

The family Crassulaceae in continental Portugal

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Santiago Castroviejo

This paper is respectfully dedicated to Dr Santiago Castroviejo Bolívar (b. 7 August 1946, d. 30 September 2009), who treated the Crassulaceae for the Flora iberica project, of which he was a major architect. He had a broad international participation in botanical thrusts of a global nature and his untimely death leaves a void that is felt beyond his native Spain.

Photograph opposite

Santiago Castroviejo processing collected material gathered around Ladysmith, KwaZulu-Natal province, during a field trip to South Africa in 1999.
Photographer: A. Prunell.

Summary: Apart from two present-day centres of high species diversity, one in southern Africa and the other in Mexico, the Crassulaceae, a large family of mainly herbaceous leaf succulents, is also well-represented in Europe in terms of both genera and species. One of these genera, the predominantly continental European genus *Sedum* L., has for a long time been acknowledged as in need of being split into smaller, more homogenous genera. The recent implementation of some of these taxonomic proposals is here applied to the crassuloid taxa of continental Portugal (islands excluded), with particular reference to *Petrosedum* Grulich. An updated and expanded checklist of the genera and species of Crassulaceae occurring in Portugal is provided, along with notes on differences between *Sedum* and *Petrosedum*. Thirty-six species of Crassulaceae are now

recorded for Portugal (continent, excluding islands), of which 14 are introduced.

Zusammenfassung: Abgesehen von zwei heutigen Zentren hoher Artdiversität (eines im südlichen Afrika, das andere in Mexiko), sind die Crassulaceae (eine grosse Familie krautiger Blattsukkulanten) in Bezug auf Gattungen wie Arten auch in Europa gut vertreten. Für eine dieser Gattungen, d.h. die vorwiegend kontinentaleuropäische Gattung *Sedum* L., war seit einiger Zeit die Notwendigkeit einer Aufteilung in kleinere, homogenere Gattungen klar. Die kürzliche Implementierung einiger dieser taxonomischen Vorschläge wird hier auf die Taxa des kontinentalen Portugals (ausgenommen Inseln) übertragen, mit besonderer Berücksichtigung von *Petrosedum* Grulich. Zudem wird eine aktual-

isierte und erweiterte Checkliste der Gattungen und Arten der in Portugal vorkommenden Crassulaceae publiziert, zusammen mit Bemerkungen zu den Unterschieden zwischen *Sedum* und *Petrosedum*. Derzeit sind 36 Arten der Crassulaceae für Portugal (Kontinent, ohne Inseln) nachgewiesen, von welchen 14 eingeführt sind.

Introduction

The family Crassulaceae have a near cosmopolitan geographical distribution range, occurring on most continents, but with significant present-day centres of diversity in southern Africa (Smith *et al.*, 1997) and Mexico (Thiede & Egli, 2007). Both intra- and inter-generic relationships in the family Crassulaceae have been the subjects of studies that resulted in considerable naming and renaming of species, facilitating more recent work to clarify the phylogeny of the family (‘t Hart & Egli, 1995; Van Ham & ‘t Hart, 1998; Mort *et al.*, 2001).

In Europe, the Crassulaceae are represented by several genera, most of which consist of small, weedy, sub-shrublets (Webb *et al.*, 1964; ‘t Hart & Egli, 1995). *Sedum* L. is the most speciose of the European genera, and has for a long time been considered to encompass entities that could be more comfortably accommodated in separate genera (Stephenson, 2007a). More recently, earlier suggestions by Berger (1930) that could better reflect crassuloid diversity at the generic rank were implemented through the general acceptance of the transferral of some species of *Sedum* to the genus *Petrosedum* Grulich (Grulich, 1984).

European species of *Sedum* can be roughly divided into four sections, each comprising similar, closely related species (Stephenson, 1994). Berger (1930) grouped one of these, the orthocarpic *Sedum* species with yellow or yellowish flowers, into *Sedum* ser. *Rupestris*. They have tall, densely flowered inflorescences with carpels that remain upright until they shed their seed, and are considered endemic to Europe or neighbouring areas of North Africa and the Middle East (Stephenson, 1994).

