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Rumex tunetanus (Polygonaceae): rediscovery of an endangered Tunisian endemic

ZEINEB GHRABI-GAMMAR[1,2*], SERGE D. MULLER[3], MAYA ROUISSI[1,4], IMTINEN BEN HAJ JILANI[1,5], LAÏLA RHAZI[6], GÉRARD DE BÉLAIR[7], SEMIA BEN SAAD-LIMAM[1,4] & AMINA DAOUD-BOUATTOUR[1,4]

[1] *Université de Manouba, Faculté des Lettres, des Arts et des Humanités de la Manouba, UR99/UR/02-04 Biogéographie, Climatologie Appliquée et Dynamique Erosive (BiCADE), 2010 Manouba, Tunisie*

[2] *Université de Carthage, Institut National Agronomique de Tunisie (INAT), 43 Avenue Charles Nicolle, 1082 Cité Mahrajène, Tunis, Tunisie; e-mail: zghrabi@yahoo.fr*

[3] *Université de Montpellier - CNRS, Institut des Sciences de l'Evolution (ISE-M), Case 061, Place Eugène Bataillon, 34095 Montpellier cedex 05, France*

[4] *Université de Tunis El Manar, Faculté des Sciences, Département de Biologie, 2092 Tunis, Tunisie*

[5] *Université de Carthage, Institut Supérieur des Études Préparatoires en Biologie Géologie (ISEPBG), Choutrana II, 2036 Soukra, Tunisie*

[6] *Université Mohamed V- Rabat, Laboratoire de Botanique et Environnement, Faculté des Sciences, 4 avenue Ibn Battouta B.P. 1014 RP, Rabat, Maroc*

[7] *Université Badji Mokhtar, Laboratoire de Pédologie et Développement Durable, Faculté des Sciences, 23000 Annaba, Algérie*

**author for correspondence*

Abstract

Rumex tunetanus is a strictly endemic species occurring on the banks of the dried lake of Sejenane (NW-Tunisia) which was discovered in 1888 (published in 1899), but never seen until our rediscovery in 2009. This finding allowed us to give a more complete morphological description of the species, as well as to specify its ecological preferences and conservation status. A lectotype preserved at P was designated for the name *Rumex tunetanus*.

Keywords: conservation, Garâa Sejenane, North Africa, *Rumex*, wetland

Introduction

The Tunisian flora includes 40 endemic species, each characterized by a narrow distribution area (Cuénod 1954, Pottier-Alapetite 1979 and 1981, Neffati *et al*. 1999, Le Floc'h *et al.* 2010). All these species are poorly known in terms of frequency, ecology and population dynamics, making a difficult to assess their conservation status. In fact, 12 % of these species are classified as *Data Deficient* under IUCN (2008). One of the most intriguing of these Tunisian endemics is the Tunisian dock *Rumex tunetanus* Baratte & Murbeck ex Murbeck (1899: 5), which is represented by perennial herbs growing in the wet marshes of the Sejenane plain. This species was never seen after its discovery in 1888 (date of collections of the type of *R. tunetanus*—see the paragraph "Taxonomic treatment").

Until the 1950s, the Garâa Sejenane (37°05′N, 09°12′E, 110 m a.s.l.; Fig. 1) was described as a shallow lake (area 15 km^2) that never completely dries up (Le Floc'h 1959). "Garâa" is a Tunisian word designating permanent, freshwater lakes and marshes (Hughes *et al.* 1997). With a maximal depth of 1 m, the site was covered by an extended marsh of *Schoenoplectus lacustris* (Linnaeus 1753: 47) Pallas (1888: 49), which is locally associated with *Nymphaea alba* Linnaeus (1753: 510), and at borders of the lake with a large belt of *Isoetes velata* A. Braun (1850: 19) and *Eryngium pusillum* Linnaeus (1753: 233) (see e.g., Gauthier-Lièvre 1931, Pottier-Alapetite & Labbe 1951, Pottier-Alapetite 1952, 1958). The lake was the home for several rare species, such as: *Armeria spinulosa* Boissier (1848: 675), *Butomus umbellatus* Linnaeus (1753: 372), *Mibora minima* (Linnaeus 1753: 63) Desvaux (1818: 45), *Persicaria amphibia* (Linnaeus 1753: 361) Gray (1821: 268), *Rumex tunetanus*, *Utricularia vulgaris* Linnaeus (1753: 18) (see e.g., Cuénod 1954, Pottier-Alapetite 1979 and 1981, Rouissi *et al.* 2016). The drainage of the waterlogged plain that began in the 1960s lowered the water level and led to the partition of hydrophytic plant communities. Today, the water level does not exceed 50 cm in the deepest zones (in winter), and the garâa dries out completely in summer. It is extensively grazed

and cultivated (off-season and summer market gardening) and comprises a patchwork of marshes, temporary swamps, and temporarily flooded cultivated fields (Ferchichi-Ben Jamaa *et al.* 2010, Rouissi *et al.* 2016). Several species have disappeared (e.g., *Alternanthera sessilis*, *Butomus umbellatus*, *Nymphaea alba*, *Utricularia vulgaris*), but most of the other taxa that had been known before the drainage began, remain as well as some newly-discovered species for Tunisia: *Chara braunii* Gmelin (1826: 646), *Crassula helmsii* Cockayne (1907: 349), *Cr. decumbens* Thunberg (1794: 54), *Cr. vaillantii* (Willdenow 1798: 720) Roth (1827: 992), *Nitella opaca* (C.Agardh ex Bruzelius 1824: 16, 23) C.Agardh (1824: 124) and *Pilularia minuta* Durieu (1810: 540) (Muller *et al.* 2008, Daoud-Bouattour *et al*. 2009 and 2014, García *et al.* 2010, Rouissi *et al.* 2016).

