



New distribution and taxonomic information on *Callitriche* (Plantaginaceae) in the Mediterranean region

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Abstract

This article presents new records of water-starworts (*Callitriche* sp. pl.) from the Mediterranean basin, resulting from review of herbarium specimens and field work. *Callitriche brutia* var. *naftolskyi* is stated as a new combination and confirmed from Greece (Lesvos and Milos), Israel, Italy (Sardinia and Sicily), Libya, Morocco and Syria; *C. lusitanica* from Greece (Lesvos), Israel and Italy (Sardinia and Sicily); *C. brutia* var. *brutia* has been known from Greece for some time but is confirmed from Lesvos and Milos; *C. obtusangula* and *C. truncata* subsp. *truncata* are both confirmed from Sardinia and Sicily, while the latter is also confirmed from Syria. *Callitriche lenisulca* and *C. stagnalis* are confirmed from Sardinia but records of the latter from Lesvos appear to be erroneous; *C. truncata* subsp. *occidentalis* is known from Lesvos but records from Sardinia and Sicily appear to be erroneous. Records of *C. regis-jubae* from Sardinia are probably misidentifications for *C. brutia* var. *naftolskyi*. Records of *C. brutia* var. *hamulata* from the region are likely to be erroneous. A recent find of the alien *C. terrestris* in Spain is the first record for that country and the second record for Europe.

Key words: *Callitriche brutia* var. *naftolskyi*; *Callitriche lusitanica*; *Callitriche terrestris*; Greece; Sardinia; Sicily; Spain; water-starworts

Introduction

Callitriche Linnaeus (1753: 969) (Plantaginaceae) is a sub-cosmopolitan plant genus occurring throughout temperate regions of both hemispheres, including the peri-Antarctic islands but typically mainly at high altitude in the tropics (Lansdown 2008). Approximately 75 species have been recognized worldwide (Lansdown 2008), of which 16 are known to occur in the Mediterranean. Records of *Callitriche* include frequent and extensive misidentification due to a combination of factors including a lack of taxonomic and nomenclatural clarification before the mid-20th century, critical distinctions between similar species and the difficulty of locating and recognising identification features. In recent years, clarification of the identification characters for *Callitriche* species occurring in the Mediterranean basin (e.g. Schotsman 1967, 1973, 1977, 1982, Schotsman & Andreas 1974, Lansdown 2008) has enabled revision of some herbarium specimens, as well as stimulated collection of new records, including review of the distribution and taxonomy of members of the genus in Sardinia and Sicily in Italy, and the islands of Lesvos and Milos in Greece. Information is presented here on new records and taxonomic clarification arising from this review, together with a new report of *C. terrestris* Rafinesque (1808: 358) from Spain.

Material and methods

This article is based on analysis of relevant literature, revision of herbarium specimens and field work. *Callitriche* specimens cited in this article have been reviewed from the following herbaria: ATHU, BM, BR, C, CGE, E, FI, G, HUI, K, L, P, RAB, SS, STU and U (abbreviations according to Thiers 2017). Specimens of *C. brutia* var. *naftolskyi* have been deposited in SS, specimens of *C. lusitanica* from Lesvos in ATHU and of *C. terrestris* from Córdoba in WAG. Plant names follow The Plant List (2013) apart from *Isoetes*, for which the names follow Troia *et al.* (2016), and *Callitriche*.

Results and discussion

Callitriche brutia var. *naftolskyi* (Warburg & Eig) Lansdown *comb. nov.* *Callitriche naftolskyi* Warburg & Eig (1929: 84), basionym.

Lectotype (designated here; cited but not formally designated by Schotsman 1967): ISRAEL. Sharon Plain, north-east of Tel Aviv, 23 April 1927, *Naftolsky No. 01853* (HUI) [not seen].

Callitriche brutia var. *naftolskyi* has been overlooked, dismissed as a synonym of *C. brutia* Petagna (1787: 10) var. *brutia* or treated as unresolved by most authors (e.g. Schotsman 1967, Schotsman 1977, Lansdown 2008). However, a chance encounter by RVL with populations agreeing with the description of *C. naftolskyi* at a number of sites during the *International Symposium on Mediterranean Temporary Ponds* held in Sassari in 2015, led to a re-evaluation of its status which is here regarded at the varietal rank (see below).

Callitriche naftolskyi was described as a new species by Warburg & Eig (1929), based on material from the Sharon Plain, NE of Tel Aviv in Israel (lectotype: *Naftolsky 01853*, HUI; cf. Schotsman 1967). Subsequently, Schotsman (1967) initially considered single specimens from Sardinia (*Huet de Pavillon s.n.* 1854, P) and Morocco (*Nègre 4876*, RAB) to be *C. naftolskyi*, but then expressed doubt (Schotsman 1977) and ultimately assigned them to *C. brutia* (*C. brutia* var. *brutia*). She also annotated a specimen from Palermo (*Birch s.n.* 1854, K) “probably *C. pedunculata* De Candolle (in Lamarck & Candolle 1805: 415) (= *C. brutia* var. *brutia*) with some big fruits and broad winged seeds”, but this material clearly conforms to the original concept of *C. naftolskyi*. The discovery of populations in Sardinia prompted review of material from the Isola di Capraia, formerly identified as *C. regis-jubae* Schotsman (1974: 25) (cf. Lansdown *et al.* 2014) and this was also shown to agree with the description of *C. naftolskyi*. Fieldwork in April 2016 revealed *C. brutia* var. *naftolskyi* to be fairly widespread in suitable habitat in Sardinia and present in at least two seasonal pool complexes in Sicily. Furthermore, review of herbarium specimens also revealed specimens from Greece (Lesvos and Milos), Libya, Morocco and Syria. This review of the literature and herbarium specimens suggests that *C. brutia* var. *naftolskyi* is endemic to but widespread within the Mediterranean basin, occurring on larger islands and in North Africa east to the Middle East.

The following description is based on a combination of biometrics from material collected at a range of sites in Sardinia in April 2016, together with information from the protologue (Warburg & Eig 1929) and details provided by Schotsman (1967): Stem much-branched, supported by water or when terrestrial, prostrate and creeping. Stem scales with 10–19 cells, often irregular in outline; axillary scales fan-like with 6–8 cells. Floating leaves narrowly elliptic, at most very shallowly notched at the apex, 1.3–2.4 mm wide × 2.5–4 mm long, petiole 0.3–2.3 mm, with 3–5 veins, terrestrial leaves typically smaller. Bracts apparently lacking; flowers solitary in leaf axils, the most frequent pattern involves a male flower opposed by a female; pollination appears to be through self-fertilisation; anther average 0.3–0.4 mm wide × 0.3 mm high; stigma 0.6–1 mm long, persistent, initially reflexed, then appressed to the side of the fruit; peduncle 4–12 mm; fruit 0.9–1.6 mm wide × 1–1.5 mm high; wing 0.02–0.1 mm, radial thickenings in the wings are very branched and interlinked; toward the base of the wing there are often polygonal cells aligned in radiating directions, continuing the mesocarp cells.

