Hacquetia 21/1 • 2022, 187–195 DOI: 10.2478/hacq-2021-0018 sciendo

A new species for the vascular flora of Algeria: *Cyperus eragrostis* (Cyperaceae)

Mohammed Bouldjedri[1,2], Gerard De Belair[3], Boualem Mayache[1,2] & Mohamed Sebti[1,2]

Key words: Algerian flora, alien species, Cyperaceae, *Cyperus eragrostis*, naturalized plant, wetlands.

Ključne besede: flora Alžirije, tujerodne vrste, Cyperaceae, *Cyperus eragrostis*, naturalizirana rastlina, mokrišča.

Abstract

This study provides a definition and description of *Cyperus eragrostis* as a new alien species to Algeria and North African flora. This hemicryptophyte, native to the tropical parts of South America, is recorded for the first time in Jijel eco-complex wetlands in North-East Algeria. Applying the standard phytosociological method we studied the stands in which this alien species grows together with other hygrophilous and ruderal species. The present study improves the knowledge of the Algerian flora and completes the information about the distribution of *C. eragrostis* reported by the available international literature and public herbaria.

Izvleček

V raziskavi smo opisali vrsto *Cyperus eragrostis* kot novo tujerodno vrsto v flori Alžirije in severne Afrike. To hemikriptofitsko vrsto, ki je domorodna v tropskih predelih Južne Amerike, smo prvič zabležili v mokrišču Jijel v severovzhodni Alžiriji. Sestoje, v katerih uspeva ta tujerodna vrsta skupaj z ostalimi higrofilnimi in ruderalnimi vrstami, smo preučili s standardno fitocenološko metodo. Naša raziskava dopolnjuje znanje o flori Alžirije in izboljšuje poznavanje razširjenosti vrste *C. eragrostis*, ki je na voljo v mednarodni literaturi in javno dostopnih herbarijih.

Corresponding author:
Mohammed Bouldjedri
E-mail:
mbouldjedri@yahoo.fr
wahaza29@gmail.com

Received: 16. 10. 2020
Accepted: 10. 7. 2021

1 Department of Environmental and Agricultural Sciences, Faculty of Nature and Life Sciences, University Mohamed-Seddik Benyahia, Jijel, Algeria.
2 Laboratory of Biotechnology, Environment and Health, University Mohamed-Seddik Benyahia, Jijel, Algeria.
3 Wetland laboratory, Badji-Mokhtar University, Annaba, Algeria.

Introduction

Cyperaceae is a monocotyledonous angiosperm plant family, it is one of the 10 largest families of Angiosperms and it is the second one within the Poales order (Govaerts et al., 2007). This family has a morphological similarity to Poaceae (grasses), with gutter-shaped leaves and sometimes unisexual inflorescence (spike umbelliform cyme); their smooth stem is frequently triangular in section. The Cyperaceae family was formerly ranked in the order Cyperales (Cronquist & Takhtadzhiann, 1981). However, the phylogenetic classification (APG II 2003, APG III 2009 and APG IV 2016) using DNA sequencing showed that Cyperaceae are very close to Juncaceae (rushes) (Dahlgren et al., 1985; Muasya et al. 1998; Givnish et al., 2006; Muasya et al., 2009). This family has a cosmopolitan distribution, inhabits mainly open areas (Larridon et al., 2013) and disturbed environments (Bryson & Carter, 2008). It includes ca.104 genera and ca. 5000 species, the largest genus being *Carex*, with ca. 2000 species, followed by the pantropical genus *Cyperus* with ca. 950 species (Larridon et al., 2013; Pellizzari & Verloove, 2017). According to Mabberley (2008), *Cyperus* is a cosmopolitan genus, with a concentration of species in the tropics.

In the Algerian flora, the genus *Cyperus* is hitherto represented with 13 species (Battandier & Trabut, 1884; Battandier & Trabut, 1902; Maire, 1952; Quézel & Santa, 1962). These species can be classified according to their biogeographical origins:

- the palaeotropical or sub-tropical species (*C. bulbosus* Vahl., *C. conglomeratus* (Rottb.), *C. laevigatus* ssp. *distachyos* (ALL.) M. and W., *C. longus* L., *C. rotundus* L.)
- the palaeotemperates ones (*C. flavidus* Retz., *C. fuscus* L. , *C. miehelianus* (L.) Delile)
- the pantropical and cosmopolitan species (*C. corymbosus* Rottb., *C. esculentus* L., *C. flavescens* L., *C. polystachyos* Rottb.)
- and the *C. capitatus* Vand. which is native to the Mediterranean climate.
- All species are native to Africa except the pantropical and cosmopolitan species *C. esculentus*, *C. laevigatus* and *C. polystachyos* that are considered native to America.

Cyperus eragrostis Lam., enclosed in the section *Luzuloidei* (Kunth) C.B. Clarke (Larridon et al., 2011) grows in damp and wet places on the margins of water bodies. It is native to the tropical regions of South America (De Filipps, 1980; Petřík, 2003; Stoyanov & Barzov, 2018), it grows spontaneously in the Pacific Northwest geographic region (California, Oregon, Washington and British Columbia in North America) (Denton, 1978). The species was early recorded in Europe from 1840 (Nyman, 1889). It has spread almost throughout Europe probably with agricultural activities (e.g. with oilseed crops, rice varieties and sheep's wool) (Petřík, 2003). This species was not reported in the Algerian flora cited above, as well as the flora of the neighboring countries Tunisia (Cuénod et al., 1954; Le Floc'h et al., 2010); although in May 2021 El Mokni and Verloove confirm the presence of *C. eragrostis* as a naturalized species along and around some ponds and streams within Kroumiria region (NW of Tunisia) after several years of confusion in the identification of the species (El Mokni & Verloove, 2021). In Morocco the authors (Fennane et al., 2014) report the presence of *C. eragrostis* as a weed, it seems to us that it is not yet naturalized in this country, because its occurrence is restricted to the crop fields.

