Composition of and changes in the spontaneous flora of Feiran Oasis, S Sinai, Egypt, in the last 60 years

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Abstract

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Based on investigations of the spontaneous flora of Feiran Oasis in 1995 and 1996, 70 taxa of vascular plants, 49 dicots and 21 monocots, are listed, of which 33 taxa are recorded for the first time from the oasis. This inventory is compared with herbarium collections and published records of investigations made in the 1930s and 1960s. Considerable changes in the composition of the spontaneous flora of Feiran Oasis in the last 60 years are ascertained and reasons are discussed.

Introduction

During the last two decades, the plant cover of the major inhabited oases in the Western Desert of Egypt have intensively been studied, viz Bahariya (Abd El-Ghani 1981), Farafra and Faiyum (Abd El-Ghani 1985), Kharga and Dakhla (Abu Ziada 1980), Qara Oasis (Abd El-Ghani 1992) and Siwa Oasis (Abd El-Ghani 1994). Also the flora and vegetation of uninhabited oases in this desert, such as Kurkur (Boulos 1966), Moghra (Girgis & al. 1971), Nabta (El-Hadidi 1980a), Bir Safsaf, El Shab and Nuwaimsa (Bornkamm 1986) have been investigated. Vegetation and agriculture in all these oases are largely groundwater-dependent (Bornkamm & Kehl 1990). The water appears in naturally flowing springs (some are hot) or is pumped from wells. The date palm, *Phoenix dactylifera*, occurring individually or in groves, indicates the presence of a freshwater zone among the underground water layers (Abdel Rahman & al. 1965) and grows near the wells ('bir') or springs ('ayn' in Arabic), which are usually clearly marked by the growth of the tall reed *Phragmites australis.* A grass community of *Desmostachya bipinnata* (or, sometimes, *Stipagrostis vulnerans*) extends over vast areas and is delimited in various directions by low phytogenic sand dunes that support *Tamarix* or *Acacia* shrubs and trees.

Similar oases are also found in Sinai along the Gulf of Suez, e.g., Ayon Musa (Moses springs) and Hammam Musa (Moses bath), which are two uninhabited oases c. 20 and 240 km S of Suez, respectively (Fig. 1). The largest and most conspicuous inhabited oasis in S Sinai is Feiran Oasis. During the last 60 years, studies on the ecology, flora, vegetation-soil-environmental relationships and phytogeography of the Sinai Peninsula have been carried out. The flora of Feiran Oasis has been studied by Drar in 1939, by Taeckholm in 1961 and by El Hadidi in the 1960s (El Hadidi 1967, El Hadidi & al. 1970), but not since then. Based on recent floristic investigations by the authors in Feiran Oasis, the current situation of its spontaneous flora and

vegetation is reported. Our results are compared with the earlier floristic investigations made in this oasis and reasons for the changes in the floristic composition are discussed.

Material and methods

The authors had the opportunity to study the flora and vegetation of Feiran Oasis in April 1995 and October 1996. The authors' collections are deposited in the herbaria of the University of Cairo (CAI) and the Botanic Garden and Botanical Museum Berlin-Dahlem (B).

Apart from our own collections, we also studied the herbarium specimens of previous investigations of the flora of Feiran Oasis. The specimens collected by M. Drar in 1939 (unpublished) are deposited in the herbarium of the Agriculture Museum (CAIM), those collected by Taeckholm in 1961 (unpublished) and by El Hadidi and El-Hadidi & al. in the 1960s (El Hadidi 1967, El-Hadidi & al. 1970) are deposited in the herbarium of the University of Cairo (CAI).

The plants were determinated with the help of Taeckholm (1974), Zohary (1966-72) and Feinbrun-Dothan (1978-86). The nomenclature follows Boulos (1995).

The similarity coefficients were calculated following Sørensen's formula (see Müller-Dombois & Ellenberg 1974).

The study area

Wadi Feiran (28°30′-47′N, 33°33′-34°00′E) is, with a length of c. 59 km, the longest and also broadest wadi in S Sinai. It rises from the mountains surrounding the monastery of St Catherine at about 2500 m. At an elevation of 750 m and 43 km E of the mouth of the wadi lies Feiran Oasis (Fig. 1). It is a small depression, which appears as a deep, fertile extension of the wadi, surrounded by high red mountains of igneous and metamorphic rocks (Kassim 1983), and extends over a distance of 10 km with a dense growth of date palms. Abundant ground water and deep sand-clay deposits (wadi terrace) as well as the natural protection of the locality against wind, favour the utilization of the oasis as a productive site to cultivate fruit trees and crops.

