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Can material of a putatively extinct new species of *Ruta* (*Rutaceae*), preserved with mummies, provide new knowledge about evolution in the Canary Islands flora?

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Abstract: Based on analyses carried out with plant material found in mummy shrouds preserved in the archaeological museum El Museo Canario, a putatively extinct new species of *Ruta* (*Rutaceae*) was identified and is described here as *R. museocanariensis*. The mummies were found in the funerary sites of Acusa and the Barranco de Guayadeque on Gran Canaria, Canary Islands, Spain. This article discusses taxonomic relationships with other species of the genus, aspects of colonization and evolutionary processes on islands. The archaeological plant material consists of vegetative and reproductive branches with leaves, remains of flowers and capsules. Several morphological traits, especially the type of fruits, establish a clear difference between *Ruta* species from Gran Canaria and the mainland (dehiscent) and species from the W Canary Islands (indehiscent). The discovery of *R. museocanariensis*, with dehiscent fruits, suggests that indehiscence is a post-colonization evolutionary process in the Canary Islands. It also supports a stepping-stone model of inter-island colonization with Gran Canaria as its starting point, in agreement with the age of the islands and to some extent with their distance from the mainland.

Keywords: archaeobotany, Canary Islands, El Museo Canario, evolutionary process, extinct new species, mummy shrouds, *Ruta*, *Rutaceae*

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Introduction

Archaeological research in the Canary Islands has intensified in recent decades, particularly focusing on funerary contexts (Alberto & Velasco 2010; Alberto-Barroso & al. 2016; Alberto-Barroso 2020). Since 2015 this has led to the development of a research programme by El Museo Canario (Las Palmas de Gran Canaria) centred on a comprehensive study of its collection of mummies from the pre-Hispanic period of Gran Canaria (Delgado-Darias & al. 2018; Alberto-Barroso & al. 2019a).

The studies carried out so far have delved into fields as diverse as funerary practices (Delgado-Darias & al. 2017), radiocarbon dating (Velasco-Vázquez & al. 2020), the diachronic aspects of funerary practices (Alberto-Barroso & al. 2019b) and artefacts (trousseaus, amulets, relics) (Alberto-Barroso & al. 2022a; Velasco-Vázquez & al. 2021), funerary wood use (Vidal-Matutano & al. 2021a),

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palaeoentomology (Lopez-Dos Santos & al. 2022) and bioanthropology (Alberto-Barroso & al. 2022b; Delgado-Darias 2022), in parallel with activities combining investigation and the transfer of knowledge to a public audience (Delgado-Darias & al. 2018).

Wrapping a corpse in a shroud was common practice across the entire population of the whole island of Gran Canaria (Alberto & Velasco 2010; Alberto-Barroso & al. 2016; Delgado-Darias & al. 2017, 2018). The practice can be traced to the first settling of the island in the 3rd to 4th centuries CE by NW African populations of Berber origin commonly known as Guanches (Alberto-Barroso & al. 2019a). Burials or corpse depositions took place in different types of funerary features or cemeteries, such as caves, tumuli and cists/pits. However, only burial caves have been documented as a constant throughout the entire indigenous cultural sequence (Alberto-Barroso & al. 2019a, 2021). The caves provided ideal conditions for the preservation of both corpses and their wrappings, and the processes of mummification or the safeguarding of soft body parts have been ascertained exclusively in these sepulchral contexts (Delgado-Darias & al. 2017; Alberto-Barroso & al. 2019a). Certain desiccated plant remains have occasionally been recovered and exceptionally recorded in mounds (Jorge-Blanco 1989; Alberto-Barroso & al. 2016), where the incidence of natural agents usually led to the virtual disappearance of shrouds and other soft tissues (Alberto & Velasco 2010).

One line of study of the research programme focusing on the collection of mummies housed in El Museo Canario was centred specifically on analysing the xylological remains of the wrappings of the mummies consisting in whole or in part of plant materials (Vidal-Matutano & al. unpubl. data). At the same time, given the favourable state of preservation of many plant remains, their study and identification was carried out using classical taxonomic methods by observing their morphological characteristics.

Little research has been carried out to date on the plant species serving to treat and prepare or to shroud corpses in the Canary Islands. The data currently available focus on abdominal contents (Mathiesen 1960; Sánchez-Pinto & Ortega 1995; Afonso-Vargas 2016), which has led to the identification of the presence of *Pinus canariensis* C. Sm. ex DC. and other undetermined herb macro-remains as well as microfossils of grasses, legumes, pine and *Pteridium aquilinum* (L.) Kuhn. Other research has been oriented toward the ancient fibre industry (Galván-Santos 1980; Rodríguez-Santana 2002). The work of Jorge-Blanco (1989) on plant remains recorded at an archaeological tumulus in Arteara necropolis, in Gran Canaria, offers a new approach that complements the archival data recorded by the first chronicles of the conquest of the Canary Islands, which reported the application of natural substances to the corpse in order to favour the mummification process (Núñez de la Peña 1994 [1676]; Morales-Padrón 1978). Other recent research, on the other hand, has provided new data on the use of wood, herbs or fruits, along with crops, in other archaeological sites such as settlements, domestic contexts, cave granaries, and so on (Morales-Mateos 2003, 2010; Morales-Mateos & al. 2017; Vidal-Matutano & al. 2021b). However, there is a dearth of research on the relationship between the mummification processes and the plants used to prepare the shrouds and wrappings.

The study of plant remains in the Arteara mounds (Jorge-Blanco 1989) identified the following: *Cistus monspeliensis* L. (leaves and tomentum of leaves); *Juncus acutus* L. (stems); *Juniperus canariensis* Guyot & Mathou (*J. turbinata* subsp. *canariensis* (Guyot & Mathou) Rivas Mart. & al. (wood); *Pinus canariensis* (wood, needles, female cone scales, male cones); *Ruta oreojasme* Webb (leaves and cuticle of leaves); *Scirpoides holoschoenus* (L.) Soják (stems); *Teucrium heterophyllum* L'Hér. (leaves and tomentum of leaves); and undetermined grasses (culms). The *Ruta* pinnae were unambiguously identified as belonging to *R. oreojasme*, a species that grows in rocky areas near this archaeological site. The remaining species, although of wider distribution, are also present in the vicinity of Arteara. However, the study by Jorge-Blanco (1989), although exhaustive, was limited to identifying and enumerating the plant species and their relationship with their surroundings, without investigating their use in burials.

With the exception of reeds and grasses used to make twine and mats, there is a remarkable dominance of aromatic species that, as Morales-Mateos (2003) pointed out, could have acted as repellents and preservatives due to their resins and oils. It is pertinent that the detailed description made toward the middle of the 20th century by the archaeologist Luis Diego Cuscoy, of a shroud found in a sepulchral cave of the Barranco de Jagua, in Tenerife (Cuscoy 1957), where the deceased had been deposited on a funerary board made of *Pinus canariensis* heartwood (locally known as "tea"), was covered with a bed of herbs, among them aromatic species such as *Micromeria hyssopifolia* Webb & Berthel., in addition to "cerrillo" (wild grasses such as species of *Avena* L., *Bromus* L., *Hyparrhenia* Andersson ex E. Fourn., etc.) and dried stems of "cardón" (*Euphorbia canariensis* L.). Similarly, the study of the funerary bundles in the Sánchez Araña collection (Santa Lucía, Gran Canaria) revealed the presence of bunches of pine needles, among other plants, that have been associated with prophylactic practices (Alberto-Barroso & al. 2020). These bunches may also have a structural function by increasing the consistency and density of the funerary bundle. The study also revealed for the first time the introduction of rods, in this case leaf rachises of the palm *Phoenix canariensis* H. Wildpret, at both sides of the wrappings to give greater stability (Alberto-Barroso & al. 2020), a practice subsequently recognized in other shrouds.

The identification at the genus or species level of archaeological plant remains, their distribution and their characteristics or properties may shed light on different aspects that, until now, remain poorly known or not addressed in funerary archaeological studies of indigenous Canarians, and more specifically of those who inhabited Gran Canaria. We refer to aspects such as the degree of knowledge that indigenous communities had of their biological environment in relation to funerary practices, the existence (or lack thereof) of exchange networks and barter of certain herbs for such uses, their cultural practices and knowledge about wild plants, or the possible use, not casual but as a directed practice, of certain herbs or plants in funerary rituals, etc. In addition to providing data on all these processes, which are to be addressed in depth elsewhere, such approaches provide valuable input for other disciplines, helping to answer for instance biological questions (chorological or taxonomic).

