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# Ecosystem services in salt lakes: An ethnobotanic case study of halophytes from Algeria

## *Services écosystémiques des lacs salés: étude de cas ethnobotanique des plantes halophytes d'Algérie*

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### Abstract

Ecosystem services are well recognized in wetlands; however, less attention is given to the services provided in salty wetland habitats. There are numerous salt lakes of international importance located in the northern Sahara region of Algeria.

An ethnobotanical survey was conducted among the local population surrounding Chott Merouane. This survey was implemented to determine plant diversity and possible ecosystem services and improve conservation in these sensitive wetland habitats. Chott Merouane is a Ramsar site located in the southeast of Algeria in the Mediterranean bioclimatic Sahara. Based on a literature review of halophytic plants in the study area. The botanical inventory identified 22 plant species belonging to 20 genera and 16 families. Amongst these plants, Amaranthaceae, Zygophyllaceae, Nitrariaceae and Asteraceae dominated. A total of 48 participants were randomly selected and interviewed from three villages. The semi-directed interviews revealed that 77% of the plant species were used for traditional medicine, 65% for fodder, 41% for

wood-fuel, 14% for crafts and 5% for food and other uses. The three endemic species identified (*Tetraena geslinii* (Coss.) Beier & Thulin, *Limoniastrum guyonianum* Boiss. and *Euphorbia guyoniana* Boiss. & Reut.) had the highest values of relative frequency of citation and use value. Local knowledge was unevenly distributed and showed significant differences by gender and education level.

This study highlights the importance of provisioning and cultural ecosystem values attributed to plants in salty wetlands and demonstrates the importance of ethno-botanical studies as a basic tool to contribute to the management and conservation of wetland plant resources in salty wetland environments.

### Résumé

Les services écosystémiques des zones humides sont bien reconnus, cependant, moins d'attention est accordée aux services fournis par les zones humides salées. Il existe de nombreux lacs salés d'importance internationale situés dans la région nord du Sahara, en Algérie.

**Keywords:** Chott, cultural services, ethnobotanical survey, provisioning services, salt lakes.

**Mots-clés :** Chott, services culturels, étude ethnobotanique, services d'approvisionnement, lacs salés.

*Une enquête ethnobotanique a été menée auprès de la population locale autour du Chott Merouane. Cette enquête a été mise en œuvre pour déterminer la diversité végétale et les services écosystémiques possibles et améliorer la conservation dans ces habitats humides sensibles. Le Chott Merouane est un site Ramsar situé au sud-est d'Algérie dans l'étage bioclimatique méditerranéen saharien. En se basant sur une revue de la littérature sur les plantes halophytes dans la zone d'étude. L'inventaire botanique a identifié 22 espèces végétales appartenant à 20 genres et 16 familles. Parmi ces plantes, les Amaranthaceae, Zygophyllaceae, Nitrariaceae et Asteraceae dominaient. Un total de 48 participants a été sélectionné au hasard et interrogés dans trois villages. Les entretiens semi-dirigés ont révélé que 77 % des espèces végétales étaient utilisées pour la médecine traditionnelle, 65 % pour le fourrage, 41 % pour le bois de chauffage, 14 % pour l'artisanat et 5 % pour l'alimentation et d'autres usages. Les trois espèces endémiques identifiées (*Tetraena geslinii* (Coss.) Beier & Thulin, *Limoniastrum guyonianum* Boiss. et *Euphorbia guyoniana* Boiss. & Reut.) sont les plus citées avec les plus fortes valeurs d'utilisation. Les connaissances locales sont inégalement réparties et présentent des différences importantes selon le sexe et le niveau d'éducation.*

*Cette étude souligne l'importance de la valeur des services écosystémiques et culturels attribuée aux plantes dans les zones humides salées et démontre l'importance des études ethnobotaniques comme outil de base pour contribuer à la gestion et à la conservation des ressources végétales dans les zones humides salées.*