Five *Callitriche* taxa in the Mediterranean region produce winged, pedunculate fruit. Of these, both *C. mousterdei* Schotsman (1969: 617) and *C. regis-jubae* have persistent bracts approximately 1 mm long, long filaments (at least post-anthesis), yellow pollen and erect or recurved styles. *Callitriche brutia* var. *naftolskyi* lacks bracts, the anther is subsessile, pollen is colourless and the style is strongly reflexed and soon appressed to the side of the fruit. *Callitriche truncata* Gussone (1826: 4) subsp. *truncata* differs from *C. brutia* var. *naftolskyi* in its leaves which are always single-

veined, and lack of peltate scales on the stem and leaves. *Callitriche brutia* var. *naftolskyi* can be distinguished from *C. b.* var. *brutia* by the wings on mature fruit which are wider and have an undulate margin; the fruit are matt (shiny in var. *brutia*); the style is persistent and the fruit typically wider than long, although this can be difficult to measure because of the shape of the wing. Although *C. b.* var. *naftolskyi* differs from *C. b.* var. *brutia* in a number of ways, these are insignificant compared to the characters separating most species within the genus, and pending molecular clarification it is appropriate to treat *C. naftolskyi* as a variety within *C. brutia* as *C. brutia* var. *naftolskyi*. It is of note that the genome is the same size in both *C. brutia* var. *brutia* and *C. b.* var. *naftolskyi* (J. Prancel pers. comm.).

Callitriche brutia var. *naftolskyi* has not been found with sessile fruit. All fruit are pedunculate including young, green ones with peduncles 4 mm or more in length, even in aquatic material, and most fruit are on peduncles 10 mm or more in length. This differs from *C. brutia* var. *brutia* which has sessile fruit when growing in water, but pedunculate fruit when terrestrialised (Lansdown 2008). Warburg & Eig (1929) suggested that the fruits of *C. naftolskyi* penetrate the soil vertically which is considered by Schotsman (1967) unlike *C. brutia* and to more closely resemble *C. deflexa* A. Braun ex Hegelmaier (1864: 58). However, this is not a very reliable difference given that the direction of entry into the soil and even whether fruit grow under a mat of vegetation or penetrate into the soil, depends very much on the nature of the substrate in which the plant is growing.

In Sardinia and Sicily *C. brutia* var. *naftolskyi* was recorded exclusively from temporary wetlands, both in well-known species-rich sites such as the seasonal pool complexes at Giara di Gesturi and Monte Minerva in Sardinia and a wetland complex near Buccheri and pools at Castello della Pietra in Sicily; but also in a relatively banal ditch running through pasture east of Perdasdefogu in eastern Sardinia. In these sites it was recorded from a variety of habitats, all of which are seasonally inundated, including deeply rutted areas on tracks, pools and hollows in pasture, as well as open shallow hollows and a cupular pool on limestone “pavement”. In Sicily and Sardinia, *C. brutia* var. *naftolskyi* was most frequently recorded with a range of species characteristic of seasonal pools such as *Bellis annua* Linnaeus (1753: 887), *Carex divisa* Hudson (1762: 348), *Crassula vaillantii* (Willdenow 1798: 720) Roth (1827: 992), *Eryngium barrelieri* Boissier (1844: 125), *Juncus pygmaeus* Richard ex Thuillier (1800: 178), *Lythrum hyssopifolia* Linnaeus (1753: 447) and *Ranunculus ophioglossifolius* Villars (1789: 731); less often with *Apium crassipes* (W.D.J. Koch ex Reichenbach 1825: tab. 21) Reichenbach (1863: 9), *Callitriche brutia* var. *brutia*, *C. stagnalis* Scopoli (1772: 251), *Chamaemelum nobile* (Linnaeus 1753: 894) Allioni (1785: 185), *Corrigiola litoralis* Linnaeus (1753: 271), *Damasonium bourgaei* Cosson (1849: 47), *Isoetes* species (including *I. hystrix* Bory 1844: 1167, *I. longissima* Bory 1844: 1165, and *I. tiguliana* Gennari 1861: 42), *Lythrum borysthenticum* (M.Bieb. ex Schrank 1822: 643) Litvinov (1917: 209), *L. thymifolia* Linnaeus (1753: 447), *Mentha pulegium* Linnaeus (1753: 577), *Myosotis sicula* Gussone (1843: 214), *Pilularia minuta* Durieu in Bory & Durieu (1848: plate 38, figs. 120), *Ranunculus muricatus* Linnaeus (1753: 555) and *R. revellieri* Boreau (1857: 85). It was also recorded once with each of the following species varying from what may be described as “true” aquatics such as *Ranunculus aquatilis* Linnaeus (1753: 556) and *R. peltatus* Schrank (1789: 103), through species typical of seasonal pools such as *Antinoria insularis* Parlato (1845: 93) and *Juncus heterophyllus* Dufour (1825: 88), to those which rarely, if ever actually grow in water but are characteristic of damp ground including *Cicendia filiformis* (Linnaeus 1753: 231) Delarbre (1795: 20), *Juncus bufonius* Linnaeus (1753: 328), *J. capitatus* Weigel (1772: 28) and *Pulicaria sicula* Moris (1840: 363).

No assessment of the extinction risk of *C. brutia* var. *naftolskyi* has been published, the extent of its range, combined with the occurrence of extensive populations in many different water bodies in Sardinia and Sicily mean that it should be classed as Least Concern (IUCN 2012).

Callitriche lusitanica Schotsman (1961: 112)

In 2003, a *Callitriche* specimen was sent to RVL by IB from between Parakila and Agra on Lesbos. It was tentatively identified as *C. lusitanica* but could not be confirmed as some critical elements were lacking. Further material was collected from the same site by IB and S. Zervou on 10 May 2014 and confirmed as *C. lusitanica* by RVL in January 2015. Subsequently, in the course of fieldwork, *C. lusitanica* was found at four sites scattered through the mountainous central and eastern parts of Sardinia. In all of the Sardinian sites it was associated with the main channel of medium-sized to large rivers, either in the channel itself, where it formed large stands, in backwaters, on the margins or growing over boulders. In deeper water, it occurred with *Callitriche obtusangula* Le Gall (1852: 202), filamentous green algae, *Lemna gibba* Linnaeus (1753: 970), *Myriophyllum spicatum* Linnaeus (1753: 992), *Nasturtium officinale* Brown (1812: 110), *Potamogeton crispus* Linnaeus (1753: 126), *P. schweinfurthii* Bennett (1901: 220), *Ranunculus peltatus*, *R. penicillatus* (Dumortier 1863: 216) Babington subsp. *pseudofluitans* (Syme 1863: 20) Webster (1988: 20) var. *vertumnus* Cook (1966: 160), *R. trichophyllus* Chaix ex Villars (1786: 335), *Sparganium erectum* Linnaeus (1753: 971), and *Stuckenia*