Grulich (1984) erected the new genus *Petrosedum* Grulich in which to accommodate species of *Sedum* ser. *Rupestris*, simultaneously publishing new combinations for *P. forsterianum* (Sm.) Grulich, *P. pruinatum* (Brot.) Grulich and *P. sediforme* (Jacq.) Grulich. Based on Grulich’s grouping, Velayos (1989) later published the new combinations for *P. amplexicaule* (DC.) Velayos and *P. amplexicaule* subsp. *tenuifolium* (Sm.) Velayos.

In *Flora iberica*, Castroviejo & Velayos (1997a) synonymised *Petrosedum*, and upheld *Sedum* ser.

Rupestris. Thiede & Egli (2007), on the other hand, accepted *Petrosedum*. This treatment is followed in the present paper.

This paper updates the generic concepts recently proposed for the Crassulaceae in Europe and provides an updated checklist of the species of the family that occur in continental Portugal, both naturally and as alien introductions (Castroviejo, 1997a; Sequeira *et al.*, 2011). In addition, the four species of *Petrosedum* that occur in Portugal are briefly discussed and a key useful to separate them, especially in the vegetative phase, is provided. This paper also updates and supplements the treatment of *Sedum* as included in the *Flora iberica*.

Genus	Species (introduced species)
* <i>Aeonium</i> Webb & Berthel.	2 (2)
* <i>Aichryson</i> Webb & Berthel.	1 (1)
<i>Crassula</i> L.	6 (4)
* <i>Graptopetalum</i> Rose	1 (1)
* <i>Hylotelephium</i> H. Ohba	1 (1)
* <i>Kalanchoe</i> Adans.	3 (3)
<i>Petrosedum</i> Grulich	4
<i>Pistorinia</i> DC.	1
<i>Sedum</i> L.	14 (1)
* <i>Sempervivum</i> L.	1 (1)
<i>Umbilicus</i> DC.	2

Table 1. Genera and number of species of Crassulaceae occurring in continental Portugal. (* = introduced genus)

Key to the species of *Sedum* and *Petrosedum* in Portugal

- 1. Petals yellow (rarely creamy), anthers yellow2
- 1. Petals white or pinkish, anthers red or purple4
- 2. Growth form shrubby, up to 75 cm high *Sedum praealtum**
- 2. Growth form herbaceous, much smaller3
- 3. Sepals free; follicles spreading in a star-shape *Sedum acre*
- 3. Sepals united at the base; follicles erect 15 (*Petrosedum*)
- 4. Stamens 4–5, as many as the sepals5
- 4. Stamens 10–12, twice the number of sepals7
- 5. Plants glabrous6
- 5. Plants glandulose *Sedum rubens*
- 6. Flowers pedicellate; follicles erect *Sedum andegavense*
- 6. Flowers sessile; follicles spreading in a star-shape *Sedum caespitosum*
- 7. Petals united at the base for 1/4–3/4 of their length, forming a tube8
- 7. Petals free11
- 8. Corolla >7 mm long *Sedum mucizonia*
- 8. Corolla <7 mm long9
- 9. Plants glabrous *Sedum candollei*
- 9. Plants glandulose10
- 10. Annual, in humid areas; without basal rosettes *Sedum maireanum*
- 10. Perennial, in rocky areas; stems arising from basal rosettes *Sedum hirsutum*
- 11. Sepals free; follicles spreading in a star-shape or sub-erect12
- 11. Sepals united at the base; follicles erect13
- 12. Annual, erect, stem branched from the base with ascending branches *Sedum arenarium*
- 12. Perennial, prostrate-ascending, multi-stemmed, radiating, much branched *Sedum anglicum*
- 13. Annual, with an erect stem, branched above *Sedum pedicellatum*
- 13. Perennial, caespitose, multi-stemmed, with sterile branches14
- 14. Leaves of sterile branches alternate, ovoid to cylindrical; sepals obtuse *Sedum album*
- 14. Leaves of sterile branches opposite in 4 rows, subglobose; sepals acute *Sedum brevifolium*

(*Petrosedum*)

- 15. Leaves thick, succulent, apically flared open, boat-shaped in outline and cross-section; stems robust, 5 mm or more thick *Petrosedum sediforme*
 - Leaves thin, slightly succulent, hair-like, apically incurved; stems flimsy, 0.5–2.0 mm thick16
- 16. Leaf bases broadened, stem-clasping *Petrosedum amplexicaule*
 - Leaf bases joined to stem at a narrow point17
- 17. Dried leaves on sterile branches shed early yielding a smooth, leafless stem, except at the apex where the leaves are clustered into a small ball-shaped rosette; plant green or glaucous
 - *Petrosedum pruinautum*
 - Dried leaves on sterile branches persistent yielding a leafy, club moss-like stem; plant reddish.....
 - *Petrosedum forsterianum*