In this paper, we approach the taxonomic study of plant remains recently found in the shrouds of mummies stored at El Museo Canario. The morphological observations allowed us to identify at least a dozen different taxa, including needles of *Pinus canariensis*, several species of *Apiaceae* (*Ferula* L., *Todaroa* Parl.), *Fabaceae* (*Chamaecytisus* Link) and *Lamiaceae* (*Lavandula* L., *Micromeria* Benth., *Salvia* L., etc.), stems of *Juncus* L., *Scirpoides* Ség. and *Typha* L., as well as unidentified grasses (materials that will be treated and analysed in a separate work). Most notably, an unknown species within the genus *Ruta* L. (*Rutaceae*) was identified.

After an exhaustive morphological analysis of an adequate sample of the new plant material and its comparison with herbarium material of all related taxa in the genus *Ruta* (Appendix 1), we conclude that it is a distinct new species that cannot be assigned to any of the extant species of the genus. We describe it here as *R. museocanariensis*. It is currently known only from the shrouds kept in El Museo Canario and is likely extinct in the wild. The characteristics of the new species provide new explanations as to the evolution, colonization and diversification of *Ruta* within the archipelago, different from those proposed in recent papers (Salvo & al. 2010; Soto & al. 2022). This unique find may also add to our understanding of how indigenous Canarian cultures used the plants for ritual and/or exchange purposes.

Material and methods

Plant material and sampling

All the material in this study is from mummies and bundles of branches deposited in El Museo Canario. The description and figures of the new species is based on a thorough study of the morphological characteristics of the plants extracted from the shrouds of two mummies (EMC no. 49991 and EMC no. 10) and a branch bundle (EMC no. 46558). The materials consist of vegetative and reproductive branches with leaves, remains of flowers and capsules.

The mummy EMC no. 49991 from Acusa (Artenara, Gran Canaria) is that of an infant, around one year old, dated to 1290 BP ± 30 (7th–8th centuries CE, 660–776 cal CE, 95.4% probability) (Velasco-Vázquez & al. 2020). The wrapping is entirely made of plant branches tied directly to the corpse and it contains bunches of *Ruta*, along with remains of *Lavandula*, *Todaroa* and needles of *Pinus canariensis*. These branches are partially covered with tufts of perennial grasses and tied with bulrush or aneas stems (probably *Scirpioides* or *Typha* spp.) (Fig. 1A).

The mummy EMC no. 10 from the Barranco de Guayadeque (Ingenio/Agüimes, Gran Canaria) is that of an adult, dated to 1430 BP ± 30 (6th–7th centuries CE, 584–658 cal CE, 95.4% probability) (Velasco-Vázquez & al. (2020). Its wrapping contained bunches of *Ruta* and *Chamaecytisus prolifer* (L. f.) Link, most likely placed adjacent to the corpse, as well as the remains of *Ferula linkii* Webb (*F. communis* subsp. *linkii* (Webb) Reduron & Dobignard) and *Micromeria* spp., and small pieces of mats and lattices of *Juncus*, *Scirpioides* or *Typha* spp. The whole was wrapped in several layers of sewn leather (Fig. 1B).

The branch bundle EMC no. 46558 is of unknown origin and is composed of clumps of ripped bushes of *Micromeria* spp. and a few *Ruta* branches. This bundle must have been woven as a mat with leaves of *Typha* sp. and stems of *Juncus* or *Scirpioides* species, of which some traces remain (Fig. 1C). The mummies came from burial caves; the branch bundle must have the same origin because, as Delgado-Darias & al. (2017) pointed out, these spaces are the only ones that have the appropriate conditions for the preservation and mummification of the corpse, as well as for the preservation of their wrappings. However, the exact location of recovery is unknown because it was carried out in the late 19th and early 20th centuries, when current methods of archaeological recording and conservation had not yet been fully developed.

Preparation of samples and morphological analysis

Branches with leaves and remains of infructescences were extracted from the shroud of the infant mummy EMC no. 49991 and the adult mummy EMC no. 10. The branches and leaves were subjected to a process of hydration by immersion and gentle heating in a Samsung MG23F301TAK microwave oven, then spread on cardboard, pressed, dried and assembled as herbarium sheets suitable for metric study and iconographic reconstruction.

All measurements were taken with a millimetre ruler, an electronic digital calibre Centigraff CF-7114, or millimetre paper under an Olympus-Tokyo-259571 binocular magnifier, with which the micromorphological observations were made. For the taxonomy and nomenclature, we followed Acebes Ginovés & al. (2010) or the up-

Fig. 1. A: infant mummy EMC no. 49991, from which holotype and isotype specimens of *Ruta museocanariensis* were extracted; B: adult mummy EMC no. 10, from the shroud (wrapped in layers of leather) of which the two paratype specimens were extracted; C: branch bundle EMC no. 46558. – Photographs by T. Delgado, El Museo Canario.

dated information available at Biota (2021+) and GBIF (2022+). *The International Code of Nomenclature for algae, fungi, and plants* (*Shenzhen Code*; Turland & al. 2018) was repeatedly consulted. The comparative taxonomic study was carried out by analysing material from different species of *Ruta* deposited in the LPA herbarium. Taxonomic terminology mainly follows Stearn (1990) and Flora treatments of the *Rutaceae* (Bennig 2007; Muñoz-Garmendia & al. 2015).

Potential habitat and chorological and bioclimatic characterization

We propose a potential environmental and chorological characterization of the species based on the surroundings of the mummies' origin sites, as well as on extant island toponyms that refer to "ruda" (the most common name in Spanish for *Ruta* species) and the habitats of other plant species present in the funerary shrouds. The geological description of the potential distribution area follows the Geological Map of Spain, of the Spanish Geo-Mining Technological Institute (Balcells & Barrera 1990; Balcells & al. 1990a, 1990b). The bioclimatic characterization mainly follows the proposals of Rivas-Martínez & al. (1993, 2002) and del Arco & al. (2002).

Results and Discussion

Taxonomic and systematic aspects of the genus *Ruta*

Candolle (1824) recognized four sections in *Ruta*: (1) *R.* sect. *Pinnatae* DC., with 1-pinnate leaves and indehiscent and subfleshy fruits, including the only species then known from the Canary Islands, *R. pinnata* L. f.; (2) *R.* sect. *Decompositae* DC., with 2- or multi-pinnate leaves, fruits dehiscent capsules, and a continental distribution, including *R. angustifolia* Pers., *R. chalepensis* L., *R. corsica* DC., *R. graveolens* L. and *R. montana* (L.) L., as well as *R. crithmifolia* Moric. ex DC. and *R. divaricata*

Ten. (now treated as conspecific with *R. graveolens*) and *R. macrophylla* Moris (now treated as conspecific with *R. chalepensis*); (3) *R.* sect. *Trifoliae* DC. with 3-foliolate leaves; and (4) *R.* sect. *Integrifoliae* DC., with simple leaves. The species in the last two sections are now segregated as the genus *Haplophyllum* A. Juss.

When Webb & Berthelot (1836–1850) prepared their *Phytographia canariensis*, they recognized two species in the Canary Islands: one as *Ruta bracteosa* DC. (now treated as conspecific with *R. chalepensis*), a species shared with the continent, and the other in a new genus, *Desmophyllum* Webb & Berthel., as *D. pinnatum* (L. f.) Webb & Berthel. (now *R. pinnata*), because of its indehiscent carpels united in a rounded and somewhat fleshy fruit, as well as other characters such as plant size and leaf shape.

Engler (1896) recognized two subgenera in *Ruta*: the not validly published *R.* subg. "*Euruta*" (correctly *R.* subg. *Ruta*) and *R.* subg. *Haplophyllum* (A. Juss.) Engl. For the first, he classified the different species according to petal shape and ornamentation and the complexity of the more or less pinnate leaves. However, in *R.* subg. *Haplophyllum*, which is currently accepted as a separate genus (Salvo & al. 2008; Muñoz-Garmendia & al. 2015; Morales 2015), he established two sections based on fruit type: *R.* sect. *Dehiscentes* Engl. and *R.* sect. *Indehiscentes* Engl.

Therefore, in the taxonomic treatment of *Ruta* (and *Haplophyllum*), some features are given more or less importance than others, depending on the author and the plant group or subgroup studied. Nevertheless, three traits are largely accepted: (1) leaf shape, from simple to complexly pinnate; (2) petal adornment, from entire to crenate, undulate or fimbriate; and (3) fruit type, from a more or less dry and dehiscent fruit with almost free or deeply incised carpels to a fleshy one with fused and indehiscent carpels.