Feiran Oasis lies in the hyperarid zone with hot summer, mild winter and winter rainfall (Ayyad & Ghabour 1986). Available meteorological information (1970-1994) of the St Catherine station (at c. 1550 m) shows that the mean annual precipitation is 45 mm per year. Gebel Catherine (2637 m) receives a mean annual precipitation of up to 100 mm as rain and snow (Danin 1983). Moustafa & Zaghloul (1996) report for the montane St Catherine area a mean air temperature (1982-1991) ranging from 5.4 to 25.1 °C, with the minimum in January and February and the maximum in July and August. At Gebel Catherine, the mean monthly temperature ranges from -1 to 2 °C in winter and 17 to 19 °C in summer.

Said (1990) notes that the fossil ground water of Feiran Oasis originated from ancient lakes, which were formed as a result of the blocking of water courses by resistant porphyry dikes. Kassim (1983) and Zahran & Willis (1992) report two main water resources in S Sinai: (1) scanty rainfall on the mountains, which runs over the slopes and collects in narrow deep wadis forming perpetual streams and rivulets. In rainy years, the excess water percolates and is stored underground in rock crevices. It may be obtained by digging wells with an average water table ranging between 17 to 25 m in old wells, and 35 to 40 m in the new ones. (2) Snow, which covers the high mountain summits in winter, is an effective water resources when it melts by the onset of warm months, runs down the slopes and collects in the wadis.

The vegetation of Feiran Oasis

Feiran Oasis is located in El-Hadidi's (1980b) "mountainous Sinai proper" phytogeographic region of Egypt. Although the perennial vegetation is generally sparse, spectacular spring displays of wildflowers occur during rainy years. Two different ecosystems can be distinguished: (A) the adjoining desert and (B) the cultivated areas.

