

Updating the distribution of the genus *Callitriche* (Plantaginaceae) in Italy from the study of the *Herbarium Centrale Italicum* collections

Lorenzo Lastrucci¹ , Daniele Saiani², Alessio Mugnai³, Giulio Ferretti¹ & Daniele Viciani³ 

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Abstract. The first results of a herbariological study on the genus *Callitriche* L. at the Central Italian Herbarium (Herbarium Centrale Italicum) of the Museum of Natural History of the University of Florence are presented. This genus represents a critical group from a systematic and taxonomic point of view, as the diagnostic characters mainly consist in details of the reproductive structures that are difficult to observe and interpret. The herbarium specimens represent a material suitable for study only if they have anthers and especially ripe fruits. The study of these samples has brought to light the presence of material from newly reported locations for various Italian regions. In some cases, the reports derive from original new revisions, in other cases they are the result of the discovery and confirmation of previous revisions not incorporated by the modern Italian floras.

Keywords. Museum collections, Italian flora, critical plant groups, Systematics, Taxonomy.

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Introduction

The herbarium specimens are precious material for systematic and taxonomic studies, for distributional and phytogeographic analyzes and for planning conservation strategies (Schatz, 2002; Loiselle *et al.*, 2008; Wen *et al.*, 2015). In particular, the study of herbarium samples is important for the analysis of taxonomic critical groups, for which the revisions of herbarium materials can lead to considerable changes as regards the distributive knowledge at different scales (Lastrucci *et al.*, 2014). The genus *Callitriche* L. includes about 75 aquatic, amphibious or terrestrial species which may present identification problems on a morphological basis, because the vegetative characters alone are often not sufficient to identify the specimens at a specific level. In fact, the most solid diagnostic characters are dependent on the reproductive structures such as anthers but especially fruits, which in this case are schizocarps composed of four mericarps and which must be ripened to allow a correct determination (Schotsman, 1967, 1972; Lansdown, 2008, 2022; Saiani, 2009, 2018; Lansdown *et al.*, 2017; Prančl *et al.*, 2020). These difficulties have even more repercussions on herbarium materials, which can consist in individuals with only vegetative characters, with immature fruits or damaged structures (Lansdown, 2022), thus making identification

problematic if not impossible. In Italy, 11 species and 4 subspecies of *Callitriche* are known, while one species (*C. regis-jubae*) is considered as indicated by mistake in the Italian territory (Bartolucci *et al.*, 2018; Portal to the Flora of Italy, 2023). In this work, the first regional distribution novelties for Italy are reported, deriving from an extensive revision work, still in progress, on the herbarium materials occurring in the *Herbarium Centrale Italicum* of Florence (Italy).

Materials and Methods

The specimens examined are conserved in the open section of the Botanical Collections of the University Museum System of the University of Florence, i.e. in the *Herbarium Centrale Italicum* (hereafter HCI), international herbarium code: FI (all the cited herbarium codes are in accordance to Thiers, 2020). Only specimens bearing diagnostic reproductive characters such as anthers and ripe fruits were analyzed in the present work. The identification was carried out using the keys present in Schotsman (1967, 1972), Lansdown (2008), Murillo (2010) and Saiani (2018).

The collection sites were georeferenced and the distribution maps were created using the software QGIS 3.28.2-Firenze.

¹ Natural History Museum, University of Florence. Via G. La Pira 4, Firenze, Italy

² Via Malvito 16 22100 Como Italy

³ Department of Biology, University of Florence. Via G. La Pira 4, Firenze, Italy. E-mail: daniele.viciani@unifi.it



Figure 1. Specimen from Sardinia of *Callitriche cophocarpa* collected by P.V. Arrigoni at Abbasanta (Oristano), stored in FI.

