

# Vegetation development on gravel sites of the Soča river between the towns of Bovec and Tolmin

## Vegetationsentwicklung an Kiesbänken des Flusses Soča zwischen den Städten Bovec und Tolmin

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**Key words:** *Myricaria germanica*, the Soča, phytosociology, *Salix*.

**Schlagwörter:** *Myricaria germanica*, Soča, Pflanzensoziologie, *Salix*.

**Summary:** The article studies the vegetation of gravel sites between Bovec and Tolmin, classified into the associations Salici-Myricarietum and Salicetum incano-purpureae. Apart from that it describes syndynamic relationships between the studied syntaxa.

**Zusammenfassung:** Der Beitrag untersucht die Vegetation von Kiesbänken zwischen Bovec und Tolmin, eingeteilt in die Assoziationen Salici-Myricarietum und Salicetum incano-purpureae. Weiters beschreibt er die syndynamischen Beziehungen zwischen den untersuchten Syntaxa.

### 1. Introduction

Gravel sites at the village of Čezsoča have so far been phytosociologically researched only by WRABER (1965), who described the association Leontodonti berinii-Chondrilleto, but only briefly mentioned other types of vegetation. Due to several oral accounts (dipl. ing. MLEKUŽ) relating the reappearance of the species *Myricaria germanica* we decided to study the vegetation of the alliance Salicion eleagno-daphnoidis in the upper course of the Soča river. So far, there has been no relevé material on the stands with the species *Myricaria germanica* in Slovenia, and the willow stands of the grey willow have only recently been researched (ŠILC & ČUŠIN 2000, ŠILC 2003, DAKSKOBLER et al. 2004).

We researched an approx. 40-km-long section of the Soča between the confluence with Lepena and Tolmin. Many gravel pockets occur within this section. The largest is at Čezsoča and covers a considerable part of the holocene valley bottom. At this point the Soča has a very slight fall (3-4.8 ‰) and deposits gravel without organic alluvium (PETERLIN & SEDEJ 1963/64, ČERNOLOGAR et al. 1991, 1993). The research area is situated in the moderate continental climate of western and southern Slovenia (OGRIN 1996). Mean annual temperature of the air in Bovec is 9.3°C and in Tolmin 10.6° C (MEKINDA-MAJARON 1995). Mean annual rainfall in Log Čezsoški is 2988 mm and 2987 mm in Kobarid (ZUPANČIČ 1995).

The Soča is a river with snow-rain regime, with average discharge 25.4 m<sup>3</sup>/s at the station of Log Čezsoški and 34.1 m<sup>3</sup>/s at Kobarid (KOLBEZEN & PRISTOV 1998).

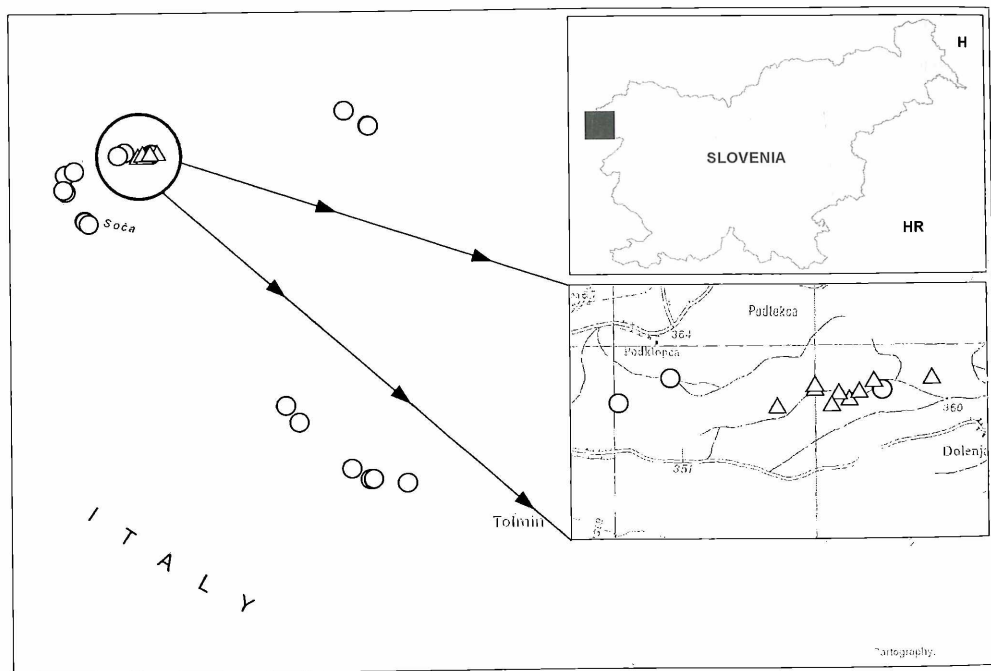


Figure 1: Research area with locations of relevés. Legend: triangle- Salici-Myricarietum, circle- Salicetum incano-purpureae.

