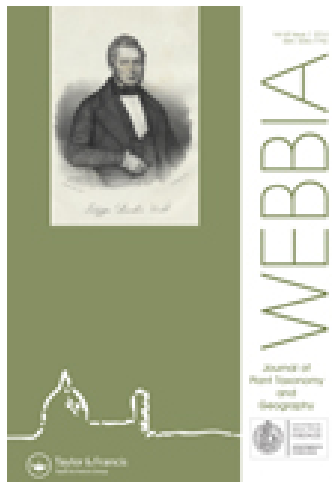


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Francisco Fernandes^a & José Augusto Carvalho^a

^a Jardim Botânico da Madeira Eng. Rui Vieira, Caminho do Meio Bom Sucesso, Madeira, Portugal

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ARTICLES

An historical review and new taxa in the Madeiran endemic genus *Monizia* (Apiaceae, Apioidae)

Francisco Fernandes* and José Augusto Carvalho

Jardim Botânico da Madeira Eng. Rui Vieira, Caminho do Meio Bom Sucesso, Madeira, Portugal

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The monotypic genus *Monizia* (Apiaceae) endemic to Madeira was published by Richard Thomas Lowe in 1856. Several authors have considered different taxonomic arrangements either by merging the genus with *Thapsia* or with *Melanoselinum*. Recent molecular data suggested a clear-cut separation of both *Monizia* and *Melanoselinum* from *Thapsia* but also from *Tornabenea*, a genus that is endemic to the Cape Verde Islands. The genus *Monizia* was initially recorded on one single island of the archipelago of Madeira; it was later reported on two other islands of the same archipelago and also in the Selvagens archipelago. Only recently, *Monizia* was found to occur on one of the islets of Porto Santo. In the present work, *Monizia* is retained as a monotypic genus and four subspecies of *Monizia edulis* are described and illustrated, based on morphological traits: two on the island of Madeira, namely *M. edulis* subsp. *isambertoii* and *M. edulis* subsp. *giranus*; one on Deserta Grande, namely *M. edulis* subsp. *edulis*; and one on Porto Santo, namely *M. edulis* subsp. *santosii*. These new taxa are distinguished in generic terms by their differences in stem and umbel length, the degree of division of the radical leaves and arrangement of ultimate segments, dimensions of calyx teeth, style orientation and length, mericarp size and shape, mericarp texture, and mericarp rib size and shape. Typification of the genus *Monizia*, its species and subspecies, descriptions, present-day geographical distribution, habitats, conservation status, synonymy and a comprehensive key to the new taxa are presented and discussed.

Keywords: Desertas; Madeira; *Melanoselinum*; *Monizia*; Porto Santo; taxonomy

Introduction

Monizia (Apiaceae) was published by Richard Thomas Lowe (1802–1874; see Trimen 1874) in 1856 to honour the Madeiran naturalist João Maria Moniz (1822–1898; see Silva and Menezes 1940). Several authors have considered different taxonomic arrangements either by merging the genus with *Thapsia* or with *Melanoselinum* (see Table 1). Bentham (1867), in the seminal work *Genera Plantarum*, merged this genus and the monotypic *Melanoselinum* Hoffm. with *Thapsia* L., but made no new combinations. Regarding this taxonomic arrangement, Huxley (1918a) mentioned that on 4 February 1867 Joseph D. Hooker (1817–1911, see Huxley 1918b) sent a letter to Charles Darwin (1809–1882, see Berra 2009) stating:

Bentham is doing Umbelliferae for Gen. Plant., and finds that the two remarkable umbelliferous genera of Madeira, *Monizia* and *Melanoselinum*, are only species of *Thapsia*, a Mediterranean genus of most remarkable and exceptional habit. Now this is one of those cases of Genera confined to the Island, being then created out of a continental form; the genus I suspect not having ever existed on the Continent. It appears to me that it will always be difficult to say whether a genus that has continental allies, is an insular development, or an old, now extinct Continental genus.

Hooker (1868), after a careful examination of living material, retained *Monizia*, indicating:

differs from *Thapsia* in its singular habit, well-developed involucre bracts, and the thick ribs of the fruit, the lateral secondary of which are very much incrassated and corky when ripe, with no disposition whatever to produce wings.

Lyell (1868) stated:

Another plant of singularly aberrant form, and which we may well imagine to be the last survivor of a Miocene type is the *Monizia edulis*, belonging to a genus which has now no representative elsewhere in the world.

Subsequent authors have questioned the status of *Monizia* as a distinct genus.

Nicholson (1877) considered *Thapsia* sensu Bentham (1867), i.e. *Monizia* (*M. edulis* Lowe) and *Melanoselinum* Hoffm. (*Melanoselinum decipiens* (Schrad. & J.C. Wendl.) Hoffm.) as part of *Thapsia*. New combinations were made, respectively *Thapsia edulis* (Lowe) G. Nicholson and *Thapsia decipiens* (Schrad. & J.C. Wendl.) Hook.f.

Bailon (1876–1879), in opposition to Bentham (1867) and Nicholson (1877), considered *Melanoselinum* to be clearly distinct from *Thapsia*, and suggested *Monizia* to be congeneric with *Melanoselinum* in a section of its own. Moreover, Baillon (1876–1879) merged both *Tornabenea* Benth. & Hook.f. (accepted name: *Tornabenea* Parl.) and *Monizia* within *Melanoselinum*. A new combination for *M. edulis* Lowe was suggested, i.e. “*Melanoselinum* (*Monizia*) *edule*”.

*Corresponding author. Email: franciscofernandes.sra@gov-madeira.pt

Table 1. Historical 19th and 20th Centuries taxonomical treatments for *Monizia edulis*.

Authors (*)	Date	Genus	Taxonomic combinations ¹	Genera included ¹
R. T. Lowe	1856 1868	<i>Monizia</i> Lowe	<i>Monizia edulis</i> Lowe in Hookers J. Bot. 8: 295 (1856).	
G. Bentham	1867	<i>Thapsia</i> L. <i>sensu</i> Bentham	–	<i>Thapsia</i> , <i>Melanoselinum</i> , <i>Monizia</i>
G. Nicholson	1877	<i>Thapsia</i> L. <i>sensu</i> Bentham	<i>Thapsia edulis</i> (Lowe) G. Nicholson in Dict. Gard. 4: 74 (1877).	<i>Thapsia</i> , <i>Melanoselinum</i> , <i>Monizia</i>
H. Baillon	1879	<i>Melanoselinum</i> Hoffm. <i>sensu</i> Baillon	<i>Melanoselinum edule</i> (Lowe) Baillon in Hist. Pl. 7: 93 (1879).	<i>Tornabenia</i> , <i>Melanoselinum</i> , <i>Monizia</i>
R. Masferrer	1881	<i>Thapsia</i> L. <i>sensu</i> Bentham	<i>Thapsia Monizia</i> Masf. in Anal. Soc. Esp. Hist. Nat. 10: 185 (1881).	<i>Thapsia</i> , <i>Melanoselinum</i> , <i>Monizia</i>
O. Drude	1898	<i>Melanoselinum</i> Hoffm. <i>sensu</i> Drude	<i>Melanoselinum edulis</i> (Lowe) Drude in Engler et Prantl. Pflanzenfam. 3 (8): 247 (1898).	<i>Melanoselinum</i> , <i>Monizia</i>
A. Chevalier	1935	<i>Melanoselinum</i> Hoffm. <i>sensu</i> Baillon	<i>Melanoselinum Moniza</i> (Masf.) A. Chev. in Bull. Mus. Natl. Hist. Nat., Ser. II. vii. 144, in obs. (1935)	<i>Tornabenia</i> , <i>Melanoselinum</i> , <i>Monizia</i>

¹Spelling according to authors (*).

Masferrer (1881), with the same line of thought as Bentham (1867) and Nicholson (1877), considered both monotypic genera *Monizia* and *Melanoselinum* under *Thapsia*, but new combinations were made, respectively *Thapsia Monizia* Masf. (accepted name: *Thapsia monizia* Masf.) and *Thapsia Melanoselina* Masf. (accepted name: *Thapsia melanoselina* Masf.).

Drude (1898), in opposition to Baillon (1876–1879), considered *Tornabenia* distinct from *Melanoselinum* and that both genera were not part of *Thapsia*. Drude merged *Monizia* with *Melanoselinum* with an additional new combination: *Melanoselinum edulis* (Lowe) Drude (accepted name: *Melanoselinum edule* (Lowe) Drude).

Chevalier (1935) agreed with Baillon (1876–1879) and merged *Monizia* and *Tornabenia* with *Melanoselinum*, and produced a new combination for *M. edulis* Lowe, i.e. *Melanoselinum Moniza* (Masf.) A. Chev. (accepted name: *Melanoselinum moniza* (Masf.) A. Chev.). Chevalier (1946) confirmed the inclusion of *Monizia* and *Tornabenia* within *Melanoselinum*, but did not consider his own new combination as a synonym of *M. edulis* Lowe.

Other authors have adopted specific taxonomic treatments without explanations for these choices. Menezes (1914) recognized *Monizia* as a monotypic genus and distinguished *Melanoselinum* from *Thapsia*. Hansen (1969) recognized Lowe's species of *Monizia* as *Melanoselinum edulis* (Lowe) Drude.

Heywood (1973) adopted *Melanoselinum sensu* Baillon without mentioning any of the species in the genus. Hansen and Sunding (1985) accepted the generic status of *Monizia* and considered *Melanoselinum* as a monotypic genus. Monod (1990) recognized Lowe's species of *Monizia* as *Melanoselinum edule* (Lowe) Baillon, but stated that the taxonomic relationships of *Monizia*, *Melanoselinum*, *Tornabena* Parl. (*Tornabenia* Benth. & Hook.f.) (accepted name: *Tornabenea* Parl.) and *Thapsia* remained opened to discussion. Hansen and Sunding

(1993), Press and Short (1994) and Dalgaard (1994) recognized *M. edulis*. Hansen and Sunding (1993) implicitly accepted the generic status of *Monizia*, whereas the other three authors considered *Monizia* as a monotypic genus (with *M. edulis*). More recently, Brochmann et al. (1997) regarded *Monizia* as congeneric with *Melanoselinum sensu* Drude) and *Tornabenea* as an endemic genus to Cape Verde Islands. Jardim and Sequeira (2008) considered *Monizia* and *Melanoselinum* as separate monotypic genera.

Molecular studies: key contributions

Studies based on molecular data (Downie et al. 2000; Spalik and Downie 2007; Spalik et al. 2010; Vandeloos et al. 2012) suggested that both *Monizia* Lowe (i.e. *M. edulis*) and *Melanoselinum* Hoffm. (i.e. *Me. decipiens*) should be separated from *Thapsia* L. or *Tornabenea* Parl.

