COMPARATIVE STUDY OF ALLUVIAL CNIDION-TYPE MEADOWS IN THE LOWER DANUBE RIVER BASIN

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ABSTRACT

Alluvial Cnidion-type meadows (Habitat type 6440 of the Habitats Directive), mostly characteristic for the lower courses of large rivers in continental climate conditions of Europe are presented from the Lower Danube upstream the municipality of Giurgiu (river-km 510-524). The ecological requirements of the characteristic species, as well as their sensitivity to human-induced changes that derive from regular flooding, drainage, intensification of use and/or abandonment, are highlighted; these changes frequently lead to a decrease of biodiversity of the Cnidion-type meadows or to their total loss The studied meadows are compared with similar alluvial meadows from other sites of the lower Danube River basin. Finally, the strong interlocking of Cnidion type meadows with those of the Agropyro-Rumicion, Molinion and Deschampsion caespitosae alliances are discussed.

ZUSAMMENFASSUNG: Vergleichende Untersuchungen der Brenndoldenwiesen (Cnidion) im Einzugsgebiet der Unteren Donau.

Überschwemmungswiesen des Verbandes Cnidion (Habitattyp 6440 der Habittat-Richtlinie), die für die Unterläufe meist größerer Flüsse im kontinentalen Klimabereich Europas kennzeichnend sind, werden von der unteren Donau oberstrom der Stadt Giurgiu (Fluss-km 510-524) beschrieben. Dabei geht die Verfasserin auf die ökologischen Ansprüche der charakteristischen Arten sowie ihre Empfindlichkeit gegenüber menschlichen Eingriffen (Abtrennung vom Überflutungsregime, Entwässerungsmaßnahmen, Nutzungsintensivierung oder Nutzungsaufgabe) ein, die zu einer Veränderung der Artenvielfalt der Cnidion-Wiesen oder gar zu ihrem Verschwinden führen. Die untersuchten Wiesen werden mit ähnlichen von anderen Flüssen aus dem Einzugsgebiet der unteren Donau verglichen und schließlich die engen Beziehungen zu den Agropyro-Rumicion, Molinion und Deschampsion caespitosae - Verbänden aufgezeigt.

REZUMAT: Studiul comparativ al pajiștilor de tip Cnidion în bazinul Dunării de Jos.

Pajiştile aluviale de tip Cnidion (tipul de habitat 6440 după Directiva Habitate), caracteristice mai ales pentru cursul inferior al râurilor mai mari din regiunile cu climat continental ale Europei, sunt descrise din lunca Dunării de Jos, în amonte de municipiul Giurgiu (km-fluvial 510-524). Autoarea analizează cerinţele ecologice ale speciilor caracteristice, scoţând în evidenţă sensibilitatea lor faţă de impactul uman, cum ar fi despărţirea prin diguri de regimul liber de inundaţie, prin drenaje şi desecări în luncă, prin schimbări ale modului de folosinţă, intensificarea sau din contră abandonarea pajiştilor, toate acestea ducând la scăderea biodiversităţii sau chiar pierderea completă a pajiştilor de tip Cnidion. Acestea sunt comparate cu pajişti aluviale similare din alte localităţi ale bazinului Dunării inferioare. În încheiere, sunt discutate relaţiile ecologice strânse între alianţa Cnidion cu pajiştile de luncă de tip Agropyro-Rumicion, Molinion şi Deschampsion caespitosae.

INTRODUCTION

In the last decades, i.e. in the second half of the 20th century, the area of wet, temporary flooded meadows decreased and suffered many changes in Europe due to manifold human impacts. Duration and intensity of man interventions influenced the species composition and structure of meadow communities. Presently, only a small part of the remained floodplain meadows are supposed to regularly flood, the most of them being separated by dykes from the natural river dynamics and influenced in the old floodplain only by changing groundwater level.

In the Danube River basin, flooded meadows have been described in detail by Balátová-Tulácková (1965, 1966, 1969, 1979) from Southern Moravia on the Dyje River, (a tributary of the Morava River) also from the Morava River - a left tributary of the Danube - in Southern Slovakia, on the border between Slovakia and Austria and as well from the Danube River in Austria. She was the first author describing a new alliance of flooded meadows characteristic for the floodplains of large rivers in continental to subcontinental climate conditions with low precipitation named Cnidion venosi (Balátová-Tulácková, 1965). The Cnidion venosi alliance which stays on the base of the habitat type 6440 of the Habittat-Directive (***, 2013) is represented according to its author by species with small ecological amplitude, which attaints in this alliance of the highest constancy (Balátová-Tulácková, 1966).

The distribution area of the alliance is the continental part of Europe; this fact being in strong relation with the distribution area of the most of its characteristic species. Cnidion meadows are regularly flooded throughout spring and dry up during the summer due to the continental climate conditions (Balátová-Tulácková, 1966, 1969). Determinant, from the ecological point of view is the period of flooding as well the duration, height and periodicity of floods with input of suspended solids. The phytocoenoses of the associations included in the alliance Cnidion generally occurs on the lower courses of the rivers, on heavy, clay-like soils with a low buffering capacity and light salinity (Balátová-Tulácková, 1966, 1969, 1988).

Cnidion type meadows are known not only from the Morava and Dyje rivers and the lowest stretch of the Upper Danube in Austria, but also from the Elbe River and some of its tributaries in Germany (Hundt, 1958; Passarge, 1964) and as well from the Odra River (Rast et al., 2000; Burkart et al., 2004). Also, they have been described from the Upper Rhine as the most western limit of such type of continental-subcontinental communities (Dister, 1980; Oberdorfer, 1983). Although these communities constitute on the Upper Rhine, an outpost area, the characteristic species of the alliance Cnidion are almost well represented.

The characteristic species for the Cnidion venosi alliance = Cnidion dubii are according to Balátová-Tulácková (1966) *Viola elatior*, *Viola persicifolia* (*stagnina*), *Viola pumila*, *Cnidium venosum* (*dubium*), *Allium angulosum*, *Gratiola officinalis*, *Lathyrus paluster*, *Scutellaria hastifolia*, *Leucojum aestivum*, *Lythrum virgatum*, *Juncus atratus*, *Oenanthe silaeifolia*, and *Clematis integrifolia* (Eastern and South-Eastern Europe). In contact with the phytocoenoses of the alliance Cnidion there are, on the one part species of more wet areas of the alliances Agropyro-Rumicion and Caricion gracilis; and on the other side, species of the Molinion as well as Arrhenatherion and Arrhenatheretalia. Between the lastly mentioned, *Alopecurus pratensis*, is represented frequently with high abundance-dominance values. This is why phytocoenoses are frequently edified by *Alopecurus pratensis*, and species of the Cnidion alliance are included in this phytocoenological unit. The high abundance-dominance values of this depends on the more or less eutrophic conditions as a consequence of flooding and as well in some cases by an additional anthropogenic fertilization (Burkart et al., 2004).

The Cnidion alliance is characteristic for continental floodplain meadows, and have been considered as a vicariance of the Deschampsion caespitosae Horvatic alliance (1930) 1935, this last being described for the first time by Horavtic from Northern Croatia (Balátová-Tulácková 1966 and 1988). According to Schubert et al. (1995), the alliance Cnidion dubii Bal.-Tul. 1966 is synonymous with the alliance Deschampsion caespitosae Horvatic 1935, including meadows with changing wetness. But the boundaries of this alliance are larger and its clear content is still missing for South-Eastern Europe (Burkart et al., 2004).