### 3. Methods

The vegetation was researched according to the standard Central-European, Zürich-Montpellier method (BRAUN-BLANQUET 1964; WESTHOFF &

VAN DER MAAREL 1978). Numerical analyses were performed with the computer programme SYN-TAX 2000 (PODANI 2001).

The nomenclature of vascular plants follows MARTINČIČ et al. (1999), except for the species *Solanum lycopersicum* L. For the syntaxonomical scheme of the class Salicetea purpureae we followed the work of ORIOLO & POLDINI (2002), which among others treats also the territory of Slovenia.

## 4. Results

### 4.1. Description of communities

Syntaxonomically classified stands studied:

Salicetea purpureae MOOR 1958

Salicetalia purpureae MOOR 1958

Salicion eleagno-daphnoidis (MOOR 1958) GRASS 1993

Salici-Myricarietum MOOR 1958

Salicetum incano-purpureae SILLINGER 1933

#### 4.1.1. Salici-Myricarietum MOOR 1958

##### Character and differential species

*Myricaria germanica* is the character species, while the differential species are *Juncus articulatus*, *Juncus bufonius*, *Tussilago farfara*, *Equisetum variegatum* and *Cyperus fuscus*.

*Myricaria* is a typical pioneer shrub species on gravel bars of Alpine rivers (BILL et al. 1997), able to survive a long-term time and space isolation. It can distribute vegetatively when covered by debris (MÜLLER 1995). In order to disseminate with seeds the species requires a moist sandy substrate on bare gravel at a specific time, which can only be ensured by undisturbed morphodynamics of the river (MÜLLER 1998).

*Myricaria germanica* is on the Red list of endangered flora in Slovenia (WRABER & SKOBERNE 1989). Gravel sites at Čezsoča still have a natural regime- even following critical floods- which allows *Myricaria* to thrive and even spread. Its mass occurrence on gravel sites at Čezsoča can be related to a large flood in 2000, which considerably altered the gravel site. Apart from the natural dynamics of the river, gravel excavation can also contribute to the preservation of the association, as it forms microrelief and microhydrology which is comparable to natural gravel sites.

