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Phytosociological Studies on the Wild *Mesembryanthemum* Species in Egypt 1. Quantitative Analysis of the Representative Communities

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Abstract: Communities of *Mesembryanthemum* species were studied quantitatively. Surveys were carried out in five habitats supporting *M. crystallinum*, four habitats supporting *M. forsskaolii* and six habitats supporting *M. nodiflorum*. Vegetation analysis of the community types included (density, frequency, cover area, relative density, relative frequency, relative cover, fresh weight and biomass) of each species. Results indicated that *M. crystallinum* and *M. forsskaolii* had higher densities than *M. nodiflorum*, while *M. nodiflorum* and *M. crystallinum* had higher biomass than *M. forsskaolii*. Results also showed highest cover for *M. crystallinum* and lowest for *M. nodiflorum*.

Key words: *Mesembryanthemum* species, quantitative analysis, communities, habitat types, abundance

Introduction

There are three species of the genus *Mesembryanthemum* recorded in Egyptian deserts. *M. crytallinum, M. forsskaolii* and *M. nodiflorum* (Muschler, 1912; Mantasir and Hassib, 1956; Täckholm, 1994; Boulos, 1999).

According to El-Shayeb *et al.* (1999) *M. crystallinum* grows in the habitats near the sea with high soil moisture, sandy and loamy soil, moderate rainfall and moderate temperature, *M. forsskaolii* grows in habitats of sandy plains or slopes, low rainfall and high temperature; *M. nodiflorum* is characterized by a wide ecological amplitude: sandy habitats that are characterized by low rainfall and high temperature and silty and loamy habitats with moderate rainfall and temperature. *M. crystallinum* and *M. nodiflorum* may grow in salty soil, while *M. forsskaolii* grows in the soil with low salinity.

Montasir and Abdel Rahman (1951) recorded *M.forsskaolii* as rarely associated with dominating *Zygphyllum simplex* in Wadi Hof, while it grows dominantly (819 individuals/60 m^2) in Gebel Asfar with *Z. simplex*, *Fagonia arabica* and *Stipa tortilis* occasionally and *M. nodiflorum* rarely.

M. crystallinum grows as rare associate with *Fagonia arabica* in Gebel Asfar (Montasir and El-Shafey, 1951). Abdel Rahman and El Batanouny (1959) found that the number of *M. forsskaolii* reached 600 individuals /100 m^2 after rains in January in Cairo-Suez road. In May the number of individuals for all ephemerals disappeared except few species as *M. forsskaolii, Z. simplex, Malva parviflora* and *Mathiola livida*. The two first named species continued till the end of June and even till July. This is largely referred to their succulent habit. Succulence helps to reduce transpiration during the day (Evenari and Richter, 1937; Migahid and Abdel Rahman, 1953).

Abdel Rahman and Batanouny (1959) also noticed that in June, the cover of *M. forsskaolii* decreased from 14% in February to 7% in June. Tadros and El-Sharkawi (1960) found that *M. nodiflorum* appear in the list quadrates of the *Anabasis articuluta* community, while disappeared in the list quadrates of *Salsola tetrandra* plant community in Fuka - Ras El Hekma area. The presence of halophytic species in some list quadrates owing to this inevitable accumulation of salts.

El-Ghareeb and Rezk (1989) recorded that the recurrence of *M. crystallinum* was 60% of the stands of the Mediterranean coastal land at Bousseli. El-Ghareeb (1991) studied the effects of the invasion of *M. crystallinum* on vegetation composition in Mediterranean desert ecosystem after 12 years. The density of *M. crystallinum* increased from 3.4 to 89.5 plants/100m^2 and its cover increased from 21 to 143.8 cm^2 /100 m^2. This was associated with an overall decrease in the total density of annuals of about 68%. Also there was an overall decrease in their total cover of about 48%.

Jacobsen and Hermann (1974) found that the main growth of *Mesemhryanthemum* species occurs in rainfall months mostly in summer (November to April) in South West Africa whereas in the regions with less summer rainfall the resulting period comes at this time.

The aim of the present work is to deal with ecological studies on three *Mesembryanthemum* species growing naturally in the Egyptian deserts. The studies include the effect of habitat types supporting the growth of the investigated *Mesembryanthemum*.

Materials and Methods

The studies were carried out in parts of the Egyptian desert; Mediterranean coastal land, Cairo-Ismailia Desert Road, Cairo-Suez Desert Road, Cairo - Alexandria Desert Road and Sinai Peninsula (Fig. 1).

