Vegetation and habitat of conservation interest of the lake Acquato (Grosseto – Central Italy)

L. Lastrucci1, G. Ferretti2, N. Mantarano2, B. Foggi2
1University Museum System, Natural History Museum of the University of Florence, Botany, via G. La Pira 4, I-50121 Florence, Italy.
2Department of Biology, University of Florence, via G. La Pira 4, I-50121 Florence, Italy.

Abstract
The vegetation of the Mediterranean wetland of the lake Acquato (Grosseto Province, southern Tuscany) was studied according to the phytosociological method. The study put in evidence the occurrence of hydrophytic, helophytic, perennial wet meadow and annual hygrophilous communities, respectively belonging to the following classes: Lemnetea minoris, Potametea pectinati, Phragmito-Magnocaricetea, Agrostietea stoloniferae, Bidentetea tripartitae and Isoëto-Nanojuncetea. Some vegetation types are reported for the first time for Italy. Two habitats of conservation value according to the 92/43/CEE Directive Habitats have been identified.

Key words: annual hygrophilous coenoses, aquatic vegetation, helophytic communities, Mediterranean wetlands, phytosociology, southern Tuscany.

Introduction
The high conservation importance of wetlands in the Mediterranean basin was recognised in several recent studies (Benavent-González et al., 2014; García-Madrid et al., 2014; Bagella et al., 2016; Angiolini et al., 2017; Tornero et al., 2018). Biondi et al. (2012) and Gigante et al. (2016, 2018) emphasized the central rule of phytosociology for the individuation of habitats of conservation importance and their monitoring. Then the phytosociological approach, including floristic, ecological, syndinamic and phytogeographic components (see Biondi, 2005) can be very helpful in the study of the high biodiversity of these habitats. The phytosociological approach applied in several recent studies on Tuscan wetlands allowed to identify new or rare vegetation types and a large number of habitats of conservation interest (e.g. Lastrucci et al., 2010a, 2010b, 2012, 2014, 2016, 2017a; Mereu et al., 2012), leading to the production of cartographic documents representing relevant for the habitat management and the monitoring planning (Viciani et al., 2017). The present contribution is part of a series of surveys focused on the wetland vegetation of the southern Tuscan Maremma, in the province of Grosseto, with particular reference to the Capalbio area, where previous studies put in evidence the presence of rare and interesting phytocoenoses (Lastrucci et al., 2007).

The study area: ecological features and botanical knowledge
The lake Acquato (UTM 32T: 4706600N; 701680E) is located in a small depression between the hills at north-east of Poggio Monteti (Grosseto province); according to Pesaresi et al. (2017) the study area is included in the Mediterranean Macrobioclimate. The lake is part of the Natura 2000 network as a Site of Community Importance, named “Lago Acquato, Lago San Floriano” (IT51A0030), recently approved as a Special Area of Conservation. As for other wetlands of the Capalbio area, also for this basin a karst origin can be hypothesized (Tomei et al., 1986; Guazzi & Tomei, 1996). Several authors (Mori, 1932; Tomei et al., 1986; Guazzi & Tomei, 1996) underlined the absence of a real tributary, so that the water supply comes essentially from rainwater and, at lesser extend, from a small spring in the south-east shore. The high fluctuation of the seasonal water level, depending on rainfall and temperatures, and the long-term changes of the biotope, already evidenced by Mori (1932) and Guazzi & Tomei (1996), reverberate in more or less long periods of basin drainage. During our surveys (until the summer 2018), the presence of few centimetres of water in the small open spaces between the marsh vegetation was observed until the early summer, fast decreasing to the complete drying in late summer.

The lake is subject to a strong anthropogenic disturbance due the presence of cultivated areas around the wetland (Tomei et al., 2001). This implies an intense human management such as the recurrent cutting of vegetation or the creation of paths for heavy vehicles.

A small-size pond surrounded by a thicket of Fraxinus angustifolia Vahl subsp. oxybarpa (M.Bieb. ex Willd.) Franco & Rocha Afonso and Populus nigra L.
is present in the south-western part of the wetland. Although the pond depth decreased during the summer, it never reached the total drainage during our surveys.

The botanical knowledge of the study area was almost exclusively floristic, thanks to the Sommier collections (see Sommier, 1892a, 1892b) and to the more recent contributions by various botanists (Tomei et al., 1986; Tomei & Guazzi, 1996; Guazzi & Tomei, 1996: Tomei et al., 2001); in addition, an overall floristic contribution to the flora of the Tuscan Maremma, also reporting data about the lake Acquato, was published by Selvi (2010).

