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Two new North African genera related to *Limoniastrum* (Plumbaginaceae)

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Two new genera are described to include six taxa commonly considered members of *Limoniastrum* Heist. ex Fabr. ***Saharanthus*** M.B. Crespo & M.D. Lledó **nom. nov.** is proposed on the basis of the illegitimate *Lerrouxia* Caball., for a woody species from western Sahara, also known as *Caballeroa* Font Quer. ***Ceratolimon*** M.B. Crespo & M.D. Lledó **gen. nov.** is proposed for a group of five taxa (four species and one additional variety) of dwarf shrubs with horned spikelets, which show a disjunct distribution on the edges of the Sahara Desert. This latter name applies to most species formerly placed in the illegitimate *Bubania.* Types are indicated for all taxa, and identification keys are also presented.

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ADDITIONAL KEY WORDS:—biogeography – *Bubania* – *Caballeroa* – nomenclature – taxonomy – typification.

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INTRODUCTION

Limoniastrum Heist. ex Fabr. *s.l.* includes seven species mostly with sub-Saharan and circummediterranean distributions (Ozenda, 1983: 570). Most of them are medium-sized shrubs, commonly living in coastal salt marshes or saline and dry regions.

In a comprehensive study of the Plumbaginaceae (*s.l.*), Boissier (1848) revived *Limoniastrum*, which had been earlier validated by Fabricius (1759). He reported several diagnostic characteristics separating it from other related genera of the family, and included *L. monopetalum* (*Statice monopetala* L.) and *L. guyonianum* Durieu ex Boiss.

Girard (1848) described a new genus, *Bubania*, in which he placed a curious plant from sub-Saharan areas of Algeria. Chiovenda (1929) reported a rare species from Somalia also related to *Bubania*. Later, Caballero (1935) proposed a new genus *Lerrouxia* to include a plant he collected in Morocco, which was renamed *Caballeroa* by Font Quer (1935) since *Lerrouxia* was illegitimate. Maire & Wilczek (1935) described another plant from southern Morocco related to Girard's genus. All these plants are currently included in *Limoniastrum* by most authors dealing with the North African flora (Sauvage & Vindt, 1952; Quézel & Santa, 1963; Ozenda, 1983) and in recent comprehensive treatments of the family (Kubitzki, 1993). Plants described by Pomel (1874) and Lanza (1932), respectively as *L. ouarglense* and *L. majus*, correspond to taxa not distinct from *L. guyonianum* and *L. monopetalum*, respectively. Recently, Edmondson (1996) has proposed a new *Limoniastrum* species from Yemen and Somalia related to Chiovenda's *Bubania*.

Cladistic analyses based on DNA sequence data have revealed the diphyly of *Limoniastrum s.l.* (see companion paper, pp. 175–191). Taxa of *Limoniastrum* fall into two distinct clades, one of them subdivided into two well-supported subclades. These three clades correspond to three morphologically well defined groups, which have been accepted by several authors as sections, subgenera or distinct genera. According to the molecular evidence, as well as morphological features present in those groups, these three clades are best treated as independent genera (see companion paper, pp. 175–191).

In this contribution, relationships of *Limoniastrum* to other taxa of Plumbaginaceae are summarized and two new genera are presented: *Saharanthus* which replaces the invalidly published *Caballeroa*, and *Ceratolimon* for plants commonly referred to *Bubania*, a name here demonstrated to be illegitimate.

MATERIAL AND METHODS

Observations were undertaken on both living plants and dried specimens from ABH, BC, BM, FT, K, MA, MPU and P. For light microscope studies, fresh samples were fixed in absolute alcohol–acetic acid (3:1 v/v) and herbarium material was re-hydrated in distilled water with a drop of soap for 30 min. Observations were carried out on an Olympus BH2-RFCA microscope. Biogeographical distributions are from Takhtajan (1986). Authorities follow Brummitt & Powell (1992), and nomenclature is in accordance with the International Code of Botanical Nomenclature (ICBN) (Greuter *et al.*, 1994).