Furthermore; Dobignard & Chatelain (2010–2020) in their synonymous and bibliographic index of the North African flora cite this species as a neophyte for Azores and Canary Islands, confirmed by Verloove (2014). We also referred to the website of the herbarium of the botanist researcher Gérard De Bélair (http://gdebelair.com/tax/famicype.html), who did not note the presence of *C. eragrostis* in Algeria.

The current study presents the first record of this naturalized alien species that is considered new to the Algerian flora and provides additional information on its distribution as reported by the available published literature and public herbaria. Furthermore, a detailed morphological description of the plant, supported by detailed photographs, is provided.

Materials and methods

The vegetation was studied using the Braun-Blanquet cover-abundance scale (1964), which is the standard approach frequently used to analyze vegetation in several ecological studies in most North-African countries, with a standard sampling unit 10–16 m² commonly used to study the macrophyte communities. During this field investigation, a population of an unusual *Cyperus* was found. The collected specimens were kept in our herbarium. For determination of *Cyperus*, we first examined herbaria available online (e.g. BCN, KEW and PRC-LL) and we identified the species as *Cyperus eragrostis* Lam. The identification of the species was confirmed by Dr. Patrick Grillas (Tour du Valat research institute-France) and Dr. Petr Petřík (Institute of Botany, the Czech Academy of Sciences). Then for the species description, we referred to the keys of Flora Europaea (De Filipps, 1980); Flora d'Italia (Pignatti, 2017); Flora Iberica (Castroviejo et al., 2007), Flora of North America (FNA 2002), Flore de la France méditerranéenne continentale (Tison et al., 2014).

Research area

Cyperus eragrostis was found during fieldwork in the Jijel eco complex of wetlands between 2003 and 2017, along the banks of the Marshs (El-Kennar and Redjla) dominated by herbaceous rather than woody plant species and the Beni-Belaid Lake, localized in an endorheic depression which is characterized by alternating low water levels and flooded phases. This study area extends between 36° 47'–36° 52' N, 5° 55'-6° 10' E, elev. 6–10 m. It belongs to the hot spot of plant diversity "Kabylia-Numidia-Kroumiria" of the Mediterranean basin (Véla & Benhouhou, 2007) in the northeast coast of Algeria. This ecoregion constitutes the interface between the Mediterranean Sea and the catchment area of the Numidic mountain chain and acts as a buffer area by regulating the water and sediment transfer by the hydrographic network before their emptying into the sea, it is separated from the sea by narrow barriers of land (Figure 1A, Figure 1B). The soil, of alluvial origin, is characterized by coastal and marine deposits dominated by sand.

The climate in this ecotone coastal region (data of Jijel meteorological station) is Mediterranean type, characterized by a hot and dry summer period, a mild winter due to the moderating influence of the sea, with an average annual temperature of 18 °C, and mean annual precipitation approximately 929 mm. The rainfall pattern is strongly seasonal with 80% of precipitation occurring between December and February. According to Rivas-Martinez (1996), our site has a Mediterranean temperate climate of hot-type. The vegetation period with an average daily temperature above 15 °C goes from April to November; throughout the year the average daily temperature exceeds 11 °C.