Material and methods

The Lake Acquato vegetation was studied through the phytosociological method (Braun-Blanquet, 1932; Biondi, 2011; Pott, 2011). A total of 46 relevés were carried out. The phytocoenoses were sampled according to the principle of “local and physiognomic micro-homogeneity” (Géhu, 1988).

The matrix of relevés, previously transformed according to the ordinal scale proposed by van der Maarel (1979), was subjected to cluster analysis basing on the Euclidean distance and the average linkage clustering method. Statistical analysis were performed using the software Syntax2000 (Podani, 2001).

The groups identified in the dendrogram were classified, whenever possible, at association level according to the main European and Italian phytosociological literature (e.g. Mucina et al., 1993; Grabherr & Mucina, 1993; Valachovič, 2001; Rivas-Martínez et al., 2001, 2002; Chytrý, 2011; Landucci et al., 2013) and to the specific papers mentioned below. The syntaxonomic scheme follows Biondi & Blasi (2015) and, for some aquatic coenoses, Lastrucci et al. (2014). Species nomenclature follows Bartolucci et al. (2018) and Galasso et al. (2018). The specimens collected during the field survey were stored in the Herbarium Centrale Italicum (FI) and in the Herbarium of the Department of Biologia of the University of Florence.

Results and discussion

Cluster analysis

The cluster analysis allows to identify 13 groups, interpreted as 12 vegetation types (see following chapters). The clusters A-B include hydrophyte-dominated relevés; the cluster C groups hydrophyte-dominated relevés rich in marsh species, resulting in the dendrogram close to some of the clusters of helophyte-dominated relevés (D-G); the clusters H-I include hemicryptophyte/geophyte-dominated relevés; the clusters J-K include therophyte-dominated relevés, as well the cluster L, grouping the Sporobolus schoenoides-dominated relevés.

Fig. 1 - Study area.
The vegetation of the Mediterranean wetland of the lake Acquato

Aquatic vegetation of the classes Lemnetea minoris and Potametea pectinati

**CERATOPHYLLETUM DEMERSI** Corillion 1957

(Rels. 1-4, Tab. 1; gr. A of cluster Fig. 2)

A phytocoenosis dominated by *Ceratophyllum demersum* was detected in the pond near the lake Acquato. The community can be attributed at the association *Ceratophylletum demersi* Corillion 1957, typical of water bodies with still or slowly running, eutrophic to hypertrophic waters (Sumberová, 2011a). *Ceratophyllum demersum* communities have been reported both in shallow (e.g. Sburlino *et al.*, 2004; Sumberová, 2011a) and in deep waters (Buchwald, 1995; Lastrucci *et al.*, 2014). In the study area the community grows in the deepest areas of the pond and tolerates strong water-level variation, as already put in evidence by other authors (Hrivnák, 2002). In Tuscany the association was reported from the southern to the north-western wetlands of the region (Lastrucci *et al.*, 2006, 2014, 2016).

**POTAMETUM LUCENTIS** Hueck 1931

(Rels. 5-6, Tab. 1; gr. C of cluster Fig. 2)

The strong changes in the level of the Lake Acquato, the density of the helophytes and the anthropogenic disturbance factors affecting the small biotope represent negative factors for the optimal development of hydrophyte vegetation. Tomei *et al.* (1986) already underlined the exiguity of hydrophytic flora. It is important to note, however, that all the aquatic species previously reported in literature (see also Guazzi & Tomei, 1996) were confirmed by our observations.

The only aquatic vegetation type, rather diffused in the lake, is represented by *Potametum lucentis* Hueck 1931, developing on the shallow and small open areas between the helophytic vegetation. This association was reported also for the lake of La Sdriscia near Calpbio (Lastrucci *et al.*, 2007). Few other hydrophytes are present in the relevés (*Ranunculus rionii* and the aquatic ecophene of *Persicaria amphibia*). The high presence of helophytes in the rel. 6 testifies the close contact of this association with the marsh vegetation.

