Plant Sociology, Vol. 51, No. 2, December 2014, pp. 29-55
DOI 10.7338/pls2014512/03

PLANT SOCIOLOGY
©Italian Society for Vegetation Science

Vegetation of Lakes Chiusi and Montepulciano (Siena, central Italy): updated knowledge and new discoveries

L. Lastrucci[1], G. Bonari[2], C. Angiolini[2], F. Casini[2], T. Giallonardo[3], D. Gigante[4], M. Landi[2], F. Landucci[5], R. Venanzoni[4], D. Viciani[1]

[1]Department of Biology, University of Florence, Via La Pira 4, I-50121 Florence, Italy.
[2]Department of Life Sciences, University of Siena, Via P.A. Mattioli 4, I-53100 Siena, Italy.
[3]Department of Life, Health & Environmental Sciences, University of L'Aquila, Piazza Salvatore Tommasi 1, I- 67010 L'Aquila - Coppito, Italy.
[4]Department of Chemistry, Biology and Biotechnology, University of Perugia, Borgo XX giugno 74, I-06121 Perugia, Italy.
[5]Department of Botany and Zoology, Masaryk University Kotlářská 2, CZ-611 37 Brno, Czech Republic.

Abstract

The aquatic and hygrophilous vegetation of Lakes Chiusi and Montepulciano (Siena, central Italy) was studied according to the phytosociological method. The survey led to the identification of 44 community types belonging to 10 syntaxonomic classes. A comparison between the current and past situation is also shown, taking into account the main floristic and phytosociological literature sources for the study areas. Some coenoses dominated by rare species at the national or regional scale were detected, such as *Najadetum minoris, Potamo perfoliati-Vallisnerietum spiralis, Eleocharis acicularis* community, *Mentho aquaticae-Caricetum pseudocyperi, Thelypterido palustris-Phragmitetum australis* and *Eleocharito palustris-Hippuridetum vulgaris*. Seven habitats are important for nature conservation according to the European Directive 92/43/EEC. Two other habitats are considered of regional interest according to Tuscan legislation. Moreover, this study emphasises the presence of several communities of great naturalistic and phytogeographic importance which are currently not included in any habitat of conservation interest. Similar to many other wetland systems across the Italian peninsula, the survey showed that the study areas still host a remarkable floristic and vegetation biodiversity, in spite of strong anthropogenic pressures putting at risk their conservation in the long term.

Keywords: aquatic coenoses, biodiversity conservation, hygrophytic coenoses, Mediterranean Basin, phytosociology, wetlands.

Introduction

Wetlands are recognised to be very important for biodiversity conservation; however, they are subjected to several kinds of threats and negative pressures that, in the past and in recent times, have greatly reduced their number and surface and led to the rarefaction or sometimes extinction of related species (Denny, 1994; Davis & Froend, 1999; Dudgeon *et al*., 2006). This trend is particularly noticeable in plains and lowlands, where urbanisation and intensive agriculture add their effects either to historic threats, such as drainage and land reclamation, or to current ones, such as pollution, inappropriate management of wetland vegetation, or exploitation of water resources (Casale, 2000; Croce *et al*., 2012; Viciani *et al*., 2014). The Valdichiana territory is an important example of national relevance, comprising a plain formerly occupied by swamps, marshes and ponds that over time has undergone a long history of drainage and land reclamation (Alexander, 1984; Barsanti, 2004). These human actions led to the development of an area with a strong agricultural vocation, in which wetlands are for the most part reduced to a network of canals and ponds, prevalently man-made. Despite this, recent surveys have shown that these residual wet areas still host many plant species (Lastrucci & Raffaelli, 2006) and vegetation types (Lastrucci *et al*., 2010) of relevant conservation interest. Lakes Chiusi and Montepulciano are at present the two most important wetlands remaining from the ancient Valdichiana swampland (Arrigoni & Ricceri, 1982; Tomei *et al*., 2001; Anselmi, 2001). Both lakes are surrounded by intensely cultivated areas (see also Giallonardo *et al*., 2011; Anselmi, 2001) but, nevertheless, historical data assess the presence of interesting plant species and communities in the two wetlands, as reported below. On the other hand, there is a lack of updated information, at least from the phytosociological point of view, as the latest vegetation surveys date back to 20-30 years ago (Arrigoni & Ricceri, 1982; Orsomando & Pedrotti, 1986; Buchwald, 1994). The aim of this study was to implement and update the knowledge about the wet vegetation of Lakes Montepulciano and Chiusi through the analysis of new phytosociological data resulting from repeated surveys carried out during the last decade. This new and more in-depth vegetation knowledge may provide the information necessary for the management and the effective conservation of the-

Corresponding author: Lorenzo Lastrucci. *Department of Biology, University of Florence, Via La Pira 4, I-50121 Florence, Italy; e-mail: lastrucciorenzo73@gmail.com*

se remnant wetlands, which are under threat by the strong human impact in the surrounding areas.

Materials and Methods

Study area

Lake Chiusi (43°03'22.11"N, 11°57'55.79"E) is located in the municipality of Chiusi (Siena Province), at 252 m a.s.l. (Fig. 1). It is the southernmost of the two lakes and is included in a protected natural area of local interest (named A.N.P.I.L. "Lago di Chiusi") with an area of approximately 805 ha (Regione Toscana, 2011). The maximum depth of the lake varies according to the different seasons, averaging approximately 5.7 m, as reported by Arrigoni & Ricceri (1982). The Tresa stream is its main tributary while the Fosso della Ripa is the emissary channel bringing the waters to the north, towards Lake Montepulciano. Lake Montepulciano (43°05'29.12"N, 11°55'53.08"E) is located in the municipality of Montepulciano (Siena Province), at 249 m a.s.l. and is included in the Provincial Natural Reserve "Lago di Montepulciano", with an area of 453 ha (Regione Toscana, 2011). The depth of the lake is around 3.4 m, as reported by Arrigoni & Ricceri (1982). The "Canale Maestro della Chiana", an artificial channel, originates from Lake Montepulciano and flows northwards to the river Arno, merging with it near to the village Ponte a Buriano (Arezzo). Both lakes have been designated part of the Natura 2000 network as SCI (Sites of Community Importance) and SPA (Special Protection Areas), named "Lago di Chiusi" and "Lago di Montepulciano", respectively. According to Carmignani & Lazzarotto (2004), the territory of the two studied lakes lies on sands, pebbles and muds of Quaternary origin. Thermopluviometric data from Montepulciano bioclimatic station (Bigi & Rustici, 1984), the closest station to the of area the lakes, although located at a higher altitude (605 m), records 13.8°C as the mean annual temperature and 736 mm as the mean annual rainfall. According to the climatic classification by Thornthwaite & Mather (1957), the climate formula of Montepulciano is B'2 b'4 C2 s (Bigi & Rustici, 1984), while with reference to Rivas-Martínez & Rivas-Saenz (1996-2009) this site belongs to the "Mediterranean Pluviseasonal-Oceanic" bioclimatic belt (Fig. 2). Both lakes have often been the object of interest for botanists; a wealth of information on the flora of these areas derives from the works of the 19th and early 20th centuries (Caruel, 1860-64; Baroni 1897-1908). In the first half of the 20th century, some floristic data were reported by Riccardi (1939) for Lake Chiusi. In the 1980s, important floristic contributions were made by Granetti & Bencivenga (1980) for Lake Chiusi, with occasional references to the vegetation, whereas Arrigoni & Ricceri (1982) reported an extensive list of flora and several vegetation surveys for both the lakes. Data on specific vegetation types were reported again in the 1980s by Orsomando & Pedrotti (1986). In the 1990s, further contributions on vegetation were reported by Buchwald (1994), while floristic updates were published by Mariotti (1990), Tomei *et al.* (1991) and Tomei & Guazzi (1996). In the following decade, other primarily floristic data were reported by Tomei *et al.* (2001), Anselmi (2001), Angiolini & Casini (2004), Landi *et al.* (2005) and Giallonardo *et al.* (2011). Studies about the use of satellite imagery and remote sensing to assess plant species richness (Rocchini *et al.*, 2005, 2007) and of multistage cluster sampling for quantifying and monitoring plant species richness at multiple spatial grains (Baffetta *et al.*, 2007) have also been carried out for Lake Montepulciano.

Data collection and analysis

A total number of 186 relevés were carried out according to the phytosociological method (Braun-Blanquet, 1932; Biondi, 2011; Pott, 2011) at both Lakes

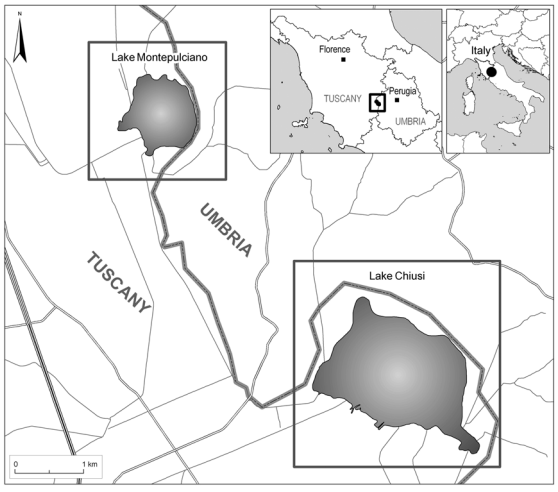

Fig. 1 – The study area.

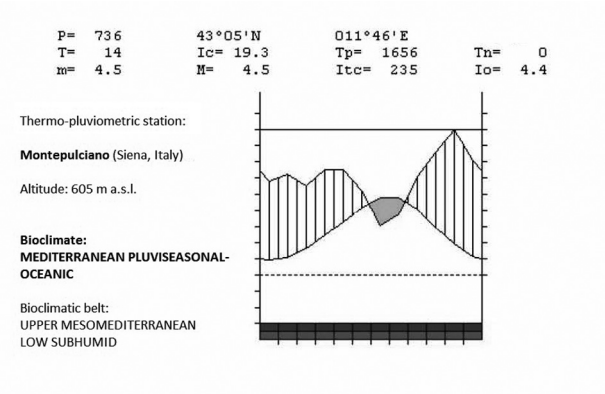

Fig. 2 – Bioclimatic diagram and diagnosis of the Montepulciano thermopluviometric station.

Chiusi and Montepulciano between the years 2001 and 2013. In order to analyse and classify the relevés, a first division was made based on the dominant growth forms. Hygrophilous herbaceous communities were separated from the aquatic ones (see Den Hartog & Segal, 1964); likewise, the *Salix cinerea* thickets were separated from the *Salix alba* and *Populus nigra* woods. A second step concerned the subdivision of aquatic and hygrophilous phytocoenoses through an agglomerative hierarchical cluster analysis, carried out using the program SYNTAX 2000 (Podani, 2001), applying as the distance measure the Euclidean Distance and as the group linkage method the Group Average (UPGMA) on a matrix transformed according to the van der Maarel scale (van der Maarel, 1979). Taxonomic arrangement of the species refers to Pignatti (1982) and Tutin *et al*. (1968-1980, 1993) and recent taxonomic contributions. Nomenclature follows Conti *et al*. (2005; 2007), Fuentes-Bazan *et al*. (2012) for taxa belonging to *Chenopodium* genus and Banfi & Galasso (2010) for alien species. The nomenclature of syntaxa was determined from the comparison with specific literature (e.g. Grabherr & Mucina, 1993; Schaminée *et al*., 1995; Rivas-Martínez *et al*., 2001, 2002; Chytrý, 2011; Landucci *et al*., 2013; Biondi & Blasi, 2013), and by following the International Code of Phytosociological Nomenclature (Weber *et al*., 2000). The syntaxonomic scheme follows mainly Biondi *et al*. (2014), with the exception of pleustonic communities which have been all attributed to *Lemnetea minoris* class (Chytrý, 2011), and of riparian woody vegetation types, which have been included as a whole in *Salici-Populetea nigrae* class (Rivas-Martínez *et al*., 2002). Due to nomenclatural problems of synonymy, the *Calystegietalia sepium* order is attributed to *Galio-Urticetea* class (see Rivas-Martínez *et al*., 2002). Moreover, we use here the name *Oenanthetalia aquaticae* Hejný ex Balátová-Tuláčková *et al*. 1993 instead of *Oenanthetalia aquaticae* Hejný in Kopechý & Hejný 1965, which is invalid (art. 2b). All relevés are stored in the national vegetation web database VegItaly (www.vegitaly.it; Gigante *et al*., 2012; Landucci *et al*., 2012). The sampling sites are reported in the tables using the following designations: C= Lake Chiusi, including the adjoining tracts of Tresa and Fosso della Ripa channels; M= Lake Montepulciano, including the adjoining tracts of Fosso della Ripa and Canale Maestro della Chiana channels. The syntaxa correspondence with the habitat codes of the 92/43 EEC Directive follows Annex I of the European Interpretation Manual (European Commission, 2007) and Biondi *et al*. (2009, 2012).

Results and discussion

The dendrograms deriving from the cluster analysis of the aquatic and hygrophilous phytocoenoses are shown in Figs. 3 and 4. The cluster of aquatic coenoses (Fig. 3) groups the pleustonic communities (marked in grey) mostly on the left side of dendrogram (with the exception of *Ceratophyllum demersum*-dominated communities), whereas the rhizophytic communities are clustered mostly in the right side. All the aquatic coenoses were classified according to the results of the

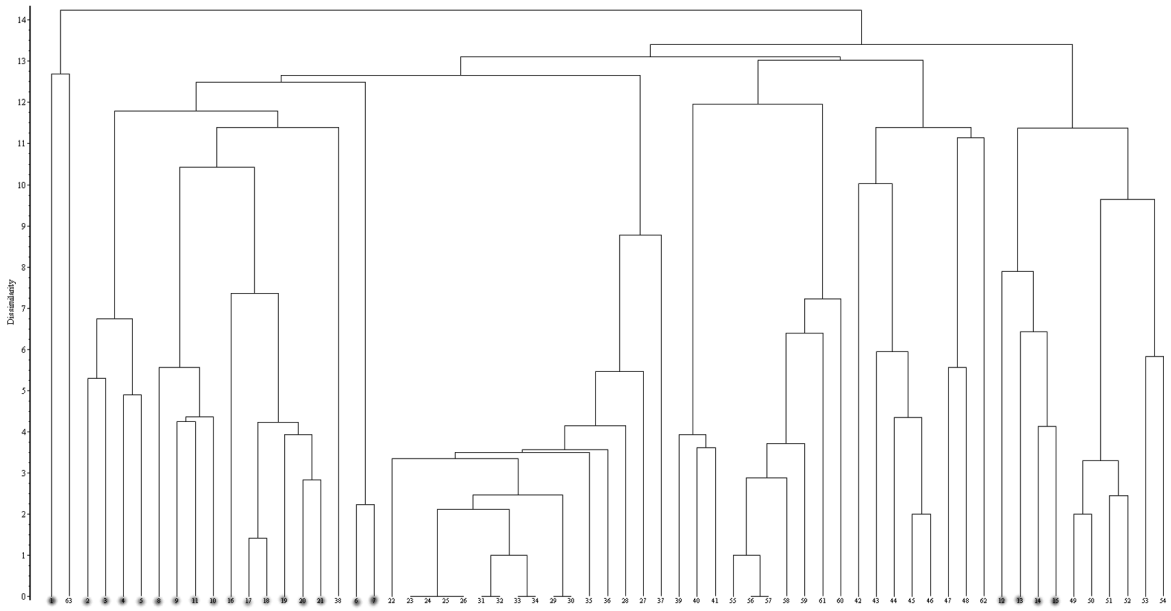

Fig. 3 – Dendrogram of phytosociological relevés of aquatic communities.

cluster analysis. Also, for hygrophytic communities (Fig. 4), the syntaxonomic classification follows the results shown by the dendrogram, except for few cases where our interpretation does not conform to it, e.g. in the case of *Phragmites australis*-dominated relevés (n. 89 and 90) with low cover values of *Hippuris vulgaris*, grouped in the cluster together with the *Hippuris vulgaris*-dominated community. The analysis of the relevés led to the identification of 44 community types belonging to 10 syntaxonomic classes, according to the syntaxonomic scheme.

Aquatic vegetation of the Lemnetea minoris and Potametea pectinati

LEMNETUM GIBBAE Miyawaki et Tüxen 1960 (Tab. 1, rel. 1)

This association is widely distributed in Italy and Europe, and is typically species-poor, growing on anthropogenic habitat with eutrophic waters rich in organic matter (Géhu *et al*., 1975; Scoppola, 1982; Sburlino *et al*., 2004). In the study area, it was found only at Lake Chiusi at the edge of the reed bed, where it appears very poor in species.

LEMNETUM TRISULCAE den Hartog 1963 (Tab. 1, rel. 2-5)

This association is typical from oligotrophic to mesotrophic waters (Venanzoni & Gigante, 2000). It was found only in Lake Montepulciano at the edge of the reed bed. The relevés show a high frequency and cover of pleustonic species such as *Utricularia australis, Lemna trisulca, L. minor* and *Salvinia natans*. *Riccia fluitans*, which is not a very common species in central Italy, probably due to the increasing eutrophication of water bodies (Landucci *et al*., 2011), also occurs in this association in the study area. The presence of *Phragmites australis* and *Hippuris vulgaris* in our relevés shows how this association develops preferentially in the clearings of the reed bed, in shallow waters, where the pleustonic species grow anchored to the emergent plants (Venanzoni & Gigante, 2000). Furthermore, the shading of helophytes seems to play a beneficial role for this generally sciaphilous association (Sburlino *et al*., 2004).