In strong relation with the flooding, i.e. the period in the year, duration, height and frequency, displacements occur in the species composition of Cnidion-type meadows in the direction of the more wet side to Agropyro-Rumicion, Caricion gracilis and Agrostion albae; or on the dryer side to Arrhenatheretalia and in some cases to Brometalia. Changes and reduction of Cnidion type meadows were also generated by changes in the hydrological regime due to drainage. These measures create a lack of water in summer time which together with the poor buffering capacity of soils lead to the deterioration of the site conditions for Cnidion type meadows, and an evolution to the poorer Molinion meadows (Balátová-Tulácková, 1981).

In Romania, alluvial Cnidion type grasslands of large river valleys belonging to the habitat type 6440 were not considered as "existing" in Romania until the last research was conducted (Schneider and Drăgulescu, 2005; Gafta and Montford, 2008) and documented with the association Cnidio-Deschampsietum Passarge (1960) from the floodplains of Râul Negru, a tributary of the human impacted Olt River basin (Sîrbu et al., 1999) and from the Upper Olt area in the Ciuc Depression (Danciu et al., 2009) although they are mentioned as existing (Balátová-Tulácková, 1969) according to data from Puşcaru-Soroceanu (1963). As typical floodplain grasslands are mentioned as representative, the associations of *Elymus (Agropyron) repens* with various charactertistics on the larger and smaller floodplains, the association of *Elymus (Agropyron) repens* and *Alopecurus pratensis*, the association of *Poa trivialis*, the association of *Agrostis alba* and the association of *Alopecurus pratensis* are in different variants. This has last been studied in detail and described from the large floodplains on the Cibin River and some smaller tributaries as the Ruscior and Strâmb streams in the area of Sibiu Depressions (Schneider-Binder, 1978). As *Alopecurus pratensis* is the characteristic species of the Cnidion alliance, as are well represented *Viola persicifolia, Clematis integrifolia, Allium angulosum, Gratiola officinalis, Scutellaria galericulata, Lythrum virgatum, Filipendula ulmaria, Galium rubioides*, and *Veronica longifolia*. With high abundance-dominance values, it became clear that these meadows belong to the Cnidion type meadows.

The floodplain grasslands of Romania are mainly considered as taking part of the Agropyro-Rumicion alliances, Agrostion albae, Deschampsion caespitosae, and Arrhenatherion (Puşcaru-Soroceanu, 1963; Sanda et al., 2008; Coldea et al., 2012). As the boundaries of the Cnidion alliance and the interlocking with the above mentioned alliances are not clear and well known in South-Eastern Europe, further studies are needed. In this context the present study will contribute to the understanding and better delineation of the Cnidion type grasslands with a presentation from the lower Danube floodplains.

MATERIAL AND METHODS

During field researches (2004-2008) on the lower Danube, upstream the town of Giurgiu, river kilometres 510-524, flooded meadows between river banks and the flood protection dykes have been studied. Samples were taken according to the method of Braun-Blanquet (1964) with the seven degree scale of abundance-dominance values for covering degrees, the number of species in each sample, and locality. The size of the sampling area has been in 25 m^2 (5 m x 5 m) with some exceptions. The species where analysed according to their indicator values for wetness according to Ellenberg et al. (2001) and Sanda et al. (1983). Also, new long term observations were taken into account for indicator value considerations. Discussions concerning conservation management measures were taken into account as were the indicator values for mowing compatibility (Briemle and Ellenberg, 1994) as the species present different sensitivity vis-à-vis mowing frequency. For comparison, older and recent author's data (2012) from the area of Sibiu Depression has been taken into account (Schneider-Binder, 1978, 1998), as well data from older literature (Pușcaru-Soroceanu, 1963) and recent publications. They were included in synthetic tables with frequency values (I-V) for showing commonalities and differences of flooded meadows from various regions. The nomenclature of the species listed in the tables follows Ciocârlan (2009), Oprea (2005) and Sârbu et al. (2013).

RESULTS AND DISCUSSIONS

On the lower Danube, temporary flooded meadows similar to those described by Bálatová-Tulcaková from the Morava Basin (1965, 1966, 1967, 1969, 1979, 1984) are distributed during field researches on small areas and can be found only as fragments, or strips along the dykes. It seems they have never occupied large areas on the lower Danube; being bound as replacing communities to the hardwood forest level of the floodplain (middle and higher level) edified by oak (*Quercus robur, Quercus pedunculiflora*), elm (*Ulmus laevis, U. minor*), ash (*Fraxinus excelsior, F. angustifolia*) and in a transition situation from soft- to hardwood forest by Black poplar (*Populus nigra*) and elm (*Ulmus laevis*).

In the large river floodplain of the lower Danube, the hardwood forest level is naturally not of large extend and is concentrated to the high natural riverbank levees (in Romanian "grinduri de mal"), which are relatively small for the lowland stretch of the Danube (Schneider-Binder, 2010) in comparison with the whole extent of the floodplain. This is characterized by large wetlands including larger and smaller floodplain lakes, small water courses and flood channels, galleries with willow-like (*Salix alba*) softwood forests along the river courses, large reed beds and small grasslands. Small patches of grasslands edified by *Elymus repens* are natural, but most of the grasslands' development is due to human activities. This is similar to the Cnidion type meadows which evolved after cutting parts of the Querco-Ulmetum hardwood floodplain forests included as habitat type "91F0 Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (Ulmenion minoris)" in the list of habitats of community interest. The floodplain forests are covered naturally by only small, belt-like parts on the lower Danube, located on the riverbank levees; they are clearly visible in the field, and also clearly visible on older maps of the area. These maps show the lower Danube, the small forested area along the Danube River and the pre-terrace Gârla Pasărea (long water course) of the floodplain (Fig. 1).

