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Floristic Features of El -Burullus Wetland: a RAMSAR site in Mediterranean Coast of Egypt

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AbstractThe current study investigates the floristic aspects of Burullus wetland, including a list of plant species, life-span, life-form spectra, and floristic analysis of the plant life in the Deltaic Mediterranean coast. Floristically, the total number of the recorded flowering plant species in the present study is 63, belonging to 50 genera and related to 30 families. Chenopodiaceae, Asteraceae, Poaceae and Cyperaceae are the main families being represented collectively by 28 species or about 44.4 % of the total number of the recorded species. Cryptophytes, which comprise helophytes, geophytes, and hydrophytes (32 %), and partially nanophanerophytes, make up the bulk of plants (4 %). These species are divided into four groups based on their ecological characteristics: a) four floating hydrophytes, b) four submerged hydrophytes, c) fourteen emergent species, and d) 41 terrestrial species. The floristic analysis of the research region indicates that Mediterranean taxa account for 35 species, or roughly 55.55 percent of the total number of species reported. Pluriregional (18 species = 28.57 %), biregional (16 species = 25.39 %), or monoregional (6 species = 9.52 %) taxa are represented.

This study will be useful for the future oriented management plan for the protectorate

keywords: Burullus, Lake; wetland; Floristic, Hydrophytes, Vegetation.

1. Introduction

Wetlands are primarily areas of shallow standing water that are home to a diverse range of aquatic plants and animals, including birds and fish, and are heavily impacted by climate and weather [1,2]. Cheremisinoff [3] reported that wetlands are of ecological importance due to their hydrologic attributes and often transitional habitats between terrestrial and aquatic systems, where the water table is usually at or near the surface or the land is covered by shallow water.

In recent, the use of constructed wetlands for wastewater treatment is applied in Egypt. Several natural wetlands prevail in the Egyptian environment especially within the Northern Lakes of Egypt. These lakes function as downstream recipients of water and waste from both natural and human sources through discharging drains, and have been often transformed to dry lands for agriculture and human settlements, among others [4].

Egypt has many mesmerizing lakes in the world from North to South. Some of them are more popular than others but all are important and beneficial to the environment. Currently, there are about 7 large lakes in coastal and inland area of Egypt. The Egyptian Mediterranean coast has five natural brackish lakes: Mariuot (western section), Idku, Burullus and Manzala (Deltaic section) and Bardawil (North Sinai) along the Mediterranean coast of Egypt. The northern Delta lakes are connected directly to the Mediterranean Sea, except Lake Mariut is directly connected to the sea. Fresh, brackish, saline or hypersaline water bodies with depths ranging from 50 to 180 cm make up the coastal lakes. They are Egypt's most prolific lakes. They are also globally significant wintering grounds for migrating birds, providing essential habitat for them as well as a major natural resource for Egypt's fish supply [5].

Many natural water bodies in the world are threatened by cultural eutrophication resulted from the extremely high nutrient inputs through agricultural, industrial and untreated domestic sewage discharges [6]. In recent years, the northern part of the Nile Delta has been subjected to extensive unplanned development projects, which accelerated hazardous changes in the Nile Delta coast [7]. Various anthropogenic activities developing along the watersheds, which receive inputs of polluted water containing organic and inorganic compounds from point and non-point sources, are directly and/or indirectly affecting the Nile Delta's coastal lakes (Mariut, Idku, Burullus, and Manzala) and other aquatic ecosystems in Egypt. The progressive development of these distinct contaminants is also linked to changes in aquatic vegetation composition over time [8].

This work mainly aims to study the floristic features including: record of the plant species, life-span, life-form spectra and floristic categories of the wild plants in El- Burullus protectorate, Egypt.

2. Materials and Methods

2.1. Study area

Lake Burullus is the second largest of the delta lakes and one of the most important wetlands of Egypt [9]. It is a large, shallow, fresh-to-brackish coastal lagoon situated along the Mediterranean coast and occupies a more or less, central position between the two branches of the Nile. Lake Burullus was declared a protectorate to conserve its biological diversity and also to provide endangered species a natural habitat whose endangerment was a result of the human activities [10,11]. Also, making the lake a protectorate helped in monitoring environmental changes and in encouraging natural or ecotourism in Egypt. Its protectorate status also helps in conducting applied scientific research. The lake helps in protecting natural resources especially those that are of economic significance [5] (Figure 1).