pectinata (Linnaeus 1753: 127) Börner (1912: 713). On the margins and in backwaters, it was recorded with *Apium nodiflorum* (Linnaeus 1753: 251) Lagasca (1821: 101), *Corrigiola littoralis*, *Cyperus fuscus* Linnaeus (1753: 46), *C. longus* Linnaeus (1753: 45), *Fontinalis hypnoides* Hartman (1843: 434), *Scirpoides holoschoenus* (Linnaeus 1753: 49) Soják (1972: 127), *Juncus articulatus* Linnaeus (1753: 327), *J. pygmaeus*, *Mentha* × *villosa-nervata* Opiz (1831: 60), *M. pulegium*, *Montia fontana* Linnaeus (1753: 87) var. *chondrosperma* (Fenzl in Ledebour 1843: 152) Walters (1956: 4), *Oenanthe crocata* Linnaeus (1753: 254), *Parentucellia viscosa* Caruel (1885: 482), *Ranunculus muricatus*, *R. ophioglossifolius*, *R. peltatus*, *Rumex conglomeratus* Murray (1770: 52), *Schoenoplectus lacustris* (Linnaeus 1753: 48) Palla (1888: 299), *Typha angustifolia* Linnaeus (1753: 971) and *Veronica anagallis-aquatica* Linnaeus (1753: 12). A notable feature of populations in Sardinia not recorded in populations in the Iberian Peninsula is the development of extensive, evidently persistent terrestrial plants, both on the margins where water-levels had dropped but particularly growing over boulders in the channel where they may remain humid for months.

Callitriche lusitanica is fairly widespread in the western half of the Iberian Peninsula, it has been recorded from Algeria, Morocco, Tunisia and there is a specimen collected by the late Avinoam Danin from Golan in Israel (BR). A plant found in Siracusa Province, Sicily by AT was identified as this species from a photograph. It is clearly much more widespread than previously thought and likely to have been under-recorded throughout much of the region. The range of *C. lusitanica* can now be seen to extend from the Iberian Peninsula and Morocco east through Sardinia and Lesvos to Israel, suggesting that this species should be sought elsewhere in North Africa, as well as possibly in the Balearic Islands.

In 2010, an assessment of the extinction risk of European populations of *C. lusitanica* classed it as Near Threatened (Bilz *et al.* 2011) on the basis that “This species is classed as Near Threatened as it has a restricted distribution area and its freshwater habitat is degrading. Expected future demand of water in the southern European regions, will worsen the situation for this species and it could quickly fall into a threatened category”. The discovery of additional populations extending from Sardinia and Sicily east to Syria and Israel means that its distribution is no longer restricted and although its habitat is threatened throughout its range, the likelihood of extinction must now be considered remote. *Callitriche lusitanica* should therefore be classed as Least Concern (IUCN 2012).

Callitriche terrestris Rafinesque (1808: 358)

In May 2016 a population of *C. terrestris* was found growing on moist soil between cobbles in the street in the Jewish quarter of Córdoba (southern Spain), where it was dominant with a few other species such as *Poa annua* Linnaeus (1753: 68), *Plantago major* Linnaeus (1753: 112), *Sagina apetala* Arduino (1764: 22) and *Polycarpon tetraphyllum* (Linnaeus 1753: 89) Linnaeus (1759: 881). In its native range, *C. terrestris* grows in seasonally wet hollows and damp soil, in cultivated fields, rocky ground, paths, tracks and on sandy river bars (Fassett 1951). It has been recorded only once previously in Europe, on the margin of an acid pool (pH = 5.6) at Clairefontaine in the Forêt des Yvelines, Seine et Oise Department in central France, in 1930 (Schotsman 1967, Lansdown 2008), but there are no recent records from this site. *Callitriche terrestris* is native to the United States and southwards through Central America to Brazil and Ecuador (Fassett 1951). It is naturalised in Taiwan (Lansdown 2006a) and has been reported from Japan (Katsuyama & Kawasumi 1999), although the latter report has not been critically confirmed. The record from Spain therefore represents the second one for Europe for this species. Since the previous record is over 85 years old, the population in Spain may be considered a new introduction into Europe. Introduction from the Americas, especially North America, is a known source for alien species in Europe (van Kleunen *et al.* 2015). Terrestrial *Callitriche* species are increasingly occurring as contaminants in ornamental plant pots in international trade (unpublished data) and this is one possible explanation for the route by which this plant entered the country; alternatively it could have been brought in as seed carried accidentally by tourists visiting the nearby Mezquita-Catedral de Córdoba.



FIGURE 1. *Callitriche brutia* var. *naftolskyi*, showing the fruit wider than high and broadly winged, near Perdasdefogu, Sardinia, 23 April 2016. Photograph by Richard V. Lansdown.



FIGURE 2. Terrestrial *Callitriche brutia* var. *naftolskyi*, near Perdasdefogu, Sardinia, 23 April 2016. Photograph by Richard V. Lansdown.



FIGURE 3. Terrestrial *Callitriche brutia* var. *naftolskyi*, Pauli Piccia, Sardinia, 23 April 2016. Photograph by Richard V. Lansdown.



FIGURE 4. Dense beds of *Callitriche lusitanica* with flowering *Ranunculus peltatus* in a bedrock and cobble-dominated channel, Ollastu River, Sardinia, 23 April 2016. Photograph by Richard V. Lansdown.



FIGURE 5. Terrestrial *Callitriche lusitanica* growing over a boulder in the channel of the Rio Picocca, Sardinia, 23 April 2016. Photograph by Richard V. Lansdown.



FIGURE 6. *Callitriche lusitanica* in a lowland, silt-dominated channel, Fiume Temo, Sardinia, 24 April 2016. Photograph by Richard V. Lansdown.



FIGURE 7. *Callitriche terrestris* growing between cobbles in the street in Córdoba, 4th May 2016. Photograph by J.J. Wieringa.