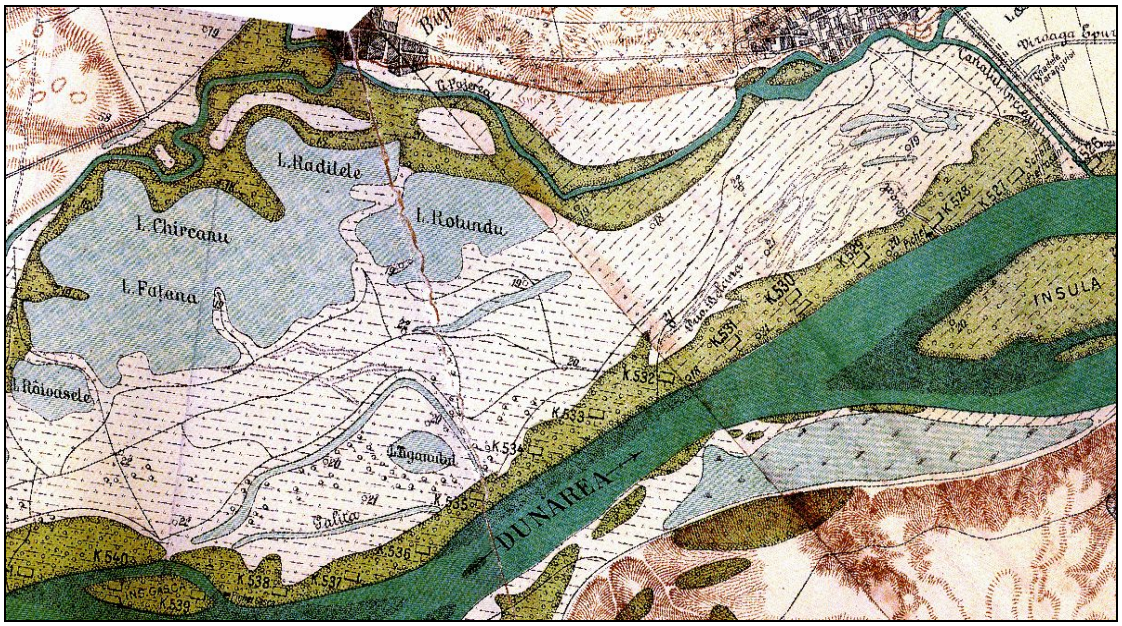

Figure 1: The Danube stretch upstream of Gâsca Island with small forest vegetation on river bank levees of the Danube and the Gârla Pasărea on the foot of the terrace, according to the "Map of the Danube course", Bucharest, 1934, edited by the Romanian Hydraulic Service, Scale 1: 50.000, volume III, km 770-390 (***, 1934)**.**

In this area, small agricultural lands arise (especially small meadows of Agropyro-Rumicion) on lower places, and Cnidion on the higher places; even if the difference in height between both is of only a few centimetres. In this area, it has been possible for the development of small flooded grasslands with characteristic species of the Cnidion dubii alliance. According to Ivan (1983) the long period of flooding in a year excluded the development of larger areas of meadows edified by *Alopecurus pratensis*, typical for lowlands. Although they occur in small areas in strong contact with still existing small patches of remained hardwood floodplain forests (habitat type 92 F0) and are characterized in the studied area by *Carex tomentosa, Clematis integrifolia, Lythrum virgatum, Scutellaria hastifolia, Gratiola officinalis, Carex praecox, Veronica longifolia, Elymus repens* and *Alopecurus pratensis.* Present as well are species of tall herbaceous fringes which are strongly related to the Cnidion type meadows, as well as the Agropyro-Rumicion species, and Molinio-Arrhenatheretea among other species, which occurs partly with high abundance-dominance values (Tab. 1).

As the characteristic species of the Cnidion alliance are almost present and partly with high abundance-dominance values and high frequency, the phytocoenoses of these studied flooded meadows upstream of Giurgiu near the villages Cetăţuia and Pietroşani can be considered as taking part of the Cnidion dubii alliance. Through the species combination of *Clematis integrifolia* and *Carex tomentosa*, present with high constancy and accompanied by species characteristic for fringes of South-Eastern Europe (such as G*lycyrrhiza echinata, Cynanchum acutum* and *Asparagus pseudoscaber*) this association can be considered as a new South-Eastern association taking part of the Cnidion alliance and characteristic for the lower Danube. The sample number three is typical and representative for this association.

Table 1: Clematido-Caricetum tomentosae ass. nova.

Number of samples	1	2	3	4	5	6	7	8	9	10	11	12	
Samplings size	25	25	25	25	25	25	25	25	9	25	25	25	
Covering degree %	100	85	95	100	90	100	80	100	100	95	100	85	
Species													F
Clematis integrifolia	2.5	2.5	2.5	2.4	2.5	+	+	2.5	+	+	1.3	+	V
Carex tomentosa	3.5	2.5	4.5	3.3	+	3.5	3.5	3.5	4.5	+	2.5	2.4	V
Lythrum virgatum	+	+	+	.	.	.	2.2	.	+	.	.	1.5	III
Scutellaria hastifolia	+	+	.	.	.	.	.	+	.	+	.	.	II
Carex praecox	.	.	+	.	.	.	+	.	.	2.5	+	.	II
Galium rubioides	.	.	+	.	.	.	.	+	.	.	4.5	+	II
Veronica longifolia	+	+	+	.	.	.	.	.	.	.	.	+	II
Gratiola officinalis	+	2.5	.	.	.	.	.	.	.	.	.	.	I
Tall herbaceous fringe species accompanying Cnidion type meadows													
Aristolochia clematitis	+	.	+	+	+	+	+	+	.	2.3	2.5	2.3	V
Thalictrum flavum	+	+	+	.	.	.	+	.	.	.	.	.	II
Euphorbia lucida	+	.	.	.	.	+	.	.	.	.	.	+	II
Glycyrrhiza echinata	2.4	2.5	1.2	.	.	.	+	+	.	1.2	.	.	III
Cynanchum acutum	+	+	.	+	.	.	.	.	.	.	.	.	II
Asparagus pseudosc.	+	.	+	.	3.5	.	+	.	.	.	.	.	II
Agropyro-Rumicion = Lolio-Potentillion													
Elymus repens	1.3	1.4	1.3	1.5	+	1.5	+	3.4	3.5	+	2.5	3.5	V
Carex hirta	.	.	+	+	.	+	+	+	+	.	.	+	III
Althaea officinalis	1.3	+	+	.	.	+	+	+	.	.	+	.	III
Molinio-Arrhenatheretea													
Symphytum officinale	+	+	+	.	+	+	.	+	+	.	+	1.5	IV
Alopecurus pratensis	3.5	1.5	1.2	.	.	4.5	.	2.3	.	3.5	+	+	IV
Arrhenatherum elatius	.	.	.	3.5	.	.	2.3	.	.	+	+	.	II
Poa pratensis	.	.	.	+	+	.	.	.	.	+	.	.	II
Vicia sepium	.	.	.	+	+	.	.	.	.	2.4	.	.	II
Other species													
Cichorium intybus	.	.	+	.	.	+	1.3	+	+	+	.	+	III
Cirsium arvense	.	.	.	.	.	+	+	.	.	.	+	+	II
Convolvulus arvensis	.	.	.	+	.	.	.	.	.	+	.	+	II
Erigeron canadensis	.	.	+	.	.	.	+	.	+	.	.	+	II
Lathyrus tuberosus	.	.	+	.	.	+	.	.	.	.	.	+	II
Lactuca serriola	.	.	+	.	+	.	+	.	.	.	.	.	II
Matricaria tenuifolia	.	.	+	.	.	.	.	.	+	.	.	+	II
Sorghum halepense	+	.	.	.	.	.	.	+	.	.	+	.	II
Bromus inermis	+	1.4	.	2.3	+	.	.	.	.	.	.	.	II
Morus alba	1.2	.	+	+	.	.	+	+	.	.	+	.	III
Phragmites communis	.	+	.	+	.	.	+	.	.	.	.	.	II
Galium aparine	.	.	.	.	3.5	.	.	.	.	.	.	.	I

Table 1 (continuing): Clematido-Caricetum tomentosae ass. nova.

