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Floristic diversity of Saharan wetlands in the region of Oued Righ, northeastern Sahara of Algeria

HALIS Youcef*, BENHADDYA Mohammed Lamine, Khellou Mayada, Hadjoudj Moussa, Benhania Amel

* Scientific and Technical Research Centre for Arid Areas (CRSTRA), Biophysical Station, 3240 Nezla, Touggourt, Algeria

HALIS Youcef Scientific and Technical Research Centre for Arid Areas (Algeria)
E-mail: youcefhal@gmail.com

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Abstract

The main objective of this study was to investigate the floristic composition and the vegetation structure of different Saharan wetlands in the region of Oued Righ. Six (6) Saharan wetlands were examined; the Lake of Merjaja, Lake of Megarine, Lake of Sidi Slimane, lake of Ayata, Lake Ain Zerga, and Oued Khrouf. A total of 25 stands were investigated using the quadrat method, with five stands for each wetland. The different vegetation parameters, such as cover, frequency and density were calculated. A total of 24 plant species belonging to 20 genera and 13 families were identified. Chenopodiaceae was the predominant family with 6 species. The majority of the species were of Saharo-Arabian distribution. Chemaephytes had the highest contribution to the life forms spectra. The potential role of the halophyte species is discussed. These results might contribute to a better understanding of the functions, requirements, and sensitivities of these ecosystems.

Key words: Halophyte vegetation, Floristic diversity, Saline habitats, Oued Righ, Sahara desert, Algeria.

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Introduction

The region of Oued Righ is located in the low Sahara basin of Algeria. Climatically, this zone falls under hyperarid conditions and belongs to the Saharo-Arabian phytogeographical region. Oued Righ is the richest part of Sahara desert of Algeria in aquatic ecosystems. The presence of various wetlands in the region, e.g. canals, irrigation and drainage networks, salt lakes and salt marshes create high suitable habitats for wildlife species, compared to the surrounding areas. The main salt wetlands in Oued Righ are: Chott Merouane, Lake of Temacine, Merjaja Lake, Megarine Lake, Ain Ezerga Lake, and Ayata lake. These wetlands are of international conservation importance for migratory birds.

Salty soils (habitats) are the most abundant ecosystem characterizing the wetlands of Oued Righ. Saline soils of various nature and degree occupy more than 50 % of the total area of the region. High salinity, in combination with high temperatures, exerts a strong influence over the distribution of plants in the arid and semiarid areas [1, 2].

Halophyte vegetation is a characteristic feature of saline lands. Halophytes are the plants capable of growing and surviving in the saline environments. A number of different mechanisms are used by halophytes to achieve osmotic adjustment, including inorganic ion accumulation, synthesis or accumulation of organic compounds and minimizing water loss [3]. Halophyte communities are of great importance in the valley of Oued Righ. They play crucial role in wind prevention and environmental protection. They also offer habitats for large numbers of various organisms. Many halophytes are beneficial with respect to economic aspect. They provide food products; building materials and fuel wood etc [4, 5].

Up to now, most of the studies on salt areas in the great Sahara Desert are just descriptive documentation of species and their classification [6, 7, 8, 9]. No detailed examinations of the vegetation were carried out to describe various types of plant communities in different saline areas of Oued Righ. To offset this insufficiency of floristic knowledge, it is essential to determine and characterize the vegetation structure and species composition. Therefore, the main aims of the present study are to provide a contribution to the vascular flora, analysis of the structure and life forms of the vegetation, and quantitative description of different plant communities from various wetlands in the valley of Oued Righ.

Materials and Methods

Study area:

The valley of Oued Righ is located in the northeastern Sahara of Algeria. It extends about 160 km from El Goug in the South to Oum EL Thiour in the North (Fig. 1). More exactly the study area lies between 32°53' 50" to 34°10' 00" north latitudes and between 5°47' 50" to 6°10' 00" east longitudes. The climate along this area is arid to hyperarid, characterized by low rainfall and high rates of evapotranspiration. Daily mean temperatures vary between 10°C in the winter to 32°C in the summer with August being the hottest month. Rainfall is generally low and tends to fall between November and March. A total of 05 wetlands were surveyed along the valley of Oued Righ. These wetlands are; the Lake of Merjaja, Lake of Megarine, Lake of Sidi Slimane, Ayata lake, and Oued Khrouf.