## Introduction

Ecosystem services (ESS) represent the benefits human populations derive, directly or indirectly, from ecosystem functions (Costanza *et al.* 1997) and are categorized into four categories: supporting, regulating, provisioning and cultural services (de Groot *et al.* 2010). ESS vary greatly depending on ecosystem type and are specific to each type of habitat (Sieben *et al.* 2018). Provisioning services are often the most recognized for the direct benefits that they provide such as food, fuel, water... etc. (Euliss *et al.* 2013). Given the provisioning services, plant biodiversity is often recognized as an economic resource (Sop *et al.* 2012). There has been a push to recognize ESS by the scientific community (Seppelt *et al.* 2011) with important work dedicated to ESS in wetland ecosystems (He *et al.* 2015; Mitsch *et al.* 2015). Despite this trend, wetland ESS are not often recognized (Bouahim *et al.* 2011), contributing

to wetland conversion and degradation (de Groot *et al.* 2018). Salty wetland habitats host a relatively low number of living species, but often contain a relatively high degree of endemism (Le Berre & Ramousse 2003), creating a unique biodiversity (Mouat *et al.* 1992). Despite the rich biodiversity, the goods and services provided by these habitats are not often recognized (Demnati *et al.* 2017) leading to over-exploitation and ecosystem degradation (Kaplowitz 1999).

Ethnobotany is the science that studies the relationships between plant and cultural diversity as well as perceptions, uses and managements of plants (de Albuquerque & Hanazaki 2009). This emerging science includes aspects of biodiversity conservation, genetics, ethno pharmacology, ecology and anthropology (Houéhanou *et al.* 2016). Ethnobotany is recognized by the scientific community as a potential tool that can be used to develop conservation strategies at a local and regional level (de Albuquerque *et al.* 2009).

There are many local terms for salt lakes in Algeria: Sebkhass, Chotts and Garaetes are just a few. In this paper, we will use the local term Chott to designate salt lakes. Algerian chotts constitute prime habitat for many species of wintering and migrating birds (Houhamdi *et al.* 2008; Samraoui & Samraoui 2008) and offer a range of activities and uses to the local populations including agriculture, hunting, tourism and salt production (Demnati *et al.* 2017). Despite the protected status of chotts, these environments are often ignored and are subject to very few conservation measures (Bouldjedri *et al.* 2011). Today Algerian chotts continue to be threatened or affected by human activities including the diversion of surface water inflow for agriculture which may constitute a potential danger, especially for the region of Oued Righ (Khadraoui 2010). Chott Merouane and Chott Melghir create the largest chott complex in Algeria (figure 1). This complex has been degraded over the last 30 years caused by an extension of agricultural surface area, agricultural intensification and changes in salt mining practices (Demnati *et al.* 2017). The study area has harsh climatic conditions with a reduced amount of rainfall and a drought that lasts almost throughout most of the year; despite these conditions sparse halophyte vegetation exists.

In order to determine the possible ESS locally provided by plant diversity we implemented an ethnobotanic study based on semi-directive interviews.

## Methods

### Description of the Study Area

Chott Merouane (34°10.63' N, 6°17.32' E) is a Ramsar site located in the southeast of Algeria (figure 1). The chott is considered the lowest in northern Africa as it reaches 40 m below sea level. Chott Merouane is located in the Mediterranean bioclimatic Sahara and is characterized by mean temperatures over 30°C with average high temperatures in summer over 40°C. Daily variations are extreme ranging between 37.5 to 5°C, with average precipitation limited to < 100 mm/year. These harsh conditions are intolerable for most plant species (Demnati 2014); however, the biodiversity and localization create unique conditions for migratory and nesting birds (Samraroui *et al.* 2011). The population in the study area is c. 25,000 with an annual growth rate of 3% per year (Direction of agricultural services, unpublished data). The majority of the population is concentrated in the commune capitals, which were developed principally at trading and administrative centers. The region's economy is based on agriculture and salt production (Demnati 2014).