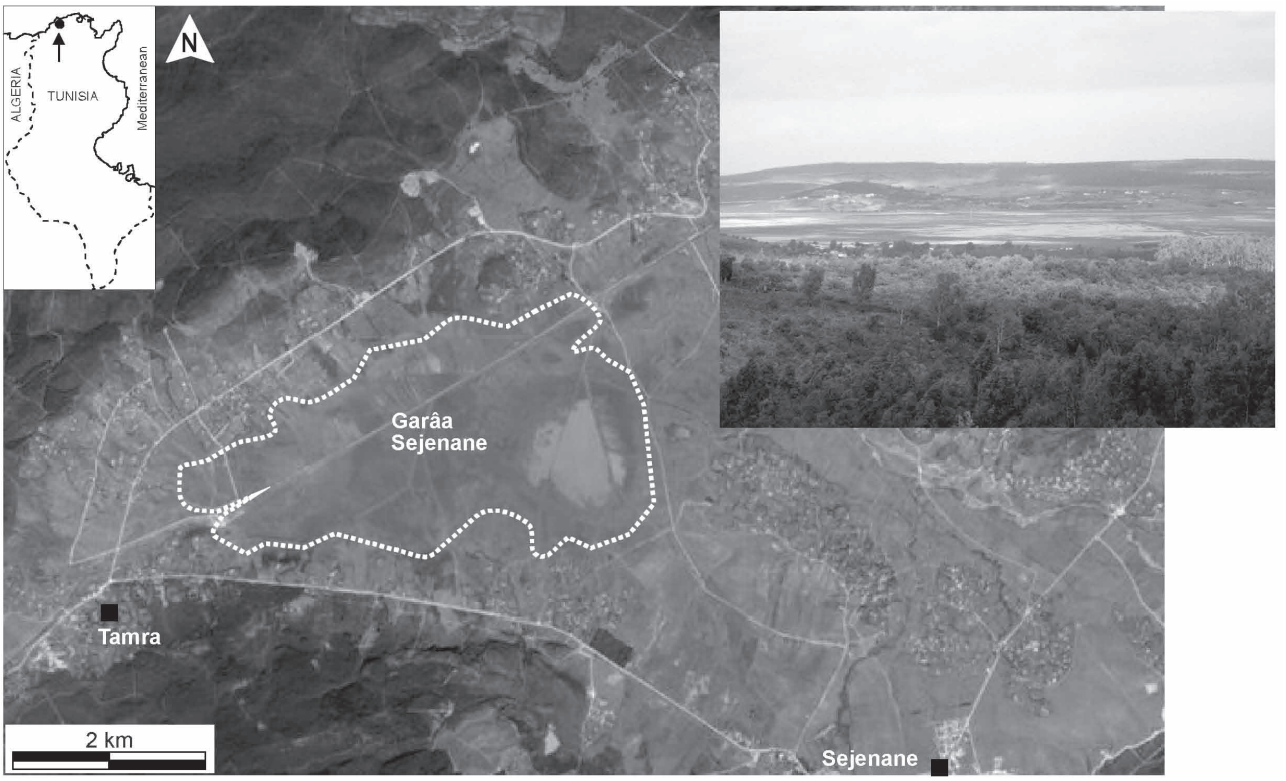

FIGURE 1. Location of Garâa Sejenane (Google earth V 7.1.7.2606). The ancient lake is represented in dots. The photograph shows Garâa Sejenane viewed from the south (photo by A. Daoud-Bouattour, February 2010): the central zone of the plain is cultivated and grazed, and the surrounding hills are covered with degraded cork-oak woods.

As part of field surveys carried out on the Sejenane plain (see e.g., Muller *et al*. 2008, Daoud-Bouattour *et al*. 2009, Ferchichi-Ben Jamaa *et al*. 2010, Rouissi *et al.* 2014 and 2016) and more than 120 years after the discovery of the Tunisian dock, we found a large population of *Rumex tunetanus* in December 2009. Between 2010 and 2014, we discovered in the same area five additional smaller populations of this steno-endemic species. This work is part of an assessment program of the Plant Red List of Tunisia (REGNES), launched in 2008 by the Tunisian Ministry of the Environment (MEDD 2006), and associated with the selection of Important Plant Areas (IPA) under the aegis of the IUCN (Radford *et al.* 2011).

Material and Methods

Phytosociological relevés (Braun-Blanquet 1932) were carried out during the spring (period 2010–2014) in the 6 sites where *Rumex tunetanus* was discovered: one relevé per site were made, except in the case of the largest population (GS1) where two relevés were performed in 2010 and 2013.

Plant species were identified using Tunisian floras (Cuénod 1954, Pottier-Alapetite 1979 and 1981), Algeria (Quézel & Santa 1962–1963) and North Africa (Maire 1952–1987). So as to compare *Rumex tunetanus* to morphologically related species, samples of the Algerian endemic *R. algeriensis* Barratte & Murbeck (in Murbeck 1899: 6) var. *hipporegianus* Battandier (1919: 79) and of the cosmopolitan species *R. crispus* Linnaeus (1753: 335), were collected in Annaba (Numidia-Algeria) and in Garâa Sejenane, respectively, in Spring 2012. A thorough morphological analysis

of 10 samples of *R. tunetanus* was carried out to complete the description of the species, especially its underground organs, basal leaves, achene and pollen, and to provide an exhaustive description. To determine its ecology and habitat, a Correspondence Analysis (CA) was performed by integrating the phytosociological relevés of *R. tunetanus* sites to the complete set of relevés carried out in the garâa (Rouissi *et al.* 2016) using PAST software (Hammer *et al.* 2001).