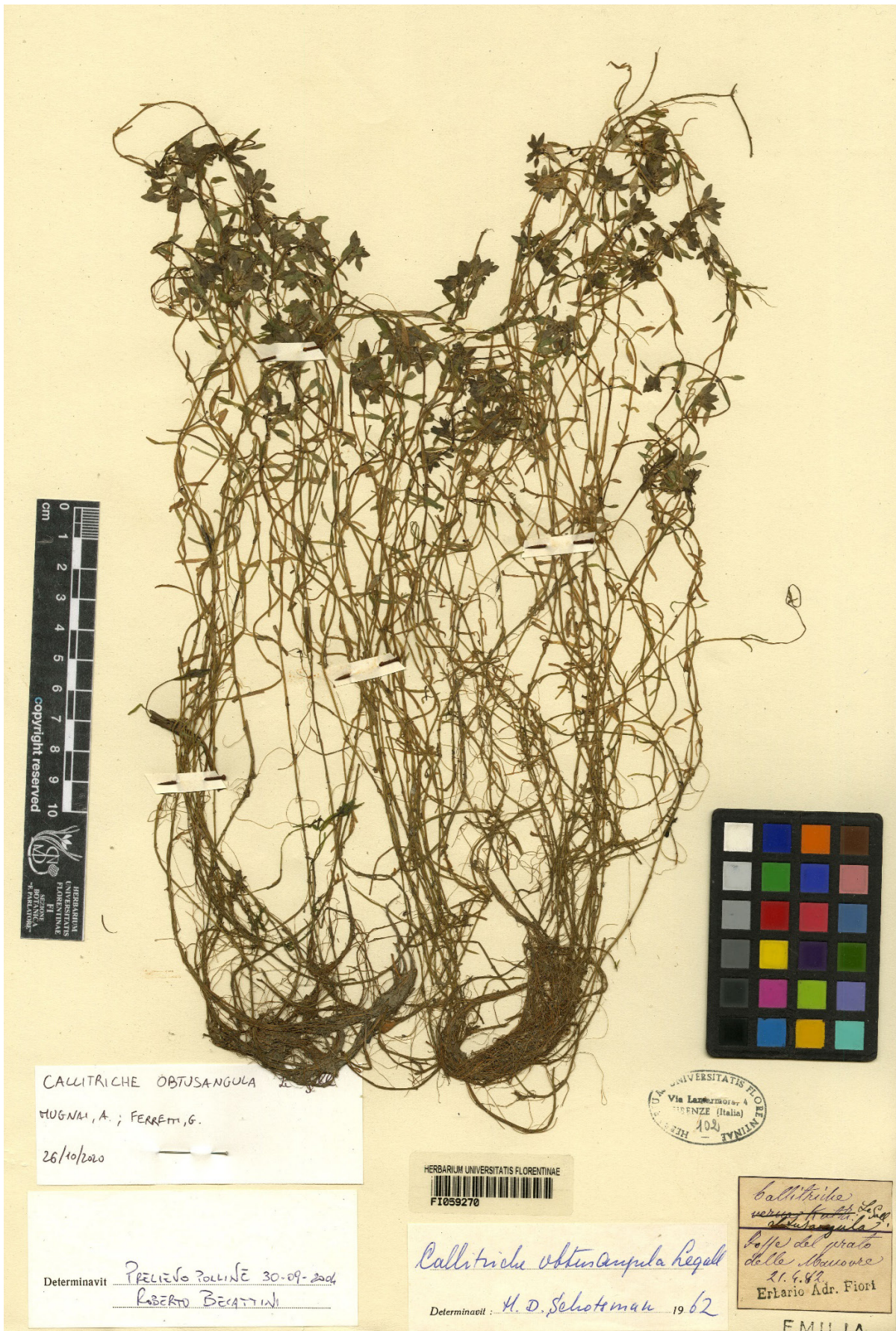


Figure 2. Specimen of *Callitriche obtusangula* stored in FI and collected by Adr. Fiori at “prato delle Manovre” (Modena); the record was subsequently confirmed by Schotsman in 1962.

In agreement with Bartolucci *et al.* (2018), a species was considered as confirmed and present in the area when collected after 1950 (P). For the oldest specimens, the entity was considered as “no long recorded” (NC) and its current presence will have to be ascertained with appropriate field research. In the results paragraph, each taxon name is followed by P or NC, the abbreviation of the name of the Italian administrative region, the collection site(s) reported in the herbarium labels and an explication note. The abbreviation of the names of the Italian administrative regions always follow Bartolucci *et al.* (2018) and those here used, in alphabetical order, are: CAL, Calabria; EMR, Emilia-Romagna; FVG, Friuli-Venezia Giulia; SAR, Sardinia; TOS, Tuscany; UMB, Umbria).

Results and Discussion

Callitriche cophocarpa Sendtn.

(P SAR) Abbasanta [Oristano], prati umidi lungo la SS. Carlo Felice, presso il bivio di Norbello. Substrato basaltico, 06 June 1989, *P.V. Arrigoni, R.M. Baldini et C. Ricceri*, s.n. (FI n. FI059370).

