Flora Diversity of Garaet Ouajaa (Wetlands of Guerbes-Senhadja, Northeast Algeria)

Tarek Hamel*, Abderachid Slimani, Ratiba Seridi
Laboratory of Plant Biology and Environment, Badji Mokhtar University Annaba, Algeria
* Corresponding author: Tarek Hamel Email: tarek_hamel@yahoo.fr

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The Analysis of the flora diversity of Guaraet Ouajaa between the period 2015 - 2016 revealed the existence of 125 taxa belonging to 48 families and 102 genera. This flora is dominated by therophytes 54%. Of the listed vascular plant species, 32 are of Mediterranean origin. Three endemic taxa have been inventoried, two of which are rare. Urgent protection efforts must be made to conserve this wetland and the species under its control.

INTRODUCTION
Wetlands play important ecological and landscape roles, including flood control, recharge of aquifers, trapping of toxic chemicals, and nutrient recycling [1]. They also constitute remarkable habitats for adapted flora and fauna, contributing strongly to regional biodiversity [2]. The great ecosystem and biological richness of the North of Algeria has recently prompted the proposal to classify the phytogeographic sectors including Kabylie, Numidia (Algeria) and Kroumirie (Tunisia) as a hot spot of biodiversity [3]. This specific richness has long been noticed in the wet complexes of the coastal plains of the regions of El Kala-Edough peninsula-Guerbes-Senhadja. They most probably house the richest hygrophilous and hydrophilic communities in North Africa [4]. This study aims to evaluate the floristic, biological and biogeographic composition of the hydrophytic vegetation one of the Guerbes-Senhadja wetland ponds, "Guareat Ouajaa".

Study Area
Guaraet Ouajaa (36 ° 53'192 "N, 7 ° 18'963" E), a marshy depression, with an area of 20 ha [5]. It is bounded to the north by Guareat Nechmaya, to the south by the commune of Ben Azzouz, to the east by Oued Magroun and by lake Sidi Fritis to the West. It contains an artificial ditch almost always in water and constitutes a reserve for the needs of irrigation and a marshy area with alluvial texture, partially covered with a sandy-peat horizon; It is either submerged or totally dried and placed in culture depending on the alternation of wet or dry years; Its fringes are occupied by damp meadows [6].
METHODS
This inventory was carried out using 10 plant surveys according to the phytosociological method [7]; For two years 2015-2016. The surface of the survey must be at least equal to the minimum area, containing almost all the species present [8]. The control samples are deposited in the herbarium of the Laboratory of Plant Biology and Environment (L.B.V.E) University Badji Mokhtar Annaba, Algeria. The nomenclature of taxa is updated according to recent work [9]. The species listed were informed by their biogeographic type [9, 10, 11], and their biological type according to [8].

RESULTS AND DISCUSSION
The inventory of the Garaet Ouajaa flora revealed the presence of 125 species mainly belonging to Poaceae (16 species), Asteraceae (14 species), Fabaceae (7 species) and Polygonaceae (6 species) (Table 1).

The flora studied is dominated by dicotyledonous angiosperms which form the largest systematic group with 96 taxa belonging to 40 families and 77 genera; The monocotyledons gather 27 taxa distributed in 7 families and 22 genera. Pteridophytes have 2 taxa of the family Isoëtaceae and Salvinaceae.
The species scarcity rate is 10.4%, or 13 species. These rare species are therefore of great value in terms of conservation, either for heritage reasons or for their risk of extinction [13, 14].

