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# Rocks supporting endemic plant species in East Mediterranean deserts

**Abstract**

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East Mediterranean deserts of Israel, Jordan, and Sinai have a few endemic species which firmly occur on specific rocks. The extent of these rocks and the size of their outcrops have a profound impact on the distribution of certain narrow endemics. The aim of the present article is to deal with examples of distribution of a few endemic plants as related to their specific rock types.

*Key words*: Endemism, Ecology, Desert Flora.

## Introduction

East Mediterranean deserts of Israel, Jordan, and Sinai have a few endemic species which firmly occur on specific rocks (Shmida 1984). The extent of these rocks and the size of their outcrops have a profound impact on the distribution of certain narrow endemics. Of the many rock types which occur in the study area three chemically rare rock types are selected – Triasic gypsum in the Ramon depression, Negev Highlands, Tertiary sandstone, and Senonian silicified chalk found in the Judean Desert between Jerusalem and the Dead Sea valley. The fourth rock type are smooth-faced limestone and dolomite and smooth-faced hard sandstone. Much of the rocks smoothness is caused by the protection from weathering of epilithic lichens developing on north-facing limestone, dolomite, and sandstone. The aim of the present article is to deal with examples of distribution of a few endemic plant related to the various rock types.

## *Capparis ramonensis* on Triasic gypsum

*Capparis ramonensis* Danin is an endemic (Danin 2011) species found only on outcrops of Triasic gypsum in the Negev Highlands, Makhtesh Ramon (in Fig.1: No. 1; for color images of all plants mentioned here see: http://www.flora.org.il). The most common rock types surrounding the gypsum outcrop are limestone of various eras. The geologists consider the palaeo-environment forming these gypsum sediments a “product” of a palaeo-