Figure 1: Map of the region of Oued Righ with the location of the research localities. 1: Lake of Merjaja; 2: Lake of Megarine; 3: Lake Sidi Slimane; 4: Lake Ayata; 5: Lake Ain Zerga; 6: Oued Khrouf.

Floristic analysis

The vegetation studies were carried out according to the Quadrat method by following the work of Braun-Blanquet (1932) [10]. A homogenous area, where species abundances and spatial distributions appeared uniform and where habitat conditions were constant, was used for the vegetation description. A total of twenty five (25) quadrats were investigated in this study, five (5) quadrats for each wetland. Thie investigation was conducted during the period of optimal vegetation, i.e. in March and May 2014. The quadrat size was estimated by means of minimal area and was determined as 400 m^2 (20m×20m). For each quadrat group, the quantitative account of vegetation such as cover, density and frequency were calculated. Species identification and floristic categories were determined according to Quzel and Santa (1963) [6] and Ozenda (1977) [7]. The life forms were determined according to Raunkiaer (1937) [11].

Results and Discussion

A total of 24 halophytic species within 20 genera and 13 families of flowering plants were recorded in the various habitats of the valley (Table 1). Dicotyledons comprised 83.4% of the total (20 species in 11 families), while the remainder consisted of 4 monocotyledons species (2 families). The family with the highest number of species was Chenopodiaceae, with 12 species, followed by Poaceae (3 species) and Plumbaginaceae (4 species). Regarding the life forms spectra (Figure 2), chamaephytes is the predominant life-form and constitutes 33.3% of all recorded species, followed by therophytes (25%), phanerophytes (12.5 %), geophytes (12.5%), hemicryptophytes (8%), and parasites (2.5%). These information regarding the life form of plant species may help in assessing the response of vegetation to variations in environmental factors [12]. In the present study, chamaephytes is the predominant life-form. The high percentage of chamaephytes may be related to their ability to resist drought and salinity [13].

Table 1: List of plant species recorded in the study area with their families, life forms and floristic regions (Chorotype). The life forms are Ch: chaemaephytes; Ge: geophytes; He: helophytes; Hm: hemicryptophytes; P: Parasites; Ph: phanerophytes; Th: therophytes. The floristic regions are COSM: Cosmopolitan; EN: Endemic to Sahara desert; ES: Euro-Sibarian; IT: Irano-Turanian; ME: Mediterranean; SA: Saharo-Arabian

Family	Plant species Plant species	Life forms	Chorotype
Asclepiadaceae	*Cynanchum acutum L.*	Th	ME
Astraceae	*Sonchus maritimus* L.	Ge	COSM
Caryophyllaceae	*Spergularia diandra* (Cuss.) Heldr.	Th	ME+SA+IT
	Spergularia salina J. & C. Presl.	Th	ES+IT+ME
Chenopodiaceae	*Atriplex halimus* L.	Ch	ME+SA
	Arthrochnemum glaucum Boiss.	Ch	COSM
	Halocnemum strobilaceum (Pall.) M. Bieb.	Ch	ES+SA+ME+IT
	Salsola tetragona Delile.	Ch	SA
	Salsola tetrandra Forsk.	Ch	SA
	Sueda fructicosa L.	Ch	SA
Convolvulaceae	*Cressa cretica* L.	Th	ME+IT
Frankeniaceae	*Frankenia pulverulenta L.*	Th	ME+IT+ES
Juncaceae	*Juncus maritimis* Lam.	He	SA+IT
Orobanchaceae	*Cistanche violaceae* (Desf.) Beck.	P	IT+ME+SA
Plantaginaceae	*Plantago coronopu* L.	Th	SA+IT
Plumbaginaceae	*Limonium pruinosum* (L.) Chaz.	Ch	SA
	Limonium echioides L.	Hm	ME
	Limoniastrum guyonianum Dur.	Ph	EN
Poaceae	*Aeluropus littoralis* (Gouan) Parl.	Ge	ME
	Phragmites comminus Trin.	He	COSM
	Cynodon dactylon (L.) Pers.	Ge	COSM
Tamaricacea	*Tamarix gallica* Webb.	Ph	SA
Zygophyllaceae	*Nitraria Retusa* (Forssk.) Asch.	Ph	SA
	Zygophyllum album L.	Ch	ME+SA