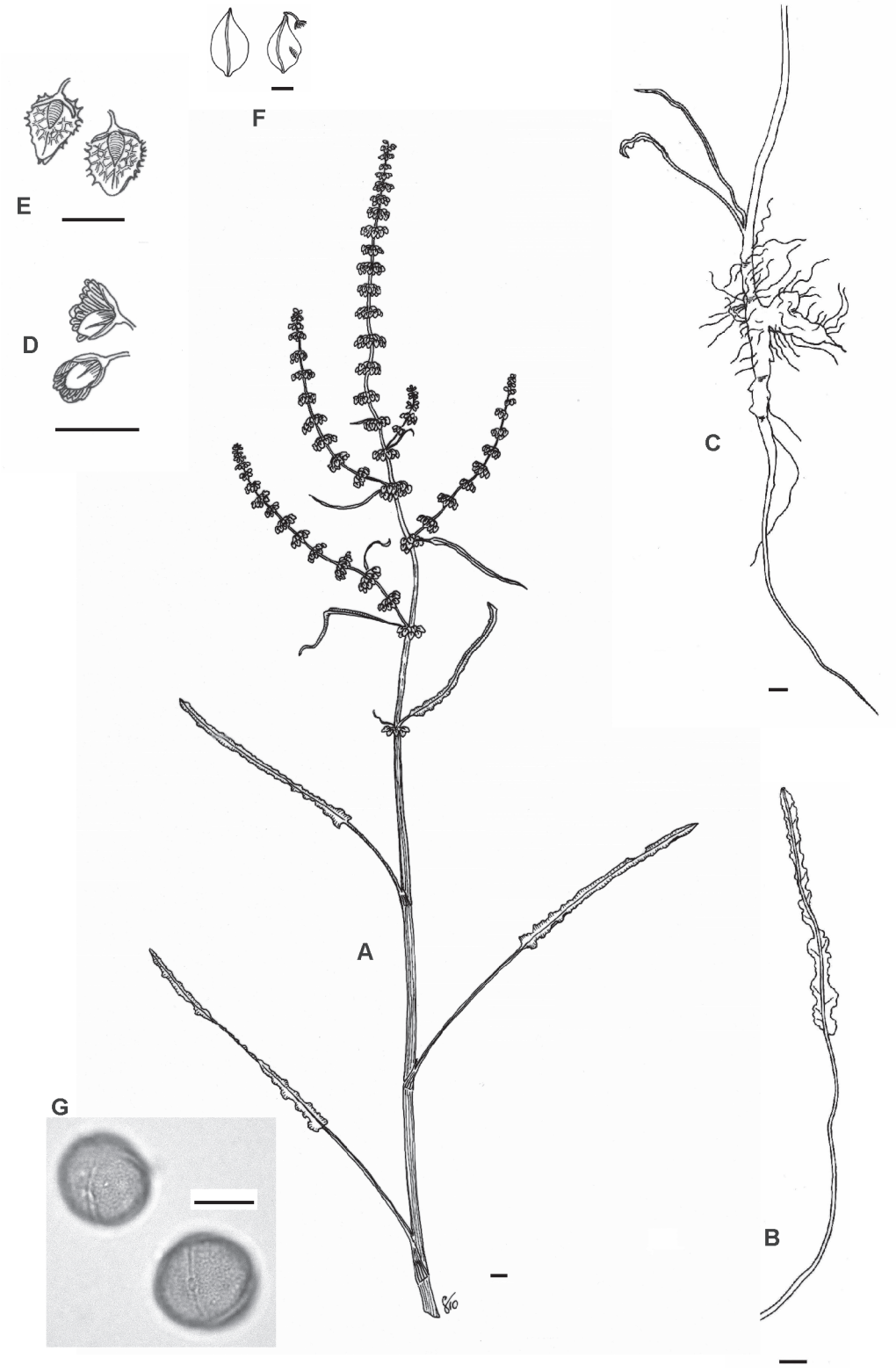

FIGURE 2. *Rumex tunetanus* : **A**, habitus; **B**, basal leaf; **C**, tuberous taproot; **D**, flowers showing stamens; **E**, fruit surrounded by three serrated valves; **F**, 3-angled achenes, with one bearing a dried style; **G**, tricolporate pollen grains. Scales: **A–C**, 1 cm; **D–E**, 5 mm; **F**, 1 mm; **G**, 20 µm (drawings S.D. Muller & Z. Ghrabi-Gammar, photo S.D. Muller).

In April 2010, the water pH was measured and soil samples taken in GS1. Soil samples of the GS1 site underwent a granulometric analysis and loss on ignition at 550°C to measure the quantities of organic matter and at 1000°C to measure carbonates (Dean 1974).

The size and density of the most important population (GS1) was defined using GPS techniques (April 2010).

Herbarium collections examined are preserved kept in Tunisia at the Faculty of Sciences of Tunis, at the Herbarium of the National Institute of Agronomy of Tunis and at the National Gene Bank, and in France at the Herbarium of Université de Montpellier (MPU).

The nomenclature according to Le Floc'h *et al*. (2010).

Taxonomical treatment

Rumex tunetanus Barratte & Murbeck ex Murbeck (1899: 5)

Type (lectotype designated here): *mission botanique de Tunisie, bords du lac Cejnan, Kroumirie orientale*, 23 June 1888, *Cosson, Barratte & Duval s.n.* (P-05338611!, image of the lectotype available at http://mediaphoto.mnhn.fr/media/1441386044455s2QUltcOdjvT6n2t; isolectotype P-05338612!, image of the isolectotype available at http://mediaphoto.mnhn.fr/media/1441386044474M1oZVHh7XfuUEtr0).

Description (Fig. 2)**:—**perennial, amphibious geophyte, with a tuberous vertical, thick, dark-brown taproot topped off with 1–4 short rhizomes, each developing an aerial axis. Stem erect, 80–120 cm tall, thin, reddish, striped, with 8–10 internodes (basal internode reaches 25 cm in length). Basal leaves petiolate (petiole about 18 cm long, and slightly enlarged at the base), with blade 18–20 cm long, ridged, more or less cordate at the base; cauline leaves similar to the basal one but smaller in size. Inflorescence branched 4, in the upper half of the stem, each consisting in a loose leafless panicle. 15 flowering whorls, the lower ones spaced (distance between two successive whorls 2.0–2.5 cm) and bearing about 25 flowers, the upper whorls more densely arranged (0.5 cm) and with 3–5 flowers. Outer sepals pinkish, linear and adpressed on the edges of fruit-bearing valves that are triangular, densely reticulated by barely bulging veins, with 5–8 shallow pairs of uneven, slightly curved teeths (5–6 or 4–6 mm long), with an oblong-ovoid callosity (equal to or longer than half the valve length), the two lateral leaves are shorter and have smaller callosities; anthers, which are as long as the fruit-bearing valves, become flat and large with curved edges after pollen release. After fertilization, each flowering axis can release between 400 and 600 brown, shiny achenes (2.7–3.0 mm long with a maximum width at the middle). Pollen grain subsphaerical (30–35 µm in diameter), micro-cross-linked, tricolporate, with thin, long furrows (ectoapertures) and small, round pores (endoapertures).