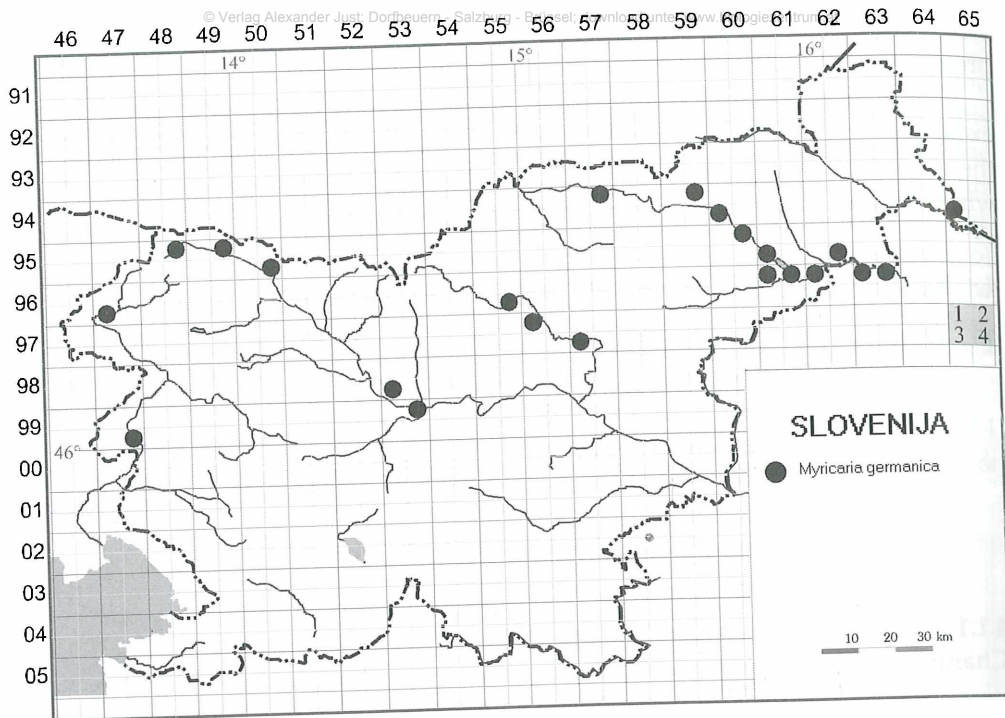


Figure 2: Distribution of the species *Myricaria germanica* in Slovenia.

### Floristic composition

In the shrub layer, the dominant species *Myricaria germanica* is accompanied by *Salix eleagnos*, *S. purpurea* and *S. alba*. Most common species among herbs are those of the class Molinio-Arrhenatheretea: *Agrostis stolonifera*, *Deschampsia cespitosa*, *Festuca arundinacea*, *Molinia caerulea*.

Stands from the gravel sites of the Soča are very similar to those described by MOOR (1958) in the original diagnosis, and less similar to the relevé material from the neighbouring Friuli Venezia Giulia (ORIOLO & POLDINI 2002). The relevé material collected by MOOR (1958) is from the warm Alpine valleys (OBERDORFER 1992). We can also conclude that our stands are better preserved. The stands described by MOOR (1958) have changed completely and have been replaced by a drier or a more nitrophilous variant (GALLANDAT ET AL. 1993).

### Ecology

The community thrives on gravel sites with fine sand. It is often found in depressions where fine material has been deposited. Despite the fact that the species with its small leaves is adapted to drought, it thrives on moist, flooded sites. Older individuals can grow on gravel as well, reaching for ground water

with their deep roots (BILL et al. 1997). PETUTSCHNIG (1994) is of opinion that also dry variant of the association should be considered.

### Synchorology

The community is distributed along the Alps, with the southern edge of the areal being the northern Apennines and the Balkans (ORIOLO & POLDINI 2002). As the sites on which it grows are endangered and because dominant species cannot grow in substitute habitats (MÜLLER 1995) the community is in regression. Its only locality, known so far in Slovenia, is on gravel sites at Čezsoča.

#### 4.1.2. *Salicetum incano-purpureae* SILLINGER 1933

##### Character and differential species

The character species is *Salix eleagnos*. The species *Solanum dulcamara*, which ORIOLO & POLDINI (2002) propose as differential species is rare.

##### Floristic composition

*Salix eleagnos* is the dominant species, which is accompanied by *Salix purpurea* and *Alnus incana* in the shrub layer. The most common species among herbs are *Petasites paradoxus*, *Rubus caesius*, *Galium mollugo*, *Molinia caerulea*, *Calamagrostis varia*.

##### Ecology

The community thrives on gravel and sand, usually on elevated sites. The site is basic ( $\text{pH}_{(\text{H}_2\text{O})}=8,3$ ), with low values of maximum water capacity of the soil (38,3 vol. %) (the Bistrica stream, ŠILC (2003)).

##### Subtypes

###### *Hieracietosum porifolii* subass. nova

Differential species are: *Hieracium porrifolium*, *Biscutella laevigata*, *Centaurea dichroantha*, *Stachys recta*, *Carduus crassifolius*, *Hieracium piloselloides*. Other species of the classes *Thlaspietea rotundifolii* and *Seslerietea albicantis* indicate an initial site. The stands grow on gravel which dries up during the summer. The willows are between 0.5 to 1 metre tall.

Successionally, the subassociation is related to the association *Leontodonti-berinii-Chondriletum* WRABER 1965. In more developed stands of this association, willows grow together with numerous character species of the class *Thlaspietea rotundifolii*. WRABER (1965) equates them with similar stands of *Myricario-Chondriletum salicetosum*.

The nomenclature type of the subassociation is relevé 9 in table 1.

Differential species are: *Cirsium oleraceum*, *Eupatorium cannabinum*, *Knautia drymeia*, *Peucedanum verticillare*, *Petasites hybridus* and *Chaerophyllum hirsutum*. The site is less disturbed, usually on higher parts of the gravel bar, and is mesophilous and nitrophilous. The willows are between 3 and 4 metres tall.