Communities supporting the growth of *Mesembryanthemum* species have been studied quantitatively and the quadrate method described by Weaver and Clements (1938) and Braun-Blanquet (1964) has been followed. The stands were visited throughout the flowering periods: May- July (1993-1995).

For the quantitative study of *Mesembyanthemum* communities, ten randomly chosen quadrates (1x1 m^2 each) in each stand were plotted. In each quadrate the species were listed, the total number of individuals of each species is counted, density, frequency, frequency index, frequency class were recorded according to Raunkiaer (1934).

Relative frequency, total area covered for each species in ten quadrates, cover per m^2, relative cover and biomass for each species were estimated in the ten quadrates.

Results

The localities and the habitats of these stands supporting the growth of *Mesembryanthemum* species are shown in Table 1.

Mesembryanthemum crystallinum: Stand 23 was distinguished with the relatively high values of total number of individuals (8330), density of 833 individuals/m^2, relative density of 99.97% (Table 2) while the lowest value of relative density was 34.82 % in stand 1 , The high value of relative frequency is 78.6%, total area covered 7.35 m^2 and relative cover 90.74%. Stand 9 was distinguished by high values of fresh weight 62 41.4 g and biomass 3144.7g.

The cover per m^2 ranged between 0.38 m^2 in stand 2 (non-saline depression) and 0.73 m^2 in stand 23. The fresh weight per m^2 ranged between 883 g in stand 14 (wadi beds) to 6241.4g in stand 9 and the biomass per m^2 ranged between 157.5g in stand 2 to 3144.79g in stand 9.

Associate species with high values of frequency (more than 50%) included *M. nodiflorum* (100%) in stands 9 and 11 and *Chenopodium album* (60%) in stand 9. The species with high density included *M. nodiflorum* 319.4, 9.8 and 6.4 in stands 11,14