Typification:—Baratte & Murbeck (1899: 5) described *Rumex tunetanus* through a short diagnosis: "*is mostly characterized by stem leaves which are quite narrow, very elongated, more or less highly corrugated and stiff in the edges, more or less deeply cordate at the base where the limb reaches its biggest width*"; they also provided an illustration which is part of the original material. In the protologue, *R. tunetanus* was considered to be related to the sympatric *R. crispus*, and *R. stenophyllus* Ledebour (1830: 58). Baratte & Murbeck (1899: 5) also cited two specimens (syntypes according to the Art. 9.7 of ICN, McNeill *et al.* 2012) collected in 1888 during the last botanical mission of the Committee Responsible for the Scientific Exploration of Tunisia. We found these two specimens at P (codes 05338611, and 05338612), both bearing plants whose features matches the diagnosis. We here designate the P-05338611 as the lectotype of the name *Rumex tunetanus*, while the P-05338612 is the isolectotype.

Chromosome number:—Unknown.

Habitat and ecology:—*Rumex tunetanus* grows on temporary habitats (Fig. 3 A) characterized by sandy-silty soils at water depths of 20–50 cm during the flooding period [marshes of the ancient lake of Sejenane (Fig. 1; see also Gauthier-Lièvre 1931, Pottier-Alapetite & Labbe 1951, Pottier-Alapetite 1958)]. This particular wetland was comparable to the large lakes of NE-Algeria (Samraoui & de Bélair 1997, Stevenson *et al.* 1998, Rouissi *et al*. 2016) before it was seriously damaged by the various water projects between 1958–1980 (digging drainage ditches, drilling wells, building dams on the Sejenane River, etc.) and, perhaps, by drought between 1980–2002 (Ouali *et al.* 2014). These disturbances have led to the partition of the garâa and to its transformation into a patchwork of temporary habitats and cultivated lands that have resulted in a reorganisation of hydrophytic plant communities and the extinction of the most of vulnerable species. Today, the area is mainly used for grazing, fodder (sorghum), summer crops (tomato, pepper, watermelon, melon, tobacco) and off-season crops (potato, green beans) (I. Ben Haj Jilani, unpublished data).

FIGURE 3. GS1: **A**, temporary marsh with *Rumex tunetanus* during a high-water period (**p**hoto by S.D. Muller, 03 October 2009); **B**, production of hay fodder by local inhabitants during summer (photo by A. Daoud-Bouattour, 12 July 2010).

The communities including *Rumex tunetanus* thus appear to be temporary habitats somewhere between marshes and ponds, with a physiognomy of marshes related to the occurrence of high perennial helophytes but sheltering a number of annual species which are typical of temporary ponds. Both sites have higher water depths (from 30 to 50 cm in winter) that are entirely mown in summer; the 4 other sites are grazed in spring. They have apparently never been cultivated, probably because of their late submersion until the end of spring. The water pH is slightly acid (6.7), and the sandy-silty soils (2/3 sand, 1/3 silt and clay) contain 16.3 % of organic matter and 2.7 % of carbonates.

Our phytoecological study shows that the habitat dominated by the longest hydroperiod seems the most favorable: *R. tunetanus* occurs in dense populations within helophytic vegetation including species such as: *Bolboschoenus glaucus* (Lamarck 1791: 142) S.G. Smith (1995: 101), *Helosciadium crassipes* W.D.J. Koch ex Rchb. (1824: 16), *Oenanthe fistulosa* Linnaeus (1753: 254) and *O. silaifolia* M. Bieb. (1819: 232). Shallower habitats with shorter hydroperiods show lower densities, with plant communities including numerous species of temporary ponds [particularly, *Isoetes velata*, *Myosotis sicula* Gussone (1843: 214) and *Pilularia minuta*]. This difference suggests that *R. tunetanus* is sensitive to the nature and intensity of disturbances, and that it endures late mowing (June; Fig. 3 B) better than spring grazing, which may be attributed both to the preservation of its sexual reproduction and to its capacity for vegetative regeneration by rhizome fragmentation.

Despite these drastic changes, traditional agro-pastoral practices such as summer mowing of wet meadows and marshes, have preserved a rich biodiversity, particularly concerning that of the plant communities with *Rumex tunetanus*. Local agricultural practices are rapidly evolving, however, and significant projects (dam, roads…) are ongoing or planned for the near future so as to open the region up and encourage its economic development (Ferchichi-Ben Jamaa 2010). The population growth that will follow these changes will surely put growing pressure on the already weakened, fragmented wet habitats and most likely threaten *R. tunetanus*.

Distribution:—*Rumex tunetanus* is the only Tunisian endemic belonging to the genus *Rumex* (see e.g., Le Floc'h *et al*. 2010), with a distribution are restricted to Garâa Sejenane (area ranging from 500 m^2 to 30 ha).

Taxonomical notes:—*Rumex tunetanus* is morphologically similar to *R. algeriensis* var. *hipporegianus*, and *R. crispus*. Murbeck (1899) compared *R. algeriensis* with *R. tunetanus* from the morphological point of view showing similarities "*especially in its quite narrow, very elongated stem leaves which are more or less deeply cordate at the base where the limb reaches its biggest width*", but distinguishing *R. tunetanus* by "*its full length heavily ridged rod, by its thicker panicle, by its multiflorous look like whorls, by its longer and more twig-like pedicles, by its fuller more narrow valves, by its callus which length does not generally reach half of that of the valves, by the caryopse having its biggest width in the middle, etc.*".