SALVINIO NATANTIS-SPIRODELETUM POLYRHIZAE Slavnić 1956 (Tab. 1, rel. 6-7)

This association dominated by *Salvinia natans,* typical of eutrophic waters, was found only in Lake Chiusi. As pointed out by Sburlino *et al*. (2004), this association may develop different aspects dominated either by *Salvinia natans* or *Spirodela polyrhiza* (see also Scoppola, 1982). The association was observed in shallow waters, sheltered by helophytic vegetation, in agreement with the synecology of this vegetation type (Sburlino *et al*., 1985; Sburlino *et al*., 2004). Arrigoni & Ricceri (1982) reported for Lake Chiusi coenoses with *Salvinia natans, Hydrocharis morsus-ranae* and *Alisma plantago-aquatica*, while Buchwald (1994) reported for Lake Montepulciano aspects of overlap between *Salvinio-Spiroledetum* and *Hydrocharitetum morsus-ranae*. The latter was not observed during our research, suggesting a reduction of the populations of the dominant species.

CERATOPHYLLO-AZOLLETUM FILICULOIDIS Nedelcu 1967 (Tab. 1, rel. 8-11)

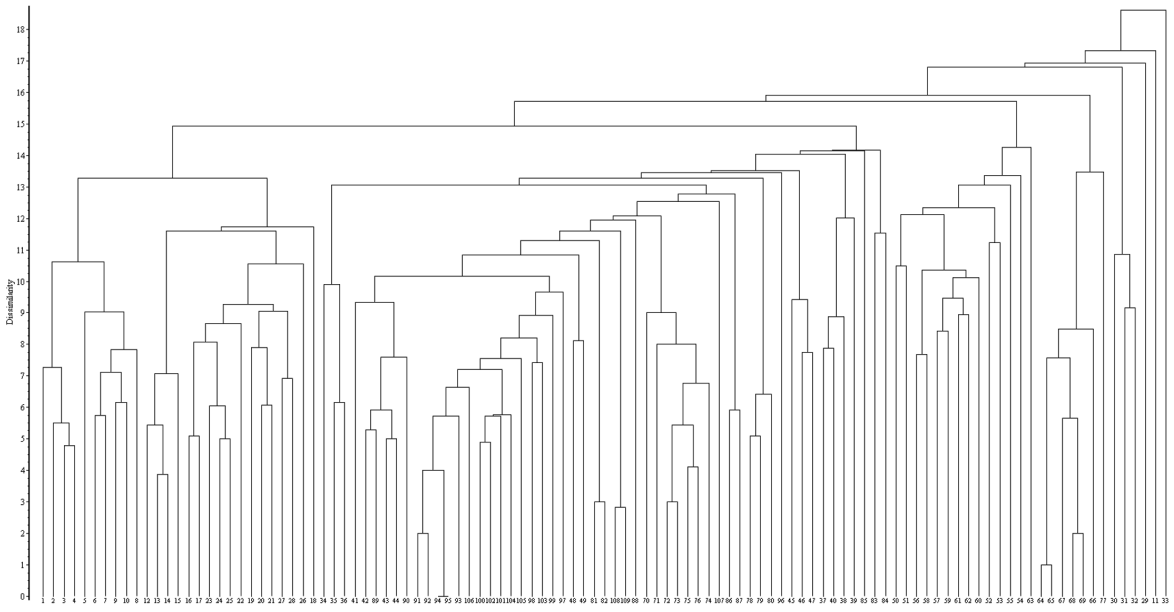

Fig. 4 – Dendrogram of phytosociological relevés of emergent and hygrophilous herbaceous communities.

Tab. 1 – Vegetation of the class *Lemnetea minoris*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Number in the cluster 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Locality	C	M	M	M	M	C	C	C	C	C	C	C	C	M	M	C	M	M	C	C	C	
Total cover (%)	80	100	100	60	100	100	100	8	50	70	40	100	100	100	90	90	70	70	95	85	80	
Area (m^2)	1	2	2	2	2	2	2	1	1	1	1	4	4	2	2	0,5	4	4	4	4	4	
Date	Jul/07	Jul/05	Jul/05	Jul/05	Jul/05	Jul/01	Jul/01	Jul/07	Jul/07	Jul/07	Jul/07	Jul/01	Jul/01	Sept/13	Sept/13	Aug/01	Sept/13	Sept/13	Jul/07	Jul/07	Jul/07	Presences
Charact. of *Lemnetum gibbae*																						
Lemna gibba L.	5	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	2
Charact. of *Lemnetum trisulcae*																						
Lemna trisulca L.	.	5	5	3	4	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	5
Charact. of *Salvinio natantis-Spirodeletum polyrhizae*																						
Salvinia natans (L.) All.	.	+	+	.	.	5	5	.	.	.	+	.	.	.	.	+	.	.	.	.	+	7
Spirodela polyrhiza (L.) Schleid.	.	.	r	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Charact. of C*eratophyllo-Azolletum filiculoidis*																						
Azolla filiculoides Lam.	.	.	.	.	.	+	.	1	3	4	3	.	.	.	.	.	+	1	1	+	.	9
Charact. of *Ceratophylletum demersi*																						
Ceratophyllum demersum L.	.	.	.	.	.	.	.	.	.	.	.	5	5	5	5	.	+	+	.	.	.	6
Charact. of *Utricularietum australis*																						
Utricularia australis R. Br.	.	2	+	2	3	.	.	.	.	.	+	.	.	.	.	4	4	4	5	5	5	11
Charact. of upper units																						
Lemna minor L.	.	+	1	1	+	+	+	+	1	+	+	.	.	.	.	.	+	1	.	.	.	12
Riccia fluitans Mill.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	3
Hydrocharis morsus-ranae L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	2
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Other species																						
Phragmites australis (Cav.) Trin.	2	.	+	+	2	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	5
Nuphar lutea (L.) Sm.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	+	.	.	1	.	.	4
Hippuris vulgaris L.	.	2	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Najas marina L. subsp. marina	.	.	.	.	.	.	.	.	.	.	.	3	1	1	.	.	.	.	.	.	.	3
Myriophyllum spicatum L.	.	.	.	.	.	.	.	.	.	.	.	+	2	.	.	.	.	.	.	.	.	2
Sporadic species	1	0	0	0	1	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0	

Azolla filiculoides is a thermophilic species of tropical origin, widely naturalised in western, central and southern Europe, with strong affinity for eutrophic water bodies (Scoppola, 1982; Sburlino *et al*., 2004; Ceschin *et al*., 2010). Communities dominated by this species are quite widespread at Lake Chiusi, always in sheltered situations, on the edge of reed beds or of communities with *Nuphar lutea*. The syntaxonomical interpretation follows Šumberová (2011a), although *A. filiculoides* tends to penetrate in various coenoses of *Lemnetea* class, showing a scarce sociological valence. Indeed, not all the authors agree in attributing to such communities the role of association (Müller, 1977; Pott, 1995). In certain cases, the coenoses dominated by *A. filiculoides* were considered stages of senescence of other phytocoenoses (Sburlino *et al*., 2004; Lastrucci *et al*., 2010). *Azolla filiculoides* as well as its association were not yet reported for the study area. However, almost certainly the reports of *A. caroliniana* Willd. by Granetti & Bencivenga (1980) and Arrigoni & Ricceri (1982) should be referred to as *A. filiculoides*, also considering that the presence of *A. caroliniana* has not been recently confirmed in Italy as in many other European countries (Celesti-Grapow *et al*., 2009; Hussner, 2012).

CERATOPHYLLETUM DEMERSI Corillion 1957 (Tab. 1, rel. 12-15)

This association is fairly widespread in the study area, as documented also in the past by several authors (Granetti & Bencivenga, 1980; Arrigoni & Ricceri, 1982; Buchwald, 1994). It is a vegetation type typically growing in still waters, with a very high content of nutrients (Sburlino *et al*., 2004; Ceschin *et al*., 2010). Although generally growing in shallow waters (Sburlino *et al*., 2004), *Ceratophyllum demersum* can sometimes colonise waters deeper than 4 m (Buchwald, 1994); indeed, in the study area, these communities develop in rather deep waters (more than 1 m on average), in clearings. Some authors do not agree in attributing to *Ceratophyllum demersum*-dominated vegetation the role of association (e.g. Sburlino *et al*., 2004). However, in the study area this vegetation shows a strong ecological identity, compared to other coenoses of the *Lemnetea* class, just because it tends to develop in deeper waters (see also Granetti & Bencivenga, 1980). This justifies its treatment to the rank of association.

UTRICULARIETUM AUSTRALIS Müller et Görs 1960 (Tab. 1, rel. 16-21)

This association develops in waters with a rather variable level of trophism (Lastrucci *et al*., 2008). It is regarded as a transitional vegetation type, compared to other *Nymphaeion* associations (Brullo *et al*., 1994), represented, in the study area, mainly by *Nymphaeo albae-Nupharetum luteae* Nowinsky 1927. *Utricularia*

vulgaris had been reported for the study area both as herbarium specimens and as species occurring in communities, until a few years ago (Arrigoni & Ricceri, 1982; Buchwald, 1994). However, neither the species nor the association *Utricularietum vulgaris* have been found during the present study.

NYMPHAEO ALBAE-NUPHARETUM LUTEAE Nowiński 1927 nom. mut. propos. (Tab. 2, rel. 1-16)

This association is typical of eutrophic and mesotrophic waters (Šumberová, 2011b). Stands dominated by *Nuphar lutea* are quite common in the study area, where they were also reported in the past (Arrigoni & Ricceri, 1982; Buchwald, 1994). The detected stands are generally poor in species, or even monospecific, with a prominent dominance of *Nuphar lutea*. Only the relevés at Lake Chiusi seldom include *Nymphaea alba*, which nevertheless has always very low cover values. Communities dominated by *Nymphaea alba,* as reported in the past by Arrigoni & Ricceri (1982), have not been found recently.

NYMPHOIDETUM PELTATAE Bellot 1951 nom. mut. propos. Šumberová in Chytrý 2011 (Tab. 2, rel. 17)

This association is dominated by *Nymphoides peltata*, a very rare species in Tuscany (Tomei & Guazzi, 1996). From the ecological point of view this association, structurally similar to *Nymphaeo albae-Nupharetum luteae*, differs by having better tolerance to overheating conditions and strong water level fluctua-

Tab. 2 – Vegetation of the class *Potametea pectinati*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Number in the cluster 1	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
Locality	C	C	M	C	C	C	C	C	C	C	C	C	C	M	C	C	M	M
Total cover (%)	97	90	95	85	100	100	90	95	95	85	95	65	60	90	25	100	40	70
Area (m^2)	25	25	6	25	25	10	100	25	25	25	100	100	100	6	95	2	6	1
Date	Jul/07	Jul/07	Sept/13	Sept/07	Sept/07	Sept/07	Sept/07	Sept/07	Sept/07	Sept/07	Sept/07	Sept/07	Sept/07	Sept/13	Sept/11	Jul/01	Jul/03	Sept/13
Charact. of *Nymphaeo albae-Nupharetum luteae*																		
Nuphar lutea (L.) Sm.	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	5	.	.
Nymphaea alba L.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Charact. of *Nymphoidetum peltatae*																		
Nymphoides peltata (S.G. Gmel.) Kuntze	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.
Charact. of *Potametum pectinati*																		
Potamogeton pectinatus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	4
Charact. of *Potametum denso-nodosi*																		
Potamogeton nodosus Poiret	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Charact. of *Potametum crispi*																		
Potamogeton crispus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Charact. of Najadetum marinae																		
Najas marina L. subsp. marina	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	+	.	.
Charact. of *Najadetum minoris*																		
Najas minor All.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Charact. of *Potamo perfoliati-Vallisnerietum spiralis*																		
Vallisneria spiralis L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Charact. of *Potamo crispi-Ranunculetum trichophylli*																		
Ranunculus trichophyllus Chaix	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Charact. of Callitrichetum obtusangulae																		
Callitriche obtusangula Le Gall.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Charact. of upper units																		
Myriophyllum spicatum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.
Potamogeton lucens L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Persicaria amphibia (L.) Delarbre aquatic ecophene	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Potamogeton perfoliatus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potamogeton pusillus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other species																		
Ceratophyllum demersum L.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	3	.	1
Mentha aquatica L. subsp. aquatica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Phragmites australis (Cav.) Trin.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Alisma plantago-aquatica L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chara sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glyceria fluitans (L.) R. Br.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Utricularia australis R. Br.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Bolboschoenus glaucus (Lam.) S.G. Sm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lythrum salicaria L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Iris pseudacorus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica anagallis-aquatica L. subsp. anagallis-aquatica	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Sporadic species	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

tions (Sburlino *et al*., 2008). *Nymphoides peltata* is uncommon in the study area. The only relevé in which occurs was carried out at Lake Montepulciano, in an area characterised by shallow water, close to the reed bed.

POTAMETUM PECTINATI Cartensen 1955 (Tab. 2, rel. 18-20)

From the ecological point of view, this association tolerates poorly oxygenated waters, rich in phosphates and nitrogen, from eutrophic to hypertrophic (Ceschin & Salerno, 2008; Šumberová, 2011b). Therefore, its presence is usually an indicator of organic pollution (Baldoni & Biondi, 1993). In both lakes, *Potamogeton pectinatus* forms coenoses extremely poor in species.

POTAMETUM DENSO-NODOSI O. Bolós 1957 (Tab. 2, rel. 21-25)

The vegetation with *Potamogeton nodosus* develops in both lentic and lotic environments (Landucci *et al*., 2011; Lastrucci *et al*., 2012) and is considered as an indicator of medium water quality, being rather tolerant to organic pollution. It also occurs in eutrophic water bodies (Ceschin *et al*., 2010). The association *Potametum denso-nodosi* was mainly found close to the banks of both lakes or on the edge of the reed bed, in waters less than one meter deep. Vegetation dominated by *P. nodosus* had already been previously reported by Arrigoni & Ricceri (1982) for Lake Chiusi.

POTAMETUM CRISPI Soó 1927 (Tab. 2, rel. 26-27)

This association has a rather wide ecological range, developing both in natural and artificial environments, both in stagnant and flowing waters (Hrivnák, 2002).

19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	
40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	
C	C	M	M	M	C	C	M	M	C	C	M	M	C	C	C	C	C	C	C	C	C	M	C	
100	60	75	60	70	70	70	75	45	90	90	100	70	60	100	75	90	85	90	70	100	70	80	90	
2	1	25	15	4	5	2	15	15	4	4	4	4	4	4	4	4	8	10	3	4	2	1	2	
Jul/07	Jul/07	May/03	May/03	May/03	Jul/07	Jul/07	May/03	May/03	Jul/07	Jul/07	Sept/13	Sept/13	Jul01	Jul01	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul01	Jul/07	May/03	Jul/07	Presences
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
5	4	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	2	1	.	.	8
.	.	3	4	4	4	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	7
.	.	.	+	.	.	.	4	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	.	.	5	5	5	4	2	2	.	.	.	.	.	.	.	.	.	8
.	.	.	.	.	.	.	.	.	.	+	.	.	3	4	.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	4	5	5	5	4	5	3	.	.	8
.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	+	3
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	1
.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	2	.	.	.	5
.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	1	.	.	.	.	2
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1
.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1
.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	+	.	.	.	.	.	10
.	.	.	+	1	.	.	+	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	7
.	.	2	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	3	6
.	.	1	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	5
+	.	.	1	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	5
.	.	.	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	5
.	.	.	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
.	+	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	3
.	.	.	r	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	2
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	2
0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	

It prefers waters with a high trophic level (Šumberová, 2011b). This association was found only in Lake Montepulciano, in shallow water close to the reed bed and to the banks of emergent vegetation. Also, the communities reported by Lastrucci *et al.* (2007) and Biondi *et al.* (1997) can be referred to this association.

NAJADETUM MARINAE Fukarek 1961 and *NAJADETUM MINORIS* Ubriszy 1961 (Tab. 2, rel. 28-31 and 32-33)

Coenoses with *Najas minor* and *Najas marina* together are known in literature (e.g. Piccoli & Gerdol, 1980; Landucci *et al.*, 2011). For the syntaxonomic attribution of this kind of vegetation, according to Landucci *et al.* (2011), a particular weight should be given to dominance and mutual abundance of the species that form the community. In the study area, it was possible to recognise both the associations *Najadetum marinae* Fukarek 1961 (Tab. 2, rel. 28-31) and *Najadetum minoris* Ubriszy 1961 (Tab. 2, rel. 32-33). Communities dominated by *Najas marina* were also reported by Arrigoni & Ricceri (1982) for Lake Chiusi, while *Najadetum minoris* is reported here for the first time. Both associations show a similar synecology (Landucci *et al.*, 2011), preferring mesotrophic waters even though eutrophic conditions are also tolerated.

POTAMO PERFOLIATI-VALLISNERIETUM SPIRALIS Losev et Golub in Golub, Losev et Mirkin 1991 (Tab. 2, rel. 34-40)

This association develops generally in mesotrophic to eutrophic waters (Landucci *et al.*, 2011). It was found in Lake Chiusi, where it forms underwater grasslands localised especially near the moorings for boats, with a water depth of less than one meter. The detected phytocoenoses are poor in species. In shallower waters the increase of *Phragmito-Magnocaricetea* species suggests the transition toward marsh coenoses.

POTAMO CRISPI-RANUNCULETUM TRICHOPHYLLI Imchenetzky 1926 (Tab. 2, rel. 41)

Ranunculus trichophyllus communities typically grow both flowing (Sburlino *et al.*, 2008; Ceschin & Salerno, 2010; Lastrucci *et al.*, 2010) and standing waters (Scoppola, 1998; Hrivnák, 2002). *Potamo crispi-Ranunculetum trichophylli* develops generally in oligo-mesotrophic to eutrophic waters. It tolerates high levels of turbidity (Šumberová, 2011b).

In Lake Montepulciano, the association was found in shallow water in contact with *Potametum denso-nodosi*, in sheltered conditions at the limit of the emergent vegetation. It should be noted that a relevé with high cover value of *Ranunculus trichophyllus*, but attributed to *Glycerietum maximae*, was reported for Lake Chiusi by Buchwald (1994).

