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Current Status of the Flora of North Sinai: Losses and Gains

Wafaa M. Kamel, Mohamed S. Zaghloul*, Raafat H. Abd El-Wahab, and Abdel-Raouf A. Moustafa
Botany Department, Faculty of Sciences, Suez Canal University, 41522 Ismailia, Egypt

ABSTRACT

Recent changes in floristic composition and structure in North Sinai due to human impact and contemporary prevailing drought were studied. Three-hundred plots distributed in one-hundred sites were sampled throughout the North Sinai covering different seasons of 2005 and 2006. Two-hundred and eighty-one species were recorded belonging to 187 genera and 52 families. The collected species included a new record to Egypt (*Cyperus glaber*) L., a new record to Sinai (*Persicaria sengalensis* (Meisn.) Soják), and a new record to North Sinai (*Eminium spiculatum* (Blume) Schott subsp. *negevensis* Koach & Feinbrun). The distribution of the recorded species was estimated quantitatively based on the frequency of presence. The comparisons of the floristic composition and structure in present study with earlier studies (1960s and 1970s) revealed that the flora of North Sinai has been changed dramatically in the past 40-50 years. Four-hundred and fifty-one (62.3%) of previously recorded species were not recorded in the present survey. Our study concluded that unless refugee sites would be established representing different habitats in North Sinai, the documented change in floristic composition and structure would be continue leading to more loss in flora of North Sinai.

Key words: Floristic composition and structure; North Sinai, temporal variation, human impact.

INTRODUCTION

Flora of Sinai deserts is subjected to a number of threats, which cause populations of its unique elements to decline in both number and size. Some of these threats are specific to certain taxa's populations, but the majority affects the functional communities and ecosystems in which these populations ultimately exist and interact with other species and the abiotic environment (e.g. Zaghloul, 1997; Moustafa *et al.*, 2001; Zaghloul, 2003; and Abd El-Wahab *et al.*, 2004). These threats are either natural or human-induced. The natural threats include drought, floods, and natural enemies (e.g. rodents, insects, and rotting fungi). Drought and flood years' cycle has been observed in the area (Zaghloul, 2003; and Abd El-Wahab, 2003). While drought and rarity of precipitation may be the prevailing climatic pattern for seven to ten successive years, it may be followed by rainy year/years with torrential rainfall causing destructive flash floods destroying the vegetation in Wadis (dry valleys) and runnels. While the drought itself has effects on sparse vegetation in arid to extremely arid ecosystems, it also aggravates any other threat especially human-induced ones (Abd El-Wahab *et al.*, 2004).

Since 1981, many attempts of modern urbanization have been made in North Sinai including projects for land reclamation and settlement of Bedouins in places of available fresh water resources, opening of schools, roads construction, and availing public traffic (North Sinai Governorate, 2004). These activities resulted in a close contact between the area and the rest of Egypt and made many sites and localities in remote deserts more easily accessible. This urbanization movement has mixed values; among the bad ones are the stressing and the destruction of unique natural ecosystems supporting unique and critical floristic elements of the area. Disturbances due to human impact have been recorded in the area include over-grazing, over-collecting, uprooting, over-cutting for fuel wood, urbanization (construction of new settlements and infrastructure, e.g. El-Salam irrigation canal), quarrying, solid wasting, and removing natural vegetation for cultivation projects. These disturbances lead to the destruction of natural habitats and the disappearance of previously recorded plant communities in which unique floristic elements live and interact, which in turn lead to loosing diversity and to change in floristic composition and structure of the area (Medicinal Plants Conservation Project, 2006).

Disappearance of plant species due to prevailing contemporary (the past 40-50 years) drought and the aforementioned unmanaged anthropogenic practices has been observed but not been documented. For this reason, the present study was undertaken to evaluate the current status of North Sinai flora and to document the recent changes in its composition (species richness) and structure (distribution of richness among the taxonomic families and/or genera).

MATERIALS AND METHODS

Study area

The North Sinai lies at the north eastern corner of Egypt between 32^o 20'- 34^o 30' E and 30^o 05'- 31^o 10' N (Fig. 1). It is located along the Mediterranean Sea starting from Balloza village at the west to Rafah at the east. The eastern border is the eastern international political borders of Gaza strip and Israel starting with Rafah at the north to Taba at the south. The western border extends from Balloza village at the north to Ras Masala at the south. Its area is 27564 km^2 (≈ 2.8% of total Egyptian land; North Sinai Governorate, 2004). The geographic elements of North Sinai are distinguished into two main districts. The first is the coastal district which includes coastal plain that extends 20 to 40 kilometers southward from the Mediterranean coast and are covered by different types of sand dunes.

* *Corresponding author: zaghloul_mohamed@yahoo.com*

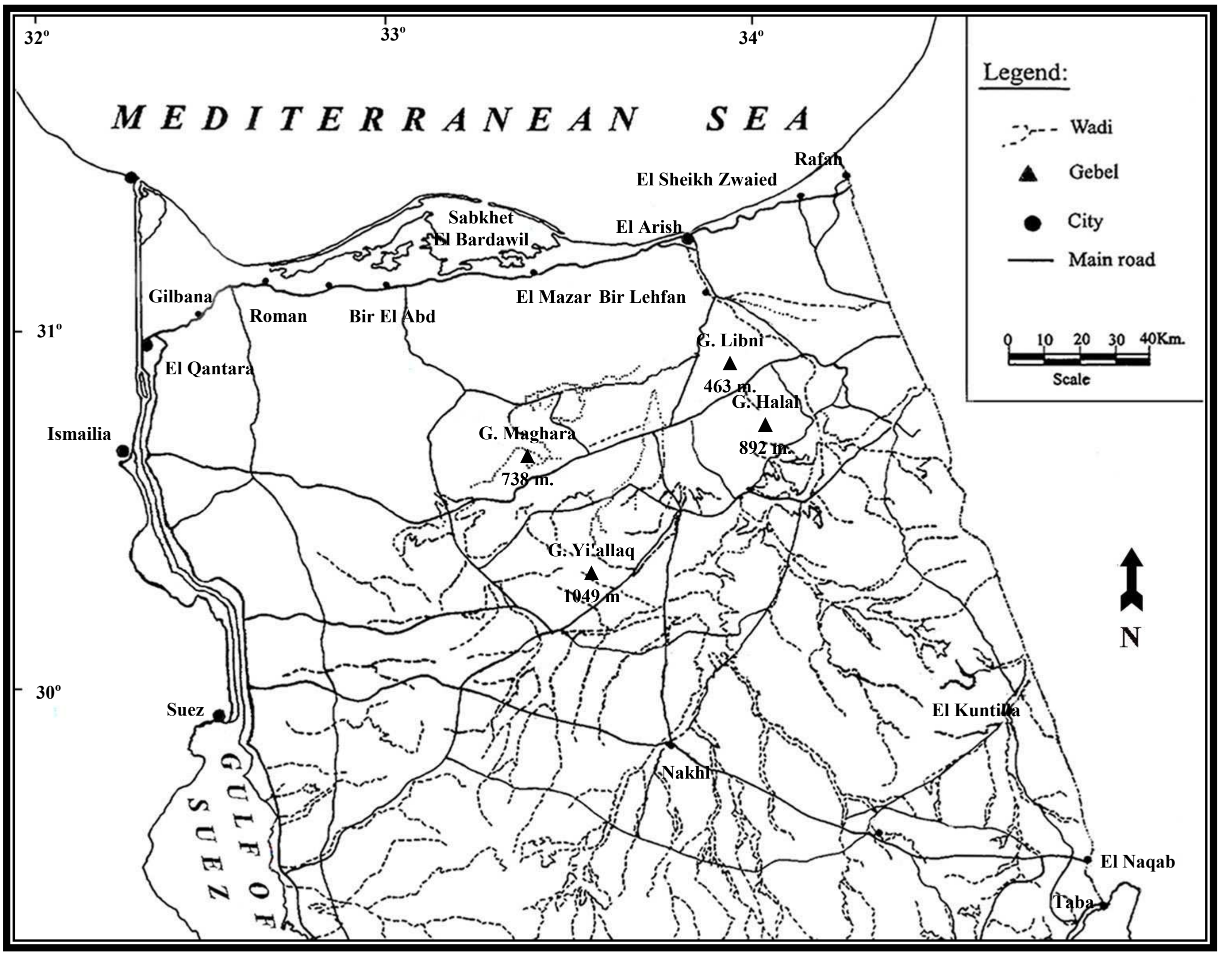

Figure (1): Map of North Sinai showing the study area.

The second is the desert district (Isthmic or Tih desert) which dominates the central part of North Sinai and includes plateaus and prominent but isolated mountain peaks. It forms a distinct geomorphological and structural unit characterized by a large number of northeast- trending elliptical anticlines and intervening synclinal depressions. These anticlines and synclines are breached by erosion and fractured along lines that run more or less parallel to the axes of the anticlines. It is in radical contrast to the plateau character of central Sinai which is made of horizontal Cretaceous and Eocene strata (Said, 1990). This synclinal structure is obscured by a series of superimposed structures manifested in a number of elongated hog-baked massifs that stud the chalk plains of central Sinai. Of these Gebel El-Maghara (738 m a.s.l.), Gebel El-Halal (892 m a.s.l.), Gebel Yi'allaq (1049 m a.s.l.), and Gebel Libni (463 m a.s.l.) are the largest.

As a part of the Saharo- Arabian deserts (McGinnies *et al.*, 1968; Danin, 1983), North Sinai is characterized by an arid (< 100 mm precipitation/year) to extremely arid climate with Mediterranean influences on the coastal area (Ayyad and Ghabbour, 1986). According to the available fragmentary climatic data from Bir El-Abd, El-Arish, Rafah, El-Maghara, El-Melaz, and Nekhel meteorological stations (between 1955 and 1998), temperature changes widely between below 0^o C during winter nights to several degrees above 40^o C during the summer daytime. The annual mean temperature is about 20^o C and as a result, dew is common expectance in winter. The mean maximum value of temperature is recorded in August and the mean minimum value is recorded in January. The humidity is quite variable seasonally and spatially. It is generally higher in winter than in summer due to the hot dry winds blowing from the south. The Mediterranean coastal area is more humid (74%) than the internal deserts of North Sinai (eg. El-Maghara area, the annual mean relative humidity is 47%) and Egypt in general. Rainfall on North Sinai varies considerably from one year to another. The annual mean rainfall at the coastal plain (El-Arish) was 97 mm and decreased to 84 mm in 1990s, while it ranges between 40 and 50 mm at El-Maghara area. It reaches its lowest value at Nekhel station (15.4 mm) and its highest value at Rafah (157.4 mm).