Phytosociological remarks:—The phytosociological data reveal the occurrence of 58 species (Table 1), of which 70 % are strictly associated with wetlands (Ghrabi-Gammar *et al*. 2009). Based on the result of the correspondence analysis (CA; Fig. 4), plant communities with *R. tunetanus* refer to temporary habitats (temporary marshes, flooded crops and temporary ponds). These communities include many helophytes [*Alisma lanceolatum* Withering (1796: 362), *Alopecurus bulbosus* Gouan (1762: 37), *Bolboschoenus glaucus*, *Cyperus longus* Linnaeus (1753: 45) subsp. *badius* (Desfontaines 1798 : 45) Bonnier & Layens (1894: 324), *Eleocharis palustris* (Linnaeus 1753: 47) Roemer

& Schultes (1817: 151), *Helosciadium crassipes*, *Juncus heterophyllus* Dufour (1825: 88), *Oenanthe fistulosa*, *O. silaifolia*, *O. virgata* Poiret (1798: 529), *Rumex pulcher* Linnaeus (1753: 336)] as well as typical amphibious species of temporary Mediterranean pools [such as *Elatine macropoda* Gussone (1827: 475), *Eryngium pusillum*, *Isoetes velata*, *Juncus capitatus* Weigel (1772: 28), *J. pygmaeus* Richard ex Thuillier (1799: 178), *Lythrum borysthenicum* (Schrank 1822: 643) Litvinov (1917: 209), *L. hyssopifolia* Linnaeus (1753: 447), *L. tribracteatum* Salzmann ex Sprengel (1827: 190), *Myosotis sicula*, *Pilularia minuta*, *Ranunculus baudotii* Godron (1840: 21), *R. ophioglossifolius* Villars (1789: 731), *R. sardous* Crantz (1763: 84)]. Two populations of *R. tunetanus* occur on the CA graphs in the temporary ponds (Fig. 4), showing a species tolerance to summer drying out. Communities with *R. tunetanus* have maximum densities of 150 plants/ha for the most extensive population (GS1), and densities of 5–30 plants/ha for other populations.

TABLE 1 (1/2)**.** Phytosociological relevés for *Rumex tunetanus* (+, isolated plants; 1, 1–5 %; 2, 5–25 %; 3, 25–50 %; 4, 50–75 %; 5, 75–100 %).

Site	**GS1**		**GS2**	**GS3**	**GS4**	**GS5**	**GS6**
Date	22.04.10	01.05.13	22.04.10	26.05.10	09.05.12	02.05.13	05.05.14
Altitude (m)	102		101	100	106	101	102
Surface area (m^2)	30000		15000	500	15000	2000	1500
Water depth in April-May (cm)	15	30	0	0	0	0	0
Maximal water depth in winter (cm)	50	50	30	20	20	20	20
Bare soil (%)	0	0	10	10	10	0	10
Vegetation coverage (%)	100	100	90	90	90	100	90
Agrostis pourretii Willd.	.	.	.	.	2	.	.
Alisma lanceolatum With.	2	1	2	1	1	.	3
Alopecurus bulbosus Gouan	5	2	5	2.3	4	.	5
Anacyclus clavatus (Desf.) Pers.	.	.	.	.	.	1	.
Asphodelus ramosus L. subsp. *ramosus*	.	.	.	.	.	.	+
Bellis annua L.	.	.	+	.	1	1	.
Bolboschoenus glaucus (Lam.) S.G. Smith	5	5	1	.	1	2	3
Callitriche obtusangula Le Gall	.	.	.	.	.	.	5
Carex divisa Huds. subsp. *chaetophylla* (Steud.) Nyman	1	1.2	.	.	.	.	.
Chamaemelum fuscatum (Brot.) Vasc.	.	.	.	.	1	.	.
Cichorium intybus L.	.	.	.	.	.	1	.
Coronopus squamatus (Forssk.) Asch.	.	.	.	.	.	1	.
Crassula helmsii Cockayne	.	.	.	.	3	.	.
Crypsis schoenoides (L.) Lam.	.	.	.	.	2	.	.
Cuscuta epithymum L.	4.5	.	.	2	.	.	.
Cynodon dactylon (L.) Pers.	.	.	.	.	2	.	1
Cyperus longus L. subsp. *badius* (Desf.) Bonnier & Layens	1.2	.	1	.	.	.	.
Damasonium bourgaei Coss.	.	.	+	.	.	.	.
Elatine macropoda Guss.	.	.	1	.	.	.	.
Eleocharis palustris (L.) Roem. & Schult.	1	.	1	4.5	.	2	2.3

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TABLE 1. (Continued)

Site	GS1		GS2	GS3	GS4	GS5	GS6
Eryngium pusillum L.	.	.	.	3	2	1	3
Galactites tomentosa Moench	.	.	.	.	1	.	.
Geranium dissectum (L.)	.	.	.	.	.	1	.
Glyceria spicata (Biv.) Guss.	1	2	1	.	.	.	4
Helosciadium crassipes W.D.J. Koch ex Rchb.	4	5	.	.	.	.	.
Isoetes velata A. Br.	.	.	1	.	+	.	+
Isolepis cernua (Vahl.) Roemer & Schultes	.	.	1	+	1	.	.

TABLE 1 (2/2)**.** Continue.