Low abundance-dominance (+) in one or two samples, as well low frequency (I):
Iris pseudacorus (1), *Mentha longifolia* (1), *Bidens frondosa* (1), *Plantago media* (1, 2)
Pastinaca sativa (1, 7), *Plantago major* (1, 7), *Plantago media* (2), *Lotus tenuis* (3)
Plantago lanceolata (3), *Sonchus asper* (3, 7), *Anthemis arvensis* (4), *Dactylis glomerata* (4)
Papaver rhoeas (4), *Senecio vernalis* (4, 7), *Anthriscus sylvestris* (5), *Humulus lupulus* (5)
Lysimachia nummularia (5), *Populus alba* (5), *Quercus robur* (5), *Ulmus laevis* (5), *Urtica dioica* (5)
Agrostis stolonifera (6), *Rumex crispus* (6), *Poa trivialis* (6, 8), *Rorippa sylvestris* (6, 10)
Crepis setosa (7), *Caucalis daucoides* (7), *Trifolium echinatum* (7), *Ulmus minor* (7)
Dipsacus laciniatus (7, 9), *Taraxacum officinale* (7, 9), *Serratula tinctoria* (8)
Xanthiums strumarium (8), Erigeron annuus (8, 11), Bromus mollis (10), *Erodium cicutarium* (10)
Geranium robertianum (10), *Sonchus arvensis* (10), *Tragopogon dubius* (10)

Locality and data of sampling:
1: Cetăţuia, Giurgiu County, recent Danube floodplain, river-km 521, 43’42,576, 25, 45, 194, 30.07.2006; 2: Cetăţuia, Giurgiu County, recent Danube floodplain, river-km 524, 43’42,066, 25, 43,714, 30.07.2006; 3: Cetăţuia, Danube River-km 521, near Șaica, 43’42,556, 25, 45,165; 30.07.2006; 4: Cetăţuia, near Șaica, river-km 518, 28.05.2004; 5: Cetăţuia, Șaica, river-km. 517, 28.05.2004; 6: Șaica area, river-km 518, old floodplain, near the flood protection dyke, 20.07.2004; 7: Danube river-km 520, 22.07.2004; 8: Danube river-km 521, 27.07.2004; 9: Șaica area, river-km. 521, 27.07.2004; 10: Danube river-km 518, 27.07.2004; 11, 12: Șaica area, Danube river-km 522, 27-07.2004.

Through the high abundance and frequency of the sedge *Carex tomentosa* this association can be considered as a connecter to the Cnidio-Violetum pumilae caricetosum tomentosae Bal.-Tul. and Hübl 1974, described from the Danube in Austria, near Orth/Donau (Balátová-Tulácková and Hübl, 1974; Balátová-Tulácková, 1988). The frequency of *Clematis integrifolia* and the other above mentioned species underlines a more continental character of these Cnidion type of meadows.

In strong relation with the above described Clematido-Caricetum tomentosae meadow type are flood-grasslands with changing wetness, but on more wet sites, characterized by high abundance-dominance values of *Elymus repens* (Tab. 2). Together with the couch grass, (*Elymus repens*) occurs Cnidion species in these phytocoenoses, which indicates the closeness of these phytocoenoses to the above mentioned association. Present are *Clematis integrifolia* with frequency IV and *Scutellaria hastifolia, Veronica longifolia, Galium rubioides, Carex tomentosa* with frequency II. Present as well are species of Molinietalia, Arrhenatheretalia, Molinio-Arrhenatheretea and Lolio-Potentillion anserinae (Agropyro-Rumicion). Considering the species composition, the phytocoenoses with high abundance-dominance of *Elymus repens* can be considered as a sub-association of Clematido-Caricetum tomentosae with transition to phytocoenoses of the alliance of flood-grasslands Agropyro-Rumicion = Lolio-Potentilletum anserinae Tx. 1947.

The grasslands dominated by *Elymus repens*, but accompanied by species of Cnidion and of Molinietalia as well Molinio-Arrhenatheretea are recommended to be included in the Cnidion alliance (Dierschke, 2012). Such types of grasslands have been described from the Northern Upper Rhine (Dister, 1980).

Table 2: Clematido-Caricetum tomentosae subass. Elymetosum repentis; 1, 2, 3: Şaica, river-km 517.5, Cetăţuia, 4.06.2004; 4, 5: Şaica, river-km 518.5, Cetăţuia, 27.07.2004; 6, 7: Şaica oxbow lake, river-km 518, Cetăţuia, 28.05.2004; 8: Şaica, river-km 519, Cetăţuia, 29.05.2004; Giurgiu County.

	Number of samples	1	2	3	4	5	6	7	8	
	Sampling size m^2	25	25	25	25	25	25	25	20	
	Covering degree %	100	85	100	100	85	90	100	100	
										F
	Elymus repens	3.5	4.5	4.5	5.5	4.5	4.5	4.5	5.5	V
	Clematis integrifolia	+	.	1.2	+	+	.	1.3	+	IV
	Scutellaria hastifolia	.	+	+	.	+	.	.	.	II
	Veronica longifolia	.	.	.	+	+	.	.	.	II
	Galium rubioides	.	.	.	.	.	.	+	+	II
	Carex tomentosa	+	+	.	.	.	.	.	+	II
Molinietalia										
	Symphytum officinale	.	+	+	.	+	.	.	.	II
Tall herbaceous vegetation associated to Cnidion and couch grass associations										
	Aristolochia clematitis	3.5	1.5	+	+	+	+	+	+	V
	Glycyrrhiza echinata	.	.	.	.	1.4	.	.	.	I
	Cynanchum acutum	.	.	.	.	+	+	.	.	II
	Asparagus pseudoscaber	.	.	+	.	.	.	+	+	II
	Euphorbia lucida	.	.	.	.	+	+	+	.	II
Arrhenatheretalia, Molinio-Arrhenatheretea										
	Arrhenatherum elatius	.	+	+	.	.	2.3	.	.	II
	Poa pratensis	.	.	+	.	.	1.5	+	.	II
	Alopecurus pratensis	+	.	.	2.2	.	.	.	.	II
	Dactylis glomerata	.	.	+	.	.	+	.	.	II
	Carex praecox	+	+	.	.	.	.	.	.	II
	Vicia sepium	+	2.5	.	.	.	+	+	+	III
Lolio-Potentillion anserinae (Agropyro-Rumicion)										
	Althaea officinalis	.	.	.	+	+	.	.	.	II
	Carex hirta	+	.	1.2	.	.	.	+	+	III
Other species										
	Glecoma hederacea	.	+	+	.	.	+	+	.	III
	Galium aparine	3.5	+	3.5	.	.	.	2.5	+	III
	Cirsium arvense	+	.	.	.	+	.	.	.	II
	Dipsacus laciniatus	.	.	.	+	+	.	.	.	II
	Phragmites communis	.	.	.	.	2.2	1.3	.	.	II
	Bromus inermis	.	.	.	.	+	+	+	.	II
	Papaver rhoeas	.	.	+	.	.	+	.	.	II
	Lactuca serriola	.	.	.	.	.	+	+	.	II
	Ulmus minor	.	.	.	.	.	+	.	+	II
	Populus nigra	.	.	+	+	.	+	.	.	II
	Amorpha fruticosa	+	.	+	.	+	.	.	.	II

Table 2 (continuing): Clematido-Caricetum tomentosae subass. Elymetosum repentis;

Species noted with + in one sampling area (and frequency class I):
1: *Anthriscus sylvestris, Carex spicata, Sonchus arvensis.*
2: *Conyza canadensis, Morus alba, Urtica dioica*.
3: *Carex echinata, Cornus sanguinea, Leonurus cardiaca, Lycopus europaeus*.
Lysimachia nummularia, Melandrium album, Pyrus pyraster, Sonchus asper.
4: *Cichorium intybus, Echinocloa crus-galli, Lathyrus pratensis, Lotus tenuis,*
Pastinaca sativa, Plantago major, Poa trivialis, Ranunculus repens
Sium latifolium, Trifolium fragiferum.
5: *Iris pseudacorus, Sorghum halepense*.
6: *Achillea collina, Bromus sterilis, Carduus acanthoides, Carex flacca, Coronilla varia,*
Convolvulus arvensis, Daucus carota, Erigeron annuus, Geranium columbinum,
Lepidium ruderale, Leucanthemum vulgare, Lolium perenne, Plantago lanceolata,
Quercus robur (regeneration), *Tragopogon dubius, Trifolium campestrei*.
7: *Rorippa sylvestris, Ulmus laevis,* 8: *Crataegus monogyna*.