2.2. Estimation of plant species

The current study is represented by 44 stands (area = 10 x 10 m) at three sites: site 1 represents the lake coast (22 stands), site 2 represents the lake islands (11 stands), and site 3 represents open water (11 stands). The stands were placed across the research region to cover a variety of habitats and to guarantee that a diverse range of vegetational variables was sampled. The Botany Department's Herbarium at Mansoura University's Faculty of Science received all of the samples. This study's taxonomy of living forms was based on Raunkiaer's [12] categorization scheme. For classification, identification, nomenclature, and floristic categories, Davis [13], Zohary [14], Täckholm [15], Meickle [16], Feinbrun-Dothan [17], and Boulos [18] were utilized

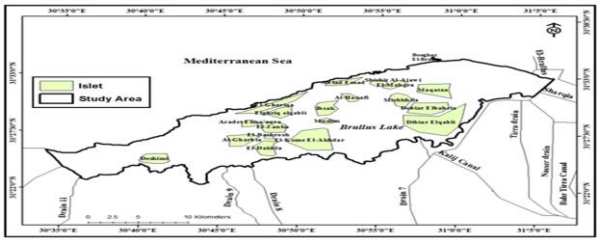

Fig 1: Map showing the study area.

3. Results and Discussion

3.1. Floristic Composition and Distribution of Plant Species in the Study Area

The recorded hydrophytes and Lake shores species in Burullus Lake are shown in Table 1. The whole number of the listed species is 63. These taxa can be categorized ecologically into four major groups, namely: a) four floating hydrophytes, b) four submerged hydrophytes, c) fourteen emergent species and d) 41 terrestrial species (Table 1).

a) The floating hydrophytes include four species, namely: *Eichhornia crassipes, Lemna gibba, Ludwigia stolonifera and Marsilea aegyptiaca* recorded in two habitats (Lake shores and Open water) of the Burullus Lake (P = 54.55, 15.91, 18.18 and 13.64%, respectively).

b) The four submerged hydrophytes are: three species namely *Ceratophyllum demersum, Potamogeton crispus and Potamogeton pectinatus* recorded in two habitats (Lake shores and Open water) of the Burullus Lake with presence value (P = 31.82, 15.91 and 40.91 %, respectively). One species namely Najas minor has been recorded in one habitat (Open water) with presence value (P = 9.09).

c) The emergent species are 14 species. Out of these, six species namely *Alternanthera sessilis, Bolboschoenus glaucus, Cyperus Laevigatus, Cyperus articulates, Juncus*

subulatus and Persicaria salicifolia. Each species has been recorded in one habitat (Lake shores or Lake islets) with presence value (P = 6.82, 2.27, 25, 2.27, 4.55, and 2.27%, respectively). Five species namely, *Cyperus alopecuroides, Echinochloa stagnina, Ranunculus sceleratus, Saccharum spontaneum and Typha domingensis* have been recorded in two habitats (Lake shores and Open water) with presence value (P = 2.27, 40.91, 6.82, 20.45 and 56.82 %, respectively). Whereas, two other species have been recorded in only two habitats (Lake shores and Lake islets), these are *Juncus acutus and Juncus rigidus* (P = 18.18 and 25 %, respectively). One specie namely *Phragmites australis* has been recorded in three habitats (Lake shores, Lake islets and Open water) with presence value (P = 95.45%).

d) The terrestrial species represent the main bulk of the flora (41 species) in the study area. These species occur either as weed flora associating the field crops or canal bank plants of the cultivated lands. Sixteen species have been recorded in two habitats (Lake shore and Lake islets) such as *Arthrocnemum macrostachyum, Bassia indica, Tamarix nilotica, Cynanchum acutum and Halocnemum strobilceum* with presence value (P= 27.27, 29.55, 29.55, 31.82 and 34.09%). Twenty-five species have been recorded in one habitat (Lake shore or Lake islets) such as *Cynodon dactylon, Limbarda crithmoides, Mesembryanthemum nodiflorum, Rumex dentatus and Sonchus oleraceus* with presence value (P=11.36, 27.27, 11.36, 9.09 and 11.36 %, respectively). It is also clear that, the terrestrial plants are the most frequent species in the different studied three habitats, followed by the emergent species, then the floating hydrophytes and finally the submerged hydrophytes.