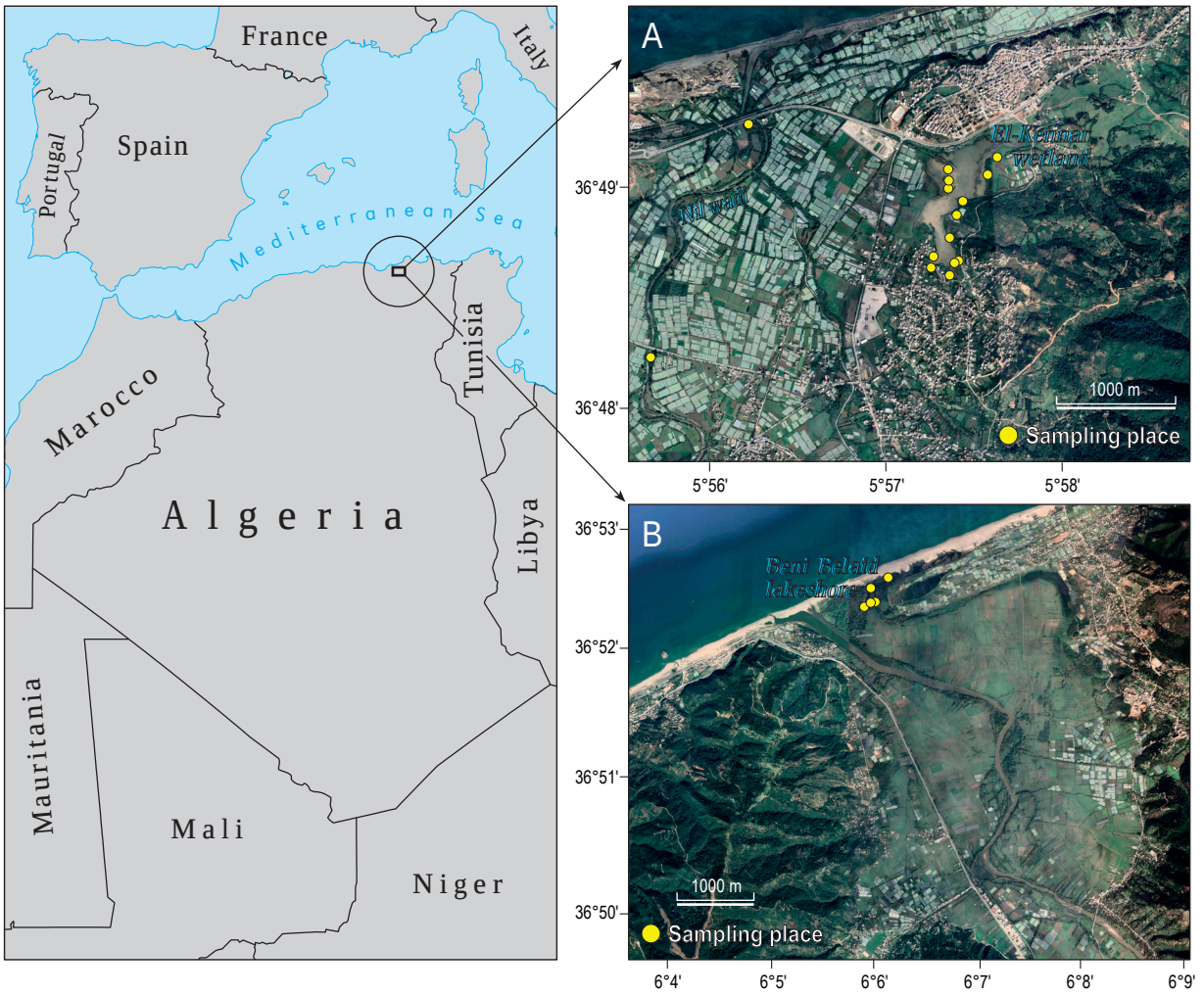

Figure 1: Map showing Algeria and locations of the sampling localities. **A**. El-Kennar wetland. **B**. Beni-Belaid lakeshore (Google Earth 2021).
Slika 1: Karta Alžirije in lokacije mest vzorčenja. **A**. mokrišče El-Kennar. **B**. obala jezera Beni-Belaid (Google Earth 2021).

Results and discussion

Morphological description

Cyperus eragrostis is a perennial species of sedge, a rhizomatous hemicryptophyte with caespitose culms. It is a diploid species (karyotype 2n=42) with a C3 photosynthetic pathway (Bruhl & Wilson, 2007). Based on its area of distribution, *C. eragrostis* appears to be a thermophilous and heliophilous taxon. The heliophilous feature can be explained by the pattern of leaf development which is more condensed than that found in the Poaceae, this may partly result from differences in relative amounts of light transmitted to developing leaves through the encircling sheaths of old leaves (Soros & Dengler, 1996).

Under sufficient supply of water, nutrients and sunlight, the plant has green, smooth and erect stems, triangular in cross-section, 20–80 cm in height. By contrast, on dry or nutrient-poor sites the plant retains a smaller stature (10–20 cm). The slender, grass-like leaves grow from the base of the stem, and about 2–6 involucral leaves are horizontal to ascending (flat or V-shaped) often exceeding the inflorescence (Figure 2A, Figure 3A).

The flowers are monoecious with anemogamous pollination. These asepal and apetal flowers are united in spikelets, themselves forming very dense kinds of spikes grouped together in glomeruli (Figure 3B); the spikelets have a golden brown colour at maturity (Figure 4A). Each flower consists of a sharp uniform green scale, a single stamen and a superior ovary topped with a 3-stigma style 1–1.2 mm long (Figure 3C). The fruit is an achene of dark brown to black colour, broadly ellipsoid, 1.2–1.3 mm long (Figure 2B), with a beak up to 0.3 mm long (Figure 3D). The plant has scaly stolons terminating in nut-like tubers (Figure 2A, Figure 2C, Figure 3A). *C. eragrostis* is differentiated from its closest species, *C. difformis* L., by the higher length and different shape of glumes. Phenologically, *C. eragrostis* starts flowering in July whilst fruiting time ends in late September (pers. obs.).