Site	GS1		GS2	GS3	GS4	GS5	GS6
Juncus bufonius L.	.	.	+	.	1	.	.
Juncus heterophyllus Dufour	.	.	.	.	.	.	4
Juncus pygmaeus Rich. ex Thuill.	.	.	+	+	1	.	.
Juncus capitatus Weigel	.	.	.	.	1	.	.
Juncus tenageia Ehrh. ex L. f.	.	.	+	.	.	.	.
Linum usitatissimum L.	.	.	.	.	1	.	.
Lolium rigidum Gaudin	.	.	.	2.3	.	.	.
Lotus hispidus Desf. ex DC.	+	.	+	2	.	.	1
Lythrum borysthenicum (Schrank) Litv.	.	.	.	1	4	.	1
Lythrum hyssopifolia L.	+	.	.	2	2	.	1
Lythrum tribracteatum Salzm. ex Spreng.	+	.	1	+	.	1	+
Melilotus indicus (L.) All.	.	.	.	.	.	1	.
Mentha pulegium L.	+	.	+	.	.	1	1
Myosotis sicula Guss.	1.2	2.3	3	3	3.4	3	3
Oenanthe fistulosa L.	1	1	.	.	.	.	.
Oenanthe silaifolia M. Bieb.	3	2	1	+	.	1	3
Oenanthe virgata Poir.	.	.	.	.	1	.	.
Pilularia minuta Durieu	.	.	+	.	2	.	.
Plantago lanceolata L.	.	.	.	.	1	1	.
Poa annua L.	.	.	.	.	.	1	.
Polypogon monspeliensis (L.) Desf.	.	.	.	+	.	.	.
Ranunculus baudotii Godr.	1	.	.	.	.	.	1
Ranunculus ophioglossifolius Vill.	1	.	1	.	1	.	.
Ranunculus sardous Crantz.	1	2	1	2.3	2.3	3	.
Rumex conglomeratus Murray	.	1	.	.	.	2	1
Rumex pulcher L.	+	.	.	.	1	.	.
Rumex tunetanus Barratte & Murb.	2	3	1	1	1	1	2

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TABLE 1. (Continued)

Site	GS1		GS2	GS3	GS4	GS5	GS6
Solenopsis laurentia (L.) C. Presl.	.	.	.	.	1	.	.
Trifolium filiforme L.	.	.	+	.	1	4	.
Trifolium nigrescens Viv.	5	.	.	3	.	2	.
Trifolium resupinatum L.	1	.	1	+	1	2	.
Total	22	11	25	19	30	21	21

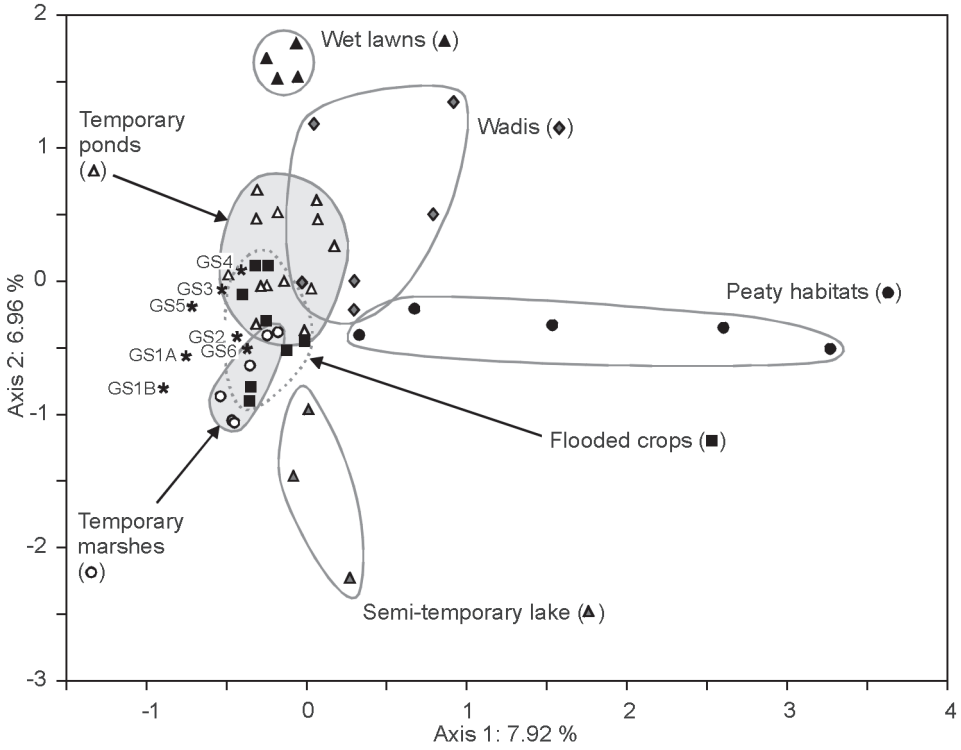

FIGURE 4. Correspondence analysis (CA) performed on the 176 species and 52 relevés, including 45 relevés from 36 regional wetlands (Ferchichi-Ben Jamaa *et al.* 2010) and 7 samples carried out between 2009 and 2014 in populations of *Rumex tunetanus*. Axes 1 and 2 represent respectively 7.92% and 6.96% of the total variability.

Conservation status:—Any assessment appears to be defined at present. The conservation of *Rumex tunetanus* requires the protection of its habitat and the continuity of current traditional agro-pastoral practices that appear to be compatible with its preservation. The most urgent measures include: 1) the legal protection of the species by adding it to the national list of protected species, 2) the survey of existing populations, 3) the acquisition of all or parts of the fields where the species grows (state property) or setting up management conventions with owners, 4) the preservation of traditional agro-pastoral activities that are compatible with the species conservation, 5) raising the awareness of local inhabitants about the importance of safeguarding wetlands, and their involvement in and contribution to their conservation, and 6) the implementation of *ex-situ* conservation measures of the species (Genes Bank) by preserving ripe fruit picked during the summer before mowing and species cultivation in suitable wet areas.

On the basis of the distribution of *Rumex tunetanus*, which is limited to a few hectares, and the threats to its habitat, this Tunisian steno-endemic is listed as Critically Endangered (B1ab(ii,iii)+2ab(ii,iii), IUCN 2008; see also García *et al*. 2010, Rhazi *et al*. 2010). The Garâa Sejenane has recently been designated as the first *Important Plant Area* in Tunisia (Radford *et al.* 2011).