CALLITRICHETUM OBTUSANGULAE Seibert 1962 (Tab. 2, rel. 42)

Callitriche obtusangula can form communities in running waters as well as slow or stagnant waters (Sburlino *et al.*, 2008). *Callitrichetum obtusangulae* Seibert 1962 is the typical association in running and eutrophic waters (Sburlino *et al.*, 2008); it was found only in Lake Chiusi, where it is in contact with the emergent vegetation. It grows in very shallow waters near to the tributary of the lake in moderately running waters. Buchwald (1994) reported a community dominated by *Callitriche* cfr. *stagnalis* for Lake Chiusi, but this species was not detected during the present study.

Annual hygro-nitrophilous vegetation of the Bidentetea tripartitae class

RUMICI MARITIMI-RANUNCULETUM SCELERATI Oberdorfer 1957 variant with *CYPERUS FUSCUS* (Tab. 3, rel. 1-10)

This association, dominated by *Ranunculus sceleratus,* is typical of muddy deep soils, rich in nutrients, developing in the dry phase on the bottom sediment of natural or artificial water bodies (Šumberová & Lososová, 2011). Helophytes are quite frequent, indicating a high variation of the water level (Kiesslich *et al.*, 2003). In Lake Chiusi, this association is characterised by high cover values of *Ranunculus sceleratus*, mostly where there has been prolonged stagnation. With faster desiccation, the community is richer in species and a *Cyperus fuscus*-dominated aspect can be identified. *C. fuscus* is considered a characteristic taxon of the order *Nanocyperetalia* (Brullo & Minissale, 1998), but it can be favoured by high disturbance levels, forming communities rich in *Bidentetea* species as reported for several Italian wetlands (e.g. Biondi *et al.*, 1999; Venanzoni & Gigante, 2000; Ceschin & Salerno, 2008). Baldoni & Biondi (1993) identified a variant with *Cyperus fuscus* of the association *Bidenti-Polygonetum mitis* (Roch 1951) Tx. 1979 in the Esino River (Marche, central Italy). A similar interpretation for the association *Rumici maritimi-Ranunculetum scelerati* is also proposed here for Lake Chiusi, where *C. fuscus* tends to become dominant in an ecological context where species of the class *Isoëto-Nanojuncetea* are not to be found. The species tend to replace *Ranunculus sceleratus* in situations of intense disturbances (e.g. paths, clearings, depressions at the edge of the fields) and premature desiccation.

BIDENS FRONDOSUS community (Tab. 3, rel. 11)

Bidens frondosus is an alien species of North American origin, considered invasive in many Italian regions (Celesti-Grapow *et al.*, 2009). It forms communities that have been attributed to different associations (Venanzoni & Gigante, 2000; Kiesslich *et al.*, 2003; Ami-

go, 2006), generally included in the alliance *Bidention*. Sometimes, however, these communities are difficult to classify in terms of association, due to their lack of floristic characterisation (Lastrucci *et al*., 2006), such as in the study area.

ECHINOCHLOO-POLYGONETUM LAPATHIFOLII Soó et Csurös 1947 (Tab. 3, rel. 12-15)

In marginal moist areas, near the cultivated fields around Lake Chiusi, vegetation dominated by *Polygonum lapathifolium* was detected. This species appears in several associations of the *Bidentetea* class, in both the alliances *Bidention* and *Chenopodion* (Geisselbrecht-Taferner & Mucina, 1993). In the study area, this kind of vegetation can be included in the *Chenopodion* alliance, due to the occurrence of species such as *Oxybasis rubra, O. chenopodioides, Lipandra polysperma*. The coenosis differs from the rather common association *Polygono-Xanthietum italici* Pirola & Rossetti 1974, more typical of sandy-pebbly shores of rivers (Biondi & Baldoni, 1994). For this reason, we referred our relevés to the association *Echinochloo-Polygonetum lapathifolii* Soó et Csurös 1947, linked to moist soils, rich in nutrients, with high pH and sometimes even high salinity (Geisselbrecht-Taferner & Mucina, 1993).

CHENOPODIO CHENOPODIOIDIS-ATRIPLICETUM PROSTRATAE Slavnić 1948 corr. Gutermann et Mucina in Mucina, Grabherr et Ellmauer 1993 (Tab. 3, rel. 16-28)

In the emerged areas, externally to the helophytic vegetation, at the edge of the cultivated areas at Lake Chiusi, pioneer vegetation dominated by *Oxybasis chenopodioides* was sampled in late summer. This species was recently recorded for this area (Iamonico *et al*., 2013). *O. chenopodioides* forms a dense vegetation with other species such as *O. rubra* (which in some cases becomes dominant), *Lipandra polysperma* and other pioneer hygro-nitrophilous species of the class *Bidentetea*. The association is in contact with the variant of *Rumici-Ranunculetum scelerati* with *Cyperus fuscus* and with *Echinochloo-Polygonetum lapathifolii*. For the syntaxonomical classification, we refer to *Chenopodio chenopodioidis-Atriplicetum prostratae*, association of saline water, periodically flooded soils and dried bottoms of wetlands (Šumberová & Lososová, 2011).

Pioneer annual of ephemeral wetlands of the Isoëto-Nanojuncetea class

JUNCUS BUFONIUS community (Tab. 4, rel. 1)

A short-size community dominated by *Juncus bufonius* was found along the shores of Lake Chiusi. This species was already confirmed for the study area (Grannetti & Bencivenga, 1980; Arrigoni & Ricceri, 1982), but information about vegetation lacked. Similar phytocoenoses have been reported for other wetlands in central Italy by Scoppola (1998) and Biondi *et al*. (2002). The latter described the association *Crypsido schoenoidis-Juncetum bufonii* showing good ecological affinity with the community of Lake Chiusi, which may represent an impoverished aspect.

LUDWIGIA PALUSTRIS community (Tab. 4, rel. 2-3)

Ludwigia palustris is a species that tolerates swampy or flooded soils, preferring those rich in nutrients. It grows in areas temporarily emerged during the summer or in areas vacated by large helophytes (Lastrucci *et al*., 2008). At Lake Chiusi, it forms small communities in some areas behind *Carex elata* communities, in situations of partial shading by trees and shrubs around the lake. This species is generally considered as a characteristic of the lower syntaxa of the *Isoëto-Nanojuncetea* class (Deil, 2005; Rivas-Martínez *et al*., 2002), although some of its coenoses have been attributed to *Bidentetea* (Dimopoulos *et al*., 2005; Lastrucci *et al*., 2008) or *Littorelletea* (e.g. Oberdorfer, 2001).

Dwarf emergent amphibious vegetation of the Littorelleta uniflorae class

ELEOCHARIS ACICULARIS community (Tab. 4, rel. 4)

Eleocharis acicularis is a rare species for Tuscany (Lastrucci & Becattini, 2007). Vegetation data about *E. acicularis*-dominated communities in Italy are very restricted (Gerdol, 1987; Pedrotti, 1990). This species is included in more than one association, such as *Limosello aquaticae-Eleocharitetum acicularis* Wendelberger-Zelinka 1952 and *Eleocharito-Littorelletum uniflorae* Chouard 1924 (syn. *Eleocaritetum acicularis* Koch 1926, see Šumberova *et al*., 2011a).

Our relevé from Lake Chiusi shows a low number of species, making its attribution to the level of association rather hard. It seems preferable to treat this vegetation at the level of community. Nevertheless, this finding provides a reconfirmation of the presence of this threatened species in the study area (see Lastrucci & Becattini, 2007).

Emergent vegetation of the Phragmito australis-Magnocaricetea elatae class

PHRAGMITETUM AUSTRALIS Savič 1926 non. mut. propos. Šumberová *et al*. in Chytrý 2011 (Tab. 5 ril. 1-18)

This association grows in different environmental conditions. However, its typical habitats are muddy soils, both acidic and basic, and meso-eutrophic waters (Buchwald, 1994). Although the association is very common in the wetlands of central Italy (Landucci *et al*., 2013), it currently shows symptoms of stress

Tab. 3 – Vegetation of the class *Bidentetea tripartitae*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Number in the cluster 2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Locality	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Total cover (%)	95	90	95	70	100	80	98	100	100	95	100	100	100	100	100	100	100	100	90
Area (m^2)	2	2	2	4	4	25	12	4	4	10	12	8	6	8	4	4	4	4	8
Date	Jul/07	Sept/11	Jul/07	Jul/07	Jul/07	Sept/08	Sept/08	Sept/08	Jul/07	Sept/08	Jul/07	Sept/11	Sept/11	Sept/11	Sept/11	Sept/11	Sept/11	Sept/11	Sept/11
Charact. of *Rumici maritimi-Ranunculetum scelerati*																			
Ranunculus sceleratus L.	4	5	4	4	.	2	1	r	.	+	.	.	.	.	.	.	.	.	.
Diff. of *Cyperus fuscus* variant																			
Cyperus fuscus L.	2	1	2	1	5	4	5	5	5	5	.	2	4	3	3	1	2	3	2
Bidens frondosa community																			
Bidens frondosus L.	.	.	.	.	.	+	.	.	+	.	5	.	.	.	+	.	.	.	.
Charact. of *Echinochloo-Polygonetum lapathifolii*																			
Persicaria lapathifolia (L.) Gray	.	.	.	.	+	+	+	.	.	.	+	5	5	5	4	2	4	1	1
Echinochloa crus-galli (L.) P. Beauv.	.	.	.	.	.	.	.	+	1	+	+	.	+	+	+	+	+	.	+
Charact. of *Chenopodio chenopodioidis-Atriplicetum patulae*																			
Oxybasis chenopodioides (L.) S. Fuentes, Uotila & Borsch	.	.	1	.	+	.	+	2	.	+	.	1	1	1	1	4	3	3	4
Charact. of upper units																			
Oxybasis rubra (L.) S. Fuentes, Uotila & Borsch	.	.	.	.	1	.	.	.	.	.	.	2	2	2	+	1	+	.	.
Lipandra polysperma (L.) S. Fuentes, Uotila & Borsch	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	1	1	.	.
Bidens tripartitus L.	.	.	.	.	.	.	.	.	.	.	1	+	1	.	.	.	.	.	+
Portulaca oleracea L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Xanthium orientale L. subsp. italicum (Moretti) Greuter	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Atriplex prostrata Boucher ex D.C.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.
Other species																			
Barbarea vulgaris R. Br.	1	+	.	.	1	.	.	+	.	.	.	+	+	+	1	1	+	+	2
Typha latifolia L.	.	+	1	+	1	.	.	.	.	.	.	.	.	.	1	1	+	+	1
Carex pseudocyperus L.	.	.	.	+	1	.	.	+	.	.	1	.	.	.	+	+	+	1	1
Lythrum salicaria L.	1	.	1	+	+	+	+	1	+	+	.	.	+	+	.	.	.	1	.
Oenanthe aquatica (L.) Poir.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	+	+
Phragmites australis (Cav.) Trin.	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	+	r
Mentha aquatica L. subsp. aquatica	.	.	+	+	.	+	.	.	+	1	+	.	.	.	.	.	.	.	+
Salix alba L.	+	+	+	.	+	.	+	.	.	+	.	.	.	.	.	.	+	.	.
Cirsium arvense (L.) Scop.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	+
Sonchus asper (L.) Hill.	.	.	.	.	+	.	.	+	.	.	.	.	+	1	.	.	.	.	.
Lycopus europaeus L.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	+
Veronica anagallis-aquatica L. subsp. anagallis-aquatica	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.
Alisma plantago-aquatica L.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+
Daucus carota L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Iris pseudacorus L.	.	.	.	.	.	.	.	.	+	.	2	.	.	.	.	.	.	.	.
Lactuca serriola L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio aquaticus Hill	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Solanum dulcamara L.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.
Stachys palustris L.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.
Typha angustifolia L.	2	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica catenata Pennell	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Sporadic species	0	0	0	0	1	0	1	0	0	0	4	0	0	0	0	0	0	1	0

in the study area (Gigante *et al*., 2014) as well as in neighbouring areas (Reale *et al*., 2012; Gigante *et al*., 2011, 2013). It is widespread in the whole study area where it forms a continuous belt around the two lakes, along the main waterways, extending into drier areas at the edge of the fields. According to Gigante *et al*. (2013), there is a strong difference between the drier sites, which are most rich in species, and the underwater environments, generally poorer or even monospecific. From a syntaxonomical point of view, Gigante *et al*. (2013) distinguish the drier reed beds, rich in nitrophilous species, referring them to a variant with *Rubus ulmifolius*.

SCHOENOPLECTETUM TABERNAEMONTANI Soó 1947 (Tab. 5, rel. 19)

The association occurs both in brackish and fresh water bodies rich in calcium and nutrients (Landucci *et al*., 2013), flooded during autumn and winter but also totally dry in summer (Šumberová *et al*., 2011b). In the study area, it occurs along a waterway at Lake Chiusi; *Schoenoplectus tabernaemontani*-dominated communities have also been reported for the neighbouring wetlands of the Valdichiana (Lastrucci *et al*., 2010).

GLYCERIETUM MAXIMAE Nowiński 1930 corr. Šumberová, Chytrý et Danihelka in Chytrý 2011 (Tab. 5, rel. 20-21)

This vegetation type was found at Lake Montepulciano. It was formerly reported for Lake Chiusi by Arrigoni & Ricceri (1982) and in channels between the two lakes by Buchwald (1994). It is typical of mesotrophic and eutrophic environments, regularly exposed to floods, often developing between reed beds and the sur-

20	21	22	23	24	25	26	27	28	
20	21	22	23	24	25	26	27	28	
C	C	C	C	C	C	C	C	C	
100	98	100	100	100	100	100	90	100	
4	4	8	4	6	9	6	6	6	
Sept/11	Sept/11	Sept/11	Sept/11	Sept/11	Sept/11	Sept/11	Sept/11	Sept/11	Presences
+	.	.	.	+	.	.	+	1	12
3	2	+	.	.	.	1	1	1	24
.	+	.	.	+	+	.	.	+	8
.	r	+	1	+	+	+	+	+	20
r	.	+	.	.	+	+	+	1	16
3	4	4	5	5	5	1	2	4	22
+	1	1	+	1	1	5	3	2	16
2	1	1	+	2	2	+	2	2	14
+	.	.	+	.	+	.	.	.	7
.	.	.	.	.	.	.	.	.	1
.	.	.	.	.	.	.	.	.	1
.	.	.	.	.	.	.	.	.	1
2	2	.	+	1	1	+	3	2	20
+	+	.	+	+	.	+	1	+	16
+	+	+	.	.	+	.	+	r	15
.	.	+	.	+	.	.	1	.	15
1	+	.	.	.	.	.	1	.	8
.	.	+	.	.	.	+	.	r	8
.	.	.	.	.	.	.	.	.	7
.	.	.	.	.	.	.	.	.	7
+	.	.	.	+	+	.	.	.	6
.	.	.	.	r	.	+	.	.	5
.	.	+	.	.	.	.	.	.	5
+	.	.	.	.	.	.	.	.	4
.	.	.	.	.	.	.	+	.	4
.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	+	+	2
.	.	.	.	.	.	.	.	.	2
.	+	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	.	2
.	.	.	+	.	.	.	.	.	2
0	0	1	0	0	0	0	0	0	

roundings areas (Landucci *et al*., 2013). Communities in the study area are very poor in species, as is typical of this association (Landucci *et al*., 2013).

ELEOCHARITETUM PALUSTRIS Savič 1926 (Tab. 6, rel. 1-4)

In the study area, this community shows pioneer behaviour, growing in areas with emerging bottom sediments due to the temporary summer retreat of the waters, not colonised by other vegetation types (see also Venanzoni & Gigante, 2000). The association can tolerate long periods of flooding, but it can also withstand periods with dry soil (Šumberová *et al*., 2011b). It was already known for Lake Montepulciano (Arrigoni & Ricceri, 1982).

ELEOCHARITO PALUSTRIS-HIPPURIDETUM VULGARIS Passarge 1955 (Tab. 6, rel. 5-8)

This association is typically poor in species and develops on meso-eutrophic, stagnant or slowly flowing waters, rich in calcium, sometimes also in brackish waters, subject to dry periods (Balátová-Tuláčková *et al*., 1993). In the two lakes, this association was found in water a few centimetres deep, mostly drying in late summer, within the clearings of the high herb communities, especially *Phragmitetum australis*. Similar communities dominated by *Hippuris vulgaris* were reported by Venanzoni & Gigante (2000) for Lake Piediluco in Umbria. In particular ecological conditions, *H. vulgaris* behaves as a hydrophyte, rather than a helophyte. Some authors attributed these communities to different alliances, such as *Nymphaeion albae* (e.g. Görs, 1992), *Ranunculion fluitantis* (Sburlino *et al*., 2008) or *Ranunculion aquatilis* (Cernohous & Husak, 1986). This species was reported in Tuscany only for Lake Montepulciano and Valdichiana (Caruel, 1860-64; Angiolini & Casini, 2004), so the present finding at Lake Chiusi represents an important confirmation of the presence of *H. vulgaris* in southern Tuscany.

BOLBOSCHOENUS GLAUCUS community (Tab. 6, rel. 9-11)

Bolboschoenus glaucus is described in the literature as frequent in southern Europe (Landucci *et al*., 2013), although up to recent times it has often been neglected in favour of the similar *B. maritimus*. It occurs in river floodplains, but also in man-made habitats such as rice fields and other types of arable lands (Hroudová *et al*., 2007; Landucci *et al*., 2013). At Lake Chiusi, this species forms vegetation at sites with considerable anthropogenic disturbance, i.e. at the edge of the fields, along the canals or in the outer edge of the reed beds. Arrigoni & Ricceri (1982) reported for Lake Montepulciano a community dominated by *Bolboschoenus maritimus*,

Tab. 4 – Vegetation of the classes *Isoëto-Nanojuncetea and Littorelletea uniflorae*.