Webb and Berthelot's *Phytographia canariensis* appeared between 1836 and 1850. Around this time, the French botanist Jean-Marie Despréaux sent to Webb material of a new *Ruta* from Gran Canaria. Webb observed that its fruits were dehiscent capsules, such as those of a "true" *Ruta*, and described it as *R. oreojasme*, noting the differences from his *Desmophyllum pinnatum* (Webb 1840), i.e. *R. pinnata*. Two more species have since been described in the Canarian flora: *R. microcarpa* Svent. (Sventenius in Agulló-Martínez & al. 1967) and *R. nanocarpa* R. Mesa & al. (Mesa-Coello & al. 2023) from La Gomera, both characterized by indehiscent subfleshy fruits (in neither case was Webb's genus *Desmophyllum* mentioned). Therefore, the genus *Ruta* currently includes 11 species: four circum-Mediterranean ones, two endemics to Corsica and Sardinia, respectively, and five endemics to the Canary Islands, to which must be added the new species described in this paper.

Ruta and *Haplophyllum*, despite having had a long history of confusion, are now accepted as separate genera (Bennig 2007; Muñoz-Garmendia & al. 2015). *Ruta* is characterized by 1–3-pinnatisect leaves, normally 4-merous petals and fruits and glabrous stamen filaments, whereas *Haplophyllum* has simple leaves, whole or toothed, or more rarely 3-fid, with 2 small basal appendages, 5-merous petals and fruits, and stamen filaments hairy at the base (Bennig 2007; Muñoz-Garmendia & al. 2015). The new species described here as *R. museocanariensis* has 1-pinnatisect leaves and 4-merous fruits (the stamens cannot be seen), characters that lead us to include it unambiguously in the genus *Ruta*.

Affinities and morphological differences with other species of the Canary Islands

Ruta museocanariensis is the only endemic *Ruta* of the Canary Islands with linear-filiform pinnae. This, together with the fruits being dehiscent capsules, differentiates it from the species of the W Canary Islands (La Palma, La Gomera and Tenerife): *R. microcarpa*, *R. nanocarpa* and *R. pinnata* sensu lato (Mesa-Coello & al. 2023); although *R. nanocarpa* has very narrow pinnae, these are narrowly oblanceolate (Fig. 2G). *Ruta museocanariensis* resembles *R. microcarpa* and *R. nanocarpa* in size and habit, but not in the shape of the pinnae of the leaves or in the development of the fruit. On the other hand, it does not resemble the other species of Gran Canaria, *R. oreojasme*, a stumpy, twisted chamaephyte, which has broadly oblanceolate or elliptic pinnae and larger fruits of different shape than those of *R. museocanariensis*.

Two other species grow in the Canary Islands. *Ruta chalepensis* is of circum-Mediterranean distribution, extending S from NW Africa to the Atlantic Sahara. It is cited as spontaneous in all islands, albeit more common in El Hierro and Lanzarote. It is considered to be "probably introduced" (Acebes Ginovés & al. 2010; Biota 2021+), but it cannot be ruled out that it may be native, at least in Lanzarote. The other species is *R. graveolens*, native to the C and E Mediterranean and introduced in the Canary Islands, appearing as subspontaneous on certain islands (although rarely naturalized today) (San Miguel 2015).

Ruta chalepensis and *R. graveolens*, along with *R. angustifolia* and *R. montana*, belong to the circum-Mediterranean continental group (Salvo & al. 2010; San Miguel 2015). These latter two species are found throughout much of Morocco, extending south to the High Atlas, Mid-Atlantic Morocco or even to the Anti-Atlas (Bennig 2007). *Ruta montana*, in turn, extends all the way to the Anti-Atlas, where it forms part of the communities of *Dracaena draco* subsp. *ajgal* Benabid & Cuzin, and other species of the African Macaronesian enclave. Two other Mediterranean species are *R. corsica* DC. and *R. lamarmorae* Bacch. & al., endemic to Corsica and Sardinia, respectively. They are quite similar to the continental species, with leaves that are also 2- or 3- pinnatisect, albeit more glaucous, fruits dehiscent, and branches and floral scapes in a zig-zag, reminiscent of aulaga, i.e. *Launaea arborescens* (Batt.) Murb.

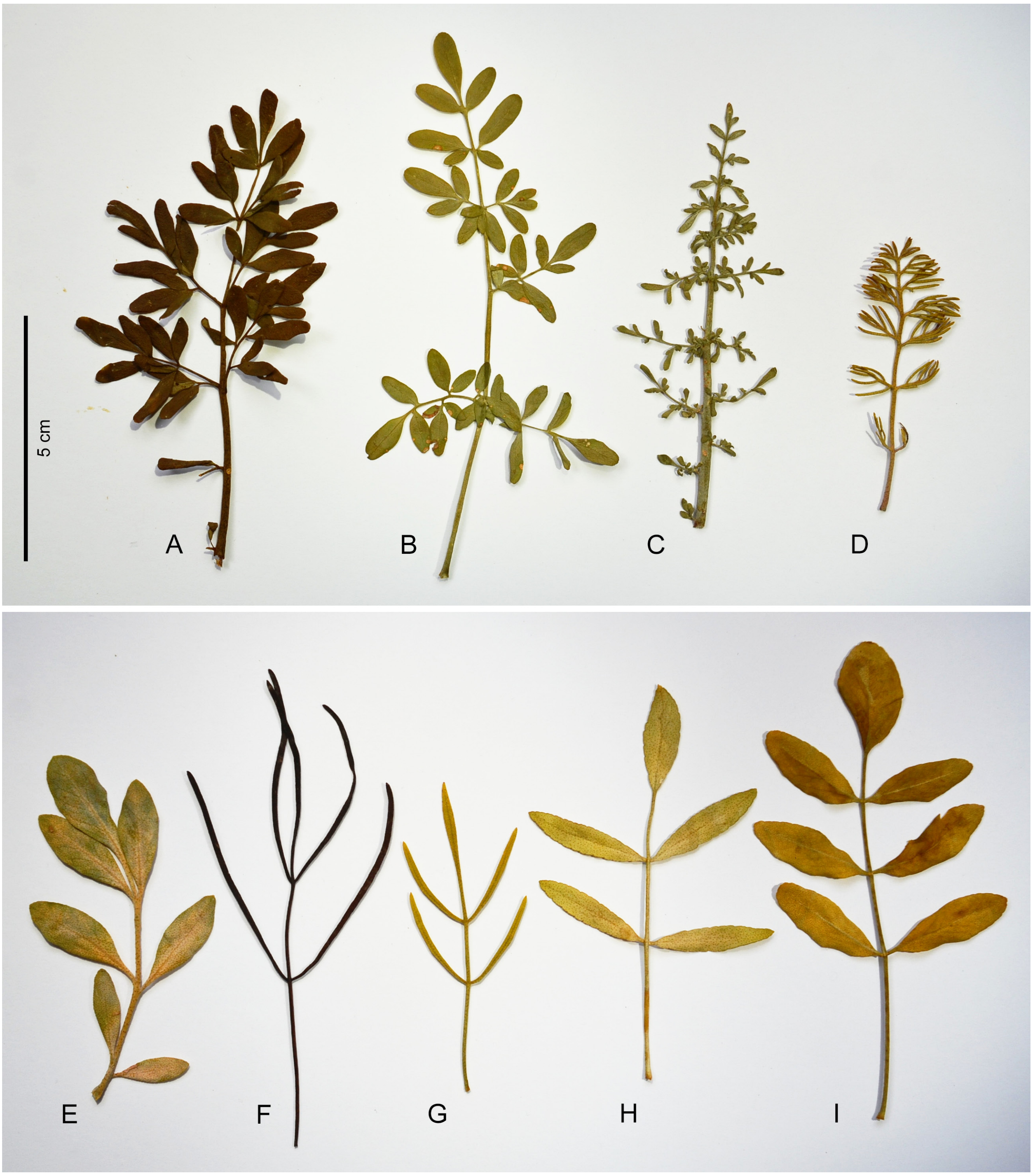


Fig. 2. Leaves of *Ruta*; A–D: species from N Africa and Mediterranean Europe; E–I: endemic species of the Canary Islands. – A: *R. graveolens*, Gran Canaria, Valleseco (LPA 2844); B: *R. chalepensis*, El Hierro, San Andrés (LPA 40201); C: *R. angustifolia*, Castellón, Benicarló (LPA 24834); D: *R. montana*, Morocco, between Tanalt and Tidli (LPA 34069); E: *R. oreojasme*, Gran Canaria, San Bartolomé de Tirajana, Amurga, Barranco del Cañizo (Arteara) (LPA 29007); F: *R. museocanariensis*, Gran Canaria, El Museo Canario (LPA 39792); G: *R. nanocarpa*, La Gomera, Roque Sombrero (LPA 34071); H: *R. microcarpa*, La Gomera, Alojera (LPA 36031); I: *R. pinnata*, Tenerife, El Tanque (LPA 34695). – Scale bar applies to A–I. – Photographs by Á. Marrero.

