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Floristic feature of plant cover associated with invasive weed Ranunculus sceleratus L. Nile Delta, Egypt

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Abstract This study aims to survey the plant flora associated with *Ranunculus sceleratus* of the Ranunculaceae family in deltaic Governorates to investigation of the floristic features, including list of plant species, life-span, life-form spectra and floristic analysis. The selected area for the current study is situated in north and middle borders of three Deltaic Governorates namely: Damietta, ElDakahlia and Kafr-ElSheikh. Floristic analysis of the associated flora revealed that, the whole number of the listed plant flora surveyed in the current study is 72 species belonging to 59 genera and 23 families. Poaceae, Asteraceae, Amaranthaceae, Chenopodiaceae, Cyperaceae, Polygonaceae, Brassicaceae are the largest families. The life-form spectra in the study area are represented by therophytes (47.5%), helophytes and geophytes (17.5% each), hemicryptophytes (8.75), chamaephytes (5%) and finally nanophanerophytes which attained value of (3.75 %). Chorologically, the floristic investigation of the selected area shown that, about 41.88% of the whole number of the listed species is Mediterranean flora.

keywords: Ranunculus, Vegetation, Chorotype, Duration, Life form

1.Introduction

The genus *Ranunculus sceleratus* (R. *sceleratus* L. subsp. *sceleratus*) is a recognized by the synonyms names celery-leaved-buttercup [1], a type of flowering plant in the buttercup family Ranunculaceae. It has a peripheral distribution in the northern hemisphere, native to temperate and boreal-north Eurasia and America, whereas it grows in humid and moist environments, comprising irrigation and drainage canals, water banks and ponds. Celery-leaved buttercup (*R. sceleratus*) generally grows in moist or muddy sites (e.g. along drainage banks, in swamps and marshes, in moist low-lying areas and in poorly drained areas) and can displace native species from such areas [1]**.** It is listed as an invasive weed in northern Africa (i.e. northern Algeria, northern Egypt, Morocco and Tunisia), Europe, western and northern Asia, the Indian Sub-continent (i.e. northern India, Bhutan, Nepal and Pakistan) and North America (i.e. most of the USA) [2, 3].

Ranunculus sceleratus L. (Ranunculaceae) is an annual herb of length range from twenty to sixty centimeters that branches and inhabits moist lands, swamps and canal banks [1]**.** It is growing in shallow water and could tolerate drought. Its root system is distributed in the upper sediment layer with depth of ten to twenty five centimeters and rhizosphere diameter of eighteen centimeters. The stems are pale green and smooth while the aerial parts have abundant trichomes [4] (Figure 1).

Hu *et al.* [5] assumed that *R. sceleratus* has the ability to adsorb several trace metals like iron and zinc while roots have capability to adsorb iron. Therefore, this plant is used as accumulator for such heavy metals from water-bodies [6, 7]. Guo [8] described that the studied plant could be used for biomonitoring of water pollution. Mei *et al.* [9] reported the potentiality of *R. sceleratus* in eutrophication and adsorption of iron and zinc from wetland ecosystems. Farahat and Galal [10] reported that *R. sceleratus* capability for accumulation manganese, nickel, copper and lead in its roots indicates the usage of such species for

phytoremediation of trace metals (specially manganese) in polluted water-bodies.

The development of all vegetation types, terrestrial and aquatic, is influenced by several interacting factors. Geological history and soil types that develop from parent rock of a given region, combined with climatic factors such as rainfall, temperature and light, determine which plant species will survive under prevailing conditions [11]. Environmental conditions impact stress or disturbance on the plant could signal favorable or unfavorable conditions for growth and reproduction of the plant [12-13]. Water availability is one of the major limitations to plant productivity [14], and is one of the main factors controlling the distribution of plant species.

Several studies have been directed towards the introduction and farming of some desert flora such as feed, building materials, furniture, agricultural materials, textiles, and mats in Egypt [15-19]. Therefore, the current study aimed to survey the associated plant species with *R. sceleratus* (Ranunculaceae) in the Nile Delta for detection of the life-span, life-form spectra and floristic analysis of wild flora in selected region.