Table 1. List of species in the study area

| Family          | Species                          | Life Form | Chrotype | Scarcity |
|-----------------|----------------------------------|-----------|----------|----------|
| Alismataceae    | *Alisma lanceolatum* With.       | Hydr      | Paleotemp| CC       |
|                 | *Baldellia ranunculoides* (L.) Parl. | Hydr      | Med Atl  | AC       |
| Apiaceae        | *Ammi majus* L.                  | Th        | Circumed | CC       |
|                 | *Ammi visnaga* Lamk              | Th        | Circumed | CC       |
|                 | *Daucus carota* L. subsp. mauritanicus (L.) Quézel & Santa | Hem | Med | CC |
|                 | *Helosciadium nodiflorum* (L.) W. D. J. Koch | Hydr  | Paleotemp| C       |
|                 | *Oenanthe globulosa* L.          | Hydr      | Med      | C       |
| Araceae         | *Arum italicum* subsp. italicum* Miller | Geo     | Circumed | C       |
| Asteraceae      | *Acanthoxanthium spinosum* (L.) Fourr | Th      | Subcosmop| C       |
|                 | *Andryala integrifolia* L.       | Th        | Circumed | C       |
|                 | *Bellis annua* subsp. annua L.   | Th        | Med      | C       |
|                 | *Bellis repens* Lamk.            | Hydr      | Trop     | R       |
|                 | *Centaurea calcitrapa* L.        | Th        | Euro-Med | C       |
|                 | *Cichorium intybus* subsp. glabratum Arcang. | Hem | Euro-Med | C       |
|                 | *Cladanthus mixtus* (L.) Oberprieler | Th      | Circumed | C       |
|                 | *Conyza canadensis* (L.) Cronq.  | Th        | Intrad   | C       |
|                 | *Cotula coronopifolia* L.        | Th        | Intrad   | C       |
|                 | *Echinops bovei* Boiss.          | Th        | Ibero-Mag| AC      |
|                 | *Galactites mutabilis* Durieu    | Hem       | End Alg-Tun | C |
|                 | *Gleobiis segetum* (L.) Fourr.   | Th        | Euro-Med | C       |
|                 | *Senecio vulgaris* L.            | Th        | Subcosmop| C       |
|                 | *Xanthium strumarium* L.         | Th        | Intrad   | C       |
| Betulaceae      | *Alnus glutinosa* (L.) Gaertn.   | Ph        | Paleotemp| AR      |
| Boraginaceae    | *Echium plantagineum* L.         | Th        | Med      | C       |
|                 | *Heliotropium europaeum* L.      | Th        | Med Atl  | C       |
| Brassicaceae    | *Biscutella maritima* Ten.       | Th        | Med      | C       |
|                 | *Brassica procumbens* (Poiret) O.E. Schulz | Hem | Med | C |
|                 | *Capsella bursa-pastoris* (L.) Medik. | Th       | Cosmop  | C       |
|                 | *Cardamine hirsuta* L.           | Th        | Subcosmop| C       |
|                 | *Nasturtium officinale* R. Br.   | Hem       | Med      | C       |
|                 | *Rorippa amphibia* (L.) Bess.    | Hydr      | Holarc   | RR      |
|                 | *Sisymbrium officinale* (L.) Scop. | Th      | Cosmop  | C       |
| Cactaceae       | *Opuntia maxima* Miller          | Ph        | Intrad   | C       |
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| Family                  | Species                                                                 | Distribution | Phenology       |
|-------------------------|-------------------------------------------------------------------------|--------------|-----------------|
| Callitrichaceae         | Callitriche obtusangula Le Gall                                          | Hydr         | Med             |
|                         | Cerastium glomeratum L.                                                 | Th           | Holarc          |
|                         | Corrigiola littoralis subsp. littoralis L.                               | Th           | Med             |
|                         | Silene colorata Poiret subsp. colorata                                   | Th           | Med             |
|                         | Silene gallica L.                                                       | Th           | Subcosmop       |
|                         | Spergula arvensis L.                                                    | Th           | Cosmop          |
| Ceratophylaceae         | Ceratophyllum demersum L.                                                | Hydr         | Subcosmop       |
