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Vegetation of the class *Salicetea purpureae* in Dolenjska (SE Slovenia)

U. Šilc
Institute of Biology, Scientific research centre of Slovenian Academy of Sciences and Arts, Novi trg 2, SI-1000 Ljubljana, Slovenia; e-mail: urban@zrc-sazu.si

Abstract
Riparian willow communities along the rivers Krka and Mirna are presented. The standard Central European phytocoenological method was used. Site conditions were described by measurements of the ground water table and maximum water capacity of the soil. In the researched area three associations and two communities were found. Into class *Salicetea purpureae* Moor 1958 we classify associations *Salicetum incano-purpureae* Sillinger 1933, *Salicetum triandrae* Malcuit ex Noirfalise in Lebrun *et al*. 1955, *Salicetum albae* Issler 1926, and basal communities *Salix purpurea*-[*Salicetea purpureae*] and *Salix triandra*-[*Salicetea purpureae*].

Key words: phytosociology, *Salicetea purpureae*, willow communities.

Résumé
La végétation de la class Salicetea purpureae *dans la région de Dolenjska (SE Slovénie)*. Cette étude comporte la présentation des communautés dominées par des différentes espèces de saules sur la bord de la rivière Krka suivant la méthod phytosociologique. Les conditions des sites (habitats) ont été décrites par la mesure de la nappe d'eau souterrain, et de maximum capacité d'eau dans le sol. Dans l'aire de rechereche trois associations et deux groupements ont été trouvés. On les a classées dans la class *Salicetea purpuraeae* les associations suivantes *Salicetum incano-purpureae* Sillinger 1933, *Salicetum triandrae* Malcuit ex Noirfalise in Lebrun et al. 1955, *Salicetum albae* Issler 1926, et les groupements de base *Salix purpurea*-[*Salicetea purpureae*] et *Salix triandra*-[*Salicetea purpureae*].

Mots clés: communautés de saules, phytosociologie, *Salicetea purpureae*.

Introduction

Willow stands in Slovenia are an endangered habitat and relatively poorly researched, too. A historic survey of the research of willow stands in Slovenia was presented by Šilc & Čušin (2000). More recent studies of these stands, however, have so far been presented only as university graduation theses.

The objective of our research was the syntaxonomical and synecological determination of willow stands in southeastern Slovenia.

Methods

Willow groves were studied applying the standard Central-European, Zürich-Montpellier method (Braun-Blanquet, 1964; Westhoff & van der Maarel, 1973). For processing vegetation relevés the statistics computer package Syn-tax 5.0 was used (Podani, 1993). Cover values were transformed according to van der Maarel (1979). When subdividing the association in lower units we used the principle of multidimensional division of vegetation units (Matuszkiewicz & Matuszkiewicz, 1981). When classifying the relevés without their own character and differential species we used the deductive method of classification (Kopecký, 1992). Syntaxonomic nomenclature is congruent with the work of Mucina *et al.* (1993), whereas the nomenclature of vascular plants follows Ehrendorfer (1973).

Measurements of the underground water were conducted according to the method suggested by Steubing (1965), with partial consideration of Egloff & Naef (1982). In the year of 1999, the ground water level in selected stands was measured in the period between 25th March and 22nd October. The measurements were conducted in intervals of fourteen days. Ground water fluctuation data were transformed to cumulative frequency diagrams, where each line represents separate measurment site. For the maximum soil capacity we applied the Steubing & Fangmeier (1992) method. The soil reaction was measured according to ISO 10390 (1994).

Study area

The research was limited to the rivers of Krka and Mirna and some of their tributaries (the Bistrica, the Gomilščica, the Radulja). A part of the research was extended also on the Sava River. The course of the Mirna lies in the pre-Dinaric phytogeographical region, as well

as that of the Krka, which in its lower course passes into the sub-Pannonian phytogeographical region (Wraber 1969). Rock composition of the Mirna River basin follows description of Topole (1998). A third of the river basin is extremely heterogenous, as there is a mixture of hard and soft carbonate and silicate rocks. The prevailing rock is dolomite, with admixtures of silt, sandstone, slate, marl and oolitic limestone, argillite, tuff, limestone breccia and conglomerate. Another third of the region is occupied by carbonate rocks: limestone and dolomite. Remaining third is occupied by tertiary sediments and holocene alluvium.

Characteristic for the river basin of the Krka is the prevailence of limestone and dolomite, which constitute the wide region of the High karst plateaus, the region of Suha krajina, Rog and the Gorjanci mountains (Šifrer *et al.*, 1980). They are well represented also in the area of karstic fields, in the Krško-šmarjesko hribovje hills, in the Posavsko hribovje hills, as well as in the basin of Novo mesto, where there are patches of watertight slate, marl and sand rocks. There are more water-resistant hills only in the Kostanjevica basin. Despite the prevailence of the karstic world it is the surface outflow of water from an entirely watertight world which is most important for the formation of floods. This is particularly typical for the Kostanjevica basin, where water-resistant clayey, sandy, marly and slaty rocks prevail in the relief. A dense river system with permanent surface streams developed here.

The lowland area was mostly covered by deposits from the Sava and the Krka River with its left tributaries. The Sava deposited large quantities of gravel and filled with it the entire eastern part of the Krka Valley.

The other part of the plain was filled by the Krka and its tributaries. However, unlike the Sava and the tributaries from the Gorjanci mountains which deposited coarse gravel, the Krka deposited mostly clayey and sandy sediments with addition of gravel, which only prevails in certain layers.

According to the Koppen climate system the study area lies in two climatic types (Ogrin, 1996).

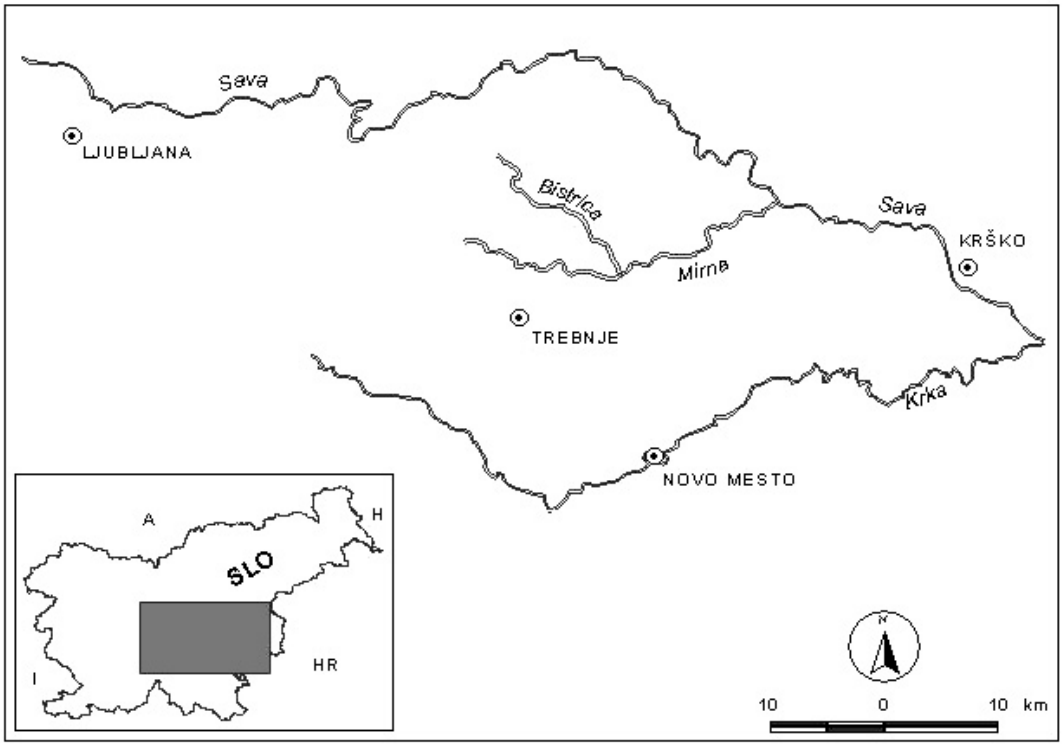


Fig. 1- Researched area of southeastern Slovenia

In the larger part (the Mirna Valley, the upper stream of the Krka), the study region is calssified into the type of moderate-continental climate of central Slovenia (Ogrin, 1996). Characteristic of it is that the mean October temperature is higher than in April, the rainfall regime is sub-continental and mean annual rainfall is between 1000 in 1300 mm.

The lower stream of the Krka river from Otočec downwards is classified into the type of moderate-continental climate of eastern Slovenia (Pannonian climate). Characteristic for this type is that mean April temperatures are higher than in October or are about the same. The rainfall regime is sub-continental and mean annual rainfall is between 800 and 1000 mm.

The Krka Valley itself is on the transition to the Pannonian climatic region, whose influence diminishes towards the west (Gams, 1962).

Results

Syntaxonomical scheme

The syntaxonomical scheme, as well as the character and differential species of the syntaxa, follows Grass (1993).

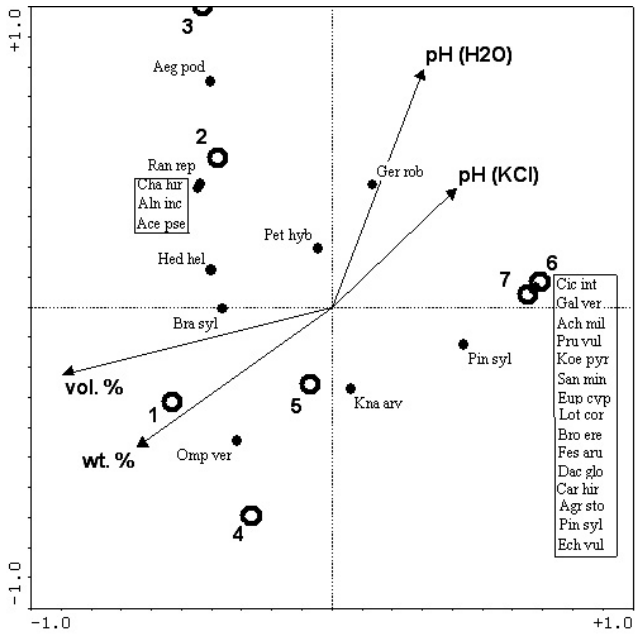
Salicetea purpureae Moor 1958
Salicetalia purpureae Moor 1958
Salicion eleagno-daphnoidis (Moor 1958) Grass 1993
Salicetum incano-purpureae Sillinger 1933
Salicion albae Soó 1930
Salicetum triandrae Malcuit ex Noirfalise in Lebrun *et al.* 1955
Salicetum albae Issler 1926
Communities classified into class
BC *Salix purpurea*-[*Salicetea purpureae*]
BC *Salix triandra*-[*Salicetea purpureae*]

Ass. *SALICETUM INCANO-PURPUREAE* Sillinger 1933 (Tab. 1**)**

CHARACTER SPECIES: *Salix eleagnos* and *Salix purpurea* are the species which give the stands their typical appearance. In accordance with Grass (1993), in our stands the following species can be classified as the differential species of the association: *Aegopodium podagraria, Angelica sylvestris, Chaerophyllum hirsutum, Cirsium oleraceum, Geranium robertianum, Lamium maculatum* and *Senecio fuchsii.* However, the typical combination is impoverished in comparison with the one described by Grass (1993). Missing are the species *Mentha longifolia, Primula elatior, Stachys sylvatica* and *Valeriana officinalis* agg.

FLORISTIC COMPOSITION: The tree layer is poorly developed and in places formed by *Salix eleagnos*. The shrub layer of the association *Salicetum incano-purpureae* is formed by grey (*Salix eleagnos*) and red willow (*Salix purpurea*). The latter is more heliophilous**,** has a smaller coverage and is most often found on the verge of the stands (Moor, 1958). Jovanovič & Tucovič (1965) relate this to a higher moisture demand. The shrub layer is well developed, with a coverage of 80-90 per cent, only exceptionally smaller, and measures 4 metres in height. *Cornus sanguinea* and other species of the class *Rhamno-Prunetea* are very common. Beside these species, *Alnus incana* also occurs occasionally. The herb layer is relatively rich and has at least 50 per cent coverage. The most common species are: *Cirsium oleraceum, Deschampsia cespitosa, Eupatorium cannabinum, Petasites hybridus* and *Peucedanum verticillare*.

ECOLOGICAL CONDITIONS: The stands described thrive on gravel and sand along the streams in the montane belt. In the study area they grow only along the Bistrica.