Specimen originally identified by Arrigoni as *C. cophocarpa* and confirmed by us during the revision of the herbarium material (Figure 1). Despite the presence of other Sardinian samples determined as *C. cophocarpa*, the cited specimen is the only one attributable with certainty to this entity, on the basis of the measurements of the anther (greater than 0.5 mm) and the presence of some completely male or female branches, so the reported station is the only one that can be confirmed as regards the exsiccata present in the HCI (Figure 1). Although neither Schotsman (1977), Pignatti (1982), Conti *et al.* (2005) nor Lansdown (2008) mentioned the presence of this species for Sardinia, it had been subsequently indicated by Arrigoni (2013); however, the species was still considered absent from this region in Bartolucci *et al.* (2018) and subsequent updates (see also Portal to the Flora of Italy, 2023).

Callitriche obtusangula Le Gall

(NC EMR) Fossi attorno a Modena, 4 June 1883, *Adr. Fiori*, s.n. (FI, n. FI059263); Bologna, May 1873, *C. Marchesetti*, s.n. (FI, n. FI059264); Modena, Nonantola, fossi lungo la via, June 1873, *C. Marchesetti*, s.n. (FI, n. FI059265); Fossi a S. Faustino presso Modena, July 1894, *Adr. Fiori*, s.n. (FI, n. FI059267); Cesena nelle acque lentamente scorrenti, June 1891, *A. Del Testa*, s.n. (FI, n. FI059268); Fosse del prato delle Manovre [Modena], 21 April 1892, *Adr. Fiori*, s.n. (FI, n. FI059270); Fossati d'acqua corrente nei contorni di Modena, 10 May 1889, *G. Gibelli*, s.n. (FI, n. FI059271).

(NC UMB) Torricella, May 1890, *G. Cicioni*, s.n. (FI, n. FI059517); Lago Trasimeno, paludi di Tuoro, May 1890, *G. Cicioni*, s.n. (FI, n. FI059518).

(NC CAL) La Sila (Calabria), La Scurca [La Sculca] (S.S. 107 k 91) pascolo umido m. 1300, 8 May 1950, *G. Sarfatti et R. Contardo*, s.n. (FI, n. FI059712).

Almost all these specimens, originally attributed to different *taxa* with the exception of exsiccatum no. 6 (FI059270), correctly identified by Adriano Fiori (Figure 2), had been subsequently revised by Schotsman between 1962 and 1975, and all attributed to *C. obtusangula*, a diagnosis we confirmed. The specimen from Calabria (sub *C. stagnalis* Scop.) was instead determined by us as *C. obtusangula*. The cited *exsiccata* have been attributed to this entity due to the presence of wingless, sessile fruits, slightly longer than wide, with persistent styles protruding beyond the apex of the mericarps and not closely appressed to them.

Schotsman (1977), probably just on the basis of her herbarium revisions, reported the species generically for Emilia (see also Fiori, 1926 who indicated it for the Parma area) and Umbria, on the basis of specimens in HCI which, however, she did not precisely report, contrary to what she did for the exsiccata of Sardinia. Despite this, the presence of this species for the regions mentioned above was not reported either in Pignatti (1982) or in Bartolucci *et al.* (2018) and subsequent updates (see also Portal to the Flora of Italy, 2023). For all regions, the reference *exsiccata* are very old and the most recent specimen dates back to 1950. Given also the types of environments to which these species are linked, so subject to degradation or modifications due to anthropic interventions, the presence of this species in the regions mentioned above (Figure 6), as for all the other entities that will be reported on the basis of ancient samples, should be verified with targeted research in the field. The recent discovery of the species in the province of Arezzo, a few hundred meters from the Tuscan-Romagna border (loc. Fresciano, 16 July 2022, *D. Saiani*, Herb. Saiani), suggests to schedule accurate field campaigns in the surrounding areas to possibly verify the presence in the Emilia-Romagna region.

Callitriche platycarpa Kütz.

(NC FVG) Trieste, Monfalcone, August 1898, *C. Marchesetti*, s.n. (FI, n. FI059582).

(NC EMR) Nei fossati ad acqua stagnante nei contorni di Modena, April 1876, *G. Gibelli*, s.n. (FI, n. FI059584); Circa Mutinam, in stancis, April 1877, *R. Ricci*, s.n. (FI, n. FI059583).