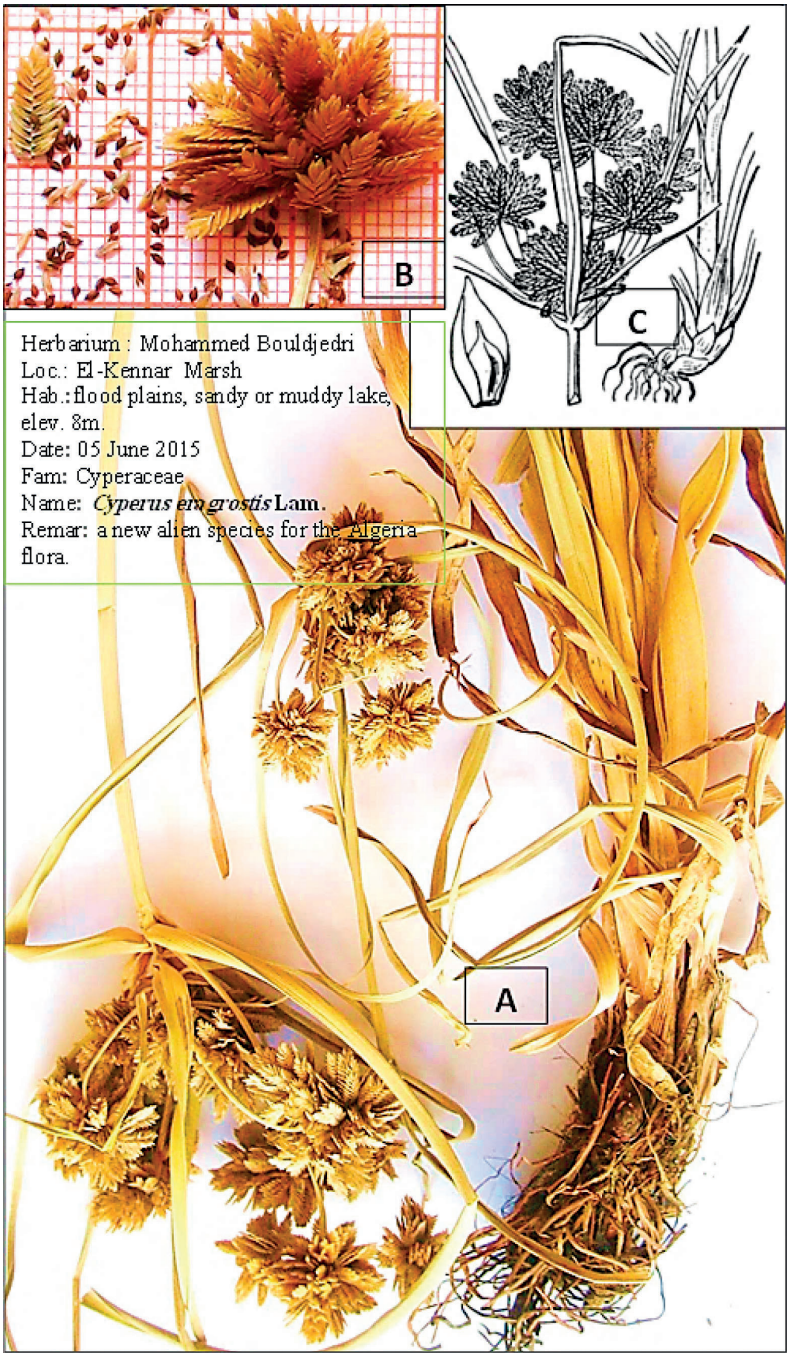

Figure 2: *Cyperus eragrostis* Lam. **A**. Photography of a herbarium specimen collected (30% of real size). **B**. Zoom on the spikelet, glumes and achenes (on graph paper). **C**. Drawing of the vegetative plant body showing inflorescence, stem and rhizome (Coste, 1906).

Slika 2: *Cyperus eragrostis* Lam. **A**. Fotografija herbarijskega primerka (30 % dejanske velikosti). **B**. povečano klasek, ogrinjalna pleva in (na milimeterskem papirju). **C**. Risba vegetativnega dela rastline s socvetjem, steblom in rizomi (Coste, 1906).

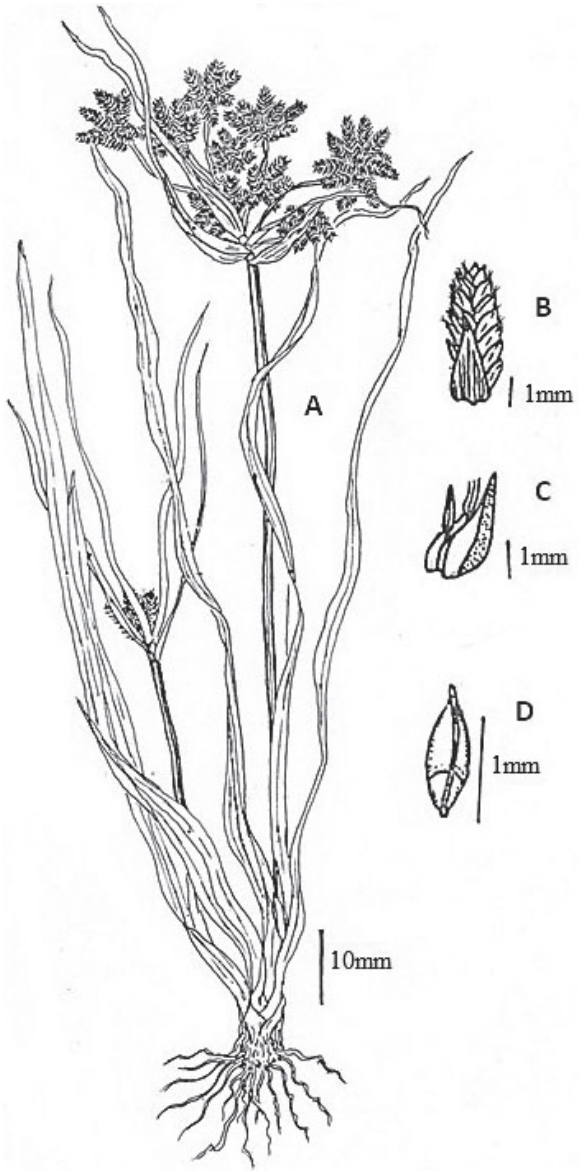

Figure 3: *Cyperus eragrostis* Lam. **A**. Drawing of the vegetative plant body showing inflorescence, stem and rhizome, **B**. spikelet, **C**. achene in glume with style and stamen, **D**. achene (B,C,D, drawn by Kazi-Tani C.).

Slika 3: *Cyperus eragrostis* Lam. **A**. Risba prikazuje socvetje, steblo in rizome, **B**. klasek, **C**. orešek z ogrinjalno plevo z vratom pestiča in prašniki, **D**. seme (B, C, D, risba Kazi-Tani C.).

Spreading and possible modes of introduction

According to the literature, *Cyperus eragrostis* (Cyperaceae) is originally native to South America and parts of Western USA (Tropical America). It has been noticed in many European countries; this distribution is confirmed by the herbaria specimens reported in the literature (only reliable and the oldest sources were cited); France and Switzerland (Camus, 1888), Spain (Bubani, 1901), Germany (Hegi, 1907), Hungary (Jávorka, 1925), Netherlands (Heukels, 1927),) Portugal (Pereira Coutinho, 1939), Italy (Pignatti, 1982), England (Ellis, 1983), Montenegro (Karaman, 1998), Czech Republic (Petřík, 2003), Slovenia (Dakskobler & Vreš, 2009), Bulgaria (Stoyanov & Barzov, 2018). The presence in Turkey, after a former citation for a single site («Costantinopel» : Kükenthal, 1935-36), is confirmed in 2018 along the Black Sea Coast (Şapci & Vural, 2018). The Caucasian Flora (Menitsky & Popova, 2006) treats *C. eragrostis* as a synonym of *C. noeanus* Boiss., a turkish endemic species; but the last is probably to be enclosed on the variation range of the annual *C. glaber* L. (Mesterházy & Verloove, 2018).