RESULTS AND DISCUSSION

The case of Lerrouxia ifniensis *Caball.*

Caballero (1935) described a plant he collected near Assaka, in the former Spanish Sahara (henceforth Sahara), for which he proposed the monotypic genus *Lerrouxia*. This plant mainly differs from other taxa of *Limoniastrum* in the following features: (i) the leaves lack chalk glands secreting calcium carbonate; (ii) the outer bract of the spikelets is as long as the inner and is widely hyaline-scariose on the margin; (iii) the filaments of the stamens are connate at the base of the corolla tube, and (iv) the anthers form a right angle with the filament.

Font Quer (1935) regarded *Lerrouxia ifniensis* as belonging to *Limoniastrum* and made the new combination *L. ifniense* (Caball.) Font Quer. In addition, he noted that *Lerrouxia* Caball. was a later homonym of *Lerouxia* Mérat, a genus previously published (Mérat, 1812) to segregate *Lysimachia nemorum* L. (Primulaceae). Therefore, he proposed the new name *Caballeroa* to replace Caballero's genus, explicitly remarking that he accepted it within *Limoniastrum*. This opinion was supported by Maire (1936) who also regarded his *L. melançonianum*, a plant he described a little earlier (Maire & Wilczek, 1935), as synonymous with *L. ifniense*.

Several authors (Linczevski, 1968, *inter alia*) have accepted *Caballeroa* Font Quer as a validly published genus related to *Limoniastrum*. However, this genus is not validly published (Art. 34.1, I.C.B.N.), since Font Quer did not accept it in that rank in the original publication. Later authors did not validate that name (Art. 32.4). Moreover, as the name *Caballeria* Ruiz & Pavón was published earlier for a genus of Myrsinaceae (Ruiz & Pavón, 1794), a new genus name is necessary for the invalid *Caballeroa*.

The case of Bubania *Girard*

In a familial synopsis of Plumbaginaceae, Boissier (1848) included two species in *Limoniastrum*—*L. monopetalum* and *L. guyonianum*—both showing the following generic features: (i) the inner bract of the spikelet convolute, coriaceous, completely concealing the calyx; (ii) styles connate up to the middle; (iii) stamens adnate to the upper half of the corolla tube, and (iv) leaves alternate, with a closed sheath. In a 'genus addendum', he also mentioned *Bubania* Girard, a peculiar genus still unpublished, that he knew from a manuscript sent by Durieu, which included the illustration of a plant collected by Fée. That illustration was later published by Bory & Durieu (1846–1869) together with results of their scientific expedition to Algeria.

Girard (1848) published *Bubania* including surprisingly both *B. monopetala* (*Statice monopetala* L.) and Fée's Algerian plant which he called *B. feei*. Among the synonyms of the former, Girard included *Limoniastrum articulatum* Moench. This name was first published by Moenchius (1794) as the only species in the genus *Limoniastrum* that he proposed to segregate from *Statice*, and which was later treated by Boissier (1848) as synonymous with his *L. monopetalum* (L.) Boiss. Therefore, *Bubania* must be regarded as illegitimate, since it implicitly included *Limoniastrum*, which has priority. Bentham & Hooker (1876) noted it as follows: "Genus a Girardio l.c. optime illustratum, sed auctor infeliciter nomen genericum novum Moenchiano ab ipso citato anteposuit".

Several authors (e.g. Linczevski, 1968; Brummitt, 1992) have maintained the

generic segregation of *Bubania* from *Limoniastrum*, including in the former *B. feei* and other related sub-Saharan plants with horned floral bracts, as Boissier (1848) implicitly suggested. Indeed, there seem to be sufficient morphological differences among the species in *Limoniastrum* (*s.l.*) to recognize two groups: (i) shrubs with alternate leaves, and 3-bracteate spikelets with an unhorned inner bract, which correspond to the typical *Limoniastrum*; (ii) dwarf shrubs with rosulate leaves, and 2-bracteate spikelets with a horned inner bract, which correspond to *Bubania* (*sensu* auct., non Girard). These groups have been treated as sections (Battandier, 1890; Maire & Wilczek, 1935), subgenera (Maire, 1936) or even genera (as indicated above).