All these continental-Mediterranean species have the habit of small bushes, cushion-shaped, woody at the base, somewhat herbaceous above, and with 2- or 3-pinnatisect leaves and broad pinnules that are oblong, rounded or spatulate, with the exception of *Ruta montana*, which has linear or narrowly spatulate pinnules. In contrast, all species of the Canary Islands have 1-pinnatisect leaves (Fig. 2). As for the fruits, all continental-Mediterranean species, as well as the two species of Gran Canaria, have dehiscent fruits (capsules), while the species of the W Canary Islands, *R. microcarpa*, *R. nanocarpa* and *R. pinnata*, have indehiscent and sub-

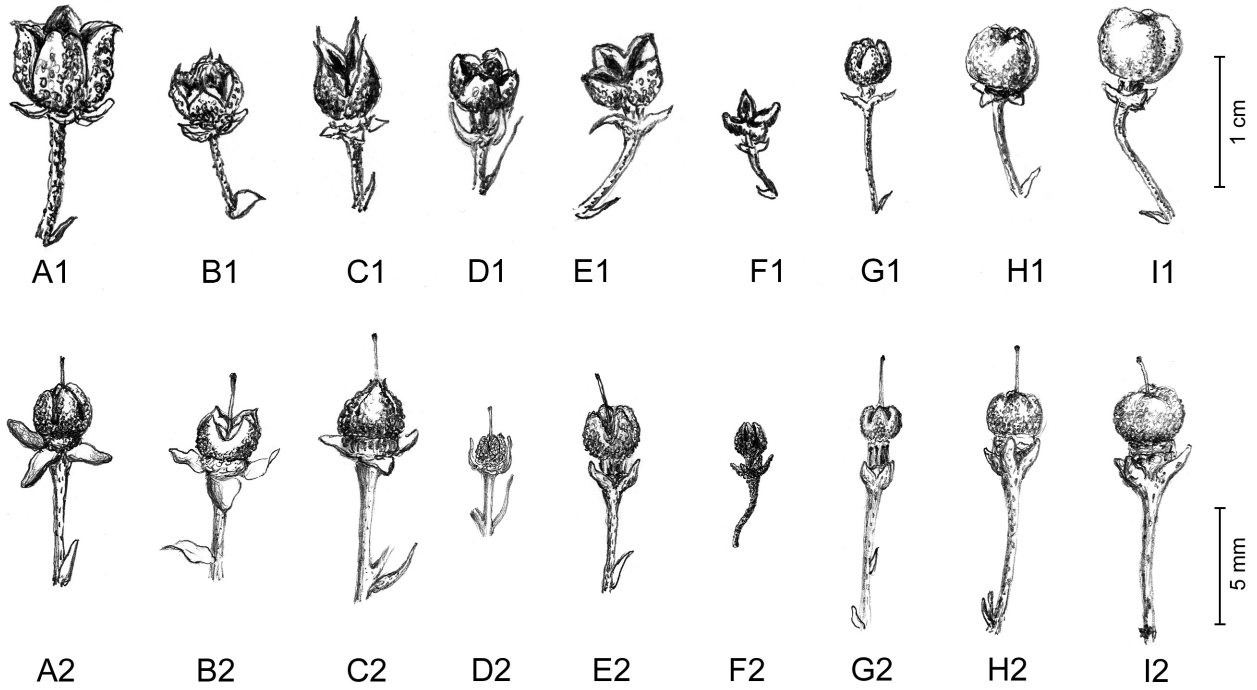


Fig. 3. A1–I1: fruits of *Ruta* species from the Canary Islands, N Africa and Mediterranean Europe. – A1: *R. graveolens*; B1: *R. chalepensis*; C1: *R. angustifolia*; D1: *R. montana*; E1: *R. oreojasme*; F1: *R. museocanariensis*; G1: *R. nanocarpa*; H1: *R. microcarpa*; I1: *R. pinnata*. – A2–I2: fruit primordia of same species and in same order as A1–I1, illustrating how degree of carpel fusing varies from dehiscent fruits (A2–F2), to non-dehiscent, fleshy fruits (G2–I2). – Drawn by Á. Marrero.

fleshy fruits (Fig. 3). In the genus *Ruta*, this feature correlates with the depth of the carpel incisions from the early stages of fruiting.

Identification key to the Canarian species of *Ruta*

1. Leaves 2- or 3-pinnatisect **2**
– Leaves 1-pinnatisect **3**
2. Petals entire; infructescence branches lax, non-spiciform; fruit 3.5–9(–11.5) mm long (Mediterranean; cultivated and subspontaneous in Canary Islands) . . . . *R. graveolens*
– Petals laciniate; infructescence branches spiciform; fruit 3.5–6.9(–7.9) mm long (Mediterranean; cultivated and subspontaneous in Canary Islands, probably native to Lanzarote) . . . . ***R. chalepensis***
3. Fruits dehiscent **4**
– Fruits indehiscent **5**
4. Plant stumpy, twisted, with decumbent branches; pinnae broadly spatulate, obovate or oblong (Gran Canaria) . . . . ***R. oreojasme***
– Plant taller, with erect or ascending branches; pinnae linear-filiform (Gran Canaria, putatively extinct) . . . . ***R. museocanariensis***
5. Plant lax, slender, 1.5–2(–3) m tall; pinnae broadly spatulate, oblong or broadly oblanceolate (La Palma, La Gomera, Tenerife) . . . . ***R. pinnata***
– Plant ± dense, 40–100 cm tall; pinnae ± narrow, mostly oblanceolate **6**
6. Plant 80–100 cm tall; pinnae narrowly spatulate, oblong, oblanceolate or rhombic; fruit 4–5 mm long (La Gomera) . . . . ***R. microcarpa***
– Plant 40–60 cm tall; pinnae very narrowly oblanceolate; fruit 2.5–3 mm long (La Gomera) . . . . ***R. nanocarpa***

Ruta museocanariensis Marrero Rodr., Vidal Matutano, Delgado Darias & Jaén Molina, **sp. nov.** – Fig. 2F, 3F, 5.

Holotype: from the shroud of infant mummy no. 49991 [Fig. 1A] in El Museo Canario, originating according to available data from sepulchral cave archaeological sites of Acusa (Spain, Canary Islands, Gran Canaria, Artenara), plant material extracted in February and March 2021 and March 2022 by T. Delgado, P. Vidal and Á. Marrero (LPA 39791 [Fig. 4A]; isotype: LPA 39790). – Paratypes: from the shroud of adult mummy no. 10 [Fig. 1B] in El Museo Canario, originating according to available data from sepulchral cave archaeological sites of Barranco de Guayadeque (Spain, Canary Islands, Gran Canaria, Ingenio/Agüimes), plant material extracted in February and March 2021 by T. Delgado, P. Vidal and Á. Marrero (LPA 39792, LPA 39793 [Fig. 4B]).

