

Article

Relative Importance of Plant Species Composition and Environmental Factors in Affecting Soil Carbon Stocks of Alpine Pastures (NW Italy)

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Abstract: Alpine pastures are agricultural systems with a high provision of ecosystem services, which include carbon (C) stocking. Particularly, the soil organic C (SOC) stocks of Alpine pastures may play a pivotal role in counteracting global climate change. Even if the importance of pasture SOC has been stated by several research studies, especially by comparing different land uses, little is known about the role of plant species composition. We studied a wide sample of 324 pastures in the north-western Italian Alps by performing coupled vegetation and soil surveys. Climatic (i.e., mean annual precipitation), topographic (i.e., elevation, slope, southness), vegetation (i.e., the first three dimensions of a non-metric multidimensional scaling—NMDS), and soil (i.e., pH) parameters were considered as independent variables in a generalised linear model accounting for SOC stocks in the 0–30 cm depth. Pasture SOC was significantly affected by precipitation (positively) and by pH (negatively) but not by topography. However, the higher influence was exerted by vegetation through the first NMDS dimension, which depicted a change in plant species along a thermic-altitudinal gradient. Our research highlighted the remarkable importance of vegetation in regulating SOC stocks in Alpine pastures, confirming the pivotal role of these semi-natural agricultural systems in the global scenario of climate change.

Keywords: grassland; elevation; forage; mountain; pH; precipitation; slope; vegetation



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1. Introduction

Mountain pastures can provide many ecosystem services, such as provisioning services (e.g., biodiversity, forage), regulation and maintenance services (e.g., water purification, soil retention), and cultural services (e.g., nature-based recreation, eco-tourism) [1,2]. Among regulation services, carbon (C) stocking is of particular relevance [3]. Carbon stocking is a key process, able to reduce the amount of atmospheric CO₂ originated by anthropogenic emissions [4]. Therefore, the role of land uses efficient in C stocking, namely, able to counteract current climate change, is becoming essential worldwide. Indeed, the land sinks represent the main reduction factor in the global C balance by removing about one fourth of the total emitted C [5]. Part of the C is stocked in the above ground biomass (especially in woodlands), but a major portion is allocated in the soil [6]. Soil organic carbon (SOC) mainly derives from the stocking of atmospheric CO₂ fixed by plants through photosynthesis and its amount can vary depending on site conditions, biotic factors, including vegetation composition, and anthropic management [7].

Although the importance of SOC stocking in slowing global warming has been widely studied [4,8], little is known about the role of Alpine pastures and the variability of SOC stocks related to climatic, environmental, and vegetation features [9]. Specifically, several research studies compared different land uses (e.g., grasslands, forests, arable crops) in terms of their ability to stock C in the European Alps, but the importance of botanical composition within pastures has not been explored yet. It is worth mentioning that Alpine pastures in Europe are composed by a huge variety of plant species and habitats, determined by different topographic (elevation, slope, aspect), abiotic (climate, bedrock type), and biotic (pastoral management, first of all, which directly affects soil fertility) conditions [10,11].

The present study aimed at evaluating the relative importance of various abiotic and biotic (i.e., vegetation) drivers in affecting SOC stocks in a wide sample of pastures in the western Italian Alps.

2. Materials and Methods

The study was conducted in a wide number of Alpine valleys within the Piedmont region, north-western Italy (Figure 1), characterised by contrasting climatic, topographic, vegetation, and soil conditions. Between years 2000 and 2007, we surveyed 324 grassland sites, encompassing a wide geographical and ecological range. The survey sites were ascribable to 54 different vegetation types (*sensu* Cavallero et al. [12]; see Appendix A). All the grasslands were grazed by cattle during summers, generally with lenient stocking rates.

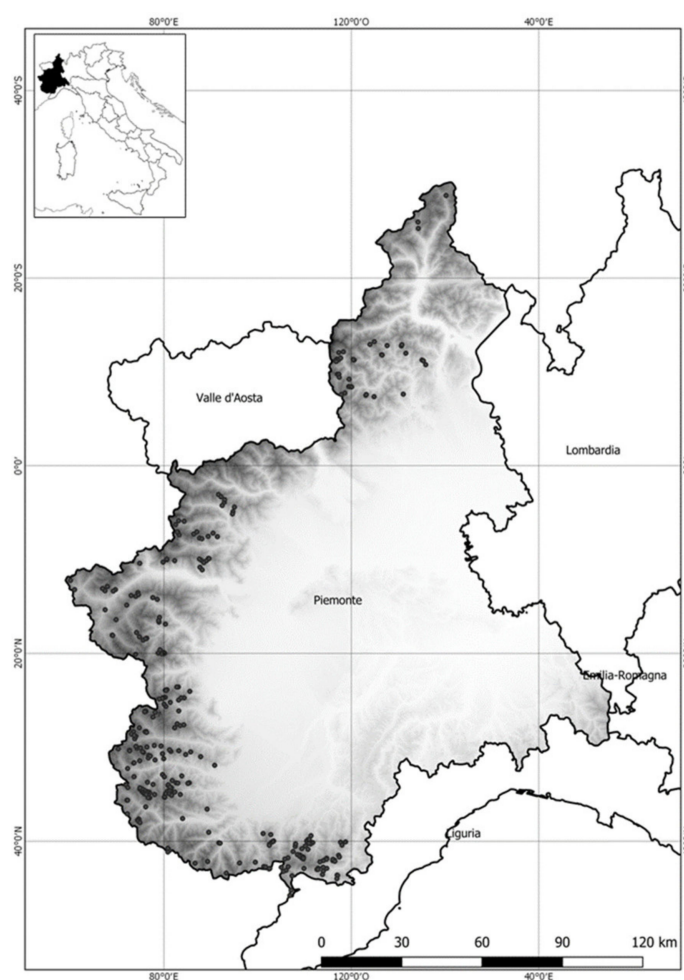


Figure 1. Location of the 324 survey sites in north-western Italian Alps. Each black dot represents a site.

Elevation, slope, and southness of the sites were computed using a digital terrain model at 5-m resolution [13]. Mean annual precipitation was assessed at each site using a 1-km resolution raster obtained by interpolating the long-time data series (1977–2007) of 386 weather stations spread all over the region [14]. Spatial analyses were carried out with QGIS v.3.16 LTR software [15].