Graph 1- CCA scatter diagram. Site parameters are presented with arrows, the relevés with empty circles (numbers refer to the number of relevé in the Table 1) and the species with dots. Symbols: vol.% = maximum soil capacity for water (voluminal), wt.% = maximum soil capacity for water (weight), pH(KCl) = pH of the soil in the stands, pH(H_2O) = pH of the soil in the stands

Tab. 1 - *Salicetum incano-purpureae*

	Relevé number		1	2	3	4	5	6	7	P
	Relevé area (m²)		25	25	90	30	30	100	50	r
	Altitude (m)		300	300	340	300	300	340	340	e
	Cover (%)									s.
	Tree layer	A	20	0	0	10	20	0	0	
	Shrub layer	B	80	80	90	90	80	60	80	
	Herb layer	C	80	80	50	80	90	60	70	
	Number of species		40	43	30	56	36	54	53	
	Character and differential species of the association									
MO	Angelica sylvestris		+	1	.	+	+	.	.	4
GU	Geranium robertianum		.	+	+	.	.	+	+	4
QF	Senecio fuchsii		.	+	.	.	+	.	.	2
GU	Lamium maculatum		.	.	+	.	.	.	.	1
	Differential species of the subassociation *petasitetosum hybridi*									
	Petasites hybridus		1	3	3	1	2	2	2	7
MO, dA	Cirsium oleraceum	C	1	1	+	+	1	1	+	7
C	Eupatorium cannabinum		1	1	1	1	1	1	+	7
EP	Peucedanum verticillare	C	.	+	+	1	+	1	+	6
F2	Knautia drymeia subsp. drymeia		+	.	.	1	+	+	+	5
MO, dA	Chaerophyllum hirsutum		+	1	+	.	.	.	.	3
GU, dA	Aegopodium podagraria		.	+	+	.	.	.	.	2
	Differential species of the hill form									
	Galium laevigatum		.	+	.	+	+	+	+	5
AI	Alnus incana	B	1	1	1	.	.	.	.	3
AI	Alnus incana	C	.	.	+	.	.	.	.	1
	Calamagrostis varia		+	+	.	+	.	.	.	3
QF	Corylus avellana	B	1	.	.	+	.	.	.	2
AI	Fraxinus excelsior	B	.	.	.	+	.	.	.	1
AI	Fraxinus excelsior	C	.	.	+	.	.	.	.	1
	Differential species of the variant *Galium verum*									
FB	Galium verum		.	.	.	.	.	1	+	2
FB	Carex flacca		.	.	.	+	.	+	1	3
FB	Euphorbia cyparissias		.	.	.	+	r	.	.	2
FB	Salvia pratensis		.	.	.	.	r	+	.	2
FB	Bromus erectus		.	.	.	.	.	1	1	2
FB	Sanguisorba minor		.	.	.	.	.	+	+	2
FB	Koeleria pyramidata agg.		.	.	.	.	.	+	+	2
FB	Filipendula vulgaris		.	.	.	.	.	+	.	1
FB	Ononis spinosa		.	.	.	.	.	+	.	1
FB	Asperula cynanchica		.	.	.	.	.	.	+	1
SAL	Character species of the order, alliance and class (*Salicion eleagno-daphnoidis, Salicetalia purpureae, Salicetea purpureae*)									
	Salix eleagnos	A	1	.	.	+	1	.	.	3
	Salix eleagnos	B	3	4	5	4	3	4	4	7
	Salix purpurea		2	1	1	1	1	1	1	7
A	Artemisietea									
DM	Erigeron annuus	C	+	.	+	+	.	.	+	4
DM	Picris hieracioides		.	+	.	+	.	+	+	4
DM	Daucus carota		.	.	.	+	.	+	+	3
DM	Cichorium intybus		.	.	.	.	.	+	1	2
DM	Echium vulgare		.	.	.	.	.	+	+	2
GU	Galio-Urticetea									
C	Rubus caesius		2	.	1	2	2	1	.	5
	Heracleum sphondylium		.	+	.	.	+	.	.	2
	Euphorbia serrulata		.	.	.	.	.	+	+	2
MO	Molinietalia									
	Deschampsia cespitosa		3	2	+	1	+	+	1	7
	Molinia arundinacea		+	1	+	.	3	2	2	6
	Lysimachia vulgaris		r	.	.	.	1	+	+	4

MA	Molinio-Arrhenatheretea									
	Taraxacum officinale agg.		r	+	+	+	.	+	+	6
	Vicia cracca		+	.	.	.	+	+	+	4
	Pimpinella major subsp. major		+	+	.	.	+	.	.	3
	Centaurea jacea		.	.	.	+	.	+	+	3
	Leucanthemum ircutianum		.	.	.	+	.	+	+	3
	Pastinaca sativa		+	.	.	+	.	.	.	2
	Dactylis glomerata		.	.	.	.	.	+	+	2
	Lotus corniculatus		.	.	.	.	.	+	+	2
	Achillea millefolium		.	.	.	.	.	+	+	2
	Prunella vulgaris		.	.	.	.	.	+	+	2
	Agrostis stolonifera		.	.	.	.	.	+	+	2
	Festuca arundinacea		.	.	.	.	.	+	+	2
	Carex hirta		.	.	.	.	.	+	+	2
P	Rhamno-Prunetea									
	Cornus sanguinea	B	+	1	.	+	1	+	+	6
	Cornus sanguinea	C	.	.	1	.	.	.	.	1
	Clematis vitalba	B	.	.	.	+	1	.	+	3
	Clematis vitalba	C	.	+	+	+	.	+	+	5
	Crataegus monogyna		+	+	r	+	.	.	+	5
	Viburnum opulus	B	.	+	.	.	+	.	.	2
	Viburnum opulus	C	+	+	.	.	.	.	.	2
	Lonicera caprifolium		+	.	.	+	.	.	.	2
	Berberis vulgaris	B	.	1	.	.	.	+	.	2
	Prunus spinosa		.	.	.	.	+	+	.	2
F2	Fagetalia									
	Acer pseudoplatanus	B	+	.	.	1	.	.	+	3
	Acer pseudoplatanus	C	+	+	+	.	.	.	.	3
	Omphalodes verna		1	.	.	1	+	.	.	3
	Salvia glutinosa		.	+	.	1	+	.	+	4
	Melampyrum nemorosum subsp. nemorosum		.	.	+	+	.	+	+	4
	Ranunculus lanuginosus		+	+	+	.	.	.	.	3
	Carpinus betulus	B	.	+	.	.	.	.	.	1
	Carpinus betulus	C	.	.	+	+	.	.	.	2
	Rosa arvensis	B	1	.	.	+	.	.	.	2
	Sanicula europaea	C	.	+	.	+	.	.	.	2
	Asarum europeum		.	+	.	+	.	.	.	2
QF	Querco-Fagetea									
	Brachypodium sylvaticum		2	2	1	2	+	.	.	5
	Hedera helix		+	+	+	+	.	.	.	4
EP	Erico-Pinetea									
	Pinus sylvestris	B	.	.	.	+	.	1	1	3
	Pinus sylvestris	C	.	.	.	.	.	+	+	2
	Buphthalmum salicifolium		.	.	.	+	.	+	.	2
O	Other									
	Equisetum arvense		+	+	.	+	+	.	1	5
	Frangula alnus	B	.	+	.	.	.	+	.	2
	Frangula alnus	C	.	.	.	.	+	.	+	2
	Vincetoxicum hirundinaria		+	+	.	+	.	.	.	3
	Picea abies	B	.	.	.	.	.	.	+	1
	Picea abies	C	.	.	r	r	.	.	.	2
	Alnus glutinosa	B	.	.	.	.	1	+	+	3
	Lycopus europaeus	C	+	.	.	.	+	.	.	2
	Cerastium glomeratum		.	+	.	+	.	.	.	2
	Solidago virgaurea subsp. virgaurea		.	.	.	+	+	.	.	2

Tab. 2 - Measurements of maximum soil capacity for water (WK) and pH in the stands.

Relevé	1	2	3	4	5	6	7
WK (vol. %)	41,5	42,5	38,9	43,6	41,1	32,9	27,6
WK (wt. %)	52,7	48,3	44,4	61,4	66,7	41,7	25,7
pH (H_2O)	8,2	8,3	8,5	8,2	8,3	8,3	8,3
pH (KCl)	7,6	7,7	7,8	7,5	8,0	7,9	7,7

Typical for these sites is the summer drought period, when the water level is low, the ground water level drops and the gravel and sand no longer retain moisture.

Values for maximum soil capacity for water are low, on average 48,7 weight % or 38,3 volume %. Measurements of pH determined the stands as distinctly basophilous, since the average value is 8,3 (H_2O) or 7,7 (KCl) (values for individual stands are given in Tab. 2).

The results of CCA ordination are presented in the graph. The abscissa represents above all the maximum soil capacity for water and divides the stands in the same way as classification. The species characteristic for dry sites that appear above all in the stands of the variant *Galium verum*, have the highest positive values. On the left side of the diagram are the mesophilous species which occur in the stands of the variant *typicum*. Only the species whose proportion of the explained variance is over 0.7 are presented in the graph.

Subdivision into lower units

On subdivision into lower syntaxa we followed the system proposed by Oriolo & Poldini (2002). All relevés were classified into subassociation *Salicetum incano-purpureae petasitetosum hybridi* Oriolo & Poldini 2002 and into hill altitudinal form. Floristically stands are very similar to one from the Nadiža (Natisone) river described by Šilc & Čušin (2000). On the basis of numerical analyses we then classified the relevés into two variants: var. *typicum* and var. *Galium verum*. Variant are floristically similar to the subassociations proposed by Lippert *et al.* (1995).

SALICETUM INCANO-PURPUREAE PETASITETOSUM HYBRIDI var. *typicum* (Tab. 1/1-4)
It is found along the stream where the water supply of the soil is constant. It grows on sites where finer sand is deposited. Due to the narrow stream the stands of the var. *typicum* grow directly along the Bistrica brook. It is in contact with hornbeam or beech stands, since the stands of the association *Alnetum incanae*, which is teoretically the next stage in the succession, do not appear.

The variant is without differential species. The development towards potential natural vegetation is indicated by the species of the alliance *Alnion incanae*, order *Fagetalia* and class *Querco-Fagetea*.

SALICETUM INCANO-PURPUREAE PETASITETOSUM HYBRIDI var. *GALIUM VERUM* **(**Tab. 1/5-7**)**
The var. *Galium verum* is found on the soil which comprises larger quantities of gravel. Its sites are only rarely flooded (with exception of severe floods), as it often grows along old riverbeds, where there is usually no flowing water.

The differential species are from the class *Festuco-Brometea*: *Galium verum, Euphorbia cyparissias, Salvia pratensis*, *Bromus erectus*, *Sanguisorba minor*, *Koeleria pyramidata* agg. They occur in the stands and indicate the dryness of the site.

The subassociation is additionally characterized by a larger number of species of the class *Molinio-Arrhenatheretea* and a higher coverage of the species *Molinia arundinacea*.

Presence of the species *Pinus sylvestris* indicates the zonation towards the association *Genisto januensis-Pinetum*, which is found fragmentarily developed on smaller surfaces also on older gravelly terraces along the Bistrica.

Ass. *SALICETUM TRIANDRAE* Malcuit ex Noirfalise in Lebrun *et al.* 1955 (Tab. 3**)**
CHARACTER SPECIES: Character species of the association are *Salix triandra* and *Salix viminalis*. The differential species are: *Rorippa amphibia, R. sylvestris* and *Rumex crispus*. Besides these Grass (1993) mentions also *Atriplex prostrata* and *Bidens frondosus*.
FLORISTIC COMPOSITION: The community is two-layered. The coverage of the shrub layer is high (about 80%), also due to lianas. The willows do not exceed the height of 5 metres; the stands are usually 3-4 metres high.

The shrub layer consists of almond willow (*Salix triandra*), alongside with other willow species: *Salix cinerea*, *Salix viminalis* and *Salix purpurea*.

Besides the shrub species, a number of lianas from

the order *Convolvuletalia sepium*, such as *Calystegia sepium, Echinocystis lobata, Solanum dulcamara*, are found in the shrub layer covering the willows and sometimes overgrowing them completely.

In comparison with other willow communities the herb layer has a smaller coverage here. It consists of few species and individuals, which is the result of unfavourable site conditions.

ECOLOGICAL CONDITIONS: In the study area, the association *Salicetum triandrae* was found along the Krka and Mirna rivers.

Almond willow shrub stands are found on lower sites along the streams where they overgrow the lowest position among woody communities, directly above the water surface. The stands usually form the mantle of the association *Salicetum albae*. Every time the water level rises, the site is flooded. Among all of the willow species *Salix triandra* and *S. fragilis* are the least adapted to constant mechanical disturbances and have fragile boughs. Therefore, *Salix triandra* most often thrives along slowly running rivers. When a stream has a more torrential character, the almond willow is replaced by *Salix viminalis*, *Salix purpurea* or *Salix eleagnos*. This is a community which thrives on soil dominated by fine soil particles, while it is not to be found on sites with a higher content of sand or on gravel sites. Pedogenetic processes are not well developed because of the youth of the deposits, or because sedimentation prevails over pedogenesis. Horizons are badly developed and initial (A), and also G (gleyic) horizon can occur. On account of dynamics, pedogenesis is obstructed so there are no developed horizons, only layers of sedimentation. Therefore, the soil is classified as a type of riverine soil.

Subdivision into lower units

Regarding the relevé material we decided to classify the stands into the subassociation *Salicetum triandrae typicum*. Diversity within this subassociation was defined as variants.

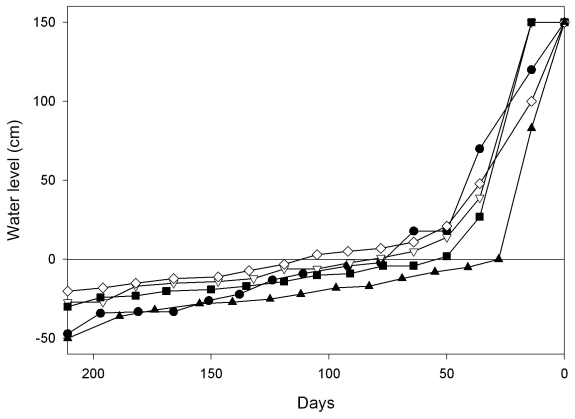
SALICETUM TRIANDRAE TYPICUM var. *typica* **(**Tab. 3/ 1-8)

The typical variant differentiated by the species *Rorippa amphibia* presents the core of the association. It thrives on longest-flooded sites. As presented in the graph, the site remained flooded for 75 days in the vegetation season.