Genera and species of Crassulaceae in Portugal

The Flora iberica project (Aedo, 2013), which aims to provide a comprehensive hard-copy and on-line identification and information tool to the flora of the Iberian Peninsula lists nine crassuloid genera as occurring on the subcontinent. Of these, seven were recorded for Portugal, comprising a total of 27 species of Crassulaceae recorded for this country. Sequeira *et al.* (2011) similarly list 27 species of Crassulaceae for continental Portugal.

A recent assessment of introduced plant species in Portugal (Almeida & Freitas, 2006) resulted in two further genera (*Graptopetalum* Rose and *Kalanchoe* Adans.) being recorded for the country, in addition to the genera *Petrosedum* (see above), and *Hylotelephium* H. Ohba, which had been previously recorded but were omitted in *Flora iberica* (Table 1). The total number of species of Crassulaceae recorded for Portugal therefore increases to 36, of which 14 are introduced.

Key to the species of *Sedum* and *Petrosedum* in Portugal

The key to the genera of Crassulaceae in *Flora iberica* (Castroviejo, 1997a) does not include the genus *Petrosedum*. This genus can be separated from *Sedum* on account of a combination of characters. It consists of perennial plants with 5–12-merous flowers, sepals united at the base, petals free, yellow, white or creamy, stamens 10–24, with yellow anthers, erect follicles, and oblong seeds. An artificial key to the 14 species of *Sedum* and 4 species of *Petrosedum* occurring naturally and as introduced aliens (*) in Portugal is provided on the opposite page.

Checklist of crassuloid taxa occurring in Portugal.

Synonyms are here restricted to those relevant to continental Portugal, and references pertain to the Portuguese flora. Synonyms, occurrence by province and vernacular names are based on Castroviejo (1997a). Province delimitations and abbreviations follow Aedo (2013) (see Figure 1).

1. *Aeonium* Webb & Berthel.

1.1 **A. arboreum* (L.) Webb & Berthel.; Santos Guerra pro parte (1997a: 117); Almeida & Freitas (2006: 119); Sequeira *et al.* (2011).

= *Sempervivum arboreum* L.; Coutinho (1939: 335); Sampaio (1947: 375).

V.n.: Saião

BL E

Introduced from Macaronesia.



Figure 1. Map showing the delimitation of provinces in Portugal, based on Aedo (2013).

1.2 **A. haworthii* Salm-Dyck ex Webb & Berthel.; Almeida & Freitas (2006: 119).

Introduced from Macaronesia.

Note: Treated as a synonym of *A. arboreum* by Santos Guerra (1997a: 117), but here retained as a distinct species.

2. *Aichryson* Webb & Berthel.

2.1. **A. laxum* (Haw.) Bramwell; Santos Guerra (1997b: 119); Nyffeler (2003: 25, 26); Almeida & Freitas (2006: 119); Sequeira *et al.* (2011).

= *A. dichotomum* (DC.) Webb; Franco (1971: 248). = *Sempervivum annuum* C.Sm. ex Buch.; Coutinho (1939: 335).

= *S. dichotomum* DC.; Sampaio (1947: 375).

Naturalized in the area of Sintra (E).

Introduced from the Canary Islands.

3. *Crassula* L.

3.1. **C. aquatica* (L.) Schönland; Franco (1971: 246); Fernandes (1997: 103); Almeida & Freitas (2006: 121); Sequeira *et al.* (2011).

Naturalized in the area of Montemor-o-Velho (BL) Introduced from Eurasia and North America.

3.2 **C. multicava* Lem.; Almeida & Freitas (2006: 121).

Introduced from South Africa.

3.3 **C. muscosa* L.; Almeida & Freitas (2006: 121).

Introduced from South Africa.



Figure 2. *Aeonium haworthii*.
Photograph: Gideon F. Smith.



Figure 5. *Crassula vaillantii*.
Photograph: M. Porto.



Figure 3. *Aichryson laxum*. Photograph: M. Porto.



Figure 6. Inflorescence of *Kalanchoe delagoensis*.
Photograph: Gideon F. Smith.



Figure 4. *Crassula tillaea*. Photograph: M. Porto.