Comparing floodplain meadows of different parts of the lower Danube River basin can have stated commonalities, but as well remarkable differences (Tab. 3). Older samples from floodplains of the Oltenia region, in particular from the floodplains of Jiu and Olt rivers, from the Muntenia region tributaries of the Danube and the Danube floodplain in forms of synthetic tables. Unfortunately, without mentioning the number of field samples (Puşcaru-Soroceanu, 1963; Tab. 3, columns 1, 2 and 3), visible differences are compared with Cnidion type meadows. This concerns phytocoenoses structure, species composition and frequency values of species. At the same time, it can be stated that Cnidion type meadows were not mentioned at that time, and this was probably because the meadows area near the hardwood floodplain forests or replacing the small patches of hardwood floodplain forests on the lower Danube were not remarked. The Cnidion species (at that time all included to the Molinietalia) in the Oltenia region are mentioned with poor representation; only *Oenanthe banatica* and *Gratiola officinalis*. Species of Molinietalia are lacking apart from *Poa trivialis* ssp. *sylvicola* (Tab. 3, column 1). In general, the floodplain grasslands of Oltenia and Muntenia region (Tab. 3, columns 1 and 2) are poor in species, only some of the Molinio-Arrhenatheretea classes such as *Alopecurus pratensis* and *Poa pratensis* are well represented. A better representation has the species of the Agropyro-Rumicion alliance, but with high frequency and *Elymus repens* and *Agrostis stolonifera* occur. Furthermore, they are characterised by halophilous species and some Festuco-Brometea species which show summer dryness due to the continental climate.

The only floodplain grassland given in a synthetic table from the Danube floodplain (Puşcaru-Soroceanu, 1963) is poorer than the two above discussed (Tab. 3, column 3). This grassland type is dominant, as well *Elymus repens* and species of Agropyro-Rumicion such as *Mentha pulegium, Trifolium fragiferum, Trifolium hybridum* and *Inula britannica*. The occurrence of such grasslands corresponds to the softwood level and the transition to the hardwood forest level. The studied Cnidion type floodplain meadows (Tab. 3, column 4) occur on the hardwood forest level and are only of small extends; not mentioned before.

Next to the Cnidion type meadows of the Middle Danube are those described from the Ozun floodplain of Râul Negru/Upper Olt basin (Danciu et al., 2009), characterized by high frequency of *C. dubium, V. pumila* and *D. caespitosa* and *A. pratensis* (Tab. 3, columns 5 and 6).

Table 3: Comparison of the different types of floodplain meadows.

			Number of columns	1	2	3	4	5	6	7
			Number of samples	-	-	-	12	7	7	7
	U	mc								
Cnidion										
	8 ~	5	*Cnidium dubium*	-	-	-	-	V	V	-
	7 ~	4	*Viola pumila*	-	-	-	-	V	III	-
	8 ~	4	*Allium angulosum*	-	-	-	-	II	III	-
	8 =	3 x	*Scutellaria hastifolia*	-	-	-	II	I	I	II
	8 ~	4 x	*Gratiola officinalis*	I	-	-	I	-	-	I
	8 =	3 x	*Oenanthe banatica*	II	-	-	-	-	-	I
	7 ~	3 x	*Clematis integrifolia*	-	-	-	V	-	-	I
	4	3	*Galium rubioides*	-	-	-	II	-	-	II
	8 ~	3 x	*Lythrum virgatum*	-	-	-	III	-	-	I
Differential species for Clematido-Caricetum tomentosae										
	4 ~	3 x	*Aristolochia clematitis*	-	-	-	V	-	-	-
	3 ~	3 x	*Glycyrrhiza echinata*	-	-	-	III	-	-	-
	4 ~	-	*Cynanchum acutum*	-	-	-	II	-	-	-
	3 ~	-	*Asparagus pseudoscaber*	-	-	-	II	-	-	-
Molinion, Molinietalia										
	7 ~	3	*Carex tomentosa*	-	-	-	V	II	-	-
	x	3	*Serratula tinctoria*	-	-	-	I	V	-	-
	x ~	4	*Stachys officinalis*	-	-	-	-	V	-	I
	7 ~	5	*Deschampsia caespit.*	-	-	-	-	V	II	III
	7 ~	4	*Lychnis flos-cuculi*	I	-	-	-	III	III	I
	8	3 x	*Thalictrum lucidum*	-	-	-	-	I	I	I
	8 ~	3	*Iris sibirica*	-	-	-	-	-	-	II
	6 ~	3 x	*Gladiolus imbricatus*	-	-	-	-	-	-	II
	8 ~	4 x	*Cirsium canum*	-	-	-	-	-	-	III
	4	-	*Poa trivialis sylvicola*	III	-	-	-	-	-	-
Filipendulion										
	8 ~	3	*Veronica longifolia*	-	-	-	II	-	-	IV
	8 ~	3	*Thalictrum flavum*	-	-	-	II	-	-	-
	7 ~	3	*Euphorbia lucida*	-	-	-	II	-	-	-
	8 ~	3	*Lysimachia vulgaris*	-	-	-	-	-	III	III
	8	3	*Filipendula ulmaria*	-	-	-	-	-	-	IV
	8 ~	3	*Lythrum salicaria*	-	-	-	-	-	III	I
Arrhenatherion										
	4	7	*Galium mollugo*	-	-	-	-	-	-	II
	x	6	*Arrhenatherum elatius*	-	-	-	-	-	-	II
	5	5	*Campanula patula*	-	-	-	-	-	-	III
	6	6	*Crepis biennis*	-	-	-	-	-	-	II
	5	8	*Trifolium repens*	III	I	-	-	-	I	I
	5	8	*Lolium perenne*	II	II	-	-	-	-	I