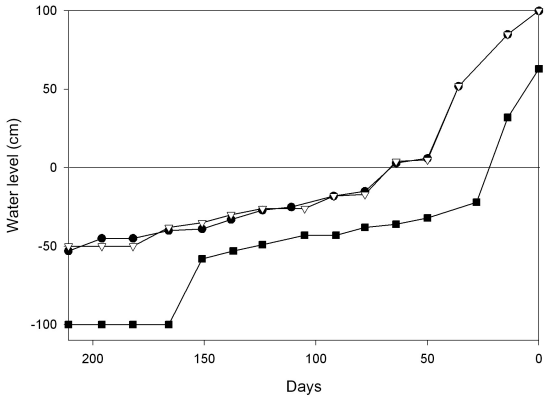
SALICETUM TRIANDRAE typicum var. *ALLIARIA PETIOLATA* **(**Tab. 3/ 9-23**)**

The stands classified into this variant thrive in highest positions on the river-bank and are flooded for the shortest period of time among the stands of almond willow. Two stands surveyed along the Mirna were found on the part where the river-bank was stabilised.

The differential species of the variant, *Alliaria petiolata*, can be also classified as a differential species of the association *Salicetum albae* (Grass, 1993). The



Graph 2 - Cumulative frequency diagram in the stands of *Salicetum triandrae typicum* var. *typica*



Graph 3 - Cumulative frequency diagram in the stands of *Salicetum triandrae typicum* var. *Alliaria petiolata*

Tab. 3 - *Salicetum triandrae*

	Relevé number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	P
	Relvé area (m²)		10	30	15	15	15	50	50	50	30	20	50	30	20	40	15	50	30	10	20	30	30	25	25	15	50	40	40	30	30	40	20	60	80	15	100	r
	Altitude (m)		240	240	150	200	220	150	150	150	150	220	150	150	150	150	150	150	150	140	150	160	150	150	150	200	160	150	150	150	150	150	150	200	150	160	200	e
	Exposition		SSE	NNE	-	-	EES	EES	SSE	E	-	NNE	-	-	S	-	-	NE	SSE	NNE	E	-	-	S	-	SE	SE	S	-	NNE	E	SE	SE	S	S	SE	-	s.
	Slope (°)		5	20			10	5	5	5		20			5			5	10	5	5			5		5	5	5		5	5	5	5	5	5	5	5	
	Cover (%)																																					
	Shrub layer	B	90	100	90	80	90	90	70	90	90	80	90	70	90	90	60	90	90	80	70	80	80	70	90	80	90	60	90	70	80	70	90	80	80	50	80	
	Herb layer	C	30	30	40	60	40	50	20	30	50	60	70	50	30	40	80	50	30	30	40	40	60	60	20	60	90	40	50	50	70	30	15	20	30	20	70	
	Number od species		22	20	20	15	16	21	24	16	26	27	15	17	19	21	15	17	18	13	13	17	16	23	24	24	24	20	15	21	19	13	16	13	21	16	22	
	Character and differential species of the association																																					
	Salix triandra	B	5	5	5	3	5	4	3	2	5	5	5	5	5	5	4	5	5	5	4	4	5	4	4	3	3	4	2	.	3	3	3	3	.	.	.	31
	Salix triandra	C	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
dF	Salix viminalis	B	.	.	.	.	+	1	3	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Differential species of the variants																																					
			var. *Alliaria petiolata*								var. *typicum*															var. *Salix purpurea*					var. *Salix cinerea*							
GU	Lamium maculatum	C	+	+	1	1	.	.	.	.	+	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	8
GU	Alliaria petiolata		2	1	+	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	6
GU	Galium aparine	B	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
GU	Galium aparine	C	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
PM	Rorippa amphibia		.	.	.	.	.	.	+	.	.	+	1	+	+	+	2	+	.	.	1	+	.	.	.	.	.	.	.	1	3	.	.	.	.	.	.	12
SAL	Salix purpurea	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	4	1	4	4	.	.	.	.	.	.	.	6
ALN	Salix cinerea		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	3	2	4	5	3	5	7
SAL	Character species of the alliance *Salicion albae* , order *Salicetalia purpureae* and class *Salicetea purpureae*																																					
	Salix purpurea		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	4	1	4	4	.	.	.	.	.	.	.	6
	Salix viminalis x purpurea		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
B	Bidentetea																																					
	Polygonum hydropiper	C	.	.	.	.	2	1	1	1	1	3	3	2	1	2	3	2	+	+	1	+	.	1	.	.	.	2	3	1	1	.	1	1	1	+	.	25
	Bidens tripartita		.	.	.	.	.	1	+	.	+	1	+	+	+	.	+	1	.	.	.	.	+	+	.	+	+	+	+	+	.	.	.	+	+	.	.	18
	Polygonum mite		+	+	2	.	.	+	+	.	1	+	.	.	.	.	+	.	.	.	.	.	+	+	+	+	+	+	.	.	.	1	1	.	.	.	.	16
GU	Galio-Urticetea																																					
	Urtica dioica		1	+	1	2	+	2	2	3	2	1	3	+	1	+	+	.	2	2	+	+	2	1	1	1	2	+	.	3	+	2	+	2	1	+	+	33
C	Solanum dulcamara	B	1	+	1	.	1	.	+	.	1	1	.	.	.	+	.	2	2	2	.	.	.	.	.	.	1	1	1	1	+	1	1	.	.	.	.	18
C	Solanum dulcamara	C	+	.	.	1	+	3	+	1	+	.	.	+	1	1	.	+	1	.	.	+	.	+	+	+	1	.	+	1	.	.	.	+	2	+	+	23
C	Echinocystis lobata	B	.	.	1	.	.	.	+	+	1	1	2	1	2	1	+	+	2	+	.	.	1	1	1	.	.	+	+	+	.	.	.	+	.	.	.	20
C	Echinocystis lobata	C	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	+	.	.	6
C	Calystegia sepium	B	1	+	+	1	.	.	.	.	1	1	.	.	1	.	.	.	+	1	.	.	+	.	+	.	.	.	.	+	.	+	+	.	.	.	.	14
C	Calystegia sepium	C	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	+	.	.	+	.	.	.	1	+	.	.	9
	Glechoma hederacea		.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	+	+	+	6
C	Humulus lupulus	B	.	.	.	2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	+	.	.	.	.	5
C	Humulus lupulus	C	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
C	Rubus caesius		.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	.	r	5
C	Impatiens glandulifera		+	1	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4

C	Scrophularia umbrosa	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Aegopodium podagraria	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	3
	Aristolochia clematitis	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	3
C	Rudbeckia laciniata	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
PM	Phragmiti-Magnocaricetea																																						
	Phalaris arundinacea	+	1	1	2	2	+	.	1	+	1	1	1	2	+	1	1	+	1	3	1	2	2	1	3	3	3	2	+	+	+	1	+	2	.	.	32
	Galium palustre agg.	.	.	.	.	.	.	+	+	+	.	+	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	.	+	1	.	+	+	3	1	2	19
	Alisma plantago-aquatica	.	.	.	.	.	.	.	r	.	+	1	+	+	1	.	.	+	+	.	.	+	+	+	+	.	+	+	.	+	.	.	.	.	.	.	.	15
	Mentha aquatica	.	.	.	.	.	.	.	.	2	1	.	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	6
	Lycopus europaeus	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	4
	Scutellaria galericulata	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	3
	Iris pseudacorus	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Phragmites australis	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
MO	Molinietalia																																						
	Lythrum salicaria	+	.	+	.	.	+	1	2	+	+	.	.	1	1	.	1	+	1	+	+	1	+	1	+	+	+	1	.	+	.	.	+	1	+	.	25
	Myosotis scorpioides	.	.	.	.	.	.	+	+	+	+	.	.	.	+	.	1	.	.	.	+	+	+	+	2	.	.	.	.	+	.	.	.	.	+	1	14
	Lysimachia vulgaris	.	.	.	.	.	.	.	.	1	.	3	.	.	.	.	.	.	.	.	1	+	+	.	.	+	1	.	.	.	.	.	.	.	.	.	.	7
	Angelica sylvestris	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	1	5
	Cirsium oleraceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	+	2
POT	Potentillo-Polygonetalia																																						
	Agrostis stolonifera	1	+	1	.	1	+	+	1	1	1	2	.	.	.	1	1	+	+	1	1	+	+	+	.	2	1	+	1	4	+	2	.	1	+	.	28
	Rorippa sylvestris	.	+	.	.	.	.	.	.	.	.	.	+	+	+	+	.	1	1	+	+	+	1	1	.	2	1	1	+	.	+	+	.	.	.	.	18
	Ranunculus repens	.	.	+	.	.	+	+	.	+	+	.	+	+	+	+	.	+	.	.	.	.	+	+	+	.	.	.	.	+	.	.	.	+	+	2	17
	Rumex crispus	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	+	+	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	7
	Barbarea vulgaris	2	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	6
	Lysimachia nummularia	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	2	.	3	5
	Rumex obtusifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	2
MA	Molinio-Arrhenatheretea																																						
	Taraxacum officinale agg.	.	.	.	.	.	+	+	.	.	r	.	.	+	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	+	.	.	.	+	.	.	8
	Poa trivialis	.	.	.	2	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	2	+	.	.	.	.	.	.	.	.	.	.	5
	Galium mollugo	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Symphytum officinale	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2
O	Other																																						
	Cardamine amara	.	+	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	+	+	.	9
	Cardamine pratensis	.	.	.	.	3	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	+	.	.	.	+	.	1	7
	Plantago major	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	.	.	.	.	.	.	.	.	.	.	.	5
	Galeopsis speciosa	+	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	5
	Scrophularia nodosa	.	.	+	.	.	.	.	.	.	1	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	5
	Polygonum sp.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3
	Artemisia vulgaris	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Batrachium aquatile	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	3
	Echinochloa crus-galli	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Chenopodium album	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Leersia oryzoides	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2

species, characteristic of wet and inundated sites, classified into the class *Phragmiti-Magnocaricetea*, are not found in the stands.

The differential species of the variant are: *Alliaria petiolata, Galium aparine* and *Lamium maculatum*.

The stands in which *Salix viminalis* occurs together with the species *Salix triandra* form a specific facies within the variant. In comparison with *Salix triandra* s. str. *Salix viminalis* grows on higher positions on the embankment or on soil with a higher proportion of sand (Neumann, 1981). Osier (*Salix viminalis*) is a rare species in the region west of the Sava river, since this is the outermost edge of its distribution area (Neumann, 1981; Schiechtl, 1992). Although it is often planted, we have not found its plantations in the study area.

SALICETUM TRIANDRAE typicum var. *SALIX PURPUREA* **(**Tab. 3/ 24-28**)**

The differential species of the variant is *Salix purpurea*, while the species *Rorippa amphibia*, which thrives on explicitly muddy soil, characterizes the variant negatively.

The variant characterized with the presence of the species *Salix purpurea* grows on sites, where similarly to the stands with *Salix viminalis*, there is a higher proportion of sand in the soil. When boring with a pedological drill we came across a layer of sand relatively close to the surface, which has a strong impact on the drainage of the soil. Willows take roots in this layer, which is more suitable for *S. purpurea* than for other willow species. Hydrological measurements show a large span between both stands within the variant where the measurements were conducted. Important for the growth of the species *Salix purpurea* are the soil conditions and the shape of the embankment, which both indirectly determine the duration of flooding.

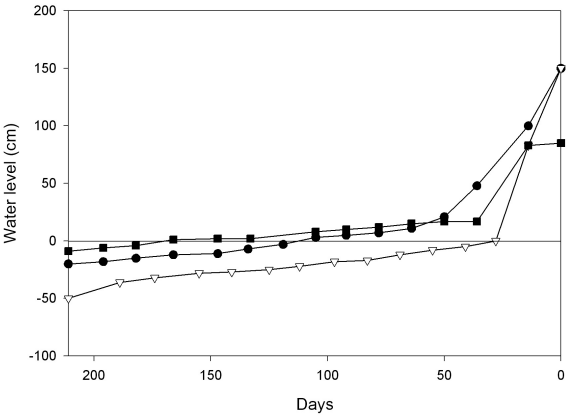
In the Žužemberk stand, where the water level was measured, the pipe was 100 cm long alongside the red willow, and 150 cm long alongside the almond willow. The latter was flooded for almost half of the vegetation period, and the red willow for only 50 days. The difference occurred because of the shape of the embankment. Nevertheless, it is characteristic for the two species that they grow on different altitudes on the embankment.

SALICETUM TRIANDRAE typicum var. *SALIX CINEREA* **(**Tab. 3/ 29-35**)**

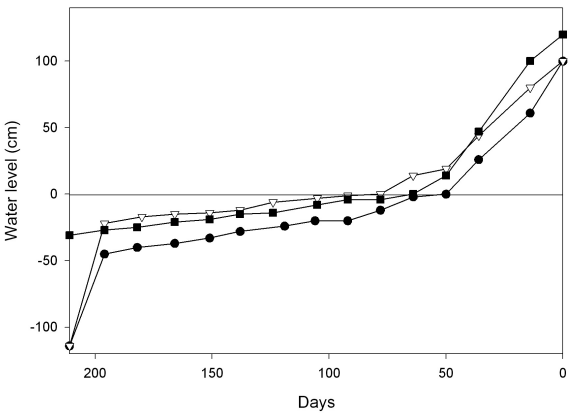
The variant with the species *Salix cinerea* was found only along the Krka River, which has the slightest fall among Slovenian rivers. In places where the current is especially slow or where the water is retained because of the shape of the embankment, there are mixed stands where ash-grey willow (*Salix cinerea*) grows together with the almond willow.

As evident from the water level diagrams, there are no obvious discrepancies with the typical variant regarding the water level or the range of fluctuation of the water level; the cause of thriving is above all the slower current.

Pautou & Wuillot (1989, cit. in Gallandat *et al.* 1993) noticed the increase in the number of stands with the



Graph 4 - Cumulative frequency diagram in the stands of *Salicetum triandrae typicum* var. *Salix purpurea*



Graph 5 - Cumulative frequency diagram in the stands of *Salicetum triandrae typicum* var. *Salix cinerea*

species *Salix cinerea* along the Rhine, while the willow populations, on the other hand, generally decrease in number. The principal reason for constant control of the water current and smaller oscillation in water level are dams (Wildi, 1989).