Figure 1. Close up view of *Ranunculus sceleratus*

1. STUDY AREA

Egypt is situated in the north-eastern corner of Africa and south- western Asia. The Nile Delta is the only delta in Egypt and is a classic Delta with a triangular shape broader at its base than the sides. Its distance from northward to south is 170 km, and their breadth from eastward to west is 220 km with an area about of 22,0000 km^2 and thus resembles about sixty three percent of the fertile lands in Egypt, while the Nile-Valley area is around 13000 km^2 [20,21]. The canal system in the Nile Delta is widespread. The central Nile-Delta drainage system comprises ten main drains [22]. The selected region for this study is in the northern-part of the Nile Delta zone of Egypt that covers the northern and middle borders of Damietta, ElDakahlia and Kafr-ElSheikh Governorates (Figure 2).

The distribution of the arid regions in the world [23] indicates that the climatic situations of the Nile-Delta are like to those of the northern-part of Egypt, it is rather arid to semiarid, whereas the degree of evaporation exceeds the degree of precipitation. The study area lies in Meig's warm coastal deserts [24] where the average summer temperature less than 30°C, and in winter with an average temperature above 10°C with occasional rainstorms, but most of the days are sunny and mild.

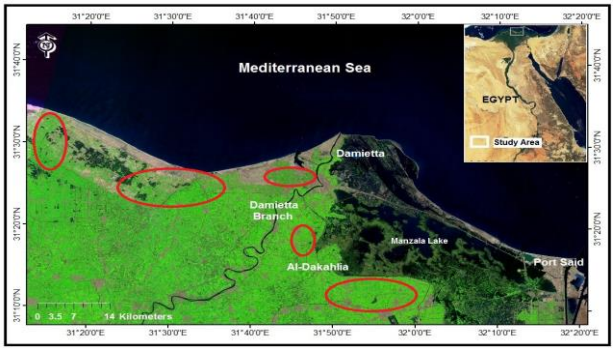

Figure 2. Location Map showing the study area.

2. Materials and methods

The present study is represented by 48 stands (240 plots) in canal bank of north Nile Delta (Damietta and El-Dakahlia Governorates). The stands were distributed in the study area to cover different sites of canal bank in north Nile Delta and to ensure sampling of wide range of vegetational variations. In each quadrate, all served vegetation were listed in 5 plots (30 m² each) and the species frequency was determined in one sample quadrate according to Westhoff and Van der Maarel [25] and Muller-Dombios and Ellenberg [26].

During each visit (2019), the collected plant samples were nomenclature and Herbarium specimens were deposited in the herbarium of Botany Department-Faculty of

ScienceDamietta University. The life-forms were described and classified agreeing to Raunkiaer [27, 28]. The floristic categories were identified and classified agreeing to Tutin *et al.* [29], Davis [30], Zohary [31], Täckholm [32], Meikle [33], Feinbrun-Dothan [34] and updated by Boulos [35].

3. Results and Discussion

The genus Ranunculus sceleratus (R. sceleratus L. subsp. sceleratus) recognized by the synonyms names celery-leaved buttercup [1], and is a species of flowering plant in family Ranunculaceae. Floristic investigation of the associated flora showed that, the total number of the listed flora species surveyed in the current study is 72 species belonging to 59 genera and 23 families (Table 1). Out of these families, Poaceae comprises 14 species (19.44%) by family Asteraceae 11 species (15.27%), then family Chenopodiaceae 7 species (9.72%), Amaranthaceae, Cyperaceae, Polygonaceae 5 species each (6.94%), Brassicaceae 4 species (5.55%) (Figure 3). The previous seven families are represented collectively about 52 species 72.22% of the total recorded species. This may indicate that, these seven families are leading taxa and constitute the major bulk of the flora of the study area. This agrees more or less with the findings of El-Shiekh [36] on the canal drain vegetation in the middle Delta region, Shaltout *et al.* [37] on the vegetation of different habitats in the south Nile Delta, Shaltout *et al.* [38] studied the plant life in the Nile Delta and Al-Mamoori [39] on the plant life of the Damietta branch, River Nile and El-Amier and Al-Mamory [40] on relationship between aquatic plants and environmental factors along Rosetta Branch of the River Nile inEgypt