Table 1. Plant species documented of the different environments in the study region.

No.	Species	Family	Life span	Life form	Floristic category	Habitat types			P%
						Lake shores	Lake islets	Open water	
A) Hydrophytes									
1. Floating Hydrophytes									
1	*Eichhornia crassipes* (C. Mart.) Solms	Pontederiaceae	Perennials	Hy	NEO	+	-	+	54.55
2	*Lemna gibba* L.	Lemnaceae	Perennials	Hy	COSM	+	-	+	15.91
3	*Ludwigia stolonifera* (Guill. & Perr.) P.	Onagraceae	Perennials	He	S-Z	+	-	+	18.18
4	*Marsilea aegyptiaca* Willd	Marsileaceae	Perennials	H,He	PAL	+	-	+	13.64
2. Submerged hydrophytes									
5	*Ceratophyllum demersum* L.	Ceratopyllaceae	Perennials	Hy	COSM	+	-	+	31.82
6	*Najas minor* All.	Hydrocharitaceae	Annuals	Hy	ME+PAL	-	-	+	9.09
7	*Potamogeton crispus* L.	Potamogetonaceae	Perennials	Hy	PAN	+	-	+	15.91
8	*Potamogeton pectinatus*	Potamogetonaceae	Perennials	Hy	ME+IR-TR	+	-	+	40.91
3. Emergent species									
9	*Alternanthera sessilis* (L.) DC.	Amarantheceae	Perennials	He	PAN	+	-	-	6.82
10	*Bolboschoenus glaucus* (Lam.) S.G. Smit	Cyperaceae	Perennials	G,He	COSM	-	+	-	2.27
11	*Cyperus alopecuroides* Rottb.	Cyperaceae	Perennials	He	PAN	+	-	+	2.27
12`	*C. Laevigatus* L.	Cyperaceae	Perennials	G, He	PAN	-	+	-	25
13	*C. articulatus* L.	Cyperaceae	Perennials	G , He	PAN	+	-	-	2.27
14	*Echinochloa stagnina* (Retz.) P. Beauv.	Poaceae	Perennials	G,He	PAL	+	-	+	40.91
15	*Juncus acutus* L.	Juncaceae	Perennials	H	IR-TR +ME+ ER-SR	+	+	-	18.18
16	*J. rigidus* Desf.	Juncaceae	Perennials	G,He	SA-SI +ME+IR-TR	+	+	-	25
17	*J. subulatus* Forssk.	Juncaceae	Perennials	G,He	ME+IR-TR+SA-SI	-	+	-	4.55
18	*Persicaria salicifolia* (Willd) Assenov	Polygonaceae	Perennials	G	PAL	+	-	-	2.27
19	*Phragmites australis* (Cav.) Trin. ex Steud.	Poaceae	Perennials	G, He	COSM	+	+	+	95.45
20	*Ranunculus sceleratus* L.	Ranunculaceae	Annuals	Th	ME+IR-TR+ER-SR	+	-	+	6.82
21	*Saccharum spontaneum* L. Mant. Alt	Poaceae	Perennials	G, He	ME+PAL	+	-	+	20.45
22	*Typha domingensis* (Pers.) Poir.ex	Typhaceae	Perennials	He	PAN	+	-	+	56.82