Typification — The four type specimens are physically deposited in the archaeological collection of El Museo Canario (Las Palmas de Gran Canaria, Canary Islands, Spain) but are linked to and registered in the LPA herbarium (of

Herbario - LPA
JARDÍN BOTÁNICO CANARIO "VIERA Y CLAVIJO"
CABILDO DE GRAN CANARIA
FLORA DE: Islas Canarias

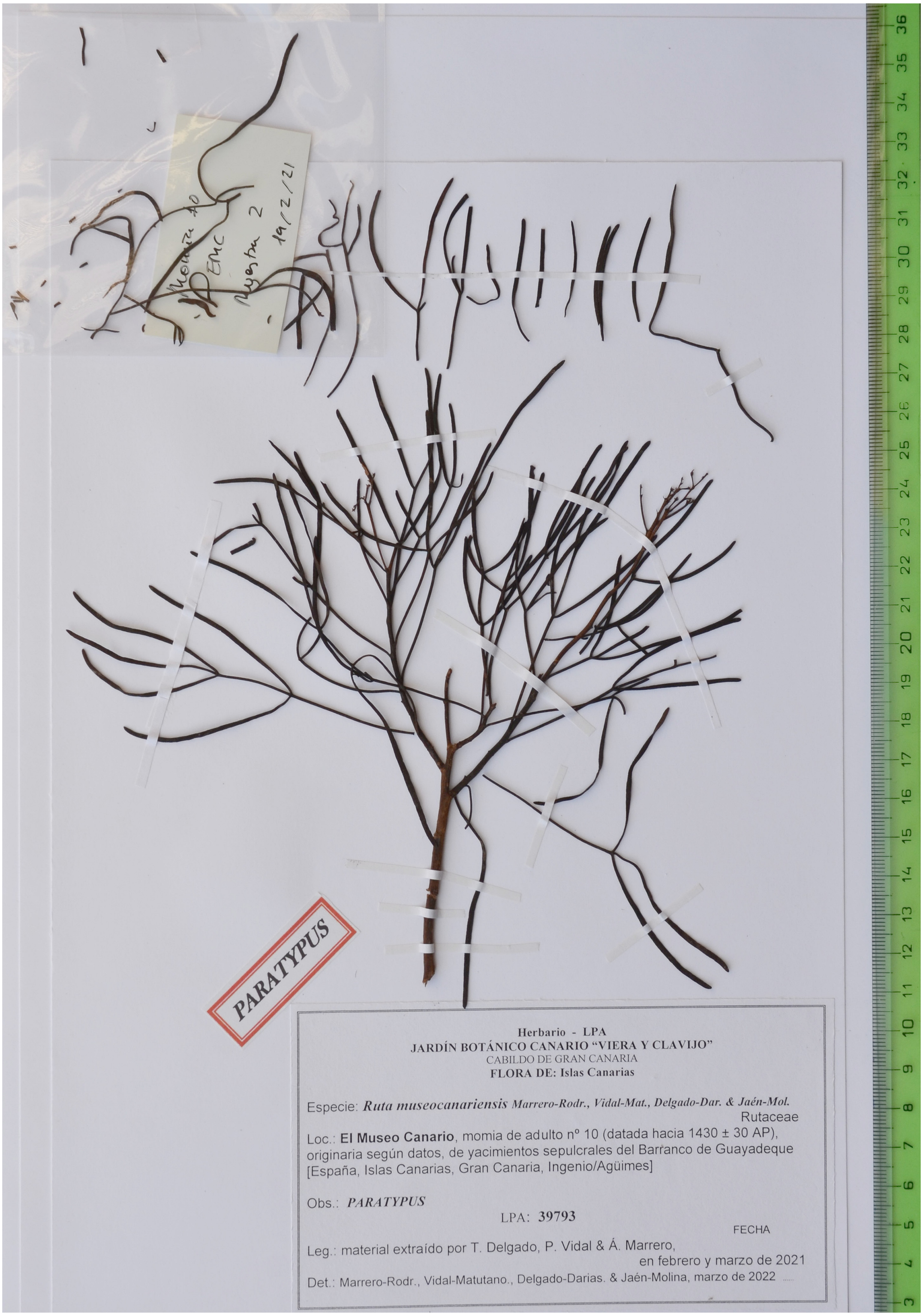
Especie: ***Ruta museocanariensis*** *Marrero-Rodr., Vidal-Mat., Delgado-Dar. & Jaén-Mol.*
Rutaceae

Loc.: **El Museo Canario**, momia infantil nº 49991 (datada hacia 1290 ± 30 AP), originaria, según datos disponibles, de yacimientos arqueológicos sepulcrales de Acusa [España, Islas Canarias, Gran Canaria, Artenara]

Obs.: ***HOLOTYPUS***
LPA: **39791**
FECHA

Leg.: material extraído por T. Delgado, P. Vidal & Á. Marrero,
en febrero y marzo de 2021 y marzo de 2022
Det.: Marrero-Rodr., Vidal-Matutano., Delgado-Darias. & Jaén-Molina, marzo de 2022

Fig. 4A. Holotype of *Ruta museocanariensis* (LPA 39791). – Material extracted from infant mummy EMC no. 49991, originating, according to available data, from sepulchral archaeological sites of Acusa (Gran Canaria, Artenara), dated to 1290 BP ± 30. Leaves reveal markedly erect arrangement, maintaining rigidity of original shroud.



Herbario - LPA
JARDÍN BOTÁNICO CANARIO “VIERA Y CLAVIJO”
CABILDO DE GRAN CANARIA
FLORA DE: Islas Canarias

Especie: *Ruta museocanariensis Marrero-Rodr., Vidal-Mat., Delgado-Dar. & Jaén-Mol.*
Rutaceae
Loc.: **El Museo Canario**, momia de adulto nº 10 (datada hacia 1430 ± 30 AP), originaria según datos, de yacimientos sepulcrales del Barranco de Guayadeque [España, Islas Canarias, Gran Canaria, Ingenio/Agüimes]

Obs.: ***PARATYPUS***
LPA: **39793**
FECHA
Leg.: material extraído por T. Delgado, P. Vidal & Á. Marrero,
en febrero y marzo de 2021
Det.: Marrero-Rodr., Vidal-Matutano., Delgado-Darias. & Jaén-Molina, marzo de 2022

Fig. 4B. Paratype of *Ruta museocanariensis* (LPA 39793). – Material extracted from adult mummy EMC no. 10, originating, according to data, from sepulchral sites of Barranco de Guayadeque (Gran Canaria, Ingenio/Agüimes), dated to 1430 BP ± 30.

Fig. 5. *Ruta museocanariensis* – A: habit, terminal branch; B: pinna on one side of rachis, adaxial view; C: pedicel, calyx and ovary; D: terminal infructescence twig with open, star-shaped fruit, persistent calyces, bracteoles and immature fruit still closed; E: mature capsules showing dehiscence of valves, basal (left) and apical (right) views. – Image reconstructed from various twigs and fruits in different maturation stages extracted from infant mummy EMC no. 49991 (holotype and isotype) and branches and leaves extracted from adult mummy EMC no. 10 (paratypes). – Drawn by Á. Marrero.

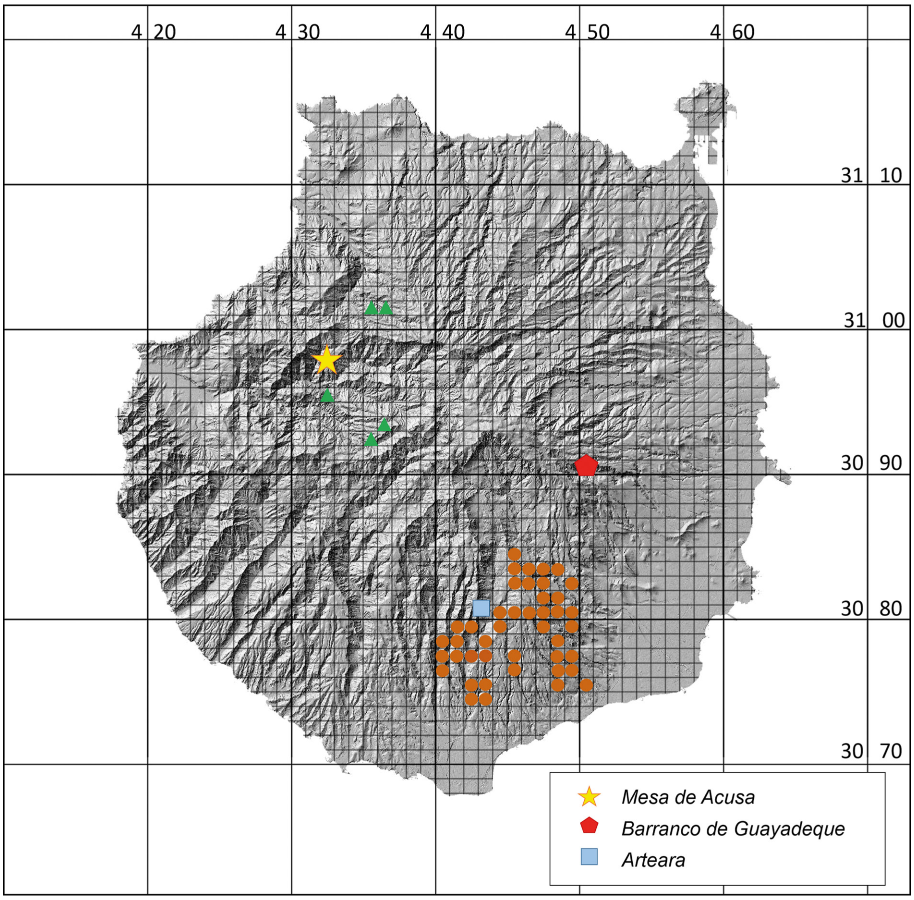


Fig. 6. Map of Gran Canaria indicating places (green triangles) with names that contain the word ruda (meaning *Ruta*) in the surroundings of Mesa de Acusa; and the spread of *R. oreojasme* (orange dots) according to BIOTA (2022). Funerary sites mentioned are indicated in the text box. – UTM coordinates, 1 × 1 km grid, GRAFCAN cartographic base, https://visor.grafcan.es/visorweb/, January 2022.

the Jardín Botánico Canario Viera y Clavijo, Unidad Asociada al CSIC) by means of scanned copies or photographs and entry records. These are the oldest specimens among the collections of the LPA herbarium.