of the total listed flora species, followed

Tables 1. Floristic composition of survey plant species associated with *Ranunculus sceleratus* in the different water bodies in the study area. Life Form: H= Hemicryptophytes, G.= Geophytes, He.= Helophytes, Th=Therophytes, Nph=Nanophanerophytes Ch=Chamaephytes; Floristic Category: C.O.S.M.=Cosmopolitan, PAN=Pantropical, PAL=Palaeotropical, NEO=Neotropical, ME=Mediterranean, SI=Saharo-Sindian, ER=Euro-Siberian, IR=Irano-Turanian, S-Z=Sudano-Zambezi

Species	Family	Life span	Life form	Floristic category
Alhagi graecorum Boiss.	Fabaceae	Perennial	H	PAL
Alternanthera sessilis (L.) DC.	Amaranthaceae	Perennial	He	PAN
Amaranthus graecizans L.	Amaranthaceae	Annual	Th	ME+ IR
A. viridis L.	Amaranthaceae	Annual	Th	ME +IR
Anagallis arvensis L.	Primulaceae	Annual	Th	COSM
Arundo donax L.	Poaceae	Perennial	G , He	Cult. & Nat.
Atriplex halimus L.	Chenopodiaceae	Perennial	NPh	SI + ME
A. portulacoides L.	Chenopodiaceae	Perennial	Ch	IR+ER+ ME
Bassia indica (Wight) A. J. Scott	Chenopodiaceae	Annual	Th	S-Z+IR
Beta vulgaris L.	Amaranthaceae	Biennial	Th	IR +ER+ ME
Bidens pilosa L.	Asteraceae	Annual	Th	PAN
Chenopodium album L.	Chenopodiaceae	Annual	Th	COSM
C. ficifolium Sm.	Chenopodiaceae	Annual	Th	ER+ ME
C. murale L.	Chenopodiaceae	Annual	Th	COSM
Convolvulus arvensis L.	Convolvulaceae	Perennial	H	COSM
Conyza bonariensis (L.) Cronquist, Bull.	Asteraceae	Annual	Th	NEO
Coronopus didymus (L.) Sm.	Brassicaceae	Annual	Th	COSM
C. squamatus (Forssk.) Aschers	Brassicaceae	Annual	Th	IR +ME+ ER
Cynanchum acutum L.	Asclepiadaceae	Perennial	H	IR+ ME
Cynodon dactylon (L.) Pers.	Poaceae	Perennial	G	PAN
Cyperus alopecuroides Rottb.	Cyperaceae	Perennial	He	PAN
C. articulatus	Cyperaceae	Perennial	G , He	PAN
C. difformis L.	Cyperaceae	Annual	Th	PAL
C. laevigatus L.	Cyperaceae	Perennial	G , He	PAN
C. rotundus L.	Cyperaceae	Perennial	G	PAN
Echinochloa stagnina (Retz.) P. Beauv.	Poaceae	Perennial	G , He	PAL
Eclipta prostrata (L.) L.	Asteraceae	Annual	Th	NEO
Ethulia conyzoides L.F.	Asteraceae	Annual	Th	PAL