Eco-geomorphologically, North Sinai could be divided into three main areas; the Mediterranean coast, the anticline and the inland area (Danin, 1983; Gibali, 2000). The Mediterranean coastal area which is characterized by sparse vegetation of shrubs and semi-shrubs has open undulating sand plains dominated by *Artemisia monosperma*, sand dunes dominated by the perennial grass *Stipagrostis scoparia*, and sabkhas or salt marches which are located at depressions and near the foothills of sandy dunes (Danin, 1983; and Zahran and Willis, 1992). The anticlinal area has sandy plains surrounding the mountains dominated by *Anabasis articulate* and *Panicum turgidum*, wadis supporting *Retama raetam*, *Acacia tortilis*, *Acacia pachyceras* and *Tamarix nilotica* or *Tamarix aphylla* (e.g. W. Masaged), and anticlines with limestone, chalk, dolmite, and marl outcrops (Danin, 1983). Slopes and gorges of the anticlines are dominanted by *Zygophyllum dumosum*, *Reseda arabica*, *Retama raetam*, *Lycium shawii*, and *Juniperus phoenica* (Medicinal Plants Conservation Project, 2006). The inland area has coarse-texture sandy plains near the west characterized by poor vegetation cover of few number of species dominated by *Anabasis articulata* and *Artemisia monosperma*; fine-textured sandy plain with scattered mobile sandy dunes of different densities characterized by higher vegetation especially in channels and depression between the sandy dunes, and dominated by *Stipagrostis scoparia*; and gravelly plains that are covered by sand sheets shifted from the Mediterranean region and dominated by *Retama raetam* shrubs (Medicinal Plants Conservation Project, 2006).

Surveying the literature for previous floristic status

Documenting any change in floristic composition of an area needs refereeing to previous floristic surveys. A thoroughly survey of every available related floristic and/or ecological study published in the last five decades on North Sinai, Sinai or even Egypt had been checked. Species nomenclature was updated according to Boulos (1999, 2000, 2002 & 2005). Danin *et al.* (1985) was used as the main reference (previous status) in comparing the distribution of each taxon with the current status as it provides more detailed information on taxa's distribution.

Sampling protocol

During the different seasons of 2005 and 2006, 300 plots distributed in 100 sites were sampled throughout North Sinai; 180 plots (10 x 10 m) in 60 sites from Qantara to Rafah representing the Mediterranean coastal area; 90 plots in 30 sites representing the anticlines area (Gebel Halal, Gabel El-Maghara, Gabel Libni, and Gabel Yi'allaq), and 30 plots in ten sites representing the inland area. The number of sites selected in each area depended largely upon the variation in the physiognomy, habitat feature, prevailing environmental factors, and nature of soil surface. In each plot, a species list was recorded as presence/absence. Identification and nomenclature of the collected specimens were carried out according to Täckholm (1974), Zohary (1966 & 1972), Feinbrun-Dothan (1978 & 1986), and Boulos (1999, 2000, 2002 & 2005). All specimens cited are deposited in the Suez Canal University Herbarium. Each species was assigned a degree of occurrence following categories of Danin *et al.* (1985) and using the following subjective scale; Dom. = dominant in plant communities in different sites over considerable area (>14% presence); Dom. local = dominant in communities within a relatively restricted habitat (9<14% presence); Cp. = companion of plant communities but not a rare plant (6<9% presence); Occ. = occasional or rare plant (3<6% presence); Spor. = sporadic or very rare (<3% presence). The life form was assigned following Boulos (1995).

Evaluating changes in floristic composition and structure

To compare the species richness values of the current and previous (Danin *et al.*, 1985) surveys, the Sørenson's similarity equation (Greig-Smith, 1983) was used. Sørenson's similarity = $2C/(A+B)$, where A and B are the richness values of each of the surveys in the comparison and C is the number of common taxa shared by the two surveys. Variations between the two surveys in species richness for each eco-geomorphological area (Mediterranean coast, anticlines, and inland) were assessed by calculating Beta diversity using Wilson-Shmida index ($\beta_T = \{g(\text{H}) + L(\text{H})\}/2\ \alpha$) due its ability to reflect the biotic change along environmental variations and its strength in fulfilling the criteria of additively and independence of alpha diversity (Wilson and Shmida, 1984; Magurran, 1988). This index adds the number of species gained $\{g(\text{H})\}$ to the number of species lost $\{L(\text{H})\}$ along a habitat gradient (H), standardized by the average sample richness α. To assess the relation between the two surveys in species richness, the RELATE function in PRIMER 5 computer software was used. The RELATE function tests the null hypothesis of no relation between multivariate patterns from two sets of samples (Clarke and Warwick, 2001).

The recorded species in both the current survey and the previous survey of Danin *et al.* (1985) and their degree of occurrence were re-tabulated according to family to assess the changes in floristic structure between the surveys. Then, the RELATE function in PRIMER 5 computer software were used to assess the significance of variation in floristic structure between the two surveys.

To assure that the apparent difference in floristic structure between the surveys is not due to the contemporary un-recorded families (20 family), these families were omitted from Danin *et al.* (1985) survey and the resulted virtual previous survey was incorporated in the randomized block experiment as a third survey. Friedman test, a nonparametric analysis of a randomized block experiment, was applied using MINITAB 14 statistical software to test the significance of the difference. The Friedman test hypotheses are: H_0: all treatment (survey) effects are zero, which mean no significant difference between the surveys, versus H_1: not all treatment (survey) effects are zero which means a significant difference between the surveys. Randomized block experiments are a generalization of paired experiments, and the Friedman test is a generalization of the paired sign test. The test statistics were corrected for ties (if there are ties within one or more blocks, the average rank is used).

RESULTS

The previous status

Due to differences in aims and scopes of the studies, the thoroughly survey of the previous and/or ecological studies on North Sinai revealed a fairly large discrepancy (Table 1). Some contributions dealt with documenting new records (e.g. Danin, 1973; Danin and Hedge, 1973), while others were limited to certain areas and/or taxa in North Sinai (e.g. Boulos, 1960; El Hadidi, 1969 & 1970; Danin, 1987; Gamal Eldin, 1993; and Gazar *et al.*, 2000). Few studies were comprehensive; Täckholm (1974), Danin *et al.* (1985), and Gibali (1988) of which only one study, Danin *et al.* (1985), gave detailed estimations on distribution of the taxa within different eco-geomorphological areas in North Sinai. The recorded number of species in these studies varied from 279 in Gibali (1988) to more than 690 in Täckholm (1974).

Boulos (1960) collected 199 species from El-Maghara area belonging to 153 genera and 44 families. Täckholm (1974) recorded 670 species from the Eastern Mediterranean coastal region (Mp) and Isthmic desert (Di) which by definition includes North Sinai and the region North of Wadi Tumilat in Eastern Desert. These 670 species belong to 74 family. If we include the species recorded in (M) region, which is by definition, the coastal strip from El-Sallum to Rafah, the figure would rise to be 694. Danin *et al.* (1985) recorded 569 species in the North Sinai belonging to 72 family. In El Hadidi *et al.* (1989), 641 species were recorded from North Sinai (Mediterranean, M; and Isthmic Desert, Di) belonging to 69 family.

Gamal El-Din (1993) recorded 114 species of seed plants in G. Halal belonging to 33 family. Gazar *et al.* (2000) 154 species belonging to 32 family growin on Gebel El-Halal. Annual species represented 44.16% of the collected species. Gibali (1988) recorded 279 speceis belonging to 56 families from North Sinai. Gibali (2000) made a botanical survey of the inland desert region of the North Sinai. He recorded 119 species; 76 of them were recorded too in the coastal region (Gibali, 1988). The rest 43 species are confined to the central Sinai (Table 1).

Floristic composition in the present survey

In the present study, 281 species were collected and identified from 300 plots representing 100 sites in North Sinai (Table 2). The identified species belong to 198 genera (average = 1.5 spp./genus and 3.63 genus/family) and 52 families (average = 5.4 spp./family). The most represented families are: Compositae (42 spp.), Gramineae (31 spp.), Leguminosae (28 spp.), Cruciferae (23 spp.), Chenopodiaceae (21 spp.), Caryophyllaceae (15 spp.), Zygophyllaceae (9 spp.), Labiatae and Euphorbiaceae (7 spp. each), and Liliaceae, Polygonaceae, and Resedaceae (6 spp. each). The other recorded families are represented by 1-5 species each.

One-hundred and thirty-seven species in present survey are annuals (49%) and 144 are perennials (51%). 188 species (66%) were collected from Mediterranean coast, 131 (47%) from the anticlinal area (G. El-Halal, G. El-Maghara, G. Libni, and G. Yi'alleq), and only 58 (20%) from inland areas. Some species were collected from two or more eco-geomorphological areas which make the percentages overlap. Anticlines and inland areas have the highest floristic composition similarity (S.C. = 36.84) followed by Mediterranean coast and anticlines (S.C. = 31.78%).

Table (1): A comparison of modern floristic studies (arranged chronologically) with the present survey.

Reference	Scope of the study	No. of species	No. of families
Boulos, 1960	G. Maghara	199	44
Batanouny, 1964	El-Arish	17	13
Danin, 1973	Sinai	64	29
Täckholm, 1974	Egypt	670	74
Danin *et al.*, 1985	Sinai	569	72
Danin, 1986	Sinai	19	10
Gibali, 1988	North Sinai	279	56
Taeckholmia, 1989	Sinai	641	69
Boulos and Gibali, 1993	Sinai	160	39
Gibali, 2000	North Sinai	119	32
Gamal El-Din, 1993	G. Halal	114	33
Gazar *et al.*, 2000	G. Halal	154	32
El-Bana *et al.*, 2000	Lake Bardawil	118	40
El-Bana *et al.*, 2002	Lake Bardawil	136	42
Present survey	North Sinai	281	52

Changes in floristic composition

Based on the present and previous surveys (excluding Boulos, 1999, 2000, 2002, & 2005 where they didn't give detailed distribution to the North Sinai), we can deduce that the flora of North Sinai comprises more than 710 species. The estimated figure includes 569 species were recorded by Danin *et al.* (1985), 61 in present survey but not in Danin *et al.* (1985), 36 species were recorded in other studies but neither Danin *et al.* (1985) nor present survey, and 53 only in Täckholm (1974) in Mp or Di. An extra 100 species were recorded in Täckholm (1974) in isthmic desert, Mediterranean coast, or Mediterranean coast and isthmic desert.

Of the North Sinai flora, 451 species (62.3%) were lost in present survey. Four species (*Adonis cuparriana, Cuscuta brevistyla, Moltkea callosa, Sedum viguieri*) were not recorded since 1957 (G. Maghara, Boulos, 1960) and even not mentioned in Egyptian flora (Täckholm, 1974, and Boulos, 1999, 2000, & 2005).