Stands of both willow species were also described by Walther (1987). With the exception of dominant species, they are not similar in terms of floristics, but in terms of synsystematics Walther treats them similarly. The differential species of the form are *Salix cinerea* and *Salix aurita*. The stands are characteristic for the sites with stagnant water.

The same classification of the stands with the species *Salix cinerea* and *Salix triandra* is found in Jelem (1975). In the analytic table he clearly distinguishes groves of almond willow, groves of ash-grey willow and swampy scrub communities of ash-grey willow. The groves of ash-grey willow are floristically similar to the association *Salicetum triandrae*, as there are no species typical for marshy sites.

In his comparison of the stands of the species *Salix cinerea* in the swamp and on the embankment, Vollrath (1965) ascertains that also the species *Urtica dioica* and *Glechoma hederacea* occur within the latter. Even the species *Calystegia sepium* occurs in the stands with dominating *Salix cinerea*, as long as there is also *Salix triandra*. He clearly indicates that these stands should be classified within the association *Salicetum triandrae*.

According to our observations and literature we can determine that two types of stands dominated by *Salix cinerea* can be found in the study area. The stands on permanently flooded site are classified into the association *Salicetum cinereae* (Šilc 2002), and the stands along running waters into the association *Salicetum triandrae typicum* var. *Salix cinerea*. Stands without *Salix triandra* (Tab. 3/33-35) could be classified according to system of Kopecký (1992), but because of small number of relevés and site circumstances they were joined to the *Salicetum triandrae typicum* var. *Salix cinerea*.

Ass. *SALICETUM ALBAE* Issler 1926 (Tab. 4**)**

CHARACTER SPECIES: As the character species of the association Grass (1993) mentions *Populus alba*, and as differential species *Brachypodium sylvaticum*, *Saponaria officinalis*, *Stellaria media*. Differential species towards the association *Salicetum triandrae* are *Alliaria petiolata* and *Circaea lutetiana*, and towards the association *Salicetum fragilis* the species *Deschampsia cespitosa* and *Senecio fluviatilis*.

FLORISTIC COMPOSITION: The stands of the association *Salicetum albae* are divided into three layers. The tree layer is dominated by the species *Salix alba*, which is in places accompanied by *Salix fragilis*, but with a smaller coverage. The tree layer is up to 25 m high, but on average the stands are 15 to 20 metres high. A lower stand height is noticed only within the subassociation *myosotidetosum*, which remains flooded for the longest period of time, so the site conditions there are most unfavourable. The canopy is not closed, the stands are lighted and the coverage is usually 70 per cent.

The shrub layer is composed of a large number of species and its composition and coverage change considerably with site conditions. Different willow species occur in the shrub layer. The most common species are: *Salix alba*, *S. purpurea*, *S. triandra*. A high constancy is also noticed with the species of order *Prunetalia*, especially in the stands which have the highest position on the embankment: *Cornus sanguinea*, *Euonymus europaea*, *Sambucus nigra*, *Viburnum opulus*.

Besides the woody species, the lianas *Echinocystis lobata* and *Solanum dulcamara* which climb on scrubs and trees and can additionally shade the stands with their rather high coverage, are also found in the shrub layer.

The herb layer is well developed and covers on average 90 per cent of the surface. The stands are often dominated by only a few species of tall herbs, among them *Angelica sylvestris*, *Phalaris arundinacea*, *Urtica dioica*, whereas due to shading other species have only a moderate coverage and are therefore not numerous. In the association *Salicetum albae* there are fewer species classified into the class *Phragmiti-Magnocaricetea* in comparison with the contact association *Salicetum triandrae*, since these stands are flooded for a shorter period of time. Periodical floods deposit a lot of organic material, and at the same time, a great deal of fertilizers accumulate from the nearby fields. Therefore, nitrophilous species which are syntaxonomically classified into the classes *Artemisetea* and *Galio-Urticetea*, prevail.

Spring aspect in the association *Salicetum albae* is not developed in the study area, there are only patches of the species *Ranunculus ficaria*. Similar observations were mentioned by Grass (1993), while Marinček & Seliškar (1984) in the stands along the Mura river clearly define a spring aspect of geophytes and a summer aspect with prevailing tall herbs. High waters in spring destroy the bulbs of geophytes, while the Mura is rather regulated. The same is characteristical for the Soča river, where some of the stands are only occasionally flooded.

ECOLOGICAL CONDITIONS: As a result of human impact

Tab. 4 - *Salicetum albae*

	Relevé number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	P
	Relvé area (m²)		60	100	200	100	30	250	250	100	200	200	200	60	150	200	100	100	200	220	150	50	200	200	120	200	200	150	150	200	100	200	100	200	200	r
	Altitude (m)		150	150	150	150	150	150	150	150	150	140	150	150	150	155	220	240	150	150	160	220	145	240	240	150	220	200	200	150	150	240	145	240	240	e
	Cover (%)																																			s.
	Tree layer	A	70	80	70	70	50	60	70	70	70	70	70	80	60	70	70	50	70	60	60	60	80	70	60	70	70	60	60	80	70	80	80	80	60	
	Shrub layer	B	10	5	40	5	5	40	30	10	40	50	40	30	40	20	10	30	50	25	10	10	30	40	60	20	40	40	60	30	20	80	30	20	40	
	Herb layer	C	90	50	80	100	90	90	90	90	95	90	90	100	90	90	90	90	80	70	80	90	100	90	100	90	70	80	80	90	85	60	90	90	90	
	Number of species		24	29	30	23	19	23	30	24	30	32	21	20	33	22	35	34	35	36	26	23	23	31	49	30	27	37	33	30	39	39	24	30	34	
	Differential species of the association																																			
GU	Alliaria petiolata	C	.	.	+	.	.	.	+	+	1	1	.	+	.	.	1	1	+	+	.	+	+	.	.	+	.	+	+	.	1	+	+	.	1	19
SM	Stellaria media		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.	+	3
QF	Brachypodium sylvaticum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	3
A	Saponaria officinalis		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
MO	Deschampsia cespitosa		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Differential species of the alliance *Salicion albae*																																			
C	Calystegia sepium	B	.	.	.	.	.	+	1	.	+	.	.	.	+	.	+	.	+	1	1	.	.	.	.	.	.	.	.	+	.	.	+	.	.	10
C	Calystegia sepium	C	.	.	.	.	.	.	1	+	+	+	.	.	+	.	+	+	+	+	+	.	+	+	+	1	.	.	+	+	+	+	.	+	+	20
C	Humulus lupulus	B	.	+	.	.	.	.	.	.	.	1	1	.	.	.	.	.	1	1	.	1	+	.	+	.	1	1	2	1	+	1	1	.	+	16
C	Humulus lupulus	C	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	+	.	.	.	.	5
MA	Symphytum officinale		.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+	.	.	.	+	+	.	.	+	+	.	1	1	9
C	Impatiens glandulifera		.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	2	.	.	.	1	.	.	+	.	+	.	.	.	.	+	.	.	+	8
C	Solidago gigantea		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	3
SAL	Character species of the alliance *Salicion albae*, order *Salicetalia purpureae* and class *Salicetea purpureae*																																			
	Salix alba	A	4	4	4	4	3	4	4	4	4	4	4	5	4	4	4	2	3	.	4	4	.	4	4	4	2	4	4	4	4	5	3	5	4	31
	Salix alba	A2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	1
	Salix alba	B	.	.	2	.	.	1	+	.	.	.	.	.	.	.	1	1	2	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	8
	Salix fragilis	A	.	.	.	.	.	1	.	.	3	1	.	.	.	.	.	2	3	4	.	.	4	.	.	2	4	.	2	.	.	.	2	.	.	11
	Salix fragilis	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Salix triandra		1	.	.	1	.	2	1	2	.	.	.	.	1	.	1	.	.	1	.	.	.	1	.	.	.	.	.	.	+	.	.	.	10
	Salix purpurea		.	.	.	.	.	2	.	.	2	.	.	.	.	.	.	.	.	+	.	.	.	1	3	.	.	3	1	.	.	+	.	.	.	8
	Salix viminalis		.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Salix sp.		.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Salix _ rubens	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
	Differential species of the subassociation *myosotidetosum*																																			
B	Polygonum hydropiper	C	3	3	2	1	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	9
POT	Agrostis stolonifera		2	1	2	.	.	.	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	7
POT	Rorippa sylvestris		+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	5
MO	Lysimachia vulgaris		1	+	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	9
MO	Myosotis scorpioides		.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Differential species of the subassociation *caricetosum*																																			
B	Juncus effusus		.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
PM	Mentha x verticillata		.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
MO	Succisella inflexa		.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
PM	Carex vulpina		.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
PM	Carex appropinquata		.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
	Differential species of the subassociation *typicum*																																			
PM	Phalaris arundinacea		3	+	4	4	.	2	2	2	1	1	2	2	1	1	+	+	+	+	+	+	+	.	+	3	.	.	.	.	3	.	+	.	+	25
GU	Urtica dioica		1	2	3	2	.	5	5	5	4	4	4	4	5	5	3	3	4	3	5	2	2	1	+	4	1	3	4	5	2	2	2	2	2	32
	Differential species of the subassociation *rubetosum*																																			
GU	Rubus caesius	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
GU	Rubus caesius	C	.	.	r	+	+	.	.	.	.	.	.	.	.	.	2	+	1	2	1	1	1	+	1	1	2	2	2	1	2	2	1	3	2	22
	Differential species of the subassociation *cornetosum sanguinei*																																			
P	Cornus sanguinea	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	3	3	1	1	1	3	2	1	1	11
P	Cornus sanguinea	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1
P	Viburnum opulus	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	1	.	2	2	4
QF	Brachypodium sylvaticum	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	3
P	Prunus spinosa	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	2
P	Crataegus monogyna		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	2
P	Crataegus monogyna	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	+	.	3
P	Corylus avellana	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	2
P	Ligustrum vulgare		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
P	Ligustrum vulgare	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1
QF	Paris quadrifolia		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1
QF	Allium ursinum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1
P	Rhamnus catharticus	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	1

B	Bidentetea triparitae																																					
	Polygonum mite	C	+	+	+	.	+	.	.	+	+	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	10
	Bidens tripartita		+	.	1	.	.	.	+	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	6
	Myosoton aquaticum		.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	6
A	Artemisietea vulgaris																																				
	Artemisia vulgaris		.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	+	+	1	.	.	.	+	.	.	.	.	.	.	+	.	+	+	11
	Erigeron annuus		.	.	+	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	+	+	.	.	.	.	+	.	.	+	.	8
C	Convolvuletalia																																				
	Echinocystis lobata	B	1	+	+	.	.	.	+	1	1	.	.	+	1	.	.	.	1	.	.	.	1	.	+	+	.	.	.	+	.	.	1	.	.	14
	Echinocystis lobata	C	+	.	.	+	.	2	+	+	2	1	.	+	3	.	.	+	1	1	+	.	.	.	.	+	.	.	.	.	.	.	+	.	.	15
	Solanum dulcamara	B	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	4
	Solanum dulcamara	C	1	+	.	.	.	.	+	1	+	.	+	.	+	.	.	.	+	+	.	.	.	.	+	+	.	+	.	+	+	+	.	+	.	16
	Cuscuta europaea		.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	+	.	1	.	.	.	.	7
	Eupatorium cannabinum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	4
	Epilobium hirsutum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	3
GU	Galio-Urticetea																																				
	Glechoma hederacea		+	+	1	.	.	.	1	+	+	+	1	3	+	1	.	+	2	+	3	+	+	+	1	2	+	2	1	1	2	.	+	.	.	26
	Lamium maculatum		.	.	+	.	.	+	1	.	3	3	2	2	.	+	3	.	3	4	2	3	1	3	.	3	1	3	2	1	2	3	+	.	1	24
	Galium aparine		.	.	.	.	+	.	+	.	+	1	+	.	.	.	1	+	1	1	+	+	+	2	+	1	2	1	1	.	+	1	+	1	+	23
	Aegopodium podagraria		.	.	.	.	+	.	+	.	+	.	.	.	2	+	.	1	1	2	.	3	2	2	.	.	4	.	+	+	.	3	1	.	.	16
	Urtica dioica		.	.	+	+	.	.	.	.	.	.	+	.	+	+	.	.	.	.	+	.	.	.	+	.	.	.	.	+	+	.	.	.	.	9
	Rudbeckia laciniata		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	3	4	.	1	.	.	+	.	+	.	2	2	9
	Heracleum sphondylium		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	4
	Galeopsis pubescens		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	4
	Parietaria officinalis		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	+	.	.	.	2	.	.	4
	Aristolochia clematitis		.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.	3
	Chaerophyllum temulum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	3
	Cruciata laevipes		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	2
PM	Phragmiti-Magnocaricetea																																				
	Iris pseudacorus		.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	.	.	+	+	10
	Carex gracilis		.	.	.	.	4	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	2	.	1	2	.	.	.	1	.	1	1	8
	Galium palustre agg.		+	+	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
	Rorippa amphibia		+	1	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	5
	Mentha aquatica		.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	4
	Veronica anagallis-aquatica		.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
	Lycopus europeaus		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	2
POT	Potentillo-Polygonetalia																																				
	Ranunculus repens		+	.	+	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	.	.	.	+	+	.	.	+	.	.	.	9
	Lysimachia nummularia		2	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	6
	Rumex obtusifolius		.	+	.	+	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	6
	Mentha longifolia		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	3
	Agrostis stolonifera		.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Barbarea vulgaris		.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	2
MO	Molinietalia																																				
	Angelica sylvestris		.	.	.	.	.	.	2	.	+	1	+	+	.	+	+	+	.	.	1	.	.	+	2	1	.	+	.	.	1	1	.	1	+	17
	Cirsium oleraceum		.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	+	.	+	.	+	+	+	+	+	1	.	.	+	.	.	+	+	14
	Lythrum salicaria		+	1	+	.	+	+	+	+	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	13
	Filipendula ulmaria		.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	1	+	r	.	+	.	+	.	.	+	+	10
	Chaerophyllum hirsutum		.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	4
	Selinum carvifolia		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
MA	Molinio-Arrhenatheretea																																				
	Poa trivialis		+	.	+	.	.	.	.	+	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	1	.	13
	Anthriscus sylvestris		.	.	+	.	.	.	.	+	1	+	+	.	+	+	.	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
	Taraxacum officinale agg.		+	r	.	.	.	.	.	.	.	+	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
	Galium mollugo		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	3
	Silene alba		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	3
	Achillea millefolium		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	3
	Dactylis glomerata		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	2
P	Rhamno-Prunetea																																				
	Euonymus europaea	B	.	.	.	.	.	.	.	.	.	2	2	.	1	1	+	.	.	1	.	1	1	.	+	2	2	2	2	1	2	2	+	1	.	18
	Euonymus europaea	C	.	.	r	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	r	.	.	.	.	+	+	.	+	.	+	.	.	+	.	12
	Sambucus nigra	B	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	2	1	.	.	2	.	.	.	.	1	1	+	.	1	2	+	+	12
	Sambucus nigra	C	+	.	.	.	.	.	+	.	+	+	.	+	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8
	Rhamnus catharticus		.	+	2	1	.	.	.	.	.	.	1	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	7
	Viburnum opulus		.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	2
	Cornus sanguinea		.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	2