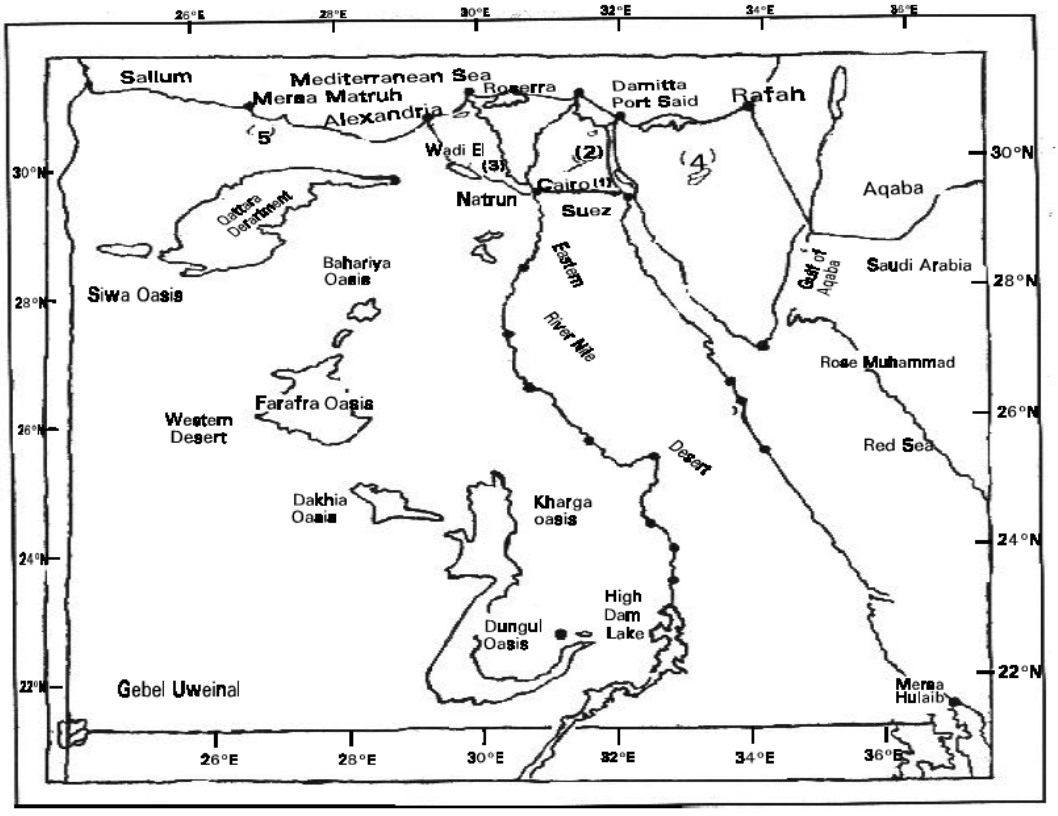

Fig. 1: Surveyed localities of *Mesembryanthemum* species: 1) Cairo - Suez Desert Road 2) Cairo-Ismailia Desert Road 3) Cairo-Alexandria Desert Road 4) Sinai Peninsula. 5) Western Coastal of Mediterranean strip

Table 1: Habitat types supporting the growth of *Mesembryanthemum* species in the studied area

Habitat type	Stand number	Location
Non-saline depression	1	El-Kasr Village, El-Kasr road west Matroth
	2	Alexandria-Matrouh road, lkm east Marakia
	3	El Arisg-El Sheikh Zowayed road
	4	Cairo- Suez Road, 60 km east Cairo
Rocy ridges	5	Fuka, Alexandria B Matrouh road 105
	6	El Salloum plateau
Inland siliceous deposits	7	El Kantara Shar; 10 km east the city
	8	El Kasr road near El Obeid
	9	El Sheikh Zoowayed Rafah road
Cultivated land	10	Ras Sedr, South Sinai
	11	Wadi El Arish, El Massaid road, North Sinai
	12	El Sheikh Zowayed B Rafah road . Abu Lahow El Bahri Resevoir road,
	13	60km est Matrouh.
Wadi beds	14	Wadi Halk El Debi, km west Matrouh
	15	Wadi El Hash El Garbi, 25 km west Matrouh
	16	Ras Sedr, South Sinai
Gravel desert	17	Cairo B Suez road, 60 km east Cairo
Sand plain	18	El Kantara Shark City
	19	Alexandria-Matrouh road 5 km west Elk Alamain
	20	Cairo B Alwxandria desert rods
Slopes	21	El Ferdan, El Kantara Shark road
	22	Easern Coast of Suez Canal
	23	El Soynat, El Kase road, 57 km west Matrouh

Table 2: Vegetation analysis of ten quardrates representing *M. crystallinum*, *M. forsskadii* and *M. nodiflorum* communities habitats during (1993-1995). Plant name are checked according to Bolous (1995)