### Methodology

The first phase of this research was based on a literature review of halophilic plants in general and in particular that of the study area. We then proceeded to conduct an exploratory survey based on semi-structured interviews with the local population known to possess a strong knowledge on local plant and their uses. This qualitative research tool was organized around a set of predetermined open-ended questions, stimulating dialogue between interviewer and interviewee (Di Cicco-Bloom & Crabtree 2006). A total of 48 participants were randomly selected. The questionnaire was addressed to the residents from three villages (Hamraia, Nessigha and OumThiour) surrounding the chotts. The age, gender, education level and commune were noted. The semi-structured interviews were conducted between 2015-2016 and each interview lasted on average 90 minutes. During the interview, the participants were asked to identify local plant species and discuss how, when and why the species are used. The questionnaire consisted of three sections: 1) Personal participant information 2) Plant use knowledge and 3)

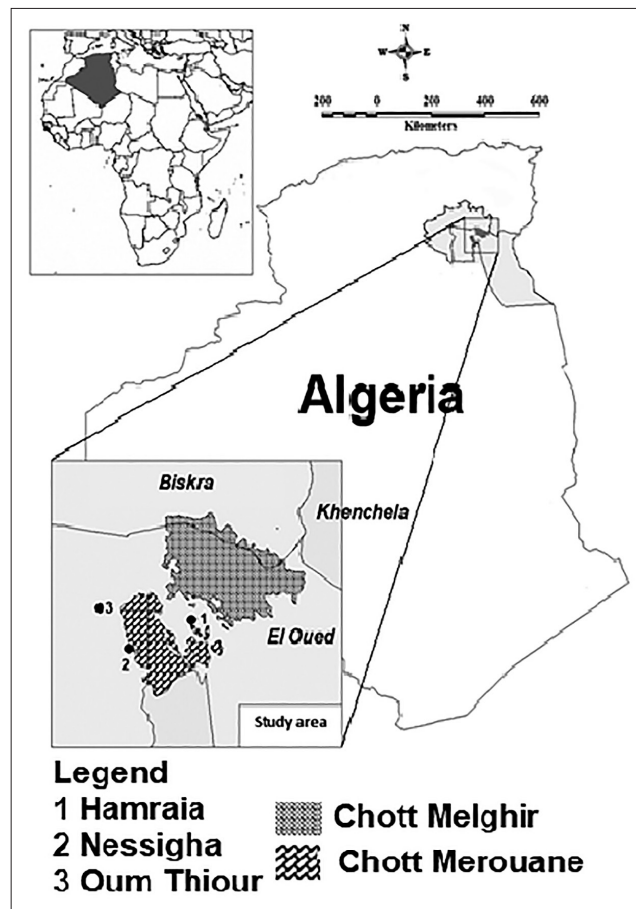


Figure 1 – Location of the study area in the complex of the chotts Merouane and Melghir.

Knowledge and Perception of the local population (Supplementary material Appendix 1). These surveys were supplemented by direct observation in the field and the information concerning the plant species was validated based on previous botanical inventories by Ozenda (1958, 1991), Quezel & Santa (1963), Chenchouni (2012) and Halis *et al.* (2012).

### Quantitative analysis

#### Relative frequency of citation

We calculated the relative frequency of citation (RFC), as defined by Vitalini *et al.* (2013) by using the frequency of citation (FC: number of informants mentioning the use of the species) and the total number of informants participating in the survey (N). RFC varies from zero to one.

$$\text{RFC} = \text{FC} / \text{N}$$

### Use value

Use value is a way of expressing the relative importance of each species for the population in the provisioning services (Ayantunde *et al.* 2009; Sop *et al.* 2012). This index was calculated as follows:

$$UV_T = \sum^P U_i / N$$

$UV_T$ : represents the total use value of the species

$U_i$ : the number of uses mentioned by each informant for a given species

$P$ : the number of use categories

$N$ : the total number of informants

### Organ response rates

We calculated organ response rate (F) in order to determine which parts of the plants are the most utilized. This was calculated using the number of people who gave a positive answer (Yes) for each of the different organs concerned (S), divided by the total number of informants (N) (Dossou *et al.* 2012).

$$F = (S/N) 100$$

### Statistical analysis

With StatPlus 6.9.1 software a descriptive statistics analysis (ANOVA) was conducted to compare the use of resources by category in each site according to the age, gender and education level of the surveyed population.

## Results

### Species diversity

A total of 22 species belonging to 16 families and 21 genres were identified in Chott Merouane. The most dominant families for all identified halophytes species was Amaranthaceae followed by Nitrariaceae, Zygophyllaceae and Asteraceae. According to the work of Ozenda (1958, 1991), this flora was dominated by Saharo-Sindian species, followed by Saharan, Saharan Endemic and Mediterranean cosmopolitan species. The Irano-Turanian and Tropical species were poorly represented. Out of the total species diversity, 18% are endemic to the Sahara and North African regions (table 1).

