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AVINOAM DANIN & IAN C. HEDGE

Contributions to the flora of Jordan 2. A new species of *Satureja (Labiatae)* and some new records

Abstract

Danin, A. & Hedge, I. C.: Contributions to the flora of Jordan 2. A new species of *Satureja (Labiatae)* and some new records. – Willdenowia 28: 135-142. 1998. – ISSN 0511-9618.

Satureja nabateorum is described as a species new to science and illustrated. It is confined to crevices of smooth-faced sandstone in SW Jordan (Edom) and closely related to *S. thymbrifolia*, a species restricted to the Judean Desert and belonging to *S.* sect. *Zatarioideae*. The different ecology of both species is discussed and their distribution mapped. Ten new records of interesting plants from Edom include the southernmost record of *Arbutus andrachne* from the Petra area. In this context also the new combination *Bituminaria bituminosa* var. *brachycarpa* is made.

Satureja (sect. *Zatarioideae* Boiss.) ***nabateorum*** Danin & Hedge, **sp. nova** – Fig. 1.
Holotypus: Jordan, Edom, 10 km E of Risha to Jabal Masonda, in crevices of smooth-faced white sandstone (Disi Formation), 650 m, 19.5.1997, *Danin 970201* (HUJ; isotypi: B, E, K)

Affinis *S. thymbrifoliae* sed caulibus intricatis (non erectis), inferne magis lignosis; calycibus aliquanto bilabiatis, dentibus acicularibus (non triangularibus); bracteolis ellipticis mucronatis basi superne glabris (non oblongo-ovatis acutis omnino pilosis); corolla calyce duplo (non triplo) longiore, tubo angustato; foliis hiemalibus ad 5-7 × 0.8-1.5 mm (nec ad 22 × 3.5 mm); inflorescentiis laxis (non congestis) recedit.

Suffrutex pilis albis eglandulosis retrorsis vel arcte recurvatis et glandulis sessilibus obsitus, valde aromaticus ("za'atar", i.e. thymol-carvacrol similis). *Caules* lignosi, 20-40(-60) cm alti, ramosissimi, intricati. *Folia* sessilia, anguste oblonga, margine aliquantum revoluta; hiemalia 5-7 × 0.8-1.5 mm, internodiis 7-12 mm; aestivalia 2-3 × 0.8-1 mm, internodiis < 0.2 mm. *Inflorescentia* 5-10(-15) cm longa, aperta; verticillastri 6-10-flori. *Bracteolae* minutae, numerosae, ovatae, mucronatae, calyce breviores, dense puberulae, basi supra glabrae. *Pedicelli* nulli. *Calyx* (3-)3.5-4 mm longus, tubulosus, 5-nervius, dense albo-pilosus et glandulis sessilibus copiose obsitus, in dentes quinque subaequales c. 1 mm longos aciculares divisus faux, dense barbata; tubus intus glaber. *Corolla* albida, extus albo-pilosa et glandulis sessilibus obsita, 6 mm longa, tubo 4-5 mm, exserto, angulato, labio superiore retuse dilatato, inferiore trilobato. *Stamina* quatuor, omnia fertilia, exserta; antherae lilacinae. *Stylus* exsertus, stigma bifidum. *Nuculae* laeves plus minusve ovoideae. Fl.: Maio-October.