Downie et al. (2000) proposed the inclusion of *M. edulis* in the tribe Scandiceae subtribe Daucinae and this taxonomic placement was confirmed by Spalik and Downie (2007). The latter study also showed that both *M. edulis* and *Me. decipiens* form a monophyletic group and, surprisingly, *Cryptotaenia elegans* (endemic to the Canary Islands, i.e. Tenerife, La Gomera, El Hierro and La Palma) appears as the sister taxon to the *M. edulis/Me. decipiens* clade. The phylogenetic reconstructions by Spalik and Downie (2007), based on internal transcribed spacer sequences, suggested that Macaronesian endemics – *C. elegans*, *Me. decipiens*, *M. edulis* and *Tornabenea* – are related to Mediterranean/northwestern African members of Scandiceae subtribe Daucinae. It was suggested that a first dispersal of Daucinae to Macaronesia gave rise to *C. elegans*, *M. edulis* and *Me. decipiens*, whereas the radiation of *Tornabenea* followed a second dispersal event to Macaronesia.

Spalik et al. (2010) estimated divergence of the *C. elegans*/*M. edulis*/*Me. decipiens* assemblage from its continental sister group to have occurred roughly around 14.6 million years ago (Ma), divergence of *M. edulis*/*Me. decipiens* from its sister taxon *C. elegans* was estimated at roughly 12 Ma, and divergence of *M. edulis* from *Me. decipiens* was estimated to have occurred roughly around 2.5 Ma ago. This is in agreement with an end of Tertiary and early Quaternary origin previously hypothesized that considered *M. edulis* as a Madeiran neo-endemism (Capelo et al. 2004). Spalik et al. (2010) suggested that the insular woodiness found in *M. edulis* and *Me. decipiens* is a derived trait that evolved under insular conditions, because its sister group is composed of herbaceous plants. The mode of seed dispersal also appears to have changed from exozoochory to wind or other modes of dispersal in *C. elegans*, *Me. decipiens* and *M. edulis* according to Spalik and Downie (2007), i.e. in the absence of dispersing agents like terrestrial mammals, the insular descendants of zoochoric species would have switched to other modes of dispersal. These authors emphasized that fruits from taxa belonging to the sister group of the *M. edulis*/*Me. decipiens*/*C. elegans* lineage are usually animal-dispersed (exozoochory) due to their spiny secondary ridge; in contrast, the fruits of the *M. edulis*/*Me. decipiens* clade are not spiny and have much broader secondary ridges, facilitating wind dispersal. Moreover, these authors also mentioned that fruits of *C. elegans* are glabrous and do not have secondary ridges or any other appendages facilitating animal (exozoochory) or wind dispersal and are probably gravity-dispersed. Despite not being mentioned by Spalik and Downie (2007), sea currents might also have played an important role in inter-island seed dispersal within Macaronesia.

Vandelook et al. (2012) based on nuclear ribosomal ITS sequences produced a phylogram showing *Thapsia garganica* L. and *Me. decipiens* (Schrad. & J.C. Wendl.) Hoffm. in two separated clades with an estimated time of divergence of more than 30 Ma.

In light of molecular data, *Monizia* and *Melanoselinum* are monophyletic and clearly separated from *Tornabenea*. Moreover, *Monizia* and *Melanoselinum*, once considered as part of *Thapsia*, were shown to be well apart.

The species: *Monizia edulis*

Lowe (1856) considered one single species within *Monizia*, i.e. *M. edulis*. This taxon was first discovered on 4 June 1855 by R.T. Lowe and T.V. Wollaston on a sea cliff on the east side of the island of Deserta Grande (Madeira Archipelago) at about 300 m. Hooker (1868) presented an illustration of this species (Figure 1) based on at least two specimens in cultivation at the Royal Botanical Gardens at Kew but made no direct reference to the collectors or provenance of these cultivated specimens, though it is clear that their wild origin can be traced to Deserta Grande because it is mentioned that the illustration corresponds to Lowe's species of *M. edulis*.

Lowe (1869) reported *M. edulis* on the Selvagens Islands (Selvagem Grande), following the observation of Constantino Cabral de Noronha, the owner of this group of islands:

it is found in the clefts of rocks and also amongst stones, that the flowers are purplish ('roxa'), and that it is called 'Aipo da Rocha.'

The presence of *M. edulis* on this archipelago can be linked to the herbarium specimen (K000272592) held at the Royal Botanic Garden at Kew and collected in 1863 by C.C. de Noronha. Reports on the presence of this species on Selvagens made by Vahl (1905) and Menezes (1914) appears to us to be based solely on published references because no reference was made to new collections. Menezes (1923), based mostly on the study of the collections of Archibald Clode (1868–1923; see Clode 1983) in 1918 and Adolfo César de Noronha (1873–1863; see Hansen 1980), and in a personal communication from A.C. de Noronha, considered this species to be extinct on this archipelago. Later expeditions to the islands have resulted in no observations or collections of *M. edulis*, namely those visits made in 1953 and 1968 by Eric R. Sventenius (1910–1973) (Santos 2001); 1953 and 1954 by Nóbrega (1955); 1958, 1959, 1961 and 1963 by C.H.C. Pickering (Pickering and Maul 1964; Pickering and Hansen 1969); 1976 by Pérez de Paz and Ginovés (1978, 1983) and 1999 by Santos-Guerra (pers. comm. 2013). More recently, Dalgaard (1991) stated:

At present time *Monizia edulis* is extinct on the Salvages Islands and very rare on Madeira, where it may still be present on Deserta Grande.

Despite these reports, Vieira (1992) and Press and Short (1994) mentioned the presence of *M. edulis* on Selvagens.

Hansen (1969) and Hansen and Sunding (1985, 1993) referred to *M. edulis* as endemic to Madeira and Selvagens without mentioning its status on Selvagens. Other authors (Jardim et al. 2006) considered reports of *M. edulis* on Selvagens as a result of misidentifications or of labels being swapped with specimens collected on Desertas Islands. Jardim and Sequeira (2008) considered *M. edulis* to be extinct on Selvagens. More recently, Isamberto Silva (pers. comm. 2013), after several visits to Selvagem Grande from 1989 to 2013, also recorded no observations of *M. edulis*. Francisco Fernandes during a 3-week stay in 2007 on Selvagem Grande could not locate this species either (unpublished data).

The presence of *M. edulis* on Porto Santo has been uncertain despite the fact that it has been mentioned in the literature. Monod (1986) revived the possibility of wild carrots ("cynoiros brauos", the vernacular name for *M. edulis*) to be present on the Porto Santo islet known as "Ilhéu das Cenouras". The name of the islet itself, translated as "Islet of Carrots", appears to be derived from the presence of wild edible carrots (Lowe 1857–1872). Moreover, local people (Luis Silva, pers. comm. 2010) visiting

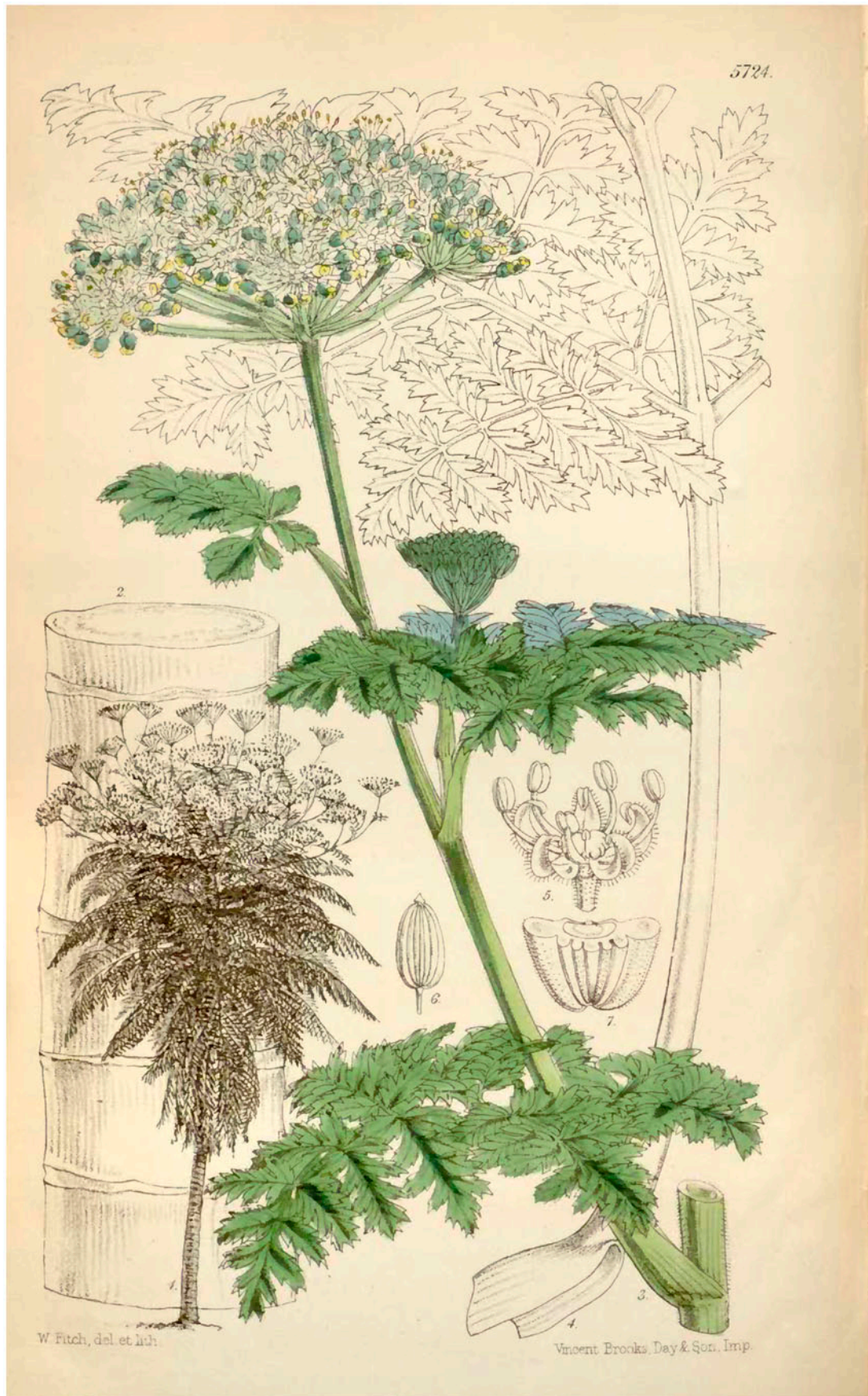


Figure 1. Plate of *Monizia edulis* (Tab. 5724 in Hooker Curtis's *Bot. Mag.*, 3rd series, Vol. XXIV., 1868). The picture was obtained from BHL (<http://www.biodiversitylibrary.org/ia/mobot31753002721683#page/1/mode/1up>) and is classified as a public domain (<http://biodivlib.wikispaces.com/Licensing+and+Copyright>). Appreciation is due to Biodiversity Heritage Library and to the Missouri Botanical Garden, Peter H. Raven Library (the library that supplied the texts for digitization).

the islet as recently as the last decade have reported the presence of these wild carrots. Despite these reports, no herbarium specimens were known from Porto Santo. Fontinha and Jardim (1999) produced a catalogue of vascular plants present on the small islands of Porto Santo but did not report the presence of *M. edulis*. In 2006, Jardim et al. indicated that *M. edulis* was extinct in Porto Santo but more recent studies suggested an uncertain distribution status on this island (Jardim and Sequeira 2008). In 2010, Carvalho et al. (2013) observed *M. edulis* on Ilhéu de Cima but no plants were found on Ilhéu da Cenouras.