Stand	Species	Total number of individuals	D	R.D(%)	F	F.I.	F.C.	R.F. (%)	Total area m^2	C/m^2	R.C.(%)	F.wt.(g/m^2)	Biomass (g/m^2)
2	*M. crystallinum* L.	1294	129.8	97.70	10	100	2	35.7	3.80	0.38	65.97	1879.6	157.5
	Thymelaea hirstuta (L) *End*	4	0.4	0.30	4	40	2	14.3	0.40	0.04	6.94	16.9	14.3
	Echium sericeum Vahl.	4	0.4	0.30	2	20	1	7.1	0.10	0.01	1.74	2.1	1.5
	Achillea santolina L	2	0.2	0.20	2	20	1	7.1	0.17	0.02	2.95	5.3	3.9
	Echinops spinosissimus Turra	2	0.2	0.20	2	20	1	7.1	0.20	0.02	3.47	6.7	5.7
	Centaurea calcitrapa L.	6	0.6	0.20	4	40	2	14.3	0.99	0.10	17.19	9.0	7.8
	Crysanthemum coronarium L.	10	1.0	0.80	4	40	2	14.3	0.10	0.10	1.74	3.4	2.3
9	*M. crystallinum* L.	46	4.6	38.90	10	100	5	38.5	3.94	0.39	50.80	6241.4	3144.7
	M. condiflorum L.	64	6.4	54.20	10	100	5	38.5	3.55	0.35	45.80	6848.6	1869.5
	Chenopodioum album L.	8	0.8	6.80	6	60	3	23.0	0.26	0.02	3.40	70.6	37.0
11	*M. crystallinum* L.	1710	171.0	34.89	10	100	5	38.5	4.13	0,41	42.40	1962.2	343.8
	M. nodiflorum L.	3194	319.4	65.05	10	100	5	38.5	4.81	0.48	49.38	1410.4	272.6
	Suaeda vera Forssk.	3	0.3	0.06	3	30	2	11.6	0.50	0.50	5.13	136.5	102.5
	Sasola longifolia Forssk	1	0.1	0.02	1	10	1	3.9	0.10	0.01	1.03	23.3	17.5
	Thymelaea hirsuta (L) *End*	2	0.2	0.04	2	20	1	7.7	0.20	0.02	2.05	10.2	8.4
14	*M. crystallinum* L.	2908	290.8	96.70	10	100	5	76.9	6.60	0.70	84.60	88.3	343.2
	M. nodiflorum L.	98	9.8	3.30	3	30	2	38.6	1.20	0.10	15.40	103.0	39.5
23	*M. crystallinum* L.	8330	833	99.97	10	100	5	78.6	7.35	0.73	90.74	3148.0	496.9
	Suaeda vera Forssk	2	0.2	0.02	2	20	1	14.3	0.65	0.06	8.02	98.5	65.2
	Cressa cretia L.	1	0.1	0.01	1	10	1	7.1	0.10	0.01	1.24	10.6	7.2
	M. forsskadii												
7	*M. forsskadii Hochst*	6160	616	99.97	10	10	5	83.33	7.20	0.720	90.23	448.5	158.4
	Zygophyllum albul L.f.	1	0.1	0.02	1	10	1	8.33	0.20	0.020	2.50	21.9	12.1
	Nitraria retusa (Forssk.) Asch.	1	0.1	0.02	1	10	1	8.33	0.68	0.048	7.25	253.5	188.6
17	*M. forsskadii Hochst.*	2572	257.2	99.40	10	100	5	41.66	4.95	0.495	64.45	181.3	62.3
	Bassia muricata (L.) *Murr.*	1	0.1	0.040	1	10	1	4.17	0.08	0.008	1.04	16.2	10.5
	Trigonella stellata forssk.	1	0.1	0.04	1	10	1	4.17	0.07	0.007	0.91	12.0	8.9
	Zygophyllum album L.f.	3	0.3	0.12	3	30	2	12.50	0.74	0.074	9.64	114.5	45.6
	Lycium shawii Schweinf.	1	0.1	0.04	1	10	1	4.17	0.58	0.058	7.55	59.6	42.5
	Centaurea calcitrapa L.	2	0.2	0.08	2	20	1	8.33	0.58	0.058	7.55	22.0	19.9
	Anthemis pseudocotula Boiss.	3	0.3	0.12	2	20	1	8.33	0.12	0.012	1.56	11.5	7.4
	Senecio barbatus												
	(hojer ejusd L.*) Thell.*	1	0.1	0.04	1	10	1	4.17	0.08	0.008	1.04	7.5	4.3
	Aristida plumosa L.	2	0.2	0.08	2	20	1	8.33	0.08	0.008	1.04	5.0	2.8
18	*M. forsskadii Hochst*	1	0.1	0.04	1	10	1	4.17	0.40	0.004	5.21	23.5	17.5
	Bassiia muricata (L.) *Murr.*	173	17.3	99.53	10	100	5	55.56	6.2	0.062	79.39	1893.5	182.9
	Eremobium aegyptiacum												
	(Spreng) Asch.	3	0.3	1.64	3	30	2	16.67	0.32	0.032	4.09	12.9	9.5
	Zygophyllum simplex L.	2	0.2	1.09	2	20	1	11.11	0.31	0.031	3.97	13.6	9.4
21	*M. forsskadii Hochst*	5	0.5	2.73	3	30	2	16.67	0.98	0.098	12.55	125.8	68.5
	Haloxylon salicornicum (Bunge)	1360	136	99.85	10	100	5	83.33	6.8	0.68	90.91	117.7	36.6
	Botsch.	1	0.1	0.07	1	10	1	8.33	0.44	0.044	5.88	88.9	68.5
	Zygophyllum album L.	1	0.1	0.07	1	10	1	8.33	0.24	0.024	3.21	28.5	15.5
	M. nodiflorum												
1	*M. nodiflorum* L.	3194	319.4	65.05	10	100	5	38.64	4.81	0.481	49.38	1410.7	272.6
	M. crystallinum L.	1710	171.0	34.82	10	100	5	38.46	4.13	0.413	42.40	1962.2	343.8
	Suaeda vera Forssk	3	0.3	0.06	3	30	2	11.55	0.50	0.050	5.13	136.5	102.5
	Salsola longifolia Forssk	1	0.1	0.02	1	10	1	3.85	0.10	0.010	1.03	23.3	17.5
	Thymelaea hirsuta (L) *End.*	2	0.2	0.04	2	20	1	6.69	0.20	0.020	2.05	10.2	8.4
5	*M.nodiflorum* L.	134	13.4	72.04	10	100	5	27.03	1.51	0.151	39.32	22.5	6.9
	Atriplex halimus, L.	4	0.4	2.15	4	40	2	10.81	1.20	0.120	31.33	91.5	63.4
	Bassia muricata (L.) *Murr*	1	0.1	0.54	1	10	1	2.70	0.05	0.005	1.31	5.4	3.2
	Suaeda vera Forssk.	1	0.1	0.54	1	10	1	2.70	0.33	0.033	8.62	22.8	18.5
	Salsola longifolia forssk.	1	0.1	0.54	1	10	1	2.70	0.28	0.028	7.31	27.4	20.3
	Schismus barbatus												
	(Hojer ejusd L.*) Thell.*	28	2.8	15.05	10	100	5	27.03	0.25	0.025	6.53	12.5	8.0
	Stipa capensis Thumb.	17	1.7	9.14	10	100	5	27.03	0.21	0.021	5.48	11.3	7.4
8	*M. nodiflorum* L.	1466	146.6	63.70	8	80	4	7.27	1.90	0.19	22.54	377.5	103.4
	Polycarbon succulentum												
	(Del.) J. Gay	39	3.9	1.70	6	60	3	5.45	0.30	0.03	3.56	38.5	24.0
	Herniaria hemistemon, J. Gay	14	1.4	0.60	4	40	2	3.64	0.22	0.022	2.61	2.2	1.9
	Beta velgaris L.	4	0.4	0.20	2	20	1	1.82	0.30	0.030	3.56	0.6	4
	Suaeda pruinosa Lenge.	1	0.1	0.04	1	10	1	0.91	0.16	0.016	1.89	25.4	21.2
	Haloxylon scoparium (Pomel) Iljin	52	5.2	2.30	10	100	5	9.10	0.62	0.062	7.35	98.6	78.2
	Papaver hybridum L.	5	0.6	0.30	4	40	2	3.64	0.12	0.012	1.42	11.2	7.6
	Matthiola livida (Del.) Dc.	8	0.8	0.30	6	60	3	5.45	0.18	0.018	2.14	1.1	0.8
	Erucaria pinnata Viv.) Tackh	103	10.3	4.50	8	80	4	7.27	0.74	0.074	8.78	62.3	48.9
	Reseda pruinosa Del.	2	0.2	0.09	1	10	1	0.91	0.10	0.010	1.19	0.2	0.1
	Trigonella stellata Forssk.	24	2.4	1.00	4	40	2	0.64	0.15	0.015	1.78	6.4	3.3
	Medicago laciniata (L.) *Mill.*	3	0.3	0.10	2	10	1	0.91	0.15	0.015	1.78	0.8	0.6
	Astragalus tribuloides Del.	2	0.02	0.03	1	20	1	0.91	0.10	0.10	1.19	0.5	0.5
	Astragalus peregrinus, Vehl.	15	1.5	0.04	2	20	1	1.82	0.52	0.052	2.97	10.0	3.2
	Malva aegyptica L.	3	0.3	0.10	2	20	1	1.82	0.10	0.010	1.19	0.03	0.01
	Thymelaea hirsuta (L) *Endl*	1	0.1	0.04	1	20	1	0.91	0.10	0.010	1.90	2.1	1.5
	Deverra tortuosa (Desf.)												
	Benth &Hook	12	1.2	0.50	6	20	2	5.45	0.70	0.070	8.30	85.1	63.6
	Salvia lonigera Poir.	5	0.5	0.20	4	60	3	3.64	0.15	0.015	1.78	5.1	3.4
	Atracrylis carduus												
	(Forssk.) Christens.	30	3.0	1.40	10	40	5	9.10	1.41	1.041	16.73	40.7	35.5
	Folago desertorum Pomel.	9	0.9	0.40	4	100	2	3.64	0.10	0.010	1.19	0.1	0.08
	Launaea nudicaulis (L.) *Hook*	30	3.0	1.40	8	40	4	7.27	0.25	0.025	2.97	90.3	67.8