AI	Alnion incanae																																		
	Equisetum sylvaticum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	+	.	+	.	.	.	.	+	+	.	+	+	8
	Impatiens noli-tangere		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	3
	Festuca gigantea		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	3
	Ranunculus ficaria		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	2
QF	Querco-Fagetea																																			
	Scrophularia nodosa		.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	+	.	+	.	+	.	.	7
	Dryopteris filix-mas		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1
	Ranunculus lanuginosus		.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Hedera helix		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	.	+	.	.	.	.	.	.	3
O	Other																																			
	Galeopsis speciosa		.	.	.	.	.	.	.	.	1	+	.	1	1	.	+	+	1	+	.	+	3	+	+	+	.	.	.	3	+	2	+	+	18
	Cardamine amara		.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	3
	Carex sp.		.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	+	.	.	.	.	.	.	3
	Robinia pseudacacia	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
	Robinia pseudacacia	B	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Veronica chamaedrys	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	3
	Salix cinerea	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	+	3
	Echinochloa crus-galli	C	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Mentha sp.		.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Polygonum sp.		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	2
	Equisetum arvense		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	2
	Cardamine impatiens		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	2

in the study area along the Krka and Mirna rivers, the stands of white willow thrive only on small surfaces. They develop under the direct influence of streams just above the mean water level and are often flooded.

The soil is explicitly structureless and only layers of sedimentation are found within it. Particularly along the Krka the sediments are thinly grained with scarce layers of sand. In spite of the high quantity of organic residues (willow leaves, withered parts of tall herbs, river deposits) there is very little humus, since every year organic residues are covered by river sediments which hinder decomposition. Also common, besides accumulation, is erosion, which interrupts the development of the soil and vegetation.

Stritar (1990) classifies this type of soil into the pedosequence on sand and gravel, into the community of riverine soils. He subdivides the riverine soils into those with automorphous development (rough riverine soil, poorly developed riverine soil, developed riverine soil) with A- (B)- C horizon and those with hydromorphous development (riverine gleyic soil), where a different amount of gley occurs.

Willows can be classified among softwood trees. On harsh weather conditions a great deal of boughs break and this biomass additionally contributes to the fertility of the site. This can only be noticed in the stands of white willow, whereas the species of shrub stands are better adapted to mechanical disturbances.

Subdivision into lower units and their synecology

The sites of softwood trees stands are often non-homogenous, which can make the subdivision into lower units very difficult. Additional problem for the classification is a different response of character and differential species to the ecological complex of the site. For this reason we were forced to neglect some differential species quoted in literature because they did not clearly divide subassociations. When defining diagnostic combinations of species we therefore took into consideration several authors (Wendelberger & Wendelberger, 1956; Kárpáti & Kárpáti, 1969). Literature sources presented additional problems since the published relevés are rare, and diagnostic species often not quoted.

SALICETUM ALBAE MYOSOTIDETOSUM I. Kárpáti ex Soó 1958 **(**Tab. 4/ 1-4**)**

Subassociation *myosotidetosum* is found on the lowest positions on the embankment, often in contact with the stands of the association *Salicetum triandrae*. The soil consists of a large proportion of clay particles. Every time the water level rises the stands are flooded, and these floods also last for the longest period of time.

The tree layer consists of white willow exclusively, and the shrub layer is most often missing, besides from

a few shrub examples of willows (*Salix triandra, S. alba*). With higher coverage and frequency the following species occur in the herb layer: *Lysimachia vulgaris, Phalaris arundinacea, Polygonum hydropiper, Urtica dioica*. The species of the alliance *Alnion incanae* and class *Querco-Fagetea* are not to be found in the subassociation.

Within the subassociation *baldingeretosum* Wendelberger-Zelinka (1952) described the variant with the species *Myosotis scorpioides* with the following differential species: *Agrostis stolonifera* agg., *Filipendula ulmaria, Myosotis scorpioides, Polygonum hydropiper, Ranunculus repens, Rorippa sylvestris, Rumex obtusifolius, Salix fragilis*.

Jovanović & Tucović (1965) mention as differential species of the subassociation *myosotidetosum* the following species: *Equisetum palustre, Iris pseudacorus, Juncus articulatus, Lysimachia vulgaris, Myosotis scorpioides, Polygonum lapathifolium, P. hydropiper, Rumex sanguineus, Veronica anagalis-aquatica* etc., and Kárpáti & Kárpáti (1969) *Caltha palustris, Myosotis scorpioides, Poa palustris, P. trivialis, Polygonum hydropiper, Rorippa islandica, Rumex hydrolapathum, R. sanguineus.*

The asssociation *Galio-Salicetum albae* Rauš 1973 can be treated as a synonym of the subassociation *myosotidetosum.*

Listed among the differential species proposed by Kárpáti & Kárpáti (1969), two can be found in the study area: *Myosotis scorpioides* and *Polygonum hydropiper*. Apart from that the subassociation is well characterised by the species *Agrostis stolonifera, Lysimachia vulgaris* and *Rorippa sylvestris*, which connect the subassociation described with the contact association *Salicetum triandrae*.

SALICETUM ALBAE PHRAGMITO-CARICETOSUM Jurko 1958 **(**Tab. 4/ 5**)**

Only one stand of this subassociation was found in the study area, namely at Robic on the flood plain of the Krka River, which is, however, surface limited and only fragmentarily developed. The stand grows in a slight depression which has no outflow and where the water is retained on abundant rainfall or floods.

The tree layer consists of the species *Salix alba*. There is no shrub layer developed. The herb layer is dominated by *Carex gracilis*. As differential species the following were determined in the study area: *Carex appoprinquata, C. vulpina, Juncus effusus, Mentha* x *verticillata* and *Succisella inflexa*.

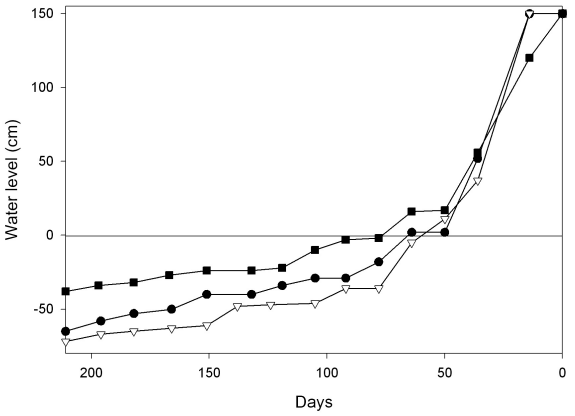
The differential species of the subassociation are the species of tall sedge from the order *Magnocaricion* (*Carex riparia, C. acutiformis* etc.) or *Phragmites australis* (Jovanović & Tucović, 1965).

Kárpáti & Kárpáti (1969) quote as differential the following species: *Carex acutiformis, Erigeron annuus, Eupatorium cannabinum* and *Glyceria maxima*.

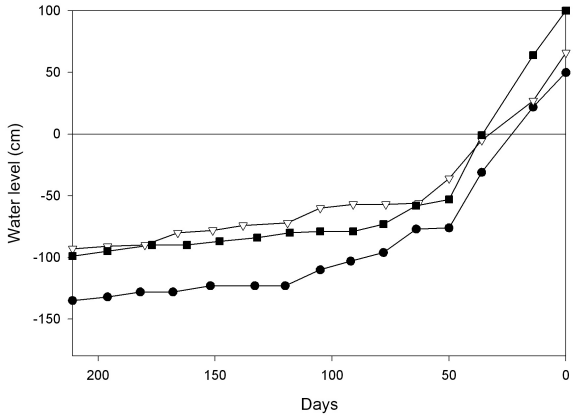
Kárpáti (1982) described the subassociation as rare with a large distribution area. The stands are found in depressions with retaining water and along back waters.

SALICETUM ALBAE typicum (*normale*) Soó 1958 **(**Tab. 4/ 6-14**)**

The subassociation *typicum* is the central subassociation.



Graph 6 - Cumulative frequency diagram in the stands of the subassociation *Salicetum albae myosotidetosum*



Graph 7 - Cumulative frequency diagram in the stands of the association *Salicetum albae typicum*

It remains flooded for up to 50 days during the vegetation season. The shrub layer is already developed within the subassociation, but it is dominated by different willow species which prevail over the species of the class *Rhamno-Prunetea*.

In the herb layer of the typical subassociation Jovanović & Tucović (1965) found: *Althea officinalis, Clematis integrifolia, Mentha aquatica, Phalaris arundinacea, Symphytum officinale, Veronica anagallis- aquatica.*

Kárpáti & Kárpáti (1969) do not mention the differential species. Within the subassociation they described the facies *rubosum* with two differential species: *Rubus caesius* and *Urtica galeopsifolia* Wierzb. ex Opiz.

Kárpáti (1982) mentions as differential the following species: *Angelica sylvestris, Lysimachia nummularia, Symphytum tanaicense*.

Phalaris arundinacea and *Urtica dioica*, which have the highest coverage within the typical subassociation, were taken as differential species.

SALICETUM ALBAE RUBETOSUM (Soó 1958) Šilc subass. nova hoc loco **(**Tab. 4/ 15-22; holotypus Tab. 4/ 17**)**

The subassociation is more similar to the subassociation *cornetosum* than to the subassociation *typicum*, which is not in accordance with the results of Hungarian authors (Kárpáti & Kárpáti, 1969; Kárpáti, 1982). We therefore decided to classify the stands within an autonomous subassociation *rubetosum*, as they remain flooded for a longer period, they have a similar soil water capacity and a smaller average number of species in a relevé than the relevés of a similar subassociation *cornetosum*.

The differential species of the subassociation is *Rubus caesius*, which occurs in the herb layer and in one relevé as a shrub, and which often forms dense stands.

The significance of the species *Rubus caesius* as a differential species was first noted by Slavnić (1952), and later followed by Jovanović & Tucović (1965).

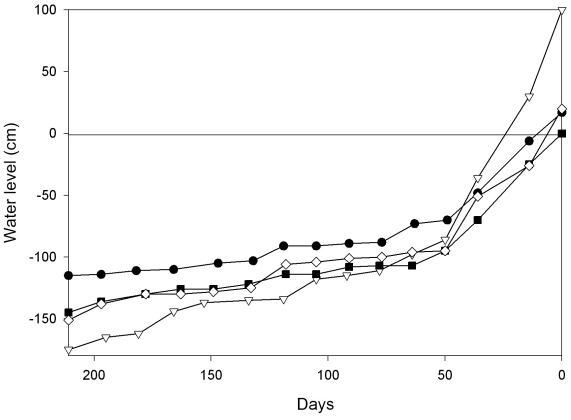
Within the subassociation *rubetosum* occur also the species from the order *Alnion incanae*, and with a higher frequency also the species of the class *Querco-Fagetea*. This way, the successional development towards the subassociation *cornetosum* and groves of hardwood trees is indicated.

The sites of the subassociation are flooded for a shorter period of time than the sites of the subassociations described so far.

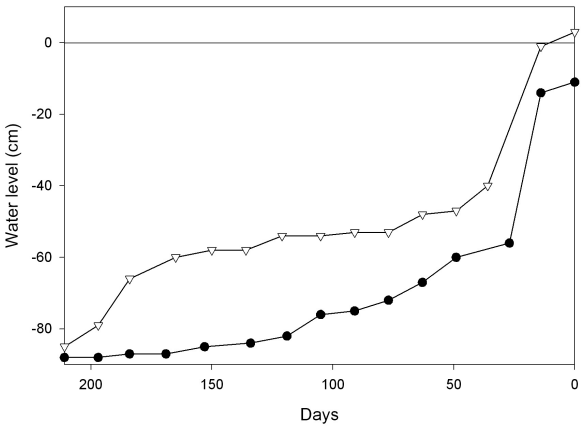
SALICETUM ALBAE CORNETOSUM Wendelberger-Zelinka 1952 **(**Tab. 4/ 23-33**)**

Among all of the stands of white willow the sites of the subassociation *cornetosum* are situated on highest positions on the embankment and are flooded for the shortest period of time, or they grow on more coarse-grained deposits where the water drains faster. These stands are often found along the Krka, and more rarely along the Mirna River.