Monizia is retained as a monotypic genus and based on morphological and field studies we consider *M. edulis* to form a species complex with four different morphs that deserve taxonomic recognition. In this paper, we provide a formal revision for this infra-specific complex, with four new subspecies described within *M. edulis*.

Materials and Methods

Herbarium specimens were collected on the islands of Porto Santo and Madeira during spring 2011 and 2012. They are deposited in Jardim Botânico da Madeira (MADJ; including types). We sampled material from all known populations of this species with the exception of two on the island of Madeira (i.e. Ilhéu da Ribeira da Janela and Rocha do Navio) and another one on the Desertas Island (i.e. Island of Bugio). Additional herbarium specimens from MADJ, Museu Municipal do Funchal (MADM), Museu de História Natural of the University of Porto (PO), the Natural History Museum, London (BM), Royal Botanic Gardens at Kew (K) and Muséum National d'Histoire Naturelle, Paris (P) were examined. The morphological characters used by Lowe (1856, 1857–1872) for his original species and expanded descriptions were selected for the present study. Consistency of characters used for the descriptions produced herein followed Feliner et al. (2003). Based on our morphological observations, we included an additional set of characters as they proved to have taxonomic value for distinguishing the taxa described in this study. Geographical coordinates of the specimens studied were obtained through GPS technology. Distributions were plotted into 0.5-km² grids based on Universal Transverse Mercator using the software QGIS. Photographs of specimens were taken with a binocular magnifying glass Zeiss Stemi 2000-C with a Canon PowerShot G6 camera. Images and morphological measurement were processed using Canon Utilities ZoomBrowser EX 5.0 version 5.0.0.142 and AxioVision Rel. 4.4 software.

Results and Discussion

Typification of the genus *Monizia* and the species *Monizia edulis*

Lowe (1856) described *Monizia* as a monotypic genus, based solely on specimens with fruit and leaves of the flowering stem, without designating any herbarium

specimens or illustrations but mentioning a unique locality, the “locus classicus”, as Deserta Grande. Specimens from the Herbarium of Rev. R.T. Lowe with the no. 893 and collected on 4 June 1855 on Deserta Grande, the date Lowe and Wollaston visited this island, are kept at the Royal Botanic Gardens at Kew (K000272594; K000272595), the Natural History Museum, London (BM000030963; BM000030987; BM000030988) and the Muséum National d'Histoire Naturelle, Paris (P00462010). Of all these specimens, only a single sheet (BM000030988) has fruits and leaves of the flowering stem but has no original inscription; however, on the reverse page there is the observation that this specimen was collected by Lowe on Deserta Grande in 1855. It is legitimate to assume that this is the specimen on which Lowe based his original description (Lowe 1856). Almost a decade later in 1864, Lowe (1857–1872), in part III of *A manual Flora of Madeira and the adjacent islands of Porto Santo and the Desertas*, expanded the original description of *M. edulis* and expressed: “I am now enabled to complete its description by adding the somewhat peculiar details of the fl., which confirm its approximate position to *Melanoselinum*, by the help of dried flowering spec. raised in Funchal by Sr. J.M. Moniz”. Such dried specimens sent to Lowe can be related to a specimen held at Royal Botanic Gardens at Kew (K000272591) of Deserta Grande origin, which was cultivated by J.M. Moniz and collected in 1863.

Lowe assigned an illustration to *Monizia edulis* in 1868 when it was referred to “add to syn.: BM. t. 5724” (Figure 1) (Lowe 1857–1872). This is for a plate included in Curtis’s Botanical Magazine that was drawn from plants grown at the Royal Botanic Gardens, Kew (Hooker 1868). In the text appended to the illustration, Hooker refers the illustration to “MONIZIA edulis. Lowe, Manual of Flora of Madeira, p. 365, et Hook. Kew Journ. Bot. v. 8. p. 295.” And therefore, implicitly specimens cultivated at Kew can be traced to those on which Lowe expanded the original description in 1864, i.e. the specimens cultivated by Moniz. Moreover, there is a herbarium specimen held at the Royal Botanic Gardens at Kew (K000272596) that can be related to those specimens cultivated at Kew. This specimen from Hooker’s herbarium (“Herbarium Hookerianum”) and dated 1867 contains a note: “from Mr. Lowe...Mr. Bentham” and the handwritten label “*Monizia edulis* Lowe, Great Dez^a June 55” and also “Hort. Kew 1864”. This indicates that a year after the collection of Moniz’s dried specimens in 1863, material of *M. edulis* was cultivated at Kew in 1864, and herbarium specimens with fruits were produced in 1867 a year earlier than Hooker’s publication in 1868.

Two interesting additional notes can be given on three specimens, one held at the Royal Botanic Gardens, Kew and two held at the Muséum National d'Histoire Naturelle, Paris. The first specimens held at the Royal Botanic Gardens at Kew (K000272593) can be linked to a report published in volume three of the *Journal of the Proceedings of the Linnean Society (Zoology)* published

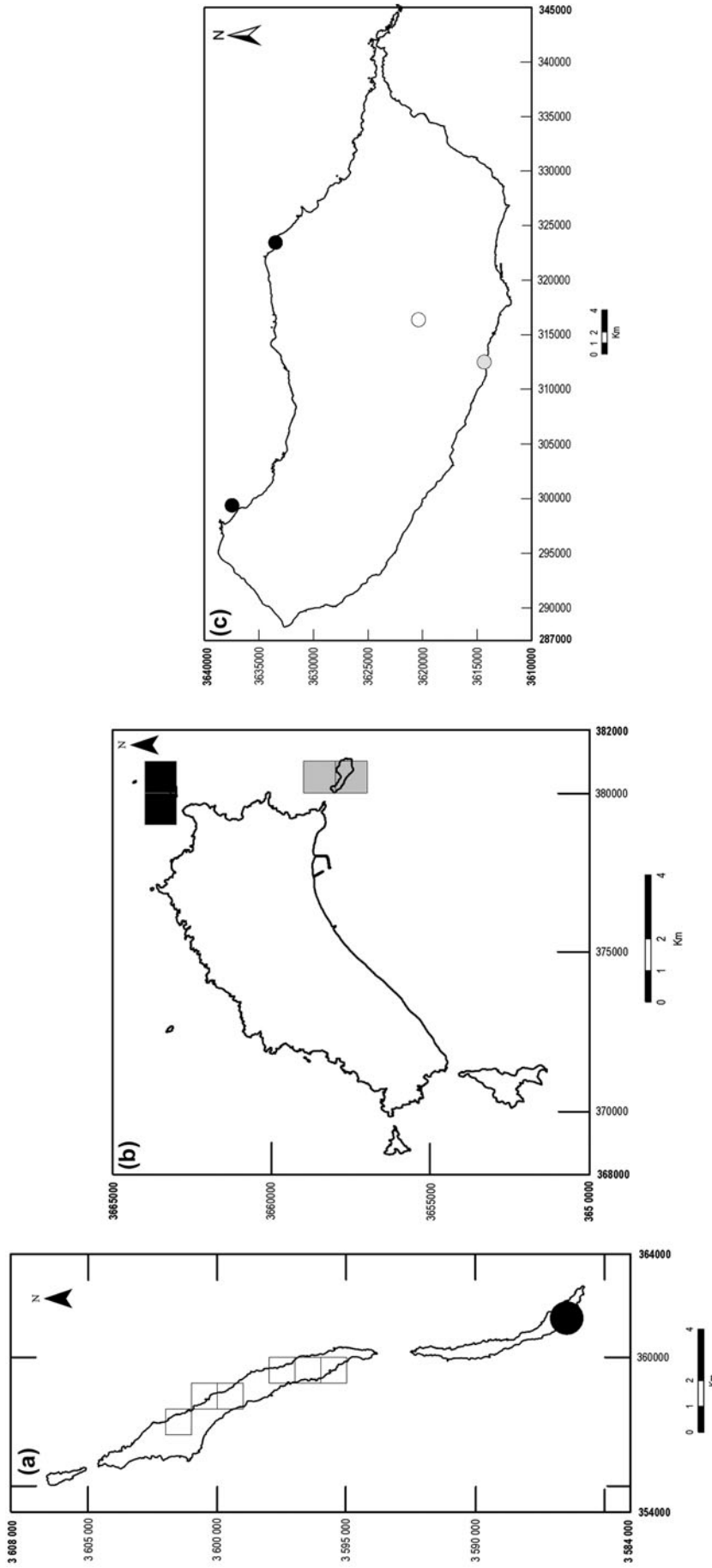


Figure 2. Distribution of *Monizia*: (a) **Desertas**: *Monizia edulis* subsp. *edulis* (□) on Deserta Grande and non studied populations (●) on Bugio; (b) **Porto Santo**: *Monizia edulis* subsp. *santosii* (□) on Ilhéu de Cima and presumed extinct on Ilhéu das Cenouras (■); (c) **Island of Madeira**: *Monizia edulis* subsp. *isambertoi* (○), *M. edulis* subsp. *giranus* (○), and non studied populations (●) on Madeira.

in 1859 in which was mentioned a plant of *M. edulis* collected on Madeira (archipelago) by N.H. Mason (date of birth and death unknown, see Hansen 1980) in 1856 and donated to the Museum of the Linnean Society. The second and third specimens held at the Muséum National d'Histoire Naturelle, Paris (P03248923 and P03248924) collected both in 1857 hold the inscriptions “Màdere” or “Ile Madère”. However, with careful examination of leaves and comparison with present day known morphotypes, we must assume such specimens to be of Desertas Islands origin but possibly cultivated on the Island of Madeira, considering that on the label reference is made to the island of Madeira.