Table (2): Distribution and conservation status of 281 species recorded in NS; **M** = Mediterranean cost, **Mg** = G. Maghara, **H** = G. Halal, **L** = G. Libni, **Y** = G. Yi'allaq, **In** = Inland areas. Distribution according to Täckholm (1974); **c.** = common, **cc.** = very common, **r.** = rare, **rr.** = very rare, Distribution according to Danin *et al.* (1985); **1** = Mediterranean, **2** = Gravelly plains, **3** = Transition zone between **1** & **2**, **4** = Anticlines, **N.R.** = not recorded, **Dom.**= dominant in plant communities in different sites over considerable area; **Dom. local** = dominant in communities within a relatively restricted habitat; **Cp.** = companion of plant communities but not a rare plant; **Occ.** = occasional or rare plant; **Spor.** = sporadic or very rare. Families and species are listed in alphabetical order

Family	**Species**	**Growth form**	**Present Survey**		**Täck. (1974)**	**Danin *et al.* (1985)**	
			Dist.	**Status**		**Dist.**	**Status**
Aizoaceae	*Aizoon hispanicum* L.	Ann.	M	Spor.	r.	2, 4	Dom. loc.
	Mesembryanthemum crystallinum L.	Ann.	M	Dom. loc.	c.	1	Dom. loc.
	Mesembryanthemum forsskaolii Hochst. ex. Boiss.	Ann.	M	Spor.	c.	1, 2	Spor.
	Mesembryanthemum nodiflorum L.	Ann.	M, Mg	Cp.	c.	4	Cp.
Alliaceae	*Allium curtum* Boiss.& Gaill. subsp. *curtum*	Per.	L	Spor.	r.	N.R. in Sinai	
	Allium desertorum Forssk.	Per.	M	Spor.	r.	4	Spor.
Amaranthaceae	*Aerva javanica* (Burm. f.) Juss. ex Schult.	Per.	Mg	Spor.	c.	N.R. in Sinai	
Amaryllidaceae	*Pancratium sickenbergeri* Asch. & Schweinf.	Per.	M	Cp.	r.	1, 2, 4	Cp.
Araceae	*Eminium spiculatum* (Blume) Schott	Per.	M	Spor.	c.	N.R. in study area	
Asclepiadaceae	*Asclepias sinaica* (Boiss.) Muschl.	Per.	Mg, H, Y	Occ.	r.	2, 4	Cp.
	Calotropis procera (Aiton) W. T. Aiton	Per.	M, In, Y	Cp.	cc.	3, 4	Occ.
	Pergularia tomentosa L.	Per.	Mg, H, L, Y	Cp.	cc.	2, 4	Cp.
Asparagaceae	*Asparagus aphyllus* L.	Per.	M, Mg	Cp.	rr.	N.R. in Sinai	
	Asparagus stipularis Forssk.	Per.	Mg, H, L, Y	Dom. loc.	c.	1, 2, 3, 4	Cp.
Asphodelaceae	*Asphodelus viscidulus* Boiss.	Ann.	Mg, H, L, In	Cp.	c.	1, 3, 4	Occ.
Boraginaceae	*Anchusa humilis* (Desf.) I. M. Johnst.	Ann.	Mg	Spor.	c.	1	Occ.
	Heliotropium arbainense Fresen.	Per.	Y, In	Occ.	c.	2, 4	Cp.
	Heliotropium digynum (Forssk.) Asch. ex C.Chr.	Per.	M, In	Dom. loc.	cc.	1, 3, 4	Dom. loc.
	Heliotropium ramosissimum (Lehm.) Sieb. ex. A. DC.	Per.	Mg, H, Y	Occ.	cc.	N.R. in Sinai	
	Moltkiopsis ciliata (Forssk.) I. M. Johnst.	Per.	M, L, In	Cp.	c.	1, 3, 4	Dom. loc.
Capparaceae	*Capparis spinosa* L. var. *spinosa*	Per.	In	Spor.	cc.	2, 4	Dom. loc.
	Cleome amblyocarpa Barratte & Murb.	Ann.	M, Mg, H, L, Y, In	Dom. loc.	cc.	1, 2, 3, 4	Cp.
Caryophyllaceae	*Gymnocarpos decandrus* Forssk.	Per.	Mg, H, L, Y	Cp.	cc.	1, 2, 3, 4	Dom.
	Gypsophila capillaris (Forssk.) C. Chr.	Ann.	Mg, H, Y	Occ.	c.	2	Cp.
	Herniaria hirsute L.	Ann.	M, L	Cp.	c.	1, 2, 3, 4	Cp.
	Paronychia arabica (L.) DC.	Ann.	M, H, L	Cp.	r.	1, 2, 3, 4	Cp.
	Paronychia argentea Lam.	Ann.	M	Occ.	r.	1	Occ.
	Paronychia sinaica Fresen.	Per.	Mg	Spor.	r.	1, 2, 4	Cp.
	Polycarpaea repens (Forssk.) Asch. & Schweinf.	Per.	M, In	Spor.	cc.	1, 3, 4	Cp.
	Polycarpon prostratum (Forssk.) Asch. & Schweinf.	Ann.	L	Spor.	c.	N.R. in Sinai	
	Polycarpon succulentum (Delile) J. Gay	Ann.	M	Spor.	cc.	1	Cp.
	Polycarpon tetraphyllum (L.) L. var. *Alsinifolium* (Biv.) Ball	Ann.	M	Spor.	c.	1	Cp.
	Silene succulenta Forssk.	Per.	M	Spor.	c.	1	Cp.
	Silene villosa Forssk.	Per.	M	Cp.	r.	1, 3, 4	Cp.
	Spergula fallax (Lowe) E.H.L. Krause	Ann.	M	Spor.	c.	1, 2, 4	Cp.
	Spergularia diandra (Guss.) Boiss.	Ann.	M	Spor.	cc.	1, 2, 4	Cp.
	Spergularia marina (L.) Bessler	Ann.	M	Spor.	cc.	1, 2, 4	Cp.
Chenopodiaceae	*Agathophora alopecuroides* (Delile) Fenzl ex Bunge	Per.	Mg, H	Occ.	r.	1, 2, 4	Dom.
	Anabasis articulata (Forssk.) Moq.	Per.	M, Mg, H, L, Y, In	Dom. loc.	cc.	1, 2, 3, 4	Dom.
	Anabasis setifera Moq.	Per.	Mg, L, In	Occ.	c.	1, 3, 4	Dom. loc.
	Arthrocnemum macrostachyum (Moric.) K. Koch	Per.	M	Cp.	c.	1	Dom.
	Atriplex farinosa Forssk.	Per.	Mg	Spor.	r.	N.R. in study area	
	Atriplex halimus L.	Per.	M	Occ.	c.	1, 2, 4	Dom.
	Atriplex leucoclada Boiss.	Per.	M, Mg	Spor.	r.	2, 4	Dom.
	Atriplex rosea L.	Ann.	M	Occ.	rr.	N.R. in Sinai	
	Bassia muricata (L.) Asch.	Ann.	M, H, In	Cp.	cc.	1, 2, 3, 4	Cp.
	Chenopodium album L.	Ann.	M	Cp.	c.	1	Cp.
	Chenopodium glaucum L.	Ann.	M	Occ.	rr.	N.R. in Sinai	
	Chenopodium murale L.	Ann.	M	Cp.	cc.	1, 4	Cp.
	Cornulaca monacantha Delile	Per.	M, Mg, H, L, Y, In	Dom.	c.	1, 3, 4	Dom.
	Halocnemum strobilaceum (Pall.) M. Bieb.	Per.	M	Occ.	c.	1	Dom.
	Haloxylon salicornicum (Moq.) Bunge ex Boiss.	Per.	Mg, Y, In	Dom. loc.	cc.	1, 2, 3, 4	Dom.
	Haloxylon scoparium Pomel	Per.	M, H, Y	Cp.	r.	1, 2, 3, 4	Dom.
	Noaea mucronata (Forssk.) Asch. & Schweinf.	Per.	Mg, L	Spor.	c.	1, 2, 3, 4	Dom.