Despite suggestions by Greuter & Nicolson (1993) pointing to prior conservation of any name for stability of nomenclature, *Bubania* was illegitimate even in its original description. Girard (l.c.) wrote: "L'étude des caractères du *St. Monopeta* [sic] L., nous avait depuis longtemps porté à séparer génériquement cette espèce des autres statice, et nous l'avions fait avec le regret de l'établir sur elle seule. Une très-curieuse plante, envoyée par M. le capitaine Durieu de Maisonneuve, chef de l'expédition scientifique en Algérie, est venue se ranger à côté de l'espèce unique connue, et, malgré quelques differences, il y a concordance des caractères principaux et vraiment essentiels", and after summarizing the diagnostic characteristics of both taxa (leaf sheath closed, petals long connate, stamens adnate to corolla tube, and styles long connate) he added: "On comprend aisément que les caractères signalés plus haut comme communs aux deux plantes designées [*B. monopetala* and *B. feei*], forment les fondements les plus solides du genre *Bubania*". It appears to be obvious that Girard had in mind the segregation of a new genus which completely fits the currently widely accepted circumscription of *Limoniastrum*.

TAXONOMIC PROPOSALS

As stated before, three morphologically well defined groups can be identified within *Limoniastrum s.l.*, as considered by many authors. There exists molecular evidence for each of them (Lledó *et al.*, in press). Thus, the new names *Saharanthus* and *Ceratolimon* are proposed here for the plants commonly referred to *Caballeroa* and *Bubania* (p.p.), respectively. Affinities and differences among the new genera are summarized in Table 1.

TABLE 1. Morphological characters differentiating genera related to *Limoniastrum*

	Limoniastrum	***Saharanthus***	***Ceratolimon***
Disposition of leaves on stems	Alternate	Alternate	Rosulate
Chalk glands on leaves	Present	Absent	Present
Inner bract of spikelets	Unhorned	Unhorned	Horned
Outer bract of spikelets	Much shorter than inner	Equalling the inner	Much shorter than inner
Middle bract of spikelets	Present	Present	Absent
Anther/filament insertion	180°	90°	180°
Filament adnation	Throat of corolla tube	Petal base	Throat of corolla tube

The genus ***Saharanthus***

Saharanthus M.B. Crespo & M.D. Lledó **nom. nov.**

Lerrouxia Caball., Trab. Mus. Nac. Ci. Nat. Madrid, ser. Bot., 28: 13 (1935), [basion.], non Mérat, Nouv. Fl. Env. Paris: 77 (1812).

Caballeroa Font Quer, Cavanillesia 7: 150 (1935), nom. inval., non *Caballeria* Ruiz & Pav., Fl. Peruv. Chil. Prodr., 141: t. 30 (1794).

Type of the genus. ***S. ifniensis*** (Caball.) M.B. Crespo & M.D. Lledó **comb. nov.**

Lerrouxia ifniensis Caball., Trab. Mus. Nac. Ci. Nat. Madrid, ser. Bot., 28: 15 (1935) [basion.].

Limoniastrum ifniense (Caball.) Font Quer, Cavanillesia 7: 150 (1935).

Caballeroa ifniensis (Caball.) Font Quer, loc. cit. 1935, comb. inval.

Limoniastrum malençonianum Maire, Bull. Soc. Hist. Nat. Afr. Nord 26: 129 (1935).

Lectotype (here designated). MA 92322! The sheet includes several fragments from which the specimen corresponding to the icon in Caballero (*loc. cit.*, lám. 1) is here selected as the lectotype. It is located on the upper-central part of the sheet and has now lost most of its spikelets.