Cyperus eragrostisis is also recorded in herbarium from South Australia and New Zealand (Healy & Edgar, 1980); South East Asia and Iran (Naqinezhad et al., 2006) and it was found naturalized in eastern Taiwan (Chen & Wu, 2007). Outside the Americas, *C. eragrostis* was claimed as a weed and potentially troublesome, notably for infesting rice fields and other cultures (Caffrey et al., 1999). In most counties, the status of this plant was given as "naturalized", "adventive" or "common"; in a few cases such as the present paper, the plant has been described as "rare".

According to Tucker (1992), some occurrences in North America may be due to escape from vegetable crops. So, a possible explanation for the occurrence of *C. eragrostis* in the Jijel locality is probably its introduction from Europe (main supplier of cultivated plants seeds for Algeria). Because of their small size, the achenes of *C. eragrostis* (Figure 2C) are difficult to detect and are readily transported as contaminants of the crop seeds; this means of introduction may also be considered because the locality where the species is found is close to areas of agricultural activity. There are also other possible vectors as endozoochory; Martin et al. (1951) noted that the seeds of *C. eragrostis* are commonly used as foods for ducks and shorebirds and the Jijel wetlands eco-complex provides important staging posts and wintering grounds for migrating Palearctic birds (Bouldjedri & Mayache, 2020).

Ecology and habitat

The combined effect of coastal environmental conditions and plant propagation strategies involve mosaic successional stages and zonation of plant assemblages along the flood-level gradient controlled by complex interactions between various natural and anthropogenic factors (De Bélair, 2005; Bouldjedri et al., 2011). In El-kennar and Redjla Marshes and at Beni-Belaid nature reserve, *C. eragrostis* spreads by underground short-rhizomes; it

grows in annual pioneer vegetation on nitrogen-rich soils, its density in the occurrence stations is up to 10 plants per m², *C. eragrostis* is usually associated with lush helophytes and aquatic plants such as *Bolboschoenus maritimus* (L.) Palla, *Carex vulpina* L., *Cynodon dactylon* (L.) Pers., *Cyperus longus* L, *Eleocharis palustris* (L.) Roem & Schult., *Juncus maritimus* Lam., *Lycopus europaeus* L., *Oenanthe fistulosa* L., *Phragmites australis* (Cav.) Trin. ex Steud. subsp. *australis*, *Symphyotrichum squamatum* (Spreng.) G.L. Nesom, *Typha domingensis* Pers., *Lythrum salicaria* L. and *Xanthium strumarium* L.; in any case, *C. eragrostis* reaches the highest abundance of about a few hundred plants. In term of species composition; the same type of plant community was described by Guinochet & De Vilmorin (1978), Sánchez-Rodríguez (1986) and Brullo & Sciandrello (2006), in France, Spain and Sicily. These plant communities belong to the phytosociological class; *Phragmiti-Magnocaricetea*, orders; *Phragmitetalia australis* and *Scirpetalia compacti*, grouping perennial communities of helophytes linked to submerged or periodically flooded soils.

According to Brako & Zarucchi (1993), in its native distribution range (Amazonian region), *C. eragrostis* inhabits various kinds of wet habitats: disturbed hydric soils of wetlands, ditches, stream and river banks, floodplains, sandy or muddy edges of ponds and swamps, swales in fields and pastures, rice fields, emergent shorelines, sand flats, shallow water along creeks. In our study area, *C. eragrostis* is found in similar habitats: wetlands and freshwater swamps, at least temporarily wet habitats and sandy-gravelly or muddy lake edges, where it was found in small groups of one to several dozen individuals (Figure 4B). From an ecological standpoint and the optimal valence based on our field observations and the sampled stands, it appears that this heliophilous taxon is sensitive to salinity; it prefers mesotrophic moist soils rich in organic matter, with clay-loam to sandy-loam texture and a neutral pH. The conditions necessary for successful seed reproduction in the field are not known, but according to our field observation, the plants produce few viable seeds.

Syntaxonomy and synecology of vegetation survey

A large part of Algerian wetland vegetation is represented by the syntaxa:

Class *Phragmito-Magnocaricetea* Klika in Klika et Novák 1941

Order *Phragmitetalia* W. Koch 1926 em. Pignatti 1953

Alliance *Phragmition* W. Koch 1926

These syntaxonomic ranks are represented by communities of helophytes with a flooded base , made up of thickets of reeds and tall sedges, growing both in fresh and brackish water and occurring in edges of permanent water points (lake, pond, wadi with permanent flow) (Braun-Blanquet et al., 1952).

Ass. *Typhetum latifoliae* (Soo 1927) Lang 1973 (Géhu et al., 1994): Vegetation dominated by *Typha latifolia* constituting the summer aspect of the plant belts. This community mostly develops in anthropogenic habitats such as canals with highly eutrophic household effluent water in our case: Elkennar and Redjla sites (Figure 1A). The *Typhetum latifoliae* constitutes the dominant helophytic community in the studied wetlands. The floristic composition is well represented by: *Typha latifolia*, *Typha domingensis, Lythrum salicaria, L. junceum, Ludwigia peploides, Xanthium strumarium, Cyperus longus, Cyperus eragrostis* and *Symphyotrichum squamatum.*

Figure 4: *Cyperus eragrostis* Lam. Photos are taken in the field, **A**. Habit and inflorescence. **B**. spikelets (June 5, 2015).
Slika 4: *Cyperus eragrostis* Lam. Fotografije so posnete v naravi, **A**. Izgled rastline in socvetje. **B**. klaski (5. junij 2015).

Order *Scirpetalia compacti* Hejny in Holub, Moravec et Neuhausl 1987

Alliance *Scirpion compacto-littoralis* (Rivas-Martinez in Rivas-Martinez et al. 1980)

Ass. *Scirpetum lacustris* Chouard 1924 (Géhu et al.. 1994).