	Steud.								
B) Terrestrial									
23	*Alhagi graecorum* Boiss.	Fabaceae	Perennials	H	PAL	-	+	-	2.27
24	*Arthrocnemum macrostachyum* (Moric.) K. Koch	Chenopodiaceae	Perennials	Ch	SA-SI+ ME	+	+	-	27.27
25	*Asparagus stipularis* Forssk	Asparagaceae	Perennials	G	SA-SI+ ME	-	+	-	4.55
26	*Atriplex halimus* L.	Amaranthaceae	Perennials	Nph	SA-SI+ ME	+	+	-	9.09
27	*A. portulacoides* L.	Chenopodiaceae	Perennials	Ch	ME+IR-TR+ER-SR	+	+	-	18.18
28	*A. prostrata* DC. in Lam.	Chenopodiaceae	Annuals	Th	ER-SR +ME+IR-TR	+	+	-	11.36
29	*A. semibaccata* R.Br.	Chenopodiaceae	Perennials	H	AUST	+	-	-	2.27
30	*Bassia indica* (Wight) A .J.Scott	Chenopodiaceae	Annuals	Th	IR-TR+S-Z	+	+	-	29.55
31	*Beta vulgaris* L.	Chenopodiaceae	Biennials	Th	ER-SR+ME+IR-TR	+	-	-	4.55
32	*Cakile maritima* Scop.	Brassicaceae	Annuals	Th	ER-SR +ME	+	-	-	2.27
33	*Chenopodium album* L.	Chenopodiaceae	Annuals	Th	COSM	+	-	-	2.27
34	*C. murale* **L.**	Chenopodiaceae	Annuals	Th	COSM	+	+	-	15.91
35	*Cressa cretica* L.	Convolvulaceae	Perennials	H	PAL +ME	+	+	-	11.36
36	*Cynanchum acutum* L.	Asclepiadaceae	Perennials	H	IR-TR +ME	+	+	-	31.82
37	*Cynodon dactylon* (L.) Pers.	Poaceae	Perennials	G	COSM	+	-	-	11.36
38	*Halocnemum strobilceum* (Pallas) M. Bieb.	Chenopodiaceae	Perennials	Ch	ME+IR-TR+SA-SI	+	+	-	34.09
39	*Heliotropium curassavicum* L.	Boraginaceae	Perennials	Ch	NEO	-	+	-	4.55
40	*Limbarda crithmoides* (L.) Dumort.	Asteraceae	Perennials	Ch	SA-SI +ME+ER-SR	-	+	-	27.27
41	*Lactuca serriola* L.	Asteraceae	Annuals	Th	ME+IR-TR+ER-SR	+	-	-	4.55
42	*Lycium schweinfurthii* Dammor	Solanaceae	Perennials	Nph	ME	-	+	-	4.55
43	*Malva parviflora* L.	Malvaceae	Annuals	Th	ME+IR-TR	+	+	-	20.45
44	*Melilotus indicus* (L.) All.	Fabaceae	Annuals	Th	SA-SI +ME+IR-TR	+	-	-	2.27
45	*Mesembryanthemum crystallinum* L.	Aizoaceae	Annuals	Th	ER-SR+ ME	+	-	-	6.82
46	*M. nodiflorum* L.	Aizoaceae	Annuals	Th	SA-SI +ME+ER-SR	+	-	-	11.36
47	*Pancratium maritimum* L.	Amaryllidaceae	Perennials	G	ME	-	+	-	2.27
48	*Pluchea dioscoridis* (L.) DC.	Asteraceae	Perennials	Nph	S-Z+SA-SI	+	-	-	6.82
49	*Polygonium equistiform* Sm.	Polygonaceae	Perennials	G	ME+IR-TR	+	-	-	4.55
50	*Rumex dentatus* L.	Polygonaceae	Annuals	Th	IR-TR +ME+ +ER-SR	+	-	-	9.09
51	*Senecio glaucus* L.	Asteraceae	Annuals	Th	ME+IR-TR+SA-SI	+	+	-	6.82
52	*Silybium marianum* (L.) Gaertn.	Asteraceae	Annuals	Th	ME+IR-TR+ER-SR	+	-	-	4.55
53	*Solanum nigrum* L.	Solanaceae	Annuals	Th	COSM	+	-	-	2.27
54	*Sonchus oleraceus* L.	Asteraceae	Annuals	Th	COSM	+	-	-	11.36
55	*Spergularia marina* (L.) Griseb.	Caryophyllaceae	Biennials	Th	ME+IR-TR+ER-SR	+	+	-	11.36
56	*Suaeda maritima* (L.) Dumort	Chenopodiaceae	Annuals	Th	COSM	+	+	-	6.82
57	*S. pruinosa* Lange	Chenopodiaceae	Perennials	Ch	ME	+	+	-	11.36
58	*Suaeda vera* Forssk. ex J.F. Gmel.	Chenopodiaceae	Perennials	Ch	ME+ER-SR+SA-SI	-	+	-	4.55
59	*Symphyotrichum squamatum* (Spren.) Nesom	Asteraceae	Perennials	Ch	NEO	+	+	-	18.18
60	*Tamarix nilotica* (Ehrenb.) Bunge	Tamaricaceae	Perennials	Nph	S-Z+SA-SI	+	+	-	29.55
61	*Urtica urnes* L.	Urticaceae	Annuals	Th	ME+IR-TR+ER-SR	+	-	-	6.82
62	*Zygophyllum aegyptium* Hosny	Zygophyllaceae	Perennials	Ch	ME	+	-	-	4.55
63	*Z. album* L.	Zygophyllaceae	Perennials	Ch	SA-SI +ME	-	+	-	2.27
Number of stands					**44**	**22**	**11**	**11**	
Number of perennials					**42**	**31**	**23**	**12**	
Number of biennials					**2**	**2**	**1**	**0**	
Number of annuals					**19**	**18**	**6**	**2**	
Total number of recorded species					**63**	**51**	**30**	**14**	