Euphorbia helioscopia L.	Euphorbiaceae	Annual	Th	ME+IR + SI
E. peplus L.	Euphorbiaceae	Annual	Th	ME+IR +ER
Imperata cylindrica (L.) Raeusch.	Poaceae	Perennial	H	ME+PAL
Ipomoea carnea Jacq.	Convolvulaceae	Perennial	G	PAN
Juncus bufonius L.	Juncaceae	Annual	Th	COSM
Leersia hexandra Sw.	Poaceae	Perennial	He	PAN
Ludwigia stolonifera (Guill. et Perr.) Raven	Onagraceae	Perennial	He	S-Z
Malva parviflora L.	Euphorbiaceae	Annual	Th	IR+ ME
Medicago sativa L.	Fabaceae	Annual	Th	ER+ ME
Melilotus indicus (L.) All.	Fabaceae	Annual	Th	IR + SI+ ME
Mentha longifolia (L.) Huds.	Lamiaceae	Perennial	He	PAL
Panicum repens L.	Poaceae	Perennial	G	PAN
Paspalidium geminatum (Forssk.) Stapf	Poaceae	Perennial	He	PAL
Pennisetum setaceum (Forssk.) Chiov.	Poaceae	Perennial	H	PAL+ ME
Persicaria lanigera (R. Br.) Sojak	Polygonaceae	Perennial	G	PAL
P. lapathifolia Willd.	Polygonaceae	Perennial	G	PAL
P. salicifolia Brouss. ex Willd	Polygonaceae	Perennial	G	PAL
Phalaris minor Retz.	Poaceae	Annual	Th	IR+ ME
Phragmites australis (Cav.) Trin. ex Steud.	Poaceae	Perennial	G, He	COSM
Plantago major L.	Plantaginaceae	Perennial	H	COSM
Pluchea dioscoridis (L.) DC.	Asteraceae	Perennial	Nph	SI+ S-Z
Poa annua L.	Poaceae	Annual	Th	COSM
Polygonum equisetiforme Sibthi & Sm.	Polygonaceae	Perennial	G	IR+ ME
Polypogon monspeliensis (L.) Desf.	Poaceae	Annual	Th	COSM
P. viridis (Gouan) Breistr.	Poaceae	Perennial	H	IR+ ME
Pseudognaphalium luteo-album (L.) Hilliard & L.	Asteraceae	Annual	Th	COSM
Ranunculus sceleratus L.	Ranunculaceae	Annual	Th	IR +ER+ ME
Rorripa palustris (L.) Besser	Brassicaceae	Biennial	Th	IR +ME+ ER
Rumex dentatus L.	Polygonaceae	Annual	Th	IR +ER+ ME
Saccharum spontaneum L.	Poaceae	Perennial	G, He	PAL+ ME
Suaeda maritima (L.) Dumort.	Amaranthaceae	Perennial	Ch	ME
Senecio aegyptius L.	Asteraceae	Annual	Th	IR +ER+ ME
Silybum marianum (L.) Gaertn.	Asteraceae	Annual	Th	IR+ER+ ME
Sisymbrium irio L.	Brassicaceae	Annual	Th	IR +ER+ ME
Solanum nigrum L.	Solanaceae	Annual	Th	COSM
Sonchus oleraceus L.	Asteraceae	Annual	Th	COSM
Spergularia marina (L.) Griseb	Caryophyllaceae	Biennial	Th	IR +ER +ME
Suaeda pruinosa Lange	Chenopodiaceae	Perennial	Ch	ME
Symphyotrichum squamatum (Spreng.) Nesom	Asteraceae	Perennial	Ch	NEO
Torilis arvensis (Huds) Link	Apiaceae	Annual	Th	IR +ER+ ME
Typha domingesis L	Typhaceae	Perennial	He	PAN
Urospermum picroides (L.) F.W. Schmidt	Asteraceae	Annual	Th	IR+ ME
Urtica urens L.	Urticaceae	Annual	Th	IR +ER+ ME
Veronica anagallis-aquatica L.	Scrophulariaceae	Perennial	He	COSM

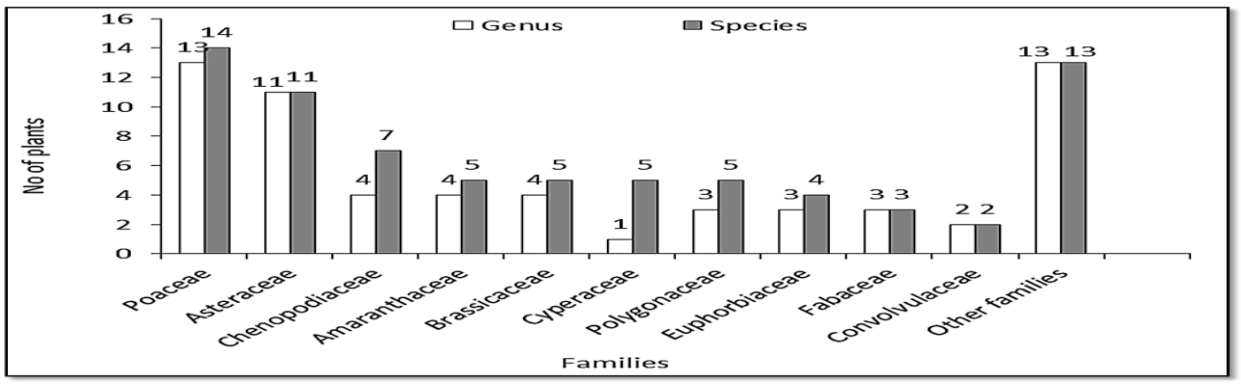

Figure 3. The whole number of listed flora genera and species in the recorded families