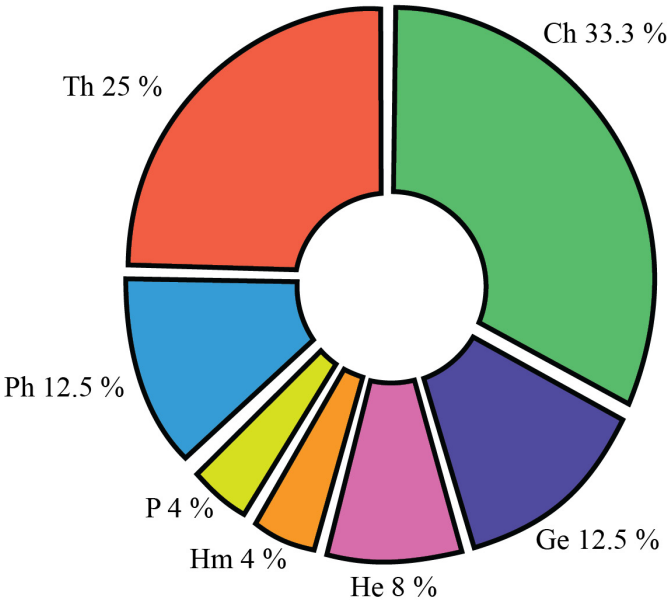

Figure 2: Spectrum of life forms for the halophyte species recorded in the study area. Ch: chaemaephytes; Ge: geophytes; He: helophytes; Hm: hemicryptophytes; P: Parasites; Ph: phanerophytes; Th: therophytes.

The phytogeographical distribution (chorotype) of the plant species is given in (Figure 3), showing that the majority of the species are of Saharo-Arabian distribution (49.2% mono-regionals + 12% bi-regionals + 25% pluri-regionals), followed by Mediterranean species (45% mono-regionals + 12.1% bi-regionals + 25% pluri-regionals). Only one species was endemic to great Sahara Desert (*Limoniastrum guyonianum*). Phytogeographical relations have a significant influence on species diversity as they largely determine the stock of species available in the past and present for inhabiting the area [14]. Analysis of the floristic data revealed that the Saharo-Arabian elements are more common than the other floristic elements in the research area. This is due to the fact that the study area is located in the Algerian Sahara which is a part of the Saharo-Arabian phytogeographical region [15].