Relevé number	1	2	3	4	
Number in the cluster 2	85	86	87	88	
Locality	C	C	C	C	
Total cover (%)	75	90	100	100	
Area (m^2)	3	1	2	0,5	
Date	Sept/07	Jul/07	Sept/07	Jul/01	Presences
Juncus bufonius community					
Juncus bufonius L.	4	.	.	.	1
Ludwigia palustris community					
Ludwigia palustris (L.) Elliott	.	5	5	.	2
Eleocharis acicularis community					
Eleocharis acicularis (L.) Roem. & Schult.	.	.	.	5	1
Charact. of *Isoëto-Nanojuncetea*					
Cyperus fuscus L.	1	+	1	+	4
Centaurium pulchellum (Sw.) Druce subsp. pulchellum	+	.	.	.	1
Other species					
Calystegia sepium (L.) R. Br. subsp. sepium	.	+	+	.	2
Juncus articulatus L.	1	+	.	.	2
Sporadic species	5	3	2	1	

Tab. 5 – Vegetation of the alliance *Phragmition australis*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
Number in the cluster 2	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	
Locality	M	C	M	M	M	M	M	M	C	M	C	C	M	M	M	C	C	C	C	M	M	
Total cover (%)	70	100	70	60	45	75	80	100	85	98	100	60	95	100	100	100	90	100	85	100	100	
Area (m^2)	4	90	10	10	10	10	10	10	10	10	50	50	10	10	10	100	100	100	2	10	4	
Date	Jun/03	Jul/08	Sept/13	Sept/13	Sept/13	Sept/13	Sept/13	Sept/13	Jul/07	Sept/13	Jul/07	Jul/07	Sept/13	Sept/13	Sept/13	Jul/07	Jul/07	Jul/07	Sept/07	May/03	Aug/13	Presences
Charact. of *Phragmitetum*																						
Phragmites australis (Cav.)	3	5	4	3	3	5	5	5	5	5	5	3	5	5	5	5	5	5	.	.	+	19
Charact. of *Schoenoplectetum*																						
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	1
Charact. of *Glycerietum*																						
Glyceria maxima (Hartm.) Holmb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	5	2
Charact. of upper units																						
Lythrum salicaria L.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	1	+	+	+	.	.	+	10
Mentha aquatica L. subsp. aquatica	3	1	.	.	.	.	.	.	+	.	.	+	.	.	.	+	+	.	.	.	.	6
Carex elata All. subsp. elata	.	.	.	.	.	.	.	.	.	.	.	2	1	2	.	+	.	.	.	.	.	4
Lycopus europaeus L.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	+	.	.	+	4
Phalaris arundinacea L. subsp. arundinacea	.	.	.	.	.	.	.	.	.	2	.	.	1	.	1	.	.	.	.	.	.	3
Hippuris vulgaris L.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Lysimachia vulgaris L.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2
Myosotis scorpioides L.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	2
Carex pseudocyperus L.	.	+	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	2
Carex riparia Curtis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	+	.	.	.	.	.	2
Berula erecta (Huds.) Coville	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1
Cyperus longus L.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Apium nodiflorum (L.) Lag. subsp. nodiflorum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Persicaria amphibia (L.)	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1
Rorippa amphibia (L.) Besser	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1
Scutellaria galericulata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1
Sparganium erectum L. subsp. neglectum (Beeby) K. Richt.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1
Veronica anagallis-aquatica L. subsp. anagallis-aquatica	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1
Teucrium scordium L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1
Other species																						
Calystegia sepium (L.) R. Br. subsp. sepium	.	.	.	.	.	.	.	+	+	1	1	1	1	1	1	1	+	+	.	.	.	11
Solanum dulcamara L.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	+	.	.	.	4
Rubus caesius L.	.	.	.	.	.	.	.	5	.	+	+	.	.	.	.	.	.	.	.	.	.	3
Atriplex prostrata Boucher ex D.C.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	2
Bidens frondosus L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2
Bidens tripartitus L.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Ceratophyllum demersum L.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Cirsium arvense (L.) Scop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	2
Galega officinalis L.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	2
Galium aparine L.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	2
Scrophularia auriculata L. subsp. auriculata	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.	2
Sonchus asper (L.) Hill.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	2
Stachys palustris L.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	2
Urtica dioica L. subsp. dioica	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	2
Sporadic species	0	1	0	0	1	0	0	2	5	1	10	1	1	1	0	0	4	0	1	0	0	

probably partly or wholly attributable to *B. glaucus*.

GLYCERIO-SPARGANIETUM NEGLECTI W. Koch 1926 em. Philippi 1973 (Tab. 6, rel. 12-14)

The relevés dominated by *Sparganium erectum* subsp. *neglectum* and carried out along the canals around Lake Chiusi belong to the association *Glycerio-Sparganietum neglecti*. This association is generally developed in stagnant waters (with high or low calcareous content) and also exposed to human disturbances (mowing, excavation, dredging; see also Philippi, 1977). Arrigoni & Ricceri (1982) reported for the two lakes the association *Sparganietum erecti*, which can be included into *Glycerio-Sparganietum neglecti* according to Landucci *et al*. (2013). Buchwald (1994) identified for Lake Chiusi a variant of the association with *Eupatorium cannabinum*.

GLYCERIETUM FLUITANTIS Nowiński 1930 (Tab. 6, rel. 15-16)

This vegetation type occurs in habitats that are in an advanced stage of terrestrialisation or periodically flooded, in oligotrophic to eutrophic water (Landucci *et al*., 2013). This association was sporadically found in the two lakes, along the edge of the reed beds.

Tab. 6 – Vegetation of the alliances *Eleocharito palustris-Sagittarion sagittifoliae* and *Glycerio fluitantis-Sparganion neglecti*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Number in the cluster 2	37	38	39	40	41	42	43	44	34	35	36	45	46	47	48	49	
Locality	C	C	M	M	C	C	M	C	C	C	C	C	C	C	M	C	
Total cover (%)	80	80	94	80	60	30	50	40	90	75	100	90	90	90	40	90	
Area (m^2)	2	2	8	4	2	1	3	3	4	3	10	4	4	4	4	4	
Date	Jul/07	Jul/01	May/05	Aug/05	Jul/07	Jul/07	Jun/03	Sept/12	Jul/07	Sept/08	Jul/10	Jul/07	Jun/08	Jun/08	May/03	Jul/07	Presences
Charact. of Eleocharitetum palustris																	
Eleocharis palustris (L.) Roem. & Schult. subsp. palustris	4	4	4	4	.	.	.	.	.	.	.	.	.	.	.	.	4
Charact. of Eleocharito-Hippuridetum vulgaris																	
Hippuris vulgaris L.	.	.	.	.	3	2	3	3	.	.	.	.	.	.	.	.	4
Bolboschoenus glaucus community																	
Bolboschoenus glaucus (Lam.) S.G. Sm.	2	.	r	1	.	.	.	.	4	4	5	1	.	.	.	1	8
Charact. of Glycerio-Sparganietum neglecti																	
Sparganium erectum L. subsp. neglectum (Beeby) K. Richt.	.	.	.	.	.	.	.	.	+	.	.	4	5	5	.	.	4
Charact. of Glycerietum fluitantis																	
Glyceria fluitans (L.) R. Br.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	2	5	4
Charact. of upper units																	
Mentha aquatica L. subsp. aquatica	.	.	.	.	2	1	+	+	.	.	.	.	.	+	+	.	6
Lythrum salicaria L.	.	.	.	.	1	.	+	.	.	+	.	.	.	.	.	.	3
Phragmites australis (Cav.) Trin.	.	.	.	.	r	.	.	1	.	.	.	.	.	.	.	+	3
Veronica anagallis-aquatica L. subsp. anagallis-aquatica	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	3
Alisma lanceolatum With.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	2
Galium palustre L. aggr.	.	.	2	.	.	.	.	.	2	.	.	.	.	.	.	.	2
Alisma plantago-aquatica L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1
Carex pseudocyperus L.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	1
Carex riparia Curtis	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
Cyperus longus L.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
Lycopus europaeus L.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1
Lysimachia vulgaris L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Oenanthe aquatica (L.) Poir.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
Persicaria amphibia (L.) Delarbre	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1
Phalaris arundinacea L. subsp. arundinacea	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Rorippa amphibia (L.) Besser	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1
Sagittaria sagittifolia L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1
Scutellaria galericulata L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1
Teucrium scordium L.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1
Other species																	
Calystegia sepium (L.) R. Br. subsp. sepium	+	.	.	.	.	.	.	.	+	.	.	+	+	+	.	+	6
Cyperus fuscus L.	.	+	.	.	2	.	.	.	.	.	+	.	.	.	.	.	3
Juncus articulatus L.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	3
Stachys palustris L.	.	.	.	.	+	.	.	.	+	.	.	.	2	.	.	.	3
Alopecurus myosuroides Huds.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	2
Althaea officinalis L.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	2
Echinochloa crus-galli (L.) P. Beauv.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	2
Lotus tenuis Waldst. & Kit. ex Willd.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	2
Lycopus exaltatus Ehrh.	.	.	2	+	.	.	.	.	.	.	.	.	.	.	.	.	2
Nuphar lutea (L.) Sm.	.	.	.	.	2	+	.	.	.	.	.	.	.	.	.	.	2
Paspalum distichum L.	.	+	.	.	.	.	.	.	.	.	.	3	.	.	.	.	2
Plantago major L.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	2
Sporadic species	0	1	7	1	1	0	3	0	3	1	2	0	0	1	1	0	

MENTHO AQUATICAE-CARICETUM PSEUDOCYPERI Orsomando et Pedrotti 1986 (Tab. 7, rel. 1-14)

In Lake Chiusi, wide communities with *Carex pseudocyperus* are present. They can be referred to the *Mentho aquaticae-Caricetum pseudocyperi* association. This vegetation type grows typically in mesotrophic to eutrophic shallow water bodies in an advanced stage of terrestrialisation, on muddy and organic sediments (Landucci *et al*., 2013). In the study area, the association develops forming floating islands of organic sediments, as also reported by Orsomando & Pedrotti (1986), in contact with the reed beds and the association *Nymphaeo albae-Nupharetum luteae*. Generally, this type of vegetation is quite dense in the study area, with the dominance of *Carex pseudocyperus* with high coverage levels. With decreasing thickness of the organic sediment in the bottom, we noticed that *Carex pseudocyperus* becomes less frequent, leaving the dominance to other species such as *Scutellaria galericulata* and *Cirsium creticum* subsp. *triumfetti*. For the higher syntaxonomic levels, we refer to Landucci *et al*. (2013).

THELYPTERIDO PALUSTRIS-PHRAGMITETUM AUSTRALIS Kuiper ex van Donselaar 1961 (Tab. 7, rel. 15-20)

In Lake Chiusi, some reed beds developing on floating islands rich in decaying organic matter were observed and sampled. In the study area, this vegetation type includes, besides the dominant *Phragmites australis*, other species such as *Thelypteris palustris, Cladium mariscus* and *Carex pseudocyperus*. These peculiar reed beds are referable to the association *Thelypteridо palustris-Phragmitetum australis*, very rare in Italy and reported only for the northern part of the country (Pedrotti, 1988, 1991; Brusa *et al*., 2006). The classi-

Tab. 7 – Vegetation of the alliances *Carici pseudocyperi-Rumicion hydrolapathi*, *Magnocaricion elatae* and *Caricion gracilis*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Number in the cluster 2	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
Locality	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	M
Total cover (%)	90	90	95	90	100	100	100	95	100	100	95	80	100	100	100	100	100	95	100	95	100	50
Area (m^2)	25	10	7	8	10	8	20	8	20	10	20	25	8	20	10	10	8	100	25	10	6	6
Date	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul/07	Jul/01	Jul/07	Jul/07	Jul/07	Jul/01	Jul/07	Jul/07	Jul/07	Jul/07	May/03
Charact. of *Mentho aquaticae-Caricetum pseudocyperi*																						
Carex pseudocyperus L.	3	4	2	3	1	5	5	4	4	4	5	4	4	2	1	1	1	.	+	+	.	.
Mentha aquatica L. subsp. aquatica	1	+	1	2	2	2	3	2	3	2	1	+	1	+	.	.	.	.	+	+	.	.
Charact. of *Thelypterido palustris-Phragmitetum australis*																						
Phragmites australis (Cav.) Trin.	.	+	.	2	.	1	+	.	.	2	+	.	1	1	3	4	2	4	3	3	2	.
Thelypteris palustris Schott	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	5	5	3	4	4	3	.
Charact. of *Caricetum elatae*																						
Carex elata All. subsp. elata	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	3
Charact. of *Cladietum marisci*																						
Cladium mariscus (L.) Pohl	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.
Charact. of *Caricetum ripariae*																						
Carex riparia Curtis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Charact. of *Phalaridetum arundinaceae*																						
Phalaris arundinacea L. subsp. arundinacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Charact. of upper units																						
Lycopus europaeus L.	+	+	+	+	+	+	1	1	+	1	+	+	1	1	+	+	+	.	.	.	.	.
Galium palustre L. aggr.	.	+	2	.	+	.	.	.	.	.	.	.	1	.	1	1	+	.	.	.	.	.
Lythrum salicaria L.	+	.	.	+	.	1	2	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.
Iris pseudacorus L.	1	1	.	+	+	.	+	.	1	.	1	.	.	+	.	.	.	.	.	.	.	.
Scutellaria galericulata L.	.	.	.	4	.	.	.	.	.	.	.	.	2	.	+	+	.	+	+	+	+	.
Rorippa amphibia (L.) Besser	2	2	2	+	+	+	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.
Lysimachia vulgaris L.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	+	.	.	+	+	.	.
Myosotis scorpioides L.	1	.	3	3	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Teucrium scordium L.	.	.	.	.	.	.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Typha angustifolia L.	.	1	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Typha latifolia L.	.	.	.	.	.	2	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Bolboschoenus glaucus (Lam.) S.G. Sm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berula erecta (Huds.) Coville	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hippuris vulgaris L.	.	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica anagallis-aquatica L. subsp. anagallis-aquatica	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Alisma plantago-aquatica L.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Oenanthe aquatica (L.) Poir.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sparganium erectum L. subsp. neglectum (Beeby) K. Richt.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Other species																						
Calystegia sepium (L.) R. Br. subsp. sepium	.	.	+	.	.	.	.	.	.	.	.	.	.	+	1	1	+	1	1	1	1	.
Cirsium arvense (L.) Scop.	+	+	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	+
Eupatorium cannabinum L.	.	.	.	+	2	.	.	1	+	2	.	.	.	.	1	1	.	.	+	+	.	.
Cirsium creticum (Lam.) d'Urv. subsp. triumfetti (Lacaita) Werner	.	.	1	+	.	+	.	.	.	.	.	.	.	4	1	1	.	.	.	.	.	.
Solanum dulcamara L.	+	+	+	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.
Epilobium tetragonum L.	+	+	.	+	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.
Poa trivialis L.	.	.	.	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium hirsutum L.	.	.	.	.	.	.	.	.	.	+	1	.	+	.	.	.	.	.	.	.	.	.
Stachys palustris L.	.	+	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium parviflorum Schreb.	1	2	.	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Samolus valerandi L.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Bidens frondosus L.	.	.	.	.	.	1	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Cyperus fuscus L.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Salix alba L.	+	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Salix cinerea L.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2	.	.	.	.	.
Urtica dioica L. subsp. dioica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Bidens tripartitus L.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex hirta L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex otrubae Podp.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Persicaria amphibia (L.) Delarbre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus repens L.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex conglomeratus Murray	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salvinia natans (L.) All.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Carex flacca Schreb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sporadic species	1	0	0	3	0	3	0	0	0	2	1	1	0	4	0	0	1	2	0	1	0	5

fication of these reed beds at a higher level is variable. Some authors attribute the association to *Phragmition* alliance (see Westhoff & Den Held, 1969) and others to *Magnocaricion* (Matuszkiewicz, 1981). According to Pedrotti (1988), the different ecology and physiognomy compared to *Phragmitetum australis* leads us to classify this coenosis within *Magnocaricetalia*, in the *Carici-Rumicion hydrolapathi* alliance. The presence of the rare *Thelypteris palustris* in the study area was only recently reported by Angiolini *et al*. (2010). It must be noted that stands of *Thelypterido-Phragmitetum* appear less subjected to die-back syndrome than those of flooded *Phragmitetum australis* (Gigante *et al*., 2014).

23	24	25	26	27	28	29	30	31	32	33	
72	73	74	75	76	77	78	79	80	81	82	
M	M	C	C	C	C	C	C	C	M	M	
80	100	100	90	70	100	100	100	100	95	95	
5	8	6	4	4	2	8	10	40	10	15	
May/03	May/03	Jul/07	Jul/07	Jul/07	Jun/01	Jul/07	Jul/01	Jul/01	May/03	May/03	Presences
.	.	.	.	.	+	.	.	.	.	.	20
.	.	2	1	+	1	.	.	.	.	.	20
1	2	1	1	1	3	.	.	.	.	.	21
.	.	.	.	.	.	.	.	.	.	.	7
5	5	5	4	4	1	.	.	.	.	.	9
.	.	.	.	.	4	.	.	.	.	.	3
.	.	.	.	.	.	5	5	5	.	.	3
.	.	.	.	.	.	.	.	.	5	5	2
.	.	.	+	+	1	.	.	.	.	.	20
.	.	+	.	.	1	+	1	1	.	.	12
.	.	.	.	.	.	.	+	.	+	+	11
.	.	+	.	.	.	.	.	.	.	.	9
.	.	.	.	.	+	.	.	.	.	.	9
.	.	.	.	.	.	.	.	.	.	.	8
.	.	.	.	+	.	.	.	.	.	.	7
.	.	.	.	.	.	.	.	.	.	.	5
.	.	+	+	.	.	.	.	.	.	.	4
.	.	+	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	1	+	.	+	3
.	.	+	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	.	.	.	1
.	.	.	.	.	.	.	.	.	.	.	1
.	.	.	.	.	.	.	.	.	.	.	1
1	1	+	1	1	1	.	+	1	.	+	18
.	.	.	.	+	.	.	+	+	.	.	7
.	.	.	.	.	.	.	.	.	.	.	9
.	.	.	.	+	1	.	.	.	.	.	8
+	1	.	.	.	.	.	.	.	.	.	7
.	.	.	.	.	.	.	.	.	.	.	6
.	.	.	.	.	.	+	+	+	.	.	6
.	.	+	.	.	.	.	.	+	.	.	5
.	.	.	.	.	1	.	.	+	.	.	5
.	.	.	.	.	.	.	.	.	.	.	4
.	.	.	+	.	.	.	.	.	.	.	4
.	.	.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	.	.	.	.	.	.	3
.	.	.	.	.	+	.	.	.	.	.	3
.	.	.	.	.	.	+	.	.	.	.	3
.	.	.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	+	+	.	.	.	2
.	.	.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	+	+	.	.	2
.	.	.	.	.	.	.	.	+	.	.	2
.	.	.	.	.	.	.	.	+	.	.	2
.	.	.	.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	.	+	1	2
0	1	0	1	0	0	1	0	2	0	0	

CARICETUM ELATAE Koch 1926 (Tab. 7, rel. 21-27)

Relevés dominated by *Carex elata* have been referred to *Caricetum elatae*. The association grows in meso-eutrophic waters, rich in carbonates and nutrients, and tolerates considerable water level changes (Landucci *et al*., 2013). In the two lakes, it was found in the clearings of the reed bed, subjected to considerable fluctuations in the water level. The association grows in contact with *Phragmitetum australis* and *Mentho aquaticae-Caricetum pseudocyperi*, replaced by *Caricetum elatae* where the organic floating mats are no longer present. In various areas of the Tuscan wetlands, this association is vanishing due the loss or degradation of habitat or the abandonment of traditional crafts, and often it is replaced by species-poor reed beds (Felicioni & Zarri, 2007; Lastrucci *et al*., 2008).