The material was extracted avoiding any additional damage to the mummies and their shrouds. Leafy branches and remains of infructescences with capsules were extracted from the shroud of the infant mummy EMC no. 49991 to assemble the holotype and isotype. The branches and leaves are very fragile and fragmented, but the capsules are well preserved (plant fruiting at the time of gathering) and offer more taxonomically valuable data. Leafy branches with inflorescences were extracted from the shroud of the adult mummy EMC no. 10 to assemble the two paratypes. This material is better preserved and less fragmented, but for taxonomic purposes it is less relevant because the inflorescences (plant flowering at the time of gathering) have deteriorated and do not include the most delicate parts such as petals or stamens. All the material was presumably originally collected from living plants by the indigenous population expressly for the preparation of the mummies' shrouds.

Description — Shrubs; *branches* bearing subepidermal glands in form of black dots throughout plant; major branches erect-ascending, 22–40 cm long, 1.6–4(–5) mm in visible basal diam.; terminal branches slender, leafy, 7–15.5 cm long, with (6–)8–15 alternate leaves. *Petiole* 1.7–4.1 cm long, 0.5–0.7 mm in diam., terete; *leaf blade* simple or 1-pinnatisect with a terminal pinna; middle leaves with 2(or 3) pairs of pinnae; basal cauline leaves simple or with 1 or 2 lateral pinnae, shorter than middle leaves; middle leaves long petiolate, 7.9–10.5 cm long including petiole, 4.6–5.2(–7.3) cm wide, slightly fleshy, glabrous; upper leaves progressively smaller and simple; *lateral pinnae* generally opposite but occasionally alternate, linear-filiform, almost indistinguishable from rachis or petiole but flattened, 1.1–4.7 cm long, 0.5–1.6 mm wide; terminal pinna linear-filiform, 1.9–5.5 cm long, slightly longer than lateral pinnae; all conspicuously dotted with sub-crateriform dark glands, midvein always visible abaxially, somewhat concave adaxially, base terete, somewhat attenuate, apex rounded or more frequently pointed. *Inflorescence* terminal, paniculate-corymbose, 9–12 cm long, with 12–15 flowers; *basal bracts* like leaves but smaller and usually simple, linear-filiform, 1–2.5(–4) cm long, upper ones minute, subulate or triangular-subulate, 1–4 mm long; *bracteoles* triangular-subulate, 0.7–1.6 mm long, gland-dotted and with minute, stipitate glands toward base; *peduncles* variable, (1.2–)3.5–10.2(–20) mm long; *pedicels* 1.3–4.8 mm long, somewhat widening distally. *Sepals* with persistent, thickened, triangular or triangular-subulate lobes, 0.6–1.1 mm long, somewhat verrucose-glandular and with minute, stipitate glands. *Petals* and *stamens* unknown. *Disk* narrow, 0.4–0.9 mm long. *Ovary* globose-ovoid, c. 1 × 1 mm, verrucose, glabrous, with 4 deeply incised carpels. *Fruits* minute, dehiscent capsules, 4–5.5 mm in diam., opening along inner sutures, with 4 divaricate lobes forming a star shape, verrucose externally, glabrous. *Seeds* unknown.

Distribution — *Ruta museocanariensis* is known only from mummy shrouds from the sepulchral cave sites of Acusa (Artenara) and Barranco de Guayadeque (Ingenio/

Agüimes). Given the pre-Hispanic population's lack of seafaring mobility between different islands of the archipelago (Morales-Mateos 2010), and even less with the African mainland, there is no doubt that the species was collected on the Island of Gran Canaria, probably in the vicinity of the funerary sites. Moreover, there are several toponyms (Fig. 6) in the surroundings of Acusa alluding to "ruda" (meaning *Ruta*). The place names at Artenara (in the Barranco Hondo) are "La Ruda", "Montaña la Ruda" and "Cañada de la Ruda"; in Tejeda (near Timagada and El Juncal) they are "Cuesta de la Ruda" and "Degollada de la Ruda"; and in El Carrizal (also in Tejeda) they are "La Ruda", "Caidero de la Ruda" and "Barranquillo de la Ruda". However, no wild populations of *Ruta* species have been observed so far in these areas. Although it is highly likely that these place names allude to or are related to the species described here, it is not possible to prove this. Otherwise, in the area of the Barranco de Guayadeque there are no references to wild *Ruta* or related toponyms.

Etymology — The specific epithet refers to the scientific entity of El Museo Canario, the institution where the mummies, branch bundle and type specimens are deposited.

Potential habitat and probable ecology

The locations of different *Ruta*-related place names are to the NE, SE and S of Acusa (Fig. 6) and sit on rocky outcrops whose origin dates back to the Middle Miocene. According to radiometric dating by McDougall & Schmincke (1976), these formations date from 13.4 million years ago (mya). From a geological perspective, the rocks of these areas are predominantly plutonic (alkaline and peralkaline syenites) and ignimbritic tuffs, as well as peralkaline rhyolitic-trachytic lavas of the trachyrhyolitic formation of the Intracaldera Domain, Cycle I, of the volcanological history of Gran Canaria (Balcells & Barrera 1990; Balcells & al. 1990a, 1990b). The current enclave names offering clues as to the presence of *Ruta* are located in the C and lower area of the "cone-sheet" (Schmincke 1967; Hernán 1976), a geological structure that clearly defines the geomorphology of the entire area.

Since their formation, the areas of Artenara and Acusa have suffered great devastation by powerful erosive processes and consequent depressions later filled with basalt, tephrite and breccias from the Roque Nublo cycle, during the Pliocene (from 5 to 3 mya). Subsequent erosion produced the current fluvial network. Such is the history of the older half of Gran Canaria, called "Palaeocanaria", and which the volcanologists Bourcart & Jérémine (1937) defined as "Tamaran". The subsequent history of the area is marked by a very prolonged erosive phase that modelled the landscapes into mainly rocky outcrops and imposing escarpments (lithosol-like soils) (Balcells & al. 1990a, 1990b).

The Guayadeque area, on the contrary, is a spectacular ravine marked by almost vertical walls, with level differences of up to 300 or 400 m. The ravine was carved in lava flows (basanitic-nephelinitic lavas) and interspersed with basic pyroclasts (tephra cones and pyroclasts). These geological formations belong to the lower or middle cycle of the Post-Roque Nublo Cycle dating to the Upper Pliocene and the Lower and Middle Pleistocene (2.8 and 1.62 mya) (Lietz & Schmincke 1975; McDougall & Schmincke 1976). The funerary sites of the area are found in outcrops of tephra cones and tuffs or pyroclasts, which are more suited to the installation of granaries as well as domestic and funerary caves.

From a biotic point of view, these processes (trachirhyolite salic formations, development of the cone sheet and the later Roque Nublo stratovolcano episode and its dismantling) must have played the role of intense evolutionary stressors for the plants of Gran Canaria, as well as being behind significant episodes of extinction (Marrero-Rodríguez & Francisco-Ortega 2001; Marrero-Rodríguez 2004). As a consequence of this, the current vegetation, to which *Ruta museocanariensis* would presumably belong, is an amalgam of plant communities with a high richness of endemic species, many of them endangered, and with a fragmented distribution, as can be currently observed.

