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Original scientific paper

SPIRAEA SALICIFOLIA L. IN CROATIAN FORESTS

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The willow-like meadowsweet (*Spiraea salicifolia* L.) is an extremely rare shrub in the forest associations of Croatia. After investigating the forest vegetations of Croatia for many years, and analyzing numbers of phytocoenological surveys of other authors, we have so far established only three forest locations where this species grows: Drežničko Polje in the wider Ogulin area; the area of Česma near Vrbovec and the Đurđevac lowland forests near the Podravina village of Kalinovac (Fig. 1).

On the first location, it grows in the association of *Genisto elatae-Quercetum roboris* Horv. 38; on the second, *Frangulo-Alnetum glutinosae* Rauš 69, and the third, in the phytocoenoses of *Pruno-Fraxinetum* Oberd. 53 and *Carici elongatae-Alnetum glutinosae* Koch 26. The habitats of these associations are of higher or lesser depression and are occasionally flooded. *Spiraea salicifolia* has not been clearly defined sociologically, and Central European authors classify it as a characteristic species of the alliance *Pruno-Rubion fruticosi* Doing 62.

Two localities in the forest associations in which these species appears have therefore been proclaimed special forest vegetation reserves, whereas the Česma locality has recently been recommended for such protection.

Introduction

Spiraea salicifolia (Fig. 2) is a Euroasian continental species distributed upon prevailing moist meadows, bogs, forest margins, near rivers, streams and small lakes, but also in alder and willow forests in Central



Fig. 1. Localities of *Spiraea salicifolia* in Croatian forests:

- A — Drežničko polje near Ogulin
- B — Česma near Vrbovec
- C — Crni jarci near Đurđevac

Europe, Asia and North America. Such a wide area is the consequence of spontaneous distribution and cultivation of the plant. Thus some authors think that the original area of the plant is in Eastern Europe and Asia, where from it naturally grew west to Czechoslovakia and Upper Austria, and south to Hungary (Hegi 1923:679, Hees et al. 1970:479, Oberdorfer 1983:499 and others); from there it was brought to West Europe and North America. Hegi (1923:679) quotes the surroundings of Maribor and Ljubljana as southernmost locations of its distribution.

In Slovenia it is recorded in the Subpannonian and Prealpine regions (Martinčić and Sušnik 1984:180, Erker 1987:300). In the flora of Croatia it is recorded on locations in Moslavina and the Sava basin (Posavina) downstream from Sisak (Schlosser and Vukotinić 1869:115), where it is also mentioned as cultivated and wild species by Domac (1979:183). In the forest associations of Croatia it was brought by Glavač (1960) in the association *Carici elongatae-Alnetosum glutinosae* from Podravina. He considers it a sociologically important species of black alder forests, though he does not specify its special features. *Spiraea salicifolia* was later mentioned by Horvat et al. (1974), mainly based on the quoted Glavač's research.

As to the ecologically indicating characteristics of the willow-like meadowsweet, Oberdorfer (1983) points out its connection with the strongly moisturized, occasionally flooded, non-carbonate, sandy lime soils rich in nutrients; Landolt (1977:126) takes it as an indicator of moist soils, in terms of humidity changeable, slightly acid, neutral or slightly alkaline, well nutritious, moderately humus-containing, fine, sandy, permeable soils and of partly shadowy, in Central Europe deep, locations.

In the many years of our phytocoenological research into the Croatian forest vegetation, the species of *Spiraea salicifolia* was identified on three biologically important and in many ways specific locations. In all three associations, permanent plots of the international research programme 'Man and Biosphere' were established (Fig. 1).

Habitats of *Spiraea salicifolia*

The synecological and vegetational features of the locations

1. Drežničko Polje

Drežničko Polje is located along the motor road Jezerane-Drežnica, at an altitude of between 437 m and 444 m mean sea level. In the north part there are peduncled oak and greenwood stands (*Genisto elatae-Quercetum roboris*, Fig. 3), extremely rare in this area. The principal reason for the growth and survival of this association in Drežničko Polje is the specific water regime characteristic of some karst fields in this part of Croatia. Along the north margin of Drežničko Polje there are numbers of small occasional sources, while along the southwest margin there are several precipices into which water flows during the rainy periods. Thus in springtime, the melting snow threatens with flooding the most part of the field and the forests, whereas the water in depressions is in places 10 m deep.