Table (2): continued

	Salsola kali L.	Ann.	M	Spor.	c.	1	Cp.
	Salsola longifolia Forssk.	Per.	H	Spor.	r.	4	Spor.
	Sarcocornia fruticosa (L.) A. J. Scott	Per.	M	Spor.	c.	1	Dom. loc.
	Suaeda pruinosa Lange	Per.	M	Spor.	r.	N.R. in Sinai	
Cistaceae	*Helianthemum lippii* (L.) Dum. Cours.	Per.	M, In	Cp.	cc.	1, 2, 3, 4	Dom. loc.
	Helianthemum sancti-antonii Schweinf. ex Boiss.	Per.	Mg	Spor.	rr.	4	Cp.
Compositae	*Achillea fragrantissima* (Forssk.)Sch.Bip.	Per.	M, Mg, H, Y	Cp.	c.	1, 2, 4	Dom.
	Achillea santolina L.	Per.	M, In	Cp.	c.	1	Spor.
	Artemisia judaica L.	Per.	M	Spor.	r.	2	Dom.
	Artemisia monosperma Delile	Per.	M, Mg, H, L, Y, In	Dom.	cc.	1, 2, 3, 4	Dom.
	Atractylis boulosii Täckh.	Ann.	L	Spor.	rr.	N.R. in Sinai	
	Atractylis carduus (Forssk.) C. Chr.	Per.	M	Occ.	c.	1, 2, 3, 4	Cp.
	Atractylis mernephthae Asch.	Ann.	H,L	Spor.	rr.	3	Spor.
	Atractylis serratuloides Sieber ex Cass.	Per.	Mg, L	Occ.	r.	N.R. in Sinai	
	Calendula arvensis L.	Ann.	M, In	Occ.	r.	1	Occ.
	Calendula tripterocarpa Rupr.	Ann.	M	Spor.	r.	4	Occ.
	Carduus getulus Pomel	Ann.	M	Spor.	c.	1, 4	Spor.
	Carduus pycnocephalus L.	Ann.	M	Spor.	c.	N.R. in Sinai	
	Centaurea aegyptiaca L.	Per.	Mg, L, Y	Cp.	cc.	1, 2, 3, 4	Cp.
	Centaurea eryngioides Lam.	Per.	M	Cp.	r.	4	Cp.
	Centaurea pallescens Delile	Ann.	Mg, H, L, In	Cp.	cc.	1, 2, 4	Cp.
	Chiliadenus montanus (Vahl) Brullo	Per.	M, Mg, H, Y	Cp.	r.	N.R. in study area	
	Echinops galalensis Schweinf.	Per.	Mg, H	Occ.	r.	4	Occ.
	Echinops spinosus L.	Per.	M, Mg, H, Y	Dom.	cc.	N.R. in Sinai	
	Filago desertorum Pomel	Ann.	M	Spor.	cc.	1, 2, 3, 4	Cp.
	Hedypnois rhagadioloides (L.) F.W. Schmidt	Ann.	In	Spor.	cc.	1, 4	Occ.
	Iflago spicata (Forssk.) Sch. Bip.	Ann.	M, In	Spor.	r.	1, 2, 3, 4	Cp.
	Iphiona mucronata (Forssk.) Asch. & Schweinf.	Per.	M	Spor.	c.	2, 4	Cp.
	Iphiona scabra DC.	Per.	H, L	Spor.	r.	2, 4	Cp.
	Koelpinia linearis Pall.	Ann.	M	Spor.	r.	4	Cp.
	Launaea capitata (Spreng.) Dandy	Ann.	H	Spor.	cc.	1, 2, 3, 4	Cp.
	Launaea fragilis (Asso) Pau	Ann.	M	Spor.	r.	1, 3	Cp.
	Launaea mucronate (Forssk.) Muschl.	Ann.	M, In	Occ.	c.	1, 2, 3, 4	Cp.
	Launaea nudicaulis (L.) Hook. f.	Per.	L	Spor.	cc.	1, 2, 3, 4	Cp.
	Nauplius graveolens (Forssk.) Wiklund	Per.	Mg	Spor.	rr.	1, 2, 3, 4	Cp.
	Phagnalon barbeyanum Asch. & Schweinf.	Per.	L	Spor.	r.	1, 2, 4	Cp.
	Picris altissima Delile	Ann.	M	Spor.	c.	N.R. in Sinai	
	Picris longirostris Sch. Bip.	Ann.	M	Spor.	rr.	4	Cp.
	Pluchea dioscorides (L.) DC.	Per.	M	Spor.	cc.	N.R. in Sinai	
	Pulicaria undulata (L.) C.A.Mey.	Per.	Y	Occ.	cc.	N.R. in Sinai	
	Reichardia tingitana (L.) Roth	Ann.	M, L, In	Occ.	c.	1, 2, 4	Cp.
	Senecio glaucus L. subsp. *coronopifolius* (Maire) C. Alexander	Ann.	M, H, In	Dom.	cc.	1, 2, 3, 4	Cp.
	Senecio glaucus L. subsp. *glaucus*	Ann.	M, H	Cp.	c.	1, 2, 4	Cp.
	Seriphidium herba-album (Asso) Soják	Per.	Mg, L, Y	Occ.	c.	1, 2, 3, 4	Dom.
	Sonchus asper (L.) Hill	Ann.	M	Spor.	c.	N.R. in Sinai	
	Sonchus tenerrimus L.	Ann.	M	Spor.	rr.	N.R. in Sinai	
	Urospermum picroides (L.) F.W. Schmidt	Ann.	M	Occ.	cc.	1, 4	Cp.
	Xanthium spinosum L.	Per.	M	Spor.	c.	1	Occ.
Convolvulaceae	*Convolvulus lanatus* Vahl	Per.	M, Mg, H	Cp.	r.	1, 3, 4	Dom. loc.
	Convolvulus oleifolius Desr.	Per.	In	Spor.	rr.	4	Occ.
	Convolvulus pilosellifolius Desr.	Per.	Mg, In	Cp.	r.	4	Spor.
	Ipomoea stolonifera (Cyr.) J. F.Gmel.	Per.	M	Spor.	r.	N.R. in Sinai	
Cruciferae	*Anastatica hierochuntica* L.	Ann.	Mg	Spor.	c.	2, 4	Dom. loc.
	Brassica deserti Danin & Hedge	Ann.	M	Spor.	rr.	2	Dom. loc.
	Brassica tournefortii Gouan	Ann.	M	Spor.	cc.	1, 2, 3	Cp.
	Cakile maritime Scop.	Ann.	M	Spor.	c.	N.R. in Sinai	
	Carrichtera annua (L.) DC.	Ann.	M	Spor.	c.	2, 4	Occ.
	Conringia orientalis (L.) Dumort.	Ann.	Mg	Spor.	rr.	N.R. in Sinai	
	Diplotaxis acris (Forssk.) Boiss.	Ann.	M	Spor.	c.	2, 3, 4	Dom.
	Diplotaxis erucoides (L.) DC.	Ann.	M	Occ.	r.	1	Occ.
	Diplotaxis harra (Forssk.) Boiss.	Per.	Mg, H, Y	Occ.	cc.	2, 4	Dom.
	Eremobium aegyptiacum (Spreng.) Asch. & Schweinf. ex Boiss. var. *egyptiacum*	Per.	M	Spor.	cc.	1, 2, 3	Dom.
	Eremobium aegyptiacum (Spreng.) Asch.&Schweinf. ex Boiss. var. *lineare* (Delile) Zohary	Ann.	In	Spor.	rr.	1, 2, 3	Cp.
	Eruca sativa Mill.	Ann.	M	Spor.	cc.	N.R. in Sinai	
	Erucaria hispanica (L.) Druce	Ann.	M	Occ.	c.	N.R. in Sinai	
	Farsetia aegyptia Turra	Per.	M, Mg, H, L, Y, In	Cp.	cc.	1, 2, 3, 4	Cp.
	Lobularia arabica (Boiss.) Muschl.	Ann.	M	Cp.	c.	1	Occ.
	Lobularia libyca (Viv.) C. F. W. Meissn.	Ann.	M	Spor.	c.	1	Spor.
	Malcolmia pygmaea (DC.) Boiss.	Ann.	M	Spor.	c.	N.R. in Sinai	

Table (2): continued

	Matthiola longipetala (Vent.) DC. subsp. *livida* (Delile) Maire	Ann.	M, Mg	Cp.	cc.	2, 4	Cp.
	Morettia canescens Boiss.	Per.	H, In	Spor.	rr.	2	Cp.
	Moricandia nitens (Viv.) Durand & Barratte	Per.	Mg, L	Occ.	r.	2, 4	Cp.
	Savignya parviflora (Delile) Webb	Ann.	M, In	Occ.	c.	1, 2, 3, 4	Cp.
	Sisymbrium irio L.	Ann.	M	Occ.	cc.	4	Cp.
	Zilla spinosa (L.) Prantl subsp. *spinosa*	Per.	M, Mg, H, Y	Dom.	c.	1, 2, 3, 4	Dom.
Cucurbitaceae	*Citrullus colocynthis* (L.) Schrad.	Per.	Mg, H	Spor.	cc.	1, 2, 3, 4	Cp.
Cupressaceae	*Juniperus phoenicea* L.	Per.	Mg, H, Y	Occ.	rr.	4	Dom.
Cyperaceae	*Cyperus capitatus* Vend.	Per.	M	Occ.	c.	N.R. in Sinai	
	Cyperus glaber L.	Per.	M, In	Spor.	N.R.	N.R. in Sinai	
Dipsacaceae	*Pterocephalus plumosus* (L.) Coult.	Ann.	Mg, H	Spor.	r.	N.R. in Sinai	
	Scabiosa eremophila Boiss.	Ann.	M	Spor.	r.	1	Occ.
Ephedraceae	*Ephedra alata* Decne.	Per.	H	Spor.	c.	1, 2, 4	Dom.
Euphorbiaceae	*Andrachne aspera* Spreng.	Per.	Y	Spor.	r.	2	Cp.
	Andrachne telephioides L.	Per.	Mg, H	Occ.	r.	2, 4	Occ.
	Chrozophora tinctoria (L.) Raf.	Ann.	H	Spor.	c.	1, 2, 4	Occ.
	Euphorbia peplis L.	Ann.	M	Cp.	r.	1	Spor.
	Euphorbia retusa Forssk.	Per.	M, Mg, H, L, Y, In	Cp.	c.	1, 2, 3, 4	Cp.
	Euphorbia terracina L.	Per.	M	Spor.	c.	1	Occ.
	Ricinus communis L.	Ann., Per.	M	Cp.	c.	1	Cp.
Fumariaceae	*Hypecoum pendulum* L.	Ann.	M	Spor.	r.	N.R. in Sinai	
Geraniaceae	*Erodium chium* (L.) Willd.	Ann.	M	Spor.	r.	N.R. in Sinai	
	Erodium ciconium (L.) L'Hér.	Ann.	M	Spor.	r.	1	Occ.
	Erodium crassifolium L'Hér.	Per.	M	Spor.	cc.	2, 4	Dom. loc.
	Erodium laciniatum (Cav.) Willd.	Ann.	M, Mg, L	Occ.	r.	1, 2, 4	Dom. loc.
	Erodium laciniatum (Cav.) Willd. subsp. *pulverulentum* (Boiss.) Batt.	Ann.	M	Cp.	cc.	N.R. in Sinai	
	Monsonia nivea (Decne.) Webb	Per.	In	Spor.	c.	1, 2, 3, 4	Dom. Loc.
Globulariaceae	*Globularia arabica* Jaub. & Spach.	Per.	M, Mg, H, Y	Cp.	c.	4	Dom. loc.
Gramineae	*Aegilops kotschyi* Boiss.	Ann.	M	Spor.	c.	N.R. in Sinai	
	Aegilops longissima Schweinf. & Muschl.	Ann.	M	Spor.	r.	N.R. in Sinai	
	Ammochloa palaestina Boiss.	Ann.	M	Spor.	r.	1	Occ.
	Avena barbata Pott ex Link	Ann.	M	Occ.	cc.	1, 2, 4	Occ.
	Bromus rubens L.	Ann.	M	Occ.	c.	2	Occ.
	Cutandia dichotoma (Forssk.) Batt. & Trab.	Ann.	M	Spor.	cc.	N.R. in study area	
	Cutandia memphitica (Spreng.) Benth.	Ann.	M	Spor.	cc.	1, 2, 3, 4	Dom. loc.
	Cymbopogon schoenanthus (L.) Spreng.	Per.	H	Spor.	rr.	N.R. in Sinai	
	Cynodon dactylon (L.) Pers.	Per.	M, In	Dom. loc.	cc.	1, 2, 4	Dom. loc.
	Eremopyrum bonaepartis (Spreng.) Nevski	Ann.	M	Spor.	rr.	4	Occ.
	Hordeum murinum L. subsp. *glaucum* (Steud.) Tzvelev	Ann.	M	Occ.	c.	1, 2, 4	Cp.
	Hordeum vulgare L.	Ann.	M	Spor.	r.	N.R. in Sinai	
	Hyparrhenia hirta (L.) Stapf	Per.	Mg	Spor.	r.	1, 2, 4	Cp.
	Imperata cylindrica (L.) Raeusch.	Per.	M	Spor.	cc.	1, 2, 4	Dom. loc.
	Lolium multiflorum Lam.	Ann.	M	Spor.	cc.	1	Occ.
	Lophochloa berythea (Boiss & Blanchet) Bor	Ann.	M	Occ.		1, 4	Cp.
	Panicum turgidum Forssk.	Per.	M, Mg, H, L, Y, In	Dom.	cc.	1, 2, 3, 4	Dom.
	Parapholis marginata Runem.	Ann.	M	Spor.	cc.	N.R. in Sinai	
	Phragmites australis (Cav.) Trin. ex Steud.	Per.	M	Cp.	cc.	1, 4	Dom. loc.
	Poa annua L.	Ann.	Mg	Spor.	c.	N.R. in Sinai	
	Poa infirma Kunth	Ann.	M	Spor.	c.	N.R. in Sinai	
	Polypogon monspeliensis (L.) Desf.	Ann.	In	Spor.	cc.	2, 4	Cp.
	Rostraria pumila (Desf.) Tzvelev	Ann.	M	Spor.	c.	N.R. in Sinai	
	Schismus arabicus Nees	Ann.	H	Occ.	c.	1, 2, 3, 4	Cp.
	Schismus barbatus (L.) Thell.	Ann.	M	Cp.	cc.	N.R. in Sinai	
	Setaria verticillata (L.) P. Beauv.	Ann.	M	Spor.	cc.	1	Cp.
	Stipagrostis ciliata (Desf.) De Winter	Per.	In	Spor.	c.	1, 2, 3, 4	Cp.
	Stipagrostis scoparia (Trin. & Rupr.) De Winter	Per.	M, Mg, H, In	Dom.	c.	1, 3, 4	Dom.
	Tetrapogon cenchriformis (A. Rich.) Clayton	Ann.	L	Spor.	rr.	N.R. in Sinai	
	Trisetaria linearis Forssk.	Ann.	L	Spor.	r.	N.R. in Sinai	
	Vulpia pectinella (Delile) Boiss.	Ann.	M	Spor.	r.	N.R. in Sinai	
Hycinthaceae	*Dipcadi erythraeum* Webb & Berthel.	Per.	M	Spor.	c.	3	Occ.
	Leopoldia comosa (L.) Parl.	Per.	M	Spor.	r.	1	Occ.
	Urginea maritima (L.) Baker	Per.	M, H	Cp.	r.	1, 4	Cp.
Juncaceae	*Juncus rigidus* Desf.	Per.	Mg	Occ.	cc.	1, 2, 4	Dom.
Labiatae	*Ballota undulata* (Fresen.) Benth.	Per.	Mg, H, Y	Cp.	r.	2, 4	Cp.
	Lavandula pubescens Decne.	Per.	Mg	Spor.	c.	2, 4	Cp.
	Salvia aegyptiaca L.	Per.	Mg, H, L, Y	Cp.	cc.	2, 4	Dom.
	Salvia lanigera Poir.	Per.	M	Spor.	c.	1, 2, 3, 4	Cp.
	Stachys aegyptiaca Pers.	Per.	M, Mg, H, L, Y	Cp.	cc.	2, 4	Dom.