**Table 1 – Global list of plant species recorded and distribution.**

Families	Species	Distribution
Thyphaceae	<i>Typha domingensis</i> (Pers.) Steud.	Cosmopolitan
Juncaceae	<i>Juncus maritimus</i> Lam.	Cosmopolitan
Poaceae	<i>Phragmites communis</i> Trin.	Cosmopolitan
Rutaceae	<i>Haplophyllum tuberculatum</i> (Forssk.) A. Juss.	Saharo-Sindian
Zygophyllaceae	<i>Tetraena alba</i> (L.f.) Beier & Thulin	Saharo-Sindian (Endemic North Africa)
	<i>Tetraena geslinii</i> (Coss.) Beier & Thulin	Endemic Saharian
Nitrariaceae	<i>Peganum harmala</i> L.	Irano-Turanian
	<i>Nitraria retusa</i> (Forssk.) Asch.	Saharo-Sindian
Asteraceae	<i>Otoglyphis pubescens</i> (Desf.) Pomel	Saharian
	<i>Cotula cinerea</i> Delile	Saharian
Amaranthaceae	<i>Traganum nudatum</i> Delile	Saharo-Sindian
	<i>Suaeda mollis</i> Delile	Saharo-Sindian
	<i>Salsola sieberi</i> C. Presl	Saharo-Sindian
	<i>Halocnemum strobilaceum</i> (Pall.) M. Bieb.	Mediterranean
Cucurbitaceae	<i>Citrullus colocynthis</i> (L.) Schrad.	Mediterranean
Lamiaceae	<i>Salvia aegyptiaca</i> L.	Saharo-Sindian
Plombaginaceae	<i>Limoniastrum guyonianum</i> Boiss.	Endemic Saharian
Tamaricaceae	<i>Tamarix gallica</i> L.	Tropical
Fabaceae	<i>Retama reatam</i> (Forssk.) Webb	Saharo-Sindian
Ephedraceae	<i>Ephedra alata</i> subsp. <i>alenda</i> (Stapf) Trab.	Saharian
Xanthorrhoeaceae	<i>Asphodelus tenuifolius</i> Cav.	Mediterranean
Euphorbiaceae	<i>Euphorbia guyoniana</i> Boiss. & Reut.	Endemic Saharian



## Provisioning service

The local population identified twenty-two plant species that were harvested and utilized. The most common provisioning service (77%) was traditional medicine, followed by 65% for fodder, 41% for wood-fuel and 14% for local crafts. Other uses (5%) included food products and fencing (Z'riba) for live-stock. The most commonly used plant organs were leaves (67%), followed by roots (29%), stems (29%) and seeds (24%). All of the plants are traditionally manually harvested (Supplementary material Appendix 2).

## Local knowledge and relative importance of halophyte plants

According to the relative frequency of citation (RFC), the most cited species were *Euphorbia guyoniana* Boiss. & Reut., *Peganum harmala* L., *Ephedra alata* Decne., *Halocnemum strobilaceum* (Pall.) M. Bieb., *Tetraena geslinii* (Coss.) Beier & Thulin, *Tetraena alba* (L.f.) Beier & Thulin, *Limoniastrum guyonianum* Boiss., while *Asphodelus tenuifolius* Cav., *Retama raetam* (Forssk.) Webb, *Juncus maritimus* Lam. showed fairly low RFC (table 2). The importance of each plant

species was determined by the use value within each category, ranging between 0.00-0.97 for different provisioning services. There was a strong correlation between RFC and use value. *Euphorbia guyoniana* Boiss. & Reut., *Peganum harmala*, *Ephedra alata*, *Halocnemum strobilaceum*, *Tetraena alba*, *Limoniastrum guyonianum*, *Nitraria retusa* (Forssk.) Asch., *Otoglyphis pubescens* (Desf.) Pomel, *Tamarix gallica* L. and *Salsola sieberi* C. Preslall had high total use values (2.94 and 1.64) (Supplementary material Appendix 3). There was a highly significant difference ( $p < 0.0001$ ) for the average use of the different species.