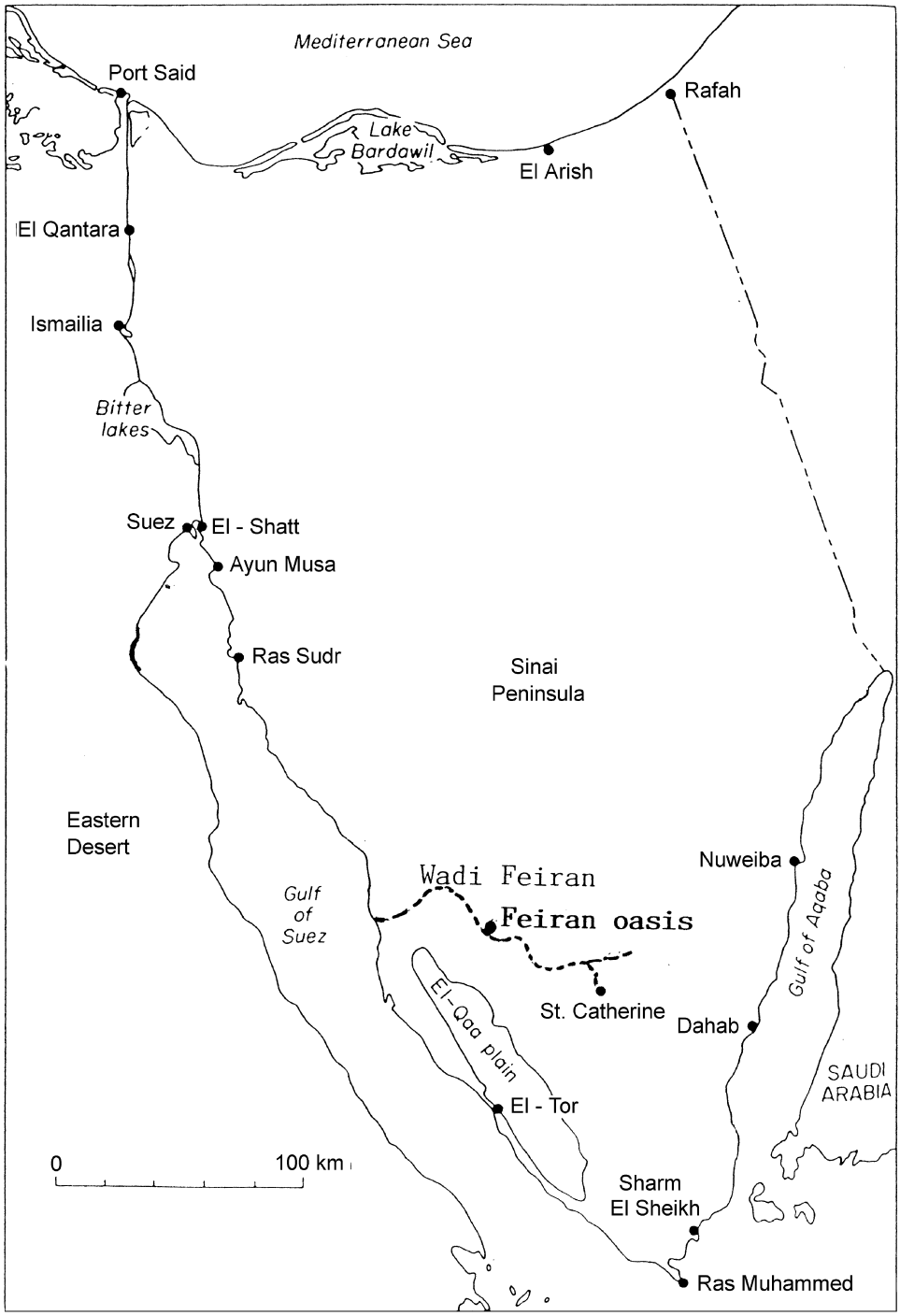

Fig. 1. Map showing Sinai and the the location of Feiran Oasis.

(A) **Adjoining desert** (desert outskirts) includes mountainous vegetation and wadi bed vegetation.
(1) The mountainous vegetation is restricted to the mountainous rocky slopes along both sides of the main wadi bed. Few scattered trees of *Moringa peregrina, Acacia tortilis* subsp. *raddiana* grow in gullies and rocky crevices. Soil and plant debris accumulate in these fissures, retaining water and forming a fertile substratum through which plant roots penetrate. Shrubs of *Ochradenus baccatus* and *Capparis sinaica* are recorded from the same habitat.
(2) Wadi bed vegetation: The main wadi bed is covered by boulders and stone fragments. The precipitation-dependent permanently contracted vegetation consists of xerophytes growing on the sand/clay matrix deposited in spaces between the rocks. Common species are *Achillea fragrantissima, "Artemisia herba-alba", Stipagrostis plumosa, Teucrium decaisnei, Gymnocarpos decander* and *Onopordum ambiguum*; less frequently also *Zygophyllum simplex, Anabasis articulata, Aerva javanica, Haloxylon salicornicum, Schismus barbatus, Hyoscyamus muticus, Zilla spinosa* and *Citrullus colocynthis* have been found.