**RANUNCULETUM RIONII** Hejný & Husák in Dykyjová et Květ 1978 nom. mut. propos.

(Rels. 7-8, Tab. 2; gr. B of cluster Fig. 2)

At the edge of the pond near the lake Acquato a belt of hydrophytic vegetation dominated by *Ranunculus rionii* was found. The study area represents the first site for in which this species was collected in Tuscany (Lastrucci *et al.*, 2019). This kind of vegetation is in contact with the *Ceratophylletum demersi*, developing in the shallower waters along the pond shores. After the partial draining of the pool during the summer this kind of vegetation tends to rarify and the only vegetation type occupying the waters of the pool is constituted by the *Ceratophylletum demersi*. From the syntaxonomic point of view this coenosis can be attributed to the association *Ranunculetum rionii* Hejný & Husák in Dykyjová et Květ 1978 nom. mut. propos., occurring in shallow, eutrophic and often salt-rich, warm fish-pond margins and pools at depths of 20–60 cm (Sumberová, 2011b). The association is here recorded for the first time in Tuscany and, based on the databases of Lisy (Bracco *et al.*, 2007) and VegItaly (Landucci

![Fig. 2 - Dendrogram of the phytosociological relevés.](image-url)
### Tab. 1 - Vegetation of the classes *Lemnetea minoris* and *Potametea pectinati*

<table>
<thead>
<tr>
<th>Rel. number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cover (%)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>70</td>
<td>100</td>
<td>90</td>
</tr>
<tr>
<td>Surface (m²)</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Rel. number in the cluster</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>44</td>
<td>45</td>
</tr>
</tbody>
</table>

**Plunostrophic vegetation of the *Lemnetea minoris* class**

- *Ceratophyllum demersum* L. (5 5 5 5)
- *Ranunculus rionii* Lagger (4 4)

**Rhophytophatic vegetation of the *Potametea pectinati* class**

- *Potamogeton lucens* L. (5 5 5 5)
- *Ranunculus rionii* Lagger (5 4)

**Characteristic species of *Potamion pectinati* and upper units**

- *Potamogeton crispus* L. (5 5 5 5)
- *Pistia stratiote L.* (5 5 5 5)
- *Alisma plantago-aquatica* L. (5 5 5 5)

**Other species**

- *Schoenoplectus lacustris* (L.) Palla (5 5 5 5)
- *Potamogeton lucens* L. (5 5 5 5)
- *Pistia stratiote L.* (5 5 5 5)
- *Alisma plantago-aquatica* L. (5 5 5 5)

### Tab. 2 - Marsh vegetation of the class *Phragmito-Magnocaricetea*

<table>
<thead>
<tr>
<th>Rel. number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tr>
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<td>100</td>
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<td>30</td>
<td>30</td>
<td>10</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>Rel. number in the cluster</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
</tbody>
</table>

**Schoenoplectetum lacustris**

- *Schoenoplectus lacustris* (L.) Palla (5 5 4 4 4)
- *Phragmites australis* (Cav.) Trin. ex Steud. (5 5 5 5 5)
- *Eleocharitetum palustris* (L.) Roem. & Schult. subsp. palustris (5 5 5 5 5)
- *Bolboschoenetus glauci* (5 5 5 5 5)
- *Bolboschoenenus glauci* (Lam.) S.G. Sm. (5 5 5 5 5)

**Upper units of the *Phragmito-Magnocaricetea* class**

- *Alisma plantago-aquatica* L. (5 5 5 5 5)
- *Xanthium italicum* Moretti (5 5 5 5 5)
- *Bidens frondosa* L. (5 5 5 5 5)
- *Lythrum hyssopifolia* L. (5 5 5 5 5)
- *Ranunculus sardous* Crantz subsp. sardous (5 5 5 5 5)
- *Echinolchus crus-galli* (L.) P.Beauv. subsp. crus-galli (5 5 5 5 5)
- *Perennial species of wet and disturbed habitats**

- *Agristis stolonifera* L. (5 5 5 5 5)
- *Elymus repens* (L.) Gould subsp. repens (5 5 5 5 5)
- *Carex otrubeae* Podp. (5 5 5 5 5)
- *Rumex crispus* L. (5 5 5 5 5)
- *Paspalum distichum* L. (5 5 5 5 5)
- *Juncus articulatus* L. subsp. articulatus (5 5 5 5 5)
- *Plantago major* L. (5 5 5 5 5)
- *Rumex conglomeratus* Murray (5 5 5 5 5)

**Other species**

- *Solanum dulcamara* L. (5 5 5 5 5)
- *Abutilon theophrasti* Medik. (5 5 5 5 5)
- *Salix alba* L. (5 5 5 5 5)
Marsh vegetation of the class Phragmito-Magnocaricetae