Final comments

The first records of *Callitriche* species on Lesvos were made by Candargy (1897, 1898) who also described *C. aeolica* Candargy (1897: 157) as a new species from Chamaris as follows “*Submersa, stomatibus pilisque stellatis carens, flores bibracteati, folia uninervia, linearia apice bifida, styli perlongi reflexo patentes, ovarium breviter pedicellatum, stamen l. flavum. Undique in stagnis littoris Charamis Malae nec non campi Ipios*”. However this material appears to have been lost. It was regarded by Greuter *et al.* (1984) as probably a synonym of *C. stagnalis* without explanation; but a plant with linear leaves which is flowering under water will not be *C. stagnalis*, and it must be treated as unresolved unless a specimen can be found. *Callitriche stagnalis* was reported by Rechinger (1943) from Lesvos, however this material was re-determined as *C. brutia* var. *naftolskyi* (see Appendix). Therefore, the presence of *C. stagnalis* on Lesvos is doubtful (see also Bazos & Yannitsaros 2004). *Callitriche stagnalis* is very rare in the Aegean, being reported from the islands of Skiathos (Economidou 1969), Kos (Hansen 1980) and Ikaria (Christodoulakis 1996), but none of these records has been critically confirmed. Schotsman & Mathez (1983) and Greuter *et al.* (1984) consider that it probably does not occur in the East Aegean Islands and it is best to treat all reports from the region as erroneous unless they can be confirmed. A plant collected by Edmondson (E) is *C. truncata* Guss. subsp. *truncata*, which settles the presence of this taxon on the island. Thus the only *Callitriche* taxa which can be confirmed as occurring on Lesvos are *C. brutia* var. *brutia*, *C. brutia* var. *naftolskyi*, *C. lusitanica*, *C. truncata* subsp. *occidentalis* (Rouy 1910: 186) Schotsman (1986: 153) and *C. truncata* subsp. *truncata*.

Callitriche lusitanica was found in Sardinia when sites from which *C. truncata* subsp. *truncata* had erroneously been reported were visited, while *C. brutia* var. *naftolskyi* was found in Sicily when visiting sites with records of the same taxon or of *C. brutia* var. *brutia* (Pasta *et al.* 2008). This suggests that misidentification of these taxa is common. Review of material at BM, CGE, E, G. K, SS and STU has located *C. truncata* subsp. *truncata* material from a single site in Sardinia, the region around Palermo in Sicily, Barbalias (a small island off the NE coast of Lesvos), and a number of locations in Syria. The sites around Palermo are very likely to have been destroyed due to coastal development since these collections were made. A second site in Sicily from which this taxon has been recorded (Minissale & Sciandrello

2016) was not visited but it would be valuable to confirm the record. No *Callitriche* was found at the site on Barbalias when it was visited by IB in the 1990s. It is not currently possible to assess the potential for survival of populations in Syria. It is clear that *C. truncata* subsp. *truncata* is very rare, however the distinction of subsp. *truncata* from subsp. *occidentalis* is difficult from herbarium specimens and there is a need for fieldwork to locate extant populations.

Records of *C. regis-jubae* from Italy are based on a specimen collected from near “R.s. Giovanni, 18 km au NW de Olbia, 30 m a.s.l., 21 April 1971, *Ast & Boischler*” (P), determined by H.D. Schotsman, and on material from the island of Capraia (Lansdown *et al.* 2014). The latter material has been redetermined as *C. brutia* var. *naftolskyi* and it seems wise to consider the occurrence of *C. regis-jubae* unconfirmed in Italy until the specimen at P can be reviewed. *Callitriche brutia* var. *brutia* and var. *naftolskyi*, *C. lenisulca* Clavaud, *C. lusitanica*, *C. obtusangula*, *C. stagnalis*, *C. truncata* subsp. *occidentalis* and subsp. *truncata* have been confirmed from Sardinia, but it is likely that records of *C. brutia* var. *hamulata* (Kützing ex W.D.J. Koch 1835: 246) Lansdown (2006b: 113), *C. palustris* L., *C. platycarpa* Kützing (1832: 174) and *C. regis-jubae* (Pignatti 1982, Schotsman & Mathez 1983, Arrigoni 2013) are erroneous. Herbarium material from Sicily has not been thoroughly reviewed, but *C. brutia* var. *naftolskyi*, *C. lusitanica*, *C. obtusangula* and *C. truncata* subsp. *truncata* have been confirmed from the island.

As noted by Schotsman (1967) and Schotsman & Mathez (1983), *C. brutia* var. *hamulata* probably does not occur in the Mediterranean basin. RVL has seen one specimen, collected by Attila Mesterházy from a small pool in the Gorgo del Drago, Godrano, Sicily which appeared to be this variety. However, given the potential significance of such a record, we cannot consider it as confirmed, and therefore records of *C. brutia* var. *hamulata* from the Mediterranean region should be treated as doubtful unless confirmed through chromosome counts or molecular analysis.

The discovery that *C. lusitanica* has a wider range than previously thought clearly shows that the genus is inadequately understood in the region. Combined with the recent discovery of *C. pulchra* Schotsman (1967: 40) in Cyprus (Lansdown *et al.* 2016), together with clarification of the taxonomic position and distribution of *C. brutia* var. *naftolskyi*, it serves to highlight the need for further critical review of herbarium material, as well as for field surveys and dissemination of identification guidance.

Key to *Callitriche* species recorded from the Mediterranean region

(Note that non-flowering plants cannot be identified reliably)

- | | | |
|-----|--|--------------------------------|
| 1. | Pollen yellow; anthers on filaments >1 mm long | 2 |
| – | Pollen colourless; anthers subsessile or on filaments ≤ 1 mm long | 14 |
| 2. | Fruit clearly winged at least at the apex | 3 |
| – | Fruit unwinged | 11 |
| 3. | Fruit winged only at the apex; mature fruit black | <i>Callitriche palustris</i> |
| – | Fruit winged throughout; mature fruit black, brown or greyish | 4 |
| 4. | Bracts present | 5 |
| – | Bracts lacking | 9 |
| 5. | Some fruit pedunculate; mature fruit maroon or dark brown | 6 |
| – | All fruit sessile; mature fruit pale brownish or greyish | 7 |
| 6. | Fruit as high as or higher than wide, < 1.2 mm wide; style > 2 mm long; peduncle < 2 mm long | <i>Callitriche mathezii</i> |
| – | Fruit wider than high, ≥ 1.2 mm wide; style < 1 mm long; peduncle ≤ 55 mm long | <i>Callitriche regis-jubae</i> |
| 7. | Testa cells punctate; some bracts forked | <i>Callitriche cribrosa</i> |
| – | Testa cells cross shaped; bracts simple | 8 |
| 8. | Pollen bluntly triangular; mature fruit pale brownish | <i>Callitriche platycarpa</i> |
| – | Pollen ellipsoid; mature fruit greyish | <i>Callitriche stagnalis</i> |
| 9. | Flowers solitary; fruit < 1 mm wide and long | <i>Callitriche lusitanica</i> |
| – | Male and female flowers in most axils; fruit ≤ 1 mm wide and long | 10 |
| 10. | Fruit sessile | <i>Callitriche terrestris</i> |
| – | Fruit pedunculate | <i>Callitriche deflexa</i> |
| 11. | Fruit pedunculate | <i>Callitriche mouterdei</i> |
| – | Fruit sessile | 12 |