A problematic specimen is held at the Museu de História Natural of the University of Porto: (PO54512) consisting of two separate sheets without any fruit or flower and with only leaves. Both sheets are labelled as collected by C. Menezes on Curral das Freiras with no date. However, the observation of such specimens indicates that each sheet corresponds to a different morphotype, i.e. one belongs to the Curral das Freiras morphotype (*M. edulis* subsp. *isambertoii*) and the other to the Deserta Grande morphotype (*M. edulis* subsp. *edulis*).

The specimen collected on Selvagem Grande held at the Royal Botanic Gardens, Kew (K000272592) has no flowers or fruits but presents a leaf morphotype that is much closer to the Deserta Grande one, i.e. *M. edulis* subsp. *edulis*, than to any other.

Species synonymy

Chevalier (1935) based his own combination (*Melanoselinum moniza*) on that of Masferrer (1881), i.e. *Thapsia monizia*, which in turn was based on “*Monizia edulis* Lowe, l.c. 365”, i.e. on the expanded description to Lowe (1857–1872: 365) in which Lowe made reference to the original protologue of *Monizia edulis* (Lowe 1856).

Drude (1898) referred to the basionym of its new combination *Melanoselinum edulis* in the following terms “*M. edulis* (Lwe.) Drude”, and therefore reference was made to Lowe’s 1856 original description of both genus and species.

Baillon (1879), in his new combination at the generic level, includes *Monizia* within *Melanoselinum* and refers to Lowe’s *Monizia* protologue (1856), Lowe’s expanded description (Lowe 1857–1872) and also to Hooker’s illustration (Tab. 5724 in Hooker 1868). However, the suggestion for a new combination “*Melanoselinum (Monizia) edule*” was made as a title of an illustration that does not correspond to *M. edulis* Lowe, and therefore it must be considered an illegitimate name.

Nicholson (1877) established the correspondence of his new combination, i.e. *Thapsia edulis* with Hooker’s illustration (Tab. 5724 in Hooker 1868). In turn, Hooker (1868) indicated his illustration corresponded to Lowe’s species of *M. edulis* (Lowe 1856; Lowe 1857–1872). On

the other hand, Lowe (1857–1872) also established the correspondence of his own species of *Monizia edulis* to Hooker’s illustration.

In conclusion, all combinations except that of Baillon (1879), refer to the *M. edulis* Lowe protologue with direct or indirect reference to the basionym and type, even if made without author citation and are based on material originated from Deserta Grande. Therefore, all but the combination of Baillon are nomenclatural synonyms of *M. edulis* Lowe.

Description and types

Monizia Lowe in Hooker’s J. Bot. 8: 295. 1856

(=) *Thapsia* L. *sensu* Benth in Gen. Pl. 1(3): 930 (1867).

(=) *Melanoselinum* Hoffm. *sensu* Baillon in Hist. Pl. 7: 93 (1879).

(=) *Melanoselinum* Hoffm. *sensu* Drude in Engler et Prantl. Pflanzenfam. 3 (8): 247 (1898).

The original description of the monotypic genus *Monizia* (Lowe 1856) is here transcribed:

“Flores ... Fructus a dorso plano-compressus, 14-costatus, costis (praesertim 4 lateralibus marginalibus) crassis fungoso-suberosis obtusis rotundatis inermibus, 10 dorsalibus (intermediis) minoribus, 4 lateralibus (marginalibus) magnis. Mericarpiis jugis primariis 5, 3 intermediis crassiusculis subfungoso-suberosis dorso, 2 lateralibus v. potius ventralibus tenuibus (vix filiformibus) simplicibus nec fungosis plano commissurali impositis; secundariis 4 dorsalibus, 2 commissuralibus latissimis; carpophoro bipartito. Semen complanatum. – Herba basi frutescens, caudice simplici abbreviato obeso crasso lignoso subarboreo, caule florifero annuo terminali erecto-ramoso, foliis aequaliter et concinne decomposito-pinnatisectis, segmentis rigidiusculis lucidis glabris, petiolis late vaginantibus velutinis. Umbellae compositae multiradiatae, bracteis bracteolisque (involucris involucellis-que) polyphyllis integris. Flores albi.”

Type: Portugal, Madeira, Desertas: Deserta Grande, 1855, Lowe, (holo BM000030988); Gr.¹ Dez.^a, 4.vi.1855, Lowe (iso K000272594, K000272595, BM000030963, BM000030987, P00462010).

Additional material examined: see Appendix 1.

Etymology

After João Maria Moniz (1822–1898) (Lowe 1856).

Distribution

Portugal, Madeira Islands: Madeira, Deserta Grande (Lowe 1856), Bugio and Ilhéu de Cima on Porto Santo (Figure 2A–C); Extinct on Selvagens.

Habitat

Plants occur in clefts of rocks and in small patches of soil in steep cliffs and areas sheltered from the sun, ranging from 18 to 1500 m.

Monizia edulis Lowe in Hooker's J. Bot. 8: 295. 1856

(≡) *Thapsia edulis* (Lowe) G.Nicholson in Dict. Gard. 4: 74 (1887).

(≡) *Thapsia Monizia* (Lowe) Masf. in Anal. Soc. Esp. Hist. Nat. 10: 185 (1881).

(≡) *Melanoselinum edulis* (Lowe) Drude in Engler et Prantl. Pflanzenfam. 3 (8): 247 (1898).

(≡) *Melanoselinum Moniza* (Masf.) A.Chev. in Bull. Mus. Natl. Hist. Nat., Ser. II. vii. 144, in obs. (1935).

The original description of *Monizia edulis* (Lowe 1856) is here transcribed:

“*Stem or sub-aerial root or caudex often 30 cm or more above the ground, strong and woody, black, covered upwards with the remains of old leaves, simple erect straight sub-obese or more or less swollen in the middle. Flower stem annual terminal single erect 30–90 cm, stiff copiously branched into a wide-spreading panicle of flowers from its base at the top or crown of the sub-aerial root or rootstock. Leaves chiefly radical broadly triangular in outline, about 30 cm long and as wide at the base as long, of a peculiar bright yellow-green with a shining varnish-like polish, slightly rigid; the lower finely, regularly and equably decomposed 3–4 pinnatisect, the ultimate segments very distinct or sub-remote equal narrow-oblong or linear sub-obtuse sharply and regularly inciso-serrate rigid shining and very smooth their rachises throughout being on the contrary all finely puberulous; upper stem and floral leaves 2–3 pinnatisect with broad short sub-ovate incised leafy segments, but otherwise like the lower leaves. Petioles and sheaths large thick highly developed and both closely but very shortly and finely pubescent. Flower stems, branches of panicle and peduncle round strongly striated finely and shortly pubescent especially upwards. Umbels compact globose rounded confluent 20–25 rayed, rays subequal crowded about 2.5 cm long stout ribbed minutely pubescent; partial rays about as many and other-wise similar but only 2–3 lines long. General and partial involucre 6–10 lanceolate or linear-lanceolate finely setaceous-acuminate and down, i. e. very shortly velvety at the back, hairy-fringed at the edges. Flowers small dull white. Ovary and the distinct ovate erect mucronate sepals thickly pubescent. Petals clothed all over outside at the back with short and ciliate or fringed at the edges with longer hairs quite to the mostly blunt sometimes acute tip of their ligulate or narrow-spathulate lacinia. Stamens twice as long as petals, anthers lilac or purple. Styles short thick erect mutually incurved or forcipate in flower, in fruit divergent. Stylopod tumid in flower, conic in fruit. Fruit dorsally flattened but thickish, oblong-oval or elliptical, a little pointed or contracted at each end, 4–6 lines long, 2 to 3½ broad, 1½ to 2 thick, finely and shortly and thickly pubescent all over pale sienna-brown or fawn-colour, 14-ribbed, the ribs all thickened obtuse corky, the 4 lateral very large, the dorsal smaller unequal. In each mericarp are visible externally 7 ribs, 5 dorsal and 2 (very large) lateral or marginal. Of the 5*

dorsal ribs 3 are primary and the 2 alternate secondary, the latter often quite as prominent or even more so than the middle one at least of the 3 primary; the 2 remaining primary are small simple and invisible except on a transverse section of the fruit, being placed almost on the commissure close behind the 2 remaining lateral or marginal vastly enlarged thickened and dilated fungose secondary ribs almost within the edges of the mericarp. Vittae (oil tubes) 6; 4 dorsal slender, one under each secondary rib, and 2 commissural very broad and shallow. Carpophore bipartite.”

Type: the same as genus.

Etymology

Edible

Common name

Cenoula da rocha (Lowe 1856), Cenoula or Cenoura da rocha (Lowe 1857–1872), Nozelha or Cenoira da rocha (Menezes 1914), Nozelha or Cenoura da rocha (Press & Short 1994).

Distribution

Portugal, Madeira Islands: Madeira, Deserta Grande (Lowe 1856), Bugio, and Ilhéu de Cima on Porto Santo (Figure 2A–C); Extinct on Selvagens. This species was firstly reported on Deserta Grande by Lowe (1856), to the Selvagens by Lowe (1869), to Bugio and Madeira by Grabham (1887) and to Porto Santo by Carvalho et al. (2013). The report of *M. edulis* on Selvagens is confirmed by the herbarium specimen K000272592 collected by C.C. Noronha in 1863. A set of populations of *M. edulis* (Figure 2) have not been sampled due to difficulties in access, namely those that have been reported to Bugio in Desertas (Grabham 1887; Isamberto Silva, pers. comm. 2011), Rocha do Navio de Santana (Horácio Caldeira, pers. comm. 2012) and Ribeira da Janela (Jardim et al. 2006) in the Island of Madeira.

Habitat

Plants occur in clefts of rocks and in small patches of soil in steep cliffs and sun sheltered areas (Figure 3A–G), ranging from 18 to 950 m. Populations at higher altitudes c.1500 m cited by Menezes (1914) have not been found in the recent past.

Conservation status

The conservation status of this species was evaluated by Jardim et al. (2006), Jardim et al. (2008) and Fernandes (2011). In the present day scenario, pressures and threats are the same. This species is to be considered Critically Endangered – CR B2ab(ii,iii,iv,v); C2a(i) due to an area



Figure 3. Habitats of *Monizia*: (a) *M. edulis* subsp. *edulis*; (b-c) *M. edulis* subsp. *santosii*; (d-e) *M. edulis* subsp. *isambertoii*; and (f-g) *M. edulis* subsp. *giranus*. In picture (c) Arnoldo Santos Guerra (left) and Isamberto Silva (right). Photographs by the authors.