(B) **The cultivated areas:** A total of 15 wells exist in Feiran Oasis, of which nine are dried up. The remaining six wells are feebly flowing (dug 8-10 years ago) and are located on the northern and southern boundaries of the oasis. Consequently, a number of scattered "small oases" are established. The cultivated areas are usually surrounded by *Casuarina* sp., *Tamarix aphylla* and *Eucalyptus rostrata*, planted as windbreak. Several sites are used by the bedouin to cultivate narcotic plants (e.g., *Cannabis sativa*). The following habitats are recognized:
(1) The water holes (well opening) are located inside the farmlands. There is no marked plant growth in the well opening, but *Cynodon dactylon*, *Phragmites australis, Tamarix nilotica* and *Cyperus rotundus* grow around it.
(2) The reservoirs (Arabic: Khazzan) are large storage ponds connected with the water hole through a culvert. The water is stored in the pond and discharged through several irrigation rubber pipes to be distributed into the cultivated areas. The plant growth in this habitat is composed mainly of green algae (e.g., *Chara* sp.), some hydrophytes (e.g., *Elodea* sp.) and *Phragmites australis.* The irrigation from the newly dug wells, in contrast, is carried out by a number of irrigation canals as in most oases of the Western Desert, and a canal bank vegetation is well established.
(3) The crop fields are represented by some patches between the trees and are usually located in the centre of this ecosystem. The main winter crops include barley (*Hordeum vulgare*), broad-beans (*Vicia faba*) and wheat *(Triticum vulgare)*, the summer crops maize *(Zea mays)*, egg-plant *(Solanum melongena)* and water-melon *(Cucumis melo).* Alfa-alfa *(Medicago sativa)* is widely cultivated in the oasis as a perennial forage-crop. Associated weeds are, in particular, *Chenopodium murale*, *Malva parviflora, Sonchus oleraceus, Euphorbia peplus, Portulaca oleracea* and *Amaranthus graecizans.*
(4) The orchards and date palm groves are the most conspicuous element in Feiran Oasis. Besides *Phoenix dactylifera,* in particular olives *(Olea europaea)*, vine (*Vitis vinifera)* and pomegranate *(Punica granatum)* are cultivated. Due to the continuous depletion and shortage of water in Feiran Oasis, three types of date palm orchards can be distinguished: (i) old orchards; since most of the old wells are dried up, many orchards are not irrigated any longer; (ii) orchards established 8-10 year ago, with wells providing insufficient water discharge; and (iii) new orchards with adequate water discharge from deep wells dug during the last four years. Whereas in the new orchards mats of *Oxalis corniculata*, *Cynodon dactylon*, *Alhagi graecorum* and *Zygophyllum simplex* usually occupy the ground between the date palms, in the older orchards only a sparse spontaneous vegetation, mainly of xerophytic species, is found.

The taxa collected by the authors in 1995 and 1996 in Feiran Oasis

The following list of taxa from Feiran Oasis is based on our collections from April 1995 and October 1996. The taxa preceded by an asterisk (*) are recorded for the first time from Feiran

Oasis. The habitats are abbreviated as follows: B1 = around the water wholes, B2 = reservoirs, B3 = crop fields, and B4 = date palm orchards.

Dicotyledoneae

Amaranthaceae
**Aerva javanica* (Burm.f.) Juss. ex Schult. – Habitat: B3, B4; 4.1995 & 10.1996.
**Amaranthus graecizans* L. – Habitat: B3 and B4; 4.1995 & 10.1996.
**A. lividus* L. – Habitat: B4; 10.1996.

Asclepiadaceae
**Calotropis procera* (Ait.) W.T. Aiton – Habitat: B4; 10.1996.
**Cynanchum acutum* L. – Habitat: B4; 10.1996.

Caryophyllaceae
Silene nocturna L. – Habitat: B3 and B4; 10.1996.
Spergularia marina (L.) Griseb. – Habitat: B1 and B3; 10.1996

Chenopodiaceae
**Bassia muricata* (L.) Asch. – Habitat: B4; 10.1996.
**Chenopodium album* L. – Habitat: B3 and B4; 10.1996.
Ch. murale L. – Habitat: B3 and B4; 4.1995 & 10.1996.
Suaeda aegyptiaca (Hasselq.) Zohary – Habitat: B4; 10.1996.

Cleomaceae
**Cleome chrysantha* Decne. – Habitat: B4; 10.1996.

Compositae
"Artemisia herba-alba" (sensu Boulos 1995, etc.) – Habitat: B4; 4.1995 & 10.1996.
**Bidens pilosa* L. – Habitat: B4; 10.1996.
Conyza bonariensis (L.) Cronquist – Habitat: B3 and B4; 4.1995 & 10.1996.
**Sonchus oleraceus* L. – Habitat: B3 and B4, 4.1995 and 10.1996.

Convolvulaceae
Convolvulus arvensis L. – Habitat: B3 and B4; 4.1995 & 10.1996.
**Cuscuta planiflora* Ten. – Habitat: B4 and occasional in B3, 10.1996.

Cruciferae
Erucaria hispanica (L.) Druce – Habitat: B4, 4.1995.
Sisymbrium irio L. – Habitat: B4; 4.1995 & 10.1996.
S. orientale L. – Habitat: occasional in B4; 4.1995 & 10.1996.
Zilla spinosa (L.) Prantl – Habitat: invading B4; 4.1995 & 10.1996.