CLADIETUM MARISCI Allorge 1921 (Tab. 7, rel. 28)

This association was found exclusively in a small stand on the edge of the reed bed of Lake Chiusi. This vegetation type is typical of oligotrophic to mesotrophic (rarely eutrophic) calcareous marshes (Balátová-Tuláčková & Venanzoni, 1989; Balátová-Tuláčková, 1991; Landucci, 2013) and is rather rare for the Italian peninsula, especially for inland wetlands (Venanzoni & Gigante, 2000).

It is considered by Venanzoni & Gigante (2000) as a terrestrialisation stage following the pioneer communities of the *Phragmition* alliance. However, in the study area, *Phragmites australis* appears to be particularly competitive in drying conditions; thus, its presence within *Cladietum marisci* should be seen in the study area as a negative aspect for the survival of this rare plant community.

CARICETUM RIPARIAE Máthé et Kovács 1959 (Tab. 7, rel. 29-31)

Relevés dominated by *Carex riparia* have been referred to the association *Caricetum ripariae* Máthé et Kovács 1959. This vegetation type, although often fragmented, is rather common in Italy, mostly below 800 m a.s.l. (Landucci *et al*., 2013). The association grows in marshy areas on nitrogen-rich carbonate substrates, at sites of primary or secondary origin, following the destruction of forests of the *Alno-Ulmion* alliance (Venanzoni & Gigante, 2000). Unlike *Carex elata* or *C. pseudocyperus*, *C. riparia* appears to be more tolerant to prolonged emersion periods (see also Sburlino & Marchiori, 1985). It grows in marginal and disturbed areas of the two lakes, near cultivated fields, showing pioneer behaviour (see also Arrigoni & Ricceri, 1982).

PHALARIDETUM ARUNDINACEAE Libbert 1931 (Tab. 7, rel. 32-33)

This association is rather common in central Italy (Venanzoni & Gigante, 2000; Lastrucci *et al*., 2007; Ceschin & Salerno, 2008; Landucci *et al*., 2013). In the study area, it was observed in marginal depressions of Lake Montepulciano, near human-disturbed areas such as cultivated fields and the margins of trails. The number of species in the community is very low and *Phalaris arundinacea* shows absolute dominance.

Tab. 8 – Vegetation of the class *Galio aparines-Urticetea dioicae*.

Relevé number	1	2	3	4	5	
Number in the cluster 2	29	30	31	32	33	
Locality	C	C	C	C	C	
Total cover (%)	100	90	100	100	100	Presences
Area (m²)	4	40	20	30	10	
Date	Jul/07	Jul/01	Jul/01	Jul/01	Jul/07	
Charact. of *Urtico dioicae-Sambucetum ebuli*						
Urtica dioica L. subsp. dioica	3	.	2	2	1	4
Sambucus ebulus L.	1	.	.	.	.	1
Charact. of *Calystegio sepium-Epilobietum hirsuti*						
Epilobium hirsutum L.	.	5	5	5	+	4
Euphorbia palustris community						
Euphorbia palustris L.	.	.	.	.	4	1
Charact. of upper units						
Calystegia sepium (L.) R. Br. subsp. sepium	.	.	+	+	+	3
Galium aparine L.	3	.	.	.	+	2
Eupatorium cannabinum L.	.	+	.	.	+	2
Lysimachia punctata L.	+	.	.	.	+	2
Cruciata laevipes Opiz	.	.	.	.	1	1
Torilis japonica (Houtt.) DC.	+	.	.	.	.	1
Althaea officinalis L.	.	.	.	+	.	1
Galega officinalis L.	.	.	.	.	+	1
Pulicaria dysenterica L.	.	+	.	.	.	1
Thalictrum lucidum L.	.	.	.	.	+	1
Other species						
Cyperus longus L.	.	+	+	1	+	4
Bromus hordeaceus L.	.	1	1	+	.	3
Carex hirta L.	.	1	1	1	.	3
Cirsium arvense (L.) Scop.	+	.	2	.	+	3
Lythrum salicaria L.	.	+	+	+	.	3
Agrostis stolonifera L.	.	.	1	+	.	2
Aristolochia clematitis L.	.	.	.	1	2	2
Artemisia vulgaris L.	1	.	.	.	2	2
Carex otrubae Podp.	.	.	+	+	.	2
Carex riparia Curtis	.	.	1	+	.	2
Cirsium vulgare (Savi) Ten.	+	.	.	.	+	2
Elymus repens (L.) Gould subsp. repens	.	.	1	.	1	2
Humulus lupulus L.	.	.	+	.	+	2
Lycopus europaeus L.	.	+	.	+	.	2
Poa trivialis L.	.	.	.	+	1	2
Ranunculus repens L.	.	2	1	.	.	2
Sporadic species	5	2	1	2	11	

Perennial hygro-nitrophilous communities of the Galio aparines-Urticetea dioicae class

URTICO DIOICAE-SAMBUCETUM EBULI (Br.-Bl. in Br.-Bl., Gajewski, Wraber et Wa1as 1936) Br.-Bl. in Br.-Bl., Roussine et Nègre 1952 (Tab. 8, rel. 1)

This is a thermo-heliophilous and nitrophilous association, typical of eutrophic soils with good water availability (Maiorca *et al*., 2007). In the study area, this vegetation type is located between the marsh vegetation of the *Phragmito-Magnocaricetea* class and the ruderal vegetation of the peripheral areas at Lake Chiusi, occupying sites with high humidity but never flooded. The association was also reported for the neighbouring wetlands of Valdichiana (Lastrucci *et al*., 2010)

CALYSTEGIO SEPIUM-EPILOBIETUM HIRSUTI Hilbert, Heinrich et Niemann 1972 (Tab. 8, rel. 2-4)

This community, dominated by *Epilobium hirsutum*, grows in the shaded areas between woody vegetation and large-size emergent vegetation at Lake Chiusi. It develops on various types of substrates, on cool and moist soils, along streams with permanent flow or at the wood fringes (Pirone, 2000; Lastrucci & Becattini, 2009). It is a vegetation type widely present along the European waterways both with natural and artificial origin, especially in their middle and terminal stretches (Hruska, 1988).

EUPHORBIA PALUSTRIS community (Tab. 8, rel. 5)

Euphorbia palustris is a rare species in Tuscany (Tomei & Guazzi, 1996). Recently, it was reported by Frignani *et al*. (2010) for the study area. It forms a community observed in a moist depression at the edge of a *Salix alba* and *Populus nigra* forest at Lake Chiusi. The relevé shows the high presence of hygro-nitrophilous species of *Galio-Urticetea* class and a good number of ruderal species of *Artemisietea* (*Artemisia vulgaris*, *A. verlotiorum* and *Elymus repens*). The syntaxonomical treatment of *Euphorbia palustris* remains unclear (Wärner *et al*., 2011). The most used association dominated by this species, *Veronico longifoliae-Euphorbietum palustris* Kornaś 1963, was attributed to the alliance *Filipendulion* by some authors (e.g. Oberdorfer, 2001) or *Senecionion fluviatilis* (= *Calystegion sepium*) by others (e.g. Berg *et al*., 2004), even if some authors (e.g. Dierschke, 1996) stressed the floristic affinity of the association to the class *Phragmitetea*. Our communities show some floristic and ecological affinity with *Calystegio-Epilobietum*, thus we attribute our relevés to the *Calystegion sepium* alliance.

Perennial wet meadows of the class Agrostietea stoloniferae

CYPERO-CARICETUM OTRUBAE Tüxen in Tüxen & Oberdorfer 1958 (Tab. 9)

At Lake Montepulciano, wet meadows of the *Cypero-Caricetum otrubae* association are an example of transition from marsh coenoses to the ruderal vegetation of dry areas around the lake. Because of their

Tab. 9 – *Cypero-Caricetum otrubae*.

Relevé number	1	2	
Number in the cluster 2	83	84	
Locality	M	M	
Total cover (%)	50	80	Presences
Area (m²)	10	8	
Date	May/03	Jul/13	
Charact. of *Cypero-Caricetum otrubae*			
Carex otrubae Podp.	3	3	2
Charact. of upper units			
Lysimachia nummularia L.	+	+	2
Carex hirta L.	.	+	1
Lotus tenuis Waldst. & Kit. ex Willd.	+	.	1
Lycopus exaltatus Ehrh.	.	+	1
Potentilla reptans L.	1	.	1
Ranunculus repens L.	.	+	1
Rumex conglomeratus Murray	.	+	1
Other species			
Phragmites australis (Cav.) Trin.	+	+	2
Lysimachia vulgaris L.	r	1	2
Althaea officinalis L.	+	1	2
Calystegia sepium (L.) R. Br. subsp. sepium	1	+	2
Sporadic species	5	6	

spatial placement, the relevés show a mixture of hygrophilous elements of the class *Phragmito-Magnocaricetea*, with some partially desiccation-tolerant hydrophytes and hygro-nitrophilous elements less related to the permanence of water. These aspects have already been highlighted for central Italy by Buchwald (1994) and Venanzoni & Gigante (2000). It seems therefore reasonable to allocate *Carex otrubae*-dominated vegetation to the alliance *Mentho longifoliae-Juncion inflexi*, in agreement with the interpretation of some Spanish authors (Díaz-González & Fernández-Prieto, 1994; Rivas-Martínez *et al*., 2001; see also Landucci *et al*., 2013).

Marshy thickets of the class Alnetea glutinosae

FRANGULO-SALICETUM CINEREAE Graebner & Hueck 1931 nom. invers. (Tab. 10, rel 1-5)

At Lake Chiusi, *Salix cinerea* communities grow in conditions of prolonged submersion. They appear as species-poor, intricate shrublands, in contact with the plant communities of *Phragmition* and *Magnocaricion* and the aquatic vegetation. Some hydrophytes can penetrate even within the shrubs (e.g. *Ceratophyllum demersum* and *Azolla filiculoides*). This vegetation type can be referred to the association *Frangulo-Salicetum cinereae* Graebner & Hueck 1931 nom. invers. It represents a rare example of the palustrine edapho-hygrophilous series in the temperate bioclimatic region (Venanzoni & Gigante, 2000). As well as the reed beds, this association seems to show remarkable stress symptoms in the study area.

Wet deciduous woodland and willow communities of the class Salici purpureae-Populetea nigrae

RUBO ULMIFOLII-SALICETUM ALBAE Allegrezza, Biondi *et* Felici 2006 (Tab. 10, rel. 6-10)

Relevés dominated by *Salix alba* with subordinate presence of *Populus nigra* are referable to the association *Rubo ulmifolii-Salicetum albae* Allegrezza, Biondi et Felici 2006. This vegetation type was described for central Italy where it replaces the *Salicetum albae* Issler 1926 of Central Europe (Allegrezza *et al*., 2006). In the study area, the association occurs as small and discontinuous woody fragments around the lakes. It is occasionally exposed to flooding, but it is always placed in drier sites compared to *Salix cinerea* communities. In our relevés, a high cover of *Rubus caesius* was observed. Shrubs such as *Crataegus monogyna* and *Cornus sanguinea* were also present with high frequency. The herbaceous layer shows the presence of nitrophilous species (e.g. *Galium aparine, Urtica dioica, Sambucus ebulus*). The presence of *Salix alba* and *Populus nigra* along the banks of Chiusi lake was reported by Granetti & Bencivenga (1980) and Giallonardo *et al*. (2011), but they did not provide relevés or other phytosociological information.

POPULUS NIGRA community (Tab. 10, rel. 11-14)

Woods dominated by *Populus nigra* develop in the buffer area around the two lakes, usually with no or scarce exposure to flooding compared to *Salix alba* community. These woods can be interpreted as transitional forms between the *Rubo ulmifolii-Salicetum albae* (with which several species are in common) and communities of more stable soils, typical of the alliance *Populion*. The lack of frequent flooding allows the presence of woody species such as *Ulmus minor* or even *Quercus cerris*, which testifies in favour of a more mature substrate. In the study area, there are also several plantations of *Populus nigra*.

Other coenoses reported in the literature

Some vegetation types were previously reported for the study area, even if they are not represented in our relevés. As already mentioned, Buchwald (1994) reported important coenoses such as *Hydrocharitetum morsus-ranae, Potametum lucentis* (overlapping with *Nymphaeo albae-Nupharetum luteae*) and *Butometum umbellati*. This last association was also reported for the neighbouring Valdichiana wetlands by Lastrucci *et al*. (2010). Arrigoni & Ricceri (1982) reported for Lake Chiusi relevés dominated by *Myriophyllum spicatum* and *M. verticillatum*.

Conservation aspects

The study of vegetation is an indispensable component of biodiversity conservation and it allows for the identification in the field of habitats of conservation interest (Biondi *et al*., 2012; Viciani *et al*., 2014). Therefore, it must be considered as an essential basis for planning and the management of natural resources. Concerning the study area, this survey shows the presence of seven habitats of conservation interest listed in the European Directive 92/43/EEC (Tab. 11). The habitat that covers larger areas corresponds to Natura 2000 code 3150 (natural eutrophic lakes with hydrophytic vegetation) which includes almost all of the aquatic plant communities recorded in the study area, according to the Italian interpretation manual (Biondi *et al*., 2009). Habitat 3260 is also present in the study area, but to a lesser extent; it consists of only two plant communities referable to the alliances *Ranunculion aquatilis* and *Batrachion fluitantis*, and the study sites do not represent their optimal ecologic condition. In muddy areas that usually emerge in summer, habitat 3270 is widespread. It is sometimes characterised by the presence of alien species (e.g. *Bidens frondosus*), as also reported by Biondi *et al*. (2009). This habitat

Tab. 10 – Vegetation of the classes *Alnetea glutinosae* and *Salici purpureae-Populetea nigrae*.

Relevé number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Locality	C	C	C	C	C	M	M	C	C	C	M	M	M	C	
Total cover (%)	90	100	90	100	95	100	100	100	100	100	100	100	100	100	
Area (m^2)	20	40	100	100	50	60	60	100	150	100	60	60	60	90	
Date	Sept/08	Sept/08	Sept/08	Sept/08	Sept/08	Sept/03	Sept/03	Sept/08	Sept/08	Sept/08	Sept/03	Sept/03	Sept/03	Sept/08	Presences
Charact. of *Frangulo-Salicetum cinereae*															
Salix cinerea L.	5	5	5	5	5	.	.	+	.	2	.	.	.	1	8
Charact. of *Rubo ulmifolii-Salicetum albae*															
Salix alba L.	.	.	.	.	.	5	5	4	3	4	.	.	.	.	5
Populus nigra community															
Populus nigra L.	.	.	.	.	.	3	.	.	.	1	5	3	3	4	6
Charact. of *Salici purpureae-Populetea nigrae* class															
Rubus caesius L.	.	.	.	.	.	2	2	+	5	+	4	+	2	.	8
Humulus lupulus L.	.	.	.	.	.	.	.	1	+	+	.	.	.	.	3
Solanum dulcamara L.	2	2	.	.	.	.	.	.	.	+	.	.	.	.	3
Equisetum telmateja Ehrh.	.	.	.	.	.	+	.	.	.	.	.	.	r	.	2
Brachypodium sylvaticum (Huds.) P. Beauv.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	2
Ulmus minor Mill.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	1
Sambucus nigra L.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
Other species															
Cornus sanguinea L.	.	.	.	.	.	3	3	1	+	.	3	2	3	3	8
Crataegus monogyna Jacq.	.	.	.	.	.	2	3	+	+	.	2	.	3	1	7
Cirsium arvense (L.) Scop.	1	1	.	.	.	2	2	+	.	.	1	.	.	.	6
Iris pseudacorus L.	1	+	+	.	.	r	.	.	.	+	.	.	.	1	6
Mentha aquatica L. subsp. aquatica	2	+	+	.	.	.	.	.	.	3	+	.	.	+	6
Lycopus europaeus L.	1	+	+	.	.	.	.	.	.	1	.	.	.	+	5
Lythrum salicaria L.	+	+	.	.	.	.	.	.	.	+	2	.	.	+	5
Dipsacus fullonum L.	.	.	.	.	.	1	+	.	.	+	1	.	.	.	4
Galega officinalis L.	.	.	.	.	.	2	3	.	.	+	1	.	.	.	4
Hypericum perforatum L.	.	.	.	.	.	1	2	.	.	.	1	.	1	.	4
Phragmites australis (Cav.) Trin.	.	.	2	.	.	+	.	.	.	.	.	.	+	+	4
Urtica dioica L. subsp. dioica	.	.	.	.	.	.	.	3	1	+	.	1	.	.	4
Acer campestre L.	.	.	.	.	.	.	.	1	2	.	.	1	.	.	3
Agrostis stolonifera L.	.	.	.	.	.	3	2	.	.	.	+	.	.	.	3
Althaea officinalis L.	.	.	.	.	.	1	.	.	+	.	1	.	.	.	3
Daucus carota L.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	3
Erigeron canadensis L.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	3
Galium aparine L.	.	.	.	.	.	.	.	3	1	.	1	.	.	.	3
Lysimachia vulgaris L.	.	.	.	.	.	+	+	.	.	1	.	.	.	.	3
Potentilla reptans L.	.	.	.	.	.	+	.	.	.	.	+	.	r	.	3
Pulicaria dysenterica L.	.	.	.	.	.	+	.	.	.	.	+	.	+	.	3
Agrimonia eupatoria L.	.	.	.	.	.	.	2	.	.	.	+	.	.	.	2
Aristolochia clematitis L.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	2
Bromus arvensis L.	.	.	.	.	.	3	2	.	.	.	.	.	.	.	2
Carex otrubae Podp.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	2
Carex pseudocyperus L.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	2
Ceratophyllum demersum L.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	2
Cruciata laevipes Opiz	.	.	.	.	.	.	.	1	+	.	.	.	.	.	2
Eupatorium cannabinum L.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	2
Mentha arvensis L.	.	.	.	.	.	+	.	.	.	.	.	.	r	.	2
Rubus ulmifolius Schott	.	.	.	.	.	.	.	.	.	.	.	.	1	3	2
Rumex conglomeratus Murray	+	.	.	.	.	+	.	.	.	.	.	.	.	.	2
Sambucus ebulus L.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	2
Senecio aquaticus Hill	.	.	.	.	.	.	+	.	.	+	.	.	.	.	2
Teucrium scordium L.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	2
Thalictrum lucidum L.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	2
Torilis japonica (Houtt.) DC.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	2
Verbena officinalis L.	.	.	.	.	.	.	+	.	.	.	r	.	.	.	2
Xanthium orientale L. subsp. italicum (Moretti) Greuter	.	.	.	.	.	.	+	.	.	.	r	.	.	.	2
Sporadic species	4	0	3	0	0	3	3	0	0	5	21	6	1	0	