12. Fruit higher than wide; pollen elongate *Callitriche obtusangula*
 – Fruit as wide as high; pollen ellipsoid 13
13. Different stem branches typically with either male or female flowers, with few if any of the other sex *Callitriche cophocarpa*
 – Pairs of male and female flowers alternate along shoots *Callitriche lenisulca*
14. Fruit with mericarps divergent; cross shaped when viewed from above; stem and leaf scales lacking 15
 – Fruit with mericarps parallel; stem and leaf scales present 17
15. Fruit unwinged *Callitriche truncata* subsp. *occidentalis*
 – Fruit winged 16
16. Wing broad; peduncle recurved *Callitriche pulchra*
 – Wing narrow; peduncle various but not recurved *Callitriche truncata* subsp. *truncata*
17. Fruit wider than high *Callitriche brutia* var. *naftolskyi*
 – Fruit as high as or higher than wide 18
18. Fruits sessile to shortly pedunculate (< 2 mm); leaf apices shallowly to deeply notched, with notch broad, irregular or regular* ...
 *Callitriche brutia* var. *hamulata*
 – Fruits subsessile to long-pedunculate (usually > 2 mm); leaf apices shallowly to deeply notched, with notch narrow and often
 irregular* *Callitriche brutia* var. *brutia*

* Intermediates cannot reliably be separated.

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References

- Allioni, C. (1785) *Flora Pedemontana*, I. I.M. Briolus, Taurini [Turin], 344 pp.
- Arduino, P. (1764) *Animadversionum botanicarum specimen alterum*. Typographia Sansoniana, Venetia, 42 pp. + 20 pl.
- Arrigoni, P.V. (2013) *Flora dell'Isola di Sardegna*, 4. Società Botanica Italiana. Carlo Delfino editore, Sassari, 584 pp.
- Babington, C.C. (1874) *Manual of British botany, containing the flowering plants and ferns. Arranged according to the natural orders*, 7th ed. J. Van Voorst, London, 473 pp.
- Bazos, I. & Yannitsaros, A. (2004) Floristic reports from the island of Lesvos (Greece) I. Dicotyledones: Aceraceae to Guttiferae. *Edinburgh Journal of Botany* 61 (1): 49–86.
<https://doi.org/10.1017/S096042860400006X>
- Bennett, A. (1901) Naiadaceae. In: Thiselton-Dyer, W.T. (Ed.) *Flora of Tropical Africa*, 7. L. Reeve & Co. Ltd., Ashford, pp. 215–230.
- Bilz, M., Kell, S.P., Maxted, N. & Lansdown, R.V. (2011) *European Red List of Vascular Plants*. Publications Office of the European Union, Luxembourg, 130 pp.
<https://doi.org/10.2779/8515>
- Boissier, E. (1844) Plantae Aucherianae, adjunctis nonnullis e regionibus Mediterraneis et Orientalibus aliis cum novarum specierum descriptione. *Annales des Sciences Naturelles, Botanique, ser. 3* 1: 120–151.
- Boreau, A. (1857) Les plantes recueillies en Corse. *Mémoires de la Société Académique de Maine et Loire* 1: 83–92.
- Börner, C.J.B. (1912) *Eine Flora für das deutsche Volk*. Voigtländer-Verlag, Leipzig, 864 pp.
- Bory, J.B.G.M. (1844) Sur les Isoetes et les espèces nouvelles de cette famille découvertes en Algérie. *Comptes rendus hebdomadaires des*

séances de l'Académie des sciences 18: 1163–1168.

- Bory, J.B.G.M. & Durieu, M.Ch. (1848) *Exploration scientifique de l'Algérie pendant les années 1840, 1841, 1842 publiée par ordre du gouvernement et avec le concours d'une commission académique. Atlas* [Livraison 8]. Imprimerie impériale, Paris, 6 plates [pl. 28, 38, 41, 54, 59 & 83].
- Brown, R. (1812) *Hortus Kewensis* 4. Longman, Hurst, Rees, Orme & Brown, London, 522 pp.
- Candargy, P.C. (1897) Flore de l'île de Lesbos. *Bulletin de la Société Botanique de France* 44: 140–162.
- Candargy, P.C. (1898) Flore de l'île de Lesbos. *Bulletin de la Société Botanique de France* 45: 181–192.
- Caruel, T. (1885) *Filippo Parlatore Flora italiana, ossia descrizione delle piante che nascono selvatiche o si sono inselvatichite in Italia e nelle isole ad essa adiacenti; distribuita secondo il metodo naturale* 6 (2). Tipografia dei successori Le Monnier, Firenze, pp. 337–656.
- Christodoulakis, D. (1996) The flora of Ikaria (Greece, E. Aegean Islands). *Phyton (Horn Austria)* 36 (1): 63–91.
- Cook, C.D.K. (1966) A monographic study of *Ranunculus* subgenus *Batrachium* (D.C.) A. Gray. *Mitteilungen (aus) der Botanischen Staatssammlung München* 6: 47–237.
- Cosson, E.S.C. (1849) *Notes sur quelques plantes critiques, rares, ou nouvelles du midi de l'Espagne, fasc. 2*. V. Masson, Paris, 91 pp.
- Delarbre, A. (1795) *Flore d'Auvergne, ou recueil des plantes de cette ci-devant province*. Imprimerie J.B. Bertet, Clermont-Ferrand, 255 pp.
- Dufour, J.-M.L. (1825) Observations sur quelques plantes de la France. *Annales des Sciences Naturelles, Botanique* 5: 82–89.
- Dumortier, B.-C. (1863) Monographie du genre *Batrachium*. *Bulletin de la Société royale de Botanique de Belgique* 2: 207–219.
- Economidou, E. (1969) *Geovotaniki erevna nisou Skiathou. Fytogeografia ton Vorion Sporadon*. Dissertation, Athens, 152 pp. [In Greek]
- Fassett, N.C. (1951) *Callitriche* in the New World. *Rhodora* 53: 137–155.
- Gennari, P. (1861) Nuova specie del genere *Isoëtes*. *Commentario della Societa Crittogamologica Italiana* 1: 42.
- Greuter, W., Burdet, H.M. & Long, G. (Eds.) (1984) *Med-Checklist 1*. Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, 330 pp.
- Gussone, J. (1826) *Plantae rariores qua in itinere per oras jonii ac Adriatici Maris et per regions Samni ac Aprutii*. Regia Typographia, Napoli, 419 pp.
- Gussone, J. (1843) *Florae Siculae Synopsis 1*. Typis Tramater, Napoli, 582 pp.
- Hansen, A. (1980) Eine Liste der Flora der Inseln Kos, Kalymnos, Pserimos, Telendos und Nachbar-Inselchen (Ostaegaeis, Griechenland). *Biologia Gallo-Hellenica* 9 (1): 3–105.
- Hartman, C.J. (1843) *Handbok i Skandnaviens Flora, ed. 4*. Zacharias Haegstrom, Stockholm, 482 pp.
- Hegelmaier, F. (1864) *Monographie der Gattung Callitriche*. Verlag von Ebner and Seubert, Stuttgart, 64 pp.
- Hudson, W.G. (1762) *Flora Anglica: Exhibens plantas per regnum Angliae sponte crescentes distributas secundum systema sexuale*. Editio altera, emendata et aucta London. Ed. 2, 504 pp.
- IUCN (2012) *IUCN Red List Categories and Criteria: Version 3.1. Second edition*. IUCN, Gland, Switzerland, and Cambridge, UK. iv + 32 pp.
- Katsuyama, T. & Kawasumi, E. (1999) *Callitriche terrestris* Raf. newly naturalized in Japan. *Journal of Japanese Botany* 74 (3):181–182.
- Koch, W.D.J. (1837) *Synopsis Florae Germanicae et Helveticae*. Lipsiae, Frankfurt am Main, 102 pp.
- Kützing, F.T. (1832) Über die deutschen Callitrichen. *Linnaea* 7: 174–192.
- Kützing, F.T. (1832) Über die deutschen Callitrichen. *Linnaea* 7: 174–192.
- Lagasca, M. (1821) Dispositio Umbelliferarum. Carpologica. In: *Amenidades Naturales de las Españas 1* (2). Impr. Ibarra, Madrid, pp. 87–106.
- Lamarck, J.B.A.P. de Monnet de & Candolle, A.P. de (1805) *Flore française ed. 3, 4* (2). Desray, Paris, pp. 401–921.
- Lansdown, R.V., Kefalas, K. & Bazos, I. (2016) New information on the status and distribution of *Callitriche pulchra* (Plantaginaceae), including a first record from Cyprus. *Willdenowia* 46: 379–385.
<http://dx.doi.org/10.3372/wi.46.46306>
- Lansdown, R., Saiani, D. & Soldano, A. (2014) Notulae alla checklist della flora vascolare Italiana 17 (2027–2070). Notula 2043 *Callitriche regis-jubae* Schotsman (Plantaginaceae). *Informatore Botanico Italiano* 46 (1): 76.
- Lansdown, R.V. (2006a) The genus *Callitriche* (Callitrichaceae) in Asia. *Novon* 16: 354–361.
- Lansdown, R.V. (2006b) Notes on the water-starworts (*Callitriche*) recorded in Europe. *Watsonia* 26: 105–120.
- Lansdown, R.V. (2008) *Water-starworts (Callitriche) of Europe*. B.S.B.I. Handbook No. 11. Botanical Society of Britain and Ireland, London, 184 pp.
- Le Gall, M. (1852) *Flore du Morbihan*. J.M. Galles, Vannes, 839 pp.
- Ledebour, C.F. von (1843) *Flora Rossica; sive, Enumeratio plantarum in totius Imperii Rossici provinciis Europaeis, Asiaticis et*