At each site, the composition of grassland vegetation was determined with the vegetation point-quadrat method [16] along 25-m transects and at 50-cm intervals. To account for species richness more accurately, the list of all occasional species not recorded along the transect but occurring in a 1-m buffer area around was completed as well [17,18]. Nomenclature followed Landolt et al. [19]. Then, the relative abundance of every species was calculated as the proportion in percentage of the frequency of occurrence of each species on the sum of the frequencies of all the species in each transect. A value of 0.3% was attributed to all occasional species [17]. Species relative abundances were used to perform a non-metric multidimensional scaling (NMDS) to take the vegetation composition of each survey into account in further analyses. The number of dimensions of the NMDS was defined after checking the goodness of stress value, while Bray–Curtis was specified as dissimilarity index and 100 maximum random starts were set. Species relative abundances were also used to compute some plant community variables, namely: Landolt's indicator values for temperature (T), humus (H), soil moisture (F), and soil nutrients (N) [19], the pastoral value (PV, which is a proxy for forage productivity and quality [16]), and Shannon diversity index [20]. These plant community variables together with species richness, were included in the NMDS biplots as supplementary variables.

A soil pit was dug close to each vegetation transect for soil description and sampling. The volumetric content (%) of coarse fragments, i.e., particles larger than 2 mm and smaller than 25 cm diameter, was visually assessed. Then, a soil sample of each horizon observed within the 0–30 cm depth interval was collected and transported to the laboratory. Samples were analysed for pH (soil:water = 1:2.5) according to standard soil analysis procedures [21] and an average pH value, weighted on the depth (in cm) of each observed horizon, was calculated. Organic C content was determined as well, using Walkley–Black titration [22].

Bulk density was estimated according to the following pedotransfer function, specifically calibrated for 'permanent grasslands' land use of the Alpine soil region [23]:

$$BD = 1.565081 - 0.3946467 \times SOC - 0.0103851 \times Skel$$

where BD is the bulk density derived from the pedotransfer function and SOC and $Skel$ are the % of OC and coarse fragments in the soil samples, respectively. Whenever $Skel$ proportion was above 10%, the following correction was applied [24]:

$$BD_c = BD \times \left[1 - 1.67 \times \left(\frac{Skel}{100} \right)^{3.39} \right]$$

where BD_c is the corrected bulk density, referred to the fine earth fraction, and $Skel$ is the coarse fragment content by mass. The OC , BD , and $Skel$ values were used to assess the SOC stocks at each site as the sum of SOC values of all i horizons found within the first 30 cm, weighted on their relative depth (in cm):

$$SOC_{stock} = \sum_{i=1}^n (OC_i \times BD_i \times depth_i \times (1 - Skel_i) \times 100)$$

Precipitation among the climatic variables, elevation, slope, and southness among the topographic ones, the components of the NMDS for vegetation, and soil pH were included in a generalized linear model to predict C stock. Previous to run the model, all variables were tested for autocorrelation, and standardised in order to compare the resulting β scores. Being SOC stock a continuous variable, the Gaussian and Gamma distributions were applied and the best fitting one, i.e., that one showing the lowest Akaike Information

Criterion [25], was retained. Statistical analyses were carried out in R environment, version 3.5.2 [26], using ‘goeveg’ [27], ‘vegan’ [28], and ‘glmmTMB’ [29] packages.

3. Results and Discussion

3.1. Climate, Topography, and Vegetation Features

Mean annual precipitation of the studied sites ranged from 727 to 1574 mm, thus including dry to wet climatic conditions. The altitude, slope, and aspect ranged, respectively, between 988 and 2688 m a.s.l., between 0.4 and 49.8°, and between 1.1 and 179.7°. Such a wide range of topographic conditions, combined with different soils and varying effects of livestock grazing, determined a huge variability of ecological conditions and consequently a considerably high species richness. Indeed, we recorded more than 685 plant species in total and about 35 species per transect. The descriptive statistics of climatic, topographic, and vegetation features of the sites are reported in Table 1.

Table 1. Climatic, topographic, and vegetation descriptors of the 324 sites. SE, standard error of the mean; Landolt’s indicators: F, soil moisture; N, soil nutrients; H, humus; T, temperature.

Variable	Min	25%	Median	75%	Max	Mean	SE
Climate							
Precipitation [mm y ^{−1}]	726.9	900.4	962.3	1103.5	1574.1	1008.2	8.88
Topography							
Elevation [m a.s.l.]	988	1813	2094	2329	2688	2041	20.0
Slope [°]	0.4	12.9	20.8	28.8	49.8	20.9	0.57
Southness [°]	1.1	78.7	124.9	155.9	179.7	111.9	2.91
Vegetation							
Species richness	9	26	35	44	62	35	0.7
Shannon index	1.3	3.2	3.7	4.1	5.0	3.6	0.04
Landolt’s F	1.6	2.3	2.6	2.9	4.2	2.6	0.02
Landolt’s N	1.6	2.2	2.4	2.7	4.7	2.5	0.02
Landolt’s H	1.9	3.0	3.2	3.4	4.9	3.2	0.02
Landolt’s T	1.9	1.9	2.3	2.7	3.9	2.3	0.03
Pastoral Value	20.9	34.4	40.6	46.3	73.1	41.2	0.51

Being 0.16 the stress value of the first three dimensions of the NMDS, i.e., less than 0.20, the fitting was considered satisfactory [30]. The supplementary variables included in the NMDS biplot improved the understanding of such a complex and variable vegetation, by highlighting its ecological trends in terms of plant community indices (Figure 2). Plant species were arranged on the first NMDS dimension according to a thermic-altitudinal gradient (Figure 2a), with thermophilic low-altitude species on the left side (such as *Bromus erectus* Huds., *Brachypodium rupestre* (Host) Roem. & Schult., *Lathyrus pratensis* L., *Plantago media* L., and *Rosa canina* aggr.) and those typical of cold, high-altitude environments on the right side (such as *Alchemilla pentaphyllea* L., *Carex curvula* All., *Leucanthemopsis alpina* (L.) Heywood, *Phyteuma globularifolium* Sternb. & Hoppe, and *Salix herbacea* L.). The arrow of Landolt’s T confirmed this gradient, being left-directed and close to the horizontal axis. The second dimension was related to the storage of dead organic material (as outlined by Landolt’s H arrow), with species growing on soils poor in humus in the upper part of the graph (such as *Anthyllis vulneraria* L., *Helianthemum oelandicum* (L.) Dum. Cours., *Helictotrichon sedenense* (DC.) Holub, *Onobrychis montana* DC., and *Sesleria caerulea* (L.) Ard.) and species found on soils with higher humus content at the bottom (such as *Calluna vulgaris* (L.) Hull, *Potentilla erecta* (L.) Raeusch., *Carex pallescens* L., *Agrostis capillaris* L., *Poa chaixii* Vill.). Finally, the distribution of the species on the third dimension showed a positive gradient of soil nutrient and forage quality, as shown by the position of Landolt’s N and PV arrows, respectively. Indeed, in Figure 2b the species typical of nutrient rich environments, such as *Taraxacum officinale* s.l., *Peucedanum ostruthium* (L.) W.D.J. Koch, *Poa pratensis* L., *Geranium sylvaticum* L., and *Silene vulgaris* (Moench) Garcke, were in the upper part of the biplot, while those typical of nutrient-poor pastures, such as *Festuca paniculata*