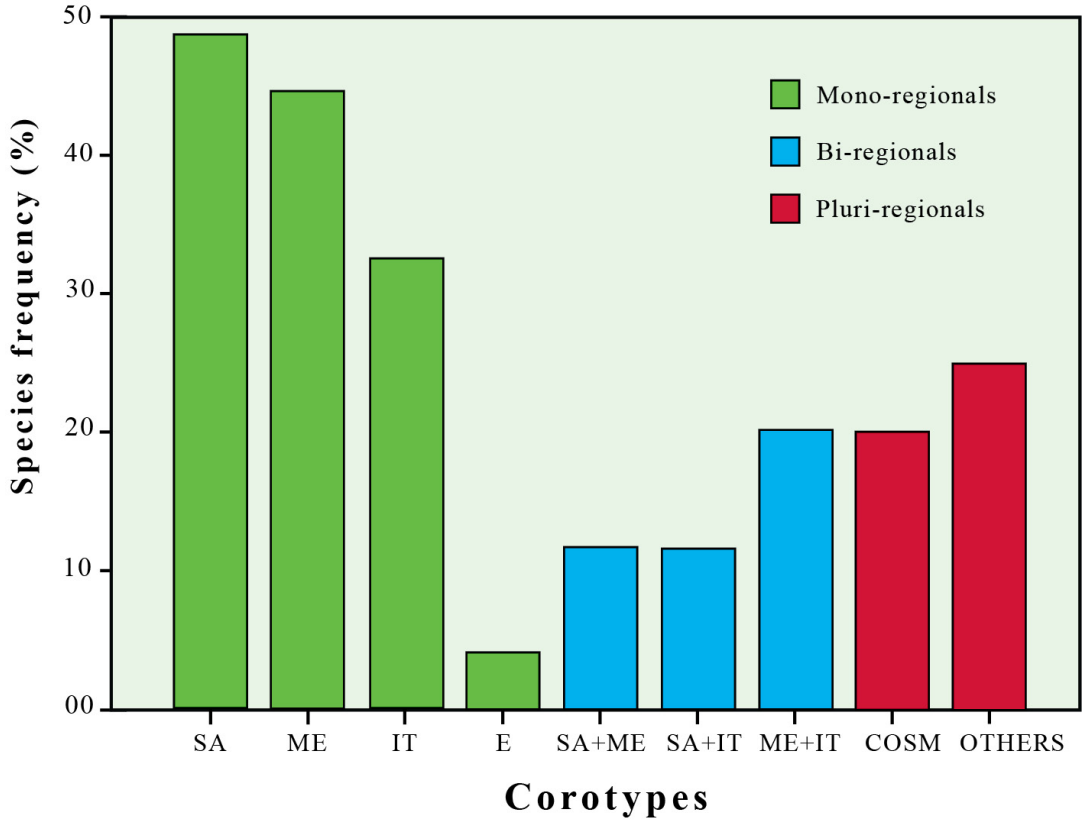

Figure 3: Phytogeographical distribution of the plant species of the different saline habitats. SA: Saharo-Arabian; ME: Mediterranean; IT: Irano-Turanian; E: Endemic to Sahara desert; SA+ME: Saharo-Arabian-Mediterranean; SA+IT: Saharo-Arabian-Irano-Turanian; ME+IT: Mediterranean-Irano-Turanian; COSM: Cosmopolitan. Others include Saharo-Arabian-Mediterranean-Euro-Siberian, Saharo-Arabian-Mediterranean-Irano-Turanian, and Saharo-Arabian-Mediterranean-Irano-Turanian-Euro-Siberian.

Quantitative investigations were carried out to describe the various types of halophyte vegetation. For each wetland, the general coverage rate was between 25 to 45%. The vegetation of these habitats consisted mainly of perennial semi-shrubby plants 10-60 cm in height. This vegetation was floristically dominated with *Halocnemum strobilaceum* species. The co-associated characteristic species in areas were *Tamarix gallica*, *Aeluropus littoralis* and *Sueda fructicosa*. Other associated species such as *Zygophyllum album*, *Phragmites comminus*, *Limoniastrum guyonianum*, *Frankenia pulverulenta*, and *Juncus maritimis* etc. could be observed. In general, the halophyte vegetation of Saharan wetland is sparse consisting mainly of dwarf shrubs and perennial herbs capable of salinity

and drought resistance. Trees are few and scattered. *Tamarix articulata* is the tallest of tree with maximum height attained 4-6 m. In addition, few ephemerals are also observed growing in these habitats like *Brocchia cinerea, Bassia muricata, Launaea glomerata, Launaea resedifolia, and Malcomia aegyptiaca.* These ephemerals come up during the rainy season; complete their life cycle before the advent of summer.

Because they exhibit special morphological and physiological adaptation to survive in saline habitats, halophyte species might play an important role in the dynamics of saline ecosystems [4, 5, 13, 16]. Spontaneous halophytes can be very effective in reforestation and recovery of saline areas. In this context, for an effective phytostabilisation strategies and sustainable land management, it is important to use native plants for phytoremediation because these plants are often better in terms of survival, growth and reproduction than plants introduced from other environment [17]. Phytomelioration by plantings on saline soils leads to a more rapid closure of the vegetation cover and helps to minimize the widespread negative effects of salt desertification [18]. In addition, halophytes are potentially used as pastures, building materials, medicinal plants, fuel wood, fertilizers, and even sequestration of CO2 [5]. Therefore, to better understand the processes and dynamics of saline ecosystems, it is necessary to study the natural halophytes and their complex physiology and ecology.

Conclusion

The present investigation allowed determining the biodiversity of some Saharan wetlands in the region of Oued Righ. The vegetation of these wetlands is composed mainly of helophyte species, represented by the Chenopodiaceae as the predominant family. Although the richness in these areas is low compared to other areas, their plants might play an important role in the stability of the ecosystem. Based on the findings of this study, it could be suggested that halophyte plants are highly suitable for the sustainable management of the Saharan wetlands.

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