- Americanis hucusque observatarum 2 (1), part 4*. E. Schweizerbart, Stuttgart, 204 pp.
- Linnaeus, C. (1753) *Species Plantarum*, 2 vols. L. Salvius, Holmiae, 1200 pp.
- Linnaeus, C. (1759) *Systema Naturae*, ed. 10. L. Salvius, Holmiae, 1384 pp.
- Litvinov, D.I. (1917) *Flora Srednei Rossii: illyustrirovannoe rukovodstvo k opredleniyu i srednorusskikh semennykh i sosudistyykh sporovykh rastenii*, ed. 5. Izdanie M.i S. Sabashnikovykh, Moscow, 909 pp.
- Minissale, P. & Sciandrello, S. (2016) Ecological features affect patterns of plant communities in Mediterranean temporary rock pools. *Plant Biosystems* 150 (1): 171–179.
<http://dx.doi.org/10.1080/11263504.2014.986248>
- Moris, G.G. (1840) *Flora Sardoia, seu historia plantarum in Sardinia et adjacentibus insulis 2*. Ex Regio Typographeo, Turin, 562 pp.
- Murray, J.A. (1770) *Prodromus Designationis Stirpium Gottingensium*. Dieterich, Gottingen, 252 pp.
- Opiz, P.M. (1831) *Nomenclator Botanicus*. Sommer, Prague, 96 pp.
- Palla, E. (1888) Zur kenntnis der gattung „*Scirpus*“. *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 10: 293–300.
- Parlatore, F. (1845) *Flora Palermitana*. Accademia Nazionale di Scienze lettere e Arti Già del Buongusto di Palermo, Palermo, 442 pp.
- Pasta, S., Bambina, A., Romano, L.C., Giancontieri, G., Messina, G., La Mantia, T., Ottonello, D. & Scuderi, L. (2008) Il sito di “Castello della Pietra” e “Riserva Zangara” (Castelvetro, Sicilia sud-occidentale): Indagine multidisciplinare e proposte di tutela. *Naturalista Siciliano*, ser. IV 32 (1–2): 3–60.
- Petagna, V. (1787) *Institutiones Botanicae 2: De plantis in specie*. Published by the author, Neapoli, 328 pp.
- Pignatti, S. (1982) *Flora d'Italia 2*. Edagricole, Bologna, 790 pp.
- Rafinesque, C.S. (1808) Essential generic and specific characters of some new genusses [sic] and species of plants observed in the United States of America, in 1803 and 1804. *Medical Repository, New York*, ser. 2 5: 356–363.
- Rechinger, K.H. (1943) *Flora Aegaea. Flora der Inseln und Halbinseln des ägäischen Meeres*. Kommission bei Springer, Wien, 824 pp.
- Reichenbach, H.G.L. (1825) *Iconographia Botanica seu Plantae Criticae 3*. F. Hofmeister, Lipsiae [Leipzig], 92 pp, t. 21.
- Reichenbach, H.G.L. (1841–1842) Callitrichaceae. In: *Icones Florae Germanicae et Helveticae 5*. F. Hofmeister, Lipsiae [Leipzig], pp. 1–2, pls. 129–130.
- Reichenbach, H.G. (1863) *Icones Florae Germanicae et Helveticae 21: 9*. Sumptibus Ambrosii Abel, Lipsiae [Leipzig], 108 pp.
- Roth, A.W. (1827) *Enumeratio Plantarum Phaenogamarum in Germania Sponte Nascentium. Vol. 1*. J.F. Gleditch, Leipzig, 2015 pp.
- Rouy, G.C.C. (1910) *Flore de la France ou description des plantes qui croissent spontanément en France, en Corse et en Alsace-Lorraine 12*. Les Fils d'Émile Deyrolle, Paris, 505 pp.
- Schotsman, H.D. (1961) Notes on some Portuguese [sic] species of *Callitriche*. *Boletim da Sociedade Broteriana* 35: 95–127.
- Schotsman, H.D. (1986) Notas breves: 208. *Callitriche truncata* Guss. subsp. *occidentalis* (Rouy) Schotsman, comb. nova. *Lagasclalia* 14 (1): 153.
- Schotsman, H.D. & Andreas, C.H. (1974) *C. lenisulca* Clav., espèce méconnue. *Actes de la Société Linnéenne de Bordeaux* 44: 43.
- Schotsman, H.D. (1967) *Les Callitriches: Espèces de France et taxa nouveaux d'Europe*. Éditions Paul Lechevalier, Paris, 153 pp.
- Schotsman, H.D. (1969) *Callitriche mouterdei* Schotsm. nov. spec. *Bulletin du Centre d'Etudes et de la Recherche Scientifique, Biarritz* 7 (3): 617–630.
- Schotsman, H.D. (1973) Note sur *Callitriche regis-jubae* nov. spec. espèce nouvelle du bassin Méditerranéen occidental. *Bulletin de la Société d'Histoire Naturelle d'Afrique du Nord* 64: 25–37.
- Schotsman, H.D. (1974) *Callitriche lenisulca* Clav. espèce méconnue. *Bulletin du Centre d'Etudes et de la Recherche Scientifique, Biarritz* 10 (2): 285–316.
- Schotsman, H.D. (1977) *Callitriche* de la région Méditerranéenne: Nouvelles observations. *Bulletin du Centre d'Etudes et de la Recherche Scientifique, Biarritz* 11 (3): 241–312.
- Schotsman, H.D. (1982) Biologie florale des *Callitriche*: Étude sur quelques espèces d'Espagne méridionale. *Bulletin du Muséum National d'Histoire Naturelle Paris*, 4ème. sér., sect. B, *Adansonia* 3–4 : 111–160.
- Schotsman, H.D. & Mathez, J. (1983) Callitrichaceae. In: Greuter, W. & Raus, T.H. (Eds.) *Med-Checklist Notulae 8*. *Willdenowia* 13: 278–280.
- Schrank, F. von P. von (1789) *Baiersche Flora 2*. Johann Baptist Strobel, Munich, 670 pp.
- Schrank, F. von P. von (1822) *Plantae ucranae. Flora (Regensburg) 5 (2)*: 641–647.
- Scopoli, J.A. (1772) *Flora carniolica*, 2. Sumptibus Joannis Thomae Trattner, S. C. R. apostolicaeque maj. nec non inclyt. stat. inf. Austriae typographi et bibliopolae, Vindobon [Vienna], 667 pp.
- Soják, J. (1972) Nomenklatorické Poznámky (Phanerogamae). *Časopis Národního Musea, Oddíl Přírodovědný* 140 (3–4): 127–134.
- Syme, J.T.B. (1863) *English Botany; or, Coloured Figures of British Plants*, ed. 3[B], 1. R. Hardwicke, London, 235 pp.
- The Plant List (2013) *The plant list 2013, Version 1.1*. Available from: <http://www.theplantlist.org/> (accessed 26 February 2017)
- Thiers, B. (2017) [continuously updated] *Index herbariorum: a global directory of public herbaria and associated staff*. New York