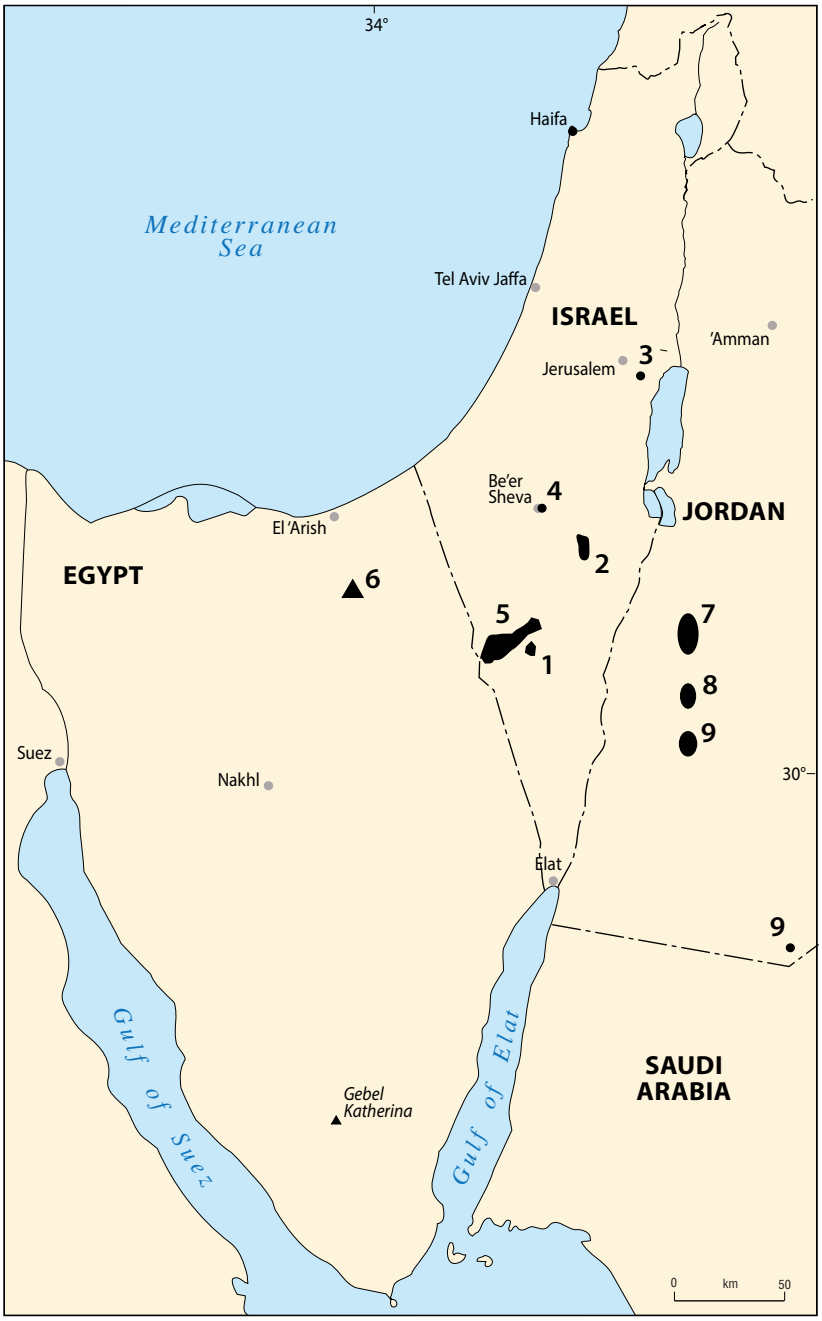


Fig. 1. Distribution map of a few endemic species in Israel, Jordan and Sinai. 1.*Capparis ramonensis,* 2.*Hormuzakia negevensis*, 3. *Satureja thybrifolia*, 4. *Origanum dayi,* 5. *O. ramonensis*, 6. *O. isthmicum*, 7. *O. punonense,* 8. *O. petraeum*, 9. *O. jordanicum.*

lagoon of the Triasic era at the margins of the Tethys Ocean. The rock is exposed only in the erosion crater of Makhtesh Ramon in an area of 3.35 km$^2$. The thickness of the gypsum layers is several hundred meters.

The mean annual rainfall in this area is 70 mm. Such gypsum rock outcrops are unique and do not occur anywhere else in the entire area of the East Mediterranean deserts. Until found in additional locations *Capparis ramonensis* should be considered as a narrow endemic with less than 200 specimens.

A few psammophytic species of the extreme desert accompany *Capparis ramonensis*. These are *Hammada salicornica* (Moq.) Iljin and *Salsola cyclophylla* Baker (=*Caroxylon cyclophyllum* (Baker) Akhani & Roalson). The association in which this caper grows is not defined yet phytosociologically, but it is evident that it belongs to the vegetation class *Anabasietea articulatae* (Danin & Orshan 1999).

### *Hormuzakia negevensis* on Neogene sandstone

The Yamin-Rotem syncline of the Negev Highlands is filled up with terrestrial sandstone and claystone deposited there some 3 to 20 million years ago during the Neogene. The Tertiary rocks passed a long period of weathering leading to reworking of sands through short distance transportation in that valley. *Hormuzakia negevensis* (Danin) Danin & Hilger (= *Anchusa negevensis* Danin) is a perennial herbaceous plant and observed so far only at the "locus classicus". It grows in a minute population with less than 20 individuals. It is one of the group of psammophytic *Boraginaceae* which have the property of vegetative reproducing by producing roots-derived shoots (Danin 1996). The other plants in that group, which are not endemics are *Echiochilon fruticosum* Desf., and *Moltkiopsis ciliata* (Forssk.) I. M. Johnst. The latter accompany *H. negevensis* in the Negev. Of the most important environmental factors associated with the occurrence of this narrow endemic is its constant exposure to wind erosion being a SW facing gentle slope. The particular type of Neogene sandstone occurs in Israel only in the Rotem – Yamin plane (Fig. 1: No. 2), and Yerokham – Dimona plane.

### *Satureja thymbrifolia* on Hatrurim Formation

*Satureja thymbrifolia* Hedge & Feinbrun is endemic to a small area of ca. 45 km$^2$ around Biqa'at Horkania in the northern Judean Desert (between Jerusalem and the Dead Sea, Fig.1: 3). It is confined within this area to outcrops of a rare rock type known as Hatrurim Formation. It is a silicified chalk and marl and regarded as a result of natural heat metamorphosis (pyrometamorphic rocks). More than 130 rare minerals (Gross 1977) are listed from the Hatrurim Formation and discussed by Sokol & al. 2008. In Jebel Harmun (12 km SW of Jericho; Fig. 1: No. 3), the northernmost location of the endemic *Satureja thymbrifolia* Hedge & Feinbrun, it grows only on the upper half of the mountain; below it the rock is a soft chalk and marl populated by *Suaedetum asphalticae* (Fig. 2). There is a rather sharp borderline between the two rocks formations. I hope future researchers will investigate the chemical composition of *S. thymbrifolia* and its relationship with the unique