Figure 3. (Continued)

of occupancy less than 10 km²; severely fragmented populations; continuing decline observed in the area of occupancy, quality of habitat, number of locations, and number of mature individuals; but also population size estimated to number fewer than 250 mature individuals, a continuing decline observed in numbers of mature individuals and no subpopulation estimated to contain more than 50 mature individuals as defined by IUCN (2012). The most important pressures and threats are heavy grazing by goats (heavily felt on Deserta Grande) and rabbits, fire, natural landslides and competition by invasive plant species.

Monizia edulis* Lowe subsp. *edulis

(≡) *Thapsia edulis* (Lowe) G.Nicholson in Dict. Gard. 4: 74 (1887).

(≡) *Thapsia Monizia* (Lowe) Masf. in Anal. Soc. Esp. Hist. Nat. 10: 185 (1881).

(≡) *Melanoselinum edulis* (Lowe) Drude in Engler et Prantl. Pflanzenfam. 3 (8): 247 (1898).

(≡) *Melanoselinum Moniza* (Masf.) A.Chev. in Bull. Mus. Natl. Hist. Nat., Ser. II. vii. 144, in obs. (1935).

Description

Plant up to 183 cm. Stem or sub-aerial root or caudex up to 123 cm simple, erect, approximately tubular. Radical leaves 3–4 pinnatisect; ultimate segments remote but

only sub-remote at the apex, angular-ovate to triangular, inciso-serrate, obtuse-acuminate pointing towards the apex (Figure 4A–D). Terminal umbel in fruit with peduncle c.9.2–12.0 cm; first order umbel rays in fruit c.2.6 cm; bracts in fruit narrowly triangular c.4.1 × longer than wide. Sepals in fruit (Figure 5D) minute 0.3–0.5 mm long. Style in fruit (Figure 5A) 0.7–0.9 mm, patent. Mericarp (Figure 5A–D) 1.0–1.3 × 0.5–0.6 cm, c.2.1 × longer than wide, elliptical; testa and dorsal ribs mostly smooth but rarely sub-tuberculate; dorsal ribs clearly differing in size: the two secondary dorsal ribs peltate or mushroom-like in transverse section often much more prominent than the median primary dorsal rib (Figure 6A), the median primary dorsal rib often inconspicuous not visible except on a transverse section and smaller in size than the two external primary dorsal ribs (Figure 6A); secondary marginal ribs obovate (Figure 6A), 1.6–1.7 × 1.1–1.4 mm.

Types: The same as genus.

Additional material examined

See Appendix 1.

Etymology

Edible.



Figure 3. (Continued)



Figure 3. (Continued)

Common name

Cenoula da rocha (Lowe 1856), Cenoula or Cenoura da rocha (Lowe 1857–1872), Nozelha or Cenoira da rocha (Menezes 1914), Nozelha or Cenoura da rocha (Press & Short 1994).

Distribution

Portugal, Madeira Islands: Deserta Grande (Lowe 1856) (Figure 2A).

Habitat

Plants occur in clefts of rocks and in small patches of soil in steep sea-facing cliffs and areas sheltered from the sun (Figure 3A), ranging from 20 (Isamberto Silva, pers. comm. 2011) to 400 m. Other species share the same habitat, e.g. *Heberdenia excelsa* (Aiton) Banks ex DC., *Sideroxylon mirmulans* R. Br., *Sonchus ustulatus* Lowe and *Tolpis succulenta* (Dryand. in Aiton) Lowe, *Siderites candicans* Aiton, *Phyllis nobla* L.

Conservation status

This subspecies has been subject to high pressure from the presence of goats. However, in the last decade, control of

herbivores has been one of the main conservation actions led by the Parque Natural da Madeira (Menezes et al. 2007). There were reports of an accentuated decrease in the number of goats on Deserta Grande with a clear increase in the number of individuals and subpopulations of *M. edulis* subsp. *edulis* (Isamberto Silva, pers. comm. 2011). However, in the last 2–3 years an increase in the population of goats along with abnormally dry years led to a decrease of food availability. Persistence and increase in number of goats led to fragmentation, decrease in numbers of subpopulations and individuals and threats to the long-term survival of this subspecies. A visit to Deserta Grande in April 2013 showed an accentuated decrease in the presence of *M. edulis* subsp. *edulis* with specimens found only in places inaccessible to goats. This subspecies is to be considered Critically Endangered – CR B2ab(ii,iii,iv,v); D due to severely fragmented populations; continuing decline observed in the area of occupancy, quality of habitat, number of locations, and number of mature individuals; and also due to a population size estimated to number fewer than 50 mature individuals as defined by IUCN (2012). The most important pressure and threat comes from heavy grazing by goats.

Monizia edulis Lowe subsp. *santosii* F. Fernandes & J.A. Carvalho, **subsp. nov.**



Figure 3. (Continued)

Description

Plant shortly caulescent, up to 46 cm. Stem or sub-aerial root or caudex up to 16 cm, conical. Radical leaves coriaceous forming compact rosettes closely appressed to soil surface 4–5 pinnatisect, mucronate; ultimate segments compact and imbricate, angular-ovate to triangular, inciso-serrate, obtuse-acuminate pointing towards the apex (Figure 4E, F). Peduncle of terminal umbel in fruit c.1.4–5.1 cm; first order umbel rays in fruit c.2.6 cm; bracts triangular c.3.4 × longer than wide. Sepals in fruit (Figure 5H) small 0.6–0.9 mm. Style in fruit 0.8–1.2 mm, patent (Figure 5E). Mericarp (1.1)1.2–1.5 × 0.5–0.6 (0.7) cm, c.2.5 × longer than wide, elliptical to slightly narrowly elliptical (Figure 5E–H); testa and dorsal ribs mostly smooth, rarely sub-tuberculate. Dorsal ribs clearly differing in size; the two secondary dorsal ribs peltate or mushroom-like in transverse section often much more prominent than the median primary dorsal rib (Figure 6B); the median primary dorsal rib often inconspicuous not visible except in transverse section and often equalling in size the two external primary dorsal ribs (Figure 6B); secondary marginal ribs obovate 1.1–1.4 × 1.0 mm wide (Figure 6B).

Type: Portugal, Madeira, Porto Santo: Ilhéu de Cima, 80 m, 02.vi.2012, B. Castro & F. Fernandes (holo MADJ12944); Ilhéu de Cima, 80 m, 02.vi.2012, B. Castro & F. Fernandes (iso MADJ13041).

Etymology

After Arnaldo Santos Guerra (born 1948) to honour his life-time contribution to the knowledge of the Macaronesian flora.

Additional material examined

See Appendix 1.

Common name

Cenoura da rocha, Nozelha da rocha.

Distribution

This subspecies is restricted to the islet known as “Ilhéu de Cima” (Figure 2B) in Porto Santo (Carvalho et al. 2013). Presumed extinct on “Ilhéu das Cenouras”.

Habitat

Plants occur in clefts of rocks and in small patches of soil in north-facing sea cliffs and areas sheltered from the sun under the direct influence of the cooler and humid northeastern sea winds (Figure 3B, C) at altitudinal levels that range from 18 to 80 m. Other species can be found sharing the same habitat with *M. edulis* subsp.



Figure 3. (Continued)



Figure 3. (Continued)

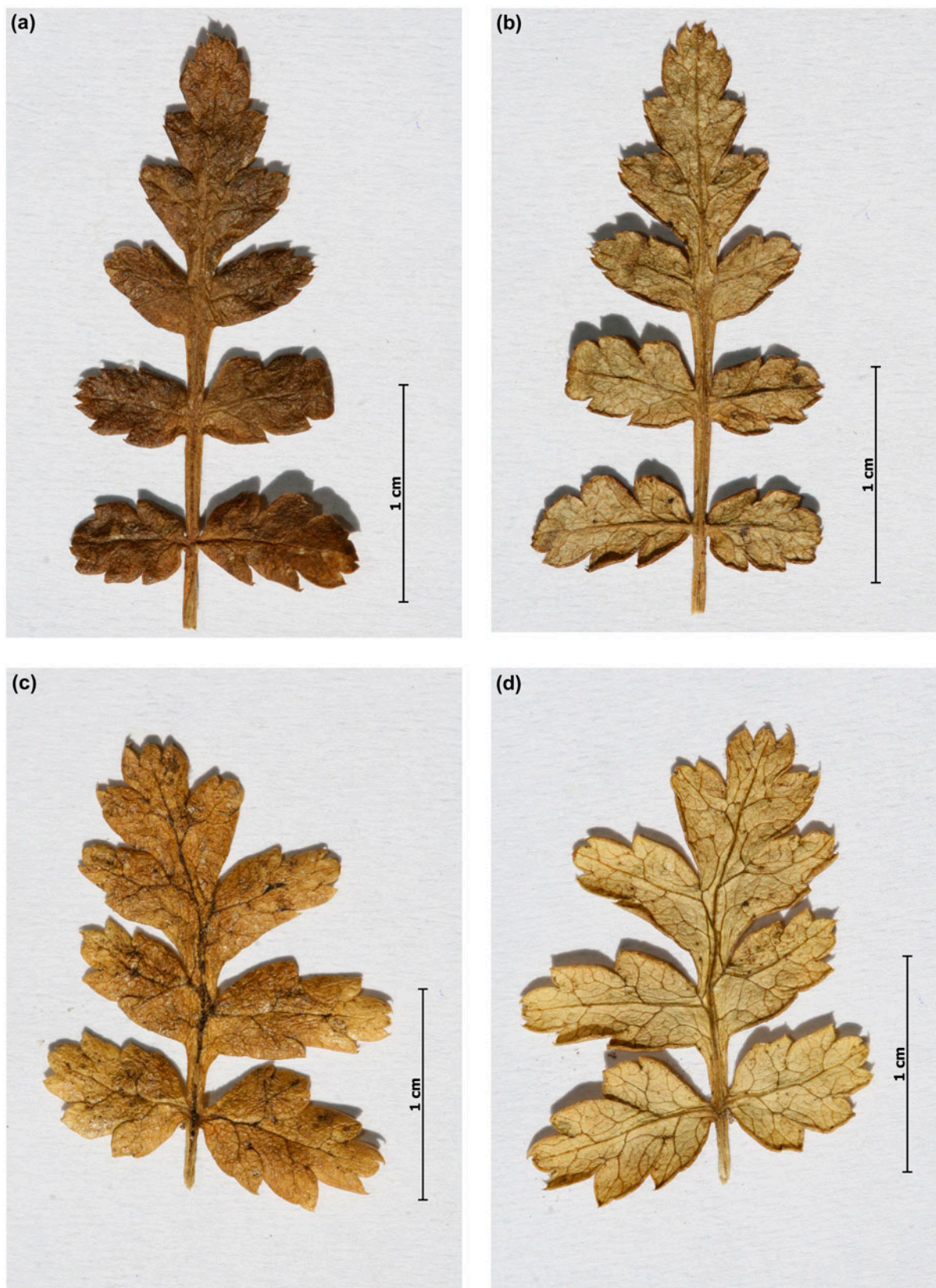


Figure 4. Leaf segments showing ultimate segments: (a-d) *M. edulis* subsp. *edulis*; (e-f) *M. edulis* subsp. *santosii*; (g-h) *M. edulis* subsp. *isambertoi*; (i-j) *M. edulis* subsp. *giranus*. Photographs by the authors.