	Hordeum leporinum Link	136	13.6	5.90	8	80	4	7.27	0.53	0.053	6.29	22.9	17.1
	Parapholis marginata Runemark	3	0.3	0.10	2	80	1	1.82	0.10	0.010	1.19	0.3	0.2
	Schismus borbatus (Hojer ejusd. L.) Thell.	39	3.9	1.70	2	20	1	1.82	0.10	0.010	1.19	1.4	1.1
	Phalaris minor Retz.	297	29.7	12.90	4	20	2	3.64	0.60	0.060	7.12	7.4	4.9
12	*M. nodiflorum* L.	64	6.4	54.10	10	40	5	38.5	0.355	0.355	45.8	6848.6	1869.5
	M. crystallinum L.	46	4.6	8.90	10	100	5	38.5	0.394	0.394	50.8	6241.4	3144.5
	Chenopodium album L.	8	0.8	6.80	6	100	3	23.0	0.26	0.026	3.4	70.6	37.3
16	*M. nodiflorum* L.	212	21.2	92.60	8	60	4	44.44	3.50	0.350	53.19	77.3	24.9
	Suaeda pruinosa Lange	2	0.2	0.90	2	20	1	11.11	2.36	0.236	35.87	160.0	144.0
	Alhagi maurorum. Medic.	15	1.5	6.60	8	80	4	44.44	0.72	0.072	10.51	13.1	10.6
20	*M. nodiflorum* L.	632	63.2	92.80	10	100	5	37.04	3.40	0.340	60.61	817.6	253.4
	Atriplex halimus L.	2	0.2	0.29	2	20	1	7.41	5.50	0.050	8.91	14.6	10.2
	Bassia muricata (L.) *Murr*	2	0.2	0.29	2	20	1	7.41	0.200	0.020	3.57	60.8	38.1
	Suaeda Vera Forssk.	1	0.1	0.15	1	10	1	3.70	0.009	0.009	1.60	11.3	8.5
	Salsola kali L.	6	0.6	0.88	4	40	2	14.82	0.008	0.008	1.43	10.6	4.6
	Salsola tetrandera Forssk.	20	2.0	2.94	8	80	4	39.63	1.134	0.124	23.89	27.4	18.4