Specimen examined:—TUNISIA. Garâa Sejenane, "mission botanique de Tunisie, bords du lac Cejnan, Kroumirie orientale", 23 June 1888, *Cosson, Barratte & Duval s.n.* (P-05338611!); Garâa Sejenane, "mission botanique de Tunisie, bords du lac Cejnan, Kroumirie orientale", 23 June 1888, *Cosson, Barratte & Duval s.n.* (P-05338612!); Garâa Sejenane, Tunisia, 26 May 2009, *Ghrabi-Gammar, Daoud-Bouattour & Muller* (INAT!); Garâa Sejenane, 02

November 2009, *Ghrabi-Gammar, Daoud-Bouattour & Muller* (*Herb. SDM*); Garâa Sejenane, 05 May 2014, *Ghrabi-Gammar, Daoud-Bouattour & Muller* (INAT!).

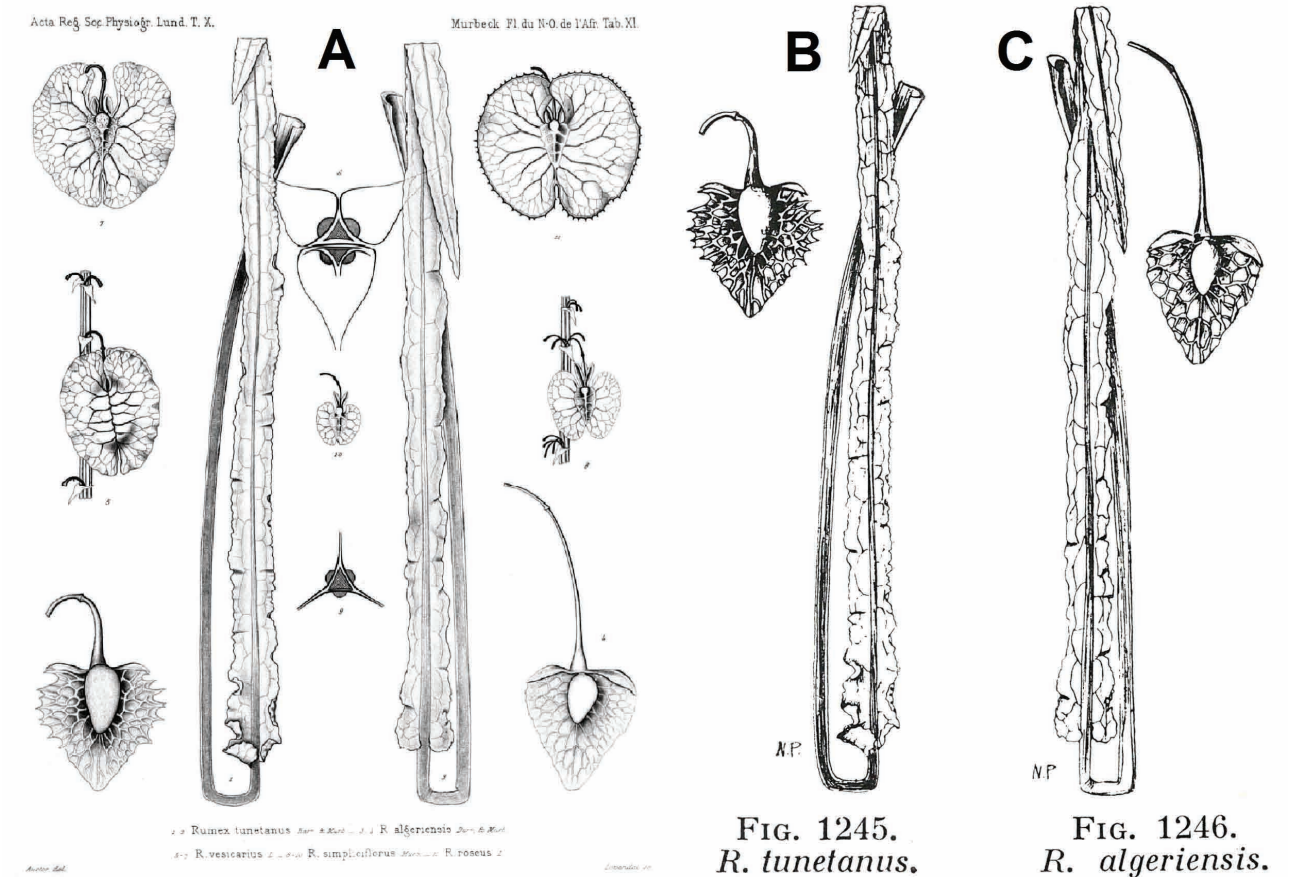

FIGURE 5. Pictures from Murbeck (1899) and Maire (1961) illustrating *Rumex tunetanus* and *R. algeriensis*. **A**, stem leaf and fruit-bearing valve of *R. tunetanus* (left), and *R. algeriensis* (right), according to Murbeck (1899); **B**, *R. tunetanus*, according to Maire (1961); **C**, *R. algeriensis*, according to Maire (1961).

Discussion

Rumex algeriensis var. *hipporegianus*[1] (Fig. 6), *R. crispus*, and *R. tunetanus* (Fig. 2) display a general resemblance in habit and flowering shoots, while differences can be observed in leaf size and fruit-bearing valves (Table 2). The basal leaves do not differ from the stem leaves for all these three species. *R. crispus* can be easily distinguished from the other two species by its smaller size, the oblong-lanceoate leaves with a distinctive larger limb. The leaf length, number of flowering stems, relative position of whorls and the shape of fruit-bearing valves allow to distinguish *R. algeriensis* var. *hipporegianus* from *R. tunetanus* (Table 2).