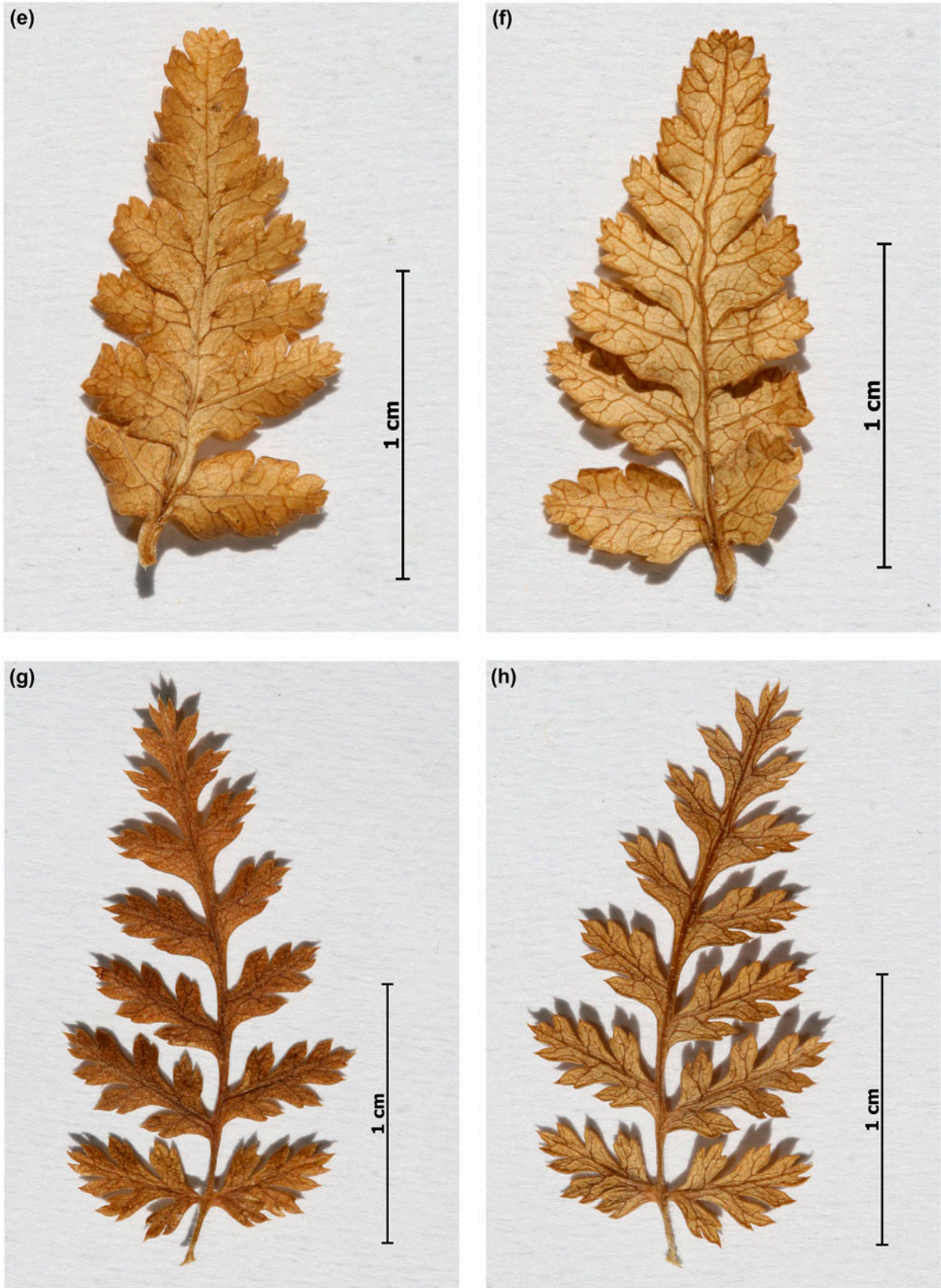


Figure 4. (Continued)

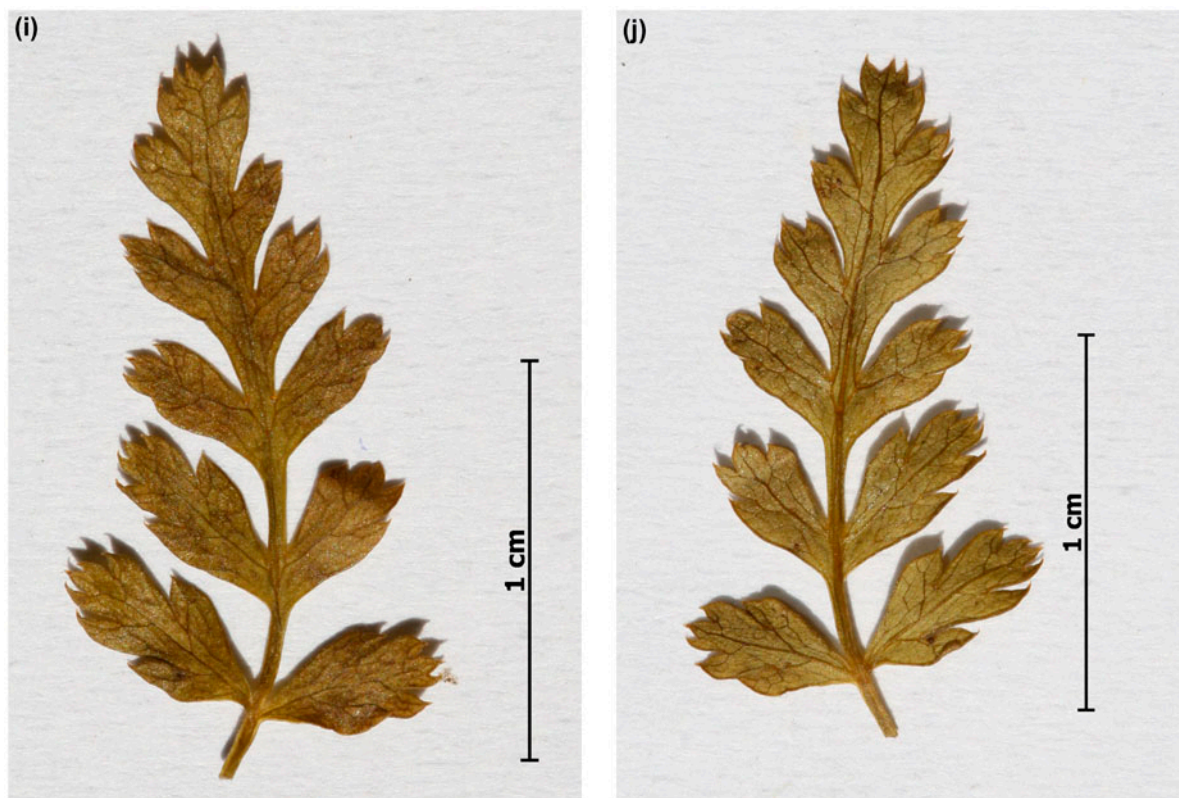


Figure 4. (Continued)

santosii at I. Cima, e.g. *Lotus glaucus* Aiton, *Phyllis nobla* L., *Crithmum maritimum* L., *Tolpis succulenta* (Dryand. in Aiton) Lowe, *Crambe fruticosa* L.f., *Matthiola maderensis* Lowe, *Andryala glandulosa* Lam. subsp. *glandulosa*, *Sonchus parathalassius* J.G. Costa ex R. Jardim & M. Seq., *Artemisia argentea* L'Hér.

Conservation status

This subspecies is to be considered Critically Endangered – CR D due to a population size estimated to number fewer than 50 mature individuals as defined by IUCN (2012). The only significant pressure and threat has been eliminated since 2012, namely rabbits. The area was classified as a natural reserve and included in the European network of protected areas. Therefore, conditions for the population to thrive were restored, which provides good prospects for the long-term survival of this subspecies. However, natural landslides are still a threat, at least until the population increases its size in the number of individuals and subpopulations.

Monizia edulis Lowe subsp. *isambertoii* F. Fernandes & J.A. Carvalho, **subsp. nov.**

Description

Plant caulescent up to 123 cm. Stem or sub-aerial root or caudex up to 60 cm, approximately tubular. Radical

leaves ascending and flexible, 4–5 pinnatisect; ultimate segments remote and only sub-remote at the apex, angular-ovate to elliptical, lacinio-serrate and dentate, acute-acuminate mostly pointing outwards and obliquely to the midrib (Figure 4G, H). Terminal umbel peduncle c. 6.8–9.5 cm; first-order umbel rays in fruit c.3.1 cm; bracts very narrowly triangular to linear-triangular c. 7.3 × longer than wide. Sepals in fruit (Figure 5L) minute, 0.3–0.6 mm long. Style in fruit (Figure 5I) 1.2–1.9 mm, erect to erect-patent. Mericarp (Figure 5I–L) 1.0–1.2 × 0.4–0.6 cm, 2.3 × longer than wide, elliptical to ovate; testa and dorsal ribs tuberculate; dorsal ribs often almost equally prominent: the two secondary dorsal ribs circular in transverse section and often slightly larger in size than the median primary dorsal rib (Figure 6C), the median primary dorsal rib visible and equalling in size the two external primary dorsal ribs (Figure 6C); secondary marginal ribs oblong to broadly oblong (Figure 6C), 1.4–1.5 × 1.0–1.2 mm.

Type: Portugal, Madeira, Island of Madeira: Cural das Freiras, 950 m, 23.iv.2013, F. Fernandes (holo MADJ13004); Cural das Freiras, 950 m, 23.iv.2013, F. Fernandes (iso MADJ13042).