Figure 7. *Petrosedum amplexicaule*.
Photograph: P.V. Araújo.



Figure 8. *Petrosedum forsterianum*.
Photograph: Gideon F. Smith.



Figure 11. *Petrosedum sediforme*.
Photograph: Gideon F. Smith.



Figure 9. *Petrosedum forsterianum*.
Photograph: Estrela Figueiredo.



Figure 12. *Sedum acre*.
Photograph: Gideon F. Smith.



Figure 10. *Petrosedum pruinaum*.
Photograph: P.V. Araújo.



Figure 13. *Sedum album* in flower.
Photograph: Gideon F. Smith.

3.4. **C. peduncularis* (Sm.) Medigen; Fernandes (1997: 103); Almeida & Freitas (2006: 121); Sequeira *et al.* (2011).

= *C. bonariensis* (DC.) Cambess.; Franco (1971: 246).

Naturalized in the area of Montemor-o-Velho (BL)
Introduced from South America.

3.5. *C. tillaea* Lest.-Garl.; Franco (1971: 246); Fernandes (1997: 100); Egli (2003b: 81); Sequeira *et al.* (2011).

= *Tillaea muscosa* L.; Coutinho (1939: 337); Sampaio (1947: 371).

Aal Ag BA Bal BB BL DL E Mi R TM

3.6. *C. vaillantii* (Willd.) Roth.; Franco (1971: 246); Fernandes (1997: 102); Van Jaarsveld (2003: 83); Sequeira *et al.* (2011).

= *Tillaea vaillantii* Willd.; Coutinho (1939: 337); Sampaio (1947: 371).

AAl Ag BA Bal DL R TM

4. **Graptopetalum* Rose

4.1 **G. paraguayense* (N.E.Br.) E.Walther; Almeida & Freitas (2006: 123).

Introduced from Mexico.

5. **Hylotelephium* H.Ohba

5.1. **H. telephium* (L.) H.Ohba

= *Sedum complanatum* Gilib., *nom. illeg.*; Coutinho (1939: 332).

V.n.: Fabária-maior, Erva-dos-calos.

Although *Hylotelephium* was not recorded for Portugal by Castroviejo & Velayos (1997b), it was recorded earlier by Coutinho (1939) as naturalized in BA, E, and by Sampaio (1947) as subspontaneous. Sampaio (1947) recorded it under the name *Sedum haematodes* Mill. (= *Hylotelephium hematodes* (Mill.) Holub.), which leaves some doubt as to the exact identity of the record.
Introduced from C and W Europe.

6. **Kalanchoe* Adans. [Some of the weedy species included in *Kalanchoe* are often referred to the genus *Bryophyllum* Salisb. See for example Crouch & Smith (2007) and Walters (2011)]

6.1 **K. daigremontiana* Raym.-Hamet & H.Perrier; Almeida & Freitas (2006: 123).

Introduced from Madagascar.

6.2 **K. pinnata* (Lam.) Pers.; Almeida & Freitas (2006: 123).

Introduced from tropical Africa.

6.3 **K. delagoensis* Eckl. & Zeyh.

= *K. tubiflora* (Harv.) Raym.-Hamet, *nom. illeg.*; Almeida & Freitas (2006: 123).

Introduced from Madagascar.

7. *Petrosedum* Grulich

7.1. *P. amplexicaule* (DC.) Velayos

= *P. amplexicaule* subsp. *tenuifolium* (Sm.) Velayos

= *Sedum amplexicaule* DC.; Coutinho (1939: 333); Castroviejo & Velayos (1997a: 142); Sequeira *et al.* (2011).

= *S. tenuifolium* (Sm.) Strobl; Sampaio (1947: 375); Franco (1971: 250).

AAl Ag BA BA Bal BB BL Mi R TM

7.2. *P. forsterianum* (Sm.) Grulich

= *Sedum forsterianum* Sm.; Coutinho (1939: 333); Sampaio (1947: 374); Franco (1971: 250); Castroviejo & Velayos (1997a: 144).

V.n.: Arroz-das-paredes

AAl Ag BA BA Bal BB BL DL E Mi R TM

7.3. *P. pruinatum* (Brot.) Grulich

= *Sedum pruinatum* Brot.; Coutinho (1939: 333); Sampaio (1947: 375); Franco (1971: 250); Castroviejo & Velayos (1997a: 145); Sequeira *et al.* (2011).