- Botanical Garden's virtual herbarium. Available from: <http://sweetgum.nybg.org/science/ih/> (accessed 26 February 2017)
- Thuillier, J.-L. (1824) *Flore des environs de Paris ou distribution méthodique des plantes qui y croissent naturellement*. Compère, Jeune, Paris, 359 pp.
- Troia, A., Pereira, J.B., Kim, C. & Taylor, W.C. (2016) The genus *Isoetes* (Isoetaceae): a provisional checklist of the accepted and unresolved taxa. *Phytotaxa* 277 (2): 101–145.
<http://dx.doi.org/10.11646/phytotaxa.277.2.1>
- van Kleunen, M., Dawson, W., Essl, F., Pergl, J., Winter, M., Weber, E., Kreft, H., Weigelt, P., Kartesz, J., Nishino, M., Antonova, L. A., Barcelona, J.F., Cabezas, F.J., Cárdenas, D., Cárdenas-Toro, J., Castaño, N., Chacón, E., Chatelain, C., Ebel, A. L., Figueiredo, E., Fuentes, N., Groom, Q. J., Henderson, L., Inderjit, Kupriyanov, A., Masciadri S., Meerman, J., Morozova, O., Moser, D., Nickrent, D.L., Patzelt, A., Pelser, P.B., Baptiste, M.P., Poopath, M., Schulze, M., Seebens, H., Shu, W.-S., Thomas, J., Velayos, M., Wieringa, J.J. & Pyšek, P. (2015) Global exchange and accumulation of non-native plants. *Nature* 525: 100–103.
- Villars, D. (1786) *Histoire des plantes de Dauphiné 1*. Grenoble, Author, Lyon les Frères Périsse, Piestre & de la Molière; Paris, Prévost, 466 pp.
- Villars, M. (1789) *Histoire des plantes de Dauphiné 3 (2)*. Grenoble, Author, Lyon les Frères Périsse, Piestre & de la Molière; Paris, Prévost, 1091 pp.
- Walters, S.M. (1956). *Montia fontana* L. *Watsonia* 3: 1–6.
- Warburg, O. & Eig, A. (1929) *Callitriche naftolskyi* spec. nov. *Repertorium Specierum Novarum Regni Vegetabilis* 26: 84.
- Webster, S.D. (1988) *Ranunculus penicillatus* (Dumort.) Bab. in Great Britain and Ireland. *Watsonia* 17: 1–22.
- Weigel, C.E. von (1772) *Observationes Botanicae*. A.F. Röse, Gryphiae, 51 pp.
- Willdenow, C.L. von (1798) *Species Plantarum 1*. Impensis G.C. Nauk, Berolini, 1568 pp.

APPENDIX. Material studied

***Callitriche brutia* var. *brutia*:—GREECE.** Lesvos: SE of Agra, near Apothika, in small pool, 28 November 1993, *I. Bazos 1454* (ATHU!); ca. 2 km NE of Achladeri, sandy bay and saltmarsh, 3 April 1994, *Nielsen & Skovgaard 9590* (C); approximately 4.5 km N of Kalloni, small temporary pond in a *Pinus brutia* forest, 24 April 1994, *I. Bazos 1654*, *A. Yannitsaros 8575* (ATHU!); 2–3 km ENE of Skalochori, 3 April 1994, *Nielsen & Skovgaard 9615* (C); in the locality called Mikri Limni, small shallow lake, 25 May 1994, *I. Bazos 1761* (ATHU!); ca. 7 km NE of crossroads to Palios (ENE of Mandamados), in seasonal pools, 2 June 1994, *I. Bazos 1907* (ATHU!); Approximately ca. 2 km SSE of Mesotopos, Dergatsidi, in semi-natural pool, 39°07' N, 26°01' E, 20 m a.s.l., 23 August 1996, *A. Yannitsaros 9193* (ATHU!). Milos: Nomos Kikladon, Eparchia Milou, small stream near Achivadolimni, 36° 41' 15" N, 24° 26' 22" E, 10 m a.s.l., 21 March 2016, *I. Bazos & A. Zikos 4690* (ATHU!).