Given the very similar ecological niches of *Rumex crispus* and the group *R. algeriensis*/*R. tunetanus* and the fact that they can grow in the same habitats, we suspect that the separation between them is probably quite old and involves incompatibility mechanisms. In contrast, the separation between *R. algeriensis* and *R. tunetanus*, whose overall shape is more similar, may be attributed to the geographical barrier formed by the Kroumirie Mountains on the Tunisian-Algerian border. *R. algeriensis* used to be present in a disjointed area between the region of Algiers (where it is probably extinct today; De Bélair 2010) and the El Kala National Park (De Bélair 2005), whereas *R. tunetanus* is endemic to the single Tunisian site of Garâa Sejenane, where its entire population occupies few hectares. Despite

1 The endemic *Rumex algeriensis* (N-Algeria) was described by Maire (1961) who reported just a translation of the Murbeck's diagnosis (Fig. 5), stating that he never probably observed the plant in the field; the accompanying figure is a clearly unmodified reproduction of the Murbeck's illustration. Maire (l.c.) also recognized two varieties under *R. algeriensis*: var. "*genuinus*" Maire & Weiller (in Maire 1961: 289, *nom. inval.* according to the Art. 24.3 of ICN, McNeill & al. 2012) from wetlands of El Harrach (Maison-Carrée) and Oued Smar, and var. *hipporegianus*, endemic to the Annaba region, where it was recently observed in ditches and in a wet lawn close to the Annaba Airport and in the Lac des Oiseaux in the El Kala National Park (see De Bélair 2010).

this strict endemism and extremely limited distribution, *R. tunetanus* remains relatively abundant locally, more than a century after its discovery.

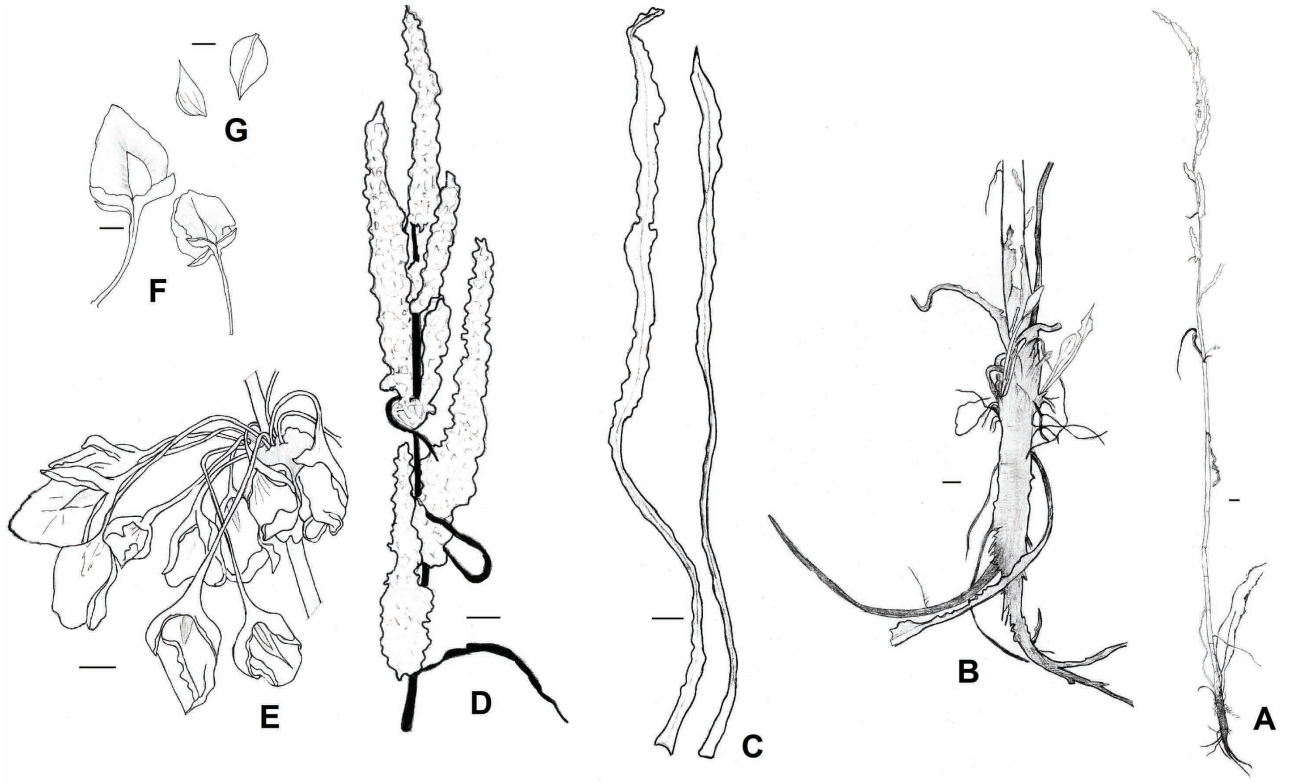

FIGURE 6. *Rumex algeriensis*: **A**, habitus; **B**, tuberous taproot; **C**, basal leaves; **D**, inflorescence; **E**, inflorescence whorl; **F**, fruit surrounded by three non-serrated valves; **G**, 3-angled achenes. Scales: **A–D**, 1 cm; **E–G**, 1 mm (drawings by Z. Ghrabi-Gammar).

TABLE 2. Morphological comparison among *Rumex tunetanus*, *R. algeriensis* and *R. crispus*.

	R. tunetanus	***R. algeriensis***	***R. crispus***
Plant height	80–120 cm	80–120 cm	30–100 cm
Basal leaves	linear, 0.8–1.4 × 40 cm	sublinear, 2.5 × 70 cm	oblong to lanceolate, 3.0 × 10–12 cm
Fruiting valves	heart-shaped, triangular toothed: 5–8 pairs of teeth, 4.5–6.0 × 5.0–6.5 mm	heart-shaped, triangular entire or briefly serrated at the base 6.0 × 4.0–5.0 mm	orbiculary entire or briefly serrated at the base 3.0 × 3.5–5.0 mm
Flowering branches (number)	4–5	> 10	7–9
Floral whorls	distant	contiguous	contiguous

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