BA BB DL Mi TM

7.4. *P. sediforme* (Jacq.) Grulich; Smith & Figueiredo (2010b).

= *Sedum altissimum* Poir.; Coutinho (1939: 333).

= *S. nicaeense* All.; Sampaio (1947: 375).

= *S. sediforme* (Jacq.) Pau; Franco (1971: 250); Castroviejo & Velayos (1997a: 148); Sequeira *et al.* (2011).

V.n.: Erva-pinheira.

Ag BA Bal BB BL E R TM

8. *Pistorinia* DC.

8.1. *P. hispanica* (L.) DC.; Franco (1971: 247); Castroviejo (1997b: 108); Sequeira *et al.* (2011).

= *Cotyledon hispanica* L.; Coutinho (1939: 337); Sampaio (1947: 376).

V.n.: Conchelos-da-água.

BA BB TM

9. *Sedum* L.

9.1. *S. acre* L.; Coutinho (1939: 333); Sampaio (1947: 374); Franco (1971: 250); Castroviejo & Velayos (1997a: 125); Sequeira *et al.* (2011).

V.n.: Uva-de-cão, vermiculária.

BA BL DL Mi TM

9.2. *S. album* L.; Coutinho (1939: 334); Sampaio (1947: 374); Franco (1971: 251); Castroviejo & Velayos (1997a: 131); Smith & Figueiredo (2010a, 2012); Sequeira *et al.* (2011).

V.n.: Arroz-dos-telhados, pinhões-de-rato.

AAl Ag BA BA Bal BB BL DL E Mi R TM



Figure 14. Close-up of the leaves of *Sedum album*.
Photograph: Gideon F. Smith.



Figure 15. *Sedum andegavense*.
Photograph: P.P. Silva.



Figure 16. *Sedum anglicum*.
Photograph: Gideon F. Smith.



Figure 17. *Sedum arenarium*.
Photograph: M. Porto.



Figure 18. *Sedum brevifolium*.
Photograph: Hélia Marchante.



Figure 19. *Sedum caespitosum*.
Photograph: M. Porto.



Figure 20. *Sedum hirsutum*.
Photograph: Hélia Marchante.



Figure 23. *Sedum pedicellatum* subsp. *lusitanicum*.
Photograph: M. Porto.



Figure 21. *Sedum maireanum*.
Photograph: M. Porto.



Figure 24. Shrubby growth form of **Sedum praealtum*.
Photograph: Gideon F. Smith.



Figure 22. *Sedum mucizonia*.
Photograph: Estrela Figueiredo.



Figure 25. Close-up of leaves and an inflorescence of **Sedum praealtum*.
Photograph: Gideon F. Smith.



Figure 26. *Sedum rubens*. Photograph: M. Porto.



Figure 27. **Sempervivum tectorum*.
Photograph: Gideon F. Smith.



Figure 28. *Umbilicus heylandianus*.
Photograph: C. Aguiar.

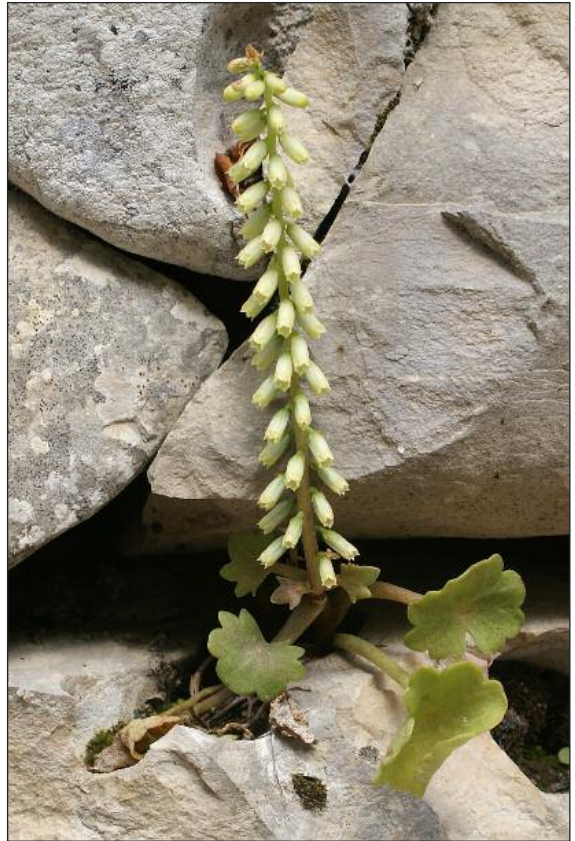


Figure 29. *Umbilicus rupestris*.
Photograph: Gideon F. Smith.