**SCHOENOPLECTETUM LACUSTRIS**

Chouard 1924 (Rels. 1-5, Tab. 2; gr. D of cluster Fig. 2)

In the central/western part of the Lake Acquato dense stands of *Schoenoplectus lacustris* have been detected. This kind of vegetation can be attributed to *Schoenoplectetum lacustris* Chouard 1924. In the study site the association develops on the long-submerged swamp areas, confirming the trend observed also by Lastrucci et al. (2007) for the Lagaccioli ponds; this can be related to the high photosynthetic efficiency of *S. lacustris* during the submersion time (Poldini, 1989). As the water depth decreases, the association tends to form a mosaic with other Phragmition (*Phragmitetum australis*) or Eleocharito-Sagittarian coenoses.

**PHRAGMITETUM AUSTRALIS**

Savić 1926 (Rels. 6-10, Tab. 2; gr. G of cluster Fig. 2)

This association is the more widespread vegetation type of the Lake Acquato. *Phragmitetum australis* develops with dense stands often monospecific or rather poor in species, confirming a general characteristic of this kind of phytocoenosis (Venanzoni & Gigante, 2000; Lastrucci et al., 2017b).

The reed-bed develops from the shallow waters up to the peripheral areas of the small biotope, fastly emerging at the beginning of the summer. In the late-summer the more external stands of the reed-bed in contact with the surrounding cultivated areas were subject to extensive mowing.

**ELEOCHARITETUM PALUSTRIS**

Savić 1926 (Rels. 11-13, Tab. 2; gr. E of cluster Fig. 2)

*Eleocharis palustris* subsp. *palustris* tends to form pioneering communities generally preceding the coenoses dominated by large-size helophytes (Biondi et al., 1997). In the study area this community develops at the edge of the *Phragmition* coenoses, forming small stands poor in species, according to the features of the *Eleocharitetum palustris* Savić 1926 (Venanzoni & Gigante, 2000). The association was already reported for other wetlands near Capalbio (Lastrucci et al., 2007).

**BOLBOSCHOENETUM GLAUCI**

Grechushkina, Sorokin & Golub 2011 (Rels. 14-21, Tab. 2; gr. F and F1 of cluster Fig. 2)

In the study area the *Bolboschoenus glaucus*-dominated vegetation forms a belt on muddy soils covered by shallow waters and progressively drying during the summer, in contact on one side with the reed-bed and on the other with the hygrophilous therophytic vegetation and the segetal communities. This kind of vegetation represents a transition between the perennial high-tall helophytic coenoses of the *Phragmition* alliance and the coenoses of the disturbed and drying sites.

Hrůdová et al. (2007, 2009) reported that *B. glaucus* represents the species with the southernmost distribution among the European ones of the genus *Bolboschoenus*. From the phytosociological point of view, data on this kind of vegetation are scarce also because this species does not occur in the Central-European plant communities. A paucispecific *B. glaucus*-dominated community including also helophytic species such as *Aeluropus littoralis* (Gouan) Parl. or *Salicornia prostrata* Pall. was described for the Russian coast of the Azof Sea with the name *Bolboschoenetum glauci* Grechushkina, Sorokin & Golub 2011 (Grechushkina et al., 2011). Nowak et al. (2013, 2014), however, included in the association also communities with a higher number of species, attributing to this syntaxon a rather high ecological amplitude and including it in the *Eleocharito-Sagittarian* alliance. This interpretation fits with the syntaxonomic interpretation of some Italian *B. glaucus* coenoses by Landucci et al. (2013) and Lastrucci et al. (2014).

Our relevés were thus referred to the association *Bolboschoenetum glauci*, included in the *Eleocharito-Sagittarian* alliance, typical of the periodically flooded habitats, often subjected to strong water level fluctuation, occupying an intermediate position between the hydrophytic communities and the coenoses of *Phragmitetalia* or playing a role of secondary replacement communities as a consequence of natural vegetation disturbance (see Otahelová, 2001). The community of the Lake Acquato shows the presence of several species of the *Phragmito-Magnocaricetae* class such as *Phragmites australis*, *Schoenoplectus lacustris*, *Alisma plantago-aquatica*, *A. lanceolatum* and *Eleocharis palustris* subsp. *palustris*. In addition in the lower layer of the community it can be noted a pool of therophytes such as *Veronica anagalloides*, *Xanthium italicum*, *Lythrum hyssopifolia*, *Ranunculus sardous* or *Polypogon monspeliensis*. Another floristic component is represented by some perennial hygro-nitrophilous pioneer species of disturbed habitats such as *Paspalum distichum* or *Elymus repens* subsp. *repens*, sometimes with high cover values. The presence of perennial species of *Agrostietea stoloniferae* class is particularly significant in the more stable areas, less long-flooded (gr. F1 of the dendrogram) indicating the transition towards the wet meadow coenoses.