Etymology

After Isamberto Silva, a Madeiran naturalist (born 1963).

Table 2. Diagnostic characters for *Monizia edulis* subsp. *edulis*, *Monizia edulis* subsp. *santosii*, *Monizia edulis* subsp. *isambertoi* and *Monizia edulis* subsp. *giranus*.

Characters	<i>Monizia edulis</i> subsp. <i>edulis</i>	<i>Monizia edulis</i> subsp. <i>santosii</i>	<i>Monizia edulis</i> subsp. <i>isambertoi</i>	<i>Monizia edulis</i> subsp. <i>giranus</i>
Stem	Up to 123 cm	Up to 16 cm	Up to 60 cm	Up to 60 cm
Stem shape	Tubular	Conical	Tubular	Tubular
Radical leaves				
division	3–4 pinnatisect	4–5 pinnatisect	4–5 pinnatisect	4–5 pinnatisect
ultimate segment arrangement	Remote and only sub-remote at the apex	Compact and imbricate	Remote and only sub-remote at the apex	Remote and only sub-remote at the apex
ultimate segment incision	Inciso-serrate	Inciso-serrate	Lacinio-serrate and dentate	Inciso-serrate
ultimate segment apex	Obtuse acuminate Pointing towards the apex	Obtuse acuminate Pointing towards the apex	Acute acuminate Mostly pointing outwards and obliquely to the midrib	Acute acuminate Pointing towards the apex
Terminal umbel in fruit				
peduncle	9.2–12.0 cm	1.4–5.1 cm	6.8–9.5 cm	c. 13.0 cm
first order umbel rays	c.2.6 cm	c.2.6 cm	c.3.1 cm	c. 3.6 cm
bracts	Narrowly triangular, c.4.1 × longer than wide	Triangular, c.3.4 × longer than wide	Very narrowly triangular to linear-triangular, c.7.3 × longer than wide	Very narrowly triangular to linear triangular, c.7.3 × longer than wide
calyx teeth (sepals)	0.3–0.5 mm	0.6–0.9 mm	0.3–0.6 mm	0.1–0.5 mm
style direction	Patent	Patent	Erect to erect-patent	Erect
style length	0.7–0.9 mm	0.8–1.2 mm	1.2–1.9 mm	0.7–1.1 mm
Mericaip				
size	1.0–1.3 × 0.5–0.6 cm	(1.1)1.2–1.5 × 0.5–0.6 (0.7) cm	1.0–1.2 × 0.4–0.6 cm	0.9–1.1 × 0.3–0.4 cm
shape (length/width)	Elliptical, c.2.1 × longer than wide	Elliptical to slightly narrowly elliptical, c.2.5 × longer than wide	Elliptical to ovate, c 2.3 × longer than wide	Narrowly ovate, c.2.9 × longer than wide
surface texture	Smooth, rarely sub-tuberculate	Smooth, rarely sub-tuberculate	Tuberculate	Tuberculate
dorsal ribs: secondary vs. primary (transverse section)	Often much more prominent	Often much more prominent	Almost equally prominent	Almost equally prominent
secondary dorsal ribs (transverse section)	Peltate or mushroom-like	Peltate or mushroom-like	Circular	Circular
secondary marginal ribs size	c.1.6–1.7 × 1.0–1.4 mm	c.1.1–1.4 × 1.0 mm	c.1.4–1.5 × 1.0–1.2 mm	c.0.9–1.2 × 0.9 mm
secondary marginal ribs (transverse section)	Obovate	Obovate	Oblong to broadly oblong	Oblong to broadly oblong

Additional material examined

See Appendix 1.

Common name

Cenoura da rocha, Nozelha da rocha.

Distribution

This subspecies is restricted to Curral das Freiras (island of Madeira) (Figure 2C), at altitudinal levels of c.950 m. Populations at higher altitudes c.1500 m cited by Menezes (1914) were not found in field observations made by Nóbrega (pers. comm.) in the recent past.

Habitat

Plants occur in clefts of rocks and in small patches of soil in sun-sheltered areas (Figure 3D, E). This species shares the same habitat with other species such as *Aeonium glutinosum* (Aiton) Webb & Berthel., *Sinapidendron frutescens* (Sol.) Lowe subsp. *frutescens*, *Phyllis nobla* L., *Saxifraga maderensis* D. Don, *Sonchus pinnatus* Aiton, *Galium productum* Lowe, *Autonoe madeirensis* (Menezes) Speta, *Carlina salicifolia* (L.f.) Cav., *Andryala glandulosa* Lam.

Conservation status

This subspecies is to be considered Critically Endangered – CR D due to a population size estimated to



Figure 5. Mericarp: (a-d) *M. edulis* subsp. *edulis*; (e-h) *M. edulis* subsp. *santosii*; (i-l) *M. edulis* subsp. *isambertoi*; (m-p) *M. edulis* subsp. *giranus*. Photographs by the authors.

number fewer than 50 mature individuals as defined by IUCN (2012). This status reflects not only the small population size but also the pressures and threats that are difficult to control, e.g. grazing by rabbits, fire, competition by plant invasive species and natural landslides.

Monizia edulis Lowe subsp. *giranus* J.A. Carvalho & F. Fernandes, **subsp. nov.**

Description

Plant caulescent up to 120 cm. Stem or sub-aerial root or caudex up to 60 cm, approximately tubular. Radical leaves ascending and flexible, 4–5 pinnatisect; ultimate segments remote and only sub-remote at the apex, angular-ovate to ovate, inciso-serrate, acute-acuminate pointing towards the apex (Figure 4I, J). Terminal umbel in fruit peduncle c.13.0 cm; first order umbel rays in fruit c.3.6 cm; bracts very narrowly triangular to linear triangular c.7.3 × longer than wide. Sepals in fruit (Figure 5P) minute 0.1–0.5 mm long. Style in fruit (Figure 5M) 0.7–1.1 mm, erect. Mericarp (Figure 5M–P) 0.9–1.1 × 0.3–0.4 cm, 2.9 × longer than wide, narrowly

ovate, testa and dorsal ribs tuberculate; dorsal ribs often almost equally prominent: the two secondary dorsal ribs circular or circular with enlarged base in cross-section and often slightly larger in size than the median primary dorsal rib (Figure 6D), the median primary dorsal rib visible and equalling in size the two external primary dorsal ribs (Figure 6D); secondary marginal ribs oblong to broadly oblong (Figure 6D), 0.9–1.2 × 0.9 mm.

Type: Portugal, Madeira, Island of Madeira: Cabo Girão, 425 m, 19.iii.2013, F. Fernandes (holo MADJ13044).

Etymology

After the place where it occurs: Cabo Girão.

Additional material examined

See Appendix 1.

Common name

Cenoura da rocha, Nozelha da rocha.



Figure 5. (Continued)

Distribution

This *taxon* is restricted to a single population located at Cabo Girão (island of Madeira) (Figure 2C) at altitudes of c.425 m.

Habitat

Plants occur in clefts of rocks and in small patches of soil close to steep sea cliffs and to agriculture lands (Figure 3F, G). It shares the same habitat with other species such as *Hyparrhenia sinaica* (Delile) Llaurodó ex G. López, *Aeonium glandulosum* (Aiton) Webb & Berthel., *Aeonium glutinosum* (Aiton) Webb & Berthel., *Carlina salicifolia* (L.f.) Cav., *Echium candicans* L.f., *Euphorbia piscatoria* Aiton, *Globularia salicina* Lam., *Micromeria thymoides* (Sol. ex Lowe) Webb & Berthel. subsp. *thymoides*, *Sedum fusiforme* Lowe, *Sinapidendron angustifolium* (DC.) Lowe, *Sonchus ustulatus* Lowe.

Conservation status

This subspecies is to be considered Critically Endangered – CR D due to a population size estimated to

number fewer than 50 mature individuals as defined by IUCN (2012). The most important pressures and threats are grazing by rabbits, fire, collecting for forage, and competition by plant invasive species such as *Ageratina adenophora* (Spreng.) R.M. King & H. Rob. and *Opuntia tuna* (L.) Mill and natural landslides.

Taxonomic remarks

The most striking difference between the taxa described herein was observed when we discovered the plants of *M. edulis* subsp. *santosii*. Individuals from this subspecies have very short conical stems rising only a few centimetres above ground (up to 16 cm) and the crown (rosette) of leaves form a mat-like surface in close contact with the soil (Figure 3B, C). This is in contrast to plants of the other subspecies that show long, mostly tubular stems and the crown of leaves positioned higher from the ground (Figure 3A, D–G). Another contrasting difference resulting from field observations is the general leaf appearance in *M. edulis* subsp. *santosii*, which is much more compact than in the remaining subspecies.



Figure 5. (Continued)

Further morphological studies revealed an additional set of diagnostic characters that differentiates each subspecies from the remaining ones (Table 2). Radical leaves are 3–4 pinnatisect in *M. edulis* subsp. *edulis* (Figure 4A–D) in contrast with 4–5 pinnatisect in the remaining subspecies (Figure 4E–J). In respect to the remoteness of the ultimate segments, these are compact and imbricate in *M. edulis* subsp. *santosii* (Figure 4E, F) but remote to subremote in the remaining taxa (Figure 4A–D, G–J). The margin of ultimate segments is lacinate-serrate and dentate in *M. edulis* subsp. *isambertoii* (Figure 4G, H) contrasting with those in the remaining taxa that are inciso-serrate (Figure 4A–F, I, J).

The dwarf-like aspect of *M. edulis* subsp. *santosii* results from the short and compact umbellate inflorescence and small height of the whole plant. In contrast, the flowering and fruiting stem is much more elongated and similar in *M. edulis* subsp. *edulis*, *M. edulis* subsp. *isambertoii* and *M. edulis* subsp. *giranus*. A character that expresses this dwarf-like aspect is the length of the peduncle of the terminal umbel, which is much shorter in *M. edulis* subsp. *santosii* (c. 1.4–5.1 cm) when compared with those of *M. edulis* subsp. *isambertoii* (c. 6.8–9.5 cm), *M. edulis* subsp. *edulis* (c. 9.2–12.0 cm),

and *M. edulis* subsp. *giranus* (c. 13.0 cm), which are much more elongated (Table 2).