Figure 30. Close-up of the leaves of *Umbilicus rupestris*.
Photograph: Gideon F. Smith.

- 9.3. *S. andegavense* (DC.) Desv.; Coutinho (1939: 335); Sampaio (1947: 371); Franco (1971: 253); Castroviejo & Velayos (1997a: 136); Sequeira *et al.* (2011).
AAI Ag BA BAI BB E TM
- 9.4. *S. anglicum* Huds. ; Coutinho (1939: 333, pro parte); Sampaio (1947: 373, pro parte); Franco (1971: 251); Castroviejo & Velayos (1997a: 126); Sequeira *et al.* (2011).
V.n.: Vermiculária-inglesa.
BA BL DL Mi TM
- 9.5. *S. arenarium* Brot.; Franco (1971: 252); Castroviejo & Velayos (1997a: 127); Sequeira *et al.* (2011).
= *Sedum anglicum* subsp. *arenarium* (Brot.) Cout.; Coutinho (1939: 333).
AAI BA BB BL DL Mi R TM
- 9.6. *S. brevifolium* DC.; Coutinho (1939: 334); Sampaio (1947: 374); Franco (1971: 251); Castroviejo & Velayos (1997a: 137); Sequeira *et al.* (2011).
V.n.: Arroz-dos-muros
AAI Ag BA BAI BB BL DL E Mi R TM
- 9.7. *S. caespitosum* (Cav.) DC.; Coutinho (1939: 335); Sampaio (1947: 371); Franco (1971: 253); Castroviejo & Velayos (1997a: 142); Sequeira *et al.* (2011).
AAI BA E TM
- 9.8. *S. candollei* Raym.-Hamet; Castroviejo & Velayos (1997a: 137); Sequeira *et al.* (2011).
= *Cotyledon sediformis* Lapeyr.; Sampaio (1947: 376).
= *C. sedoides* DC.; Coutinho (1939: 337).
= *Mucizonia sedoides* (DC.) D.A.Webb; Franco (1971: 248).
BA
- 9.9. *S. hirsutum* L.; Coutinho (1939: 334); Sampaio (1947: 374); Franco (1971: 251); Castroviejo & Velayos (1997a: 135); Sequeira *et al.* (2011).
= *Oreosedum hirsutum* (All.) Grulich
AAI Ag BA BB BL DL Mi TM
- 9.10. *S. maireanum* Sennen; Castroviejo & Velayos (1997a: 152); Sequeira *et al.* (2011).
= *S. lagascae sensu auct. non* Pau; Franco (1971: 252).
= *S. villosum sensu auct. non* L.; Sampaio (1947: 373).
AAI Ag BA BB E R TM
- 9.11. *S. mucizonia* (Ortega) Raym.-Hamet; Castroviejo & Velayos (1997a: 135); Sequeira *et al.* (2011).
= *Cotyledon hispida* Lam., *nom. illeg.*; Coutinho (1939: 337).
= *C. mucizonia* Ortega; Sampaio (1947: 376).
= *Mucizonia hispida* (Lam.) A.Berger; Franco (1971: 248).
= *Sedum mucizonia* subsp. *urceolatum* R.Stephen-son
AAI Ag BAI BB BL E R
- 9.12.1. *S. pedicellatum* Boiss. & Reut.; Coutinho (1939: 334); Sampaio (1947: 373); Franco (1971: 252); Castroviejo & Velayos (1997a: 139); Sequeira *et al.* (2011).
= *Oreosedum pedicellatum* (Boiss. & Reut.) Grulich
BA BB TM
- 9.12.2. *S. pedicellatum* subsp. *lusitanicum* (Willk. ex Mariz) M.Lainz; Castroviejo & Velayos (1997a: 139); Sequeira *et al.* (2011).
= *S. pedicellatum* var. *lusitanicum* Willk. ex Mariz; Coutinho (1939: 334); Sampaio (1947: 373).
= *S. willkommianum* R.Fern.; Franco (1971: 251).
BA
- 9.13. **S. praealtum* A.DC.; Almeida & Freitas (2006: 123).
Introduced from Mexico.
- 9.14. *S. rubens* L.; Coutinho (1939: 335); Sampaio (1947: 373); Franco (1971: 252); Castroviejo & Velayos (1997a: 130); Sequeira *et al.* (2011).
AAI Ag BA BAI BB BL DL E R TM
10. **Sempervivum* L.
- 10.1. **S. tectorum* L.; Coutinho (1939: 335); Sampaio (1947: 375); Rosseló (1997: 113); Almeida & Freitas (2006: 127); Sequeira *et al.* (2011).
Recorded by Rosseló (1997) as naturalized in Mi, TM.
Introduced from Eurasia.
11. *Umbilicus* DC.
- 11.1. *U. heylandianus* Webb & Berthel.; Franco (1971: 247); Castroviejo (1997c: 107); Sequeira *et al.* (2011).
= *Cotyledon coutinhoi* (Mariz) Cout.; Coutinho (1939: 336).
= *C. praealta* (Brot.) Samp.; Coutinho (1939: 336); Sampaio (1947: 376).
AAI BA BB DL E TM