The geological base of Drežničko Polje consists of the Quaternary unsorted alluviums of autochthonous rocks of diverse granulation. The soils are calcocambisols. The floristic characteristics of the peduncled oak and greenwood forest can be presented by a survey made on 18th May 1988 in Section 40, area 400 sq. m.:

I Tree layer		III Herb layer	
<i>Quercus robur</i>	5.5	<i>Euphorbia palustris</i>	2.2
<i>Acer campestre</i>	—	<i>Filipendula ulmaria</i>	2.3
<i>Fraxinus americana</i> (cult.)	—	<i>Lysimachia vulgaris</i>	2.1
<i>Prunus padus</i>	+	<i>Rubus caesius</i>	2.1
<i>Malus sylvestris</i>	+	<i>Filipendula vulgaris</i>	—
<i>Tilia cordata</i>	+	<i>Carex elata</i>	+
<i>Ulmus laevis</i>	+	<i>Deschampsia caespitosa</i>	—
<i>Salix cinerea</i>	+	<i>Carex distans</i>	—
II Shrub layer		<i>Melampyrum nemorosum</i>	+
<i>Genista tinctoria</i>	3.3	<i>Valeriana officinalis</i>	—
<i>Spiraea salicifolia</i>	2.3	<i>Cornus sanguinea</i>	+
<i>Crataegus monogyna</i>	2.2	<i>Corydalis cava</i>	+
<i>Viburnum opulus</i>	1.1	<i>Pteridium aquilinum</i>	+
<i>Cornus sanguinea</i>	1.2	<i>Rubus idaeus</i>	+
<i>Rosa arvensis</i>	+	<i>Stachys palustris</i>	+
<i>Staphylea pinnata</i>	+	<i>Lychnis flos-cuculi</i>	—
<i>Frangula alnus</i>	+	<i>Trifolium rubens</i>	+
<i>Corylus avellana</i>	+	<i>Convallaria majalis</i>	+
		<i>Frangula alnus</i>	—
		<i>Torilis japonica</i>	—

It should be noted that these stands have not been investigated in detail so far, though the floral composition and the structure of the association are indicative of its nature. The peduncled oak stands in the karst fields are of refugial character and they have remained here ever since the postglacial time. This unique location has been protected and no endangering activities or fellings are allowed. It could be threatened by ameliorative operations which have been planned in this field several times.

2. Česma near Vrbovec

Spiraea salicifolia grows in the 89d Section of the 'Česma' management unit on an area of 2.6 ha. This is an exceptionally beautiful, scientifically important ninety year old black alder and buckthorn (*Frangulo-Alnetum glutinosae*) forest growing upon characteristic 1.5 m high cones. The stand's altitude is 107 m.s.l., in a typical depression which is, compared to the neighbouring associations, the most exposed to floods and moisture. The phytocoenological survey of 28 July, 1988 on 400 sq. m established the following floral composition (see p. 111).

Owing to its specific floral composition and already extremely rare natural stands of the association *Frangulo-Alnetum glutinosae*, this section was recommended for protection in 1988. Since this has not been accepted by any of the authorized institutions, yet it should urgently be taken care of.



Fig. 2. *Spiraea salicifolia* in the Česma area



Fig. 3. The *Genisto elatae-Quercetum roboris* with *Spiraea salicifolia* in Drežničko polje

I Tree layer

<i>Alnus glutinosa</i>	5.5
<i>Fraxinus angustifolia</i>	--

II Shrub layer

<i>Spiraea salicifolia</i>	2.3
<i>Frangula alnus</i>	2.3
<i>Rubus fruticosus</i>	1.2
<i>Salix capraea</i>	1.2
<i>Ulmus minor</i>	--
<i>Sambucus nigra</i>	--
<i>Quercus robur</i>	--

III Herb layer

<i>Carex riparia</i>	3.4
<i>Carex elongata</i>	2.3
<i>Solanum dulcamara</i>	2.3

<i>Carex elata</i>	2.2
<i>Iris pseudacorus</i>	1.2
<i>Lycopus europaeus</i>	1.2
<i>Peucedanum palustre</i>	1.2
<i>Bidens tripartita</i>	1.2
<i>Alisima plantago-aquatica</i>	1.2
<i>Dryopteris carthusiana</i>	1.2
<i>Urtica dioica</i>	+ .2
<i>Nephrودیум filix-mas</i>	+ .2
<i>Frangula alnus</i>	+
<i>Euphorbia palustris</i>	+
<i>Polygonum hydropiper</i>	+
<i>Glechoma hederacea</i>	+
<i>Lysimachia vulgaris</i>	+
<i>Impatiens noli-tangere</i>	+
<i>Myosotis scorpioides</i>	+
<i>Circaea lutetiana</i>	+ .
<i>Galium palustre</i>	+ .

3. The Đurđevac lowland forests near Kalinovac

This area is the largest and the most important habitat of the black alder forests and, accordingly, of the species *Spiraea salicifolia* in Croatia. The forest spreads individually or in groups in two forest associations: *Carici elongatae-Alnetum glutinosae* and *Pruno-Fraxinetum*. According to Glavač (1960:4), black alder forests in the basins of the rivers Drava and Sava are of a distinguished relict origin, so that judging by the peat character of the soils, black alder conquered these areas in the earlier periods of the Postglacial.