(L.) Schinz & Thell., *C. vulgaris*, *Vaccinium myrtillus* L., *Chamaecytisus hirsutus* (L.) Link, and *Gymnadenia conopsea* (L.) R. Br., were at the bottom.

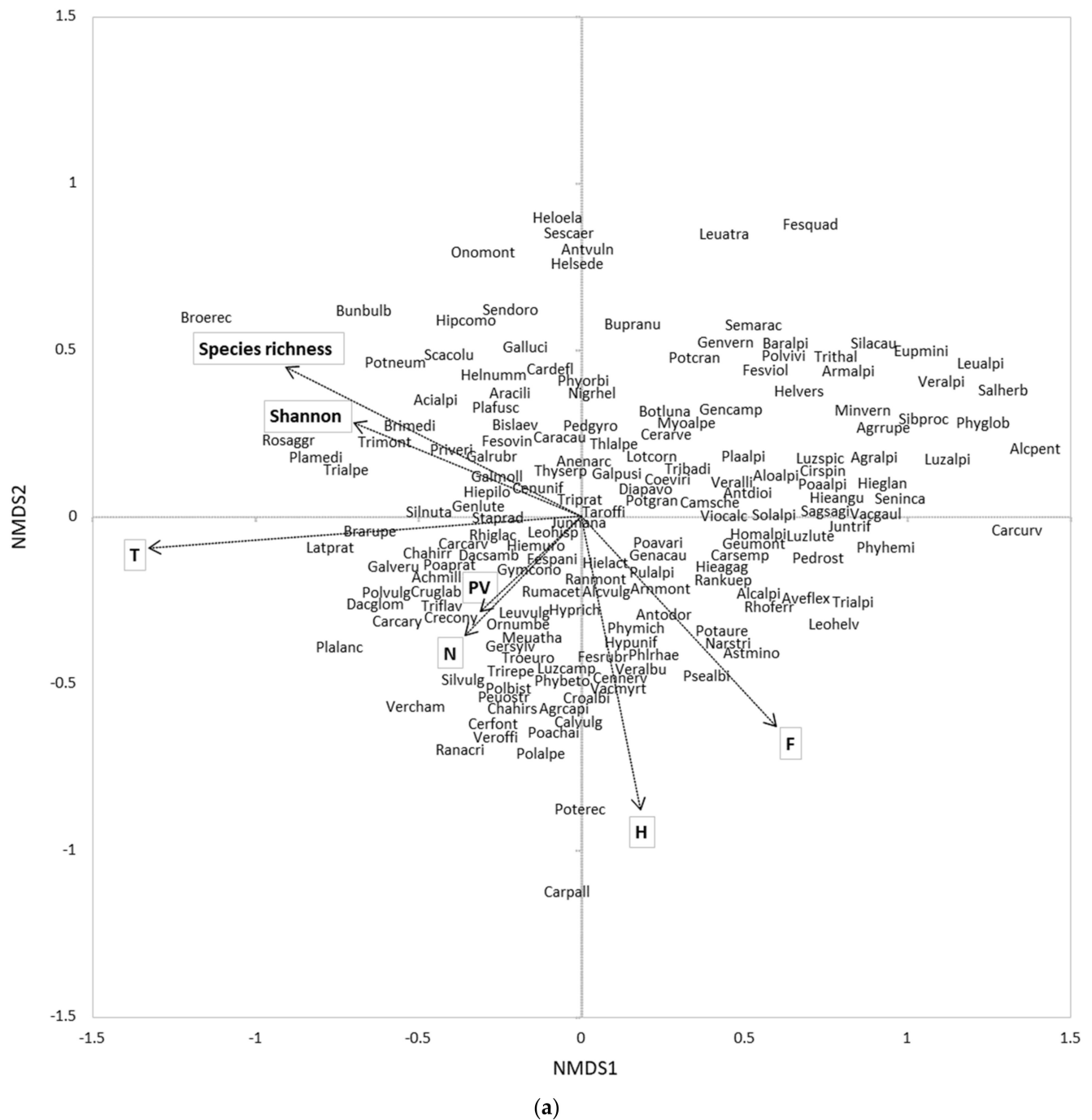


Figure 2. Cont.