D = Density; F.I. = Frequency index; Total cover in ten quadrates; F.wt = mean of fresh weight
R.D.% = Relative density; F.C. = Frequency class; C/ m^2 = mean cover per m^2; Biomass = mean of dry weight
F = Frequency; R.F.% = Relative frequency; R.C. = Relative cover

Table 3: Habitat types of *Mesembryanthemum* species in surveyed area (the degree of abundance according to Braun - Blanquet, 1964)

Stand number	Location	Habitat	Abundance
M. crystallinum			
2	Alexandria -Matrouh road 1 Km east Marakia	Non - saline depression , silty soil	Common
9	El Sheikh Zowayed-Rafah road sides of the road	Inland siliceous deposits, sandy soil	Common
11	Widi El Arish-El Massaid road North Sinai	Cultivated land by dropping sandy soil	Occasional
14	Wadi Haik El Dabi, 72Km west Matrouth	Wadi beds, silty soil, the land was prepared for cultivation	Abundant
23	El Soynat, El Kasr road, 57Km west Matrouh	Slops, the land was prepared for cultivation	Abundant
M. forsskaolii			
7	El Kantara Shark 10 Km east the city	Inland siliceous deposits ,sandy soil	Abundant
17	Cairo - Suez road, 60Km east Cairo	Graval desert, gravel surface	Occasional
18	El Kantar Shark city	Sand plain sandy soil	Abundant
21	El Ferden-El Kantra shark south the New El Kantra Shark city	Slopes, sandy soil	Common
M.nodiflorum			
1	El-Kasr village, El-Kasr road, 20 Km west Matrouh	Non-saline Depression, silty soil	Abundant
5	Fuka, Alexandria-Matrouh road 105 Km East	Rock ridges Gentile slope, gravl surface soil	Common
8	El Kasr road near El Obeid, km west Matrouh	Inland siliceous deposits	Common
12	El Sheikh Zowayed-Rafah road Cultivated land by dropping	Common	
16	Ras Seder, south Sinai	Wadi beds, silty soil	Abundant
20	Cairo-Alexandria Desert road, 30Km south Alexandria	Sand plain	Occasional

and 9, respectively. The high values of relative frequency included *M. nodiflorum* 38.5 and 28.6% in stands 9,11 and 14, respectively, *Thymelaea hirsuta, Centaurea calcitrapa* and *Chrysanthemum coronarium* (14.3% each) in stand 2 and *Suaeda vera* (14.3 and 11.6%) in stands 23 and 11, respectively. The high values of relative cover included *M. nodiflorum* (49.38, 45.8 and 15.4%) in stands 11,9 and 14, respectively. The high values of biomass per m^2 included *M.nodiflorum* (1869.5 and 272.6 g) in stands 9 and 11, respectively and *Suaeda vera* (102.5 and 65.2g) in stands 11 and 23, respectively.