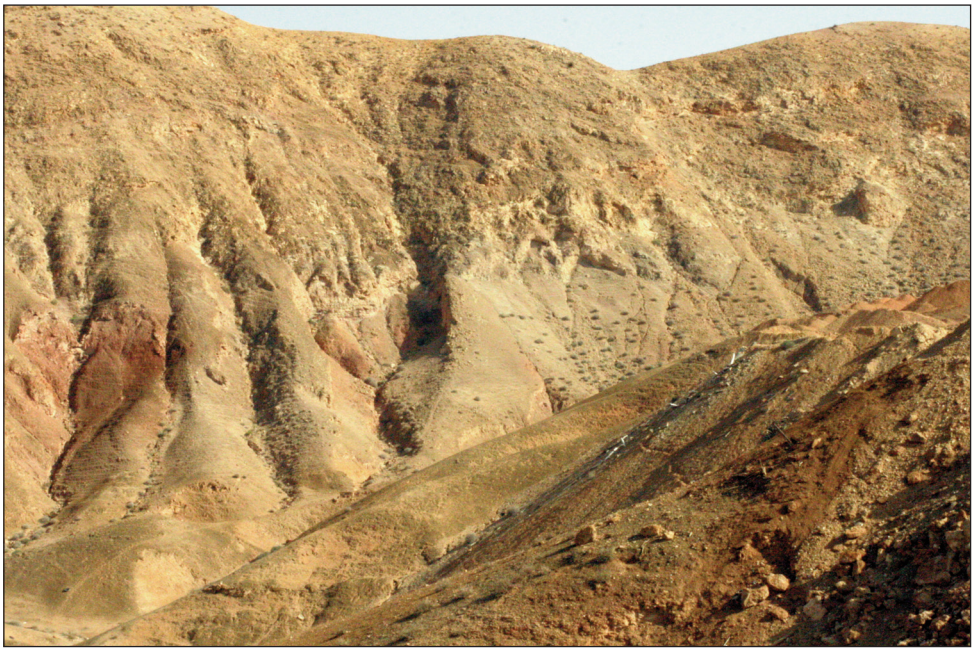

Fig. 2. Jebel Harmun in the Judean Desert with *Suaedetum asphalticae* on the soft chalk and marl (with prominent dark *Suaeda* shrubs) and the harder overlying rock populated with *Saturejo thymbrifoliae – Salsoletum vermiculatae*.

rock type. The phytosociological position of the association where *S. thymbrifolia* grows is the *Saturejo thymbrifoliae – Salsoletum vermiculatae* (Danin & Orshan 1999: p. 125).

### *Origanum* species on smooth-faced hard calcareous rocks and sandstones

Limestone and dolomite rock outcrops support three endemic species of *Origanum* from the section *Campanulatocalyx*. *O. dayi* Post grows in crevices of limestone and dolomite outcrops and adjacent wadis in the Negev Highland and southern Judean Desert (Fig. 1: No. 4), elevation 300 m below sea level to 600 m above sea level. In higher elevation (900 to 1200 m a.s.l.) *O. ramonense* Danin (Fig. 1: No. 5) occupies the same habitat. *O. isthmicum* Danin (Fig. 1: No. 6) grows in the same habitat in a small area of Gebel Halal, Northern Isthmic Desert, and Sinai. Additional species of *Origanum* from the same section grow in SW Jordan on outcrops of hard sandstone. These are *O. punonense* Danin, *O. petraeum* Danin and *O. jordanicum* Danin & Kuenne (Fig. 1: No. 7, 8, 9 accordoingly). All the above listed six species of *Origanum* are accompanied by plant communities from the vegetation order *Artemisio sieberi – Chiliadentalia iphionoidis* (Danin & Orshan 1999). They develop in crevices and soil pockets enjoying enrichment of their moisture regime by run-off water from the exposed rocks. These plants enjoy in fact moisture regime of less arid areas. This fact

may be clearer by listing several companions sharing their habitat; such are: *Juniperus phoenicea* L.*, Lonicera etrusca* Santi*, Sarcopoterium spinosum* (L.) Spach*, Narcissus tazetta* L.*,* and *Sternbergia clusiana* (Ker Gawl.) Spreng. Smooth-faced rock outcrops function in the deserts a Mediterranean refuge to plants which arrived to their isolated locations in a period when the extent of the Mediterranean zone was much southern than it is today (Danin 1999a, 1999b). Genomic investigations may enable us to follow the path of speciation in *Origanum* section *Campanulatocalyx*.

One may lump the 6 species mentioned above into two groups following flower morphology and scent of crushed green leaves. The 4 species having exerting corolla 3-4 times longer than calyx are *Origanum dayi, O. ramonense, O. punonense,* and *O. petraeum*. Their stamens are two times longer than corolla, thus exerting. These species have similar scent and differ easily from the other 2 species *O. isthmicum* and *O. jordanicum* which have the scent of "za'atar" (in Arabic) due to high content of thymol and carvacrol. *O. isthmicum* and *O. jordanicum* have corolla as long as calyx.

The distribution map of the 6 species (Fig. 1 number 4-9) looks like a map of "islands" of moist Mediterranean microhabitat in the "ocean" of deserts. Additional narrow endemic species belonging to other genera are described recently from the rocks of Edom (SW Jordan); such are *Pycnocycla saxsatilis* Danin, Hedge & Lamond (*Apiaceae*), *Silene danaensis Danin* (*Caryophyllaceae*), *Micromeria danaensis* Danin and *Satureja nabateorum* Danin & Hedge (*Lamiaceae*). There are many more taxa belonging to that group.

## Conclusions

There are two groups of endemic plant species in the East Mediterranean deserts; the large group is of relicts inhabiting smooth-faced limestone, dolomite, and sandstone. They are assumed to have been derived from a Mediterranean flora which penetrated the area in the past. When the climate became drier, Mediterranean taxa survived in soil crevices where due to run-off the microclimate continues to be Mediterranean. The other group is of species which are confined to rocks of rather local occurrence. Such are gypsum rocks, silicified chalk and marl, and tertiary soft sandstone under deflation.

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