partially overlaps with habitat 3130, formed by communities of small hygrophilous annual or perennial plants, which in the study area are always present in small patches, often dispersed in clearings within other vegetation types of a larger size and biomass. The habitat of hygro-nitrophilous tall herbs corresponding to Natura 2000 code 6430 is represented by communities of fairly common species such as *Epilobium hirsutum*, but also of rare plants, at least at the regional level, such as *Euphorbia palustris*. The only recorded forest habitat consists of formations of *Salix alba* and *Populus nigra*, well-distributed in the study area, though often fragmented and in some cases, especially for the black poplar stands, doubtfully derived from forestry activities. It is also worth noting the presence of the only priority habitat found in the area, i.e. the formations of *Cladium mariscus* attributable to habitat 7210*. Beyond the too broad definition of this habitat, and the difficulties in classifying vegetation and habitats where *Cladium mariscus* plays an important role, widely discussed in Biondi *et al.* (2009; 2012), it is worth noting the relict character of this habitat type

in the area, where it is poorly represented in terms of surface and where *Cladium mariscus* is often outcompeted by *Phragmites australis*. The reed, which suffers in situations of submersion in the study area as well as in other areas of central Italy (Reale *et al*., 2012; Gigante *et al*., 2011, 2013, 2014), becomes strongly competitive in sites with a greater degree of silting up and with periodically emerged soils; as a consequence, its invasion within *Cladium mariscus* vegetation types could threaten the survival of this rare habitat and should therefore be monitored. It should finally be noted that some other plant communities occurring in the study area must be considered habitats of regional importance, according to the regional law LR 56/2000 of the Tuscany Regional Administration. These habitats are: the formations of fast-flowing rivers dominated by small helophytes of the alliance *Glycerio-Sparganion* (here present with *Glycerio-Sparganietum neglecti* and *Glycerietum fluitantis* associations) and the large sedge communities of the *Mentho aquaticae-Caricetum pseudocyperi* association. Furthermore, we wish to emphasise the presence in the area of plant communities that can be considered very interesting from the floristic, vegetational and conservation viewpoints, but that cannot be attributed to any type of protected habitat, particularly: i) the vegetation type with *Hippuris vulgaris;* ii) *Carex elata*-dominated coenoses; iii) reed stands with *Thelypteris palustris*; iv) *Salix cinerea* formations. As properly stressed by several authors (e.g. Gigante *et al*., 2013; Biondi *et al*., 2014), several habitats of conservation significance were not included in Annex I of the 92/43/EEC Directive habitats, probably due to their relative diffusion in other biogeographical areas (above all, central and northern Europe). However, they represent valuable ecosystems from a floristic and vegetation point of view (not to mention fauna and zoocoenoses). Their current state of fragmentation, surface reduction and floristic impoverishment requires urgent protection measures to halt the anthropogenic pressures affecting the humid environments of the entire Mediterranean Basin.

Tab. 11 – Habitat of conservation interest according to European Directive 92/43/EEC (*=priority habitat).

Habitat of conservation interest according to European Directive 92/43/EEC (*=priority habitat)	
Syntaxon	Natura 2000 Habitat code
Ceratophylletum demersi *Ceratophyllo-Azolletum filiculoidis* *Lemnetum gibbae* *Lemnetum trisulcae* *Najadetum marinae* *Najadetum minoris* *Nymphaeo albae-Nupharetum luteae* *Nymphoidetum peltatae* *Potametum crispi* *Potametum denso-nodosi* *Potametum pectinati* *Potamo perfoliati-Vallisnerietum spiralis* *Salvinio natantis-Spirodeletum polyrhizae* *Utricularietum australis*	3150
Callitrichetum obtusangulae *Potamo crispi-Ranunculetum trichophylli*	3260
Eleocharis acicularis community *Juncus bufonius* community *Ludwigia palustris* community	3130
Rumici maritimi-Ranunculetum scelerati *Bidens frondosa* community *Chenopodio chenopodioidis-Atriplicetum prostratae* *Echinochloo-Polygonetum lapathifolii*	3270
Calystegio sepium-Epilobietum hirsuti *Euphorbia palustris* community	6430
Cladietum marisci	7210*
Populus nigra community *Rubo ulmifolii-Salicetum albae*	92A0
Habitat of regional interest according to Tuscan regional law LR 56/2000	
Mentho aquaticae-Caricetum pseudocyperi (Code Corine Biotope: 53.21)	
Small helophyte communities of running waters (*Glycerio-Sparganion*, Code Corine Biotope: 53.4)	

Syntaxonomic scheme

LEMNETEA MINORIS O. Bolòs et Masclans 1955
LEMNETALIA MINORIS O. Bolòs et Masclans 1955
Lemnion minoris O. Bolòs et Masclans 1955
Lemnetum gibbae Miyawaki et Tüxen 1960
Lemnetum trisulcae den Hartog 1963
Salvinio natantis-Spirodeletum polyrhizae Slavnić 1956
Ceratophyllo-Azolletum filiculoidis Nedelcu 1967
UTRICULARIETALIA MINORIS den Hartog et Segal 1964
Ceratophyllion demersi den Hartog *et* Segal ex Passarge 1996
Ceratophylletum demersi Corillion 1957
Utricularion vulgaris Passarge 1964
Utricularietum australis Müller et Görs 1960

POTAMETEA PECTINATI Klika in Klika *et* Novák 1941
POTAMETALIA PECTINATI Koch 1926
Nymphaeion albae Oberdorfer 1957
Nymphaeo albae-Nupharetum luteae Nowiński 1927 nom. mut. propos. Šumberová in Chytrý 2011
Nymphoidetum peltatae Bellot 1951 nom. mut. propos. Šumberová in Chytrý 2011
Potamion pectinati (Koch 1926) Libbert 1931
Potametum pectinati Cartensen 1955
Potametum denso-nodosi O. Bolós 1957
Potametum crispi Soó 1927
Najadetum marinae Fukarek 1961
Najadetum minoris Ubriszy 1961
Potamo perfoliati-Vallisnerietum spiralis Losev et Golub in Golub, Losev et Mirkin 1991
Ranunculion aquatilis Passarge 1964
Potamo crispi-Ranunculetum trichophylli Imchenetzky 1926
Batrachion fluitantis Neuhäusl 1959
Callitrichetum obtusangulae Seibert 1962

BIDENTETEA TRIPARTITAE Tüxen, Lohmeyer et Preising ex von Rochow 1951
BIDENTETALIA TRIPARTITAE Br.-Bl. et Tüxen ex Klika in Klika et Hadač 1944
Bidention tripartitae Nordhagen 1940
Rumici maritimi-Ranunculetum scelerati Oberdorfer 1957 var. a *Cyperus fuscus*
Bidens frondosus community
Chenopodion rubri (Tüxen 1960) Hilbig et Jage 1972
Echinochloo-Polygonetum lapathifolii Soó et Csurös 1947
Chenopodio chenopodioidis-Atriplicetum prostratae Slavnić 1948 corr. Gutermann et Mucina in Mucina, Grabherr et Ellmauer 1993

ISOËTO-NANOJUNCETEA Br.-Bl. et Tüxen ex Westhoff, Dijk *et* Passchier 1946
NANOCYPERETALIA FLAVESCENTIS Klika 1935
Nanocyperion flavescentis Koch ex Libbert 1932
Juncus bufonius community
Ludwigia palustris community

LITTORELLETEA UNIFLORAE Br.-Bl. et Tüxen ex Westhoff, Dijk et Passchier 1946
LITTORELLETALIA UNIFLORAE Koch 1926
Eleocharition acicularis Pietsch 1967
Eleocharis acicularis community

PHRAGMITO AUSTRALIS-MAGNOCARICETEA ELATAE Klika in Klika *et* Novák 1941
PHRAGMITETALIA AUSTRALIS Koch 1926
Phragmition australis Koch 1926 nom. mut. propos. Rivas-Martínez, T.E. Díaz, Fernández-González, Izco, Loidi, Lousã *et* Penas 2002
Phragmitetum australis Savič 1926 nom. mut. propos. Šumberová *et al.* in Chytrý 2011
Schoenoplectetum tabernaemontani Soó 1947
Glycerietum maximae Nowiński 1930 corr. Šumberová, Chytrý et Danihelka in Chytrý 2011
OENANTHETALIA AQUATICAE Hejný ex Bálatová-Tuláčková, Mucina, Ellmauer et Wallnöfer in Grabherr *et* Mucina 1993
Eleocharito palustris-Sagittarion sagittifoliae Passarge 1964
Eleocharitetum palustris Savič 1926
Eleocharito palustris-Hippuridetum vulgaris Passarge 1955
Bolboschoenus glaucus community
NASTURTIO OFFICINALIS-GLYCERIETALIA FLUITANTIS Pignatti 1953
Glycerio fluitantis-Sparganion neglecti Br.-Bl. *et* Sissingh in Boer 1942
Glycerio-Sparganietum neglecti W. Koch 1926 em. Philippi 1973
Glycerietum fluitantis Nowiński 1930

MAGNOCARICETALIA ELATAE Pignatti 1953
Carici pseudocyperi-Rumicion hydrolapathi Passarge 1964
Mentho aquaticae-Caricetum pseudocyperi Orsomando et Pedrotti 1986
Thelypterido palustris-Phragmitetum australis Kuiper ex van Donselaar 1961
Magnocaricion elatae Koch 1926
Caricetum elatae Koch 1926
Cladietum marisci Allorge 1921
Caricion gracilis Neuhäusl 1959
Caricetum ripariae Máthé et Kovács 1959
Phalaridetum arundinaceae Libbert 1931

GALIO APARINES-URTICETEA DIOICAE Passarge ex Kopecký 1969
GALIO APARINES-ALLIARIETALIA PETIOLATAE Oberdorfer ex Görs *et* Müller 1969
Balloto-Conion maculati Brullo in Brullo et Marcenò 1985
Urtico dioicae-Sambucetum ebuli (Br.-Bl. in Br.-Bl., Gajewski, Wraber et Wa1as 1936) Br.-Bl. in Br.-Bl., Roussine *et* Nègre 1952
CALYSTEGIETALIA SEPIUM Tüxen ex Mucina 1993 nom. mut. propos.
Calystegion sepium Tüxen ex Oberdorfer 1957 nom. mut. propos. Rivas-Martínez, T.E. Díaz, Fernández-González, Izco, Loidi, Lousã *et* Penas 2002
Calystegio sepium-Epilobietum hirsuti Hilbig, Heinrich et Niemann 1972
Euphorbia palustris community

AGROSTIETEA STOLONIFERAE Oberdorfer 1983
POTENTILLO ANSERINAE-POLYGONETALIA AVICULARIS Tüxen 1947
Mentho longifoliae-Juncion inflexi Müller et Görs ex De Foucault 2008
Cypero-Caricetum otrubae Tüxen in Tüxen et Oberdorfer 1958

ALNETEA GLUTINOSAE Br.-Bl. et Tüxen ex Westhoff, Dijk et Passchier 1946
SALICETALIA AURITAE Doing ex Westhoff in Westhoff *et* Den Held 1969
Salicion cinereae Müller *et* Görs 1958
Frangulo-Salicetum cinerae Graebner & Hueck 1931 nom. invers.

SALICI PURPUREAE-POPULETEA NIGRAE (Rivas-Martínez et Cantó ex Rivas-Martínez, Báscones, T.E. Díaz, Fernández-González *et* Loidi 2001)
POPULETALIA ALBAE Br.-Bl. ex Tchou 1948
Populion albae Br.-Bl. ex Tchou 1948
Populus nigra community
SALICETALIA PURPUREAE Moor 1958
Salicion albae Soó 1930
Rubo ulmifolii-Salicetum albae Allegrezza, Biondi *et* Felici 2006

Acknowledgements

The authors wish to thank Mario Meloni, from 'Vite d'acqua' Fishermen's Cooperative, for his kind availability to carry the study group by his boat and for the useful information provided about the ecosystem modifications he observed at Lake Chiusi.

A special thank to Prof. G. Sburlino and Prof. E. Biondi for their useful suggestions.

References

Alexander D., 1984. The Reclamation of Val-di-Chiana (Tuscany). Ann. Assoc. Am. Geogr. 74: 527-550.

Allegrezza M., Biondi E. & Felici S., 2006. A phytosociological analysis of the vegetation of the central Adriatic sector of the Italian Peninsula. Hacquetia 5(2): 135-175.

Amigo J., 2006. Los herbazales terofíticos higronitrófilos en el nordeste de la Península Ibérica (*Bidentetea tripartitae* Tüxen, Lohmeyer & Preising ex von Rochow 1951). Lazaroa 27: 43-58.

Angiolini C. & Casini F., 2004. Specie naturali di pregio della Riserva Naturale "Lago di Montepulciano". Etruria Natura 1: 70-77.

Angiolini C., Ferretti G., Foggi B., Frignani F., Gestri G., Landi M., Lastrucci L., Monacci F., Peruzzi L., Sani A., Tomei P. E. & Venturi E., 2010. Notula n. 51. *Thelypteris palustris* Schott. In Peruzzi *et al.* (Eds.), Contributi per una flora vascolare di Toscana.

I (1-85). Atti Soc.Tosc. Sci. Nat. Ser. B 116 (2009): 38.

Anselmi B., 2001. Le Riserve Naturali della Provincia di Siena. Editrice Le Balze. Montepulciano, Siena.

Arrigoni P. V. & Ricceri C., 1982. La vegetazione dei laghi di Chiusi e di Montepulciano (Siena). Atti Soc. Tosc. Sci. Nat. Mem. B. 88 (1981): 285-299.

Baffetta F., Bacaro G., Fattorini L., Rocchini D. & Chiarucci A., 2007. Multi-stage cluster sampling for estimating average species richness at different spatial grains. Community Ecol. 8: 119-127.

Balátová-Tuláčková E., 1991. Das *Cladietum marisci*. Veröff. Geobot. Inst. ETH 106: 7-34.

Balátová-Tuláčková E., Mucina L., Ellmauer T. & Wallnöfer S., 1993. *Phragmiti-Magnocaricetea*. In: Grabherr G. & Mucina L. (Eds.), Die Pflanzengesellschaften Österreichs, Teil 2, Natürliche waldfreie Vegetation: 79–130. Gustav Fischer Verlag, Jena/Stuttgart/New York.

Balátová-Tuláčková E. & Venanzoni R., 1989. Sumpf und Feuchtrasengesellschaften in der Verlandungszone des Kalterer Sees (Lago di Caldaro), der Montiggler (Monticolo) Seen und in der Etsch (Adige) Aue, Oberitalien. Folia Geobot. Phytotax. 24: 253-295.

Baldoni M. & Biondi E., 1993. La vegetazione del medio e basso corso del fiume Esino (Marche, Italia centrale). Stud. Bot. 11: 209-257.

Banfi E. & Galasso G., 2010. La flora esotica lombarda. Regione Lombardia e Museo di Storia Naturale di Milano, Milano.

Baroni E., 1897-1908. Supplemento generale al "Prodromo della Flora Toscana" di T. Caruel. Soc. Botanica Italiana, Firenze.

Barsanti D., 2004. Un paese di bonifiche e di "zone umide", pp. 201–263. In: Bonelli Conenna L., Brilli A. & Cantelli G. (Eds), Il paesaggio toscano. L'opera dell'uomo e la nascita di un mito. Monte dei Paschi di Siena, Silvana Editoriale, Milano.

Berg C., Dengler J., Abdank A. & Isermann M. (Eds.), 2004. Die Pflanzengesellschaften Mecklenburg-Vorpommerns und ihre Gefährdung. Textband, Weissdorn, Jena.

Bigi L. & Rustici L., 1984. Regime idrico dei suoli e tipi climatici in Toscana. Dipartimento Agricoltura e Foreste, Regione Toscana.