Mesembryanthemum forsskaolii: Table 2 shows that stand 7 (inland siliceous deposits were distinguished with highest values in total number of individuals (6160), density (616 individuals/m^2), relative density (99.97%), relative frequency (83.33%) and total area covered (7.20 m^2).

The density of *M.forsskaolii* ranged between 17.3 in stand 18 (sand plain) and 616 individuals/m^2 in stand 7. The relative density ranged between 99.40% in stand 18 and 99.97 in stand 7. The relative frequency ranged between 41.66% in stand 18 and 83.33% in stand 7 and 21 (slopes). The total area covered per m^2 ranged between 4.95 m^2 in stand 17 (gravel desert) and 7.20 2 in stand 7. The biomass per m^2 ranges between 36.6g in stand 21 and 182.9 in stand 18.

The associated species with *M. forsskaolii* have low total number of individuals, low density and low relative density. The relatively high values of relative density included *Zygophyllum simplex* 2.73%, *Bassia muricata* 1.64% and *Eremobium aegyptiacum* 1.09% respectively in stand 17. The high values of frequency (more than 20%) are of *Zygophyllum album*, *Bassia muricata* and *Zygophyllum simplex* 30% in stands 17 and 18 respectively.

The high values of relative frequency are of *Bassia muricata* and *Zygophyllum simplex* 16.67% in stand 18. The high values of biomass per m^2 are of *Nitraria retusa* (188.6g) in stand 7, *Haloxylon salicornicum* and *Zygophyllum simplex*. (68.5 g) in stands 21 and 18 respectively and *Zygophyllum album* 45.60 g in stand 17.

Mesembryanthemum nodiflorum: The values of density of *M.nodiflorum* ranged between 6.4 in stand 12 (cultivated land) and 3194 individuals /m^2 in stand 1 (non-saline depression)(Table 2). The relative frequency ranged between 7.27% in stand 8 (inland siliceous deposits) and 44.44% in stand 16 (wadi beds). The total area covered ranged between 1.15 m^2 in stand 5 (rocky ridges) and 3.55 m^2 in stand 12. The fresh weight per m^2 ranged between 22.5g in stand 5 and 6848.6g in stand 12, and the biomass per m^2 ranged between 6.9 g in stand 5 and 1869.5 g in stand 12.

Associated species with high frequency values (more than 50%) included: *Schismus barbatus and Stipa capensis* (100%) in stand 5, *Haloxylon scoporium* and *Atractylis carduus* (100%) in stand 8, *M. crystallinum* (100%) in stands I and I2 *Erucaria pinnata, Launea nudicaulis* and *Hordeum leporinum* (80%) in stand 8, *Alhagi maurorum* (80%) in stand 16, *Salsola tetrandra* (80%) in stand 20, *Ploycarpon succulentum, Mathiola livida* and *Deverra tortusa* (60%) in stand 8 and *Chenopodium album* (60%) in stand 12. Table 2c shows that the high density values of associated species included *M. crystallinum* 171.0 individuals/m^2 in stand 1, *Phalaris minor* 297 individuals/m^2 in stand 8 and *Hordeum leporinum* 136 individuals/m^2 in stand 8. The high values of relative frequency included *Alhagi maurorum* (44.44%) in stand 16, *M. crytallinum* (38.5 and 38.46%) in stands and 1 and 12, respectively, *Salsola tetrandra* (29.63%) in stand 20. *Schismus barbatus* and *Stipa capensis* 27.03% in stands 5.