This community grows mostly on hydromorphic soil. This soil is permanently to temporarily wet due to the groundwater table and/or flood waters. This association builds homogeneous patches in the middle vegetation belts, which are part of the mosaic complex of *Phragmito-Magnocaricetea* class. This one is organized into characteristic strips that stretch from the shore to the body of water, where one community may partially encircle another type. The characteristic and differential taxa: *Schoenoplectus lacustris, Bolboschoenus maritimus, Mentha suaveolens*, *Oenanthe fistulosa*, *Eleocharis palustris*, *Carex vulpine*, *Cyperus eragrostis*, *Cyperus longus, Samolus valerandi, Rorippa nasturtium-aquaticum,* and *Iris pseudoacorus.*

Conclusion and implication for weed management

For several decades *C. eragrostis* has been naturalized in various European and Asian countries, some of which have a warm and relatively moist Mediterranean climate. Thus, we cannot exclude that global warming has enabled alien species to expand into regions in which they previously could not survive and reproduce (Walther et al., 2009; Pellizzari, 2020). In this context, Hoffmann (1994) reported that the occurrence of *C. eragrostis* in Germany as a consequence of global climate change. In Europe, despite the low spread rate of *C. eragrostis*, either by seed or vegetative, it is currently considered an invasive plant species class II with intermediate-risk (Weber & Gut, 2004). In Jijel eco-region, *C. eragrostis* can be listed as a naturalized neophyte, probably not (yet) as an invasive species. It is therefore necessary to extend the botanical exploration to the entire geographical area constituting the natural extension of our study area, to determine the naturalization status and develop an appropriate management strategy for this exotic taxon. However, the multiplication of *C. eragrostis* in the study area appears to occur mainly vegetatively; therefore effective management of this species includes preventing the spread of rhizomes. This requires better prophylaxis through adequate cleaning of machinery and farming tools before moving from one plot to another. Further study is surely required because this xenophyte is still poorly known and maybe hides as yet unknown lookalikes.

Acknowledgements

We would like to thank Dr. Patrick Grillas (TDV research institute, France), for his help and permission to access the library of the institute. Our thanks are also extended to the editor and the two anonymous reviewers for their helpful comments.

Mohammed Bouldjedri https://orcid.org/0000-0001-6301-5953

Funding

This study has been possible thanks to assistance from the CNEPRU project (F:01720140025) and the Faculty of Nature and Life Sciences; Mohamed-Seddik Benyahia University -Jijel, Algeria.

References

Battandier, J.-A., & Trabut, L.-C. (1884). *Flore d'Alger et catalogue des plantes d'Algérie Monocotylédones*. A. Jourdan Libraire-éditeur.

Battandier, J.-A., & Trabut, L. -C. (1902). *Flore analytique et synoptique de l'Algérie et de la Tunisie*. V. Giralt Imprimeur-éditeur.

Bouldjedri, M., De Bélair, G., Mayache, B., & Muller, S. D. (2011). Threats to and conservation of North African wetlands: The case of the Ramsar site of Beni-Belaid (NE Algeria). *Comptes Rendus Biologies*, *334*, 757–772. https://doi.org/10.1016/j.crvi.2011.06.009.

Bouldjedri, M., & Mayache, B. (2020). Structure of waterbird assemblages in fragmented coastal wetlands of Northeastern Algeria. *Arxius de Miscellània Zoològica*, *18*, 123–142. https://doi.org/10.32800/amz.2020.18.0012

Brako, L., & Zarucchi, J. L. (1993). *Catalogue of the flowering plants and gymnosperms of Peru*. Missouri Botanical Garden.

Braun-Blanquet, J., Roussine, N., & Negre, R. (1952). *Les groupements végétaux de la France méditerranéenne*. C.N.R.S. et Direction de la Carte des groupements végétaux de l'Afrique du Nord.

Braun-Blanquet, J. (1964). *Pflanzensoziologie. Grundzüge der Vegetationskunde*. (3rd ed.). Springer.

Bruhl, J. J., & Wilson, K. L. (2007). Towards a Comprehensive Survey of C3 and C4 Photosynthetic Pathways in Cyperaceae. *Aliso: A Journal of Systematic and Evolutionary Botany*, *23*(1), 99–148. https://doi.org/10.5642/aliso.20072301.11

Brullo, S., & Sciandrello, S. (2006). *Cyperus alopecuroides* Rottb. (Cyperaceae): typification and first record for Sicily. *Candollea, 61*, 365–372.

Bryson, C. T., & Carter, R. (2008). The significance of Cyperaceae as weeds. In R.F., Naczi, & B.A. Ford (Eds.), *Sedges, uses, diversity, and systematic of the Cyperaceae* (pp. 15–101). Missouri Botanical Garden.

Bubani, P. (1901). *Flora Pyrenaea per ordines naturales gradatim digesta*, Vol. 4. Ulichus.

Caffrey, J., Barrett, R.F.P., Ferreira, M.T., Moreira, S.L., Murphy, K.J., & Wade, P.M. (Eds.) (1999). *Biology, Ecology and management of aquatic plants*. *Proceedings of the 10th international symposium on aquatic weeds, Vol. 45*. European weed research society.

Camus, E. G. (1888). *Catalogue des plantes de France, de Suisse et de Belgique (Vol. 7)*. Dupont & Lechevalier.

Castroviejo, S., Luceño, M., Galan, A., Mejias, J.P., Cabezas, F., & Medina, L. (Eds.) (2007). *Flora iberica, Plantas vasculares de la peninsula Iberica e Islas Baleares (Vol. 18).* CSIC.

Chen, S.-H., & Wu, M.-J. (2007). Notes on Four Newly Naturalized Plants in Taiwan. *Taiwania, 52*(1), 59–69. https://doi.org/10.6165/tai.2007.52(1).59

Coste, A. H. (1901–1906). *Flore descriptive et illustrée de la France de la Corse et des contrées limitrophes (Vol. 3)*. Librairie des sciences et des arts.

Cronquist, A., & Takhtadzhian, A. L. (1981). *An Integrated System of Classification of Flowering Plants*. Columbia University Press.