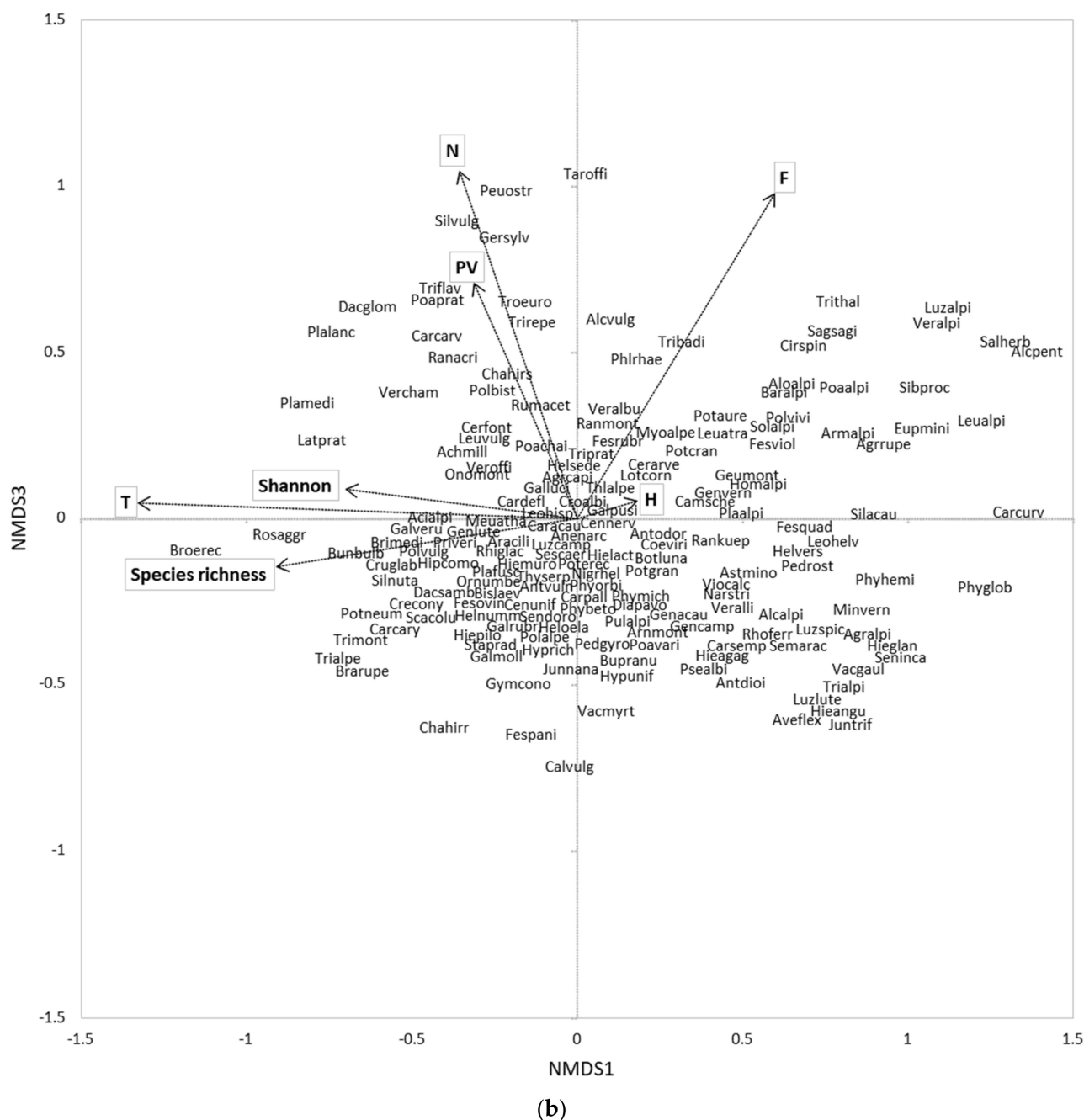


Figure 2. Biplots of the non-metric multidimensional scaling (NMDS): (a) first and second dimensions, (b) first and third dimensions. Stress value for the three dimensions: 0.16. Only species recorded in more than 5% of the surveys are displayed and identified by a species code (see Appendix A for the complete species and code list). Dashed arrows represent passive variables: biodiversity (species richness and Shannon diversity index), Landolt's indicator values (F, soil moisture; H, humus; N, soil nutrients; T, temperature), and pastoral value (PV).

3.2. Soil Features

The soil pH encompassed both acidic and basic soil conditions, ranging from 3.3 to 8.3 (Table 2). Soil C stock in the investigated pastures ranged between 1.9 and 234.9 t ha⁻¹, with an average value of 87.8 t ha⁻¹. Such values were higher when compared to those of other land uses (arable lands: 52.6 ± 5.56; permanent crops: 41.4 ± 2.06; woodlands: 71.4 ± 2.10; t ha⁻¹ ± standard error), which were recorded with the same methods in the same region during a previous trial [23]. Rodríguez-Murillo [31] and Hoffmann et al. [32]

found similar SOC contents in Spanish and Swiss pastures, respectively. Another recent study conducted by Ferré et al. [33] on Italian alpine grasslands reported lower values of C stocks. However, this trial was carried out in a single 1.5-ha study area characterised by a limited variability of ecological conditions, and the related outcomes should be considered with caution consequently. Canedoli et al. [3] in north-western Italy and Liefeld et al. [34] in Switzerland reported lower C stocks compared to our trial, but at the same time they highlighted higher SOC values in grasslands than in the woodlands and the arable lands, respectively, highlighting a similar trend. This may be due to the accumulation of OC in the upper soil horizons, which is particularly relevant in well-managed alpine pastures if compared to forests [35]. Indeed, the positive role of Alpine grasslands as CO₂ sinks may be exerted only with an active and balanced pastoral management, thus avoiding both overgrazing and abandonment [36,37]. Other research studies located in the European Alps reported SOC amounts characterised by wide variability, but they did not consider the role of differing plant species composition in determining the variations of soil bio-chemical features [38,39].

Table 2. Soil descriptors of the 324 sites. SE, standard error of the mean.

Variable	Min	25%	Median	75%	Max	Mean	SE
pH	3.3	4.6	5.0	5.8	8.3	5.3	0.06
Coarse fragment content [%]	0.0	6.8	15.9	25.8	70.0	18.5	0.81
Bulk density [t m ⁻³]	0.2	0.7	0.9	1.0	1.2	0.8	0.01
Soil organic carbon [t ha ⁻¹]	1.9	59.2	87.8	112.8	234.9	87.8	2.09

3.3. Modelling Soil Organic Carbon Stocks

Data analysed through generalised linear model with Gaussian distribution showed a lower Akaike information criterion when compared to Gamma one (3237 vs. 3287) thus the relative model results were retained. Model outputs highlighted the relative importance of each factor in affecting SOC stocks (Table 3), providing new knowledge through a comprehensive approach concerning the role of vegetation in C bio-cycling of European Alpine pastures, which was scantily focused till present. Among the selected variables, those exerting a significant influence on SOC stocks were precipitation, vegetation (particularly, the first dimension of the NMDS), and soil pH. Conversely, elevation, slope, and southness showed non-significant effects as well as the second and third NMDS dimensions. The limited importance of southness and slope confirmed the outcomes of a previous trial [40], which, however, reported significant negative effects of both elevation and precipitation. In the present study, the precipitation showed a positive influence on SOC, likely due to an indirect effect on biomass production, which is generally associated to higher C stocks [41].

Table 3. Results of the generalized linear model accounting for the stock of soil organic carbon. NMDS, non-metric multidimensional scaling; SE, standard error; ***, $p < 0.001$; **, $p < 0.01$.