Table (2): continued

	Teucrium leucocladum Boiss.	Per.	Mg, L	Spor.	rr.	2	Cp.
	Teucrium polium L.	Per.	Mg, H, Y	Occ.	c.	2, 4	Cp.
Leguminosae	*Acacia pachyceras* O. Schwartz	Per.	Mg	Occ.	rr.	2, 4	Dom. loc.
	Acacia tortilis (Forssk.) Hayne	Per.	M, Mg, H, Y, In	Dom. loc.	r.	2, 4	Occ.
	Alhagi graecorum Boiss.	Per.	M, In	Cp.	cc.	N.R. in Sinai	
	Astragalus annularis Forssk.	Ann.	M	Spor.	c.	1, 2, 4	Occ.
	Astragalus fruticosus Forssk.	Per.	M	Spor.	r.	N.R. in study area	
	Astragalus peregrinus Vahl	Ann.	M	Spor.	c.	N.R. in Sinai	
	Astragalus sieberi DC.	Per.	Mg	Spor.	c.	2	Occ.
	Astragalus spinosus (Forssk.) Muschl.	Per.	Mg, H, Y	Cp.	cc.	2	Cp.
	Astragalus trigonus DC.	Per.	In	Spor.	c.	2	Occ.
	Colutea istria Mill.	Per.	M, Mg	Spor.	rr.	4	Cp.
	Hippocrepis areolata Desv.	Ann.	M	Spor.	cc.	1, 2, 4	Cp.
	Hippocrepis cyclocarpa Murb.	Ann.	M	Spor.	cc.	N.R. in Sinai	
	Lathyrus marmoratus Boiss. & Blanche	Ann.	M	Spor.	cc.	N.R. in Sinai	
	Lotus halophilus Boiss. & Spruner	Ann.	M, L, In	Dom. loc.	cc.	1, 3, 4	Dom. loc.
	Medicago laciniata (L.) Mill.	Ann.	M	Spor.	r.	2, 4	Cp.
	Medicago sativa L.	Per.	M	Cp.	c.	1	Spor.
	Melilotus indicus (L.) All.	Ann.	M	Cp.	cc.	1, 4	Cp.
	Ononis reclinata L.	Ann.	M	Spor.	c.	4	Cp.
	Ononis serrata Forssk.	Ann.	M	Cp.	c.	1, 4	Cp.
	Ononis sicula Guss.	Ann.	M	Spor.	r.	4	Cp.
	*Retama raetam (*Forssk.) Webb & Berthel.	Per.	M, Mg, H, L, Y, In	Dom.	cc.	1, 2, 3, 4	Dom.
	Tephrosia purpurea (L.) Pers. subsp. *apollinea* (Delile) Hosni & El-Karemy	Per.	In	Spor.	rr.	N.R. in study area	
	Trifolium resupinatum L.	Ann.	M	Occ.	cc.	N.R. in Sinai	
	Trifolium tomentosum L. subsp. *curvisepalum* (Täckh.) Thiéb	Ann.	M	Spor.	rr.	1	Cp.
	Trigonella arabica Delile	Ann.	M	Spor.	r.	1, 2, 4	Cp.
	Trigonella cylindracea Desv.	Ann.	M	Spor.	r.	1	Occ.
	Trigonella stellata Forssk.	Ann.	M	Dom. loc.	c.	1, 2, 3, 4	Cp.
	Vicia sativa L.	Ann.	M	Spor.	r.	N.R. in study area	
Malvaceae	*Malva parviflora* L.	Ann.	M, Mg, H, Y	Dom. Loc.	cc.	1, 2, 4	Dom. loc.
Molluginaceae	*Telephium sphaerospermum* Boiss.	Ann.	H	Spor.	r.	2, 4	Cp.
Neuradaceae	*Neurada procumbens* L.	Ann.	M, Mg, H, L, Y, In	Dom. loc.	c.	1, 2, 3, 4	Cp.
Nitrariaceae	*Nitraria retusa* (Forssk.) Asch.	Per.	M, Mg, H, In	Dom. loc.	cc.	1, 2, 3, 4	Dom. loc.
Orobanchaceae	*Orobanche cernua* Loefl.	Per.	M	Spor.	c.	1, 2, 4	Occ.
Palmae	*Phoenix dactylifera* L.	Per.	M	Cp.	Cult.	1, 2, 4	Cp.
Peganaceae	*Peganum harmala* L.	Per.	Mg, H, L, In	Cp.	c.	1, 2, 4	Dom. loc.
Plantaginaceae	*Plantago afra* L.	Ann.	M	Spor.	r.	1, 2, 4	Cp.
	Plantago albicans L.	Per.	M	Spor.	c.	1	Occ.
	Plantago ovata Forssk.	Ann.	M, In	Cp.	cc.	1, 2, 3, 4	Dom.
Plumbaginaceae	*Limonium pruinosum* (L.) Chaz.	Per.	Mg	Spor.	cc.	1, 2, 4	Cp.
Polygonaceae	*Calligonum polygonoides* L.	Per.	M, Mg, Y	Cp.	rr.	N.R. in Sinai	
	Emex spinosa (L.) Campd.	Ann.	M, Mg, In	Cp.	cc.	1, 3, 4	Cp.
	Persicaria senegalensis (Meisn.) Soják	Per.	M	Spor.	rr.	N.R. in Sinai	
	Polygonum bellardii All.	Ann.	M	Cp.	cc.	N.R. in Sinai	
	Rumex cyprius Murb.	Ann.	Mg	Spor.	c.	1, 4	Cp.
	Rumex pictus Forssk.	Ann.	M	Cp.	c.	1, 3	Cp.
Primulaceae	*Anagallis arvensis* L.	Ann.	M	Occ.	cc.	1, 4	Cp.
Ranunculaceae	*Adonis dentata* Delile	Ann.	M	Spor.	cc.	1, 4	Occ.
	Nigella arvensis L. subsp. *taubertii* (Brand) Maire	Ann.	L	Spor.	r.	N.R. in Sinai	
Resedaceae	*Caylusea hexagyna* (Forssk.) M. L. Green	Ann.	Mg, H, Y	Occ.	cc.	2, 4	Cp.
	Ochradenus baccatus Delile	Per.	Mg, Y	Cp.	c.	2, 4	Cp.
	Oligomeris linifolia (Vahl ex Hornem.) J.F.Macbr.	Ann.	M	Spor.	cc.	1, 2, 4	Cp.
	Reseda arabica Boiss.	Ann.	Mg, L	Cp.	cc.	2, 4	Cp.
	Reseda orientalis (Müll. Arg.) Boiss.	Ann.	H	Spor.	rr.	N.R. in Sinai	
	Reseda urnigera Webb	Ann.	In	Spor.	r.	N.R. in Sinai	
Rubiaceae	*Crucianella membranacea* Boiss.	Ann.	M, Mg	Spor.	r.	1	Cp.
Rutaceae	*Haplophyllum tuberculatum* (Forssk.) Juss.	Per.	M, Mg, L	Cp.	cc.	1, 2, 3, 4	Cp.
Scrophulariaceae	*Kickxia floribunda* (Boiss.) Täckh.&Boulos	Per.	Mg	Spor.	r.	2, 4	Cp.
	Linaria haelava (Forssk.) Delile	Ann.	M	Cp.	c.	2, 3, 4	Cp.
	Linaria tenuis (Viv.) Spreng.	Ann.	M	Cp.	r.	1	Cp.
	Scrophularia syriaca Benth.	Per.	H	Spor.	N.R.	N.R. in Sinai	
	Verbascum fruticulosum Post	Per.	H	Spor.	rr.	2, 4	Cp.
Solanaceae	*Hyoscyamus muticus* L.	Per.	M, Mg, In	Dom. loc.	cc.	1, 2, 3, 4	Cp.