***Callitriche brutia* var. *naftolskyi*:—GREECE.** Lesvos: In fossis stagni exsiccati “Megali Limni”, Insula Mytilini (Lesbos), 18–24 May 1934, *K.H. & F. Rechinger 5723* (G!) (Rechinger 1943, Greuter & Raus 1984); ca. 3.5 km NW of Kalloni very close to Moni Limonos, wet flat places and seasonal pools, 28 April 1994, *A. Yannitsaros 8649* (ATHU!). Milos: Nomos Kikladon, Eparchia Milou, near Psathadika, small stream and temporary ponds, 36° 43' 10" N, 24° 21' 35" E, 140 m a.s.l., 9 March 2016, *I. Bazos & A. Zikos 4696* (ATHU!). **ISRAEL.** Sharon Plain, NE of Tel Aviv, 23 April 1927, *Naftolsky 01853* (HUJ). **ITALY.** Capraia: pozzetta sul lato est del sentiero da S. Rocco verso S. Stefano, Isola di Capraia (Livorno), Toscana, UTM: 33T 568.4765, 125 m, 25 April 2013, *A. Soldano 16260* (FI!) (Lansdown *et al.* 2014). Sardinia: Marais sales pres Villacidro, March 1854, *Huet de Pavilion* (BM!, P). Dominant in ditch, east of Perdasdefogu, 39° 40' 14.8" N, 09° 30' 22.5" E, 23 April 2016, *R.V. Lansdown*; Poached hollow along track, Paùli Piccia (Tuili, VS), 39° 44' 18.5" N, 08° 57' 27.3" E, 23 April 2016, *R.V. Lansdown*; Open, very stony and dry pool, Paùli Maiori (Tuili, VS), 39° 44' 35.2" N, 08° 57' 31.2" E, 23 April 2016, *R.V. Lansdown*; very extensive rutted area along track, Paùli Maiori (Tuili, VS), 39° 44' 32.2" N, 08° 57' 31.2" E, 23 April 2016, *R.V. Lansdown*; shallow hollow in rocky plateau, Monte Minerva (Villanova Monteleone, SS), 40° 26' 28.1" N, 08° 32' 24.6" E, 24 April 2016, *R.V. Lansdown*; shallow hollow in rocky plateau, Monte Minerva (Villanova Monteleone, SS), 40° 26' 31.4" N, 08° 32' 34.6" E, 24 April 2016, *R.V. Lansdown*; shallow hollow in rocky plateau, Monte Minerva (Villanova Monteleone, SS), 40° 26' 32.0" N, 08° 32' 24.8" E, 24 April 2016, *R.V. Lansdown*; large shallow pool beside track, Monte Minerva (Villanova Monteleone, SS), 40° 26' 32.5" N, 08° 32' 26.7" E, 24 April 2016, *R.V. Lansdown*. Sicily: Palermo, 1854 (K!); seasonal pool, Buccheri, Siracusa Province, 37° 7' 12.51" N, 14° 51' 22.60" E, 27 April 2016, *R.V. Lansdown & A. Troia*; cupular pool in karstic limestone, Castello della Pietra, Castelvetro, Trapani Province, 37°40'1.38"N, 12°53'33.70"E, 28 April 2016, *R.V. Lansdown & A. Troia*. **LIBYA.** Drying pool between El Merg

(Barce) & Holmetta, Benghazi Province, 14 April 1939, *N.D. Simpson* 39607 (BM!); Lamluda, Derma Province, 11 April 1939, *N.J. Sandwith* 2571, *N.D. Simpson* 39512 (BM!). **MOROCCO**. Daya au sud de Marchaud, 45 m, 28 April 1927, *E. Jahandiez* 35 (BM!, G!); Daya a l'W de la route Chemmaiya–Chichaoua au N. de Bled Haroussia, 6 March 1956, *Nègre* 4876 “rel. à 2368” (RAB). **SYRIA**. 1 km N of Quneitra, 7 May 1953, *P. Mouterde* P 213 (G!).

Callitriche lusitanica:—**GREECE**. Lesvos: between Parakila and Agra, crossroads to Apothica, 39° 07' 31"N, 26° 05' 11"E, ca. 130 m, 25 April 1994, *Bazos* 1683 (ATHU!); approximately 3.5 km NE of Sigri, temporary pond, 39° 13' 27" N, 26° 52' 43" E, 16 April 2015, *I. Bazos & A. Zikos* 4670 (ATHU!). **ISRAEL**. Vernal pool, 10 km NNE of Ramat Magshimim, Golan, 18 June 1984, *A. Danin s.n.* (BR! 24932653). **ITALY**. Sardinia: Ollastu River, 39° 20' 52.5" N, 09° 27' 08.4" E, 23 April 2016, *R.V. Lansdown*; backwater of Rio Picocca, 39° 21' 18.0" N, 09° 29' 34.7" E, 23 April 2016, *R.V. Lansdown*; broad shallow channel flowing through pasture, Fiume Temo, 40° 23' 54.7" N, 08° 28' 34.4" E, 24 April 2016, *R.V. Lansdown*; mainly terrestrialised on rocks on bedrock-dominated river, 40° 31' 31.4" N, 08° 28' 34.4" E, 24 April 2016, *R.V. Lansdown*. Sicily: robably permanent pool in the Bosco Pisano area, Buccheri, Siracusa Province, 37° 10' 32.67" N, 14° 51' 58.33" E, 3 April 2010, *A. Troia & F. Marrone*.

Callitriche terrestris:—**SPAIN**. Andalucía, Córdoba, between stones in street, 119 m a.s.l., 37° 52.76' N, 04° 46.60' W, 4 May 2016, *J.J. & E.H. Wieringa* 8676 (WAG!, BM!).

Callitriche truncata* subsp. *truncata:—**ALGERIA**. Prov. de Constantine, July 1861, *E. Cosson* 3 (P!). **GREECE**. Barbalias: In a tank of fresh water by the shepherds' cabin, Nomos Lesvou, Eparchia Mitilinis, 39° 19' N, 26° 26' E, 6 May 1978, *Edmondson & McClintock* 2468 (E) (Edmondson 1982). **ITALY**. Sardinia: In rivulis prope Pulam, April [no year given] *V.I. Müller* (CGE!, K!, L!). Sicily. Palermo, s.d., *Todaro* (CGE!); Palermo a Mondello, s.d., *Todaro* (P!); in calcaris hyeme inundatis, Palermo, 21 April 1882, *Todaro* 623 (K!, P!, U!); in water, Palermo, *s.n.*, 1853 (K!); in locis hieme inundatis Vergine Maria prope Panormum, 15 March 1856, *E. & A. Huet du Pavillon* (K!, P!, WAG!); April 1903, *A. Prior* (K!).