmetrical, lanceolate, acute and sessile. Basal leaves are arranged in rosette shape, ranged between 0.4- 4.5 cm X 0.1 - 0.9 cm. The total number of leaves up to 80. While cauline leaf is opposite decussate, acute, entire, symmetrical, sessile, lanceolate and smaller than basal leaf. Inflorescence has raceme flowers with 6 pedicel flowers per inflorescence. Pedicel length is about 0.5 cm, and bract length is

about 0.4 cm. Calyx is tubular, 0.8 -1.2 mm long, hairy, nerved, 10 yellow nerves” Calyx face facing sun nerved by violet color field observation”. Petal has five white with pale rose edges and it has a divided lamina. Fruit capsule is formed in July and August (As shown in Fig.1A, B, C and D)

Flowering may occur during spring months usually in March and April; it is rarely happened in December and January.



Fig 1. *Silene oreosinaica*, A and B: vegetative plant, C and D: inflorescence, E and F: Effect of drought.

3-3 Anatomical characters

3-3-1 Stem

The transverse section of the stem revealed the following that it's circular, solid stem, consisting of outer simple rectangular-oval epidermis with few stomata. Cortex formed of two layers outer spongy parenchyma and inner layer of sclerenchyma. 8 vascular bundles and paranchematic pith are present. 6-8 druses are present in outer cortex and absent in pith. (As shown in Fig.2 A).

3-3-2 Leaf anatomy and epidermal characters

The transverse section of the lamina, mid-rib and epidermal finger print revealed the following elements. Dorsi-ventral leaf with polygenal to irregular epidermis cells

varied in diameters between with normal and thick walls, striated cuticle.

Anisocytic stomata, druses are present in upper and lower epidermis. Druses present in both palisade and spongy tissue ranged in number between 40-60 / section, 6thick walled parenchyma patches present in scattered form in side mesophyll. Mid-rib is semi rounded - Crescent shaped. (As shown in Fig. 2B and C).

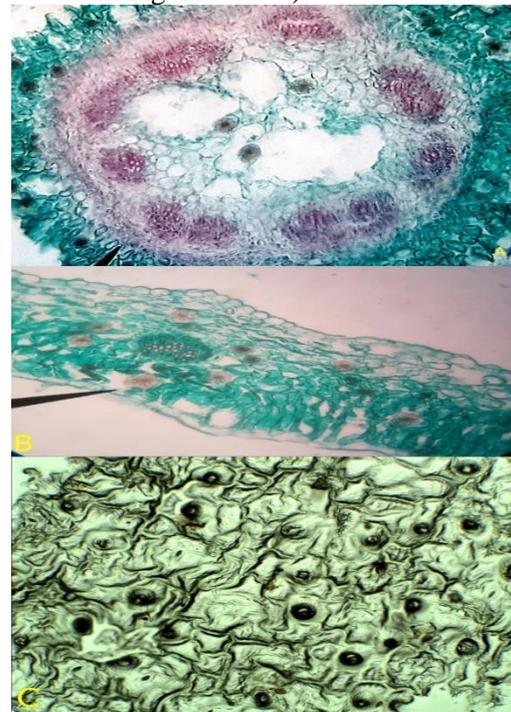


Fig.2: A) *Silene oreosinaica* stem C.S., B) leaf C.S and C) surface view of epidermal cells and stomata.

3-4 Pollen grain morphology

Pollen grains are monad, spheroid with average diameter 32.56 to 31.86 μm , polyporate with 18 to 22 pores each pore has unequal diameter ranged from 4.884 μm to 4.522 μm . Pores are covered with opercula, and pore membrane has papillae form including 8 to 10 papillae. The average distance between pores is 6.33 μm . Exine sculpture has a micro-papillae pattern (As shown in Fig 3-A)

3-5- Seed morphology

Seeds are reniform with excavate at hilum. It is reddish-brown in color, with average diameter 503.81 μm to 864.94 μm . the lateral surface of seed is concave with 4 rows of cone shaped papillae their length varied between 107.38 μm and 127.03 μm

and the base of papillae is ranging from 50 to-75 μm . Anterior testa cells are granulated and has, elongated polygonal cells. Dorsal seed face has 2 rows of appendages (small papillae, As shown in Fig. 3B).

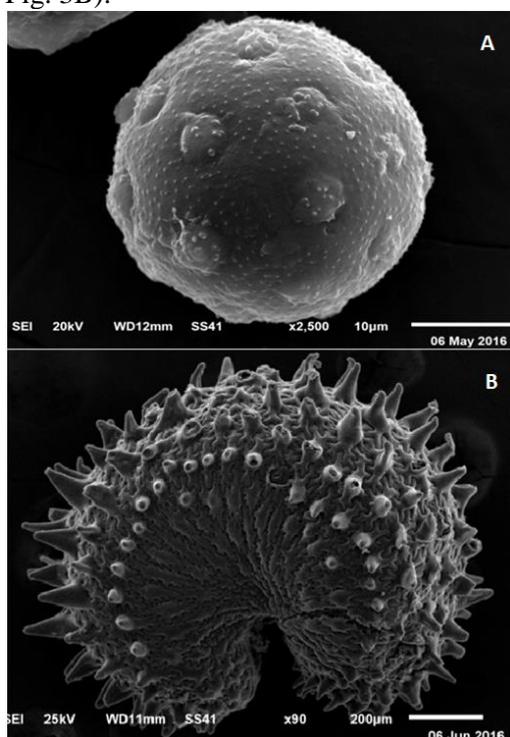


Fig 3: Micromorphology of pollen (A) and seeds (B) of *S. oreosinaica* using scanning electron microscope

3-6 *S. oreosinaica* survey

Thirty two sites were surveyed in the present study; *S. oreosinaica* was recorded only in two sites namely as Gabel Catherine and Shq Mousa. The total numbers of individuals observed were Sixty-three which were divided into eleven small populations (As shown in table 1), they were distributed along 0.232801 km^2 (As shown in Fig. 5).