Salix alba prevails in the tree layer and is occasionally accompanied by *Salix fragilis*. Among all of the subassociations, this subassociation has the best developed shrub layer which consists of the species of



Graph 8 - Cumulative frequency diagram in the stands of the association *Salicetum albae rubetosum*



Graph 9 - Cumulative frequency diagram in the stands of the association *Salicetum albae cornetosum*

the class *Rhamno-Prunetea*: *Cornus sanguinea, Corylus avellana, Crateagus monogyna, Ligustrum vulgare, Prunus spinosa, Rhamnus catharticus, Viburnum opulus.* The liana *Humulus lupulus* occurs with a higher constancy in the shrub layer.

Wendelberger-Zelinka (1952, 1956) mentions the following differential species of the subassociation: *Allium ursinum, Alnus incana, Brachypodium sylvaticum, Carduus crispus, Carex acutiformis, Chaerophyllum temulum, Cirsium oleraceum, Circaea lutetiana, Cornus sanguinea, Euonymus europaea, Fraxinus excelsior, Glechoma hedereacea, Impatiens noli-tangere, Impatiens parviflora, Paris quadrifolia, Prunus avium, Sambucus nigra, Scrophularia nodosa, Senecio fuchsii.*

Kárpáti & Kárpáti (1969) list as differential the following species: *Brachypodium sylvaticum, Cornus sanguinea, Crataegus nigra, Galeopsis pubescens, Fraxinus angustiflolia* subsp. *pannonica, Populus alba, Quercus robur, Ulmus laevis, Viburnum opulus*.

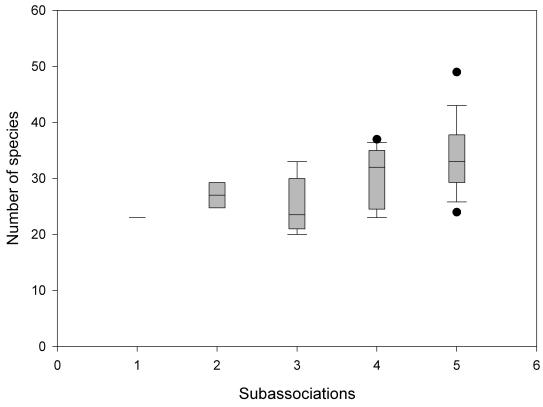
We believe that here the differential species of the subassociation, apart from *Cornus sanguinea,* are also the species: *Allium ursinum, Brachypodium sylvaticum, Corylus avellana, Crataegus monogyna, Ligustrum vulgare, Paris quadrifolia, Prunus spinosa, Rhamnus catharticus, Viburnum opulus*.

The species *Euonymus europaea* and *Sambucus nigra*, which Wendelberger-Zelinka (1952, 1956) also mentions as differential species, occur in our relevés also within other subassociations, but have a higher constancy in the subassociation *cornetosum*.

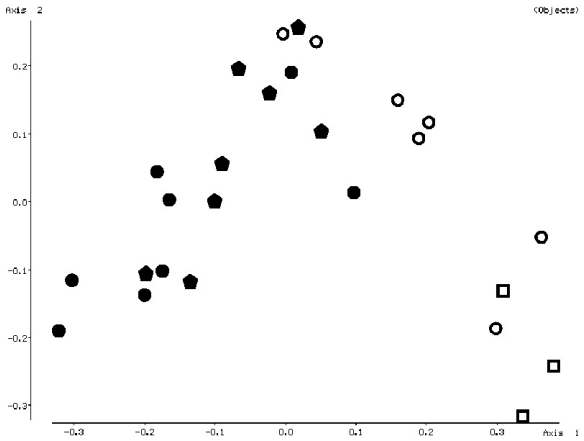
The graph presents the analysis of the relevés from the analytic table (Tab. 4). As statistic method the principal coordinate analysis (PCoA) was used, and Soerensen's index as the similarity measure.

In the direction of the abscissa, the gradient from wettest stands to the shortest time period of the flooded stands is clearly revealed. There is a noticeable arch effect (Podani, 1994).

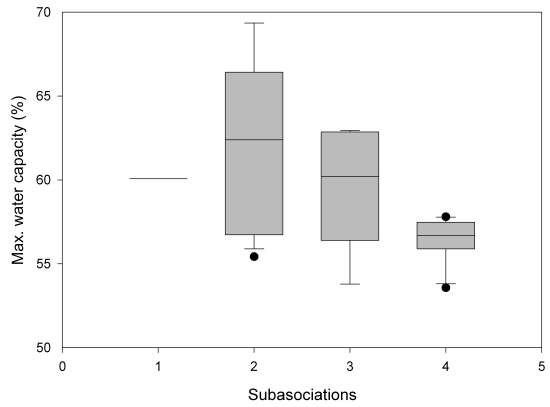
The number of species in relevés increases in relation to the duration of the floods. The shorter the period when the stands of a certain subassociation are flooded, the



Graph 11: The number of species in individual subassociations of the association *Salicetum albae*, represented as Box-and-Whisker plot. The numbers stand for: 1- *caricetosum*, 2- *myosotidetosum*, 3- *typicum*, 4- *rubetosum*, 5- *cornetosum*



Graph 10 - Scatter diagram of the association *Salicetum albae* (Tab. 4). Abbreviations: □ subass. *myosotidetosum*, ○ subass. *typicum*, ⬟ subass. *rubetosum*, ● subass. *cornetosum*



Graph 12 - Maximum water capacity of the soil in volume percentage in different subassociations of the association *Salicetum albae*. The numbers are: 1-*myosotidetosum*, 2-*typicum*, 3- *rubetosum*, 4- *cornetosum*

higher the number of species, which indicates more favourable site conditions and better developed stands.

Water capacity of the soil is connected to the moistness of the site. Longer flooded sites have a larger proportion of fine soil particles and organic substance, and therefore a higher soil capacity for water.

It is difficult to evaluate the subassociation *myosotidetosum* on the basis of only one example. The medians of the subassociations *typicum* and *rubetosum* are very close, but the scattering is very different. The subassociation *cornetosum* has a very narrow span and the lowest soil capacity for water.

BC *SALIX PURPUREA*-[*SALICETEA PURPUREAE*] (Tab 5./1-5)

CHARACTER SPECIES: Wendelberger-Zelinka (1952), who was the first to describe the association *Salicetum purpureae* (due to the absence of character species today only as a synonym), defined as character the following species: *Salix alba, Salix fragilis* and *Salix triandra*, which occur in the shrub layer. Grass (1993) mentions the following diagnostic species combination: *Salix purpurea* B, *Agrostis stolonifera, Deschampsia cespitosa, Phalaris arundinacea, Poa trivialis* and *Ranunculus repens*, which occurs also in the studied stands.

FLORISTIC COMPOSITION: *Salix purpurea* prevails in the shrub layer of the stands. The dominant species is usually accompanied by other shrub species characteristic for the class *Salicetea purpureae*: *Salix alba, Salix eleagnos, Populus nigra*. The height of the shrub layer is 4 m, and its coverage 80 %.

The herb layer has a small coverage (40-50 %). The average number of species in a relevé is higher in comparison with the association *Salicetum triandrae* (25 to 17), which was already mentioned by Jovanovic & Tucovic (1965). In comparison with the association *Salicetum incano-purpureae* the number of species is smaller (25 in comparison with 45), which indicates the pioneer character of the community.

ECOLOGICAL CONDITIONS: The stands dominated by *Salix purpurea* thrive on gravel sites in the lower course of rivers. Average volume percentage of water capacity of the soil is about 20 %, which indicates a poor ability to retain water in the soil.

Subdivision into lower units and their synecology

Numerical analysis of the analytic table shows the division of the stands into two clusters. The first two stands are situated along the Mirna and the other three on gravel sites along the Sava River. Since the stands were classified according to the deductive system of classification, the basal community was additionally subdivided into variants.

BC *SALIX PURPUREA*-[*SALICETEA PURPUREAE*] var. *POLYGONUM LAPATHIFOLIUM* **(**Tab. 5/ 3-5**)**

The stands along the Sava are initial as they occur on gravel sites in which gravel is often being excavated, or which lie directly along the water current. The stands thrive next to the river and are often flooded. Gravel stones are of a larger diameter and there is less fine sand, which is why the site is extremely dried up during the summer.

These stands are classified into the variant with the species *Polygonum lapathifolium*. The variant is, apart from the differential species, clearly defined by the species of the class *Stellarietea mediae*, such as *Chenopodium album, Echinochloa crus-galli, Sinapis arvensis* and others classified within the communities of annual weeds. The variant is related to the subassociation *Salicetum purpureae typicum*, described by Wendelberger-Zelinka (1952).

BC *SALIX PURPUREA*-[*SALICETEA PURPUREAE*] var. *PETASITES HYBRIDUS* **(**Tab. 5/ 1-2**)**

The stands along the Mirna are more developed. They are classified into the variant with the species *Petasites hybridus*. Apart from the aforementioned species the following are classified as differential species: *Lamium maculatum* and *Brachypodium sylvaticum*. Several species of the class *Galio-Urticetea*, among which we classify the communities of nitrophilous edges and riverine communities, thrive in these stands. The variant is related to the typical form of the community with the species *Salix purpurea* according to Seibert & Conrad (1992).

A stand with the dominant species *Phalaris arundinacea* or with *Petasites hybridus* (Fischer, 1997; Rauscher 1990 cit. in Grass 1993) usually develops in front of the willow stand. Due to the shading, willows only rarely thrive in the stands with the species *Petasites hybridus* (Fischer, 1997). Such was an example on the Mirna.

If willow germs settle on bare gravel when the water level is high, they usually decay. The relevé below is an example of such a stand.

Gabrje, the Mirna River, on gravel, 25.9.1998, the surface of the relevé 20 m^2, height above sea level 220 m, coverage of the herb layer 60 %:

Polygonum mite 3, *Salix purpurea* 2, *Phalaris arundinacea* 2, *Agrostis stolonifera* 2, *Ranunculus repens* 1, *Carex* sp. +, *Equisetum arvense* +, *Urtica*

Tab. 5 - BC *Salix purpurea* -[*Salicetea purpureae*] and BC *Salix triandra* -[*Salicetea purpureae*]

	Relevé number		1	2	3	4	5	6	7	8	P
	Relevé area (m²)		40	30	100	150	50	80	50	25	r
	Altitude (m)		220	220	175	175	175	150	150	220	e
	Tree layer A (%)		0	0	0	0	5	0	0	0	s.
	Shrub layer B (%)		80	80	70	90	80	90	100	90	
	Herb layer C (%)		40	40	50	40	50	40	100	50	
	Number of species		22	28	28	30	21	13	12	9	
	Leading speciesLeading species										
	Salix purpurea	B	5	4	4	4	5	.	.	4	6
	Salix triandra		.	.	.	.	.	5	4	1	3
	Diagnostic combination										
MC	Typhoides arundinacea	C	+	2	1	+	2	.	.	.	5
AGR	Agrostis stolonifera		2	2	.	+	1	.	.	.	4
POT	Ranunculus repens		.	+	.	.	.	.	.	.	1
MA	Deschampsia cespitosa		+	.	.	.	.	.	.	.	1
	Differential species of the variant *Petasites hybridus*										
GU	Lamium maculatum		2	2	.	.	.	1	1	1	5
GU	Petasites hybridus		1	1	.	.	.	.	.	.	2
QF	Brachypodium sylvaticum		1	+	.	.	.	.	.	.	2
	Differential species of the variant *Polygonum lapathifolium*										
BID	Polygonum lapathifolium		.	.	3	3	2	.	.	.	3
	Salicetea purpureae										
	Salix alba	A	.	.	.	.	+	.	.	.	1
	Salix alba	B	.	2	+	.	.	.	.	.	2
	Salix x rubens	B	.	.	+	.	.	.	.	.	1
	Populus nigra	B	.	.	1	.	1	.	.	.	2
	Populus nigra	C	.	.	.	1	.	.	.	.	1
	Salix eleagnos	B	.	.	+	1	.	.	.	.	2
	Salix triandra	B	.	.	+	.	.	.	.	.	1
	Salix viminalis	B	.	.	.	+	.	.	.	.	1
	Salix fragilis	B	.	.	.	.	+	.	.	.	1
	Bidentetea										
	Polygonum mite	C	1	+	+	+	.	.	.	.	4
	Stellarietea mediae										
	Stellaria media		+	+	+	.	.	.	.	.	3
	Chenopodium album		.	.	1	1	1	.	.	.	3
	Echinochloa crus-galli		.	.	+	+	.	.	.	.	2
	Sinapis arvensis		.	.	1	1	.	.	.	.	2
	Galinsoga parviflora		.	.	+	+	.	.	.	.	2
	Amaranthus hybridus agg.		.	.	+	+	.	.	.	.	2
	Artemisietea										
	Melilotus alba		.	.	+	+	+	.	.	.	3
	Artemisia vulgaris		+	.	+	.	.	.	.	.	2
			.	.	.	.	.	.	.	.	
	Galio-Urticetea										
	Urtica dioica		.	.	+	+	1	2	4	3	6
	Galium aparine		+	.	.	+	.	+	+	1	5
	Echinocystis lobata	C	.	.	+	+	+	.	3	.	4
	Alliaria petiolata		1	+	.	+	+	.	.	1	5
	Solanum dulcamara	B	.	r	.	.	+	.	.	+	3
	Humulus lupulus	B	.	.	.	.	.	2	+	.	2
	Humulus lupulus	C	.	.	.	.	.	+	.	.	1
	Rubus caesius	B	.	.	.	.	.	2	.	+	2
	Rubus caesius	C	.	+	.	+	.	.	.	.	2
	Saponaria officinalis		+	+	.	.	.	.	.	.	2
	Echinocystis lobata	B	.	.	.	.	.	+	.	.	1
	Rudbeckia laciniata		1	+	.	.	.	.	.	.	2
	Cucubalus baccifer	C	.	+	.	.	.	.	.	.	1
	Calystegia sepium		.	.	.	.	.	2	1	.	2
	Cuscuta europaea	B	.	.	.	.	.	1	.	.	1
	Cuscuta europaea	C	.	.	.	.	.	.	+	.	1
	Impatiens glandulifera		1	.	.	+	.	.	.	.	2
	Aegopodium podagraria		.	+	.	.	.	.	1	.	2
	Molinio-Arrhenatheretea										
	Barbarea vulgaris		+	.	+	+	+	.	.	.	4
	Rumex obtusifolius		+	1	+	+	.	.	.	.	4
	Rumex crispus		.	.	+	+	.	.	+	.	3
	Taraxacum officinale		.	+	+	+	.	.	.	.	3
	Galium mollugo		.	+	.	.	.	+	+	.	3
	Dactylis glomerata		+	+	.	.	.	.	.	.	2
	Rorippa sylvestris		.	.	+	.	1	.	.	.	2
	Other										
	Polygonum aviculare		.	.	+	.	+	.	.	.	2
	Galeopsis speciosa		.	.	.	+	.	1	.	.	2