(NC TOS) Cerbaie (Toscana), Querce, 23 May 1933, *R.E.G. Pichi Sermolli*, s.n., Herb. R. Pichi Sermolli n. 1553 (FI, n. FI059586); Cerbaie, Lucca, 24 May 1938, *E. Francini*, s.n. (FI, n. FI059575); Boscolungo, clairière (Fornace?) marais, 21 Aug 1886, *E. Levier*, s.n. (FI, n. FI059585).

The cited specimens have been attributed to this entity on the basis of the presence of mature mericarps closely winged, often “squared”, with persistent styles protruding beyond the apex of the mericarps and not closely appressed to them, and with leaves of the rosettes elliptical-spatulate, character which differentiate them from the obovate-spatulate ones of the more common *C. stagnalis*.

The Friulian sample (Figure 3), already reviewed by Schotsman in 1975 and determined as *C. platycarpa*,



Figure 3. Friulian specimen of *Callitriche platycarpa* stored in FI and collected by C. Marchesetti at Monfalcone (Trieste); the record was re-identified by Schotsman in 1975.



Figure 4. Specimen of *Callitriche truncata* subsp. *truncata* stored in FI and collected by O. Beccari at Castagnolo (Pisa); the label at the left bears the taxonomic notes and the request for a herbarium specimen by Parlatore; on the right, the subsequent revision by Schotsman of 1975.