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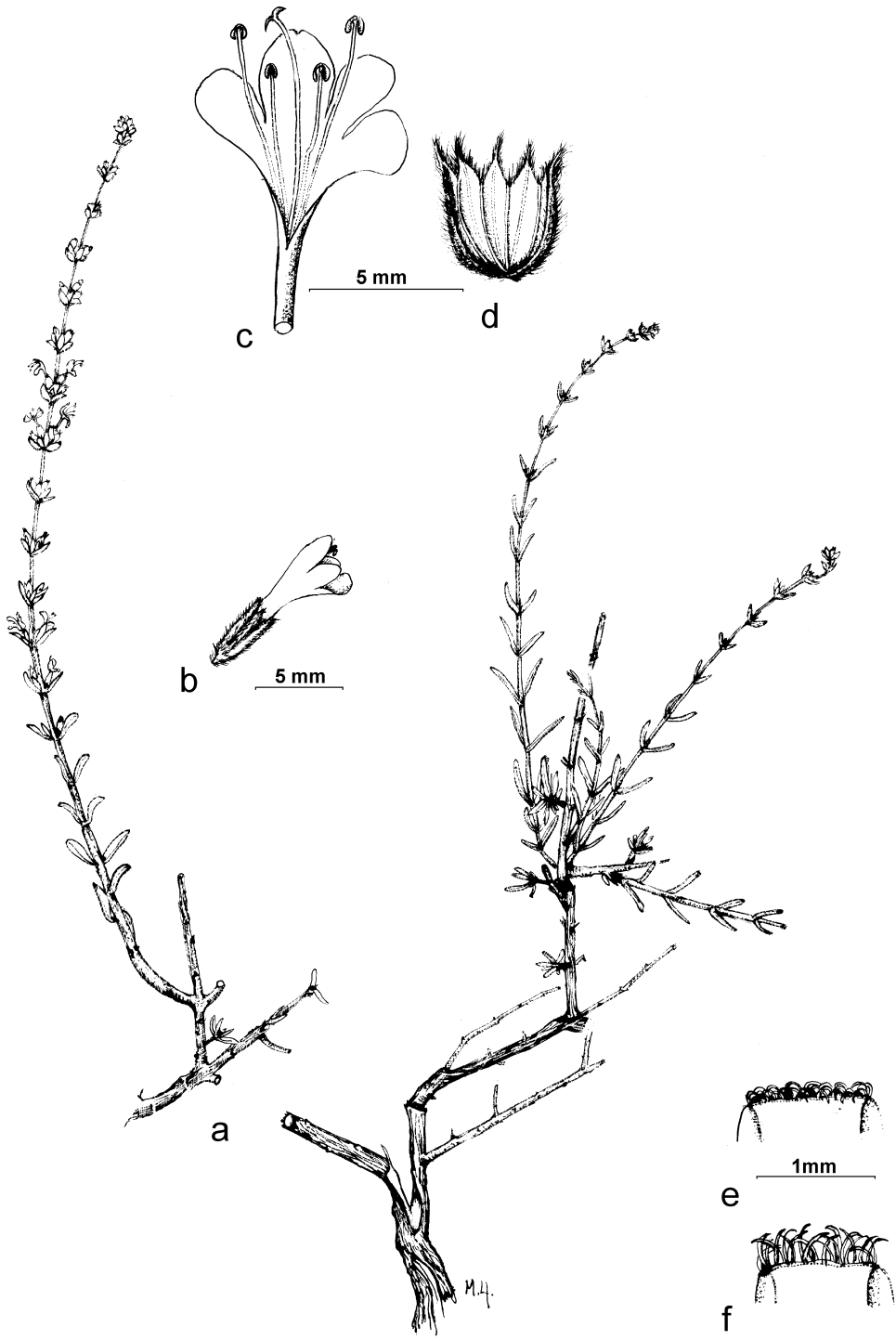


Fig. 1. *Satureja nabateorum* – a: flowering branches, b: flower, c: opened corolla, d: calyx, e-f: leaf sections showing upper leaf surface indumentum (e), compared to that of *S. thymbrifolia* (f). – Drawing by Michal Boaz.

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Chamaephyte 20-40(-60) cm, base lignified, many-stemmed, leaves and stems densely covered with white, retrorse, eglandular hairs and transparent, sessile glands, becoming reddish when ageing (in the herbarium), strongly aromatic (scent of "za'atar", i.e. thymol-carvacrol). *Stems* lignified, intricately branched. *Leaves* sessile, narrowly oblong, margin somewhat revolute; winter leaves 5-7 × 0.8-1.5 mm, internodes 7-12 mm; summer leaves 2-3 × 0.8-1 mm, internodes < 0.2 mm. *Inflorescence* 5-10(-15) cm long, lax; verticillasters 6-10-flowered. *Bracteoles* small, numerous, ovate, mucronate, shorter than calyx, densely puberulous, upper surface glabrous at base. *Pedicel* absent. *Calyx* (3-)3.5-4 mm long, tubular, 5-veined, densely white-hairy and with sessile glandular hairs; teeth nearly equal, about 1 mm, acicular, outer surface densely hairy; tube glabrous inside. *Corolla* 6 mm, white, white-hairy and with sessile glands; tube 4-5 mm, exserted, angular, upper lip retuse, lower lip with three lobes. *Stamens* four, all fertile, exserted, anthers lilac. *Style* exserted, stigma bi-lobed. *Nutlet* smooth, almost ovoid. Fl.: May-October.