Cucurbitaceae
**Cucumis prophetarum* L. subsp. *prophetarum* – Habitat: B4; 4.1995 & 10.1996

Euphorbiaceae
**Chrozophora brocchiana* Vis. – Habitat: B4 and occasional in B3; 10.1996.
Ch. tinctoria (L.) Raf. – Habitat: B4; 10.1996.
**Euphorbia heterophylla* L. – Habitat: B4; 10.1996.
E. peplus L. – Habitat: B3 & B4; 4.1995 &10.1996.

Labiatae
Mentha longifolia subsp. *typhoides* (Briq.) Harley – Habitat: B2 (new wells), B3 & B4; 4.1995& 10.1996.

Leguminosae
Alhagi graecorum Boiss. – Habitat: B2, B3 and B4; 4.1995 & 10.1996.
Lotus creticus L. – Habitat: B3 & B4; 4.1995.
Melilotus indicus (L.) All. – Habitat: B3 & B4; 4.1995 & 10.1996.

Malvaceae
**Malva parviflora* L. – Habitat: B4 and occasional in B3; 4.1995 & 10.1996.

Orobanchaceae
**Orobanche cernua* Loefl. – Habitat: B3 and occasional in B4; 10.1996.

Oxalidaceae
**Oxalis corniculata* L. – Habitat: B4; 4.1995 & 10.1996.

Portulacaceae
Portulaca oleracea L. – Habitat: B3, and occasional in B4; 4.1995 & 10.1996.

Primulaceae
Anagallis arvensis L. – Habitat: B3 & B4; 4.1995.

Resedaceae
**Caylusea hexagyna* (Forssk.) M.L. Green – Habitat: B4; 10.1996.
**Ochradenus baccatus* Delile – Habitat: B4; 4.1995 & 10.1996.

Rhamnaceae
Ziziphus spina-christi L. – Habitat: B1; 4.1995 & 10.1996.

Solanaceae
**Hyoscyamus muticus* L. – Habitat: B4; 4.1995 & 10.1996.
**Solanum nigrum* L. – Habitat: B3 and B4; 4.1995.
Withania somnifera (L.) Dunal – Habitat: B4; 10.1996.

Tamaricaceae
**Tamarix aphylla* (L.) Karst. – Habitat: occasional in B1 and B4; 4.1995 & 10.1996.
T. nilotica (Ehrenb.) Bunge – Habitat: B1 & B4, occasional in B3; 4.1995 & 10.1996.

Umbelliferae
Ammi majus L. – Habitat: B4 and occasional in B3; 4.1995.

Urticaceae
**Forsskalea tenacissima* L. – Habitat: invading B4; 10.1996.

Zygophyllaceae
Peganum harmala L. – Habitat: B4; 10.1996.
Tribulus terrestris L. – Habitat: B4; 10.1996.
**Zygophyllum simplex* L. – Habitat: B4; 4.1995 & 10.1996.

Monocotyledoneae

Cyperaceae
**Cyperus rotundus* L. – Habitat: B1, B2 (new wells) & B3; 4.1995 & 10.1996.

Gramineae
Avena sterilis L. – Habitat: B4; 4.1995.
Brachypodium distachyum (L.) P. Beauv. – Habitat: B4; 4.1995 & 10.1996.

Cynodon dactylon (L.) Pers. – Habitat: B1, B2 (new wells), B3 & B4; 4.1995 & 10.1996.
**Dactyloctenium aegyptium* (L.) Willd. – Habitat: B2 (new wells), B3 and occasional in B4; 10.1996.
**Digitaria sanguinalis* (L.) Scop. – Habitat: B3 & B4; 4.1995 & 10.1996.
Echinochloa colona (L.) Link – Habitat: B2 (new wells), B3 & B4; 10.1996.
**Eragrostis pilosa* (L.) P. Beauv. – Habitat: B4; 10.1996.
Hordeum murinum subsp. *leporinum* (Link) Acrang. – Habitat: B4 and occasional in B3; 10.1996.
**Imperata cylindrica* (L.) Raeusch. – Habitat: B2 (new wells), B3, occasional in B4; 4.1995 & 10.1996.
Lolium rigidum (L.) Goudin – Habitat: B3; 4.1995.
**Oryzopsis miliacea* (L.) Asch. & Schweinf. – Habitat: B4; 4.1995 & 10.1996.
Panicum repens L. – Habitat: B3 and occasional in B1; 10.1996.
**P. turgidum* Forssk. – Habitat: invading B4; 4.1995 & 10.1996
**Phalaris minor* Retz. – Habitat: B3; 10.1996.
Phragmites australis (Cav.) Trin. ex Steud. – Habitat: B1, B2 (new wells), occasional in B3 & B4; 4.1995 & 10.1996.
Polypogon monspeliensis (L.) Desf. – Habitat: B3 & B4, 4.1995 & 10.1996.
P. viridis (Gouan) Breistr. – Habitat: B3 & B4; 4.1995 & 10.1996.
Schismus barbatus (L.) Thell. – Habitat: occasional in B4; 4.1995.
Setaria verticillata (L.) P. Beauv. – Habitat: occasional in B3, B4; 4.1995 & 10.1996.
**Stipagrostis plumosa* (L.) Munro ex T. Anderson – Habitat: occasional in B3; 4.1995 & 10.1996.