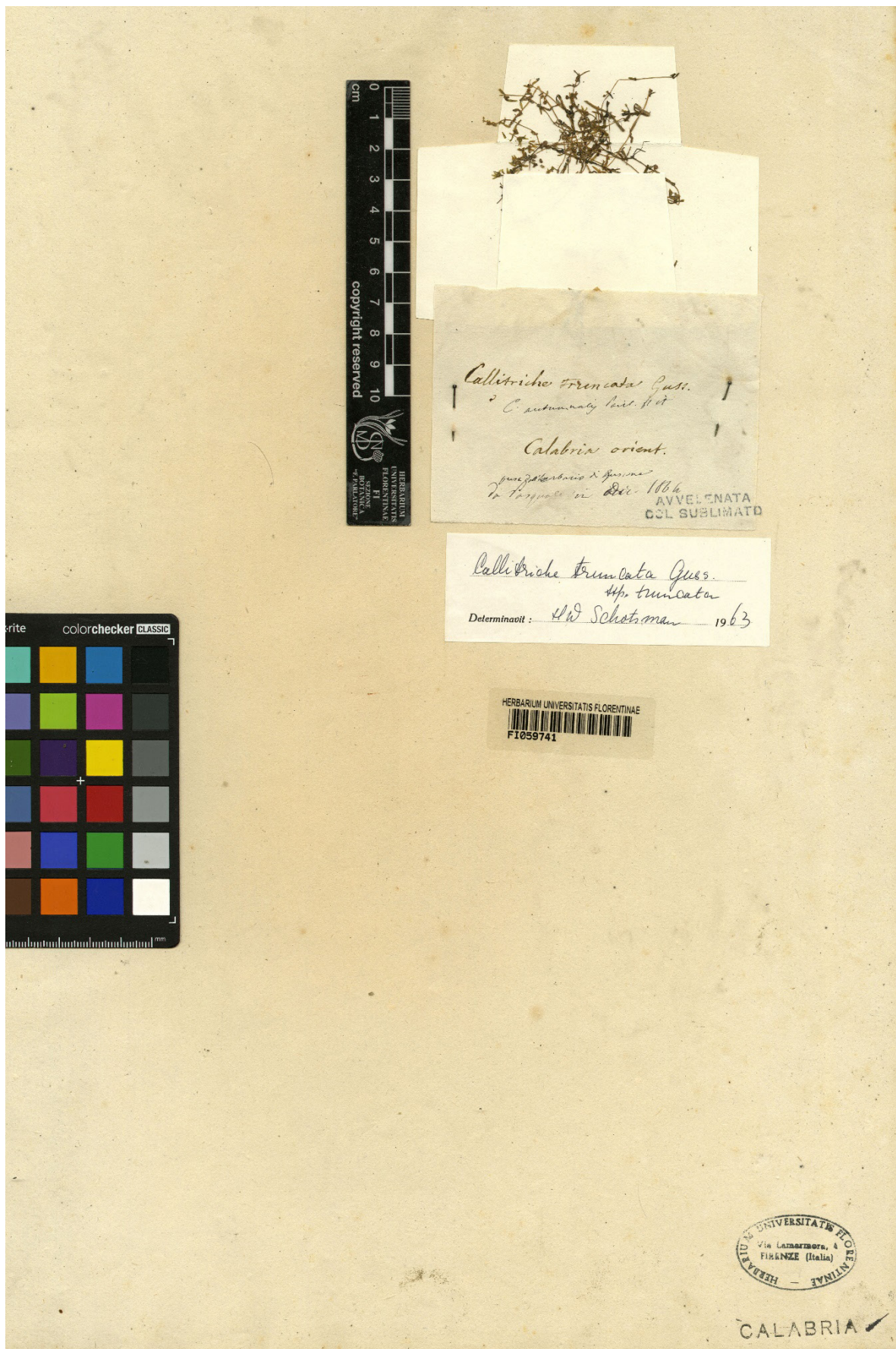


Figure 5. Specimen of *Callitriche truncata* subsp. *truncata* stored in FI and collected probably by Gussone in eastern Calabria; the identification was confirmed by Schotsman in 1963.

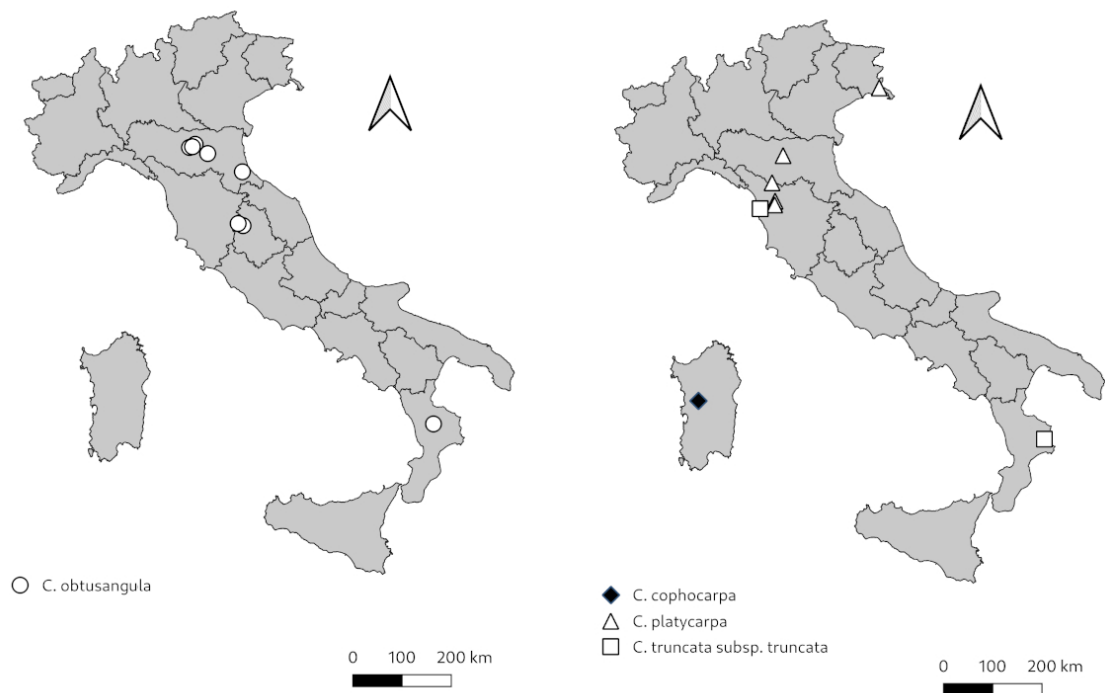


Figure 6. Distribution map of the studied taxa. Symbols in white refer to specimens collected until 1950, in black to specimens collected after 1950.

was conserved in a folder containing material from Istria and as such it had probably been reported by Schotsman (1977). However, the specimen mentioned above falls at present within Italian territory and therefore must be considered as the first report for Friuli Venezia-Giulia, where it had not currently been indicated (Bartolucci *et al.*, 2018).

Although revised by Schotsman in 1975, the samples from Emilia-Romagna have never been reported in the literature. These are two nineteenth-century specimens, originally determined as *C. stagnalis* Scop., difficult to separate but marked by two different labels, collected in two different years, belonging to the Ricci Herbarium; one is collected by Gibelli and the other by Ricci himself.