Additional specimens seen (all in HUJ)
JORDAN: Edom: 2 km SW of Taiyiba, 27.9.1994, *Künne 94-123-07*; 15 km S of Ram, in crevices of smooth-faced white sandstone, 20.5.1997, *Danin 970301*; 5 km S of the top of Ras en Naqb, white sandstone (Disi formation), in crevices, 25.5.1997, *Danin 970602*; 20 km S of Ram, Jabal Um Adammi, white sandstone (Disi formation), in crevices, 25.5.1997, *Danin 970701*; El Hesma, 22 km N of Queira, Nubian sandstone, 30.3.1936, *Eig, Zohary & Feinbrun* (det. by Hedge & Feinbrun in 1968 as *S. thymbrifolia*).

Relationships
When *Satureja thymbrifolia* was described in 1968, a rather incomplete specimen from Edom (collected by Eig, Zohary & Feinbrun 1936) was cited among the exsiccata seen. Subsequent field observations and collections by the first author have clearly shown that the Edom plants differ in a number of taxonomically important characters and merit specific rank. The species was first observed on rocks near one of the ancient paths of the Nabataean Kingdom centered in Petra.

The problems of generic delimitation of *Satureja* are seemingly almost intractable. Different authors often take radically differing views, ranging from the all-embracing concept of *Satureja* adopted by Greuter & al. (1986) to the much narrower concept supported by Cantino & al. (1992). Our new species is clearly related to *S. thymbrifolia* and, less so, to *S. bachtiarica* Bunge, which is restricted to S and W Iran. Until there is a consensus of opinion on generic limits, our new species is consequently best placed in the rather anomalous *S.* sect. *Zatarioideae.*

In order to quantify the inflorescence density, which is the most prominent diagnostic character differentiating the two *Satureja* species, the following procedure was operated. The length of the five lowest internodes was measured for 10 inflorescences of 10 plants for each of the two species. Mean internode length and the standard deviation were calculated. The sample mean for *S. thymbrifolia* was 5.12 ± 0.61 mm, whereas that of *S. nabateorum* was 10.51 ± 1.05 mm. Using t-test we found $t_{18} = 14.10$ ($p<0.001$). In conclusion, the mean length of the five lowest internodes in *S. nabateorum* is significantly larger. The upper internodes of the inflorescence of *S. thymbrifolia* are even shorter, and as a result, the inflorescence looks like a congested spike, whereas the whorls in *S. nabateorum* always look separated and distinct.

Ecology and distribution
The two desert species *Satureja thymbrifolia* and *S. nabateorum* inhabit two completely different habitats. The habitat of *S. thymbrifolia* was discussed in detail by Danin (1968). The species is confined to outcrops of an endemic rock sequence of variegated silicified limestone, currently known as Hatrurim formation of the upper Senonian and the lower Palaeogene (Bartov & al. 1981). *S. thymbrifolia* (Fig. 2) has such a strong affinity to the Hatrurim formation that so far not a single plant has been observed growing on another rock type. In addition to the collections, many field observations proved that its flowering season lasts from April to October.

S. nabateorum (Fig. 2) is confined to joints and crevices in outcrops of the Palaeozoic Disi and Umm 'Ishrin sandstone formations (Powell 1989). Most plants were growing in joints of the