## Effects of personal characteristics on local knowledge

### Age and gender

There was no significant difference in knowledge about local plants and their uses according to age. There was a slight correlation of elders (> 50 years old) having more knowledge about plants being used for fodder than their younger counterparts (table 3). There was a significant difference ( $p < 0.01$ ) in local knowledge about halophytic plant

**Table 2 – The different plant species identified, their uses value and the relative frequency of citation in Chott Merouane.**

Family	Species	Uses values (UV)	Relative Frequency of Citation (RFC) in percentage
Thyphaceae	<i>Typha domingensis</i>	0.44	0.44
Juncaceae	<i>Juncus maritimus</i>	0.44	0.40
Poaceae	<i>Phragmites communis</i>	1.04	0.52
Rutaceae	<i>Haplophyllum tuberculatum</i>	0.79	0.94
Zygophyllaceae	<i>Tetraena alba</i>	1.75	0.88
	<i>Tetraena geslinii</i>	0.88	0.88
Nitrariaceae	<i>Peganum harmala</i>	1.92	0.96
	<i>Nitraria retusa</i>	2.63	0.88
Asteraceae	<i>Otoglyphis pubescens</i>	0.79	0.79
	<i>Cotula cinerea</i>	0.75	0.75
Amaranthaceae	<i>Traganum nudatum</i>	1.04	0.52
	<i>Suaeda mollis</i>	0.83	0.42
	<i>Salsola sieberi</i>	1.83	0.92
	<i>Halocnemum strobilaceum</i>	1.88	0.94
Cucurbitaceae	<i>Citrullus colocynthis</i>	1.79	0.90
Lamiaceae	<i>Salvia aegyptiaca</i>	1.33	0.67
Plombaginaceae	<i>Limoniastrum guyonianum</i>	2.44	0.81
Tamaricaceae	<i>Tamarix gallica</i>	1.69	0.56
Fabaceae	<i>Retama raetam</i>	1.23	0.38
Ephedraceae	<i>Ephedra alata</i> subsp. <i>alata</i>	2.88	0.96
Xanthorrhoeaceae	<i>Asphodelus tenuifolius</i>	1.25	0.42
Euphorbiaceae	<i>Euphorbia guyoniana</i>	2.94	0.98

**Table 3 – Mean number of halophyte plant species and their ecosystem services (medicinal wood fuel, crafts, food, fodder) as reported by the participants of Chott Merouane.**

	N°	Medicinal	Wood fuel	Crafts	Food	Fodder	Other
<b>Sites</b>							
Hamraia	18	17 ± 0	9 ± 0	3 ± 0	1 ± 0	14 ± 0	1 ± 0
Nessigha	12	13.67 ± 0.39	7.75 ± 0.13	0.92 ± 0.29	0.17 ± 0.11	10.67 ± 0.41	0.58 ± 0.15
OumThiour	18	7.28 ± 0.94	4.72 ± 0.48	0	0	6.89 ± 0.710	0
<i>p</i>		< 0.000	< 0.000	< 0.000	< 0.000	< 0.000	< 0.000
<b>Age</b>							
> 55	12	12.55 ± 0.74	7.10 ± 0.33	1.27 ± 0.22	0.40 ± 0.08	10.53 ± 0.54	0.50 ± 0.08
< 55	36	12.38 ± 2.36	7 ± 1.16	1.75 ± 0.53	0.50 ± 0.19	10.38 ± 1.79	0.63 ± 0.18
<i>p</i>		< 0.930	< 0.910	< 0.390	< 0.610	< 0.011	< 0.530
<b>Gender</b>							
Female	6	16.67 ± 0.21	8.67 ± 0.21	2.83 ± 0.17	1 ± 0	13.67 ± 0.21	1 ± 0
Male	42	11.93 ± 0.78	6.86 ± 0.36	1.14 ± 0.21	0.33 ± 0.07	10.05 ± 0.57	0.45 ± 0.08
<i>p</i>		< 0.030	< 0.070	< 0.010	< 0.001	< 0.022	< 0.010
<b>Education level</b>							
Illiterate	16	13.75 ± 0.83	7.81 ± 0.33	1.38 ± 0.35	0.38 ± 0.13	11.25 ± 0.61	0.56 ± 0.13
Elementary	21	9.95 ± 1.28	5.86 ± 0.60	0.90 ± 0.30	0.29 ± 0.10	8.81 ± 0.96	0.33 ± 0.11
Secondary	07	15.43 ± 0.90	8.29 ± 0.36	2.14 ± 0.55	0.71 ± 0.18	12.43 ± 0.90	0.71 ± 0.18
University	04	16 ± 0.71	8.50 ± 0.29	2.25 ± 0.48	0.75 ± 0.25	13 ± 0.71	1 ± 0
<i>p</i>		< 0.008	< 0.007	< 0.116	< 0.116	< 0.024	< 0.048