Cuénod, A., Pottier-Alapetite, G., & Labbe, A. (1954). *Flore analytique et synoptique de la Tunisie*. Imprimerie SEFAN.

Dakskobler, I., & Vreš, B. (2009). *Cyperus eragrostis* Lam. a new adventitious species in the flora of Slovenia. *Hacquetia, 8*(1), 79–90.

De Bélair, G. (2005). Dynamique de la végétation de mares temporaires en Afrique du Nord (Numidie orientale, NE Algérie). *Ecologia Mediterranea*, *31*, 83–100. https://doi.org/10.3406/ecmed.2005.1481

De Filipps, R. A. (1980). *Cyperus* L. In T. G. Tutin, V. H. Heywood, N. A. Burges, D. H. Valentine, S. M. Walters, & D. A. Webb (Eds.), *Flora Europaea. Vol 5: Alismataceae to Orchidacae (Monocotyledones)*, (pp. 284–288). Cambridge University Press.

Denton, M. F. (1978). A taxonomic treatment of the Luzulae group of *Cyperus*. *Contributions from the University of Michigan Herbarium*, *11*(4), 197–271.

Dobignard, A., & Chatelain, C. (2020 [continuously updated]). *Index synonymique et bibliographique de la flore d'Afrique du Nord,* Conservatoire et Jardin botaniques & South African National Biodiversity Institute. Retrieved April 07, 2020, from https://www.ville-ge.ch/musinfo/bd/cjb/africa/index.php?langue=fr

Ellis, R. G. (1983). *Flowering plants of Wales*. National Museum of Wales.

El Mokni, R., & Verloove, F. (2021). First appointment of the invasive *Cyperus eragrostis* (Cyperaceae) as an established species in Tunisia. *Flora Mediterr*anea, *31*, 83–88. https://doi.org/10.7320/FlMedit31.083

Fennane, M., Ibn Tattou, M., & El Oualidi, J. (eds.) (2014). *Flore pratique du Maroc, Dicotylédones (p.p.), Monocotylédones (Vol. 3)*. Travaux de l'Institut Scientifique.

FNA, Editorial committee (2002). *Flora of North America, North of Mexico. Magnoliophyta: Commelinidae (in part): Cyperaceae (Vol. 23)*. Oxford University press.

Géhu, J. M., Kaabèche, M., & Gharzouli, R. (1994). Phytosociologie et typologie des rives des lacs de la région d'El-Kala (Algérie). *Colloques phytosociologiques*, *XXII*, 297–329.

Givnish, J. T., Chris, J. P., Graham, W. S., McPherson, A. M., Prince, M. L., Patterson, T. B., Rai, H. S., Roalson, E. H., Evans, T. M., Hahn, W. J., Millam, K. C., Meerow, A. W., Molvray, M., Kores, P. J., O'Brien, H. W., Hall, J. C., Kress, W. J., & Sytsma, K. J. (2006). Phylogenetic relationships of monocots based on the highly informative plastid gene ndhF: evidence for widespread concerted convergence. *Aliso*, *22*, 28–51.

Govaerts, R., Simpson, D. A., Goetghebeur, P., Wilson, K. L., Egorova, T., & Bruhl, J. (2007). *World checklist of Cyperaceae*. Royal Botanic Garden.

Guinochet, M., & De Vilmorin, R. (1978). Flore de France, Vol. 3. CNRS.

Healy, A. J., & Edgar, E. (1980). *Adventive cyperaceous, petalous and spathaceous monocotyledons, Flora of New Zealand,* Vol. 3. Manaaki Whenua Press.

Hegi, G. (1907). *Illustrierte Flora von Mittel-Europa, Monocotyledones*, Vol. 2. Blackwell Wissenschafts-Verlag.

Heukels, H. (1927). *Schoolflora voor Nederland*. (2nd ed.). Uitgever.

Hoffmann, J. (1994). Spontan wachsende C4-Pflanzen in Deutschland und Schweden eine Übersicht unter Berücksichtigung möglicher Klimaänderungen. *Angewandte Botanik*, *68*, 65–70.

Jávorka, S. (1925). *Magyar flóra (Flora hungarica).* Studium.

Karaman, V. (1998). *Cyperus eragrostis* Lam. A new adventitious plant in the flora of Balkan Peninsula. In Book of abstracts, the 1st Congress of biologists.

Kükenthal, G. (1935–1936). Cyperaceae-Scirpoideae-Cypereae. In A., Engler, (Ed.), *Das Pflanzenreich.* (pp. 1–545). Engelmann.

Larridon, I., Reynders, M., Huygh, W., Bauters, K., van de Putte, K., Muasya, A.M., Boeckx, P., Simpson, D.A., Vrijdaghs, A., & Goetghebeur, P. (2011). Affinities in C3 *Cyperus* lineages (Cyperaceae) revealed using molecular phylogenetic data and carbon isotope analysis. *Botanical Journal of the Linnean Society*, *167*, 19–46. https://doi.org/10.1111/j.1095-8339.2011.01160.x

Larridon, I., Bauters, K., Reynders, M., Huygh, W., Muasya, A.M., Simpson, D.A., & Goetghebeur, P. (2013). Towards a new classification of the giant paraphyletic genus *Cyperus* (Cyperaceae): phylogenetic relationships and generic delimitation in C4 Cyperus. *Botanical Journal of the Linnean Society*, *172*, 106–126. https://doi.org/10.1111/boj.12020

Le Floc'h, E., Boulos, L., & Véla, E. (2010). *Flore de Tunisie, Catalogue synonymique commenté.* Banque Nationale de Gènes.

Mabberley, D. J. (2008). *Mabberley's plant-book* (3rd ed.). Cambridge University Press.

Maire, R. (1952). *Flore de l'Afrique du Nord (Maroc, Algeria, Tunisie, Tripolitaine, Cyrenaica et Sahara)*, Vol. 4. Lechevalier.