Table (2): continued

	Lycium shawii Roem. & Schult.	Per.	M, Mg, H, L, Y	Dom.	cc.	1, 2, 3, 4	Dom.
	Nicotiana glauca R.C.Graham	Per.	M	Occ.	c.	1	Cp.
	Solanum elaeagnifolium Cav.	Per.	M	Spor.	r.	1	Cp.
	Solanum nigrum L.	Ann.	M	Spor.	cc.	1	Cp.
	Solanum sinaicum Boiss.	Per.	M	Spor.	rr.	4	Cp.
Tamaricaceae	*Reaumuria hirtella* Jaub. & Spach	Per.	M, Mg, H, Y, In	Cp.	cc.	1, 2, 4	Dom.
	Tamarix aphylla (L.) H. Karst.	Per.	Mg	Spor.	cc.	1, 2, 4	Dom. loc.
	Tamarix nilotica (Ehrenb.) Bunge	Per.	M, Mg, H, In	Dom.	cc.	1, 2, 4	Dom.
	Tamarix tetragyna Ehrenb.	Per.	M	Spor.	c.	4	Occ.
Thymelaceae	*Thymelaea hirsuta* (L.) Endl.	Per.	M, Mg, H, L, In	Dom.	cc.	1, 2, 3, 4	Dom. loc.
Umbellifera	*Deverra tortuosa* (Desf.) DC.	Per.	M, Mg	Spor.	cc.	1, 2, 3, 4	Dom. loc.
	Deverra triradiata Hochst. ex Boiss.	Per.	Y	Spor.	r.	1, 2, 3, 4	Cp.
	Eryngium glomeratum Lam.	Per.	H	Spor.	rr.	4	Occ.
	Ferula sinaica Boiss.	Per.	Mg	Spor.	rr.	1	Occ.
	Ridolifa segetum (L.)Moris	Ann.	M	Spor.	rr.	1	Occ.
Urticaceae	*Urtica urens* L.	Ann.	M	Occ.	cc.	1	Occ.
Zygophyllaceae	*Fagonia arabica* L.	Per.	M, Mg, H, L, Y, In	Dom.	cc.	1, 2, 3, 4	Dom.
	Fagonia glutinosa Delile	Per.	Mg, In	Spor.	c.	1, 2, 3, 4	Dom. loc.
	Fagonia mollis Delile	Per.	Mg, H, Y	Cp.	c.	2, 3, 4	Dom.
	Fagonia scabra Forssk.	Per.	Mg, H, L, Y	Cp.	r.	2, 4	Cp.
	Tribulus kaiseri Hosni	Ann.	Mg	Spor.		N.R. in Sinai	
	Tribulus terrestris L.	Ann.	M	Occ.	c.	1	Occ.
	Zygophyllum album L.f.	Per.	M, Mg, L, In	Spor.	cc.	1, 2	Dom.
	Zygophyllum coccineum L.	Per.	Y	Dom. loc.	cc.	1, 2	Dom.
	Zygophyllum dumosum Boiss.	Per.	Mg, H, L, Y, In	Spor.	rr.	1, 2, 3, 4	Dom.
	Zygophyllum simplex L.	Ann. or Bi.	M, In	Cp.	cc.	1, 2	Dom.

Reseda kahirina was recorded on G. Maghara in 1957 (Boulos, 1960) and enumerated in Täckholm (1974) but not in Boulos (1999). *Pennisetum elatum* was not recorded since Täckholm (1974). Fifty-three peceis were recorded only in Täckholm (1974). Eight of them, *Aristolochia maurorum*, *Anthemis hebronica*, *Eragrostis sarmentosa*, *Lathyrus setifolius*, *Trifolium lappaceum*, *Trifolium medium*, *Plantago bellardii*, and *Aegilops crassa*, were considered by Gibali (1988) as doubtful records or needs verification. Eighty-eight species were not recroded since 1967-1971 survey (Danin *et al.*, 1985) including nine species (*Atriplex glauca, Centaurea procurrens, Conyza Canadensis, Crotalaria aegyptiaca, Reseda stenostachya, Salsola cyclophylla, Scirpus holoschoenus* var. *australis, Suaeda palaestina, Varthemia iphionoides*) were recorded as either dominant or dominant local. Two-hundred and seventy four species were recorded by Danin *et al.* (1985) and other recent surveys (e.g. Gibali, 1988; and El Hadidi *et al.*, 1989) but not present survey. The list of these species includes 88 species were recorded as dominant or dominant local, clueing to the degree of deterioration in natural vegetation of the area since 1967-1971 survey. Nintey one (56.88%) of the 160 species recorded by Boulos and Gibali (1993) in North Sinai as rare and/or threatened species have not been recorded in present survey.

The present floristic list includ three new records; *Cyperus glaber* which is a new record to Egypt, *Persicaria sengalensis* which is a new record to Sinai, and *Eminium spiculatum* subsp. *negevensis* which is a new record to North Sinai. *Lophochloa berythea* was collected in present survey and by Danin *et al.* (1985), altghouh it is not included in the Flora of Egypt (Täckholm, 1974; and Boulos 2005).

The present survey confirms the presence of *Scrophularia syriaca* that was reported as new record to the Egyptian flora by Gibali (1988) and presence of *Reseda orientalis* that was categorized as doubtfull by Gibali (1988). Other confirmed species include *Allium curtum* subsp. *curtum*, *Asparagus aphyllus*, *Atractylis boulosii*, *Atriplex rosea*, *Hypecoum pendulum*, *Parapholis marginata*, *Persicaria senegalensis*, *Polygonum bellardii*, *Pterocephalus plumosus*, *Reseda urnigera*, and *Vulpia pectinella* which were not recorded since Täckholm (1974).

Three-hundred and forty-nine species (51.3%) of the recorded species by Danin *et al.* (1985) were disappeared in the present survey. This explains the low Sørenson's similarity between the present and the previous surveys (49.6 %) and, in the meantime, reflects the magnitude of change in species composition occurred since the previous survey (1967-1971). Supportive to this result, the RELATE function has not detected any significant relation (global R = 1, significance level = 16.4%) between the species composition of the present and previous surveys.

The inland area was the most affected by species loss where the recorded species decreased from 283 to 58 (79.5% loss). Species loss percentage decreased from 79.5% in inland area to 64.2% in anticlines and 43.3% in Mediterranean area. Losses in the recorded number of species was reflected in increasing diversity between different eco-geomorphological areas where similarity

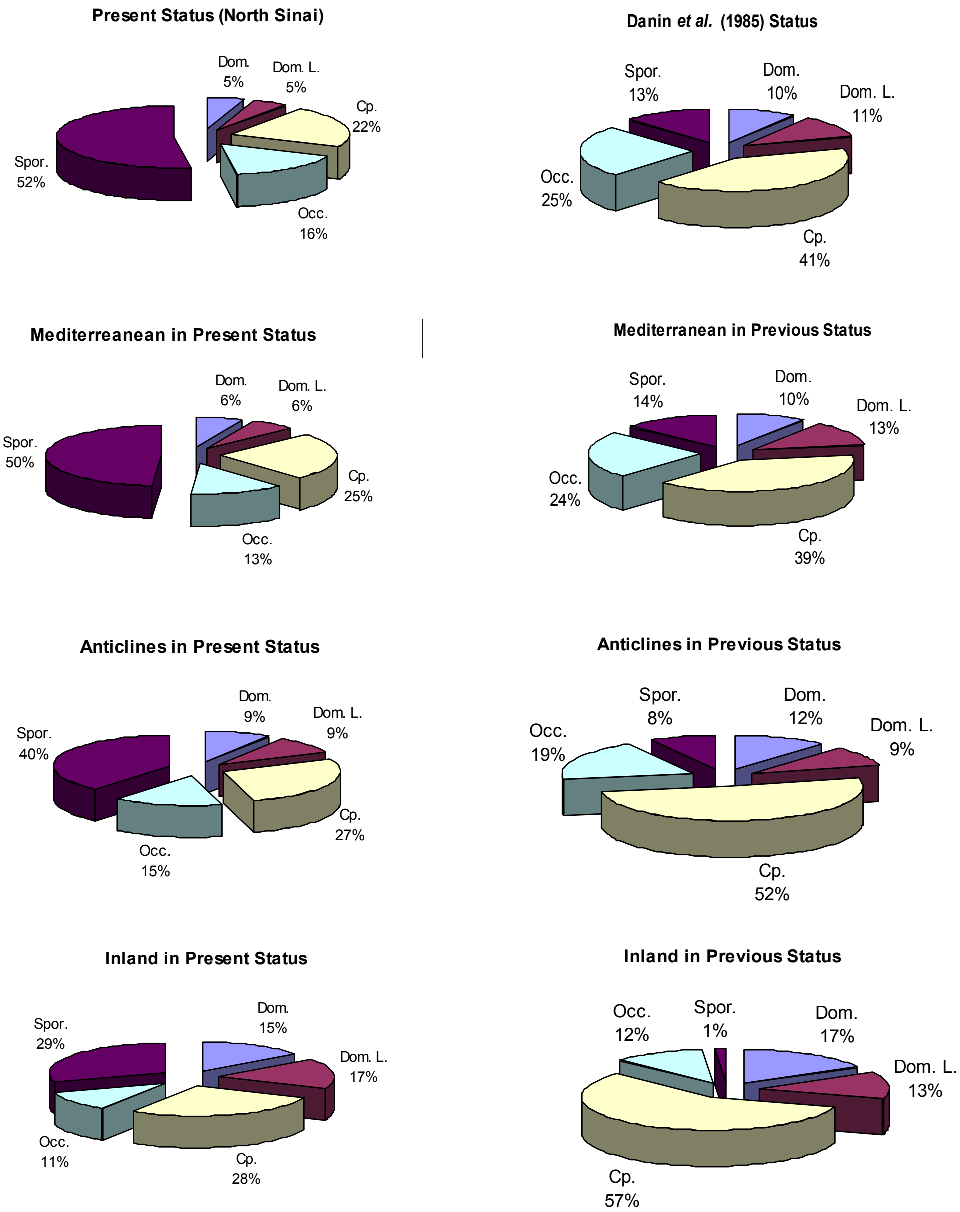

Figure (2): Distributional composition of present and previous (Danin *et al.*, 1985) statuses of North Sinai.

between different eco-geomorphological areas has been.reduced over the time elapsed between two surveys. It changed form 83.60% between anticlines and inland to 36.84%, from 67.94% to 31.78%, and from 67.33% to 29.39% between Mediterranean coast and inland, respectively.

Not only was the floristic composition changed but also the distribution of the recorded species. While present study revealed that majority (52.3%) of the North Sinai flora are sporadic, only 12.7% was recorded as sporadic by Danin *et al.* (1985). The change was at its maximum in Mediterranean coastal area where the percentage of sporadic species changed from 14% to 50% (figure 2), followed by anticlinal (from 8% to 40%) and inland area (from 1% to 29%).

Changes in floristic structure

Changes in floristic composition resulted in changes in floristic structure (distribution of the species among families). The most affected families were Compositae (39 spp., 48.1% loss), Gramineae (38 spp., 55.1% loss), Leguminosae (26 spp., 48.1% loss), and Chenopodiaceae (23 spp., 52.3% loss), while the most affected families by percentage of loss were Amaranthaceae (6 spp., 85.7% loss), Malvaceae (4 spp., 80.0% loss), Asphodelaceae (3 spp., 75.0% loss), Cistaceae (6 spp., 75.% loss), and Boraginaceae (13 spp., 72.2% loss). Twenty families (27.7% of previous status) were entirely not represented in the current survey: Acanthaceae, Anacardiaceae, Aspleniaceae, Berberidaceae, Crassulaceae, Cynomoriaceae, Frankeniaceae, Iridaceae, Liliaceae, Menispermaceae, Onagraceae, Oxalidaceae, Papaveraceae, Polygalaceae, Portulaceae, Rhamnaceae, Santalaceae, Sinopteridaceae, Typhaceae, and Verbenaceae (Table 3). At the genus level, 127 genera were not represented in the current survey (40.2% of previous status). The most affected families were Compositae (26 genera, 51.0%) and Gramineae (23 genera, 47.9%). Relative to the original number of genera, Rubiaceae (4 genera, 80.0%), Malvaceae (3 genera, 75.0%), and Boraginaceae (6 genera, 66.7%) were the most affected families (Table 3).