| Convolvulaceae          | Convulvus arvensis L. subsp. arvensis                                   | Geo          | Med             |
| Cyperaceae              | Cyperus longus subsp. badius (Desf.) Asc.                               | Geo          | Paleotemp       |
|                         | Eleocharis palustris (L.) Roem. & Schult.                               | Hem          | Med             |
|                         | Schoenoplectus lacustris (L.) Palla subsp. lacustris                     | Geo          | Subcosmop       |
|                         | Elymus repens L.                                                        | Th           | Subcosmop       |
|                         | Elymus repens L.                                                        | Th           | Circummed       |
|                         | Euphorbia helioscopia L.                                                | Th           | Subcosmop       |
|                         | Euphorbia terracina L.                                                  | Th           | Circummed       |
| Fabaceae                | Acacia karroo Hayne                                                     | Ph           | Intrd           |
|                         | Lotus corniculatus L. subsp. preslii (Ten.) P. Fourn.                   | Th           | Euras           |
|                         | Medicago littoralis Loisel.                                             | Th           | Med             |
|                         | Medicago murex Willd.                                                   | Th           | Med             |
|                         | Trifolium campestre Schreber                                            | Th           | Med Atl         |
|                         | Trifolium glomeratum L.                                                | Th           | Med             |
|                         | Trifolium repens L.                                                    | Th           | Med             |
| Gentianaceae            | Centaurium pulchellum (Swartz) Druce                                    | Th           | Med             |
|                         | Centaurium spicatum (L.) Fritsch                                        | Th           | Med             |
| Geraniaceae             | Geranium molle L. subsp. molle                                          | Th           | Paleotemp       |
|                         | Geranium robertianum subsp. purpureum Vi.                               | Th           | Euras           |
| Haloragaceae            | Myriophyllum alterniflorum DC.                                           | Hydr         | Med Atl         |
| Hypericaceae            | Hypericum pubescens Boiss.                                              | Hem          | Med             |
|                         | Iris pseudacorus L.                                                    | Hydr         | Euro-Med        |
| Iridaceae               | Isoëtes histrix Bory                                                    | Hem          | Med Atl         |
| Juncaceae               | Juncus bufonius L. subsp. bufonius                                      | Hydr         | Cosmop          |
|                         | Juncus heterophyllum L.M. Dufour                                        | Hydr         | Paleotemp       |
|                         | Juncus tenageia Ehrl. ex. L. f. subsp. tenageia                          | Th           | Subcosmop       |
| Lamiaceae               | Mentha pulegium L.                                                      | Th           | Euras           |
|                         | Mentha suaveolens Ehrl.                                                | Ch           | Euro-Med        |
|                         | Stachys arvensis (L.) L.                                                | Th           | Med Atl         |
|                         | Teucrium scordium subsp. scordioides (Schreber) Arcang.                 | Hem          | Ibero-Mag       |
| Linaceae                | Linum bienne Miller                                                    | Th           | Med Atl         |
| Lythraceae              | Lythrum juncetum Banks & Solander                                       | Th           | Med Atl         |