Arrhenatheretalia										
	4	6	*Leucanthemum vulgare*	-	-	-	-	II	II	III
	4	5	*Knautia arvensis*	-	-	-	-	-	-	IV
	4	7	*Achillea millefolium*	-	IV	-	-	-	I	IV
	5	6	*Vicia sepium*	-	-	-	II	-	-	-
Molinio-Arrhenatheretea										
	6	7	*Alopecurus pratensis*	V	V	-	IV	V	V	IV
	5	9	*Poa pratensis*	IV	V	-	II	V	II	I
	x	7	*Plantago lanceolata*	V	II	-	I	II	-	III
	x	6	*Rumex acetosa*	I	-	I	-	III	I	I
	6	6	*Festuca pratensis*	I	-	-	-	V	I	IV
	6 ~	5	*Sanguisorba officinalis*	-	-	-	-	V	I	II
	7	6	*Symphytum officinale*	I	-	-	IV	I	I	V
	4	4	*Plantago media*	I	-	III	I	-	-	-
	7	6	*Poa trivialis*	-	-	-	I	-	-	III
	6 ~	5	*Colchicum autumnale*	-	-	-	-	V	I	I
	6 ~	4 x	*Rhinanthus angustifolius*	-	-	-	-	V	III	-
	6	6	*Vicia cracca*	-	-	-	-	V	IV	-
	5	4	*Stellaria graminea*	-	-	-	-	IV	I	IV
	6	5	*Lathyrus pratensis*	-	-	-	-	V	-	III
	6	6	*Ranunculus acris*	-	-	-	-	III	-	V
	5	9	*Prunella vulgaris*	-	I	-	-	-	I	I
	5	7	*Trifolium pratense*	I	-	-	-	-	I	IV
Agropyro-Rumicion										
	6 ~	5	*Carex hirta*	-	-	-	III	II	III	I
	x ~	7	*Elymus repens*	I	V	V	V	V	III	III
	7 ~	9	*Agrostis stolonifera*	I	III	-	-	-	-	III
	7 =	3 x	*Althaea officinalis*	-	-	-	III	-	-	-
	4	5	*Rorippa sylvestris*	II	II	-	I	-	-	I
	6 ~	6	*Trifolium resupinatum*	III	-	-	-	-	-	-
	7 =	-	*Mentha pulegium*	II	-	III	-	-	-	-
	7 =	6	*Trifolium fragiferum*	I	I	III	-	-	-	-
	6	7	*Trifolium hybridum*	I	I	III	-	III	III	III
	7 ~	6	*Rumex crispus*	I	II	I	I	I	II	IV
	6	8	*Potentilla reptans*	III	I	I	-	V	IV	I
	7 =	-	*Rorippa austriaca*	I	II	-	-	-	III	-
	7 =	4	*Inula britannica*	-	II	III	-	II	III	-
	7 ~	7	*Festuca arundinacea*	-	-	-	-	-	-	III
Halophilous differential species Elymus repens-Alopecurus ass.										
	x =	-	*Juncus gerardi*	-	IV	-	-	-	-	-
	6 =	-	*Aster tripolium*	-	II	-	-	-	-	-
	6 ~	-	*Puccinellia distans*	-	II	-	-	-	-	-
	4	-	*Cynodon dactylon*	II	IV	III	-	-	-	-
	4	4	*Polygonum aviculare*	-	I	IV	-	-	-	-

Table 3 (continuing): Comparison of the different types of floodplain meadows.

Phragmition, Phragmitetalia										
	8 ~	5	*Phalaris arundinacea*	-	-	-	-	II	I	-
	9 =	5	*Poa palustris*	-	-	-	-	III	V	-
	10	3	*Eleocharis palustris*	I	I	-	-	-	-	I
	10	3	*Phragmites communis*	-	II	-	II	-	-	III
	9 =	4	*Galium palustre*	-	-	-	-	III	III	-
	8 =	3	*Carex vulpina*	-	-	-	-	III	IV	II
Festuco-Brometea and subunits										
	3 ~	4	*Filipendula vulgaris*	-	-	-	-	V	II	I
	4 ~	5	*Galium verum*	-	-	-	-	V	II	I
	2	-	*Achillea setacea*	-	IV	-	-	-	-	-
	3	6 x	*Festuca pseudovina*	-	III	-	-	-	-	-
	3	-	*Taraxacum erythrosperm.*	-	II	-	-	-	-	-
	3	-	*Poa bulbosa*	II	I	-	-	-	-	-
	4	7	*Medicago lupulina*	-	I	-	-	-	-	I
	3	6 x	*Festuca rupicola*	-	-	-	-	II	-	-
Species in different phytocoenological classes										
	5	8	*Dactylis glomerata*	-	-	-	I	-	-	III
	x ~	6	*Bromus hordeaceus*	I	I	-	I	-	-	I
	7 ~	8	*Ranunculus repens*	IV	I	-	-	I	V	II
	6 ~	6	*Lysimachia nummularia*	-	-	-	I	I	III	-
Accompaning species of other phytocoenological units										
	4	6	*Lotus corniculatus*	IV	II	-	-	IV	III	V
	5	8	*Taraxacum officinale*	IV	II	IV	I	-	-	I
	3 ~	-	*Carex praecox*	-	III	-	II	II	-	I
	x	5	*Centaurea jacea*	-	-	-	-	-	-	III
	x	5	*Polygonum amph. f. t.*	-	-	-	-	-	-	III
	5	5	*Plantago major*	I	-	-	I	-	-	II
	4	4	*Cichorium intybus*	-	II	-	III	-	-	-
	5	-	*Xanthium strumarium*	-	-	IV	-	-	-	-
	2	-	*Centaurea iberica*	-	-	IV	-	-	-	-
	x	5	*Ranunculus auricomus*	-	-	-	-	V	III	I
	6	8	*Glechoma hederacea*	-	-	-	-	II	II	-
	x	6	*Agrostis capillaris*	-	-	-	-	IV	-	-
	4 ~	5 x	*Ranunculus polyanth.*	-	-	-	-	II	-	-
	6 ~	4	*Carex pallescens*	-	-	-	-	II	-	-
	9	6	*Agrostis canina*	-	-	-	-	II	-	-
	9 =	-	*Veronica scutellata*	-	-	-	-	-	III	-
	4	-	*Vicia hirsuta*	-	-	-	-	-	-	III
	x	3	*Carex spicata*	I	III	-	-	-	-	-
	3	5	*Medicago falcata*	I	I	-	-	-	-	-
	4	3	*Trifolium medium*	-	-	-	-	II	I	-

Column 1: samples from the Oltenia region, mainly from the Olt and Jiu rivers, ass. of *Alopecurus pratensis* (Pușcaru-Soroceanu, 1963; table 122, 1963);

Column 2: samples from the rivers in the Muntenia region, ass. of *Elymus repens* and *Alopecurus pratensis* (Pușcaru-Soroceanu, 1963; table 117, 1963);

Column 3: samples from the Danube floodplain, ass. of *Elymus repens*, variant of the Lower Danube floodplain (Puşcaru-Soroceanu, 1963; table 116, 1963);

Column 4: Samples from the Danube River-km 510-524 (Tab. 1);

Column 5: Cnidio-Deschampsietum Passarge 1960 (Danciu et al., 2009), Râul Negru Lunca Ozunului;

Column 6: Ranunculo repentis-Alopecuretum pratensis Ellmauer 1933, Râul Negru Lunca Ozunului (Danciu et al., 2009);

Column 7: Alopecuretum pratensis Ruşcior meadow, Sibiu Depression, 17.06.2012.

"x" after the indicator value of mowing compatibility is given for the species with values considered according to field observations of the author.

The sign "~" after a number in the table is an indicator for strong changes.

The sign "=" after a number is a flooding indicator for a species which occurs on more or less regularly flooded soils.