Biondi E., 2011. Phytosociology today: Methodological and conceptual evolution. Plant Biosyst. 145 (Suppl.): 19-29.

Biondi E. & Baldoni M., 1994. La vegetazione del fiume Marecchia (Italia Centrale). Biogeographia 17 (1993): 51-87.

Biondi E. & Blasi C. (Eds.), 2013. Prodromo della vegetazione d'Italia. Check-list sintassonomica aggiornata di classi, ordini e alleanze presenti in Italia. Società Botanica Italiana Onlus. http://www.prodromo-vegetazione-italia.org.

Biondi E., Blasi C., Allegrezza M., Anzellotti I., Azzella M. M., Carli E., Casavecchia S., Copiz R., Del Vico E., Facioni L., Galdenzi D., Gasparri R., Lasen C., Pesaresi S., Poldini L., Sburlino G., Taffetani F.,Vagge I., Zitti S. &. Zivkovic L. 2014. Plant communities of Italy: The Vegetation Prodrome, Plant Biosystems 148 (4): 728-814.

Biondi E., Blasi C., Burrascano S., Casavecchia S., Copiz R., Del Vico E., Galdenzi D., Gigante D., Lasen C., Spampinato G., Venanzoni R. & Zivkovic L., 2009. Manuale Italiano di interpretazione degli habitat della Direttiva 92/43/CEE. Società Botanica Italiana. Ministero dell'Ambiente e della tutela del territorio e del mare, D.P.N. http://vnr.unipg.it/habitat/

Biondi E., Burrascano S., Casavecchia S., Copiz R., Del Vico E., Galdenzi D., Gigante D., Lasen C., Spampinato G., Venanzoni R., Zivkovic L. & Blasi C., 2012. Diagnosis and syntaxonomic interpretation of Annex I Habitats (Dir. 92/43/EEC) in Italy at the alliance level. Plant Sociology 49 (1): 5-37.

Biondi E., Casavecchia S. & Radetic Z., 2002. La vegetazione dei "guazzi" e il paesaggio vegetale della pianura alluvionale del tratto terminale del Fiume Musone (Italia centrale). Fitosociologia 39 (1): 45-70.

Biondi E., Lasen C., Spampinato G., Zivkovic L. & Angelini P., 2014. Habitat. In: Genovesi P., Angelini P., Bianchi E., Dupré E., Ercole S., Giacanelli V., Ronchi F. & Stoch F. (Eds), Specie e habitat di interesse comunitario in Italia: distribuzione, stato di conservazione e trend. ISPRA, Serie Rapporti, 194/2014.

Biondi E., Vagge I., Baldoni M. & Taffetani F., 1997. La vegetazione del Parco Fluviale Regionale del Taro (Emilia-Romagna). Fitosociologia 34: 69-110.

Biondi E., Vagge I., Baldoni M. & Taffetani F., 1999. La vegetazione del Parco Fluviale Regionale dello Stirone (Emilia-Romagna). Fitosociologia 36 (1): 67-93.

Braun-Blanquet J., 1932. Plant sociology. McGraw Hill Book Comp., U.S.A.

Brullo S. & Minissale P., 1998. Considerazioni sintassonomiche sulla classe *Isoeto-Nanojuncetea*. Itin. Geobot. 11: 263-290.

Brullo S., Minissale P. & Spampinato G., 1994. Studio fitosociologico della vegetazione lacustre dei Monti Nebrodi (Sicilia settentrionale). Fitosociologia 27: 5-50.

Brusa G., Raimondi B. & Cerabolini B., 2006. La vegetazione della Riserva Naturale "Lago di Biandronno" (Lombardia, Italia Settentrionale). Fitosociologia 43 (2): 111-128.

Buchwald R., 1994. Vegetazione e odonatofauna negli ambienti acquatici dell'Italia Centrale. Braun-Blan-

quetia 11: 3-77.
Casale F., 2000. Cause di perdita e di degrado delle zone umide in Europa. In: Bernardoni A. & Casale F. (ed), Atti del Convegno Zone umide d'acqua dolce – tecniche e strategie di gestione della vegetazione palustre. Quad. Ris. Nat. Paludi di Ostiglia 1: 21-28.
Carmignani L. & Lazzarotto L. (coord.), 2004. Carta geologica della Toscana (scala 1:250.000). Università di Siena, Regione Toscana. Litografia Artistica Cartografica, Firenze.
Caruel T., 1860-1864. Prodromo della Flora Toscana. Le Monnier, Firenze.
Celesti-Grapow L., Alessandrini A., Arrigoni P. V., Banfi E., Bernardo L., Bovio M., Brundu G., Cagiotti M. R., Camarda I., Carli E., Conti F., Fascetti S., Galasso G., Gubellini L., La Valva V., Lucchese F., Marchiori S., Mazzola P., Peccenini S., Poldini L. Pretto F., Prosser F., Siniscalco C., Villani M.C., Viegi L., Wilhalm T. & Blasi C., 2009. Inventory of the non-native flora of Italy. Plant Biosyst. 143 (2): 386-430.
Cernohous F. & Husak S., 1986. Macrophytic vegetation of Eastern and North-castern Bohemia. Folia Geobot. Phytotax. 21: 113-161.
Ceschin S. & Salerno G., 2008. La vegetazione del basso corso del Fiume Tevere e dei suoi affluenti (Lazio, Italia). Fitosociologia 45 (1): 39-74.
Ceschin S., Zuccarello V. & Caneva G., 2010. Role of macrophyte communities as bioindicators of water quality Application on the Tiber River basin (Italy). Plant Biosyst. 144: 528-536.
Chytrý M. (Ed.), 2011. Vegetace České republiky 3. Vodní a mokřadní vegetace [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation]. Academia Praha.
Conti F., Abbate G., Alessandrini A. & Blasi C. (Eds.), 2005. An Annotated Checklist of the Italian Vascular Flora. Palombi Editori. Roma.
Conti F., Alessandrini A., Bacchetta G., Banfi E., Barberis G., Bartolucci F., Bernardo L., Bonacquisti S., Bouvet D., Bovio M., Brusa G., Del Guacchio E., Foggi B., Frattini S., Galasso G., Gallo L., Gangale C., Gottschlich G., Grunanger P., Gubellini L., Iiriti G., Lucarini D., Marchetti D., Moraldo B., Peruzzi L., Poldini L., Prosser F., Raffaelli M., Santangelo A., Scassellati E., Scortegagna S., Selvi F., Soldano A., Tinti D., Ubaldi D., Uzunov D. & Vidali M., 2007. Integrazioni alla checklist della flora vascolare italiana. Nat. Vicentina 10 (2006): 5-74.
Croce A., Nazzaro R. & La Valva V., 2012. Evidence of dramatic biodiversity loss in a wet biotope calls for urgent conservation strategies. Plant Biosyst. 146: 827-834.
Davis J. A. & Froend R., 1999. Loss and degradation of wetlands in southwestern Australia: underlying causes, consequences and solutions. Wetl. Ecol. Manag. 7: 13-23.
Deil U., 2005. A review on habitats, plant traits and vegetation of ephemeral wetlands – a global perspective. Phytocoenologia 35: 533-705.
Denny P., 1994. Biodiversity and wetlands. Wetl. Ecol. Manag. 3: 55-61.
den Hartog C. & Segal S., 1964. A new classification of the water-plant communities. Acta Bot. Neerl. 13: 367-393.
Díaz González T. E. & Fernández-Prieto J. A., 1994. La vegetación de Asturias. Itinerea Geobot. 8: 243-520.
Dierschke H., 1996. Syntaxonomische Stellung von Hochstauden-Gesellschaften, insbesondere aus der Klasse *Molinio-Arrhenatheretea* (*Filipendulion*). Ber. Reinhold-Tüxen-Ges. 8: 145–157.
Dimopoulos P., Sykora K., Gilissen C., Wiecherink D. & Georgiadis T., 2005. Vegetation ecology of Kalodiki Fen (NW Greece). Biologia 60: 69-82.
Dudgeon D., Arthington A. H., Gessner M. O., Kawabata Z. I., Knowler D. J., Leveque C., Naiman R. J., Prieur-Richard A. H., Soto D., Stiassny M. L. J. & Sullivan C. A., 2006. Freshwater biodiversity: importance, threats, status and conservation challenges. Biol. Rev. 81: 163-182.
European Commission, 2007. Interpretation Manual of European Union Habitats. Eur 27. DG Environment.
Felicioni S. & Zarri E., 2007. Le zone umide della toscana settentrionale. Quaderni del Padule di Fucecchio 5. Centro di Ricerca, Documentazione e Promozione del Padule di Fucecchio.
Frignani F., Landi M., Lastrucci L. & Angiolini C., 2010. Notula n. 68 – *Euphorbia palustris* L. (Euphorbiaceae). In Peruzzi *et al*. (Eds.), Contributi per una flora vascolare di Toscana. I (1-85). Atti Soc. Tosc. Sci. Nat. Ser. B 116 (2009): 40.
Fuentes-Bazan S., Uotila P. & Borsch T., 2012. A novel phylogeny-based generic classification for *Chenopodium* sensu lato, and a tribal rearrangement of *Chenopodioideae* (*Chenopodiaceae*). Willdenowia 42: 5–24.
Géhu J. M., Bodard M., Bon M., Delelis-Dusollier A., Delsaut M., Delzenne-Van Halluwyn C., Géhu-Frank J. & Godin J., 1975. Etude Écologique de la cuvette audomaroise et des ses abords. Lille.
Geisselbrecht-Taferner L. & Mucina L., 1993. *Bidentetea tripartiti*. In Mucina L., Grabherr G., Ellmauer T. (Eds.) Die Pflanzengesellschaften Österreich. Teil 1: 90-109. Gustav Fischer Verlag Jena-Stuttgart-New York.
Gerdol R., 1987. Geobotanical investigations in the small lakes of Lombardy. Atti Ist. Bot. Lab. Critt. Univ. Pavia, Serie 7 Vol. 6: 5-49.
Giallonardo T., Landi M., Frignani F., Geri F., Lastrucci L. & Angiolini C., 2011. CORINE land cover and floristic variation in a Mediterranean wetland. Envi-

ron. Monit. Assess. 182: 141-154.

Gigante D., Acosta A.T.R., Agrillo E., Attorre F., Cambria V.M., Casavecchia S., Chiarucci A., Del Vico E., De Sanctis M., Facioni L., Geri F., Guarino R., Landi S., Landucci F., Lucarini D., Panfili E., Pesaresi S., Prisco I., Rosati L., Spada F. & Venanzoni R., 2012. VegItaly: Technical features, crucial issues and some solutions. Plant Sociol. 49 (2): 71-79.

Gigante D., Angiolini C., Landucci F., Maneli F., Nisi B., Vaselli O., Venanzoni R. & Lastrucci L., 2014. New occurrence of reed bed decline in southern Europe: do permanent flooding and chemical parameters play a role? C. R. Biol. 337: 487-498.

Gigante D., Landucci F. & Venanzoni R., 2013. The reed die-back syndrome and its implications for floristic and vegetational traits of *Phragmitetum australis*. Plant Sociol. 50 (1): 3-16.

Gigante D., Venanzoni R. & Zuccarello V., 2011. Reed die-back in southern Europe? A case study from Central Italy. C. R. Biol. 334: 327-336.

Görs S., 1992. Verband: *Nymphaeion* Oberd. 57. In Oberdorfer E. (Ed.) Süddeutsche Pflanzengesellschaften. I. Fels- und Mauergesellschaften, alpine Fluren, Wasser-, Verlandungs- und Moorgesellschaften: 108-118. G. Fischer, Jena, Stuttgart, New York.

Grabherr G. & Mucina L. (Eds.), 1993. Die Pflanzengesellschaften Österreichs – Teil II: Natürliche waldfreie Vegetation. Fischer, Jena.

Granetti B. & Bencivenga M., 1980. La flora del lago di Chiusi. Riv. Idrobiol. 29 (2): 371-388.

Hrivnák R., 2002. Aquatic plant communities in the catchment area of the Ipel' river in Slovakia and Hungary. Part II. Class *Potametea*. Thaiszia 12: 137-160.

Hroudová Z., Zákravský P., Ducháček M. & Marhold K., 2007. Taxonomy, distribution and ecology of *Bolboschoenus* in Europe. Ann. Bot. Fenn. 44: 81–102.

Hruska K., 1988. Vegetazione nitrofila dei corsi d'acqua del versante adriatico dell'appennino centrale. Acta Bot. Barc. 37: 253-256.

Hussner A., 2012. Alien aquatic plant species in European countries. Weed Res. 52: 297-306.

Iamonico D., Lastrucci L. & Viciani D., 2013. Notula alla checklist della flora vascolare italiana n.1965. *Oxybasis chenopodioides*. Inform. Bot. Ital. 45: 95-96.

Kiesslich M., Dengler J. & Berg C., 2003. Die Gesellschaften der *Bidentetea tripartitae* Tx. *et al*. ex von Rochow 1951 in Mecklenburg-Vorpommern mit Anmerkungen zur Synsystematik und Nomenklatur der Klasse. Feddes Repert. 114: 91-139.

Landi M., Angiolini C., Casini F. & Frignani F., 2005. Flora e vegetazione di interesse conservazionistico: studi in ambienti dulciacquicoli della Toscana meridionale. Inform. Bot. Ital. 37(1, parte A): 138-139.

Landucci F., Acosta A. T. R., Agrillo E., Attorre F., Biondi E., Cambria V. E., Chiarucci A., Del Vico E., De Sanctis M., Facioni L., Geri F., Gigante D., Guarino R., Landi S., Lucarini D., Panfili E., Pesaresi S., Prisco I., Rosati L., Spada F. & Venanzoni R., 2012. VegItaly: The Italian collaborative project for a national vegetation database. Plant Biosys. 146 (4): 756-763.

Landucci F., Gigante D. & Venanzoni R., 2011. An application of the Cocktail method for the classification of the hydrophytic vegetation at Lake Trasimeno (Central Italy). Fitosociologia 48 (2): 3-22.

Landucci F., Venanzoni R. & Chytrý M., 2013. Wetland vegetation of the class *Phragmito-Magno-Caricetea* in central Italy. Phytocoenologia 43 (1-2): 67-100.

Lastrucci L. & Becattini R., 2007. *Eleocharis carniolica* Koch (*Cyperaceae*) nuova per la Toscana (Italia Centrale) e distribuzione delle specie correlate. Webbia 62 (1): 11-26.

Lastrucci L. & Becattini R., 2009. La vegetazione delle aree umide presso Bosco ai Frati (Firenze, Toscana). Atti Soc. Tosc. Sci. Nat. mem. Ser. B 115 (2008): 57-67.

Lastrucci L., Foggi B., Gonnelli V. & Gusmeroli E., 2006. La vegetazione delle aree umide dei substrati ultramafici dell'Alta Valtiberina (Arezzo, Italia centrale). Stud. Bot. 24 (2005): 9-44.

Lastrucci L., Foggi B., Selvi F. & Becattini R., 2007. Contributo alla conoscenza della vegetazione e della flora delle aree umide nel comprensorio di Capalbio (Provincia di Grosseto, Italia centrale). Arch. Geobot. 10 (2004): 1-30.

Lastrucci L., Landi M. & Angiolini C., 2010. Vegetation analysis on wetlands in a Tuscan agricultural landscape (central Italy). Biologia 65: 54-68.

Lastrucci L., Landucci F., Gonnelli V., Barocco R., Foggi B. & Venanzoni R., 2012. The vegetation of the upper and middle River Tiber (Central Italy). Plant Sociol. 49 (2): 29-48.

Lastrucci L. & Raffaelli M., 2006. Contributo alla conoscenza della flora delle zone umide planiziarie e collinari della Toscana orientale: la provincia di Arezzo (Italia centrale). Webbia 61 (2): 271-304.

Lastrucci L., Viciani D., Nuccio C. & Melillo C., 2008. Indagine vegetazionale su alcuni laghi di origine artificiale limitrofi al Padule di Fucecchio (Toscana, Italia centrale). Ann. Mus. Civ. Rovereto 23: 169-203.

Maiorca G., Spampinato G., Crisafulli A. & Cameriere P., 2007. Flora e vegetazione della Riserva Naturale Regionale "Foce del Fiume Crati" (Calabria, Italia meridionale). Webbia 62: 121-174.

Mariotti M. G., 1990. Emergenze floristiche. In: AA.VV. (ed), Il paesaggio vegetale. Stato delle conoscenze e note sul patrimonio vegetale: 51-72.

Carta della Natura/2. Provincia di Siena. Nuova Immagine Editrice.

Matuszkiewicz W., 1981. A guide for identification of the plant communities of Poland. PWN, Warszawa.

Müller T., 1977. Klasse: *Lemnetea*. In Oberdorfer (ed.), Süddeutsche Pflazengesllschaften, Teil 1: 67-77. Stuttgart–New York.

Oberdorfer E., 2001. Pflanzensoziologische Exkursionsflora für Deutschland und angrenzende Gebiete. Ulmer, Stuttgart.

Orsomando E. & Pedrotti F., 1986. Le "praterie galeggianti" a *Carex pseudocyperus* L. di alcuni laghi dell'Italia centrale. Riv. Idrobiol. 25 (1-3): 87-103.

Pedrotti F., 1988. La flora e la vegetazione del lago di Loppio (Trentino). Giorn. Bot. Ital. 122: 105-147.

Pedrotti F., 1990. Stato dell'ambiente dei Laghi di Caldonazzo e Levico (Trentino) attraverso l'analisi della flora e vegetazione. Giorn. Bot. Ital. 124 (1): 155.

Pedrotti F., 1991. Nota sulla flora e vegetazione del Lago di Madrano (Trentino). Inform. Bot. Ital. 22 (3) (1990): 182-193.

Philippi G., 1977. Klasse: *Phragmitetea* Tx. et Prsg. 42. In Oberdorfer E. (Ed.), Süddeutsche Pflanzengesellschaften, Teil 1: 119-165 . Gustav Fischer Verlag, Stuttgart-New York..