11.2. *U. rupestris* (Salisb.) Dandy; Franco (1971: 247); Castroviejo (1997c: 104); Sequeira *et al.* (2011); Smith & Figueiredo (2011). = *Cotyledon neglecta* Cout.; Coutinho (1939: 336). = *C. umbilicus* L.; Coutinho (1939: 336); Sampaio (1947: 376).

V.n.: Cachilro, sombrerozinho-dos-telhados, orelha-de-monge, umbigo-de-vénus, copilas, bifés, bace-los, couxilgos, conchelos.

AAI Ag BA BAI BB BL DL E Mi R TM

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References

- AEDO, C. (GENERAL COORD.) (2013). *Flora iberica*. <http://www.floraiberica.es/>, [accessed in April 2013].
- ALMEIDA, J.D. & FREITAS, H. (2006). Exotic naturalized flora of continental Portugal—A reassessment. *Botanica Complutensis* **30**: 117–130.
- BERGER, A. (1930). Crassulaceae. In: ENGLER, A. & PRANTL, K. (EDS.), *Die Natürlichen Pflanzenfamilien*, 2nd edn. **18A**: 352–483.
- CASTROVIEJO, S. (1997a). Crassulaceae. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 97–160. Real Jardín Botánico, CSIC, Madrid.
- CASTROVIEJO, S. (1997b). *Pistorinia*. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 107–110. Real Jardín Botánico, CSIC, Madrid.
- CASTROVIEJO, S. (1997c). *Umbilicus*. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 103–107. Real Jardín Botánico, CSIC, Madrid.
- CASTROVIEJO, S. & VELAYOS, M. (1997a). *Sedum*. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 121–153. Real Jardín Botánico, CSIC, Madrid.
- CASTROVIEJO, S. & VELAYOS, M. (1997b). *Hylotelephium*. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 153–158. Real Jardín Botánico, CSIC, Madrid.
- COUTINHO, A.X.P. (1939, reprinted 1974). Familia 69. Crassuláceas. In: PALHINHA, R. (ED.), *Flora de Portugal. (Plantas vasculares). Disposta em chaves dicotómicas*, 2nd ed.: 332–337. Bertrand (Irmãos), Ltd, Lisboa.
- CROUCH, N.R. & SMITH, G.F. (2007). Crassulaceae. *Bryophyllum proliferum* naturalized in KwaZulu-Natal, South Africa. *Bothalia* **37**: 206–208.