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| Family            | Genus and Species                                      | Geo | Cosmop | C     | CC  |
|-------------------|--------------------------------------------------------|-----|--------|-------|-----|
| Menyanthaceae     | *Lythrum salicaria* L.                                  | Geo | Cosmop | C     |     |
| Nythoeae          | *Nymphoides peltata* (S.G. Gmel) Kuntze                | Hydr| Euras  | RRR   |     |
| Oleaceae          | *Nymphaea alba* L.                                      | Hydr| Euras  | RR    |     |
| Orobanchaceae     | *Fraxinus angustifolia* Vahl.                          | Ph  | Euras  | C     |     |
| Oxalidaceae       | *Orobanche minor* Sm.                                   | Th  | Med    | C     |     |
| Plantaginaceae    | *Nymphaea alba* L.                                      | Hydr| Med    | CC    |     |
| Poaceae           | *Aegilops triuncialis* L.                               | Th  | Circumed| C    |     |
|                   | *Agrostis stolonifera* L.                               | Hem | Holarc| AC    |     |
|                   | *Anthoxanthum odoratum* L.                              | Th  | Euro-Med| C   |     |
|                   | *Arundo donax* L.                                       | Hydr| Subcosmop| C  |     |
|                   | *Avena sterilis* L.                                     | Th  | Euro-Med| CC  |     |
|                   | *Briza maxima* L.                                       | Th  | Med    | CC    |     |
|                   | *Briza minor* L.                                        | Th  | Med Atl| CC    |     |
|                   | *Bromus hordeaceus* L. subsp. hordeaceus               | Th  | Circumed| C    |     |
|                   | *Bromus rubens* L. subsp. rubens                       | Th  | Eurosib| C     |     |
|                   | *Cynodon dactylon* (L.) Pers.                           | Geo | Cosmop | CC    |     |
|                   | *Cynosurus polyclacteus* Poiret                         | Th  | Euro   | C     |     |
|                   | *Panicum repens* L.                                     | Th  | Intrd  | C     |     |
|                   | *Phalaris aquatica* L.                                  | Hem | Med    | C     |     |
|                   | *Phragmites australis* (Cav.) Steud.                   | Hydr| Subcosmop| C  |     |
|                   | *Poa anua* L. subsp. *annua*                            | Th  | Cosmop | C     |     |
|                   | *Poa trivialis* L.                                      | Th  | Euras  | C     |     |
| Polygonaceae      | *Persicaria salicifolia* (Willd.) Asenov               | Hem | Subcosmop| AC  |     |
|                   | *Polygonum aviculare* L.                                | Th  | Cosmop | CC    |     |
|                   | *Rumex aristidis* Coss.                                 | Ch  | End Alg-Tun| R  |     |
|                   | *Rumex bucephalophorus* subsp. *gallicus* Rech.        | Hem | Med    | CC    |     |
|                   | *Rumex conglomeratus* Murr.                             | Hem | Euras  | C     |     |
|                   | *Rumex palcher* L.                                      | Hem | Med    | CC    |     |
| Portulacaceae     | *Portulaca oleracea* L.                                 | Th  | Subcosmop| C  |     |
| Potamogetonaceae  | *Potamogeton trichoides* Cham. & Schldtl.               | Hydr| Eurosib| AR    |     |
| Ranunculaceae     | *Ranunculus macrophyllus* Desf.                        | Geo | Med    | C     |     |
|                   | *Ranunculus maricutus* L.                               | Th  | Med Atl| C     |     |
|                   | *Ranunculus sardous* Crant subsp. *sardous*            | Th  | Med    | C     |     |
|                   | *Ranunculus trichophyllus* Chaix                        | Hydr| Holarc| C     |     |
| Rosaceae          | *Potentilla reptans* L.                                 | Hem | Euras  | AC    |     |
|                   | *Rubus ulmifolius* Schott.                             | Ph  | Med    | CC    |     |
| Rubiaceae         | *Galium elongatum* C. Presl.                           | Th  | Med Atl| C     |     |
|                   | *Geranium lucidum* L.                                  | Hem | Euras  | C     |     |
The distribution of the biological types in the plant formation of our study site follows the following diagram: Th > Hydr > Hem > Ph > Geo > Ch (Table 1 and Fig 2). The high frequency of therophytes attests to the disturbance of these environments (clearing, grazing, but also linked to the local climate) [15]. Hydrophytes are well represented in the flora studied (23 taxa, 18.4%). These plants are the most dynamic, but least predictable of all wetland flora [16].

**Figure 2.** Distribution of biological types in the studied flora
Most species of this group are identified with the strictly Mediterranean chorological element (Circum-Mediterranean) with 40 taxa in approximately 32% (Table 1 and Fig 3). This percentage is slightly higher than that given by [4] on the 26 temporary ponds of Numidia which is 18.2%. The dominance of this element is emphasized by [17] for all the countries of North Africa.

Cosmopolitan species occupy the second place, accounting for about 18% of the total population. These results are comparable to those of [18] in his research on the terrestrial and aquatic vegetation of Djebel Megriss (North Tellien, Algeria).

The interest of this flora lies in the presence of three Algerian-Tunisian endemics (*Rumex aristidis* Coss., *Linaria pinnifolia* (Poiret) Thell., *Galactites mutabilis* Durieu). These rare and rare rarities in Algeria reinforce the interest of the important zone for the plants "Guerbes Senhadja" referenced in North Algeria [19].

![Figure 3. Distribution of chorological types in the studied flora](image)

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