The following is a phytocoenological survey from the permanent plot in 27th compartment of the *Pruno-Fraxinetum* association (21 Aug. 1986, 400 sq. m):

I Tree layer

<i>Alnus glutinosa</i>	5.5
<i>Fraxinus angustifolia</i>	1.1
<i>Carpinus betulus</i>	+
<i>Acer campestre</i>	+
<i>Ulmus minor</i>	+

II Shrub layer

<i>Prunus padus</i>	2.2
<i>Corylus avellana</i>	2.2
<i>Spiraea salicifolia</i>	1.2
<i>Cornus sanguinea</i>	1.2
<i>Sambucus nigra</i>	1.2
<i>Crataegus oxyacantha</i>	1.1
<i>Acer campestre</i>	1.1
<i>Frangula alnus</i>	+
<i>Fraxinus angustifolia</i>	+
<i>Ulmus minor</i>	+
<i>Euonymus europaea</i>	+

III Herb layer

<i>Lamiastrum galeobdolon</i>	4.5
<i>Urtica dioica</i>	3.3
<i>Rubus caesius</i>	1.2
<i>Glechoma hederacea</i>	1.2
<i>Veratrum album</i>	1.2
<i>Dentaria polyphylla</i>	1.2
<i>Carex elata</i>	+ .2
<i>Carex brizoides</i>	+ .2
<i>Iris pseudacorus</i>	+ .2
<i>Cerastium sylvaticum</i>	+ .2
<i>Asarum europaeum</i>	+ .2
<i>Carex strigosa</i>	+ .2
<i>Oxalis acetosella</i>	+ .2
<i>Hedera helix</i>	+
<i>Polygonum hydropiper</i>	+
<i>Galeopsis tetrahit</i>	+
<i>Mercurialis perennis</i>	+
<i>Oxalis stricta</i>	+
<i>Circaea lutetiana</i>	+
<i>Callitha palustris</i>	+

It should be noted that only 10% of this region's surface has been categorized as a protected area known as 'Crni jarci', a special reserve of forest vegetation. It is an extremely important area as, besides *Spiraea salicifolia*, there are also other rare species of this part of Europe such as *Prunus padus* and *Veratrum album*.

The stability of this complex has recently been threatened by stations and drillings of the earth gas, uncontrolled gathering of medical herbs and similar activities of man.

Conclusions

In the forests of Croatia we have established only three locations on which the willow-like meadowsweet autochthonously grows in four related though different associations. Its sociological importance cannot accordingly be connected with forest ecosystems, though it plays a significant role in the forests dominated by black alder. The ecologically indicating properties of the willow-like meadowsweet are, however, considerably more closely defined, so that the already quoted properties (Landolt 1977, Oberdorfer 1983) are also applied to the lowland part of Croatia. The considerable number of the phytocoenological surveys, out of which three are quoted in the paper, do not enable us to make connections between the willowlike meadowsweet and other species in order to clearly define an ecological assembly.

In future phytocoenological research of Croatian forests (primarily of the *Salicetum* association) attention should necessarily be paid to the possible appearance of *Spiraea salicifolia*, so that final judgement could be made on the significance, range and character of its distribution in this part of southeastern Europe.

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SAŽETAK

SPIRAEA SALICIFOLIA L. U ŠUMAMA HRVATSKE

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Vrbolika suručica (*Spiraea salicifolia* L.) vrlo je rijedak grm u šumskim zajednicama Hrvatske. Dugogodišnjim vlastitim istraživanjima šumske vegetacije Hrvatske i analizom velikog broja fitocenoloških snimaka ostalih autora ustanovili smo zasad samo tri šumska lokaliteta na kojima ta vrsta raste: u Drežničkom polju na širem području Ogulina, u predjelu Česma kod Vrbovca i u đurđevačkim nizinskim šumama kod podravskog sela Kalinovca (sl. 1).

Spiraea salicifolia (sl. 2) na prvom je lokalitetu rasprostranjena u zajednici *Genisto elatae-Quercetum roboris* Horv. 38 (sl. 3), na drugom u *Frangulo-Alnetum glutinosae* Rauš 69, a na trećem u fitocenozi *Pruno-Fraxinetum* Oberd. 53 i *Carici elongatae-Alnetum glutinosae* Koch 26. Staništa su tih zajednica manje ili veće depresije i povremeno su plavljene. *Spiraea salicifolia* nije u sociološkom smislu jasno definirana i srednjoeuropski autori je svrstavaju kao svojstvenu vrstu za svezu *Pruno-Rubion fruticosi* Doing 62.

Dva od tri opisana nalazišta suručice zaštićena su kao specijalni rezervati šumske vegetacije, dok je predjel Česme upravo predložen da bude zaštićen.

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