Analysing the associations described from the Sibiu Depression with large floodplains on the Cibin River and some smaller tributaries such as the Ruşcior and Strâmb streams (Schneider-Binder, 1978, 1991, 1998), with characteristic species of the Cnidion alliance such as *Viola persicifolia, Clematis integrifolia, Allium angulosum, Gratiola officinalis, Scutellaria galericulata, Lythrum virgatum, Filipendula ulmaria, Galium rubioides, Veronica longifolia,* as well as the Eurasian-continental species *Plantago maxima* and with a high abundance-dominance of *Alopecurus pratensis*; it became clear, that Cnidion type meadows existed in the past on larger extend in those floodplains. Due to the drainage of the Cibin River area, the Ruşcior floodplains and transformation into agricultural lands, as well as an actual intensive grazing in some places, the area has been reduced to small patches or disappeared completely. On the Ruşcior canal were found in 2012 fragments of Cnidion type meadows with some Cnidion species such are *Scutellaria hastifolia, Gratiola officinalis, Clematis integrifolia, Oenanthe banatica, Lythrum virgatum* and *Galium rubioides* exist. Also, species of Molinietalia such as *Iris sibirica, Gladiolus imbricatus, Cirsium canum* and *Deschamspia caespitosa* were found together with accompanying tall herbaceous species such are *Veronica longifolia* and *Filipendula ulmaria* (Tab. 3, column 7). Edifying species are also those of the Agropyro-Rumicion alliance and species of Molinio-Arrhenatheretea; in particular *Alopecurus pratensis.*

In the Southern part of the Cibin River floodplain, near the locality of Tălmaciu, existed meadows of the Cnidion, but were modified by human intervention through drainage. The presence of the species *Cnidium dubium* has been documented near Tălmaciu in the year 2009 in a meadow considered as a transition stage from Cnidion to Molinion. Such changes and transformations of the Cnidion type temporary flooded meadows to Molinion type meadows and are caused by cutting off from the river dynamics, drainage and related changes of the hydrological regime, as it has been observed; as also on the middle Danube on the Morava and Dyije rivers (Balátová-Tulácková, 1981; Seffer et al., 2008).

The Cnidion type meadows include a great number of characteristic river valley species ("Stromtalarten") which, due to human intervention by drainage and transformation into agricultural lands, became very rare. This is why there is a need for special attention by protection and conservation management. Changes of land use have negative effects for these meadows in both cases, i.e. by intensification and as well by the abandonment of mowing and use. Through intensification of land use, the species sensitive to mowing (mc = mowing compatibility 3) or sensitive to mowing earlier than mid-July (mc = 4) are decreasing and at least endangered by disappearing. Species with five moderate compatibility (mc = 5, with first mowing not before beginning of July) will persist with longer time in these meadows (Briemle and Ellenberg, 1994). The abandonment of use by stopping the mowing leads also to a decrease of Cnidion meadow species; the meadows entering in a succession process with an increase of tall herbaceous plants as well of scrubs.

For a sustainable conservation of the species, and the habitat type 6440 of Cnidion type meadows, restoration of the hydrological regime is needed, as is the application of a conservation management with a mowing frequency corresponding to this type of meadows, (at least once or in some cases twice a year (Seffer et al., 2008)), as it is applied as well on Cnidion type meadows from rivers such are the Elbe and its tributaries (Passarge, 1964; Schneider-Binder unpublished field data, 1995).

CONCLUSIONS

As the Cnidion type flooded meadows are supposed to a certain river dynamic with changing water levels, also are the species' composition of the phytocoenoses which are supposed to a certain dynamic; and changes in the abundance-dominance with shifting to the drier or the more wet side in dependence of the hydrological regime along a year.

On the lower Danube and its tributaries in spring time and early summer, the conditions are wet; but in the summer time, due to the continental climate, they are at dry conditions. This is visible also by the occurrence in the phytocoenoses of species of the classe Festuco-Brometea and some halophilous species of other phytocoenological units.

To have a clear picture about the manifold variants of floodplain meadows, supposed to natural or near natural flooding regime, it is necessary to give more attention to these meadows even if they exist on relatively small surfaces. Further detailed studies are needed not only on the larger tributaries of the lower Danube River basin, but also on the smaller tributaries (second and third category). Also, comparative studies with such types of meadows from other European rivers are needed for the knowledge of the different geographical variants and the transition stages between them. It is necessary to study the meadows in relation with the flooding regime, but also under the aspect of their use, giving particular attention to its intensity. A restoration of the hydrological regime of the rivers and streams on which occurred or still occurs, on a small area of Cnidion type meadows is the base for their re-development.

REFERENCES

1. Balátová-Tulácková E., 1965 – Cnidion venosi, ein neuer Molinietalia-Verband (Vorläufige Mitteilung), *Biológia*, 20, 4, 294-296, Bratislava. (in German)
2. Balátová-Tulácková E., 1966 – Synökologische Charakteristik der südmährischen Überschwemmungswiesen, Rospravy CSAV 76, 1-40, Praha. (in German)
3. Balátová-Tulácková E., 1967 – Beitrag zur Systematik der Molinietalia-Gesellschaften, in Tüxen R. Pflanzensoziologische Systematik. Berichte des Internationalen Symposium in Stolzenau/Weser 1964, 281-292, Den Haag. (in German)
4. Balátová-Tuláckova E., 1969 – Beitrag zur Kenntnis der Tschechoslowakischen Cnidion venosi-Wiesen, *Vegetatio*, 17, 200-297. (in German)