Abbreviations: **P:** Presence

Life-form; Nph.: Nano-phanerophytes, **Ch.**: Chamaephytes, **H.:** Hemi-cryptophytes, **G.**: Geophytes, **He.**: Helophytes, **Hy**: Hydrophytes, **Th**: Therophytes; **Chorotype;** COSM: Cosmopolitan, PAN: Pantropical, NEO: Neotropical, PAL: Palaeotropical, IR/TR: Irano-Turanian, S/Z: Sudano-Zambezian, Cult. & Nat.: Cultivated and Naturalized, ME: Mediterranean, ER/SR: Euro-Siberian, SA/SI: Saharo-Sindian.

3.2. Plant Life-Span in the Study Area

As shown in Figure (2), the documented taxa (63) growing in the study region can be ordered into three major groups: perennials (42), biennials (2) and annuals (19 species). Lake shores habitat is floristically considered the richest habitat type among all ecological habitats in the study area, as it comprises 51 species. These species are represented by perennial species (31), biennials (2) and annual species (18). The flora of Lake Islets habitat comprises 30 species which can be divided into 23 perennials, 1 biennial and 6 annuals. Open water habitat, 14 species are recorded (12 perennials and 2 annuals).

The above stated results reveal that, the main bulk of the documented species in the present work is mainly represented by perennials followed by annuals and partly by biennials. Lake Shores habitat is clearly the most floristically diverse of all biological areas, followed by Lake Islets habitat, and lastly Open Water habitat.

3.3. Plant Life-Forms in the Study Area

The recorded species of the present study are clustered under 5 types of life-form as follows: cryptophytes, therophytes, chamaephytes, hemicryptophytes and nanophanerophytes. Cryptophytes, which comprise helophytes, geophytes, and hydrophytes (32 percent), and partially nanophanerophytes, make up the bulk of plants (4 percent). Therophytes attain value of about 20%, chamaephytes value of 10% and hemicryptophytes value of 6% of the total recorded species (Figure 3). The percentages of the life-form spectrum clearly differ from one environment to the next (Figure 3). Cryptophytes (23 percent), therophytes (20 percent), chamaephytes (6 percent), hemicryptophytes (5 percent), and nanophanerophytes (five percent) are the life forms found in Lake Shores ecosystem (3 percent).