Present composition of the flora of Feiran Oasis and comparison with previous inventories

A total of 70 spontaneously growing vascular taxa have been recorded by the authors from Feiran Oasis in 1995-96, of these 33 species are recorded for the first time. The 49 dicots and 21 moncots belong to 63 genera and 26 families. The by far largest family are the *Gramineae* (20 taxa); *Chenopodiaceae*, *Compositae* and *Euphorbiaceae* are represented by four taxa each.

The life-form spectrum of the spontaneous flora of Feiran Oasis is characterized by a dominance of therophytes, constituting 45.1 % of the species, followed by hemicryptophytes and chamaephytes (19.5 % and 14.6 %, respectively). The remaining 20.7 % are phanerophytes, geophytes and parasites. This spectrum strongly resembles that reported by Olsvig-Whittaker & al. (1983) from a Negev Desert watershed at Sede Boqer, Israel, and complies also with the observations reported by Danin & Orshan (1990) for corresponding environments in Israel. The life-form spectra of oases of the Western Desert of Egypt (Abd El-Ghani 1981 & 1985) and the Central Hijaz Mountains of Saudi Arabia (Abd El-Ghani 1997) only differ in a higher percentage of chamaephytes compared to hemicryptophytes and geophytes.

Cosmopolitan, palaeotropical and pantropical taxa constitute only 33 % of the spontaneous flora of Feiran Oasis, compared with 51.6 %, 49 % and 48.4 % in Kharga, Bahariya and Farafra Oases, respectively (Abd El-Ghani, unpublished data). This may reflect the comparatively isolated position of Feiran Oasis and its still more traditional agriculture. The pure (monoregional) Mediterranean element is insignificantly (1.2 %) represented, the bi- or pluriregional Mediterranean element is represented with 26.8 %, whereas the Saharo-Arabian element constitutes the main bulk (39 %) of the spontaneous flora of Feiran Oasis. According to the phytogeographical analysis of Israel and Sinai by Danin & Plitman (1987), the Saharo-Arabian element is also dominant in the desert vegetation in this part of Sinai.

In Tab. 1, all taxa are listed that we know to have been collected in Feiran Oasis. These are a total of 104 taxa, of which 24 taxa were recorded by Drar in 1939, 58 taxa during the 1960s, and 70 taxa in 1995-96. We cannot, of course, assume with certainty that the earlier collections

Table 1. Floristic composition of Feiran Oasis in 1939, in the 1960s and in 1995-96 according to the quoted inventories (see 'Material and methods'); + = recorded; – = not recorded.