In addition to the aforementioned reasons that justify its potential distribution area (i.e. site location and the association of toponymy and geology), it is also possible to characterize the potential habitat of *Ruta museocanariensis* based the other plant remains in the mummy shrouds or even from the intrinsic morphological characteristics of the new species, such as being woody, more or less compact bushes with pinnatisect leaves and filiform, somewhat fleshy pinnae typical of species from a xerothermophilic environment, which broadly coincides with the surroundings of the funerary sites where they were discovered (del Arco & al. 2002).

In both analysed mummy shrouds, *Ruta museocanariensis* is accompanied by other species well known from these environments, such as *Lavandula minutolii* Bolle, *Micromeria tenuis* Benth. and the more or less frequent needles of *Pinus canariensis*. This suggests that the new *Ruta* could have also been collected near the indigenous settlements, at least in the Acusa area. The gathering of plants in the vicinity of the necropolis has also been verified for the site of Arteara, in the ravine of Fataga (Jorge-Blanco 1989), where among the identified species was *R. oreojasme*, which grows on nearby cliffs.

Both Acusa and the Barranco de Guayadeque fall within the range of the thermomediterranean thermotype and between lower-dry and upper-semi-arid ombrotype, characterized by the presence of plant communities of the climatophilous series of *Pistacio lentisci-Oleo cerasiformis sigmetum*, which includes woody stands of thermophilous *Juniperus canariensis*, *Olea cerasiformis* Rivas Mart. & del Arco (*O. europaea* subsp. *guanchica* P. Vargas & al.) and *Pistacia atlantica* Desf. or *P. lentiscus* L. (Rivas-Martínez & al. 1993, 2002; del Arco & al. 2002). In the area of Acusa and its surroundings are thermo-sclerophyllous communities below pine forests, i.e. woodland of *J. canariensis* and *P. atlantica*, in which are found species such as *Allagopappus viscosissimus* Bolle, *Chrysojasminum odoratissimum* (L.) Banfi (*Jasminum odoratissimum* L.), *Chrysoprenanthes pendula* (Sch. Bip.) Bramwell (*Sonchus pendulus* (Sch. Bip.) Sennikov), *Dendriopoterium pulidoi* Svent., *Dracaena tamaranae* Marrero Rodr. & al., *Marcetella moquiniana* (Webb & Berthel.) Svent., *Parolinia filifolia* G. Kunkel and *Teline rosmarinifolia* Webb & Berthel. (*Cytisus rosmarinifolius* (Webb & Berthel.) Masf.). The surroundings of Guayadeque are made up of woodland known as "acebuchal", in which the dominant element is *Olea cerasiformis*, along the lower edges of pine forests and on the edges of the E end of Monteverde. Other plants that grow in such communities include *Malva acerifolia* (Cav.) Alef. (*Lavatera acerifolia* Cav.), *Marcetella moquiniana* and *Parolinia platypetala* G. Kunkel.

State of the population

According to IUCN criteria and sub-criteria for assessing threatened flora (IUCN 2012), *Ruta museocanariensis* is today extinct (EX). The criterion of "extinct in the wild" (EW) is not applicable in this case because the species is not known in cultivation or as naturalized outside its natural habitats. However, the IUCN definition of an extinct species is very tight: "A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual."

The only evidence of the existence of *Ruta museocanariensis* consists of the material remains (branches, leaves and capsules) preserved in the mummy shrouds. It is possible to infer tentatively its previous distribution based on the location of the archaeological sites and, above all, on the survival of toponyms likely alluding to this plant. Those place-names including the word "ruda" lead to the speculation that the species did not disappear due to its use in indigenous traditions, and that it survived until after the Spanish conquest of the Canary Islands. This is based on the fact that the word "ruda" is not indigenous (Amazigh/Berber or related language), but the most widespread name bestowed on *Ruta* in mainland Spain (Font Quer 1990; San Miguel 2015). With the disappearance of *R. museocanariensis* from its natural habitat, we may be witnessing one of the consequences, poorly documented and not taken into account, of the acculturation processes carried out by the Castilian conquerors.

Phylogenetic trends in the genus *Ruta*

All *Ruta* species restricted to the Canary Islands bear 1-pinnatisect leaves, i.e. with simple pinnae, whereas their continental counterparts have 2- or 3-pinnatisect leaves (Fig. 2). This falls in line with the results in previous molecular analyses mainly based on plastid DNA markers that supported the monophyly of all Canarian endemic *Ruta*. According to previous studies by Salvo & al. (2008, 2010) to reconstruct the phylogenetic relationships of *Ruteae* at a broader taxonomic and geographical level, the mainland *R. montana* was the closest congener of the Canarian taxa. *Ruta montana* is, in fact, the species whose distribution approaches the closest to the Canary Islands, as it grows throughout NW Africa down to the Anti-Atlas, where it is part of plant communities of the Macaronesian-African enclave. The molecular analyses carried out so far have failed to resolve whether the islands were colonized by a single ancestral species (unsampled species probably extinct) related to *R. montana* or if there were at least two colonization events (Soto & al. 2022): one that gave rise to *R. oreojasme*, a species clearly differentiated both molecularly and morphologically from the others, and a second one that gave rise to the rest of the extant endemic *Ruta* of the islands. *Ruta montana* is the only species that may have leaves with linear-filiform pinnules like the pinnae of *R. museocanariensis*, but they are 2- or 3-pinnatisect, while the morphologically closest Canarian species, *R. nanocarpa*, has leaves with clearly narrowly oblanceolate pinnae, so an evolutionary sequence can be hypothesized at the morphological level, from leaves with narrow pinnae to those of increasingly broader pinnae in the W Canary Island *Ruta* species.

Furthermore, all continental-Mediterranean *Ruta* as well as *R. museocanariensis* and *R. oreojasme* on Gran Canaria have deeply lobed carpels that are connate at their base, which allows the dehiscence of the fruit. This differs from the *Ruta* species of the W Canary Islands, which have indehiscent fruits. In general, a deep incision of the lobes between the carpels does not always imply the dehiscence of the fruits, but in the genus *Ruta* it is correlated, as in all continental-Mediterranean species and in the two species of Gran Canaria. The fact that *Ruta museocanariensis* and *R. oreojasme* of Gran Canaria bear dehiscent fruits allows us to hypothesize that the evolution toward indehiscent forms has been a post-colonizing process on the islands, and marks a change from a mainly autochorous dispersal mechanism (although seeds from fruits in capsules can also be dispersed by zoochory), to one that is probably endozoochorous (Fig. 3).

This putative evolutionary process from dehiscent to indehiscent fruits may also have important repercussions in the evolution of the island biota in terms of plant-animal mutualism, as has been documented in Canarian plant species such as *Cneorum pulverulentum* Vent. (*Neochamaelea pulverulenta* (Vent.) Erdtm.) (*Rutaceae* or *Cneoraceae*), *Plocama pendula* Aiton and *Rubia fruticosa* Aiton (both *Rubiaceae*), and their relationship with birds or lizards (Valido & Nogales 1994; Nogales & al.

1999; Olesen & Valido 2003, 2004; Valido & al. 2003; Traveset & Santamaría 2004).

The species from La Gomera, *Ruta nanocarpa*, links the two groups: although its ovaries have carpels that are lobed up to almost half of the fruit, the final dehiscence does not occur and the mature fruits remain closed (Mesa-Coello & al. 2023). Therefore, the probable evolution from dehiscent to indehiscent fruits, as well as the shape of the leaf, suggests a stepping-stone model of inter-island colonization, which fits the age of the islands and to some extent with their distances from the mainland.

This contradicts the suggestions of Salvo & al. (2010) as to the reconstruction of ancestral areas suggesting that La Gomera was the first island to be colonized from Africa. Soto & al. (2022) based their molecular analyses on a much more extensive geographical and populational sampling of Canarian *Ruta* than did Salvo & al. (2010), and the results point to Gran Canaria as the most likely dispersal centre for the genus *Ruta* in the archipelago. This hypothesis is supported both by the high diversity of the haplotypes detected for *R. oreojasme* when compared with the taxa of La Gomera and by Gran Canaria's greater age (14.5 mya vs 9.4 mya) and proximity to the continent. Moreover, both the dated phylogeny and the haplotype network obtained by Soto & al. (2022) is compatible with a stepping-stone colonization model from the continent to Gran Canaria, where *R. oreojasme* was the oldest taxon among the endemic *Ruta* analysed so far with a divergence age of approximately 5.03 mya.