	β Score	SE	p Value	Sig.
(Intercept)	87.787	1.928	<0.001	***
Precipitation	9.994	2.515	<0.001	***
Elevation	7.619	4.206	0.070	
Slope	0.241	2.325	0.917	
Southness	0.182	2.237	0.935	
NMDS1	−11.782	4.068	0.004	**
NMDS2	−3.611	2.897	0.213	
NMDS3	−1.991	2.219	0.370	
pH	−8.574	2.752	0.002	**

However, vegetation was found to be the most important driver, as highlighted by the highest β score. Its negative sign showed that higher SOC stocks were recorded in pastures with higher proportions of those species distributed on the left side of Figure 2a, i.e., in

pastures rich in plants typical of warm, low-altitude, species-rich environments. Similar to precipitation, species typical of warmer pastures (proxied by Landolt's T value) may be associated to greater biomass production, with positive effects on SOC content [41]. Species richness may exert a positive influence on C stocking as well, since it generally corresponds to a diversity of root systems (characterised by differing depths, biomasses, C storages, etc.) and to an enhanced soil microbial diversity (which improves SOC transformation and degradation), which indirectly influences decomposition processes [42,43]. Surprisingly, a significant effect of the second dimension of NMDS (i.e., a vegetational proxy of soil humus content) on SOC was not observed. This may depend on humus type, which could affect SOC content but is not taken into account by Landolt's H [19,44]. However, further investigations are needed to clarify this relationship. Finally, the lack of a significant effect of the third dimension of NMDS (related to soil fertility) was likely expected. Indeed, in this study, the pastures with low Landolt's N and PV, i.e., with low soil fertility due to undergrazing [45], were encroached by shrubs, such as *C. vulgaris*, *V. myrtillus*, and *C. hirsutus*. Likely, the low biochemical quality of shrub litter delayed its decomposition and allowed higher organic matter accumulations in the topsoil [37]. However, the effect of shrub proliferation at a depth greater than the 30 cm considered here was partially unclear since the low root turnover of shrubs compared to grasses should have reduced the C inputs in the soil.

As for pH, larger amounts of SOC were recorded in soils with an acidic reaction, confirming the remarkable importance of pH in affecting SOC stocks in Alpine grasslands [46], probably because low pH is associated to high SOC contents, or mineralisation is reduced at low pH [47,48].

According to our results, the SOC stocking of Alpine pastures, generally managed under extensive grazing regimes, was predominantly influenced by the vegetation rather than by abiotic factors. More specifically, we observed a remarkable role of warm-pasture species (such as *B. erectus*), which might have a limited interest as fodder resource (in terms of quantity and quality [49]), but which can definitely have a remarkable weight on carbon stocks. Dry pastures, which generally host large proportions of such plants, are widely represented in the Alps. For instance, the dry grasslands dominated by *B. rupestre*, *F. paniculata*, or *F. ovina* aggr. cover more than 30% of the pasture area in Piedmont Region [12]. The importance of alpine pastures in SOC stocking was in general confirmed, as the observed values were generally higher compared to other land uses. Thus, pasture conservation policies should be encouraged, such as through specific PES (payments for ecosystem services) [50]. In the current scenario of climate change, the abundance of warm grassland species will likely increase in the future years [51], and a shift at higher elevations would be expected. Consequently, an increase of SOC stocks in Alpine pastures might be observed but, precipitation being a relevant factor affecting C cycling as well, a targeted monitoring should be carried out to take the complex and spatially heterogeneous patterns of climate change into account [52,53].

Future research should be addressed to monitor the possible effects of management intensity, for instance of different stocking rates or grazing regimes. Moreover, the SOC stocking ability of permanent pasture should be compared with that of mountain hay meadows. An extension would be advisable to lowland grasslands too, where the species richness and diversity are generally lower compared to the mountain ones, and which are generally more intensively managed in terms of number of exploitations per year and fertilisation.

4. Conclusions

The novel results of this study carried out in a huge range of ecological conditions highlighted the relevant importance of grassland species composition in affecting soil C stock of Alpine soils, while topographic attributes had negligible effects. More specifically, dry pastures (which also generally host rare plants and a high species richness) stocked more carbon in the upper soil horizons. Among abiotic factors, precipitation positively

affected soil organic carbon stocks, likely through an indirect effect due to the increased herbage biomass. Conversely, lower SOC values were found on acidic soils, where mineralization might be hampered. Future conservation strategies should aim to consider the role of such extensively managed pastures, which can be found in the Alpine region, and of the dry grassland species in enhancing this ecosystem service.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. List of vegetation types (*sensu* Cavallero et al. [12]) surveyed in the 324 pastures. The dominant plant species and the number of surveys performed per each vegetation type is provided.

Vegetation Type	Surveys
<i>Agrostis schraderana</i>	2
<i>Alchemilla</i> gr. <i>alpina</i>	1
<i>Alchemilla</i> gr. <i>vulgaris</i>	5
<i>Alchemilla pentaphyllea</i>	5
<i>Alopecurus gerardi</i>	2
<i>Brachypodium caespitosum/rupestre</i>	18
<i>Briza media</i>	1
<i>Bromus erectus</i>	11
<i>Calamagrostis villosa</i>	1
<i>Carex curvula</i>	4
<i>Carex fimbriata</i>	2
<i>Carex foetida</i>	3
<i>Carex fusca</i>	2
<i>Carex humilis</i>	2
<i>Carex rupestris</i>	2
<i>Carex sempervirens</i>	5
<i>Carex tendae</i>	1
<i>Dactylis glomerata</i>	10
<i>Dryas octopetala</i>	1
<i>Elyna myosuroides</i>	1
<i>Festuca</i> gr. <i>halleri</i>	1
<i>Festuca</i> gr. <i>ovina</i>	18
<i>Festuca</i> gr. <i>rubra</i> and <i>Agrostis tenuis</i>	41
<i>Festuca</i> gr. <i>violacea</i>	14
<i>Festuca paniculata</i>	21

Table A1. Cont.