Another set of characters brought information that groups together taxa from the island of Madeira on the one hand, and those taxa from the islands of Desertas and Porto Santo on the other (Table 2). The shape of the bracts of the umbel in fruit and mericarp characters (Figures 5, 6) such as surface texture, shape and size of ribs support separation of *M. edulis* subsp. *isambertoii*/*M. edulis* subsp. *giranus* from *M. edulis* subsp. *edulis*/*M. edulis* subsp. *santosii*. Bracts are very narrowly triangular to linear-triangular (c. 7.3 × longer than wide) in *M. edulis* subsp. *giranus* and in *M. edulis* subsp. *isambertoii* and narrowly triangular to triangular (3.4–4.1 × longer than wide) in *M. edulis* subsp. *edulis* and in *M. edulis* subsp. *santosii* (Table 2). Mericarp in *M. edulis* subsp. *isambertoii*/*M. edulis* subsp. *giranus*, when compared with *M. edulis* subsp. *edulis*/*M. edulis* subsp. *santosii*, have a tuberculate surface (Figure 5I–P) in opposition to a surface that is smooth or rarely sub-tuberculate (Figure 5A–H); mostly circular secondary dorsal ribs (Figure 6C, D) in opposition to peltate or mushroom-like secondary dorsal ribs (Figure 6A, B); secondary dorsal ribs that



Figure 5. (Continued)

are often almost equally as prominent as primary dorsal ribs (Figure 6C, D) in opposition to often much more prominent secondary dorsal ribs (Figure 6A, B); oblong to broadly oblong secondary marginal ribs in transverse section (Figure 6C, D) in opposition to obovate marginal ribs (Figure 6A, B).

Diagnostic characters of *Monizia edulis* subsp. *edulis*, *Monizia edulis* subsp. *santosii*, *Monizia edulis* subsp. *isambertoii* and *Monizia edulis* subsp. *giranus* are summarized in Table 2.

Key to *Monizia* subspecies

- 1. Plant with stem up to 16 cm; ultimate leaf segments compact and imbricate **b. subsp. *santosii***
- Plant with stem more than 60 cm; ultimate leaf segments remote and only sub-remote at the apex 2
- 2. Testa and dorsal ribs smooth, rarely sub-tuberculate; secondary dorsal ribs peltate or mushroom-like in transverse section..... **a. subsp. *edulis***
- Testa and dorsal ribs tuberculate; secondary dorsal ribs circular in transverse section..... 3

- 3. Ultimate segments laciniate-serrate and dentate; style 1.2–1.9 mm **c. subsp. *isambertoii***
- Ultimate segments inciso-serrate; style 0.7–1.1 mm **d. subsp. *giranus***

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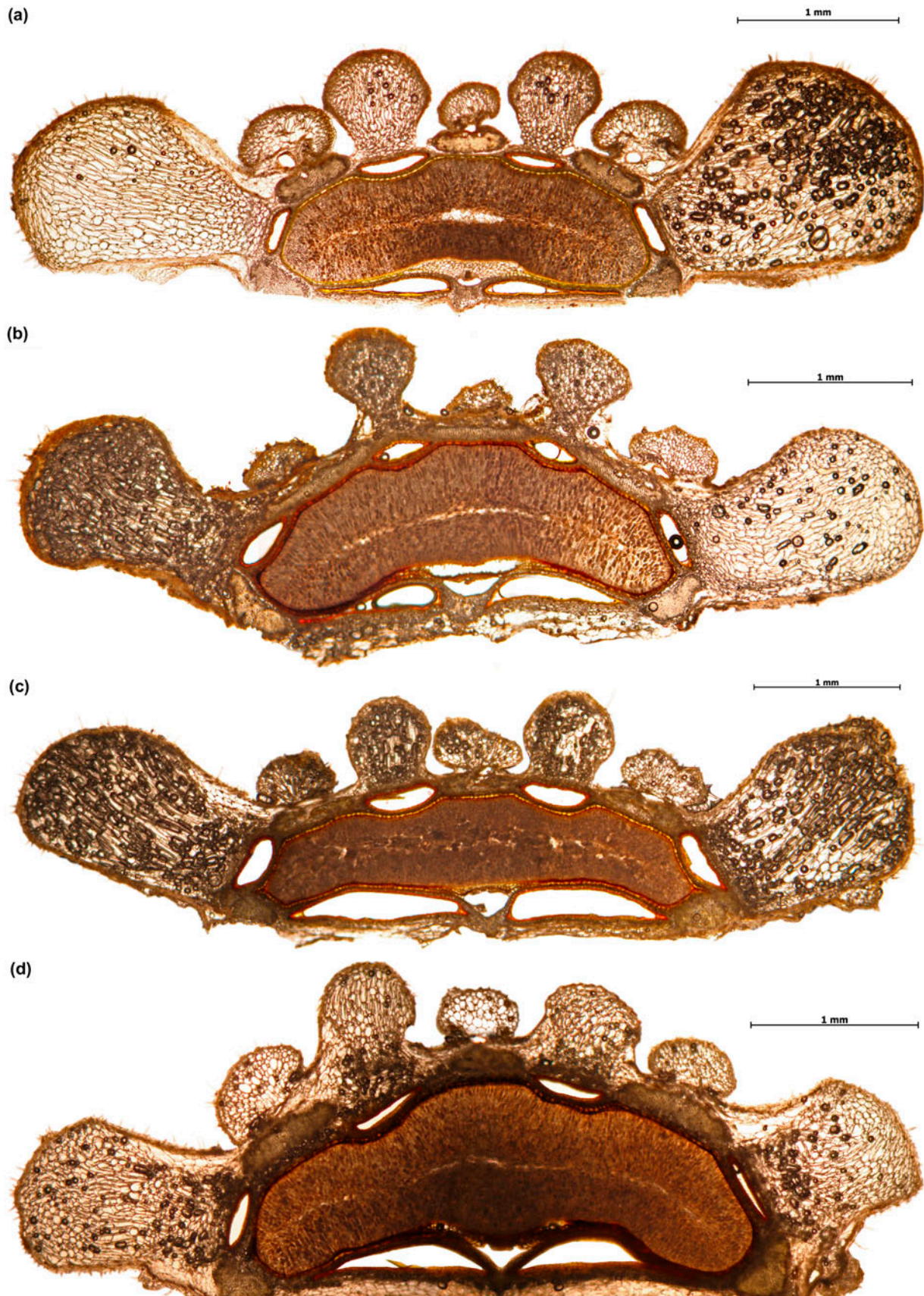


Figure 6. Mericarp cross section: (a) *Monizia edulis* subsp. *edulis*; (b) *M. edulis* subsp. *santosii*; (c) *M. edulis* subsp. *isambertoi*; (d) *M. edulis* subsp. *giranus*. Photographs by the authors.

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Appendix 1. Additional material examined

Monizia edulis Lowe subsp. *edulis*

PORTUGAL: Madeira. Desertas Islands: Deserta Grande, 29.iv.2011, *I. Silva* (MADJ12947); Deserta Grande, Vereda Doca, Topo, 29.vi.2006, *J.A. Carvalho* (MADJ12946); Deserta Grande, acima da Doca, 23.iv.2009, *J.A. Carvalho* (MADJ12945); Deserta Grande, acima da Doca, encosta Oeste, 18.iv.2013, *J.A. Carvalho* (MADJ12985); Deserta Grande, acima da Doca, encosta Oeste, 23.iv.2013, *J.A. Carvalho* (MADJ12989); Desertas, v.1857 (MADJ00602); Deserta Grande, por cima da Furna da Doca, local rochoso e protegido, 13.v.1991 (MADM1866); Deserta Grande, Vereda Doca, Topo, 04.iv.2006, *I. Silva & R. Jardim* (MADJ11260); Herbarium of Rev. R.T. Lowe, n.893, Deserta Grande, 1863, Cult. from Sr. Moniz, (K000272591); Dezertas Islands, 1856, *N.H. Mason* (K000272593); Grt Dez^a, vi.1855, Lowe, Herbarium Hookerianum 1867, Hort. Kew 1864 (K000272596); Madère, 1857, *M. Mason* (P03248923); Ile Madère, 1857, *M. Mason* (P03248924); Curral, nd, *C. Menezes* (PO54512).

Monizia edulis Lowe subsp. *santosii* F. Fernandes & J.A. Carvalho

PORTUGAL: Madeira. Porto Santo Island, Ilhéu de Cima: 12.iv.2013, *F. Fernandes* (MADJ12983); 12.iv.2013, *F. Fernandes* (MADJ12984); 27.ix.2012, *I. Silva* (MADJ12942); cultivado no Jardim Botânico da Madeira Eng. Rui Vieira, 14.xi.2012, *F. Fernandes* (MADJ12943).

Monizia edulis Lowe subsp. *isambertoi* F. Fernandes & J.A. Carvalho

PORTUGAL: Madeira. Madeira Island: Levada do Castelejo, Curral, iii.1953, *Nóbrega* (MADJ00603); Curral das Freiras, 21.iii.1989, *Nóbrega* (MADJ06640); Curral das Freiras, Eira do Serrado, 22.i.2013, *F. Fernandes* (MADJ12940); Curral das Freiras, Eira do Serrado, 18.xi.2012, *F. Fernandes* (MADJ12934); Curral das Freiras, Eira do Serrado, 22.vi.2012, *F. Fernandes & P. Gouveia* (MADJ12936); Curral das Freiras, Eira do Serrado, 09.iv.2012, *P. Gouveia & F. Fernandes* (MADJ12937); Curral das Freiras, Eira do Serrado, 05.xii.2012, *F. Fernandes* (MADJ12932); Curral das Freiras, Eira do Serrado, 18.iv.2012, *F. Fernandes & P. Gouveia* (MADJ12938); Curral das Freiras, Eira do Serrado, 21.iv.2009, *P. Gouveia* (MADJ12939); Curral das Freiras, Eira do Serrado, 23.iv.2013, *F. Fernandes* (MADJ13043); Curral das Freiras, Eira do Serrado, 13.vi.2012, *C. Nóbrega & F. Fernandes* (MADJ12935); Curral, nd., *C. Menezes* (PO54512).

Monizia edulis Lowe subsp. *giranus* J.A. Carvalho & F. Fernandes

PORTUGAL: Madeira. Madeira Island: Cabo Girão, 23.ix.2009, *J.A. Carvalho & P. Gouveia* (MADJ12930); Estreito Câmara de Lobos, viii.1958, *Nóbrega* (MADJ00601); Cabo Girão, 04.vii.2013, *F. Fernandes* (MADJ13003); Cabo Girão, 23.xi.2012, *F. Fernandes* (MADJ12931); Cabo Girão, 17.xii.2012, *F. Fernandes* (MADJ12933).

Monizia edulis Lowe

PORTUGAL: Selvagens Islands, Selvagem Grande: Herbarium of Rev. R.T. Lowe, Selvagem Gr., 1863, *C.C. de Noronha* (K000272592).