Taxon	Drar 1939	Taeckholm 1961 El-Hadidi (1967) El-Hadidi & al (1970)	Presend study 1995-96
Antirrhinum orontium L.	+	–	–
Avena barbata Pott ex Link	+	–	–
Caldesia reniformis (D. Don) Makino	+	–	–
Cichorium endivia subsp. *pumilum* (Jacq.) Cout.	+	–	–
Picris cyanocarpa (Boiss.)	+	–	–
Rostraria cristata (L.) Tzvelev	+	–	–
Trifolium stellatum L.	+	–	–
Vaccaria hispanica (Mill.) Raische	+	–	–
Anagallis foemina Mill.	–	+	–
Asphodelus tenuifolius Cav.	–	+	–
Astragalus corrugatus Bertol.	–	+	–
Carduus getulus Pomel	–	+	–
Centaurium pulchelum Druce	–	+	–
Chrozophora plicata (Vahl) Spreng.	–	+	–
Chrysanthemum coronarium L.	–	+	–
Conyza canadensis (L.) Cronq.	–	+	–
Erodium laciniatum (Cav.) Willd .	–	+	–
Frankenia pulverulenta L.	–	+	–
Fumaria parviflora Lam.	–	+	–
Glinus lotoides L.	–	+	–
Lepidium draba L.	–	+	–
Lepidium sativum L.	–	+	–
Malva neglecta Wallr.	–	+	–
Medicago hispida Gaertn.	–	+	–
M. truncatula Gaertn.	–	+	–
Mesembryanthemum nodiflorum L.	–	+	–
Parietaria alsinifolia Delile	–	+	–
Paspalum distichum L.	–	+	–
Rostraria pumila (Desf.) Tzvelev	–	+	–
Samolus valerandi L.	–	+	–
Solanum sinaicum Boiss.	–	+	–
Trigonella stellata L.	–	+	–
Xanthium strumarium L.	–	+	–
Vicia sativa L.	–	+	–
Aerva javanica (Burm. f.) Juss. ex Schult.	–	–	+
Amaranthus graecizans L.	–	–	+
Amaranthus lividus L.	–	–	+
Bassia muricata (L.) Asch.	–	–	+
Bidens pilosa L.	–	–	+
Calotropis procera (Aiton) W. T. Aiton	–	–	+
Caylusea hexagyna (Forssk.) M. L. Green	–	–	+
Chenopodium album L.	–	–	+
Chrozophora brocchiana Vis.	–	–	+
Cleome chrysantha Decne.	–	–	+
Cucumis prophetarum L. subsp. *prophetarum*	–	–	+

Tab. 1. Continued from preceding page.

Taxon	Drar 1939	Taeckholm 1961 El-Hadidi (1967) El-Hadidi & al (1970)	Presend study 1995-96
Cuscuta planiflora Ten.	–	–	+
Cynanchum acutum L.	–	–	+
Cyperus rotundus L.	–	–	+
Dactyloctenium aegyptium (L.) Willd.	–	–	+
Digitaria sanguinalis (L.) Scop.	–	–	+
Eragrostis pilosa (L.) P. Beauv.	–	–	+
Euphorbia heterophylla L.	–	–	+
Forsskaolea tenacissima L.	–	–	+
Hyoscamus muticus L.	–	–	+
Imperata cylindrica (L.) Raeusch.	–	–	+
Malva parviflora L.	–	–	+
Ochradenus baccatus Delile	–	–	+
Orobanche cernua Loefl.	–	–	+
Oryzopsis miliacea (L.) Asch. & Schweinf.	–	–	+
Oxalis corniculata L.	–	–	+
Panicum turgidum Forssk.	–	–	+
Phalaris minor Retz.	–	–	+
Solanum nigrum L.	–	–	+
Sonchus oleraceus L.	–	–	+
Tamarix aphylla (L.) H. Karst	–	–	+
Stipagrostis plumosa (L.) Munro ex T. Anderson	–	–	+
Zygophyllum simplex L.	–	–	+
Alhagi graecorum Boiss.		+	+
"Artemisia herba-alba Asso"	–	+	+
Brachypodium distachum (L.) P. Beauv.	–	+	+
Chrozophora tinctoria (L.) Raf.	–	+	+
Conyza bonariensis (L.) Cronq.	–	+	+
Echinochloa colona (L.) Link	–	+	+
Erucaria hispanica (L.) Druce	–	+	+
Hordeum murinum subsp. *leporinum* (Link) Arcang.	–	+	+
Lotus creticus L.	–	+	+
Panicum repens L.	–	+	+
Peganum harmala L.	–	+	+
Phragmites australis (Cav.) Trin. ex Steud.	–	+	+
Portulaca oleracea L.	–	+	+
Schismus barbatus (L.) Thell.	–	+	+
Setaria verticillata (L.) P. Beauv.	–	+	+
Sisymbrium irio L.	–	+	+
Spergularia marina (L.) Griseb.	–	+	+
Tamarix nilotica (Ehrenb.) Bunge	–	+	+
Withania somnifera L.	–	+	+
Zilla spinosa (L.) Prantl	–	+	+
Ziziphus spina-christi L.	–	+	+
Ammi majus L.	+	–	+
Avena sterilis L.	+	–	+
Lolium rigidum Gaudin	+	–	+

Tab. 1. Continued from preceding page.