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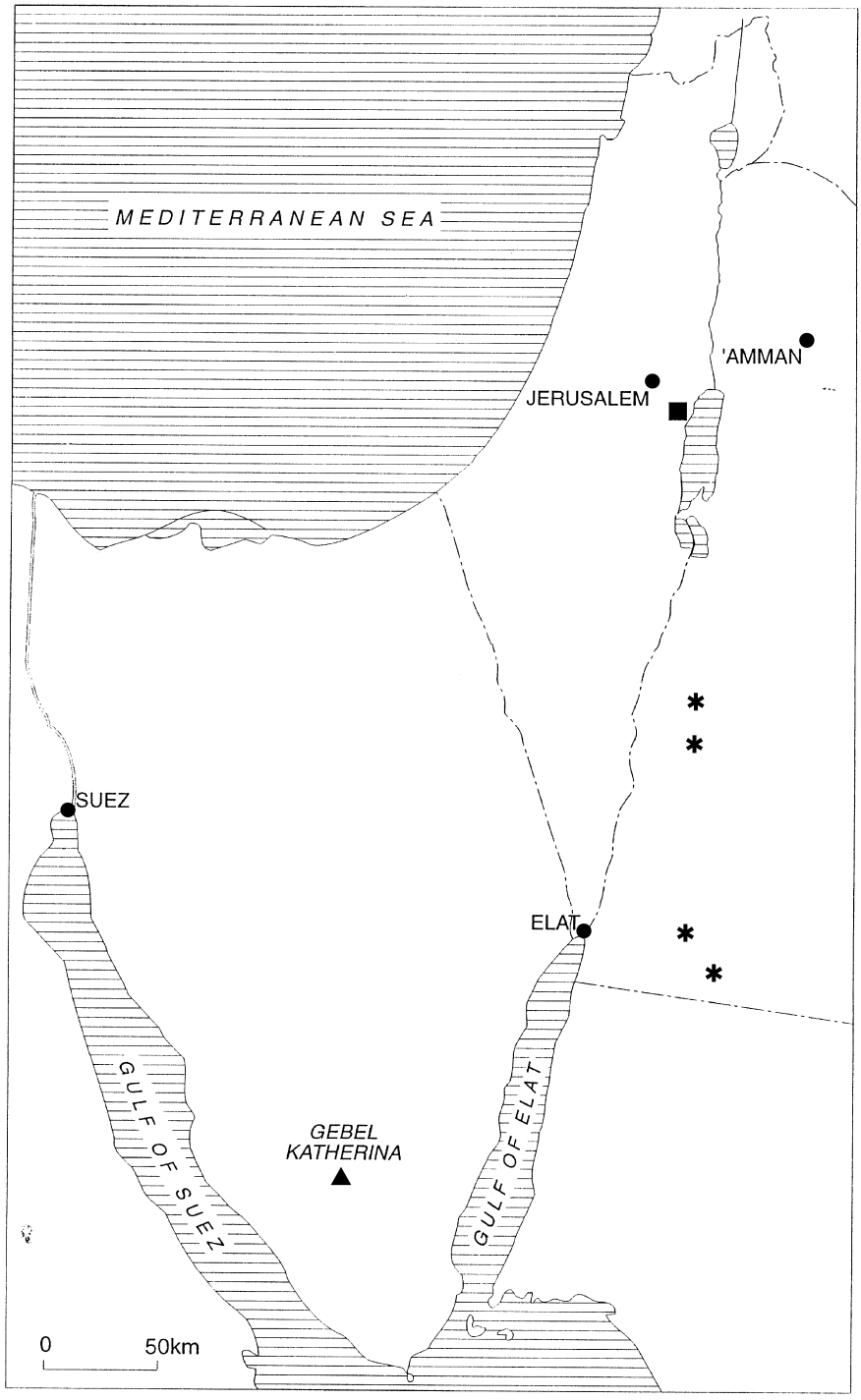


Fig. 2. Distribution of *Satureja* sect. *Zatarioideae* in Israel and Jordan – *S. thymbrifolia* ■, *S. nabateorum* ✱.

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Disi sandstone at the two northern sites or in bedding plains of Umm 'Ishrin sandstone at the two southern sites.

Ecologically the substrates of *S. thymbrifolia* and *S. nabateorum* differ clearly from each other and neighbouring substrate types. The Hatrurim formation, of silicified limestone, contains bulks of hard rocks mixed with soft rocks, forming a very specific rhizosphere, in which the hard rock sections, impermeable to roots and water, contribute their water to the soft sections, which may harbour roots. The old sandstone formations in Jordan, in contrast, are altogether hard and often covered with epilithic lichens, which further decrease the water permeability of the rocks (Danin 1997a), so that the rocks contribute the small quantities of water received to the crevices.

Satureja thymbrifolia Hedge & Feinbrun – Fig. 1f.
In addition to the material cited by Hedge & Feinbrun (1968), two other specimens were collected and studied:

Israel, Judean Desert, 5 km S of Nebi Musa, Jabal Harmun, silicified limestone, 21.3.1992, *Danin 71051*; ibid, 29.4.1994, *Danin 940401* (in full bloom).