species according to gender. Women generally had more knowledge about all plant uses (other than fodder) compared to men. On the contrary, men declared to use the plants (87%) more frequently than women (12%).

#### Education level

There was a significant difference ( $p < 0.01$ ) of local knowledge about plant species according to education level. The primary differences were seen in the local provisioning services (including wood fuel, medicine and fodder) provided by plants in the chotts (table 3). Participants with higher education levels (secondary school and university education) showed higher levels of plant and plant use knowledge compared to those participants with lower levels of formal education.

#### Village location

There was a very highly significant difference ( $p < 0.00001$ ) in plant knowledge according to the domicile of the participants. The autochthon participants from Hamraia and Nessigha villages (adjacent to the chotts) had higher levels of knowledge about the uses of different plant species originating from the chotts. The knowledge of the participants from Oum Thiour was mostly limited to species used for fuel and the craft industry.

#### Perception of the local population

All of the participants declared that there was a general deterioration in plant cover over the last two decades. The participants attributed this primarily to climate change with increased temperatures and decreased rainfall. However, 40% of the participants from Hamraia and Nessigha explained that this loss was also attributed to anthropic pressures, concerning mainly intensive livestock breeding and agricultural extension around the Chott.

## Discussion

Ethnobotanical studies can effectively be used to gain knowledge and understanding of the ecosystem service provided in a given location. In this ethnobotanical study of a chott complex in Algeria, we identified a total of 22 plant species belonging to 16 families, with an endemism rate of 18%. This plant diversity is richer than previous studies carried out by Chenchouni (2012) and Koull & Chehma (2013) in other Saharan wetlands. Endemism and scarcity of plants are important criteria for determining the biological and socio-cultural importance of a biogeographic area within a global framework for conservation and sustainable development

(Miara *et al.* 2017). The results of this study demonstrate that the region is important for both plant biodiversity and ecosystem services. Given this value, it is important to avoid heavy pressure including grazing, erosion, fire (Verlaque *et al.* 1997) and other anthropogenic impacts (Miara *et al.* 2017) in order to maintain the halophilic biodiversity (Neffar *et al.* 2013).

The plant species found in the chotts offer a variety of provisioning services for the local population. The halophytes provide medicinal resources, wood-fuel and fodder for the local population, creating important ecosystem services (Ricaurte *et al.* 2014). Similar to previous work by Etong *et al.* (2017), over half of the identified species were used in traditional medicine, maintaining an important cultural heritage. In this study, leaves remain the most used organ compared to other parts of the plant; this could be explained by the various services rendered by halophytic species especially in the field of medicine, fodder and crafts. Considering that the leaves are the most accessible organs, they are also the most solicited (Traoré *et al.* 2011; Telli *et al.* 2016). This intensive solicitation could have important impacts of vegetative cover especially in the context of climate change.

The RFC had a direct correlation with the total use value. It is important to note that some of the species that ranked highest for RFC and total use value were also endemic species (*Euphorbia guyoniana*, *Limoniastrum guyonianum*, *Tetraena alba*). Given the importance of these endemic plant species and given the perceived risks attributed to the site, it is important to put in place sustainable management practices that permit the local population to procure the services from the wetlands while maintaining the potential for future generations.

Previous work by Demnati (2014) has described the system of intensive livestock management in the area. The ecosystem services for fodder as seen in this study contribute greatly to this system and could be put at risk due to the increasing herd numbers (Thevs *et al.* 2017). Additionally, secondary grazing in the salt lakes could increase the salinity of the soil and cause shifts in flora composition as already seen in other salty environments, such as the case of Lake Samborombon Bay in Argentine (Di Bella *et al.* 2014), reinforcing the need for appropriate management strategies.