The RELATE function did not detect any relation between the current and previous surveys (global R= 0.5, and significance level = 49.1%) in floristic structure reflecting the change over time. Also, the similarity in floristic structure between eco-geomorphological areas has been reduced from 82.94% to 60.28% between anticlines and inland, from 78.23% to 72.29% between Mediterranean coast and anticlines, and from 78.17% to 56.78% between Mediterranean and inland.

These results of change in floristic structure were strengthened by Friedman test results (Table 4) where it showed a significant difference between the surveys (present, previous, and virtual previous) in number of species, number of genera, and the number of species with different degree of occurrence in each family.

Beta diversity between the present and previous surveys indicates that change in floristic structure is higher in inland area (β_T = 0.32), followed by Mediterranean area and anticlines (β_T = 0.20 and 0.19, respectively).

Discussion

Change in floristic composition and structure due to human disturbances (e.g. Abbott *et al.*, 2000, Felfili *et al.*, 2000, and Ruhan *et al.*, 2001) and/or climatic change (e.g. Medina, 2003; Anenkhonov and Krivobokov, 2006) have been documented worldwide. The comparisons of the floristic composition and structure in present study revealed that the flora of North Sinai has changed dramatically in the past 40-50 years. More than 60% of the previously recorded species are not recorded in present survey. The most affected families by loss of species are the most represented families in North Sinai flora; Compositae, Gramineae, Leguminosae, and Chenopodiaceae, while the most affected families by percentage of loss are Amaranthaceae, Malvaceae, Asphodelaceae, Cistaceae, and Boraginaceae where their species are normally poorly found. Twenty families were represented before but not in current survey. Off course this list of not recorded species and families would be reduced if a multi year survey is carried out. It is well known that poor recording of species has natural and methodological reasons (Danin *et al.*, 1985). Annual species which develop only in rainy years may be regarded as rare plants or even not recorded at all if only dry weather prevailed during the study time. However, the high percent of not recorded floristic list (62.3%) indicates that real changes in floristic composition and structure have been occurred.

Beside the prevailing drought, the recorded changes could be attributed to increment of unmanaged human-induced threats affecting wild plants. These threats include; (1) Over-cutting for fuel use, (2) Over-collection for household use and trade, (3) Overgrazing, (4) Urbanization including extensive land reclamation, and establishment of settlements and infrastructure, and (5) Quarrying. The ordering of threats differs from district to district, site to site and from species to species. The present study revealed that inland district, which been affected mostly by drought, over-grazing, and over-collection, is the most affected eco-geomorphological area, followed by Mediterranean coast and anticlines.

In Mediterranean coastal area, the most destructive threats are the over-collection and urbanization activities. Each family (with average of 5 persons) consumes about 10 kg of wood daily. The most common and favorable species used as a fuel are *Anabasis articulata, Artemisia judaica, Retama raetam, Haloxylon salicornicum, Acacia pachyceras*, and *Acacia tortilis*. The over-collection of medicinal species has been carried out for home daily uses, and local and national trade. *Artemisia judaica, Teucrium polium, Citrullus colocynthis, Seriphidium herba-album, Artemisia monosperma*, *Juniperus phoenicea*, and some Lichens are the most prominent items in the market. Urbanization such as extensive land reclamation as in El-Sheikh Zwaied and Rafah, establishment of settlements and infrastructure, and digging wells for establishing new gardens remove natural plant communities and destroy the landscape of the area.

In anticlinal mountainous area (G. Yi'allaq, G. Halal and G. Maghara), quarrying is the most threating activity besides over-cutting and overgrazing. Collection of sands and cobbles by digging and cutting the sedimentary rocks of G. Yi'allaq, G. Maghara and G. Halal cause dangerous disturbance for the plant communities and flrositic composition of the area represented in disappearance of palatable and medicinal species, paucity of trees and soil loss. While Boulos (1960) recorded 199 species in G. Maghara (Table 1), the present survey recorded only 131 from the whole anticalinal area (G. El-Halal, G. El-Maghara, G. Libni, and G. Yi'alleq) which means that 34.2% lose of the previous status in this area. *Acacia pachyceras* and *Acacia tortilis* are the most threatened species in the area as a cause of quarrying. One can observe 2km radius clear of vegetation area around any settlement due to fuel-wood collecting and overgrazing.

The increment in strength of threatening human-induced stresses was basically due to growth of human population size. According to 1996's official census, the total size of the population in North Sinai Governorate

Table (3): Floristic composition of present and previous survey.

	Present Status									Previous Status									Difference between previous and present surveys			
Family	Spp.	%	Genera	%	Dom.	L. Dom.	Cp.	Occ.	Spor.	Spp.	%	Genera	%	Dom.	L. Dom.	Cp.	Occ.	Spor.	Spp.	%	Genera	%
Acanthaceae										1	0.17	1	0.31			1			1	100	1	100
Aizoaceae	4	1.42	2	1.06		1	1		2	4	0.70	2	0.63	2	1	1			0	0.0	0	0.0
Alliaceae	2	0.71	1	0.53					2	5	0.87	1	0.31				3	2	3	60.0	0	0.0
Amaranthaceae	1	0.36	1	0.53					1	7	1.22	1	0.31			5		2	6	85.7	0	0.0
Amaryllidaceae	1	0.36	1	0.53			1			3	0.52	1	0.31			2		1	2	66.7	0	0.0
Anacardiaceae										2	0.35	2	0.63				2		2	100.0	2	100.0
Araceae	1	0.36	1	0.53					1	1	0.17	1	0.31					1	0	0.0	0	0.0
Asclepiadaceae	3	1.07	3	1.59			2	1		5	0.87	4	1.26			2	3		2	40.0	1	25.0
Asparagaceae	2	0.71	1	0.53		1	1			1	0.17	1	0.31			1			-1	-100.0	0	0.0
Asphodelaceae	1	0.36	1	0.53			1			4	0.70	2	0.63			1	2	1	3	75.0	1	50.0
Aspleniaceae										1	0.17	1	0.31					1	1	100.0	1	100.0
Berberidaceae										1	0.17	1	0.31				1		1	100.0	1	100.0
Boraginaceae	5	1.78	3	1.59		1	1	2	1	18	3.14	9	2.83		4	8	4	2	13	72.2	6	66.7
Capparaceae	2	0.71	2	1.06		1			1	5	0.87	2	0.63		1	4			3	60.0	0	0.0
Caryophyllaceae	15	5.34	9	4.76			4	2	9	25	4.36	12	3.77	2	1	17	3	2	10	40.0	3	25.0
Chenopodiaceae	21	7.47	13	6.88	1	2	5	6	7	44	7.68	16	5.03	17	11	5	3	8	23	52.3	3	18.8
Cistaceae	2	0.71	1	0.53			1		1	8	1.40	2	0.63		2	4	1	1	6	75.0	1	50.0
Compositae	42	14.95	25	13.23	3		8	8	23	81	14.14	51	16.04	8	6	43	15	9	39	48.1	26	51.0
Convolvulaceae	4	1.42	2	1.06			2		2	7	1.22	2	0.63		2		2	3	3	42.9	0	0.0
Crassulaceae										2	0.35	2	0.63			1	1		2	100.0	2	100.0
Cruciferae	23	8.19	18	9.52	1		3	6	13	28	4.89	24	7.55	4	4	11	7	2	5	17.9	6	25.0
Cucurbitaceae	1	0.36	1	0.53					1	2	0.35	2	0.63			2			1	50.0	1	50.0
Cupressaceae	1	0.36	1	0.53				1		1	0.17	1	0.31	1					0	0.0	0	0.0
Cynomoriaceae										1	0.17	1	0.31				1		1	100.0	1	100.0
Cyperaceae	2	0.71	1	0.53				1	1	4	0.70	2	0.63		3	1			2	50.0	1	50.0
Dipsacaceae	2	0.71	2	1.06					2	3	0.52	2	0.63			2	1		1	33.3	0	0.0
Ephedraceae	1	0.36	1	0.53					1	3	0.52	1	0.31	1		1		1	2	66.7	0	0.0
Euphorbiaceae	7	2.49	4	2.12			3	1	3	15	2.62	4	1.26		1	5	6	3	8	53.3	0	0.0
Frankeniaceae										2	0.35	1	0.31			1		1	2	100.0	1	100.0
Fumariaceae	1	0.36	1	0.53					1	0	0.00	0	0.00			0			-1		-1	
Geraniaceae	6	2.14	2	1.06			1	1	4	9	1.57	2	0.63		4	3	1	1	3	33.3	0	0.0
Globulariaceae	1	0.36	1	0.53			1			1	0.17	1	0.31		1				0	0.0	0	0.0
Gramineae	31	11.03	25	13.23	2	1	2	5	21	69	12.04	48	15.09	4	6	25	27	7	38	55.1	23	47.9
Hycinthaceae	3	1.07	3	1.59			1		2	9	1.57	6	1.89			2	6	1	6	66.7	3	50.0
Iridaceae										1	0.17	1	0.31			1			1	100.0	1	100.0
Juncaceae	1	0.36	1	0.53				1		2	0.35	1	0.31	1			1		1	50.0	0	0.0
Labiatae	7	2.49	5	2.65			3	1	3	15	2.62	10	3.14	2		8	3	2	8	53.3	5	50.0
Leguminosea	28	9.96	15	7.94	1	3	5	2	17	54	9.42	19	5.97	1	5	19	18	11	26	48.1	4	21.1
Liliaceae										2	0.35	2	0.63			1	1		2	100.0	2	100.0
Malvaceae	1	0.36	1	0.53		1				5	0.87	4	1.26		1	1	2	1	4	80.0	3	75.0
Menispermaceae										1	0.17	1	0.31				1		1	100.0	1	100.0
Molluginaceae	1	0.36	1	0.53					1	1	0.17	1	0.31			1			0	0.0	0	0.0
Neuradaceae	1	0.36	1	0.53		1				1	0.17	1	0.31			1			0	0.0	0	0.0
Nitrariaceae	1	0.36	1	0.53		1				1	0.17	1	0.31		1				0	0.0	0	0.0