New records

During the first author's excursions to S Jordan in 1997 and 1998 a few taxa were collected that proved to be new records either for (a) the entire area of the 'Flora Palaestina', or (b) for Jordan, or (c) for Edom. They are listed accordingly (specimens deposited in HUJ).

(a) Taxa new to the 'Flora Palaestina' area

Chloris barbata Sw.
Jordan, Ammon, Wadi Zarqa Ma'in, near the hot springs, an alluvial terrace, 18.12.1997, *Danin 974301* (det. H. Scholz).

The species is "widespread throughout the tropics" (Clayton & al. 1974), and known also from SW Saudi Arabia (Chaudhary 1989).

Phagnalon nitidum Fresen.
Jordan, Jabal Umm Adami, 55 km ESE of Aqaba, a rocky wadi, 10.5.1998, *Danin 980213.*

The closest populations of this species are known from S Sinai (Danin & al. 1985), where the species grows in smooth-faced granite outcrops. According to Lack (1980), *Ph. nitidum* is distributed also in Iran, Afghanistan and Pakistan.

Phagnalon sinaicum Bornm. & Kneuck.
Jordan, 4 km S of Wadi Sabat, 2 km N of Jabal Umm Adami, 55 km ESE of Aqaba, in crevices of smooth-faced hard sandstone, 10.5.1998, *Danin 980301.*

The closest populations of this species are in S Sinai (Danin & al. 1985), where they grow on smooth-faced granite outcrops. *Ph. sinaicum* was regarded by Taeckholm (1974) as endemic to Sinai, but Qaiser & Lack (1985) reported this species also from W Arabia.

(b) Taxa new to Jordan

Atriplex suberecta I. Verd.
Ic.: Bothalia 6: 419. 1954.
Jordan, Edom, Wadi Mousa, roadside, disturbed ground, 20.6.1997, *Danin 971801.*

This species of *A.* sect. *Semibaccatae* is found in S Australia, and also in S Africa where it may be naturalized (Verdoorn 1954). From the Near East the taxon was first reported by Danin (1982) but was named *A. microcarpa* Benth., which actually is an illegitimate name for an

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Australian species later renamed as *A. infrequens* P.G. Wilson (1984). Following Verdoorn (1954) and Wilson (1984), then Feinbrun-Dothan & Danin (1991: 165 & 1008) identified the species in the Near East as *A. suberecta*. Now it has been found in S Jordan, in the urban area of Wadi Mousa near Petra on a slope that was partially levelled during construction of new hotels in the last decade. It is accompanied by such indigenous pioneer halophytes as *Salsola inermis* Forssk., *S. volkensii* Asch. & Schweinf., *Atriplex leucoclada* Boiss., *A. lasiantha* Boiss. and *A. prostrata* DC. The latter also has not previously been recorded from Edom.

Minuartia sinaica (Boiss.) Danin
Jordan, 10 km N of Petra, Naqb Namala, stony ground, 11.5.1998, *Danin 980901*.

This species is known so far from S Sinai and the Negev Highlands (Danin 1987), where bioclimatic conditions seem similar, as is indicated by shrub steppe of *Artemisia sieberi* on stony slopes and Mediterranean or Irano-Turanian trees confined to smooth-faced rock outcrops.

Setaria verticillata (L.) P. Beauv.
Jordan, Edom, 1 km W of Adhruh, irrigated fruit tree plantation, 26.10.1997, *Danin 972704*.

The differences between the two closely related species *S. verticillata* and *S. adhaerens* (Forssk.) Chiov. were discussed by Danin and Scholz (1997). The common species in both Jordan and Israel is *S. adhaerens*.

Verbesina encelioides (Cav.) A. Gray
Jordan, Edom, Rum junction on Aqaba-Ma'an road, irrigated flower garden, 19.6.1997, *Danin* (obs. only).

This plant is a well-known adventive colonizer which was introduced to Sinai from North America (Danin & al. 1985: 280) and which established in Israel after 1967 (Feinbrun-Dothan & Danin 1991: 690-691 & 947). The first author observed a single plant as a weed in a small irrigated flower garden. There is a strong possibility that the plant will spread in S Jordan in the future.