Herbarium voucher specimens and clean mature seeds are kept at the Department of Botany, Faculty of Science, Damietta University, Egypt, and in Saint Catherine protectorate herbarium.



Accepted name	<i>Sileneoreosinaica</i> Chowdhui
Vernacular name	-----
Family	Caryophyllaceae
Habitat	Slope
Locality	Shaq (shag)musa (Musa Gorges) Saint Catherine protectorate ,South Sinai ,Egypt .
GPS reading	N:- 28.51978 E:- 33.95716 Alt: 2239 m
Collected by	Ibrahim El Gamal .
Date	22-12-2015
Identified by	Ibrahim El Gamal
Det. by	Sami Rabei
Notes	Endemic to Saint Catherine protectorate Saint Catherine protectorate,rare

Fig 4: *Silene oreosinaica* herbarium specimen

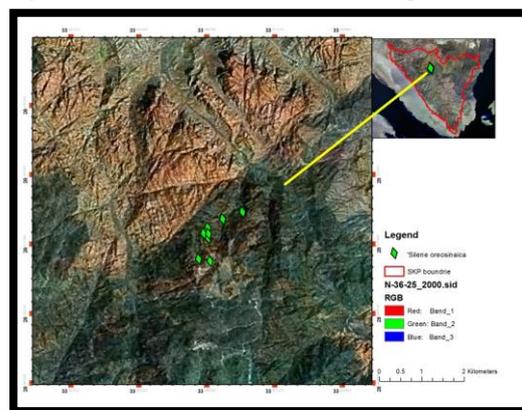


Fig. 5:-Distribution map of *Silene oreosinaica* in South Sinai, Egypt

Table 1: The GPS coordinates of 11 studied population. (Lat = latitude, long = longitude, Alt= altitudes, a.s.l =above sea level)

Lat.	Long	Alt. m. (a.s.l.)
28.52444	33.96441	2116
28.52299	33.96013	2055
28.52018	33.95652	2293
28.51986	33.95615	2310
28.52108	33.95704	2283
28.51393	33.95749	2088
28.51441	33.95510	2114
28.51441	33.95510	2131
28.51882	33.95710	2336
28.51978	33.95716	2239
28.52294	33.96024	2065

3-7 Representative specimens

Sinai, wadi Feiran, 21.8.1982; El Hadidi et al. s. n. (CAI) - Sinai, Gebel Catherine, 20.8.1982; A. Hosny s.n. (CAI) - Sinai, Gebel Catherine, Ein Shinar, 9.10.1983; A. Hosny s.n. (CAI). - Sinai, Shaq Mousa, Saint Catherine protectorate, 22.12. 2015; El Gamal. I s.n.- ibid. 7.1.2016- 22.5-2016.

3-8 Distribution

Silene oreosinaica is endemic to Saint Catherine Protectorate, South Sinai, Egypt. It was recorded only in two sites; Gabel Catherine and Shq Mousa. It is observed in rocky crevices that formed microhabitat slopes (slope in north aspect) as scattered pattern, solitary or it can be found in a small population ranged between 2 to 5 individuals in rocky bed of mountains at altitude ranged between 2055 - 2336m a.s.l.

3-9 Associated species

The studied species grows alone or in association with *Scrophularia libanotica* Boiss., and *Tanacetum sinaicum* (Fresen.) Delile ex Bremer and Humphries.

3-10 Threats

Environmental conditions and human impacts have a significant influence on diversity and distribution of the threatened endemic and medicinal plants (Abd El-Wahab et al., 2004). The threat of genetic erosion of *S. oreosinaica* is a result of abiotic effect such as scarcity of water, or biotic one like diseases that attacked plants (As shown in Fig .1-E and F) or the effect of grazing by domestic and wild animal. Therefore that could lead to the extinction of the endemic species from Egypt.

3-11 Actions and Policies for sustainable of *S. oreosinaica* in Egypt

The recommendation of the present study is to start a research program for collections of seeds, characterization, evaluations and multiplications of *S. oreosinaica* genetic resources in Saint Catherine protectorate and rehabilitation of this plant in its natural habitats.

Moreover, Bedouins should be aware of the ecological importance of this endemic species via conferences and awareness sessions that would help in the protection and the rescue of the present *S. oreosinaica*.

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الملخص العربي

عنوان البحث: دراسة تصنيفية على نبات السيلين الأوروسينيكا المتوطن . سيناء . جمهورية مصر العربية.

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الملخص العربي

السيلين أورسينيكا أحد الأنواع النباتية النادرة والمتوطنة بمحمية سانت كاترين. تم رصده لأول مرة بواسطة العالم شيمبر عام ١٨٣٥ ثم أعيد رصده عامي ١٩٨٢ و ١٩٨٣ ومنذ ذلك التاريخ لم يتمكن الباحثون من رصده. ويهدف البحث إلى تأكيد وجود السيلين أورسينيكا بالإضافة إلى توثيق كافي لكل من الصفات المظهرية للنبات اعتماداً على المشاهدات الحقلية، الصفات التشريحية لكل من الورقة والساق بالإضافة إلى الخصائص المورفولوجية لكل من حبوب اللقاح والبذور.