If new management strategies are to be proposed, it is important to understand the dynamics and practices of the local population in order to promote local buy in (Young *et al.* 2013). In this case study, there were significant differences in knowledge level and perception based on education level, gender, age and locality, supporting previous work by Sop & Oldeland (2011) and Etong *et al.* (2017). Understanding these differences is the first step to creating awareness raising campaigns and management actions that support better conservation practices and the protection of biodiversity. As Vodouhê *et al.* (2010) report, understanding local residents' perceptions and using them as a starting point could improve conservation efficiency and effectiveness.

Using the population's perception of plant species is a means of accessing vegetation cover distribution and species scarcity over time (Lykke *et al.* 2004; Sop *et al.* 2012). This study found that the participants perceived a continual degradation of the plant cover, with causes most likely attributed to climate change and anthropogenic activities. According Talbi (1997), the anthropogenic factor remains the biggest threat for desertification, while the climatic and physical constraints are contributing factors. Given the continued trends in climate change, it is important to work on the other contributing factors to promote sustainable management of the area.

## Conclusion

Despite the constraining conditions for the development of plant species in salty wetland habitats, this ethnobotanical research highlighted how wild plants provide important ecosystem services and remain an important resource pool for rural communities. Based on use values and frequency of citation indexes, this study showed the importance of certain endemic species that must be managed in order to maintain the biodiversity functions in the future. These species should be considered a priority for conservation.

New management strategies are needed to ensure the sustainable management of the chotts and this ethnobotanical study could be a starting point to work in collaboration with the local population to put in place these changes. Local knowledge of plant species is important not only for livelihood improvement, but also



for biodiversity protection. This holds true not only in vulnerable wetland habitats in the Sahara, but could be useful for the conservation of other habitats as well. As a result of this study, we encourage the use of ethnobotanical studies to increase local participation and knowledge of biodiversity conservation. The use of ethnobotanical studies could create a platform that might help to focus future research efforts and improve conservation strategies based on increased understanding of ecosystem services in different sites around the world.

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## Supplementary material Appendix 1

### Survey

District ..... Village ..... Locality ..... Date .....

#### I. Personal participant information

Q1 Respondent age: ..... Sex: .....

Q2 Origin of the respondent:

- District name .....

Q3 Educational level:

- None ..... - Primary ..... - Middle School ..... - Secondary ..... - University .....

#### Plant use knowledge

Q1 Plant vernacular name: .....

Q2 plant botanical name: .....

Q3 Which purpose collection:

a) Medicine b) Fodder c) Crafts d) Woodfuel e) Food f) Other

Q5 Collection time: .....

Q6 Plant parts used: .....

Q7 Utilization methods: .....

Q8 Collection and preparation methods: .....

#### Knowledge and Perception of the local population

Q1 Do you or somebody in your family produce handy crafts? Yes..... No.....

- If yes, what type of craft:

- Pottery ..... - Tapestry ..... - Basketwork ..... - Other .....

Q2 In this case, who practices this activity? (Women, men, both) .....

Q3 What is the source of your raw material? .....

Q4 What is the destination of your product? .....

Q5 Do you think the vegetation cover is threatened? Yes ..... No .....

- If so, what kind of threat? .....

Q2 Does the population use much the plants of the Chott? Yes ..... No .....

- If yes, type of vegetation .....

- For what purpose .....