In Egypt, most weeds are mostly herbaceous either with woody base or with tuberous underground parts and few are shrubs [21-41]. Based on plant longevity (duration), the listed species in the study region (72) can be classified under three main classes agreeing to their duration as follows: 34 annuals species (47.22%), 3 biennials species (4.05%) and 35 Perennials species (48.61%) (Figure 4).

The classes of life forms provide information which may help in evaluation the response of plant cover to the difference in certain environmental factors [42]. The life-form is important physiognomic attributes which have broadly used by ecologists and chorologists in the vegetation and floristic studies [43].

Raunkiaer [27, 28] classified the Mediterranean climate type as therophyte climate due to the high percentage (over 50% of the all species) of this life-form in the Mediterranean floras. This is confirmed later by Hassib [44] and Zohary [45] in Egypt and Palestine, respectively, as well as Quezel [46] in North-Africa. In the present study, the life-form spectrum in the Nile region of Egypt is predominantly therophytes (47.50%). Geophytes are the second frequent life-form attaining value (15.54 %) of the total life-form spectrum. Accordingly, the life-form spectra provide evidence that therophytes and geophytes form collectively about (65%) of the vegetation in the study region. The present study illustrates that, the life-form spectra in the study area is represented by therophytes (47.5%), helophytes and geophytes (17.5% each), hemicryptophytes (8.75) and chamaephytes (5%) and finally nanophanerophytes which attained value of (3.75 %)(Figure 5).

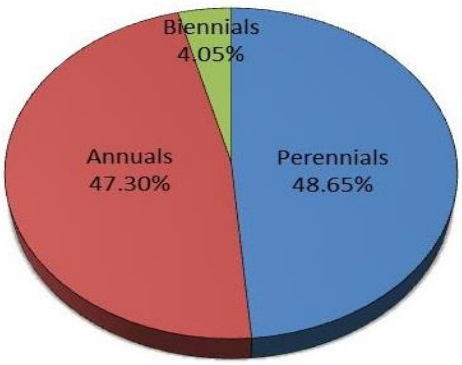

Figure 4. Plant life-span in the study zone.

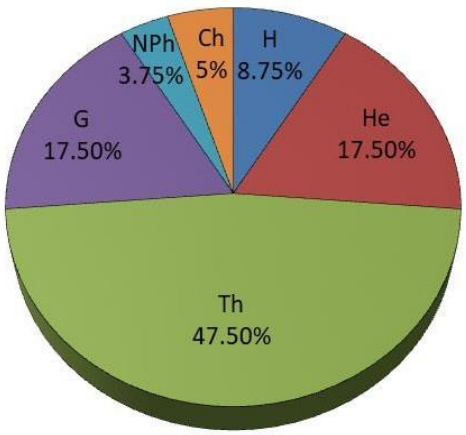

Figure 5. Plant life form spectra in the study zone.

In the earlier study by Hassib [44], therophytes were estimated by 50.3% for the whole Egyptian flora compared with 58.7% for the Mediterranean region and 59.4 % for Egyptian Nile region. Al-Sodany [47] recorded about 52.6 % of this life-form in the vegetation analysis of Nile Delta region. Studies by El-Sheikh [36] which illustrated about 59.3 % of the therophytes are recorded in the ruderal vegetation in the Nile Delta, Sheded and Shaltout [48] reported that therophytes of the weed flora in plantation of recently established tourist resorts along Red Sea coast of Egypt resemble about 56.8 %. El-Halawany [49] reported 54.1% and Shaltout *et al.* [37] illustrated 58.3% on the vegetation composition of orchards and field crops in the Nile Delta region. Maswada [50] recorded about 50.2% of this life-form in Mediterranean coastal region of Kafr El-Sheikh Province. On the other hand, therophytes were lower than those reported by El-Kady *et al.* [51] (68.8%) of habitats in the North Western part of the Nile Delta, Shaheen [52] (69.8 %) of the weed of newly farmed land on the southern border of Lake Nasser of Egypt, El-Amier [53] illustrated 32.86% on vegetation of canal bank in Nile Delta and Al-Mamoori [39] recorded about 34.29% on the plant life of the Damietta branch, River Nile.