5. Balátová-Tulácková E., 1979 – Zur Dynamik der Artmächtigkeit innerhalb südmährischer Cndion venosi - Auenwiesen, in Tüxen R. (ed.), Berichte des Internationalen Symposiums der Internationalen Vereinigung für Vegetationskunde IVV 1979, 361-377. (in German)
6. Balátová-Tulácková E., 1981 – Zur Frage der Erhaltung der natürlichen Fruchtbarkeit von Wiesenböden in den Trockengebieten, Berichte der Internationalen Symposien der Internationalen Vereinigung für Vegetationskunde, Vegetation als anthropo-ökologischer Gegenstand (Rinteln, 5.8., April 1971). Gefährdete Vegetation und ihre Erhaltung (Rinteln, 27-30, März 1972), 567-571, J. Cramer Verlag Vaduz. (in German)
7. Balátová-Tulácková E., 1984 – Les Megaphorbiales de l'ordre des Molinietalia en Tchechoslovaquie, Colloques phytosociologiques XII, Séminaire mégaphorbiaies, 93-97, Bailleul. (in French)
8. Balátová-Tulácková E., 1988 – Apercu des groupements vegetaux du Cnidion venosi decrits de la Tchecosloaquie et de l'Autriche, *Documents phyososiologiques*, N. S., XI, 343-352, Camerino. (in French)
9. Balátová-Tulácková E. and Hübl E., 1974 – Über die Phragmitetea- und Molinietalia-Gesellschaften in der Thaya-, March- und Donau-Aue Österreichs, *Phytocoenologia*, 1, 3, 263-305, Stuttgart-Lehre. (in German)
10. Braun-Blanquet J., 1964 – Pflanzensoziologie, 3 Auflage, Wien, 865. (in German)
11. Briemle G. and Ellenberg H., 1994 – Zur Mahdverträglichkeit von Grünlandpflanzen, Möglichkeiten der praktischen Anwendung von Zeigerwerten. The mowing compatibility of grassland plants. Possibilities of practical application of indicator values. Natur und Landschaft. Zeitschrift für Naturschutz, Landschaftspflege und Umweltschutz, 69, Jahrgang, Heft, 4, 139-147. (in German)
12. Burkart M., Dierschke H., Hölzel N., Nowak B. and Fartmann T., 2004 – Molinio-Arrhenatheretea (E1) Kulturgrasland und verwandte Vegetationstypen, Teil 2, Molinietalia. Futter- und Streuwiesen feucht-nasser Standorte und Klassenübersicht Molinio-Arrhenatheretea, Für die Floristische-soziologische Arbeitsgemeinschaft und die Reinhold-Tüxen-Gesellschaft herausgegeben von H. Dierschke, Göttingen, 2004, 103. (in German)
13. Ciocârlan V., 2009 – Flora ilustrată a României, Pteridophyta et Spermatophyta, Edit. Ceres, Bucureşti, 1141. (in Romanian)
14. Coldea G., Oprea A., Sârbu I., Sîrbu C. and Ştefan N., 2012 – Les associations végétales de Roumanie, 2, Les associations anthropogènes, Presa Universitară Clujeană, 482. (in French)
15. Danciu M., Indreica A. and Băcăinţan N., 2009 – Cnidium dubium (Schkuhr) Thell.: distribution in Romania, ecology and phytosociology, *Contribuţii Botanice*, XLIV, 21-29, Cluj.
16. Dierschke H., 2012 – Molinio-Arrhenatheretea (E1), Kulturgrasland und verwandte Vegetationstypen, Teil 3: Polygono-Potentilletalia anserinae Kriech- und Flutrasen, Synopsis der Pflanzengesellschaften Deutschlands Heft 11, 104, Göttingen. (in German)
17. Dister E., 1980 − Geobotanische Untersuchungen in der Hessischen Rheinaue als Grundlage für die Naturschutzarbeit, Dissertation zur Erlangung des Doktorgrades der Mathematisch-Naturwissenschaftlichen Fakultät der Georg-August Universität Göttingen, 171. (in German)
18. Ellenberg H., Weber H. E., Düll R., Wirth V. and Werner W., 2001 – Indicator values of plants in Central Europe, *Scripta Geobotanica*, 18, 1-264, Erich Goltze KG, Göttingen.
19. Gafta D. and Montford O. (eds), 2008 – Manual de Interpretare a habitatelor Natura 2000 din România, Risoprint, Cluj-Napoca, 101. (in Romanian)
20. Horvat I., Glavac V. and Ellenberg H., 1974 – Vegetation Südosteuropas, Vegetation of South-Eastern Europe, Fischer Verlag Jena, 786.
21. Horvatic S., 1930 – Soziologische Einheiten der Niederungswiesen in Kroatien und Slavonien, *Acta Botanica*, 2, 57-118, Zagreb. (in German)
22. Hundt R., 1958 − Beiträge zur Wiesenvegetation Mitteleuropas, I, Die Auenwiesen an der Elbe, Saale und Mulde, *Nova Acta Leopoldina-Abhandlungen der Deutschen Akademie der Naturforscher Leopoldina*, *Neue Folge*, 135, 20, Johannes Ambrosius Verlag, 206. (in German)

23. Ivan D., 1983 – Pajiştile de luncă, in Geografia României, I, Geografie fizică (Floodplain grasslands), in Geography of Romania, I, Physical Geography, Edit. Acad. R. S. R. 423-424. (in Romanian)
24. Moelder A. and Schneider E., 2011 – On the beautiful diverse Danube? Danubian floodplain forest vegetation and flora under the influence of river eutrophication, River Research and Application, 27, 881-894, DOI: 10.1002/rra. 1403.
25. Oberdorfer E. (ed.), 1983 – Süddeutsche Pflanzengesellschaften, III, 2, stark bearbeitete Auflage, 445, Pflanzensoziologie, Eine Reihe vegetationskundlicher Gebietsmonographien, Band 10, VEB Gustav Fischer Verlag Jena. (in German)
26. Oprea A., 2005 – Lista critică a plantelor vasculare din România, Edit. Universităţii „Alexandru Ioan Cuza" Iaşi, 668. (in Romanian)
27. Passarge H., 1964 – Pflanzengesellschaften des nordostdeutschen Flachlandes I, Pflanzensoziologie. Eine Reihe vegetationskundlicher Gebietsmonographien, 13, VEB Gustav Fischer Verlag Jena, 324. (in German)
28. Puşcaru-Soroceanu E. (ed.), 1963 – Păşunile şi fâneţele din Republica Populară Română. Studiu geobotanic şi agroproductiv, Edit. Academiei R. P. R., 458. (in Romanian)
29 Rast G., Obrdlik P. and Nieznanski P. (eds), 2000 – Atlas niv Odry/Atlas obszarow zalewowych Odry/Oder-Auen Atlas. Edit. WWF, Rastatt, 103 and 52 maps (DIN A3), ISBN 3-00-007314-0. (in Czech, Polish and German)
30. Sanda V., Popescu A., Doltu M. I. and Doniţă N., 1983 – Caracterizarea ecologică şi fitocenologică a speciilor spontane din flora României, *Studii şi Comunicări Ştiinţe Naturale*, 25, supliment, Muzeul de Istorie Naturală din Sibiu, 126. (in Romanian)
31. Sanda V., Öllerer K. and Burescu P., 2008 – Fitocenozele din România. Sintaxonomie, structura, dinamica şi evoluţie. Ars Docendi, Universitatea din Bucureşti, 570. (in Romanian)
32. Sârbu I., Ştefan N. and Oprea A., 2013 – Plante vasculare din România, Determinator ilustrat de teren, Edit. Victor B. Victor, Bucureşti, 1319. (in Romanian)
33. Schubert R., Hilbig W. and Klotz S., 1995 – Bestimmungsbuch der Pflanzengesellschaften Mittel- und Nordostdeutschlands, Gustav Fischer Verlag Jena, 403
34. Sîrbu I., Curtean A. and Bănăduc D. (eds), 1999 – *Transylvanian review of Systematical and Ecological Research*, 1, The Upper and Middle Olt River Basin, 1-214.
35. Schneider-Binder E., 1991 – Die Auen im Einzugsgebiet der unteren Donau, Laufener Seminarbeiträge, 4, 40-57, Akademie für Naturschutz und Landschaftspflege (ANL) – Laufen/ Salzach. (in German)
36. Schneider-Binder E., 1978 – Zur Verbreitung, Ökologie und Zönologie des Riesenwegerichs (Plantago maxima Juss.), *Studii şi Comunicări*, Sibiu, 22, 137-172. (in German)
37. Schneider-Binder E., 1998 − Die Auen im Hügelland Siebenbürgens aus ökologisch-vegetationskundlicher Sicht, *Mauritiana*, 16, 481-497, ISSN 0233-173, X. (in German)
38. Schneider-Binder E., 2010 – Floodplain forests along the Lower Danube, *Transylvanian Review of Systematical and Ecological Research* "The Wetlands Diversity", 8, 113-136, Sibiu, Romania.
39. Schneider E. and Drăgulescu C., 2005 – Habitate şi situri de interes comunitar, Edit. Universităţii „Lucian Blaga" Sibiu, 167. (in Romanian)
40. Seffer J., Janák M. and Sefferová Stanová V., 2008 – Management of Natura 2000 habitats, Alluvial meadows of river valleys of the Cnidion dubii 6440, Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, Technical Report 2008, 17/24, 20, European Commission (DG ENV B2) - European Communities.
41. ***, 1934 – Administraţia comercială a Porturilor şi a căilor de comunicaţie pe apă - Direcţia serviciului hidraulic Român", Harta Dunării 1:50.000, vol. III, km 770-390, Bucureşti.
42. ***, 2013 – Interpretation Manual of European Union habitats, European Commission, DG Environment, Nature ENV B.3, EUR 28, 144.