Cryptophytes (12 percent), therophytes (7 percent), chamaephytes (9 percent), hemicryptophytes (4 percent), and nanophanerophytes (4 percent) are the five types of living forms found in Lake Islets (3 percent). In Open water habitat, the recorded species (18) are grouped into: cryptophytes (16%), therophytes (1%) and hemicryptophytes (1%). It's worth noting that cryptophytes dominate the life-form spectrum in all habitats in the research region, with therophytes, chamaephytes, and hemicryptophytes filling in the gaps. The minimal values across all environments in the research region indicate the group of nanophanerophytes

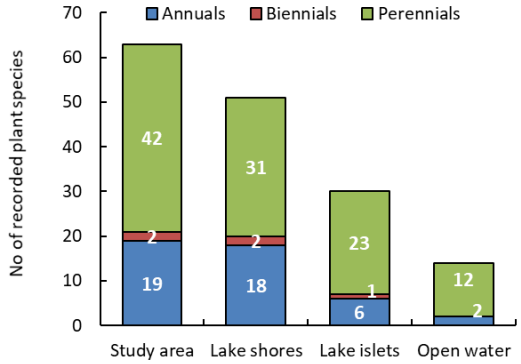

Fig 2. The study region's plant life span and three habitats.

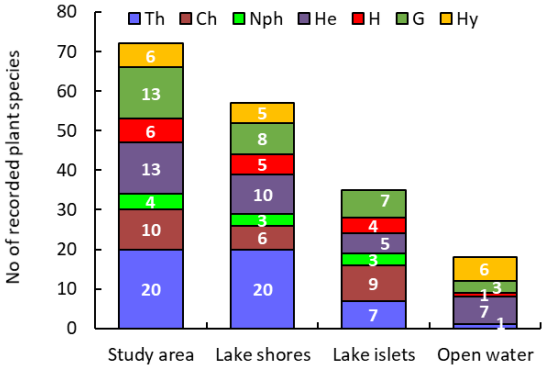

Fig 3. The study region's plant life form and three habitats.

3.4. The Floristic Analysis of the Study Area

The total number of flowering plant species found in this study is 63, including 50 genera and 30 families (Table 2). The primary families are Chenopodiaceae (13 species), Asteraceae (7 species), Poaceae, and Cyperaceae (4 species each), with 28 species representing 44.4 percent of the total number of species documented.

There are three species in each of the Juncaceae and Polygonaceae families. There are either two or one species in each of the remaining 24 families.

The floristic analysis of the research region, as shown in Table (3), demonstrates that Mediterranean taxa account for 35 species, or roughly 55.55 percent of the total number of species reported. Pluriregional (18 species = 28.57 percent), biregional (16 species = 25.39 percent), or monoregional (6 species = 9.52 percent) taxa are represented. It was also discovered that 23 species, or around 36.50 percent of all documented species, are global species. Cosmopolitan (10 species = 15.87 percent), Palaeotropical (4 species =6.35 percent), Pantropical (6 species =9.52 percent), and Neotropical (3 species =4.76 percent) species make up this group. The other floristic groups are underrepresented, with only a few species representing each chorotype (Table 3). In general, the proportions of Cosmopolitan, Pantropical, Palaeotropical, and Neotropical components are clearly comparable in all of the study area's biological sites. Lake beaches habitat (27 taxa), Lake Islets habitat (20 taxa), and Open water habitat (20 taxa) are all rich in Mediterranean components (4 taxa)

Table 2. The main phytochorotype of the families in the study region.