The percentage of cryptophytes (comprising: geophytes and helophytes) collectively attained in the present study (17.5% each) comparable to Hassib [44] who reported 25.8% of this life-form in the Egyptian flora, 15.9% in the Mediterranean region and 16.2% in the Egyptian Nile Delta region. This life form contributed about 25.8%,

20.5%, 20.5%, 26.3% and 28.57% for the studies of El-Sheikh [37], Al-Sodany [39], El-Halawany [47], Shaltout *et al.* [49] and Al-Mamoori [54] respectively. Chamaephytes, hemicryptophytes and nanophanerophytes in the present study agree more or less with the findings of Hassib [44], Al-Sodany [39], Shalaby [40], Awad [47], Maswada [50], El-Amier [53], Al-Mamoori [55] and El-Amier and Al-Mamory [56] in the Egyptian flora.

Chorolgically, the floristic elements of Egypt belong to at least 4 phyto-geographical areas that are the Afro-Sudano-Zambesian, the Asiatic-Irano-Turanian, the Afro-Asiatic/Sahro-Sindian and the Euro-Afro-Asiatic Mediterranean [57]. The floristic investigation of the study zone showed that, about 41.88% of the all number of the listed species is Mediterranean flora (Table 2). These flora are either pluri-regional (20.27%), bi-regional (18.91 %) or mono-regional (2.7 %). It has been also found that, 37 species or about 49.99% of the all number of listed flora are either Cosmopolitan (14 species =18.92%), Palaeotropical (9 species = 12.16%), Pantropical (11 species = 14.86%) and Neotropical (3 species = 4.05%). Similar investigations have been described by Abd El-Ghani and Amer [53], El-Demerdash *et al.* [55], Shalaby [58], Khedr and El-Demerdash [59], El-Halawany [60], El-Amier [61, 62], El-Amier *et al*. [63].

Ecologically, some aquatic species have limited distribution range; others possess wide ecological amplitudes and at the mean time absent from other ecological sites. This restriction based on their need for a special area like the helophytic weeds needs wet habitats. The habitat types supporting the growth of the plant species in the present study are mainly hydric and/or canal bank habitats. It is crucial to study the environmental conditions for the plants growth in their original habitats in order to know the suitable situations for each plant for maximum yield with the highest production of active materials possess economic values

Conclusion

The present study concluded that, the Nile Delta zone is rich with its wild flora, as a source for animal fodder, agro-industrial raw materials, human food, and for the medicinal purposes. *R. sceleratus* could be a useful biomonitoring plant of water pollution and eutrophication remediation as well as in removal of Fe, Mn, Ni, Cu, and Pb and Zn from the wetland ecosystem [8-10]. Therefore, the conservation of desert

ecosystem is vital importance and need judicious utilization for sustainable development.

Table 2. Number of species and percentage of various floristic categories in the study area.

No.	Floristic category	No.	%	Geographical distribution
1	COSM	14	18.92	World wide
2	PAL	9	12.16	
3	PAN	11	14.86	
4	NEO	3	4.05	
5	ME+IR-TR+ER-SR	13	17.57	Pluriregional elements
6	ME+IR-TR+SA-SI	2	2.70	
7	ME+IR-TR	8	10.81	Biregional Elements
8	ME+ER-SR	2	2.70	
9	ME+SA-SI	1	1.35	
10	ME+PAL	3	4.05	
11	S-Z+IR-TR	1	1.35	
12	S-Z+SA-SI	1	1.35	
14	ME	2	2.70	Mono-regional elements
15	S-Z	1	1.35	
16	Cult. & Nat.	1	1.35	
Total		72	100	

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