Ind. loc. "In marginibus fluminis (vulgo) Assaka ubi legi fl. 13-VII-1934... Planta que vive abundante en las orillas e isletas del río Assaka, del territorio de Ifni, sobre todo entre el poblado llamado de Assaka y la desembocadura..."

Illustration. Caballero (loc. cit.).

Distribution and biogeography. Endemic to the sublittoral areas of southern Morocco and northern Sahara (northwestern Africa), in the Saharan Province of the Saharo–Arabian Region. The distribution of *Saharanthus ifniensis* in Ozenda (1983: 571) corresponds actually to the area numbered 2.

The genus ***Ceratolimon***

Ceratolimon M.B. Crespo & M.D. Lledó **gen. nov.**

Bubania Girard, Mém. Acad. Sci. Montpellier 1848: 182 (1848), nom. illeg., p.p., excl. *B. monopetala* (L.) Girard [*Limoniastrum monopetalum* (L.) Boiss.]

Limoniastrum sect. *Bubania* Batt., Fl. Algér. (Dicot.): 726 (1890).

Limoniastrum subgen. *Bubania* (Batt.) Maire, Bull. Soc. Hist. Nat. Afr. Nord 27: 247 (1936).

Type of the genus. C. feei (Girard) M.B. Crespo & M.D. Lledó.

Description. Suffrutices humiles, dense albo-lepidoti, caespites magnos plerumque hemisphaericos efformantes. Caudiculae breves, ramosae, lignosae, nonnunquam subrepentes, basi nudae parte superiore foliis novissimis vel foliorum vetustiorum vestigiis persistentibus vestitae. Folia coriaceo-crassiuscula, rosulata, plerumque longe petiolata, in vaginam scariosam amplexicaulem basi desinentia. Inflorescentia scaposa, valde ramosa et fragillima, glabra vel hirto-pilosa pilis argenteis et glandulosis obtecta, squamis lobatis vel aristato-spinulosis amplexicaulibus basi ramorum munita. Spiculae subcylindricae apice acutae, plerumque uniflorae raro biflorae. Bracteae spicularum dorso patule argenteo-villosae vel glabrae; bractea inferior integra, lobata

vel multifida, scariosa; media nulla; superior quam altera longior, herbacea, valde indurata, convoluta calycem arcte tegens, spinis numerosis longis recurvisque armata. Calyx scariosus, 5–10-dentatus vel erosus. Corolla tubulosa, gamopetala, e medio 5-lobata. Stamina 5, filamentis plerumque pilosis basi squamis ciliatis gerentibus, fauci tubi corollae insertis. Styli 5, usque ad medium coaliti, stigmatibus filiformibus papillosis parum incrassatis. Ovarium uniloculare, cylindraceo-fusiforme, glabrum, obsolete 5-costatum. Utriculus calyce inclusus, monospermus, membranaceus, indehiscens.

Derivation. Nomen genericum datum propter bracteam internam spinosam abalteris generibus cognatis carentem.

Dwarf shrubs, densely covered with whitish scales, in general widely hemispherical-caespitose. Stems short, branched, woody, sometimes prostrate, with rosettes of fresh leaves or withered remains in the upper part and leafless at the base. Leaves coriaceous, thickened, rosulate, commonly long petiolate, with a scariose amplexicaul sheath at the base. Inflorescence scapose, widely branching, fragile, glabrous or with both patent silvery and glandulose hairs, with lobate or aristate-spinose amplexicaul scales at the base of branches. Spikelets subcylindrical, acute at the apex, mostly 1-flowered, rarely 2-flowered. Bracts silvery-hairy at the back or glabrous; outer bract entire, lobate or multifid, scarious; middle bract absent; inner bract longer, soft, indurate, convolute and completely concealing the calyx, armed with many curved long spines. Calyx scarious, 5–10-dentate or erose. Corolla tubular, gamopetalous, 5-lobate from the middle. Stamens 5, filaments commonly pilose with ciliate scales at the base, inserted almost at the top of the corolla tube. Styles 5, connate up to the middle, stigmas filiform, papillose, slightly thickened. Ovary unilocular, glabrous, cylindric-fusiform, weakly 5-nervate. Utricule included in the calyx, monospermous, membranous, indehiscent.