Compared to the stands of the subassociation petasitetosum hybridi on the Nadiža river nearby (ŠILC & ČUŠIN 2000) the stands at Čezsoča are more initial, as the Soča inundated heavily in 2000.

## Synchorology

The community is distributed everywhere in the Alps, on the Apennines and over the Balkans (ORIOLO & POLDINI 2002). As a result of the human impact on the morphodynamics of rivers and gravel sites the community is endangered. In Slovenia it can be found on gravel sites of all major rivers.

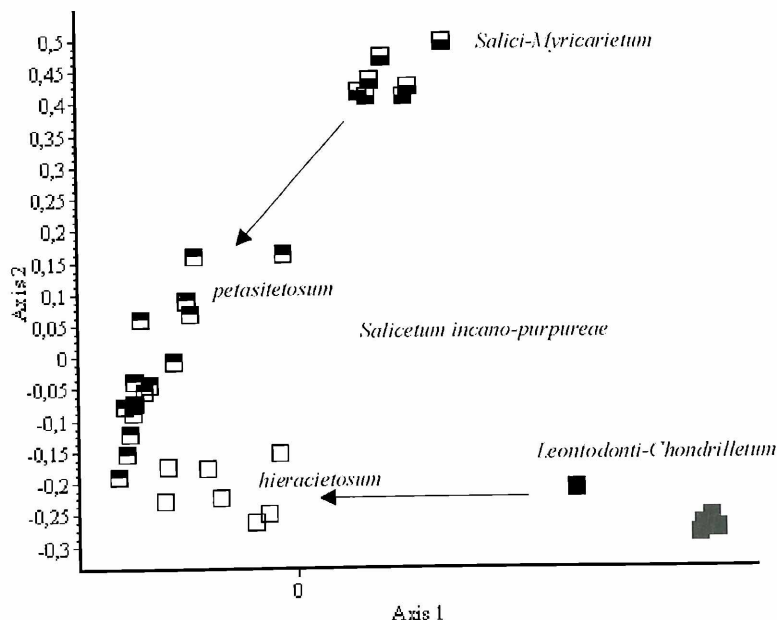


Figure 3: Ordination diagram (PCoA, similarity ratio) of relevés from Table 1 and added relevés of the association Leontodonti-Chondrilleum (WRABER 1965). Symbols: ■- Salici-Myricarietum, □- Salicetum incano-purpureae hieracietosum, ■ Leontodonti-Chondrilleum, ◐- Salicetum incano-purpureae petasitetosum hybridi.

In the ordination diagram (Figure 3) the stands clearly divide into three groups. On the abscissa is the gradient of the development of the vegetation and the gradient of moisture on the ordinate. The numerical analysis shows the direction of succession on the gravel site.

EDWARDS et al. (1999) stress the specific significance of allogenic (external) processes, in our case hydrology, for the development of vegetation on gravel sites of large Alpine rivers. Ecologists, however, are more interested in autogenic (internal) processes. The river has a dominant impact on the development of vegetation, above all on the place of development. MÜLLER (1995) mentions the temporal and spatial dimensions of vegetation of floodplains: phases of vegetation of different age are arranged as a mosaic.

The association *Salici-Myricarietum* develops in depressions made by the river in the gravel, where the river deposits fine alluvial material. The association *Salicetum incano-purpureae* develops on gravel islands which are elevated above the river level. Development of the vegetation on the islands is a specific form of vegetational syndynamics, in which allogenic processes prevail over the autogenic (KOLLMANN et al. 1999).

Stands of the association *Leontodonti-Chondriletum* are initial on rough river gravel. They are successional related to the stands of the subassociation *Salicetum incano-purpureae hieracietosum*. From the stands of the association *Salici-Myricarietum*, which are initial on finer substratum, develop the stands of the subassociation *Salicetum incano-purpureae petasitetosum*. In successional younger stands individual specimens of *Myricaria* still occur. *Myricaria germanica* is an explicitly heliophilous species, which is unable to grow on shady sites and can only be found in willow stands at their edges (BILL et al. 1997).

## 5. Acknowledgement

The authors would like to thank Dr. A. ČARNI for comments on the manuscript and M. JARNJAK for help with the figures. The FloVegSi database (Fauna, Flora, Vegetation and Paleovegetation of Slovenia) of Jovan Hadži Institute of Biology SRC SASA was used for the data and figure on distribution of species *Myricaria germanica*.