Vegetation Type	Surveys
<i>Festuca scabriculum</i>	5
<i>Hedysarum brigantiacum</i>	2
<i>Helianthemum nummularium</i>	3
<i>Helianthemum oelandicum</i>	1
<i>Helictotrichon parlatorei</i>	5
<i>Ligusticum mutellina</i>	2
<i>Luzula alpino-pilosa</i>	1
<i>Molinia arundinacea</i>	1
<i>Molinia coerulea</i>	1
<i>Nardus stricta</i>	53
<i>Onobrychis montana</i>	10
<i>Petasites hybridus</i>	1
<i>Phleum alpinum</i>	1
<i>Plantago alpina</i>	1
<i>Poa alpina</i>	2
<i>Poa violacea</i>	7
<i>Polygonum bistorta</i>	2
<i>Polygonum viviparum</i>	3
<i>Rumex alpinus</i>	1
<i>Salix herbacea</i>	2
<i>Scirpus sylvaticus</i>	1
<i>Sesleria varia</i>	7
<i>Stipa pennata</i>	2
<i>Taraxacum officinale</i>	1
<i>Trifolium alpinum</i> and <i>Carex sempervirens</i>	26
<i>Trifolium thalii</i>	2
<i>Trisetum flavescens</i>	4
<i>Vaccinium gaultherioides</i>	2
<i>Vaccinium myrtillus</i>	1
Total	324

Table A2. List of plant species recorded in the 324 vegetation transects. The species code displayed in the biplots of the non-metric multidimensional scaling (NMDS), the number and proportion of transects where the species was found, and the average species relative abundance (SRA) are reported.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Abies alba</i>		1	0%	0.30
<i>Acer pseudoplatanus</i>		2	1%	0.50
<i>Achillea erba-rotta</i>		2	1%	0.30
<i>Achillea macrophylla</i>		1	0%	2.84
<i>Achillea millefolium</i> aggr.	Achmill	133	41%	0.30
<i>Achillea moschata</i>		1	0%	2.29
<i>Achillea nana</i>		3	1%	0.66
<i>Achnatherum calamagrostis</i>		2	1%	0.63
<i>Acinos alpinus</i>	Acialpi	26	8%	0.30
<i>Aconitum napellus</i>		3	1%	2.29
<i>Adenostyles leucophylla</i>		1	0%	4.04
<i>Aegopodium podagraria</i>		4	1%	4.03
<i>Agrostis alpina</i>	Agralpi	52	16%	4.05
<i>Agrostis canina</i>		1	0%	6.29
<i>Agrostis capillaris</i>	Agrcapi	125	39%	2.25
<i>Agrostis rupestris</i>	Agrrupe	33	10%	8.63
<i>Agrostis schraderiana</i>		16	5%	0.44

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Ajuga genevensis</i>		5	2%	0.37
<i>Ajuga pyramidalis</i>		10	3%	0.84
<i>Ajuga reptans</i>		8	2%	2.12
<i>Alchemilla alpina</i> aggr.	Alcalpi	59	18%	8.66
<i>Alchemilla pentaphyllea</i>	Alcpent	26	8%	2.91
<i>Alchemilla vulgaris</i> aggr.	Alcvulg	126	39%	0.30
<i>Allium carinatum</i>		1	0%	0.45
<i>Allium lusitanicum</i>		2	1%	7.06
<i>Allium narcissiflorum</i>		2	1%	0.30
<i>Allium oleraceum</i>		2	1%	0.77
<i>Allium schoenoprasum</i>		8	2%	0.40
<i>Allium sphaerocephalon</i>		6	2%	0.30
<i>Alnus viridis</i>		9	3%	4.12
<i>Alopecurus alpinus</i>	Aloalpi	50	15%	0.30
<i>Alyssum alyssoides</i>		2	1%	0.47
<i>Alyssum montanum</i>		4	1%	0.30
<i>Anacamptis pyramidalis</i>		1	0%	0.65
<i>Androsace obtusifolia</i>		10	3%	1.88
<i>Androsace vitaliana</i>		8	2%	1.88
<i>Androsace adfinis</i>		3	1%	0.42
<i>Anemone baldensis</i>		5	2%	1.53
<i>Anemone narcissiflora</i>	Anenarc	28	9%	1.54
<i>Anemone nemorosa</i>		6	2%	1.06
<i>Anemone ranunculoides</i>		1	0%	0.30
<i>Angelica sylvestris</i>		1	0%	0.64
<i>Antennaria carpatia</i>		8	2%	0.63
<i>Antennaria dioica</i>	Antdioi	61	19%	1.86
<i>Anthericum liliago</i>		9	3%	3.05
<i>Anthoxanthum odoratum</i> aggr.	Antodor	180	56%	5.54
<i>Anthriscus sylvestris</i>		2	1%	4.00
<i>Anthyllis montana</i>		2	1%	1.53
<i>Anthyllis vulneraria</i>	Antvuln	41	13%	0.30
<i>Aphanes arvensis</i>		1	0%	0.30
<i>Arabidopsis thaliana</i>		1	0%	0.38
<i>Arabis allionii</i>		5	2%	0.30
<i>Arabis auriculata</i>		1	0%	0.31
<i>Arabis ciliata</i>	Aracili	21	6%	0.55
<i>Arabis hirsuta</i>		8	2%	0.30
<i>Arctium minus</i>		1	0%	3.67
<i>Arctium nemorosum</i>		1	0%	0.30
<i>Arenaria biflora</i>		1	0%	0.43
<i>Arenaria ciliata</i>		14	4%	1.03
<i>Arenaria serpyllifolia</i> aggr.		7	2%	0.31
<i>Armeria alpina</i>	Armalpi	33	10%	2.60
<i>Armeria arenaria</i>		8	2%	0.88
<i>Arnica montana</i>	Arnmont	88	27%	1.63
<i>Arrhenatherum elatius</i>		7	2%	0.54
<i>Artemisia absinthium</i>		5	2%	6.40
<i>Artemisia campestris</i>		2	1%	0.30
<i>Artemisia glacialis</i>		2	1%	0.91
<i>Asperula cynanchica</i>		6	2%	0.30
<i>Asperula purpurea</i>		1	0%	2.24
<i>Asphodelus macrocarpus</i>		13	4%	0.76
<i>Aster alpinus</i>		15	5%	1.73
<i>Aster bellidiastrum</i>		12	4%	2.36
<i>Astragalus alpinus</i>		8	2%	0.30