The name *Ceratolimon* refers to the horned inner bract, which is absent in all other related genera. It includes plants resembling *Limonium* and *Goniolimon*, but with floral characteristics close to *Limoniastrum*, from which it differs in its habit, rosulate leaves and spikelet structure.

Ceratolimon includes five taxa (four species and one variety) with disjunct distributions on the Atlantic and Indian edges of the Sahara Desert. Similar disjunct patterns are also present in several genera such as *Ceratonia*, *Cupressus*, *Globularia*, *Lupinus*, *Pistacia* and *Punica* and are perhaps the remains of ancient distributions of the Tertiary ancestors of the whole group along the southern coast of the Tethys (Edmondson, 1996).

Ceratolimon feei (Girard) M.B. Crespo & M.D. Lledó **comb. nov.**

Bubania feei Girard, Mém. Acad. Sci. Montpellier 1848: 185 (1848) [basion.]

Limoniastrum feei (Girard) Hook. f. ex Pax in Engl. & Prantl, Nat. Pflanzenfam. 4(1): 125 (1889).

var. ***feei.***

Lectotype (here designated). Icon in Bory & Durieu (1848, pl. 68). No herbarium sheets including relevant materials have been found.

Ind. loc. "Hab. à Do. Fée in Africâ Algeriensi lecta fuit circà lacus dictos Schott post pluvias inundatos, mox exsiccatos stratoque salino obtectos."

Illustration. Girard (loc. cit.); Bory & Durieu (1848, pl. 68).

Distribution and biogeography. Inland areas of southern Algeria, Morocco and Sahara, in the Saharan Province of the Saharo-Arabian Region. The distribution of *Ceratolimon feei* in Ozenda (1983: 571) corresponds actually to the area numbered 3.

var. ***grandiflorum*** (Maire & Wilczek) M.B. Crespo & M.D. Lledó **comb. nov.**
Limoniastrum feei var. *grandiflorum* Maire & Wilczek, Bull. Soc. Hist. Nat. Afr. Nord 26: 129 (1935) [basion.].

Lectotype (here designated). MPU! (Herbarium Maire): "In lapidosis arenaceis Anti-Atlantis austro-occidentalis, aprili florens: prope Bou-Isakaren, 400–500 m. Corolla purpurea, die 14 aprilis".

Ind. loc. "In lapidosis arenaceis Anti-Atlantis austro-occidentalis, aprili florens: prope Bou-Isakaren, Taghjicht, Tizi Anbed, etc.".

Observations. Var. *grandiflorum* differs from the typical in the petal length (up to 19 mm, instead of 15 mm) and by the spikelet size (up to 13 mm, instead of 9 m).

Distribution and biogeography. It grows together with var. *feei*, but is more common in the southwestern littoral mountains of Morocco in the Saharan Province of the Saharo-Arabian Region.

Ceratolimon migiurtinum (Chiov.) M.B. Crespo & M.D. Lledó **comb. nov.**
Bubania migiurtina Chiov., Fl. Somala: 212 (1929) [basion.].
Limoniastrum migiurtinum (Chiov.) Maire, Bull. Soc. Hist. Nat. Afr. Nord 27: 248 (1936).

Lectotype (here designated). FT! "Erbario Coloniale di Firenze. Plantae Somalenses a N. Puccioni et J. Stefanini anno 1924 lectae. Bacino del Nogal: Presso la foce del fiume Nogal. 19.VI.1924", corresponding to the icon in Chiovenda (loc. cit., tav. XXIV, fig. 2).