(c) Taxa new to Edom

Arbutus andrachne L.
Jordan, Edom, 5 km N of Petra, Jabal Al Bayda, sandstone crevices, 20.6.1997, *Danin 971703*; Dana Reserve, Ein Kaykab, a spring on a S facing cliff 2 km NNW of the Visitor Center, 21.6.1997, *Danin 972201*.

A. andrachne is a well-known component of the Mediterranean maquis in N Jordan (El Oqlah & Lahham 1985, Al-Eisawi 1996). On light Rendzina on marly ground it is codominant with *Pinus halepensis* Mill. Whereas its southern limit in Jordan is given as c. 32°N (Browicz 1983: 40), the new record from Petra is situated 180 km farther south. The tree was found growing in a fissure of smooth-faced Palaeozoic sandstone on a N facing slope of Jabal Bayda. The Bedouin Haroun Jamada, who has lived in the area all his life, evaluated it as a single tree of which no one knows the name, whereas the names of all other plants along our path were well known to him. He said that the tree carries fruits only rarely and could not refer to their colour. *A. andrachne* is accompanied by other Mediterranean trees, such as *Juniperus phoenicea* and *Ceratonia siliqua,* which also grow in rock crevices. The other individual was collected in Dana Reserve, some 35 km NNE of the first locality. It grows in a softer sandstone, on a S facing slope, but in a dripping spring named after the tree 'Ein Kaykab' (this common name for *A. andrachne* is also given by Dinsmore 1933: 172). Among its companions there are true hydrophytes such as *Schoenus nigricans* L. and *Adiantum capillus-veneris* L. The manager of the Nature Reserve, Mr T. M. Abul Hawa, informed us that there is another 'Ein Kaykab' with another single *Arbutus andrachne* tree in Dana Reserve. *A. andrachne* in Edom seems to be a relict on the threshold of extinction from natural causes. Previously, similar Mediterranean relicts in the desert zone of the Near East desert were discussed in some length by Danin (1972, 1983, 1997a).

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Cistus salviifolius L.
Jordan, Edom, Dana Reserve, near Ein Kaykab, a spring on a S facing cliff 2 km NNW of the Visitor Center, 21.6.1997, *Danin 972202*.

C. salviifolius is also one of the typical Mediterranean plants, which are restricted in the Near East to the Mediterranean zone of Israel and Jordan and which, at the same time, have a disjunct occurrence in the desert rocks (Danin, 1972, 1997a). Its previously known southern boundary in Jordan was at 32°N (Browicz 1988: 61).

Olea europaea L.
Jordan, Edom, 5 km N of Petra, Jabal Al Bayda, sandstone crevices 20.6.1997, *Danin 971601*.

As reported above for *Arbutus andrachne*, the olive was found growing on a N facing steep slope of Jabal Bayda accompanied by, among others, *Juniperus phoenicea* and *Ceratonia siliqua.* According to Haroun Jamada there are about ten such olive trees in the area of Petra and they are regarded by the Bedouin as "Zeiytun Barri", i.e. wild olives. It is not easy to suggest what their origin might be; they could be natural relicts as all the other components of the rock vegetation in this area, but they could alternatively be escapes from cultivation during the long history of human inhabitation of and olive domestication in this area (Green & Wickens 1989, Zohary 1995). Another individual olive tree was found in Jabal el Barra (Barsotti & Cavalli 1989) around 80 km S of Jabal Bayda, and is suspected to be related to "past agricultural activities". Our finding is recorded here in order to draw attention to the problem and to call for further investigations on the origin of these olives.

Bituminaria bituminosa var. ***brachycarpa*** (Feldman) Danin, **comb. nova**
≡ *Psoralea bituminosa* var. *brachycarpa* Feldman in Zohary, Fl. Palaestina 2: 455. 1972.
Jordan, Edom, Dana Reserve, weeds in irrigated terraces, 21.6.1997, *Danin 972101.*

The most common species of *Bituminaria* in Edom is *B. flaccida* (Nab.) Greuter, which grows in crevices and is confined to smooth-faced sandstone in Edom (Zohary 1972) and granite in S Sinai (Danin & al. 1985). *Bituminaria bituminosa* var. *brachycarpa* was not recorded before from Edom.

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