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Astragalus australis</i>		1	0%	5.56
<i>Astragalus cicer</i>		1	0%	3.93
<i>Astragalus danicus</i>		6	2%	0.30
<i>Astragalus glycyphyllos</i>		2	1%	0.67
<i>Astragalus monspessulanus</i>		11	3%	0.30
<i>Astragalus penduliflorus</i>		3	1%	0.93
<i>Astragalus sempervirens</i>		4	1%	0.65
<i>Astrantia major</i>		5	2%	0.86
<i>Astrantia minor</i>	Astmino	21	6%	0.30
<i>Athamanta cretensis</i>		1	0%	0.30
<i>Athyrium filix-femina</i>		2	1%	5.02
<i>Avenella flexuosa</i>	Aveflex	109	34%	0.30
<i>Barbarea intermedia</i>		4	1%	0.68
<i>Bartsia alpina</i>	Baralpi	23	7%	0.30
<i>Bellis perennis</i>		2	1%	0.30
<i>Berberis vulgaris</i>		2	1%	0.30
<i>Betula pendula</i>		4	1%	0.45
<i>Biscutella laevigata</i>	Bislaev	75	23%	0.42
<i>Botrychium lunaria</i>	Botluna	30	9%	14.56
<i>Brachypodium rupestre</i>	Brarupe	55	17%	2.10
<i>Briza media</i>	Brimedi	35	11%	16.75
<i>Bromus erectus</i>	Broerec	20	6%	0.30
<i>Bromus inermis</i>		1	0%	0.30
<i>Buglossoides arvensis</i>		1	0%	0.70
<i>Bunium bulbocastanum</i>	Bunbulb	20	6%	0.30
<i>Buphthalmum salicifolium</i>		1	0%	0.30
<i>Bupleurum falcatum</i>		2	1%	1.80
<i>Bupleurum ranunculoides</i>	Bupranu	25	8%	1.30
<i>Calamagrostis arundinacea</i>		2	1%	0.30
<i>Calamagrostis varia</i>		1	0%	26.21
<i>Calamagrostis villosa</i>		1	0%	10.26
<i>Callianthemum coriandrifolium</i>		1	0%	3.82
<i>Calluna vulgaris</i>	Calvulg	34	10%	0.69
<i>Campanula barbata</i>		16	5%	0.30
<i>Campanula cochleariifolia</i>		1	0%	0.88
<i>Campanula excisa</i>		1	0%	0.68
<i>Campanula glomerata</i>		6	2%	0.61
<i>Campanula persicifolia</i>		5	2%	0.96
<i>Campanula rhomboidalis</i>		1	0%	0.87
<i>Campanula scheuchzeri</i>	Camsche	167	52%	0.58
<i>Capsella bursa-pastoris</i>		6	2%	0.30
<i>Cardamine alpina</i>		1	0%	0.68
<i>Cardamine resedifolia</i>		10	3%	3.47
<i>Cardaminopsis halleri</i>		3	1%	1.02
<i>Carduus defloratus</i>	Cardefl	82	25%	14.18
<i>Carex acuta</i>		1	0%	0.99
<i>Carex aterrima</i>		5	2%	1.14
<i>Carex atrata</i>		2	1%	4.27
<i>Carex caryophylla</i>	Carcary	23	7%	9.78
<i>Carex curvula</i>	Carcurv	18	6%	7.62
<i>Carex echinata</i>		1	0%	1.11
<i>Carex ericetorum</i>		3	1%	20.51
<i>Carex fimbriata</i>		2	1%	4.94
<i>Carex flacca</i>		3	1%	16.27
<i>Carex flava</i> aggr.		3	1%	17.45
<i>Carex foetida</i>		15	5%	3.50

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Carex hirta</i>		1	0%	8.19
<i>Carex humilis</i>		17	5%	1.43
<i>Carex leporina</i>		11	3%	31.43
<i>Carex nigra</i>		3	1%	1.72
<i>Carex ornithopoda</i>		17	5%	2.52
<i>Carex pallescens</i>	Carpall	20	6%	4.77
<i>Carex panicea</i>		4	1%	1.90
<i>Carex paniculata</i>		1	0%	2.34
<i>Carex parviflora</i>		4	1%	1.46
<i>Carex pauciflora</i>		2	1%	5.01
<i>Carex pilulifera</i>		3	1%	1.19
<i>Carex rosae</i>		7	2%	16.43
<i>Carex rupestris</i>		4	1%	8.81
<i>Carex sempervirens</i>	Carsemp	207	64%	1.08
<i>Carex spicata</i>		1	0%	3.40
<i>Carex tendae</i>		7	2%	0.30
<i>Carlina acanthifolia</i>		1	0%	1.05
<i>Carlina acaulis</i>	Caracau	70	22%	0.63
<i>Carlina vulgaris</i>		2	1%	1.68
<i>Carum carvi</i>	Carcarv	30	9%	0.30
<i>Castanea sativa</i>		1	0%	0.76
<i>Centaurea nervosa</i>	Cennerv	18	6%	0.66
<i>Centaurea nigra</i>		11	3%	0.90
<i>Centaurea scabiosa</i>		15	5%	1.38
<i>Centaurea triumphettii</i>		16	5%	0.77
<i>Centaurea uniflora</i>	Cenunif	64	20%	0.30
<i>Cephalanthera longifolia</i>		2	1%	0.98
<i>Cerastium arvense</i>	Cerarve	123	38%	1.91
<i>Cerastium cerastoides</i>		2	1%	0.79
<i>Cerastium fontanum</i>	Cerfont	27	8%	0.73
<i>Cerinthe glabra</i>		3	1%	0.30
<i>Cerinthe minor</i>		2	1%	2.26
<i>Chaerophyllum hirsutum</i>	Chahirs	29	9%	3.31
<i>Chamaecytisus hirsutus</i>	Chahirr	31	10%	0.75
<i>Chenopodium bonus-henricus</i>		15	5%	0.62
<i>Cirsium acaule</i>		6	2%	0.30
<i>Cirsium arvense</i>		1	0%	0.50
<i>Cirsium eriophorum</i>		5	2%	0.91
<i>Cirsium palustre</i>		3	1%	0.42
<i>Cirsium spinosissimum</i>	Cirspin	26	8%	0.40
<i>Cirsium vulgare</i>		8	2%	1.05
<i>Clinopodium vulgare</i>		10	3%	0.39
<i>Coeloglossum viride</i>	Coeviri	19	6%	0.78
<i>Colchicum alpinum</i>		1	0%	0.32
<i>Colchicum autumnale</i>		11	3%	0.30
<i>Conopodium majus</i>		1	0%	0.30
<i>Corylus avellana</i>		1	0%	0.30
<i>Cotoneaster integerrimus</i>		3	1%	0.30
<i>Crataegus monogyna</i>		2	1%	0.89
<i>Crepis aurea</i>		4	1%	1.20
<i>Crepis conyzifolia</i>	Crecony	39	12%	1.57
<i>Crepis paludosa</i>		2	1%	2.39
<i>Crocus albiflorus</i>	Croalbi	64	20%	1.45
<i>Cruciata glabra</i>	Cruglab	50	15%	0.85
<i>Cruciata laevipes</i>		4	1%	0.30