The high values of total area covered included *M. crystallinum* 4.13 and 3.94 m^2 in stands I and 12, respectively, *Suaeda pruinosa* 2.36 m^2 in stand 16, *Atractylis carduus* 1.41 m^2 in stand 8, Salsola tetrandra 1.134 m^2 in stand 20 and *Atriplex halimus* 1.20 m^2 in stand 5 and the high values of biomass perm^2 included *M. crytallinum* 3144.7g and 343.8g in stands 12 and 1, respectively, *Suaeda pruinosa* 144.0g in stand 16, *Suaeda vera* 102.5g in stand 1, *Haloxylon scoparium* 78.2g in stand 8, *Launea nudicaulis* 67.8g in stand 8, *Diverra tortusa* 63.6g in stand 8 and *Atriplex halimus* 63.4g in stand 5.

Discussion

In this study *M. crystallinum* abounds in the north western Mediterranean coast especially west of Matrouh (El Kasr road), common in the eastern coast of Mediterranean sea especially east of El-Arish. The plant grows in habitats distinguished by salty sandy/silty soil, such as slopes and wadi beds.

M.forsskaolii is abundant in Sinai along the eastern coast of Suez Canal especially in El-Kantara Shark region, common along Cairo-Suez road in sandy soil. *M.nodiflorum* is abundant in the north western Mediterranean coast especially west Matrouh, common in Sinai proper and Western Desert. The plant grows in sandy, silty, rocky ridges or cultivated land.

M. crystallinum is recorded in five of the eight habitats viz. Non-saline depression, inland siliceous deposits, cultivated land, slopes and wadi beds. The high value of density, relative frequency and total cover in habitats of slopes and Wadi beds, which characterized by loamy soil, land prepared for cultivation. The high values of fresh weight and biomass is recorded in slopes, cultivated land and inland siliceous deposits. The lowest values of density and total cover are recorded in inland siliceous deposits. This habitat is characterized by sandy soil.

Table 3 also shows that *M. forsskaolii* is recorded in four habitats. The highest values of density, frequency and total cover are recorded in habitat (inland siliceous deposits) which is characterized by disturbed sandy soil. The highest values of fresh weight and biomass is recorded in sand plain habitat which is characterized by sandy/silty soil.

M. nodiflorum is recorded in six habitats with the highest values of density, relative frequency and total cover is recorded in non-saline depressions which are characterized by silty soil. The lowest values of density, relative frequency and total cover, fresh weight and biomass are recorded in rocky ridges habitat which is characterized by gravel surface soil.

The highest value of density and total area covered by *M. crystallinum* and *M. nodiflorum* are (833 and 319.4 individuals/m^2), and (7.35 and 4.81 m^2 /10m^2), respectively. They are attained in habitats distinguished by land prepared for cultivation but not cultivated. Viverette and Muller (1977) reported that open areas or areas scarcely occupied by other plants are easily invaded by *Mesembryanthemum*. Philbrick (1972) found that the intense grazing can be followed by an increase in *Mesembryanthemum* as in Santa Barbara Island. The Western Mediterranean coast of Egypt has long history of intensive land use , mainly grazing and rain-fed farming (Kassas, 1972). El-Ghareeb (1991) stated that the increasing of density and cover percentage of *M. crystallinum* is related to the cleaning of the land for barley cultivation. This type of disturbance reduces an open habitat which is often colonized by *Mesembryanthemum*. It is clear that the preparation of the land to cultivation gives a good aeration and helps to appearance of seed bank of plant and give a good conditions to the roots to extend and be fixed in the soil, also the high level of salts that are related from the leaching of *Mesembryanthemum* species by the rain prevents the growth of other annual species.

The highest values of biomass of *M. crystallinum* and *M. nodiflorum* are (3144.7 and 1869.5g/m^2) attained in habitat (disturbed soil round cultivated land by rain, silty soil). It was evident that the disturbance of soil gave a good conditions to the roots to extend and uptake the water to survival and to give the best growth. The highest value of biomass of *M. forsskaolii* was (182.9g/m^2) attained in habitat (sand plain, sandy soil) this habitat distinguishes in rainy season by good condition to the plant to give a best growth.

The results of this study also indicated that the density of *M. crystallinum* and *M. forsskaolii* is higher than that of *M. nodiflorum*, while the biomass of *M. crystallinum* and *M. nodiflorum* was mostly higher than that of *M. forsskaolii*.

The highest percentage of relative density, relative frequency and relative cover of *Mesembryanthemum* species occurred in the habitats of *M. forsskaolii* due to other ephemerals cannot survival in its habitats except the perennials, while *M. crystallinum* and *M.nodiflorum* grow widely associated with different ephemerals and perennials due to their wide habitats, and ecological amplitude.

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