## 6. Appendix

Species appearing only once:

*Veronica chamaedrys* 1: +; *Potentilla erecta* 2: +; *Ranunculus acris* 2: +; *Centaureum pulchellum* 4: +; *Cardaminopsis halleri* 14: +; *Erigeron glabratus* 14: +; *Carex* sp. 5: r; *Equisetum* sp. 15: +; *Salix alba* 6: +; *Mentha arvensis* 7: +; *Epilobium montanum* 7: r; *Campanula rotundifolia* 7: r; *Sesleria caerulea* 9: 1; *Dryas octopetala* 9: +;

*Minuartia capillacea* 9: +; *Juniperus communis* B 10: r; *Leontodon incanus* 11: +; *Lotus corniculatus* 11: +; *Ligusticum seguieri* 11: r; *Pinus* sp. 11: r; *Arabis alpina* 12: +; *Scrophularia canina* 13: +; *Kernera saxatilis* 13: r; *Populus nigra* 13: r; *Oxalis stricta* 17: +; *Lathyrus pratensis* 17: +; *Galium laevigatum* 17: +; *Barbarea vulgaris* 16: 1; *Ranunculus repens* 16: +; *Thalictrum lucidum* 18: +; *Lysimachia vulgaris* 19: r; *Cerastium holosteoides* 20: +; *Fraxinus ornus* 20: +; *Trifolium repens* 20: r; *Medicago lupulina* 20: r; *Crataegus monogyna* B 21: +; *Fraxinus excelsior* 21: +; *Pinus sylvestris* B 21: +; *Luzula pilosa* 22: +; *Corylus avellana* B 22: +; *Solidago virgaurea* 22: +; *Asarum europaeum* 22: +; *Aquilegia nigricans* 22: +; *Aconitum lycoctonum* 22: +; *Calystegia sepium* 22: +; *Asplenium trichomanes* 22: +; *Asperula aristata* 22: +; *Campanula rapunculoides* 23: +; *Adoxa moschatellina* 23: r; *Origanum vulgare* 25: r; *Mycelis muralis* 26: +; *Picea abies* 26: +; *Cardamine impatiens* 26: +; *Galinsoga parviflora* 27: +; *Galeopsis pubescens* 27: +; *Trifolium* sp. 27: r; *Fraxinus excelsior* B 27: r; *Geranium robertianum* agg. 28: 1; *Leucanthemum* sp. 28: +; *Prunella vulgaris* 29: +; *Euonymus europaeus* B 29: +; *Helianthus tuberosus* 29: +; *Impatiens parviflora* B 29: +.

#### Locations with coordinates:

1. Čezsoča, fine sand, depression, 387148, 131743; 2. Čezsoča, fine sand, verge of a puddle, 386792, 131706; 3. Čezsoča, 386979, 131793; 4. Čezsoča, ditch, fine sand, 387197, 131781; 5. Čezsoča, 387059, 131716; 6. Čezsoča, a ditch along the Soča, 387557, 131846; 7. Čezsoča, fine sand and big gravel-stones, 387270, 131834; 8. Log Čezsoški, 200 m downstream from the bridge, 383912, 130981; 9. Lepena, at the camp, 395865, 132829; 10. Log Čezsoški, south of the village, fine sand and sand, 383846, 130393; 11. Srpenica, 384682, 129187; 12. Lepena, 500 m before the turning for Lepena, fine sand-sand, 394908, 133429; 13. Kamno, 395955, 118969; 14. Čezsoča, gravel, 387095, 131774; 15. Čezsoča, 386978, 131812; 16. Kamno, gravel site under Odisej, 395840, 118969; 17. Log Čezsoški, to the south below the village, sandy, 383924, 130321; 18. Kamno, gravel site under the bridge, 395125, 119381; 19. Ladra, separation, 393067, 121212; 20. Srpenica, 384694, 129152; 21. Bovec, Plužna, 200 m upstream from the outfall of Glijun, 386265; 22. Čezsoča, elevated site, 387311, 131782; 23. Srpenica, 100 m to the east, 384833, 129052; 24. Log Čezsoški, 100 m downstream from the bridge, gravel, 384261, 131125; 25. Bovec, Plužna, 100 m upstream from the outfall of Glijun, fine sand-sand, 386008, 131719; 26. Lepena, at the camp, sandy, 395830, 132832; 27. gravel site under Ladra, 392544, 121876; 28. Kamno, 395974, 118973; 29. Volarje, 397301, 118807