Another aspect that remains unresolved is whether the W Canary Islands were colonized by the same ancestor that gave rise to *Ruta oreojasme* or if there were multiple colonization events from two or more ancestors, followed by speciation in different ecological habitats. The inclusion of *R. museocanariensis* in new molecular analyses could help determine: (1) when it arrived in the archipelago; (2) whether it is more closely related to *R. nanocarpa* than to *R. oreojasme*; and (3) if it is the ancestral or sister species to all endemic *Ruta* of the W Canary Islands.

From a bioclimatic perspective, Salvo & al. (2010) commented that the genus *Ruta* emerged in the forests of the Mediterranean area (humid) before the current Mediterranean climate arose (drier). As this process unfolded along with various geological events (temporary terrestrial connections and fragmentations, the emergence and disappearance of continental islands), *Ruta* populations diversified as they were selected by the new climatic conditions to the point that they are now normally associated with characteristic elements of the current Mediterranean plant communities of *Pistacia*, *Quercus*, etc. (Bonet 1992; Salvo & al. 2010). In the Canary Islands, although all *Ruta* species appear to be linked to thermo-sclerophyllous communities (of Mediterranean climate), there seems to be an inverse process to that which occurred in the Tertiary Mediterranean, leading from the most xeric *Ruta* species (from the W and SE parts of La Gomera, W and SW slopes in Tenerife and W and S slopes in Gran Canaria) to the most leafy *Ruta* species (from the E part of La Palma, N and NE slopes of La Gomera and N and E slopes of Tenerife), where *Ruta* is found in a diversity of plant communities, from the most xeric thermo-sclerophyllous formations to the wetter edges of the laurel forest, known as "monteverde". The species of Gran Canaria are those that grow in more xeric environments, and although *Ruta oreojasme* has leaves with broad pinnae, the plant is a small, woody, stumpy and strictly rupicolous shrub with glaucous leaves.

Final remarks

The Canary Islands constitute a very abrupt volcanic archipelago marked by an extremely complex orography (Marrero-Rodríguez & Francisco-Ortega 2001). Experiences in the field of botany serve as warnings that biodiversity lists and inventories are far from complete. New field surveys, whether casual or increasingly exhaustive, still offer remarkable surprises including, for example, the discoveries of *Argyrolobium armindae* Marrero Rodr., *Helianthemum inaguae* Marrero Rodr. & al. and *Sideritis amagroi* Marrero Rodr. & B. Navarro in Gran Canaria; *Helianthemum bramwelliorum* Marrero Rodr. in Lanzarote; *Limonium relicticum* R. Mesa & A. Santos in La Gomera; and *Lolium saxatile* H. Scholz & S. Scholz and *Ononis catalinae* Reyes-Bet. & S. Scholz in Lanzarote and Fuerteventura; (Marrero-Rodríguez 1992; Marrero-Rodríguez & al. 1995; Mesa-Coello & Santos 2001; Marrero-Rodríguez & Navarro 2003; Scholz & Scholz 2005; Marrero-Rodríguez 2008; Reyes-Betancort & Scholz 2008).

Ruta museocanariensis is possibly extinct in the wild. Several excursions and prospections carried out in near Acusa (Barranquillo de La Ruda and Cascada de La Ruda in El Carrizal, Tejeda, and in Cañada de La Ruda, Artenara) have so far been unsuccessful. However, we do not rule out that some isolated part of this island's complex geography may still provide a surprise.

Author contributions

ÁMR and PVM carried out the first plant identification analyses of the mummy shrouds and branch bundle and discovered the new species of *Ruta*. ÁMR, PVM and TDD extracted the samples from the shrouds, and together with JMM, VAB and JVV helped prepare the archaeological framework of the introduction. ÁMR and RJM prepared the discussion on systematic aspects and phylogenetic and evolutionary trends. TDD photographed the mummies and branch bundle. All authors discussed the manuscript and reviewed the final version.

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Appendix 1

Additional material studied

Ruta angustifolia Pers. — Spain: Balearic Islands: Minorca, Es Mercadal, road toward El Toro mountain, UTM: 31S 5948 44267, 200–290 m, high slope, NW, 30 Sep 2011, *Á. Marrero* (LPA 27496, LPA 27497). — Castellón: Benicarló (Baix Maestrat), slope S del Puig, UTM: 31T BE 80 83, 100 m, 3 May 2008, *V. J. Arán & G. Arán* (*V. J. Arán 6934*) (LPA 24833, LPA 24834).

Ruta chalepensis L. (*R. bracteosa* DC.) — Cabo Verde Islands: Santo Antão, Ribeira Brava, 25 Mar 1970, *E. R. Sventenius* (LPA 5845, LPA 10074). — Spain: Canary Islands: El Hierro, Valverde, San Andrés, El Jorado, UTM: 28R BR 126 791, 1250 m, 28 Mar 2012, *Á. Marrero & J. Caujapé* (LPA 40201, LPA 40202, LPA 40203).

Ruta graveolens L. — Spain: Canary Islands: Gran Canaria, [Valleseco], near Valleseco, cultivated, 3 Mar 1966, *G. Kunkel 8684* (LPA 2844).

Ruta microcarpa Svent. — Spain: Canary Islands: La Gomera, Vallehermoso, Alojera, Los Jayones, Andenitos Verdes, UTM: 28R BS 732 167, 700 m, 10 May 2017, *Á. Marrero & R. Jaén* (LPA 36027, LPA 36028, LPA 36029, LPA 36030); ibidem, Alojera, Teguerguenche, Finca La Ruda, UTM: 28R BS 724 156, 610–630 m, 10 May 2017, *Á. Marrero & R. Jaén* (LPA 36031, LPA 36032, LPA 36033, LPA 36034); ibidem, Alojera, 24 Apr 1966, *E. R. Sventenius* (ORT 5252); ibidem, Alojera, Andenitos Verdes, 23 May 1965, *E. R. Sventenius* (ORT 5253); ibidem, Alojera, Finca de La Ruda, 23 May 1965, *E. R. Sventenius* (ORT 5251).

Ruta montana (L.) L. — Spain: Burgos: Bujedo, alignment of rolling hills to W of access road to town from route N-I, UTM: 30T VN 981 232, 546 m, 12 Aug 2013, *J. A. Alejandre & M. J. Escalante* (*ALEJ 564/13*) AHIM-2013, Centuria XVIII, no. 1983 (LPA 31454); ibidem, Zamora, Santa María de la Vega, Sierra Verdenosa, c. 1.8 km to W to Morales de Rey, UTM: 30T 267496 4660782, 745 m, 17 Jul 2014, *P. Heras & M. Infante* AHIM-2014, Centuria XIX no. 2040 (LPA 32303). — Morocco: Anti Atlas: Aït Ahmed region: peaks of Jebel Imzi, high slopes above Agadir Ousgal, UTM: 29R 432 7291, 1450 m, 11 Jul 2005, *Á. Marrero* (LPA 31534, LPA 31535); ibidem, area of Agadir, between Tanalt and Tidli, 29.765881°N, 09.163230°W, 12 Nov 2015, *J. Caujapé, Ch. Arrouni, F. Msanda & al.* (LPA 34069).

Ruta nanocarpa R. Mesa & al. — Spain: Canary Islands: La Gomera, [San Sebastián de La Gomera], Roque El Sombrero, [UTM: 28R BS 87 08], [c. 650 m], 28 Mar 2016, *A. Portero Álvarez, J. Martín Carvajal & P. Romero* (LPA 34071); ibidem, 28 Sep 2018, *J. Martín Carvajal & A. Portero* (LPA 40719, LPA 40720); ibidem, 6 Jun 2019, *J. Martín Carvajal* (LPA 40721, LPA 40722).

Ruta oreojasme Webb — Spain: Canary Islands: Gran Canaria, San Bartolomé de Tirajana, Barranco Fataga, 18 Jun 1967, *E. R. Sventenius* (LPA 10069); ibidem, Vicentillo, 17 May 1973, *E. R. Sventenius* (LPA 10070, LPA 10071, LPA 10072); ibidem, Aldea Blanca, 8 May 1974, *J. Alonso* (LPA 10071); ibidem, San Bartolomé de Tirajana, Amurga, Barranco del Cañizo, upper sector, UTM: 28R DR 434 770, 450–500 m, 25 Jun 2010, *J. Caujapé & M. Soto* (LPA 29006, LPA 29007); ibidem, Barranco Hondo, Cañada de la Linde, UTM: 28R DR 50 76, 150 m, 16 Feb 2019, *R. García Medina s.n.* (LPA 38310).

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