- EGGLI, U. (2003b). *Crassula tillaea* Lester-Garland. In: Van Jaarsveld, E.J., *Crassula*. In: EGGLI U. (ED.), *Illustrated handbook of succulent plants. Crassulaceae.*: 81. Springer Verlag, Berlin.
- FERNANDES, R.B. (1997). *Crassula*. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 99–103. Real Jardín Botánico, CSIC, Madrid.
- FRANCO, J.A. (1971). *Nova Flora de Portugal (Continente e Açores), vol. 1 Lycopodiaceae–Umbelliferae*. The Author, Lisboa.
- GRULICH, V. (1984). Generic division of Sedoideae in Europe and adjacent regions. *Preslia* **56**: 29–54.
- MORT, M.E., SOLTIS, D.E., SOLTIS, P.S., FRANCISCO-ORTEGA, J. & SANTOS-GUERRA, A. (2001). Phylogenetic relationships and evolution of Crassulaceae inferred from matk sequence data. *American Journal of Botany* **88**: 76–91.
- NYFFELER, R. (2003). *Aichryson*. In: EGGLI, U. (ED.), *Illustrated handbook of succulent plants. Crassulaceae.*: 24–27. Springer Verlag, Berlin.
- ROSSELÓ, J.A. (1997). *Sempervivum*. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 110–116. Real Jardín Botánico, CSIC, Madrid.
- SAMPAIO, G. (1947). *Flora Portuguesa*. 3rd facsimile edn (1988) of the 2nd revised edn by A. Pires de Lima. Instituto Nacional de Investigação Científica, Lisboa.
- SANTOS GUERRA, A. (1997a). *Aeonium*. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 116–119. Real Jardín Botánico, CSIC, Madrid.
- SANTOS GUERRA, A. (1997b). *Aichryson*. In: CASTROVIEJO, S. *ET AL.* (EDS.), *Flora iberica* **5**: 119–121. Real Jardín Botánico, CSIC, Madrid.
- SEQUEIRA, M., ESPÍRITO-SANTO, D., AGUIAR, C., CAPELO, J. & HONRADO, J. (EDS) 2011. Checklist da flora de Portugal (continental, Açores e Madeira). http://www3.uma.pt/alfa/checklist_flora_pt.html
- SMITH, G.F. & FIGUEIREDO, E. (2010a). *Sedum album*: a mainstay of European succulents. *Cactus & Succulent Journal (U.S.)* **82**: 41–42.
- SMITH, G.F. & FIGUEIREDO, E. (2010b). *Petrosedum sediforme*, a beautiful species of Crassulaceae from Portugal. *CactusWorld* **28**: 103–106.
- SMITH, G.F. & FIGUEIREDO, E. 2011. *Umbilicus rupestris*: an interesting member of the Crassulaceae in Portugal. *Cactus & Succulent Journal (U.S.)* **83**(5):232–235.
- SMITH, G.F. & FIGUEIREDO, E. 2012. Did the Romans grow succulents in Iberia? *Cactus & Succulent Journal (U.S.)* **84**: 33–40.
- SMITH, G.F., VAN JAARVELD, E.J., ARNOLD, T.H., STEFFENS, F.E., DIXON, R.D. & RETIEF, J.A. (EDS) (1997). *List of southern African succulent plants*. Umdaus Press, Pretoria.

- STEPHENSON, R. (1994). *Sedum: cultivated stonecrops*. Timber Press, Portland.
- STEPHENSON, R. (2007a). An overall view of the genus *Petrosedum* with a description of a *P. pruinaum* location. *Sedum Society Newsletter* **82**: 92–95.
- 'T HART, H. & EGGLI, U. (EDS.) (1995). *Evolution and systematics of the Crassulaceae*. Backhuys Publishers, Leiden.
- THIEDE, J. & EGGLI, U. (2007). Crassulaceae. In: KUBITZKI, K. (ED.) *The families and genera of vascular plants, vol. 9, Flowering Plants, Eudicots*: 83–118. Springer Verlag, Berlin.
- VAN HAM, R.C.H.J. & 'T HART, H. (1998). Phylogenetic relationships in the Crassulaceae inferred from chloroplast DNA restriction-site variation. *American Journal of Botany* **85**: 123–134.
- VAN JAARSVELD, E.J. (2003). *Crassula* L. In: EGGLI, U. (ED.), *Illustrated handbook of succulent plants. Crassulaceae*: 32–84. Springer Verlag, Berlin.
- VELAYOS, M. (1989). Combinaciones en *Sedum* s.l. (Crassulaceae). *Anales Jardín Botánico de Madrid* **45**: 584–585.
- WALTERS, M. (2011) Crassulaceae. In: WALTERS, M., FIGUEIREDO, E., CROUCH, N.R., WINTER, P., SMITH, G.F., ZIMMERMANN, H.G. & MASHOPE, B.K. *Naturalised and invasive succulents of southern Africa*: 232–259. ABC Taxa, volume 11
- WEBB, D.A., FAVARGER, C. & ZÉSIGER, F. (1964). Crassulaceae. In: TUTIN, T.G. *ET AL.* (EDS.), *Flora Europaea—Psilotaceae to Platanaceae*, vol. **1**: 350–364. Cambridge University Press, Cambridge.