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received: 12/2003

approved: 9.5.2005

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Tab. 1: Association Salici-Myricarietum

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|                      |    |    |    |    |    |    |    |    |    |     |    |    |    |    |     |    |    |    |    |    |    |    |    |     |    |    |     |    |    |    |
|----------------------|----|----|----|----|----|----|----|----|----|-----|----|----|----|----|-----|----|----|----|----|----|----|----|----|-----|----|----|-----|----|----|----|
| Table 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 |    |
| Cover shrub layer    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 70 | 60 | 100 | 0  | 0  | 70 | 0  | 100 | 80 | 0  | 0  | 0  | 0  | 80 | 90 | 90 | 100 | 70 | 80 | 100 | 90 | 0  | 90 |
| (%) B                |    |    |    |    |    |    |    |    |    |     |    |    |    |    |     |    |    |    |    |    |    |    |    |     |    |    |     |    |    |    |
| Cover herb layer (%) | 80 | 70 | 60 | 70 | 60 | 80 | 30 | 30 | 70 | 70  | 70 | 20 | 70 | 40 | 30  | 90 | 0  | 90 | 80 | 60 | 60 | 60 | 60 | 40  | 20 | 60 | 10  | 70 | 40 |    |
| - C                  |    |    |    |    |    |    |    |    |    |     |    |    |    |    |     |    |    |    |    |    |    |    |    |     |    |    |     |    |    |    |
| Number of species    | 23 | 37 | 28 | 24 | 23 | 27 | 38 | 27 | 23 | 34  | 25 | 24 | 30 | 28 | 15  | 25 | 33 | 37 | 28 | 26 | 22 | 39 | 24 | 21  | 24 | 28 | 28  | 29 | 43 |    |
| Frequency            |    |    |    |    |    |    |    |    |    |     |    |    |    |    |     |    |    |    |    |    |    |    |    |     |    |    |     |    |    |    |

|                              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
|------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|----|
| Salici-Myricarietum          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Myricaria germanica B        | 4 | 2 | 2 | 2 | 3 | 4 | 3 |   |   |   |   |   |   | 2 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Tussilago farfara C          | 2 | 1 | 2 | 2 | 2 | 1 | 2 |   |   |   |   |   |   | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Juncus articulatus           | 1 | 1 | 1 | 1 | 1 | 1 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Juncus bufonius              | + | + |   | 1 | 1 | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Equisetum variegatum         | + | r |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Cyperus fuscus               | + |   |   |   | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Salicetum incano-purpureae   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Salix eleagnos B             | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 1 | 4 | 3 | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 5 | 4 | 86 |
| Salix eleagnos C             | 2 |   |   |   |   |   |   |   | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | 71 |
| Salicetea purpureae          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Salix purpurea B             | 1 |   |   |   |   |   |   |   | 2 | 3 | 2 | 2 |   | 2 | 3 | 2 | 2 |   |   |   |   |   |   |   |   |   |   |   |    |
| Salix purpurea C             | + |   |   |   |   |   |   |   | + |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Salix alba B                 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Salix alba C                 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Populus nigra B              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Populus nigra C              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Hieracium portifolium C      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Carduus crassifolius         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Hieracium pilosellodes       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Stachys recta                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Biscutella laevigata         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Centaurea dichroantha        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Eupatorium cannabinum        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Knautia drymeia              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Cirsium oleraceum            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Peucedanum verticillare      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Petasites hybridus           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Chaerophyllum hirsutum       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Scheuchzerio-Caricetea fusci |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Erucastrum gallicum          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Carex flava                  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Thlaspietea rotundifolia     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Petasites paradoxus          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Gypsophila repens            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Silene vulgaris              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| ssp. glareosa                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Achnatherum calamagrostis    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Campanula cespitosa          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Chamaenerion palustre        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Aquilegia einseleana         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Rumex scutatus               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Seslerietea albicanis        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Calamagrostis varia          |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Euphrasia salisburgensis     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Silene alpestris             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Polygono-Poetea              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Plantago major               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Poa annua                    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Artemisietea vulgaris        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Daucus carota                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Artemisia vulgaris           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Erigeron annuus              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Diplotaxis tenuifolia        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Meibomia alba                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Poa compressa                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Cichorium intybus            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Echium vulgare               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Saponaria officinalis        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Galio-Urticetea              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Rubus caesius                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Geranium robertianum         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Solidago gigantea            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Aegopodium podagraria        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Urtica dioica                |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Galeopsis speciosa           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Glechoma hederacea           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Impatiens parviflora         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Myosoton aquaticum           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Solanum dulcamara            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Lamium maculatum             |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Molinio-Arrhenatheretea      |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Galium mollugo               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |
| Taraxacum officinale         |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |    |