## Supplementary material Appendix 2

Family	Plant species	Common name in Algerian dialect	Organs used	Response rate (%)
Thyphaceae	<i>Typha domingensis</i>	Barbeta	Leaves	21.33
Juncaceae	<i>Juncus maritimus</i>	E'smara	Leaves	18.66
Poaceae	<i>Phragmites communis</i>	Gu'ssab	Leaves	10.66
Rutaceae	<i>Haplophyllum tuberculatum</i>	El Fidjel	Leaves	100
Zygophyllacées	<i>Tetraena alba</i>	Agga	Leaves	66.66
	<i>Tetraena geslinii</i>	Bougriba	Leaves	100
Nitrariaceae	<i>Peganum harmala</i>	El Harmel	Leaves, seeds	100
	<i>Nitraria retusa</i>	El Gherdegue	Leaves, seeds	42
Asteraceae	<i>Otoglyphis pubescens</i>	El Guertaifa	Leaves, roots	83.33
	<i>Cotula cinerea</i>	El Guertoufa beida	Leaves	83.33
Amaranthaceae	<i>Traganum nudatum</i>	El Dhamrane	Leaves	83.33
	<i>Suaeda mollis</i>	E'Ssouida	Whole Plant	20
	<i>Salsola sieberi</i>	El Adjram	Stems, Roots	86.66
	<i>Halocnemum strobilaceum</i>	El Guerina	Roots, Whole plant	86.66
Cucurbitaceae	<i>Citrullus colocynthis</i>	El Hdedj	Fruits	100
Lamiaceae	<i>Salvia aegyptiaca</i>	El Khayata	Leaves	100
Plombaginaceae	<i>Limoniastrum guyonianum</i>	Zeita	Leaves, Roots	66.66
Tamaricaceae	<i>Tamarix gallica</i>	E'Tarfa	Stems	66.66
Fabaceae	<i>Retama raetama</i>	R'tem	Stems	80
Ephedraceae	<i>Ephedra alata</i> subsp. <i>alenda</i>	El Alinda	Stems, Roots, Leaves	86.66
Xanthonoaeaceae	<i>Asphodelus tenuifolius</i>	E'Tazia	Bulbs	20
Euphorbiaceae	<i>Euphorbia guyoniana</i>	L'bina	Leaves, roots	100

## Supplementary material Appendix 3

Use Category	Medicinal uses	Fuel	Crafts	Food	Fodder	Other	Total Use Value
<i>Typha domingensis</i>	0.000	0.000	0.438	0.000	0.000	0.000	0.438
<i>Juncus maritimus</i>	0.000	0.000	0.396	0.000	0.000	0.000	0.396
<i>Phragmites communis</i>	0.000	0.000	0.521	0.000	0.000	0.521	1.042
<i>Haplophyllum tuberculatum</i>	0.792	0.000	0.000	0.000	0.000	0.000	0.792
<i>Tetraena alba</i>	0.875	0.000	0.000	0.000	0.875	0.000	1.750
<i>Tetraena geslinii</i>	0.875	0.000	0.000	0.000	0.000	0.000	0.875
<i>Peganum harmala</i>	0.958	0.000	0.000	0.000	0.958	0.000	1.917
<i>Nitraria retusa</i>	0.875	0.875	0.000	0.000	0.875	0.000	2.625
<i>Otoglyphis pubescens</i>	0.792	0.000	0.000	0.000	0.000	0.000	0.792
<i>Cotula cinerea</i>	0.750	0.000	0.000	0.000	0.000	0.000	0.750
<i>Traganum nudatum</i>	0.521	0.000	0.000	0.000	0.521	0.000	1.042
<i>Suaeda mollis</i>	0.417	0.000	0.000	0.000	0.417	0.000	0.833
<i>Salsola sieberi</i>	0.000	0.917	0.000	0.000	0.917	0.000	1.833
<i>Halocnemum strobilaceum</i>	0.000	0.938	0.000	0.000	0.938	0.000	1.875
<i>Citrullus colocynthis</i>	0.896	0.000	0.000	0.000	0.896	0.000	1.792
<i>Salvia aegyptiaca</i>	0.667	0.667	0.000	0.000	0.000	0.000	1.333
<i>Limoniastrum guyonianum</i>	0.813	0.813	0.000	0.000	0.813	0.000	2.438
<i>Tamarix gallica</i>	0.563	0.563	0.000	0.000	0.563	0.000	1.688
<i>Retama raetama</i>	0.375	0.375	0.000	0.000	0.375	0.000	1.125
<i>Ephedra alata</i> subsp. <i>alenda</i>	0.958	0.958	0.000	0.000	0.958	0.000	2.875
<i>Asphodelus tenuifolius</i>	0.417	0.000	0.000	0.417	0.417	0.000	1.250
<i>Euphorbia guyoniana</i>	0.979	0.979	0.000	0.000	0.979	0.000	2.938