Tab. 6 - Partial synoptic table of vegetation of the class *Salicetea purpureae* in SE Slovenia

		Salicetum incano-purpureae	BC *Salix purpurea*	*Salicetum triandrae*	BC *Salix triandra*	*Salicetum albae*
Successive number		1	2	3	4	5
Number of relevés		7	5	35	3	31
Differential species of the association *Salicetum incano-purpureae*						
Cirsium oleraceum	C	100	20	6	.	42
Angelica sylvestris		57	.	14	.	51
Geranium robertianum		57	.	.	.	.
Chaerophyllum hirsutum		43	20	.	.	12
Aegopodium podagraria		29	20	8	33	48
Senecio fuchsii		29	.	.	.	.
Lamium maculatum		14	40	23	100	73
Differential species of the alliance *Salicion eleagno-daphnoidis*						
Pinus sylvestris	B	43	.	.	.	.
Carex flacca	C	43	.	.	.	.
Trifolium pratense		14	.	.	.	.
Differential species of the association *Salicetum triandrae*						
Rorippa sylvestris		.	40	51	.	15
Rumex crispus		.	40	20	.	3
Rorippa amphibia		.	.	34	.	15
Differential species of the association *Salicetum albae*						
Alliaria petiolata		.	80	17	33	58
Stellaria media		.	60	3	.	9
Brachypodium sylvaticum		71	40	.	.	9
Saponaria officinalis		100	40	.	.	3
Deschampsia cespitosa		.	20	.	.	3
Differential species of the alliance *Salicion albae*						
Calystegia sepium	B	.	.	40	66	30
Calystegia sepium	C	14	.	26	.	61
Humulus lupulus	B	.	.	14	66	48
Humulus lupulus	C	.	.	3	33	15
Symphytum officinale		.	.	6	33	27
Impatiens glandulifera		.	40	11	.	24
Solidago gigantea		.	20	.	.	9
Character species of the alliance *Salicetalia purpureae* and class *Salicetea purpureae*						
Salix eleagnos	A	43	.	.	.	.
Salix eleagnos	B	100	40	.	.	.
Salix purpurea	B	100	100	17	33	24
Salix alba	A	.	20	.	.	94
Salix alba	B	.	40	.	.	24
Populus nigra	B	.	40	.	.	.
Populus nigra	C	.	20	.	.	.
Salix x rubens	A	.	.	.	.	3
Salix x rubens	B	.	20	.	.	.
Salix triandra	B	.	20	89	100	30
Salix triandra	C	.	.	6	.	.
Salix viminalis	B	.	20	11	.	3
Salix fragilis	A	.	.	.	.	33
Salix fragilis	B	.	20	.	.	6
Salix purpurea x viminalis	B	.	.	3	.	.
Salix sp.	B	.	.	.	.	3
Other						
Solanum dulcamara	C	14	40	66	33	48
Rubus caesius		71	40	14	67	68
Urtica dioica		.	60	94	100	97
Agrostis stolonifera agg.		29	80	77	.	23
Glechoma hederacea		14	.	17	33	84
Galium aparine		.	40	9	100	68
Echinocystis lobata		.	60	17	33	48
Galeopsis speciosa		.	20	11	33	52
Taraxacum officinale		86	60	23	.	13
Artemisia vulgaris		14	40	9	.	29
Galium mollugo		.	20	6	67	10
Dactylis glomerata		29	40	3	.	6
Phalaris arundinacea		.	100	91	.	77
Echinocystis lobata		.	.	57	33	45
Polygonum mite		.	80	46	.	32
Ranunculus repens		.	20	49	.	29
Lysimachia vulgaris		57	.	20	.	29
Barbarea vulgaris		.	80	17	.	6
Scrophularia nodosa		.	20	11	.	23
Rudbeckia laciniata		.	40	6	.	23
Rumex obtusifolius		.	80	6	.	16
Petasites hybridus		100	40	.	.	3
Sambucus nigra		14	.	3	.	26
Cardamine matthioli		.	20	20	.	3
Cuscuta europaea		.	.	3	33	23
Myosoton aquaticum		.	20	3	.	19
Silene latifolia ssp. alba		43	.	3	.	10
Plantago major		14	20	14	.	.
Echinochloa crus-galli		.	40	6	.	6
Galeopsis pubescens		.	20	3	.	13
Persicaria lapathifolia		14	60	3	.	.
Mentha species		14	.	3	.	6
Plantago lanceolata		.	20	3	.	3
Other species		100	21	42	2	100

dioica +, *Petasites hybridus* +, *Plantago lanceolata* r, *Rumex* sp.+, *Scrophularia umbrosa* r.

Along the Sava, stands with the species *Polygonum lapathifolium* which can be classified within DC *Polygonum lapathifolium*-[*Stellarietea mediae*] thrive before the willow stands.

BC *SALIX TRIANDRA*-[*SALICETEA PURPUREAE*] (Tab. 5/ 6-8)

In the gaps of white willow stands the species *Salix triandra* can branch out forming thick stands. Moor (1958) mentions similar stands of the species *Salix triandra* and *S. viminalis* as secondary scrub communities and stages of overgrowth. Similar stands of almond wilow are secondary communities on grove sites of the alliance *Alnion incanae* (Jurko, 1964).

The community is not perrenial, but the successional development can be hold up by flooding or periodical hewing, so the community can persist for a longer time.

The community is rare as the sites of white willow have been converted into farming land or meadows. In the study area it was found only along the Krka.

CHARACTER SPECIES: The community is classified applying the same principle as with the community with the dominating species *Salix purpurea*. The leading species is *Salix triandra*, and constant companions are:

Galium aparine, Lamium maculatum, Rubus caesius and *Urtica dioica.*

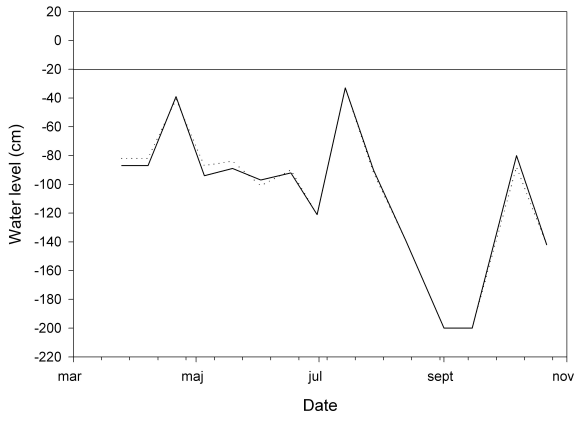
Jurko (1964) mentioned the following species from the local character and differential species of the related association *Calystegio-Salicetum triandrae*: *Alnus glutinosa, Calystegia sepium, Lythrum salicaria* ?, *Phalaris arundinacea* ?, *Phragmites australis, Salix alba, Salix triandra, Salix viminalis* and *Stachys palustris.*

Among the abovementioned species only *Salix triandra* and *Calystegia sepium* occur in our stands.

FLORISTIC COMPOSITION: Two species are found in the shrub layer: *Salix triandra* and *S. purpurea*, one of them usually prevailing. They are accompanied by the lianas *Humulus lupulus, Calystegia sepium, Cuscuta europaea, Echinocystis lobata*. The shrub layer is 2 metres high at the most, and its coverage is 90 %.

The species *Urtica dioica* has the highest coverage in the herb layer. A higher constancy have the species *Lamium maculatum, Galium aparine* and *Rubus caesius*. Apart from the leading species of the community, species of the classes *Artemisetea* and *Galio-Urticetea* also thrive in the stands.

ECOLOGICAL CONDITIONS: Volume percentage of the soil capacity for water is about 60 %, which is comparable to the results obtained in white willow stands. These results and oscillation of underground water clearly indicate the connection between the site of BC *Salix triandra*-[*Salicetea purpureae*] with the sites of the association *Salicetum albae*. The studied stand was not flooded in 1999, so the ground water decreased to 200 cm.



Graph 13 - Fluctuation diagram of the underground water level in the stands of BC *Salix triandra*-[*Salicetea purpureae*] in 1999

Conclusions

The syntaxa studied are presented in the synoptic table (Tab. 6). *Salix eleagnos* and *Salix purpurea* are the dominant species in the association *Salicetum incano-purpureae*. The majority of differential species of the association are from the class *Galio-Urticetea*, order *Molinietalia*, which indicate a moist and eutrophic site. Differential species of the alliance *Salicion eleagno-daphnoidis* are the species of dry sites, while the differential species of the alliance *Salicion albae* are the species of moist sites, rich in nutrients.

The shrub layer of the association *Salicetum triandrae* is dominated by almond willow accompanied by *Salix viminalis* and *Salix purpurea*. The differential species of the association are *Rorippa sylvestris, Rorippa amphibia* and *Rumex crispus.*

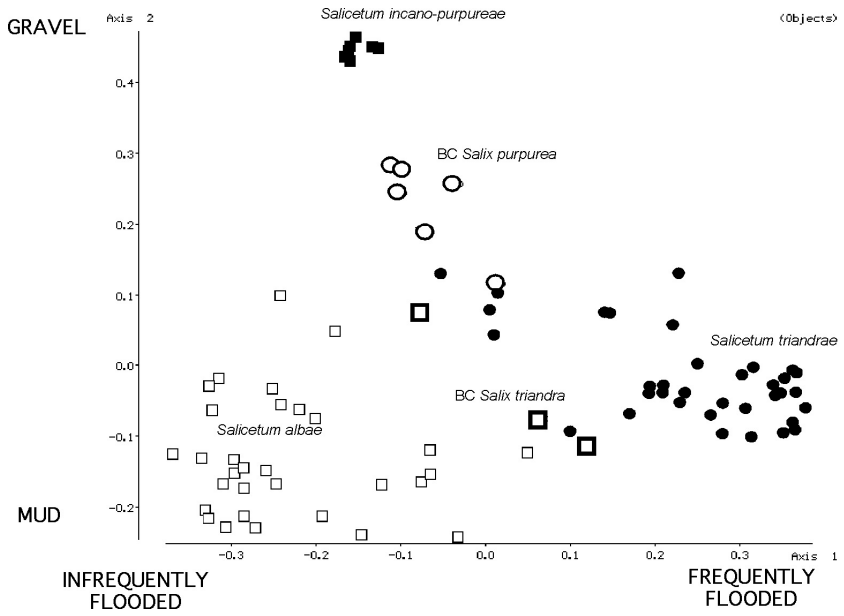
The tree layer of the association *Salicetum albae* is dominated by *Salix alba*, in the company of *Salix fragilis*. The shrub layer is badly developed. While the differential species of the association are poorly represented, there are more differential species of the alliance.

Transitional characters of both basal communities are evident in the synoptic table. The stands classified into BC *Salix purpurea* thrive on gravel sites and are more initial than the stands of the association *Salicetum incano-purpureae*. Within the synsystem stands of BC *Salix purpurea* have a transitional character between the alliances *Salicion eleagno-daphnoidis* and *Salicion albae*.

Similarly transitional position have the stands dominated by almond willow, classified into the BC *Salix triandra*. They grow on the site of the association *Salicetum albae* and are a stage in succession of overgrowth. In the herb layer, the species of the class *Galio-Urticetea* are found above all.

Numerical analysis (Graph 14) shows a clear differentiation of the stands in two gradients. The abscissa shows the gradient of moisture, and the ordinate the texture. Even the transitional position of basal communities is clearly seen. The basal community of red willow is between both alliances, and the basal community of almond willow is the transition between the associations *Salicetum triandrae* and *Salicetum albae*.

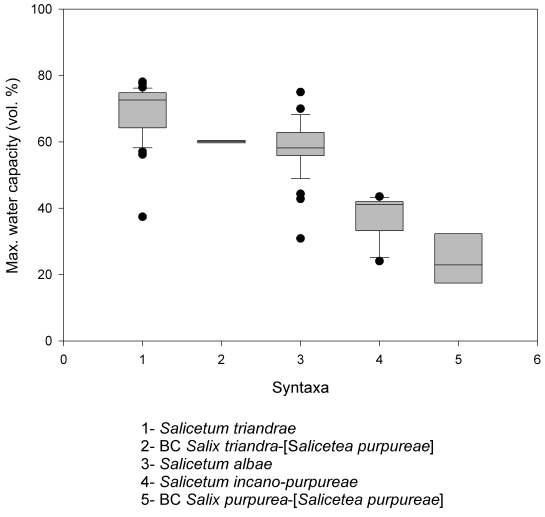
Maximum water capacity of the soil shows the differences in the quantity of water that a certain soil type can retain. It is highest in the stands classified into the alliance *Salicion albae.* Gravel and sand, where the



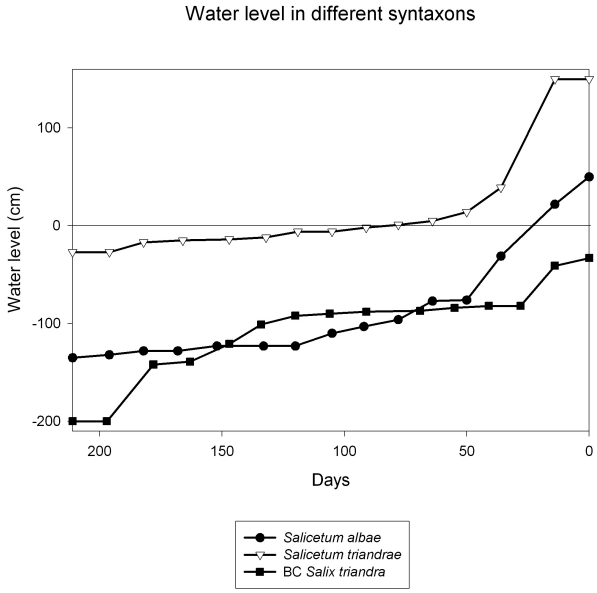
Graph 14 - Ordination of the synoptic table of the class *Salicetea purpureae* in SE Slovenia (PCoA, coefficient of similarity)

association *Salicetum incano-purpureae* and the basal community of red willow grow, have the smallest water capacity.