| Table 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  |           |
|-----------------------|----|----|----|----|----|----|----|----|-----|----|----|----|-----|----|----|----|----|----|----|----|----|----|-----|----|----|-----|----|----|-----|-----------|
| Cover shrub layer     | 0  | 0  | 0  | 0  | 0  | 0  | 70 | 60 | 100 | 0  | 70 | 0  | 100 | 80 | 0  | 0  | 0  | 0  | 80 | 90 | 60 | 60 | 100 | 70 | 80 | 100 | 90 | 0  | 90  |           |
| (%)- B                |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Cover herb layer (%)  | 80 | 70 | 60 | 70 | 60 | 80 | 30 | 30 | 70  | 70 | 20 | 70 | 40  | 30 | 90 | 0  | 90 | 80 | 60 | 60 | 60 | 60 | 40  | 20 | 60 | 10  | 70 | 40 |     |           |
| - C                   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Number of species     | 23 | 37 | 28 | 24 | 23 | 27 | 38 | 27 | 23  | 34 | 25 | 24 | 30  | 28 | 15 | 25 | 33 | 37 | 28 | 26 | 22 | 39 | 24  | 21 | 24 | 28  | 28 | 29 | 43  | Frequency |
|                       | +  | 1  | 1  | 1  | +  | +  | +  | +  |     |    |    |    |     | +  | +  | +  | +  | +  | +  | +  | +  | +  | +   |    |    |     | +  |    | 100 | 41        |
| Deschampsia           |    |    |    |    |    |    |    | +  |     |    |    |    |     | +  |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| caespitosa            |    |    |    |    |    |    |    | +  |     |    |    |    |     | +  |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Centaurea nigrescen.  |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| ssp. vochinensis      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Mentha longifolia     |    |    |    |    |    |    | 2  |    |     |    |    |    |     | +  |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Agrostis stolonifera  |    |    |    |    |    |    |    | +  |     |    |    |    |     | +  |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Leontodon hispidus    |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Angelica sylvestris   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Festuca arundinacea   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Dactylis glomerata    |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Achillea millefolium  |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Lycopus europaeus     |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Lythrum salicaria     |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Trifolium pratense    |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Rumex obtusifolius    |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Vicia cracca          |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Agrostis gigantea     |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Festuco-Brometea      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Euphorbia cyparissia: |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Buphthalmum           |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| salicifolium          |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Rhamno-Prunetea       |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Frangula alnus        |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Frangula alnus        |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Clematis vitalba      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Clematis vitalba      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Cornus sanguinea      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Cornus sanguinea      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Clematis recta        |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Quercu-Fagetea        |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Brachypodium          |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| sylvaticum            |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Alnus incana          |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Alnus incana          |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Salvia glutinosa      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Ostrya carpinifolia   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Agropyron caninum     |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Carex digitata        |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Calamintha sylvatica  |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Cerastium sylvaticum: |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Scrophularia nodosa   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Acer pseudoplatanus   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Carpinus betulus      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Hedera helix          |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Ostrya carpinifolia   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Ranunculus            |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| lanuginosus           |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Ligustrum vulgare     |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Ligustrum vulgare     |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Tilia cordata         |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Tilia cordata         |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Viburnum lantana      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Viburnum lantana      |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Other                 |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Cardaminopsis         |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| arenosa               |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Equisetum arvense     |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Hypericum perfora-    |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| lum                   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Robinia pseudacacia   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Fraxinus sp.          |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Polygonum persicaria: |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Petrorhagia saxifraga |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Polygonum mite        |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Solanum lycopersi-    |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| cum                   |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Sonchus asper         |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Hieracium saxatile    |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |
| Cerastium sp.         |    |    |    |    |    |    |    |    |     |    |    |    |     |    |    |    |    |    |    |    |    |    |     |    |    |     |    |    |     |           |

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