Ind. loc. "SOMALIA SETT.: Costa dei Migiurtini, spiaggia e duna di Hafùn 30. I (n. 10); presso la foce del fiume Nogal 19.VI (n. 840)."

Illustration. Chiovenda (loc. cit., tav. XXIV, fig. 2).

Distribution and biogeography. Endemic to the Indian coastal areas of Nugaal Region in northeastern Somalia (northeastern Africa), in the Somalo-Ethiopian Province (Eritreo-Arabian Subregion) of the Sudano-Zambezian Region.

Ceratolimon rechingeri (J.R. Edm.) M.B. Crespo & M.D. Lledó **comb. nov.**
Limoniastrum rechingeri J.R. Edm., Ann. Naturhist. Mus. Wien 98 B Suppl.: 400 (1996) [basion.].

Holotype. "Republic of Yemen, Hadhramaut region, Ghail, E. of Mukalla, 30.IX.1949, 'up to 2 ft'. K.M. Guichard no. KG/HAD/308 (BM).".

Distribution and biogeography. Endemic to South Yemen (Hadhramaut region) and northern Somalia (Sanaag and Bari regions), in the Eritreo-Arabian Subregion (Somalo-Ethiopian and South Arabian Provinces) of the Sudano-Zambezian Region.

Ceratolimon weygandiorum (Maire & Wilczek) M.B. Crespo & M.D. Lledó **comb. nov.**

Limoniastrum weygandiorum Maire & Wilczek, Bull. Soc. Hist. Nat. Afr. Nord 26: 129 (1935) [basion].

Lectotype (here designated). MPU! "R. Maire—Iter maroccanum XXV. Socio Dre E. Wilczek 1935. In pascuis et rupestribus prope castellum Aourioura, 40–60 m, corolla purpurea, die 12 aprilis". The specimen on the upper left corner (cf. icon in Maire, 1937, planche XXXV). Isolectotype in P!

Ind. loc. "Hab. in pascuis arenosis ad litus Oceani, prope castellum Aourioura, aprili florens.".

Illustration. Maire (loc. cit. 1937).

Distribution and biogeography. Endemic to a small coastal subdesert area between Aoreora and Draa rivers (La'youne province, on the border between Morocco and Sahara), in the Saharan Province of the Saharo-Arabian Region. This plant was considered an oceanic Saharan endemic (Edmondson *et al.*, 1988).

KEY FOR GENERA RELATED TO *LIMONIASTRUM*

1. Inner bract with long curved horns. Middle bract absent. Leaves in dense rosettes ..... ***Ceratolimon***
1. Inner bract unhorned. Middle bract present. Leaves alternate on stems
   2. Outer bract equal to the inner, with a wide hyaline margin. Stamens adnate at the base of corolla tube. Anthers forming a right angle with the filament. Leaves without deposits of calcium carbonate ..... ***Saharanthus***
   2. Outer bract much shorter than the inner, herbaceous. Stamens adnate to the apex of the corolla tube. Anthers not forming a right angle with the filament. Leaves with deposits of calcium carbonate ..... ***Limoniastrum***

KEY FOR THE SPECIES OF *CERATOLIMON*

1. Plants up to 25 cm high. Basal leaves sinuate-margined on its lower half. Inflorescence equalling or slightly exceeding leaves ..... ***C. weygandiorum***
1. Plants commonly taller. Basal leaves entire. Inflorescence much exceeding leaves.
   2. Basal leaves narrowly lanceolate, acute at the apex. Inflorescence sub-dichotomous, short, 2–3 times longer than leaves ..... ***C. feei***
   2. Basal leaves elliptic to obovate, rounded at the apex. Inflorescence not dichotomous, more than 4 times longer than leaves
      3. Horns on the spikelets glabrous. Petals pink, *c.* 20 mm long ..... ***C. migiurtinum***
      3. Horns on the spikelets patent-hairy. Petals white, *c.* 14 mm long ..... ***C. rechingeri***

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