Piccoli F. & Gerdol R., 1980. Rice-field weed communities in Ferrara province (Northern Italy). Aq. Bot. 10: 317-328.

Pignatti S., 1982. Flora d'Italia, voll. I-III. Edagricole, Bologna.

Pirone G., 2000. La vegetazione ripariale nei versanti nord-orientali del gran Sasso d'Italia e dei Monti della Laga (Abruzzo, Italia). Fitosociologia 37 (2): 65-86.

Podani J., 2001. Syntax 2000 computer programs for data analysis in ecology and systematics. Budapest.

Pott R., 1995. Die Pflanzengesellschaften Deutschlands. 2 Aufl. Eugen Ulmer Verlag, Stuttgart.

Pott R., 2011. Phytosociology: A modern geobotanical method. Plant Biosyst. 145 (Suppl.): 9-18.

Reale L., Gigante D., Landucci F., Ferranti F. & Venanzoni R., 2012. Morphological and histo-anatomical traits reflect die-back in *Phragmites australis* (Cav.) Steud. Aq. Bot. 103: 122-128.

Regione Toscana, 2011. Elenco Ufficiale delle aree protette regionali. Allegato A1. Delibera 834 del 3-10-2011.

Riccardi R., 1939. I laghi di Chiusi e di Montepulciano. Boll. Riv. Soc. Geogr. Ital. 4: 143-164.

Rivas-Martínez S., Diaz T. E., Fernández-González F., Izco J., Loidi J., Lousã M. & Penas A., 2002. Vascular plant communities of Spain and Portugal. Addenda to the syntaxonomical checklist of 2001. Itinera Geobot. 15 (2): 433-922.

Rivas-Martínez S., Fernández-González F., Loidi J., Lousã M. & Penas A., 2001. Syntaxonomical checklist of vascular plant communities of Spain and Portugal to association level. Itinera Geobot. 14: 5-341.

Rivas–Martínez S. & Rivas–Saenz S., 1996-2009: Worldwide Bioclimatic Classification System, Phytosociological Research Center, Spain. http://www.globalbioclimatics.org accessed 31/03/2014.

Rocchini D., Andreini Buti S. & Chiarucci A., 2005. Maximizing plant species inventory efficiency by means of remotely sensed spectral distances. Global Ecol. Biogeogr. 14: 431-437.

Rocchini D., Ricotta C & Chiarucci A., 2007. Using satellite imagery to assess plant species richness: The role of multispectral system. Appl. Veg. Sci. 10: 325-331.

Sburlino G. & Marchiori S., 1985. Considerazioni sulle cenosi a *Carex elata* All. della Pianura Padana. Not. Fitosoc. 21: 23-34.

Sburlino G., Scoppola A. & Marchiori S., 1985. Contributo alla conoscenza degli ambienti umidi della Pianura Padana Orientale. La classe *Lemnetea minoris* R. Tx. 1955 em. Schw., R. Tx. 1981. Not. Fitosoc. 21: 61-70.

Sburlino G., Tomasella M., Oriolo G. & Poldini L., 2004. La vegetazione acquatica e palustre dell'Italia nord-orientale. 1 – La classe *Lemnetea* Tűxen ex O. Bolos et Masclans 1955. Fitosociologia 41 (1) suppl. 1: 27–42.

Sburlino G., Tomasella M., Oriolo G., Poldini L. & Bracco F., 2008. La vegetazione acquatica e palustre dell'Italia nord-orientale. 2 La classe *Potametea* Klika in Klika et V. Novak 1941. Fitosociologia 45 (2): 3-40.

Schaminée J. H. J., Weeda E. J. & Westhoff V. (Eds.), 1995. De Vegetatie von Nederland, Deel 2. Plantengemeenschappen van wateren, moerassen en natte heiden [in Dutch]. Opulus, Uppsala.

Scoppola A., 1982. Considérations nouvelles sur les végétations des *Lemnetea minoris* (R.Tx. 1955) em. A. Schwabe et R.Tx. 1981 et contribution à l'etude de cette classe en Italie centrale. Doc. Phytosoc. 6: 1-130.

Scoppola A., 1998. La vegetazione della Riserva Naurale di Monte Rufeno (Vt). Reg. Lazio, Ass. U.T.V. delle risorse ambientali. Riserva Naturale Monte Rufeno, Comune di Acquapendente, Acquapendente.

Šumberová K., 2011a. Vegetace volně plovoucích vodních rostlin (*Lemnetea*). Vegetation of free floating aquatic plants. In Chytrý M. (Ed.), Vegetace České republiky 3. Vodní a mokřadní vegetace: 43-99. [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation]. Academia, Praha.

Šumberová K., 2011b. Vegetace vodních rostlin zakořeněných ve dně (*Potametea*). Vegetation of aquatic plants rooted in the bottom. In Chytrý M. (Ed.), Vegetace České republiky 3. Vodní a mokřadní

vegetace: 100-247. [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation]. Academia, Praha.

Šumberová K. & Lososová Z., 2011. Vegetace jednoletých nitrofilních vlhkomilných bylin (*Bidentetea tripartitae* Tüxen *et al*. ex von Rochow 1951). Vegetation of annual nitrophilous wetland herbs. In: Chytrý M., (ed.), Vegetace České republiky. 3. Vodní a mokřadní vegetace: 347-384. [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation]. Academia, Praha.

Šumberová K., Hájková P., Chytrý M., Hroudová Z., Sádlo J., Hájek M., Hrivnák R., Navrátilova J., Hanáková P., Ekrt L. & Ekrtová E., 2011b. Vegetace rákosin a vysokých ostřic (*Phragmito-Magno-Caricetea*). Marchland vegetation. In Chytrý M. (Ed.), Vegetace České republiky 3. Vodní a mokřadní vegetace: 385-580. [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation]. Academia, Praha.

Šumberová K., Navrátilová J., Čtvrtlíková M., Hájek M. & Bauer P., 2011a. Vegetace oligotrofních vod (*Littorelletea uniflorae*). Vegetation of oligotrophic water bodies. In Chytrý M. (Ed.), Vegetace České republiky 3. Vodní a mokřadní vegetace: 268-308. [Vegetation of the Czech Republic 3. Aquatic and wetland vegetation]. Academia, Praha.

Thornthwaite C. W. & Mather J. R., 1957. Instruction and tables for computing potential evapotranspiration and the water balance. Pubbl. Climatol. 10 (3): 1-311.

Tomei P. E. & Guazzi E., 1996. Le zone umide della Toscana. Lista generale delle entità vegetali. Atti Mus. civ. Sci. Nat. Grosseto 15 (1993): 107-152.

Tomei P. E., Guazzi E. & Kugler P. C., 2001. Le zone umide della Toscana. Indagini sulle componenti floristiche e vegetazionali. Edizioni Regionali Toscana, Firenze.

Tomei P. E., Longombardo G. & Lippi A., 1991. Specie vegetali igrofile delle zone dulciacquicole della Toscana planiziale: aspetti floristici e bioecologici. Pacini Editore. Ospedaletto (Pisa).

Tutin T. G., Burges N. A., Charte A. O., Edmonson J. R., Heywood V. H., Moore D. M., Valentine D. H., Walters S. M. & Webb D. A., 1993. Flora Europaea, 1(second edition). Cambridge University Press, Cambridge.

Tutin T. G., Heywood V. H., Burges N. A., Moore D. M., Valentine D. H., Walters S. M. & Webb D. A., 1968– 1980. Flora Europaea, 2-5. Cambridge University Press, Cambridge.

van der Maarel E., 1979. Transformation of cover-abundance values in phytosociology and its effects on community similarity. Vegetatio 39: 97-114.

Venanzoni R. & Gigante D., 2000. Contributo alla conoscenza della vegetazione degli ambienti umidi dell'Umbria (Italia). Fitosociologia 37 (2): 13-63.

Viciani D., Lastrucci L., Dell'Olmo L., Ferretti G. & Foggi B., 2014. Natura 2000 Habitats in Tuscany (central Italy): Synthesis of main conservation features based on a comprehensive database. Biodiv. Conserv. 23: 1551-1576.

Wärner C., Welk E., Durka W., Wittig B. & Diekmann M., 2011. Biological Flora of Central Europe: *Euphorbia palustris* L. Perspect. Plant Ecol. Evol. Syst. 13: 55-69.

Weber H. E., Moravec J. & Theurillat J.-P., 2000. International Code of Phytosociological Nomenclature. 3rd edition. J. Veg. Sci. 11: 739-768.

Westhoff V. & den Held A. J., 1969. Plantengemeenschappen in Nederland. [Plant communities of the Nederlands]. Zutphen, Thieme.

Appendix 1: sporadic species

Tab. 1: Rel. 1: Ranunculus trichophyllus Chaix (+). Rel. 5: Mentha aquatica L. subsp. aquatica (+). Rel. 12: Najas minor All. (2). Rel. 13: Chara sp. (+), Potamogeton lucens L. (+). Rel. 15: Potamogeton natans L. (+).

Tab. 2: Rel. 1: Azolla filiculoides Lam. (+), Lemna minor L. (+). Rel. 7: Scutellaria galericulata L. (+). Rel. 20: Sparganium erectum L. subsp. neglectum (Beeby) K. Richt. (+). Rel. 21: Butomus umbellatus L. (2), Schoenoplectus lacustris (L.) Palla (1). Rel. 40: Scrophularia auriculata L. subsp. auriculata (+). Rel. 42: Bidens frondosus L. (+),Veronica catenata Pennell (+).

Tab. 3: Rel. 5: Althaea officinalis L. (+). Rel. 7: Epilobium hirsutum L. (+). Rel. 11: Calystegia sepium (L.) R. Br. subsp. sepium (+), Carex pendula Huds. (+), Epilobium tetragonum L. (+), Erigeron canadensis L. (1). Rel. 18: Bolboschoenus glaucus (Lam.) S.G. Sm. (2). Rel. 22: Nuphar lutea (L.) Sm. (2).

Tab. 4: Rel. 1: Cichorium intybus L. subsp. intybus (1), Echinochloa crus-galli (L.) P. Beauv. (+), Juncus compressus Jacq. (1), Trifolium repens L. (1), Xanthium orientale L. subsp. italicum (Moretti) Greuter (+). Rel. 2: Alisma plantago-aquatica L. (+), Eleocharis palustris (L.) Roem. & Schult. subsp. palustris (+), Lythrum salicaria L. (1). Rel. 3: Lycopus europaeus L. (+), Mentha aquatica L. subsp. aquatica (+). Rel. 4: Paspalum distichum L. (+).

Tab. 5: Rel. 2: Azolla filiculoides Lam. (1). Rel. 5: Najas marina L. subsp. marina (2). Rel. 8: Cornus sanguinea L. (1), Crataegus monogyna Jacq. (+). Rel. 9: Cirsium vulgare (Savi) Ten. (1), Erigeron canadensis L. (+), Nuphar lutea (L.) Sm. (+), Plantago major L. (+), Senecio aquaticus Hill (+). Rel. 10: Cirsium creticum (Lam.) d'Urv. subsp. triumfetti (Lacaita) Werner (+). Rel. 11: Artemisia vulgaris L. (+), Carex hirta L. (+), Elymus repens (L.) Gould subsp. repens (+), Epilobium tetragonum L. (+), Eupatorium cannabinum

L. (+), Galium mollugo L. subsp. erectum Syme (+), Poa trivialis L. (+), Pulicaria dysenterica L. (+), Salix alba L. (+), Salix cinerea L. (+). Rel. 12: Lysimachia nummularia L. (+). Rel. 13: Hypericum tetrapterum Fr. (+). Rel. 14: Sorghum halepense (L.) Pers. (+). Rel. 17: Brassica nigra (L.) W.D.J. Koch. (+), Lipandra polysperma (L.) S. Fuentes, Uotila & Borsch (+), Echinochloa crus-galli (L.) P. Beauv. (+), Ranunculus sceleratus L. (+). Rel. 19: Equisetum palustre L. (+).

Tab. 6: Rel. 2: Eleocharis acicularis (L.) Roem. & Schult. (2). Rel. 3: Convolvulus arvensis L. (+), Crataegus monogyna Jacq. (+), Dipsacus fullonum L. (+), Helianthus annuus L. (r), Ranunculus sceleratus L. (2), Thalictrum lucidum L. (+). Rel. 4: Carex otrubae Podp. (1). Rel. 5: Oxybasis rubra (L.) S. Fuentes, Uotila & Borsch (+). Rel. 7: Lemna minor L. (+), Lemna trisulca L. (+), Salvinia natans (L.) All. (+). Rel. 9: Juncus effusus L. subsp. effusus (2), Lysimachia nummularia L. (+), Rumex conglomeratus Murray (+). Rel. 10: Samolus valerandi L. (+). Rel. 11: Bidens frondosus L. (+), Erigeron canadensis L. (1). Rel. 14: Veronica anagalloides Guss. (1). Rel. 15: Chara sp. (2).

Tab. 7: Rel. 1: Nuphar lutea (L.) Sm. (+). Rel. 4: Erigeron canadensis L. (+), Holcus lanatus L. (+), Lemna minor L. (r). Rel. 6: Agrostis stolonifera L. (2), Ludwigia palustris (L.) Elliott (2), Pulicaria dysenterica L. (r). Rel. 10: Populus nigra L. (+), Sonchus asper (L.) Hill. (+). Rel. 11: Oxybasis chenopodioides (L.) S. Fuentes, Uotila & Borsch (2). Rel. 12: Ranunculus sceleratus L. (1). Rel. 14: Cirsium vulgare (Savi) Ten. (+), Galium aparine L. (1), Persicaria decipiens (R. Br.) K.L. Wilson (+), Torilis japonica (Houtt.) DC. (+). Rel. 17: Inula salicina L. (+). Rel. 18: Ceratophyllum demersum L. (+), Thalictrum lucidum L. (+). Rel. 20: Rubus caesius L. (+). Rel. 22: Convolvulus arvensis L. (1), Galium rotundifolium L. subsp. rotundifolium (+), Geranium dissectum L. (+), Ophioglossum vulgatum L. (r), Potentilla reptans L. (+). Rel. 24: Hottonia palustris L. (+). Rel. 26: Plantago major L. (+). Rel. 29: Galium mollugo L. subsp. erectum Syme (+). Rel. 31: Althaea officinalis L., Bromus hordeaceus L. (+).

Tab. 8: Rel. 1: Acer campestre L. (+),Galium mollugo L. subsp. erectum Syme (+), Rubus ulmifolius Schott (2), Silene latifolia Poir. subsp. alba (Mill.) Greuter & Burdet (+),Verbena officinalis L. (+). Rel. 2: Holcus lanatus L. (+), Schedonorus arundinaceus (Scherb.) Dumort. (+). Rel. 3: Rumex conglomeratus Murray (+). Rel. 4: Daucus carota L. (+), Persicaria amphibia (L.) Delarbre (+). Rel. 5: Artemisia verlotiorum Lamotte (1), Dactylis glomerata L. (+), Galium lucidum All. (+), Hypericum perforatum L. (+), Lactuca serriola L. (+), Lathyrus hirsutus L. (+), Phragmites australis (Cav.) Trin. (+), Rumex crispus L. (+), Sonchus asper (L.) Hill. (+), Torilis arvensis (Huds.) Link (+).

Tab. 9: Rel. 1: Lycopus europaeus L. (1), Convolvulus arvensis L. (+), Phalaris arundinacea L. subsp. arundinacea (+), Galium mollugo L. subsp. erectum Syme (+), Ranunculus sardous Crantz (r). Rel. 2: Cirsium arvense (L.) Scop. (2), Carex flacca Schreb. (2), Chenopodium album L. (1), Lythrum salicaria L. (1), Bolboschoenus glaucus (Lam.) S.G. Sm. (+), Galium palustre L. aggr. (+).

Tab. 10: Rel. 1: Bidens frondosus L. (+),Epilobium parviflorum Schreb. (+), Lolium rigidum Gaudin (+),Veronica anagallis-aquatica L. subsp. anagallis-aquatica (1). Rel. 3: Azolla filiculoides Lam. (+), Calystegia sepium (L.) R. Br. subsp. sepium (+), Hippuris vulgaris L. (+). Rel. 6: Centaurea jacea L. subsp. gaudini (Boiss. & Reut.) Gremli (1), Dactylis glomerata L. (1), Lycopus exaltatus Ehrh. (1). Rel. 7: Brachypodium rupestre (Host) Roem. & Schult. (2), Lactuca serriola L. (+), Rosa canina L. (+). Rel. 10: Arctium nemorosum Lej. (+), Artemisia vulgaris L. (+),Cirsium vulgare (Savi) Ten. (+), Pastinaca sativa L. (+), Persicaria hydropiper (L.) Delabre (+). Rel. 11: Aquilegia vulgaris auct. Fl. Ital. (r), Atriplex prostrata Boucher ex D.C. (1), Carex riparia Curtis (+), Carex sp. (+), Convolvulus arvensis L. (2), Epilobium tetragonum L. (r), Fragaria vesca L. subsp. vesca (+), Galium palustre L. aggr. (+), Galium rotundifolium L. subsp. rotundifolium (+), Lilium bulbiferum L. subsp. croceum (Chaix) Jan (+), Lolium perenne L. (1), Lotus corniculatus L. (1), Mentha pulegium L. subsp. pulegium (1), Plantago major L. (+), Quercus cerris L. (3), Ranunculus serpens Schrank subsp. nemorosus (DC.) G.Lòpez (+), Ruscus aculeatus L. (+), Symphoytrichum squamatum (Spreng.) G.L.Nesom (+), Thalictrum flavum L. (1), Tordylium maximum L. (+). Rel. 12: Hedera helix L. (3), Laurus nobilis L. (1), Ligustrum vulgare L. (+), Prunus spinosa L. subsp. spinosa (2), Tamus communis L. (+), Viola alba Besser (+), Vitis sp. (+). Rel. 13: Chara sp. (+).