Taxon	Drar 1939	Taeckholm 1961 El-Hadidi (1967) El-Hadidi & al (1970)	Presend study 1996-96
Mentha longifolia subsp. *typhoides* (Briq.) Harley	+	–	+
Tribulus terrestris L.	+	–	+
Anagallis arvensis L.	+	+	+
Chenopodium murale L.	+	+	+
Convolvulus arvensis L.	+	+	+
Cynodon dactylon (L.) Pers.	+	+	+
Euphorbia peplus L.	+	+	+
Melilotus indicus (L.) All.	+	+	+
Polypogon monspeliensis (L.) Desf.	+	+	+
Polypogon viridis (Gouan) Breistr.	+	+	+
Silene nocturna L.	+	+	+
Sisymbrium orientale L.	+	+	+
Suaeda aegyptiaca (Hasselq.) Zohary	+	+	+

represent the entire spontanous flora of the oasis in these years, thus some caution is necessary when comparing these data. A few conclusions, however, seem reasonable.

11 taxa (at the end of Tab. 1) have been recorded in 1939, in the 1960s and in 1995-96. These represent, in fact, the most common weeds of arable land in Egypt (El-Hadidi & Kosinová 1971).

In contrast, there are 34 taxa collected in 1939 and the 1960s, which were not found by us. Among them are species that were, according to the label data, even intensively recorded by Vivi Taeckholm's group in Feiran Oasis in the 1960s, such as *Parietaria alsinifolia* Delile, *Rostraria pumila* (Desf.) Tzvelev, *Samolus valerandi* L. and *Paspalum distichum* L. The absence of these species in 1995-96 can have different reasons. The disappearance of several meso- and hydrophilous species is to some extent certainly due to the replacement of all open irrigation canals by rubber tubes. Only most recently, open irrigation canals have been re-introduced for the newly dug wells. To some other extent, species less tolerant of xeric conditions may have disappeared due to a gradual desertification of larger parts of Feiran Oasis after several older wells dried up. This process is still ongoing; the digging of four new deep wells by the authorities of the water resources to cover the touristic and military water supply negatively affects the underground water level and consequently has a negative effect on the irrigation and the palm groves.

There are, on the other hand, 33 taxa found by us that were not recorded in 1939 and in the 1960s. Of these, 13 taxa are of the surrounding desert flora, invading those date palm orchards that are not any longer, or only insufficiently, irrigated; examples are *Forsskaolea tenacissima*, *Panicum turgidum, Ochradenus baccatus, Zilla spinosa* and *Cucumis prophetarum.* The other larger group of species that are newly recorded, are common weed species of Egypt, viz *Amaranthus graecianus* und *A. lividus, Chenopodium album, Cuscuta planifolis, Cyperus rotundus, Dactyloctenium aegyptium, Digitaria sanguinalis, Malva parviflora, Solanum nigrum, Sonchus oleraceus.*

The present spontaneous flora of Feiran Oasis has little similarity with the weed flora of mountainous S Sinai as reported by El-Hadidi & al. (1970). Of the 156 species recorded by these authors and the 70 species found in 1995-96 in Feiran Oasis only 32 are in common. The index of similarity is therefore 28.3 %. Interestingly, the comparison of the species that were recorded by El-Hadidi (1967) and El-Hadidi & al. (1970) from Feiran Oasis with our findings in 1995-96 displays an even lower similarity of 21.6 %. The comparison of the present Feiran

Oasis flora with the weed flora of Egypt listed by El-Hadidi & Kosinová (1971) reveals an index of similarity of 54.6 %. This becomes meaningful when compared with the corresponding figure for the 1960s: the similarity index for that time is only 14.6 %. These figures thus indicate a considerable increase in the similarity of the spontaneous flora of Feiran Oasis with the weed flora of Egypt over the last decades. Reasons for this development can be sought in the increasing contact between Feiran Oasis and the agricultural regions of the Nile valley and delta after Sinai was returned to Egypt and a tunnel below the Suez Canal opened. Only since then, it has become a practise in Feiran Oasis to introduce crop seed from the Nile valley and delta and with this seed most likely also weeds of the latter regions may have been introduced.

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