**Therophitic hygro-nitrophilous vegetation of the class Bidentetae tripartitae**

*XANTHIO ITALICI-PERSICARIETUM MACULOSAE* O. Bolos 1957 nom. mut. propos. var. with *Abutilon theophrasti* (Tab. 3; gr. K of cluster Fig. 2)
Between the helophytic vegetation and the cultivated fields, on the humid soils drying in summer, a vegetation dominated by hygro-nitrophilous terophytes was found. This kind of coenosis replaces or forms a mosaic with the small therophytic coenoses of the Isoëto-Nanojuncetea class. For the syntaxonomic attribution we refer to the association Xanthio italici-Persicarietum maculosae, growing on nutrient-rich soils in late summer, replacing the ruderal communities of the Stellarietea mediae class on inundated soils (Amor et al., 1993). The association was reported also for the Lagaccioli ponds near Capalbio (Lastrucci et al., 2007) and for the Valdichiana valley (Lastrucci et al., 2010b). As for the Valdichiana valley in the samples near the lake Acquato Abutilon theophrasti, an alien segetal weed (Covarelli, 2002) can be detected even becoming dominant. These stands can be interpreted as a variant indicating the contact with the weed ruderal nitrophilous and sub-nitrophilous vegetation of the Stellarietea class.

Small annual hygrophytic vegetation of the class Isoëto-Nanojuncetea VERONICO ANAGALLOIDIS-LYTHRETUM HYS-SOPIFOLIAE Wagner ex Holzner 1973 var. with Polypogon monspeliensis and Xanthium italicum (Rel. 1-8, Tab.4; gr. J of cluster Fig. 2) In the belt between the coenoses of the Phragmito-Magnocaricetea class and the cultivated fields around the lake, an early community developing on wet soils quickly drying during the summer was observed. It is characterized by hygrophilous therophytes of muddy (Veronica anagalloides, Lythrum hyssopifolia, Rumunculus sardous), or sandy soils (Polypogon monspeliensis and Xanthium italicum) with some small helophytes such as Alisma plantago-aquatica or A. lanceolatum. From the ecological point of view many affinities with the association Veronicanoagalloidis-Lythretum hys-sopifoliae Wagner ex Holzner 1973 were found; this association develops in more or less humid soils, often characterized by a strong disturbance degree caused by the agricultural practices, sometimes in low salinity conditions; the association shows different features related to the substrate conditions, reverberating on different floristic composition according to the humidity gradient (Traxler, 1993; Šumberová, 2011c). In the Acquato lake a thermophilous variant with sandy soil species as Polypogon monspeliensis and Xanthium italicum was identified. This kind of vegetation is here recorded for the first time in Tuscany and, based on the databases of Lisy (Bracco et al., 2007) and VegItaly (Landucci et al., 2012; Venanzoni et al., 2012), also for Italy.

SPOROBOLUS SCHOENOIDES community (Rel. 9-10, Tab. 4; gr. L of cluster Fig. 2) In the sandy soils inundated until the late spring, near the cultivated areas a community dominated by Sporobolus schoenoides was found. This species is characteristic of the Helocholetum schoenoidis (Soó 1933) Topa 1939, a markedly halophilous association (Hejný & Husák, 1978). From an ecological point of view, the community of the Lake Acquato shows more affinity with the association Crypsido schoenoidis-Juncetum bufonii described for the Musone river plain (Marche) by Biondi et al. (2002) and attributed to the Nanocyperion alliance. Compared with the original association, at the Lake Acquato it can be noted the strong dominance of S. schoenoides, while Juncus bufonius occurs with a very low cover value in only one relevé.