Martin, A. C., Zim, H. S., & Nelson, A. L. (1951). *American wildlife and plants: A guide to wildlife food habits*. Dover Publications.

Menitsky, Y. L., & Popova, T. N. (2006). *Synopsis of the flora of the Caucasus*, Vol. 2. St. Petersburg University press. [In Russian].

Mesterházy, A., & Verloove, F. (2018). On the identity of the Turkish endemic *Cyperus noeanus* (Cyperaceae). *Turkish Journal of Botany*, *42*, 233–238. https://doi.org/10.3906/bot-1706-29

Muasya, A. M., Simpson, D. A., Chase, M. W., & Culham, A. (1998). An assessment of suprageneric phylogeny in Cyperaceae using *rbc*L DNA sequences. *Plant Systematics and Evolution, 211*, 257–271. https://doi.org/10.1007/BF00985363

Muasya, A. M., Simpson, D. A., Verboom, G. A., Goetghebeur, P., Naczi, R. F. C., Chase, M. W., & Smets, E. (2009). Phylogeny of Cyperaceae Based on DNA Sequence Data: Current Progress and Future Prospects. *Botanical Review*, *75*, 2–21. https://doi.org/10.1007/s12229-008-9019-3

Naqinezhad, A. R., Rajamand, M. A., Ramezankhah, S., & Saeidi-Mehrvarz, S. H. (2006). *Cyperus eragrostis*, a new record from wet coastal line of Caspian Sea area, N. Iran. Short Communications. *Rostaniha*, *7*, 67–68.

Nyman, C. F. (1889). *Conspectus florae Europaeae. Supplementum II.* Typis officinae Bohlinianae.

Pellizzari, M., & Verloove, F. (2017). The genus *Cyperus* in the eastern Po Plain (Italy): historical and recent data. *Webbia, 72*(1), 127–137, https://doi.org/10.1080/00837792.2017.1285524

Pellizzari, M. (2020). *Cyperus*-dominated vegetation in the eastern Po river. *Plant Sociology, 57*(2), 1–16. https://doi.org/10.3897/pls2020571/06

Pereira Coutinho, A. X. (1939). *A Flora de Portugal (Plantas vasculares)*. Aillaud, Alves & C^{ia}.

Petřík, P. (2003). *Cyperus eragrostis* – a new alien species for the Czech flora and history of its invasion of Europe. *Preslia, 75,* 17–28.

Pignatti, S. (1982). *Flora d'Italia*. Edagricola.

Pignatti, S. (Ed.). (2017). *Flora d'Italia*, 2nd Edition, Vol. 1. Edagricole.

Quézel, P., & Santa, S. (1962). *Nouvelle flore de l'Algérie et des régions désertiques méridionales*, Vol. 1. CNRS.

Rivas-Martínez, S., Costa, M., Castroviejo, S., & Valdés-Bermejo, E. (1980). Vegetación de Doñana (Huelva, España). *Lazaroa, 2*, 5–189.

Rivas-Martinez, S. (1996). Clasificación bioclimática de la Tierra. *Folia Botanica Matritensis*, *16*, 1–20.

Sánchez-Rodríguez, J. A. (1986). Aportaciones a la flora de Zamora, II. *Lagascalia*, *14*, 35–44.

Şapci, H., & Vural, C. (2018). Two new naturalized species of the genus *Cyperus* (Cyperaceae) from Turkey. *Artvin Çoruh Üniversitesi Orman Fakültesi Dergisi*, *19*(1), 35-38. https://doi.org/10.17474/artvinofd.333093.

Soros, C. L., & Dengler, N.G. (1996). Leaf morphogenesis and growth in *Cyperus eragrostis* (Cyperaceae). *Canadian Journal of Botany*, *74*, 1753–1765. https://doi.org/10.1139/b96-212

Stoyanov, S., & Barzov, Z. (2018). *Cyperus eragrostis* – an addition to the Bulgarian alien flora. *Phytologia Balcanica*, *24*(2), 239–242.

Tison, J.M., Jauzein, P., & Michaud, H. (2014). *Flore de la France méditerranéenne continentale*. Naturalia publications.

Tucker, G. C. (1992). *Cyperus*. In J. C., Hickman, T. J., Rosatti, & D. H., Wilken (Eds.), *The Jepson Manual* (pp.1138–1140). University of California Press.

Véla, E., & Benhouhou, S. (2007). Evaluation d'un nouveau point chaud de biodiversité végétale dans le Bassin méditerranéen (Afrique du Nord). *Comptes Rendus Biologies*, *330*, 589–605. https://doi.org/10.1016/j.crvi.2007.04.006

Verloove, F. (2014). A conspectus of *Cyperus* s.l. (Cyperaceae) in Europe (incl. Azores, Madeira and Canary Islands), with emphasis on non-native naturalized species. *Webbia, 69*(2), 179-223. https://doi.org/10.1080/00837792.2014.975013

Walther, G. R., Roques, A., Hulme, P. E., Sykes, M. T., Pyšek, P., Kühn I., Zobel, M., Bacher, S., Botta-Dukát, Z., Bugmann, H., Czúcz, B., Dauber, J., Hickler, T., Jarošík, V., Kenis, M., Klotz, S., Minchin, D., Moora, M., Nentwig, W., Ott, J., Panov, V. E., Reineking, B. Robinet, C., Semenchenko, V., Solarz, W., Thuiller, W., Vilà, M., Vohland, K., & Settele, J. (2009). Alien species in a warmer world: risks and opportunities. *Trends in Ecology & Evolution*, *24*, 686–693. https://doi.org/10.1016/j.tree.2009.06.008

Weber, E., & Gut, D. (2004). Assessing the risk of potentially invasive plant species in central Europe. *Journal for Nature Conservation*, *12,* 171–179. https://doi.org/10.1016/j.jnc.2004.04.002