Family	Genus	Species	COSM	PAL	NEO	PAN	Pluriregional elements	Biregional elements	ME	S-Z	AUST
Chenopodiaceae	7	13	3	-	-	-	5	3	1	-	1
Asteraceae	7	7	1	-	1	-	4	1	-	-	-
Cyperaceae	2	4	1	-	-	3	-	-	-	-	-
Poaceae	4	4	2	1	-	-	-	1	-	-	-
Juncaceae	1	3	-	-	-	-	3	-	-	-	-
Polygonaceae	3	3	-	1	-	-	1	1	-	-	-
Aizoaceae	1	2	-	-	-	-	1	1	-	-	-
Fabaceae	2	2	-	1	-	-	1	-	-	-	-
Potamogetonaceae	1	2	-	-	-	1	-	1	-	-	-
Zygophyllaceae	1	2	-	-	-	-	-	1	1	-	-
Amarantheceae	1	1	-	-	-	1	-	-	-	-	-
Amaryllidaceae	1	1	-	-	-	-	-	-	1	-	-
Asclepiadaceae	1	1	-	-	-	-	-	1	-	-	-
Asparagaceae	1	1	-	-	-	-	-	1	-	-	-
Boraginaceae	1	1	-	-	1	-	-	-	-	-	-
Brassicaceae	1	1	-	-	-	-	-	1	-	-	-
Caryophyllaceae	1	1	-	-	-	-	1	-	-	-	-
Ceratopyllaceae	1	1	1	-	-	-	-	-	-	-	-
Convolvulaceae	1	1	-	-	-	-	-	1	-	-	-
Hydrocharitaceae	1	1	-	-	-	-	-	1	-	-	-
Lemnaceae	1	1	1	-	-	-	-	-	-	-	-
Malvaceae	1	1	-	-	-	-	-	1	-	-	-
Marsileaceae	1	1	-	1	-	-	-	-	-	-	-
Onagraceae	1	1	-	-	-	-	-	-	-	1	-
Pontederiaceae	1	1	-	-	1	-	-	-	-	-	-
Ranunculaceae	1	1	-	-	-	-	1	-	-	-	-
Solanaceae	1	1	-	-	-	-	-	-	1	-	-
Solanaceae	1	1	1	-	-	-	-	-	-	-	-
Tamaricaceae	1	1	-	-	-	-	-	1	-	-	-
Typhaceae	1	1	-	-	-	1	-	-	-	-	-
Urticaceae	1	1	-	-	-	-	1	-	-	-	-
Total	**50**	**63**	**10**	**4**	**3**	**6**	**18**	**16**	**4**	**1**	**1**
Percentage			**15.87**	**6.35**	**4.76**	**9.52**	**28.57**	**25.40**	**6.35**	**1.59**	**1.59**

Table 3. Species number and % of various floristic groups in the research area's distinct habitat types.

Floristic category	Study area		Lake shores		Lake islets		Open water	
	No.	%	No.	%	No.	%	No.	%
World wide								
COSM	10	15.87	9	17.65	4	13.33	3	21.43
NEO	3	4.76	2	3.92	2	6.67	1	7.14
PAL	4	6.35	3	5.88	1	3.33	2	14.29
PAN	6	9.52	5	9.80	1	3.33	3	21.43
Pluriregional elements								
ME+IR-TR+ER-SR	10	15.87	10	19.61	4	13.33	1	7.14
ME+IR-TR+SA-SI	5	7.94	2	3.92	3	10.00	-	-
ME+ER-SR+SA-SI	3	4.76	1	1.96	2	6.67	-	-
Biregional elements								
ME+IR-TR	4	6.35	4	7.84	2	6.67	1	7.14
ME+SA-SI	4	6.35	2	3.92	4	13.33	-	-
ME+ER-SR	2	3.17	2	3.92	-	-	-	-
ME+PAL	3	4.76	2	3.92	1	3.33	2	14.29
IR-TR+S-Z	1	1.59	1	1.96	1	3.33	-	-
S-Z+SA-SI	2	3.17	2	3.92	1	3.33	-	-
Mono-regional elements								
ME	4	6.35	4	7.84	4	13.33	-	-
S-Z	1	1.59	1	1.96	-	-	1	7.14
AUST	1	1.59	1	1.96	-	-	-	-
Total	**63**	**100**	**51**	**100**	**30**	**100**	**14**	**100**

4. Conclusion

The species in the research area are noteworthy because they offer a diverse range of products and services to the local community (Tamarix nilotica, Phragmites australis, Alhagi graecorum, Atriplex halimus, Panicum turgidum, Typha domingensis, etc.). Thus, to mitigate severe human impacts, such as continued land reclamation, which has a negative impact on natural habitats, particularly salt marshes and sand formations (such as sand sheets, hillocks, and dunes) found on sand bars and some islets, plant diversity in this region requires long-term management (e.g., Al-Kawm Al-Akhdar). In these settings, several limited species that do not occur elsewhere in the region can be found.

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