Table (3): continued

Onagraceae										1	0.17	1	0.31				1		1	100.0	1	100.0
Orobanchaceae	1	0.36	1	0.53					1	3	0.52	2	0.63			1	2		2	66.7	1	50.0
Oxalidaceae										1	0.17	1	0.31				1		1	100.0	1	100.0
Palmae	1	0.36	1	0.53			1			1	0.17	1	0.31			1			0	0.0	0	0.0
Papaveraceae										1	0.17	1	0.31			1			1	100.0	1	100.0
Peganaceae	1	0.36	1	0.53			1			1	0.17	1	0.31		1				0	0.0	0	0.0
Plantaginaceae	3	1.07	1	0.53			1		2	9	1.57	1	0.31	1		6	2		6	66.7	0	0.0
Plumbaginaceae	1	0.36	1	0.53					1	3	0.52	2	0.63			2	1		2	66.7	1	50.0
Polygalaceae										1	0.17	1	0.31				1		1	100.0	1	100.0
Polygonacaceae	6	2.14	5	2.65			4		2	7	1.22	5	1.57		1	6			1	14.3	0	0.0
Portulacaceae										1	0.17	1	0.31			1			1	100.0	1	100.0
Primulaceae	1	0.36	1	0.53				1		2	0.35	2	0.63			1		1	1	50.0	1	50.0
Ranunculaceae	2	0.71	2	1.06					2	4	0.70	3	0.94			1	2	1	2	50.0	1	33.3
Resedaceae	6	2.14	4	2.12			2	1	3	8	1.40	4	1.26	1	1	6			2	25.0	0	0.0
Rhamnaceae										3	0.52	2	0.63			1	1	1	3	100.0	2	100.0
Rubiaceae	1	0.36	1	0.53					1	6	1.05	5	1.57			1	3	2	5	83.3	4	80.0
Rutaceae	1	0.36	1	0.53			1			2	0.35	1	0.31			1	1		1	50.0	0	0.0
Santalaceae										1	0.17	1	0.31					1	1	100.0	1	100.0
Scrophulariaceae	5	1.78	4	2.12			2		3	12	2.09	5	1.57			11	1		7	58.3	1	20.0
Sinopteridaceae										1	0.17	1	0.31					1	1	100.0	1	100.0
Solanaceae	6	2.14	4	2.12	1	1		1	3	11	1.92	5	1.57	1		8	2		5	45.5	1	20.0
Tamaricaceae	4	1.42	2	1.06	1		1		2	7	1.22	2	0.63	3	1		3		3	42.9	0	0.0
Thymelaeaceae	1	0.36	1	0.53	1					1	0.17	1	0.31		1				0	0.0	0	0.0
Typhaceae										1	0.17	1	0.31			1			1	100.0	1	100.0
Umberlliferae	5	1.78	4	2.12					5	12	2.09	10	3.14		1	3	6	2	7	58.3	6	60.0
Urticaceae	1	0.36	1	0.53				1		2	0.35	2	0.63			1	1		1	50.0	1	50.0
Verbenaceae										1	0.17	1	0.31				1		1	100.0	1	100.0
Zygophyllaceae	10	3.56	3	1.59	3		3	2	2	11	1.92	3	0.94	7	1	2	1		1	9.1	0	0.0

Table (4): Friedman test results for significant difference between present and previous surveys of North Sinai flora.

Eco-geomorphological area	Survey	No. of spp. ***		No. of genera ***		Dom. ***		Dom. L. ***		Cp. ***		Occ. ***		Spor. **	
		Est. Median	Sum of Ranks	Est. Median	Sum of Ranks	Est. Median	Sum of Ranks	Est. Median	Sum of Ranks	Est. Median	Sum of Ranks	Est. Median	Sum of Ranks	Est. Median	Sum of Ranks
North Sinai	**Previous**	2.67	183.5	1.33	176.0	0.00	150.5	0.00	152.5	1.00	166.5	0.67	165.5	0.00	141.5
	Virtual Previous	2.33	153.0	1.00	144.5	0.00	150.5	0.00	152.5	0.67	154.0	0.33	148.0	0.00	131.5
	Current	1.00	95.5	0.67	111.5	0.00	131.0	0.00	127.0	0.33	111.0	0.00	118.5	0.00	159.0
	Grand Median	2.00		1.00		0.00		0.00		0.67		0.33		0.00	
Mediterranean Cost	**Previous**	1.50	123.0	1.00	118.5	0.00	112.0	0.00	113.5	0.50	119.0	0.00	118.0	0.00	101.5
	Current	0.50	93.0	1.00	97.5	0.00	104.0	0.00	102.5	0.50	97.0	0.0	98.0	0.00	114.5
	Grand Median	1.00		1.00		0.00		0.00		0.50		0.00		0.00	
Anticlines	**Previous**	1.50	132.0	1.50	128.0	0.00	114.5	0.00	111.5	0.50	123.0	0.00	120.0	0.00	103.5
	Current	0.50	84.0	0.50	88.0	0.00	101.5	0.00	104.5	0.50	93.0	0.00	96.0	0.00	112.5
	Grand Median	1.00		1.00		0.00		0.00		0.50		0.00		0.00	
Inland	**Previous**	1.00	127.0	0.75	124.5	0.00	114.5	0.00	113.5	0.50	123.5	0.00	115.5	0.00	104.5
	Current	0.00	89.0	0.25	91.5	0.00	101.5	0.00	102.5	0.50	92.5	0.00	100.5	0.00	111.5
	Grand Median	0.50		0.50		0.00		0.00		0.50		0.00		0.00	

is 252160 persons. Nonetheless, 2003 estimates for the total size of the population raises the earlier figure to 326816 persons. This estimate assumed a natural population growth rate of 4%, where the percentage of inhabitants of the town represent 58% while males represent 52% from the total population size (North Sinai Governorate, 2004). The population is concentrated in the northern coastal area specially El-Arish and Rafah cities that have the highest population density where the society has been transformed from pastoral to an agricultural. The total area of the cultivated lands has increased from 34093 Feddans in 1982 to 192122 Feddans of gardens and fields of vegetables and cereals (North Sinai Governorate, 2004). The five times and half increase in the cultivated lands since 1982 are taken as a strong indication that agriculture has become one of the main professions in the region especially after digging El-Salam canal. Table (5) confirms the transformation from a pastoral society to an agricultural one. The number of cows and buffalos, which are farm animals, are more than doubled between 1997 and 2003. On the contrary, the number of sheep and goats declined during the same period, which indicates the dwindling of pastoral practices among the Bedouins of northern Sinai. Table (5) also indicates that the number of camels has dramatically plunged into lower figures during the 1997 and 2003 period. Nonetheless, the progress in transportation and communication as many roads are constructed and paved has strengthened the human impact on previously remote areas.

In the central part of North Sinai (inland), the population density decrease and the economic activities is mainly pastoralism and plant collection for trade. The collected plants are used for many purposes rather than as a medicine; *Emex spinosus*, *Reaumuria hirtella*, *Diplotaxis harra*, *Trichodesma africanum*, *Zilla spinosa*, *Centaurea eryngioides*, and *Rumex pictus* are been eaten, *Anabasis articulata* is used in cleaning, and *Calligonum comosum* for leather tanning. *Artemisia judaica*, *Achillea fragrantissima*, *Juniperus phoenicea* and *Seriphidium herba-album* are among the most traded plants from North Sinai.

Although the distribution level was basically determined in present study with a different index than that in previous survey (Danin *et al.*, 1985), the apparent change is still real that the error in estimating changes due to using different indices would appear in distribution not for presence or absence of the taxon. Meanwhile, the annuals represent 49% of the collected species which is normal to study area and even higher than that of Gazar *et al.* (2000). This means that a fairly high percent of the un-recorded species are biennial or perennial which are normally not affected by prevailing weather and in turn indicates that the observed change is real not a matter of methodological reasons. On the other hand, the index used in current survey is more accurate than the index used by Danin *et al.* (1985) as it is biased to companion (Cp.) estimation, especially in Inland area.

Table (5): Comparing the evolution of livestock growth in North Sinai Governorate between 1997 and 2003.*

Year / Livestock Type	1997	2003	Difference Amount	Difference %
Cows	1574	3629	2055	130.60
Buffaloes	73	164	91	124.70
Cheep	138931	124719	-14212	-10.20
Goats	249289	162280	-87009	-34.90
Camels	13893	2748	-11145	-80.20
Total	***403760***	***293540***	***-110220***	***-27.30***

*Source: North Sinai Governorate, Information and Decision Support Center, Census Book 2004; March 2004; p.205. The table is prepared by the author.

In conclusion, under the prevailing drought conditions which manifest the human-induced threats, if the present pressure on wild vegetation has not been altered or relieved, the documented drift in floristic composition and structure would be continue leading to more loss in North Sinai flora. To stop this drift, a number of natural flora refugee sites should be established representing different habitats along the three eco-geomorphological areas in North Sinai.

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الوضع الراهن لفلورا شمال سيناء: الخسائر والمكاسب

وفاء محمد كامل ومحمد سعد زغلول ورأفت حسن عبدالوهاب وعبدالرؤوف عبدالرحمن مصطفى
قسم النبات، كلية العلوم، جامعة قناة السويس، الإسماعيلية، مصر

الملخص العربـــى

هدفت الدراسة الحالية إلى تقييم التغيرات الحديثة فى فلورا شمال سيناء من حيث التكوين والتركيب والناتج عن النشاط الإنسانى والجفاف السائد المعاصر بالمنطقة. ولتحقيق هذا الهدف فلقد تم رصد وتعريف الأنواع النباتية فى ثلاثمائة موقع ممثلة لمائة منطقة موزعة على البيئات المختلفة فى شمال سيناء. ونتج البحث الميدانى لهذه الدراسة عن تجميع وتعريف مائتان واحد وثمانين نوع نباتى منتميين إلى مائة وسبعة وثمانين جنس فى إثنان وخمسين فصيلة. وأشتملت هذه القائمة على ثلاثة أنواع تم تسجيلهم لأول مرة سواء فى شمال سيناء (*Eminium spiculatum* subsp. *negevensis*) أو فى سيناء (*Persicaria sengalensis*) أو حتى فى مصر (*Cyperus glaber*). ولم تقتصر الدراسة على رصد الأنواع الموجودة فقط ولكن قامت بتقييم التوزيع والإنتشار لهذه الأنواع ومقارنة التواجد والتوزيع بالمسوح والدراسات السابقة على منطقة الدراسة والتى تمت فى الستينات والسبعينات.

ولقد أوضحت الدراسة حدوث تغير جذرى فى فلورا المنطقة من حيث التكوين والتركيب فى الخمسين سنة الماضية نتيجة للنشاطات الإنسانية الغير مدروسة والجفاف المعاصر السائد، وإنعكس هذا التغير فى فقد أربعمائة واحد وخمسين نوعاً. ولذا أوصت الدراسة بضرورة إنشاء عدد من الملاجىء للفلورا تضم البيئات المتنوعة بشمال سيناء كحل سريع وقائى لوقف التدهور فى الفلورا والقيام ببرنامج صون واسع المجال للحفاظ على التنوع البيولوجى المميز للمنطقة.