For Tuscany the species was instead indicated by Schotsman (1977) but Bartolucci *et al.* (2018) reported it as dubious for this region. This revision confirms Schotsman's identification for specimen no. 4 (FI059586), to which we added a further find not seen by Schotsman (FI05975), allowing to confirm the presence, at least in the past, of this entity in Tuscany for the Cerbaie area. To this collection site a further historical specimen relating to Boscolungo (Abetone) is added, again revised by Schotsman in 1975, based on an *exsiccatum* collected by Levier in 1886.

Callitriche truncata Guss. subsp. *truncata*

(NC TOS) Nelle fosse a Castagnolo presso Pisa, April 1863, *O. Beccari*, n. (FI, n. FI059738); ibidem, April 1863, *O. Beccari*, n. (FI, n. FI059739); Pisa a Castagnolo, 16 April 1869, *P. Savi*, s.n. (FI, n. FI059737).

(NC CAL) Calabria orient., *sine data, sine collector* [prob. *G. Gussone*], s.n. (FI, n. FI059741).

The specimens can be determined by the soft, semi-transparent leaves, not connected by a sheath and without secondary veins and especially by the presence of mericarps with wings less than half the width of the mericarps themselves, an aspect which differentiates the typical subspecies from *C. truncata* subsp. *occidentalis* (Rouy) Braun-Blanq., which has wingless fruits. For Tuscany, all the three *exsiccata* come from a single site (Castagnolo near Pisa) and are very ancient. They were revised and already identified as *C. truncata* subsp. *truncata* by Schotsman in 1975, who also published these data (Schotsman, 1977). Consequently, the presence in Tuscany of this entity had already been indicated by Pignatti (1982, sub *C. truncata* Guss.), although later the record is not present in the most recent Italian floristic literature (Conti *et al.*, 2005; Bartolucci *et al.* 2018 and subsequent updates (see the Portal to the Flora of Italy, 2023). Data for Tuscany are also not reported by Lansdown (2008). Curiously, the specimen which probably constitutes the first record for Tuscany by Odoardo Beccari (Figure 4) was originally identified as *C. pedunculata* DC. by this Florentine botanist. It was Filippo Parlatore, at that time director of the HCI (see Cuccuini, 2009), who, in a note pinned on the *exsiccatum*, corrected its identification and requested a new sample for the Herbarium collections which probably Beccari himself provided him, given the presence of another herbarium specimen, handwritten by Beccari and with the correct determination on the label.

The sample from Calabria (Figure 5) presents several critical points. The first is linked to the collection site which, in the label of the FI *exsiccatum*, is generically

indicated as “eastern Calabria”, a very vague indication and therefore not localizable from a cartographic point of view. However, from the protologue (Gussone, 1826), it is clear that the species has been described precisely for eastern Calabria, in Crotone (“*In stagnis Calabriae orientalis prope Cotronè*”), so the point on the map is referred to this locality (Figure 6). The second critical issue concerns the collection date which is not indicated, as the only date present on the label (Dec. 1864) refers to the year of accession in the HCI by Pasquale and not to the actual collection date. Even the collector is not expressly indicated, although a note on the label bears the wording “taken from Gussone’s herbarium”, which leads us to believe that the sample was collected by Gussone himself and initially deposited in his herbarium in Naples (NAP), and only later donated by Pasquale, his collaborator, to the HCI, probably at the request of Parlatore. In the light of these considerations, the specimen in question acquires a certain relevance, as it could be part of the “original material” (Turland *et al.*, 2018) used by Gussone for the description of the species.

From a distribution point of view, although the sample was reviewed by Schotsman in 1963 at subspecific rank, the only distributive knowledge for Calabria appearing in the recent Italian checklist (Bartolucci *et al.*, 2018) was referred to the specific rank of *Callitriche truncata*, considered as NC for the region.

Conclusions

The study of the materials of the *Callitriche* genus present in the HCI has made it possible to highlight some of the first distribution novelties at an Italian regional level (Figure 6), which implement the state of knowledge on this group reported in the most updated Italian checklists and in the Portal to the Flora of Italy. Some of these novelties derive directly from our revisions, in other cases from confirmations of material already revised in the past by experts but never published, or in any case not incorporated into subsequent Italian floras, demonstrating the importance of the museum collections for research at all levels of scale, from systematics to information on territorial distribution, and therefore also for plant conservation.

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Authorship

LL, GF, DV: conceived, designed and supervised the research; DS: reviewed the investigations; AM: performed the investigations. All authors: authored and reviewed drafts of the paper, and approved the final draft.

Conflict of interest

None.

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