The stands of the association *Salicetum triandrae* were flooded for about 50 days, and those of the association *Salicetum albe* only half as long. The ground water in the association *Salicetum triandrae* decreases for only 30 cm under the surface, but in the association *Salicetum albae* for as much as 135 cm. It drops even lower in the basal community of almond willow which thrives on the site of the driest subassociation *Salicetum albae cornetosum*.



Graph 15 - Maximum water capacity of the soil in individul syntaxa of the class *Salicetea purpureae*



Graph 16 - Measurements of the ground water level in selected stands of individual typical forms of the associations

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Appendix

Tab. 1 - *Salicetum incano-purpureae*

Localities:

1: 0056/2, Bistrica, Brod; 2: 0056/3, Bistrica, Preska; 3: 0056/3, Bistrica, pri sotocju Bena; 4: 0056/2, Bistrica, Brod; 5: at confluence with Bena 0056/3, Bistrica, V. vrh; 6: 0056/3, Bistrica, V. vrh; 7: 0056/3, Bistrica, V. vrh.

Date of the relevé:

1: 29. 07. 99; 2: 29. 07. 99; 3: 24. 07. 98; 4: 29. 07. 99; 5: 29. 07. 99; 6: 29. 07. 99; 7: 29. 07. 99.

Species present in only one relevé:

1: *Cardamine flexuosa* r, *Artemisia vulgaris* +, *Solanum dulcamara* +, *Sambucus nigra* +, *Thalictrum flavum* +; 2: *Ulmus glabra* +, *Aposeris foetida* +, *Hepatica nobilis* +, *Bromus ramosus* +, *Primula vulgaris* +; 3: *Petasites albus* +, *Plantago major* +; 4: *Listera ovata* r, *Fagus sylvatica* r, *Campanula trachelium* r, *Silene vulgaris* subsp. *vulgaris* +, *Glechoma hederacea* +, *Rhamnus catharticus* B +, *Festuca gigantea* +, *Anemone nemorosa* +, *Holcus lanatus* +, *Cyclamen purpurascens* +; 5: *Ligustrum vulgare* B +, *Euonymus europaea* B +, *Senecio germanicus* +, *Mentha* sp.+; 6: *Melilotus alba* +, *Festuca rubra* +, *Hypericum perforatum* +, *Peucedanum oreoselinum* +, *Polygonum lapathifolium* +, *Viola* sp. +, *Thymus serpyllum* +; 7: *Calystegia sepium* +, *Pulmonaria officinalis* +, *Knautia arvensis* +, *Trifolium pratense* +, *Lathyrus* sp.+.

Tab. 3 - *Salicetum triandrae*

Localities:

1: 0057/1, Mirna, Pijavice; 2: 0057/1, Mirna, Pijavice; 3: Krka, Veliko Mracevo; 4: 0155/4, Krka, Žužemberk; 5: 0158/2, Krka, Karelče; 6: 0157/2, Krka, Bela cerkev; 7: 0157/2, Krka, Gorenja Gomila; 8: 0159/1, Krka, Dolenja Pirošica; 9: 0159/1, Krka, Dolenja Pirošica; 10: 0158/1, Krka, Dobrava pri Škocjanu; 11: 0158/1, Krka, Malence, Robič; 12: 0158/2, Krka, Brod pri Podbočju; 13: 0158/1, Krka, Malence, Robič; 14: 0157/2, Krka, Stranje pri Škocjanu; 15: 0157/2, Krka, Bela cerkev; 16: 0158/2, Krka, Karelče; 17: 0159/1, Krka, Gazice; 18: 0157/2, Krka, Breška vas; 19: 0157/2, 0157/2, Krka, Gorenja Gomila; 20: 0159/1, Krka, Gazice; 21: 0158/1, Dobrava pri Škocjanu; 22: 0158/2, Krka, Brod pri Podbočju; 23: 0155/4, Krka, Žužemberk; 24: 0256/2, Krka, Zalog, Straža; 25: 0157/2, Krka, Bela cerkev; 26: 0158/1, Krka, Dobrava pri Škocjanu; 27: 0057/1, Mirna, Gabrje; 28: 0158/3, Krka, Kostanjevica, Dobe; 29: 0158/3, Krka, Kostanjevica, Dobe; 30: 0157/2, Krka, Breška vas; 31: 0157/2, Krka, Breška vas; 32: 0157/3, Krka, Otočec; 33: 0158/2, Krka, Brod pri Podbočju; 34: 0157/2, Krka, Breška vas; 35: 0155/4, Krka, Žužemberk.

Date of the relevé:

1: 24. 07. 98; 2: 24. 07. 98; 3: 03. 09. 98; 4: 01. 07. 98; 5: 25. 09. 98; 6: 06. 07. 98; 7: 02. 07. 98; 8: 02. 07. 98; 9: 30. 07. 98; 10: 26. 08. 98; 11: 02. 07. 98; 12: 31. 07. 98; 13: 06. 07. 98; 14: 31. 07. 98; 15: 10. 07. 98; 16: 28. 07. 98; 17: 03. 09. 98; 18: 10. 07. 98; 19: 02. 07. 98; 20: 09. 09. 99; 21: 12. 8. 99; 22: 09. 09. 99; 23: 09. 09. 99; 24: 26. 08. 98; 25: 09. 07. 98; 26: 03. 09. 98; 27: 10. 09. 99; 28: 06. 07. 98; 29: 10. 07. 98; 30: 28. 07. 98; 31: 30. 06. 98; 32: 02. 07. 98; 33: 06. 07. 98; 34: 09. 09. 99; 35: 01. 07. 98.

Species present in only one relevé:

1: *Myosoton aquaticum* +; 2: *Impatiens noli-tangere* +; 3: *Stellaria media* +, *Rumex* sp. +; 4: *Cuscuta europaea* +; 5: *Erysimum cheiranthoides* r; 6: *Plantago lanceolata* +, *Dactylis glomerata* +, *Euonymus europaea* +; 9: *Oxalis fontana* r, *Parietaria officinalis* +, *Poa palustris* +; 13: *Rumex conglomeratus* +; 22: *Cyperus fuscus* +; 23: *Silene alba* +, *Galeopsis pubescens* +, *Caltha palustris* +; 25: *Capsella bursa-pastoris* r; 26: *Polygonum lapathifolium* +; 27: *Carex* sp. 1; 28: *Sambucus nigra* +, *Senecio erraticus* +; 35: *Filipendula ulmaria* +; *Mentha* sp. +; *Valeriana dioica* +.

Tab. 4 - *Salicetum albae*
Localities:
1: 0157/2, Krka, Stranje pri Škocjanu; 2: 0157/2, Krka, Gorenja Gomila; 3: 0157/2, Krka, Gorenja Gomila; 4: 0157/2, Krka, Gorenja Gomila; 5: 0158/1, Krka, Malence, Robič; 6: 0158/1, Krka, Malence, Robič; 7: 0158/3, Krka, Kostanjevica, Dobe; 8: 0157/2, Krka, Stranje pri Škocjanu; 9: 0158/2, Krka, Veliko Mrasevo; 10: 0159/1, Krka, Gazice; 11: 0157/2, Krka, Družinska vas; 12: 0157/2, Krka, Stranje pri Škocjanu; 13: 0158/1, Radulja, Dobrava pri Škocjanu; 14: 0157/2, Krka, Breška vas; 15: 0057/1, Mirna, Pijavice, S, 5°; 16: 0057/1, Mirna, Gabrje; 17: 0159/1, Krka, Dolenja Pirošica, NNW, 5°; 18: 0159/1, Krka, Dolenja Pirošica, SW, 5°; 19: 0157/3, Krka, Otočec; 20: 0057/1, Mirna, Gabrje; 21: 0159/2, Krka, Krka, Čatez ob Savi; 22: 0057/1, Mirna, Pijavice; 23: 0057/1, Mirna, Gabrje; 24: 0158/2, Krka, Karelče; 25: 0057/1, Mirna, Dol; 26: 0155/4, Krka, Zužemberk; 27: 0155/4, Krka, Zužemberk; 28: 0157/2, Krka, Gorenja Gomila; 29: 0158/2, Krka, Karelče; 30: 0057/1, Mirna, Pijavice; 31: 0159/2, Krka, Čatez ob Savi; 32: 0057/2, Mirna, Puščava; 33: 0057/2, Mirna, Puščava.
Date of the relevé:
1: 10. 07. 98, 2: 12. 08. 99, 3: 03. 09. 98, 4: 09. 09. 99, 5: 03. 06. 98, 6: 31. 07. 98, 7: 06. 07. 98, 8: 10. 07. 98, 9: 03. 09. 98, 10: 31. 07. 98, 11: 22. 09. 98, 12: 10. 07. 98, 13: 26. 08. 98, 14: 26. 08. 98, 15: 08. 07. 98, 16: 24. 07. 98, 17: 26. 08. 98, 18: 26. 08. 98, 19: 22. 09. 98, 20: 25. 09. 98, 21: 10. 09. 99, 22: 27. 06. 98, 23: 24. 07. 98, 24: 06. 07. 98, 25: 25. 09. 98, 26: 23. 09. 98, 27: 23. 09. 98, 28: 22. 09. 98, 29: 08. 07. 98, 30: 27. 06. 98, 31: 10. 09. 99, 32: 14. 10. 99, 33: 14. 10. 99.
Species present in only one relevé:
1: *Plantago lanceolata* +; 2: *Acer negundo* B 1, *Conyza canadensis* 1, *Cardamine pratensis* +, *Ranunculus aquaticus* +, *Veronica beccabunga* +; 3: *Sonchus oleraceus* +; 5: *Rosa* sp. B +; 6: *Leersia oryzoides* +; 7: *Scutellaria galericulata* +, *Galeopsis* sp. +; 10: *Phragmites australis* 1; 13: *Campanula trachelium* r, 15: *Convolvulus arvensis* +; *Chaerophyllum bulbosum* +; 16: *Lamium orvala* 2; *Impatiens parviflora* +, *Agropyron caninum* +; 17: *Fraxinus excelsior* A 2, *Chaerophyllum* sp. +; 19: *Ulmus laevis* A 3; 20: *Alnus incana* A 1, *Cucubalus baccifer* +; 22: *Salix caprea* B 1, *Phleum pratense* +, *Ajuga reptans* +; 23: *Acer pseudoplatanus* B 1, *Prunus avium* B +, *Lunaria rediviva* 1, *Poa nemoralis* +, *Rumex* sp. +, *Petasites hybridus* 1, *Pimpinella major* +, *Holcus lanatus* +, *Carpinus betulus* B r, *Equisetum telmateia* +; 26: *Asplenium trichomanes* r, *Lychnis flos-cuculi* +, *Cirsium palustre* +; 29: *Cirsium arvense* +; 30: *Agropyron repens* +; 31: *Oxalis acetosella* +, *Athyrium filix-femina* +; 32: *Rumex crispus* +; 33: *Euonymus verrucosa* B 1, *Leucojum aestivum* +.

Tab. 5 - BC *Salix purpurea*-[*Salicetea purpureae*] and BC *Salix triandra*-[*Salicetea purpureae*]
Localities:
1: 0057/1, Mirna, Gabrje; 2: 0057/1, Mirna, Gabrje; 3: 0058/1, Sava, Blanca; 4: 0058/1, Sava, Blanca; 5: 0058/2, Sava, Pijavško; 6: 0159/1, Dolenja Pirošica; 7: 0159/1, Dolenja Pirošica; 8: 0155/4, Zužemberk, Dvor.
Species present in only one relevé:
1: *Cardamine matthioli* +, *Ajuga reptans* +, *Chaerophyllum hirsutum* + , *Melandryum album* +, 2: *Cirsium oleraceum* r, *Plantago lanceolata* r , *Plantago major* + , *Veronica chamaedrys* + , *Trifolium* sp. +, *Carex acuta* +, *Mentha longifolia* +, 3: *Setaria pumila*+, *Lotus corniculatus* + , *Galeopsis pubescens* +, 4: *Sonchus oleraceus* +, *Reynoutria japonica* +, *Myosoton aquaticum* +, *Galinsoga ciliata* +, *Tanacetum vulgare* +, 5: *Capsella bursa-pastoris* r, *Helianthus tuberosus* 1, *Fallopia convolvulus* +, *Scrophularia nodosa* +, *Solidago gigantea* +, 6: *Glechoma hederacea* +, 7: *Ficaria verna* +, *Symphytum officinale* +.
Date of relevés
1: 25. 09. 98; 2: 25. 09. 98; 3: 15. 07. 99; 4: 15. 07. 99; 5: 15. 07. 99; 6: 30. 7. 98; 7: 21. 4. 99; 8: 7. 10. 99.