Wet meadow vegetation of the class Agrostietea stolonifera CARICI OTRUBAE-JUNCETUM INFLEXI Minisale & Spampinato 1996 (Rel. 1-2 Tab. 5; gr. I of cluster Fig. 2) On the south-eastern shore of the lake, on damp but not submerged soil between the reed bed and the belt of hygrophilous vegetation dominated by therophytes, a community dominated by Juncus inflexus subsp. inflexus was found. This community includes several species of the Agrostietea stoloniferae class. Due to its floristic connotation it was referred to the associa-
The vegetation of the Mediterranean wetland of the lake Acquato

The vegetation of the Mediterranean wetland of the lake Acquato described for the Gurrida Lake in North-Eastern Sicily by Minissale & Spampinato (1986). The association has a subnitrophilous characters and, even developing on periodically flooded soils, shows a marked tolerance to periods of prolonged xericity (Minissale & Spampinato, 1986).

**CAREX HIRTA and CAREX OTRUBAE community** (Rel. 3-5, Tab. 5; gr. H of cluster Fig. 2)

In the southern part of the lake, at the edge of a hygrophilous grove of *Salix alba*, a dense vegetation with *Carex otrubae* and *Carex hirta* was found. This community grows on fresh, partially shaded and not submerged soils. From a phytosociologic point of view, *Carex hirta* is considered a species with a high ecological amplitude (Tomaselli & Bernardo, 2006; Lastrucci et al., 2010a). This community, showing a mixture of palustrine elements and wet meadow species, can be configured as a community of transition towards the coenoses of the most stable and not flooded habitats.

**Habitats of conservation interest**

Two habitats of conservation value were identified through the phytosociological approach (see Biondi et al., 2009, 2012; Gigante et al., 2016). The first one corresponds to the habitat 3150 (Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation) represented by the associations *Ceratophylletum demersi* and *Potamentum lucentis*, belonging respectively to the class *Lemnetea minoris* and *Potametea pectinati*. The habitat attribution of the *Ranunculetum rionii*, is instead rather critical. Even if the *Ranunculion aquatilis* alliance includes communities of both stagnant and slowly running waters, according to the Italian Interpretation Manual of the 92/43/CEE Directive Habitats (Biondi et al., 2009) it configures formally the habitat 3260 (Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callirhico-Batrachion* vegetation), although an overlap often occurs between the indicator...
The presence of this latter habitat is however related to river ecosystems (see Bracco, 2016) and its occurrence in a biotope like the lake Acquato, missing of any tributaries, is probably not appropriate. Due the annual life cycle of *Ranunculus rionii* and its optimum ecological requirements (ephemeral aquatic habitats such as wheel ruts, puddles or small pools, see Englmaier, 2016), the *Ranunculetum rionii* should instead configure an aspect related to the first evolution stage of the habitat 3130, which constitutes the second habitat of conservation value detected in the study area. The habitat 3130 (Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*) is represented in the study area by the *Veronico anagalloidis-Lythretum hyssopifoliae* Wagner ex Holzner 1973 and by the *Sporobolus schoenoides* community.

**Syntaxonomic scheme**

**LEMNETEA MINORIS O. Bolòs & Masclans 1955**

**UTRICULARIETALIA MINORIS** Den Hartog & Segal 1964

**Ceratophyllion demersi** Den Hartog & Segal ex Passarge 1996

*Corillion 1957*

**POTAMETEAE PECTINATI Klika in Klika & V. Novák 1941**

**POTAMETALIA PECTINATI** Koch 1926

**Potamion pectinati** (W. Koch 1926) Libbert 1931

**Potametum lucentis** Hueck 1931

**Ranunculion aquatilis** Passarge 1964

*Ranunculetum rionii* Hejný et Husák in Dykyjová et Květ 1978 nom. mut. propos.
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BIDENTETEA TRIPARTITAE Tüxen, Lohmeyer & Preising ex Von Rohow 1951
BIDENTETALIA TRIPARTITAE Br.-Bl. & Tüxen ex Klika in Klika & Hadac 1944

**Bidention tripartitae** Nordhagen 1940
Xanthio italicus-Persicarietum maculosae O. Bolos 1957 nom. mut. prop. var. with *Abutilon theophrasti*

ISOËTO-NANOJUNCETEA Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946
**NANOCYPERETALIA FLAVESCENTIS** Klika 1935

**Verbennion supiniae** Slavíček 1951
*Veroniceto angaloidis-Lythretum hyssopifoliorum* Wagner ex Holzner 1973 var. with *Polypogon monspeliensis* and *Xanthium italicum*

**Nanocyperion flavescens** Koch 1926
Sporobolus schoenoides community

**PHRAGMITO-MAGNOCARICETEA** Klika in Klika et Novák 1941
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