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Crupina vulgaris</i>		1	0%	0.30
<i>Cryptogramma crispa</i>		2	1%	0.63
<i>Cuscuta epithymum</i>		1	0%	1.55
<i>Cynosurus cristatus</i>		7	2%	0.67
<i>Cytisophyllum sessilifolium</i>		2	1%	0.30
<i>Cytisus scoparius</i>		3	1%	5.75
<i>Dactylis glomerata</i>	Dacglom	50	15%	0.30
<i>Dactylorhiza maculata</i>		4	1%	0.30
<i>Dactylorhiza majalis</i>		1	0%	0.34
<i>Dactylorhiza sambucina</i>	Dacsamb	18	6%	4.32
<i>Danthonia decumbens</i>		15	5%	0.30
<i>Daphne mezereum</i>		12	4%	0.50
<i>Daucus carota</i>		2	1%	3.00
<i>Deschampsia cespitosa</i>		7	2%	1.64
<i>Dianthus carthusianorum</i>		13	4%	0.57
<i>Dianthus deltoides</i>		8	2%	1.43
<i>Dianthus furcatus</i>		12	4%	0.74
<i>Dianthus pavonius</i>	Diapavo	112	35%	0.30
<i>Dianthus superbus</i>		3	1%	1.15
<i>Dianthus sylvestris</i>		7	2%	0.30
<i>Digitalis grandiflora</i>		2	1%	0.30
<i>Doronicum grandiflorum</i>		2	1%	0.36
<i>Draba aizoides</i>		9	3%	5.86
<i>Dryas octopetala</i>		9	3%	0.30
<i>Dryopteris filix-mas</i>		5	2%	0.30
<i>Echinops ritro</i>		1	0%	0.30
<i>Echium vulgare</i>		3	1%	0.30
<i>Elymus repens</i>		1	0%	4.73
<i>Elyna myosuroides</i>		15	5%	0.30
<i>Empetrum hermaphroditum</i>		1	0%	0.30
<i>Epilobium angustifolium</i>		4	1%	2.40
<i>Epilobium fleischeri</i>		1	0%	0.76
<i>Epilobium montanum</i>		1	0%	0.30
<i>Epilobium palustre</i>		2	1%	3.81
<i>Equisetum arvense</i>		1	0%	0.41
<i>Erigeron alpinus</i>		11	3%	0.30
<i>Erigeron annuus</i>		1	0%	0.60
<i>Erigeron uniflorus</i>		10	3%	3.09
<i>Eriophorum angustifolium</i>		3	1%	1.71
<i>Eriophorum latifolium</i>		2	1%	5.88
<i>Eriophorum scheuchzeri</i>		1	0%	0.96
<i>Eritrichium nanum</i>		1	0%	0.30
<i>Eryngium campestre</i>		1	0%	0.92
<i>Erysimum jugicola</i>		6	2%	0.30
<i>Erysimum virgatum</i>		2	1%	0.78
<i>Euphorbia cyparissias</i>		5	2%	1.98
<i>Euphorbia dulcis</i>		3	1%	0.47
<i>Euphrasia alpina</i>		16	5%	0.30
<i>Euphrasia hirtella</i>		1	0%	0.83
<i>Euphrasia minima</i>	Eupmini	19	6%	1.03
<i>Euphrasia rostkoviana</i>		1	0%	0.83
<i>Euphrasia stricta</i>		12	4%	0.30
<i>Fagus sylvatica</i>		2	1%	2.83
<i>Festuca arundinacea</i>		2	1%	5.50
<i>Festuca dimorpha</i>		2	1%	3.34

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Festuca filiformis</i>		6	2%	15.64
<i>Festuca flavescens</i>		2	1%	4.60
<i>Festuca gigantea</i>		3	1%	5.93
<i>Festuca halleri</i> aggr.		13	4%	8.66
<i>Festuca ovina</i> aggr.	Fesovin	160	49%	12.36
<i>Festuca paniculata</i>	Fespani	62	19%	3.99
<i>Festuca pratensis</i>		4	1%	4.90
<i>Festuca quadriflora</i>	Fesquad	24	7%	10.26
<i>Festuca rubra</i>	Fesrubr	163	50%	11.50
<i>Festuca scabriculum</i>		17	5%	8.90
<i>Festuca violacea</i> aggr.	Fesviol	82	25%	0.40
<i>Fourraea alpina</i>		9	3%	0.95
<i>Fragaria vesca</i>		8	2%	0.71
<i>Fraxinus excelsior</i>		3	1%	0.36
<i>Fritillaria tubaeformis</i>		4	1%	3.28
<i>Gagea fragifera</i>		2	1%	9.84
<i>Galeopsis ladanum</i>		1	0%	0.30
<i>Galeopsis pubescens</i>		1	0%	0.71
<i>Galeopsis tetrahit</i>		5	2%	16.67
<i>Galium laevigatum</i>		1	0%	1.32
<i>Galium lucidum</i> aggr.	Galluci	21	6%	1.77
<i>Galium mollugo</i> aggr.	Galmoll	22	7%	0.98
<i>Galium pusillum</i> aggr.	Galpusi	60	19%	0.98
<i>Galium rubrum</i> aggr.	Galrubr	40	12%	0.90
<i>Galium verum</i>	Galveru	37	11%	5.39
<i>Genista cinerea</i>		2	1%	1.54
<i>Genista germanica</i>		17	5%	2.36
<i>Genista pilosa</i>		7	2%	1.31
<i>Genista tinctoria</i>		12	4%	0.93
<i>Gentiana acaulis</i> aggr.	Genacau	89	27%	0.34
<i>Gentiana campestris</i> aggr.	Gencamp	26	8%	0.30
<i>Gentiana cruciata</i>		1	0%	0.36
<i>Gentiana lutea</i>	Genlute	23	7%	0.77
<i>Gentiana nivalis</i>		3	1%	0.36
<i>Gentiana punctata</i> aggr.		6	2%	0.30
<i>Gentiana purpurea</i>		1	0%	0.52
<i>Gentiana ramosa</i>		3	1%	0.63
<i>Gentiana verna</i>	Genvern	53	16%	0.30
<i>Geranium molle</i>		2	1%	0.34
<i>Geranium pyrenaicum</i>		4	1%	1.67
<i>Geranium sylvaticum</i>	Gersylv	34	10%	2.43
<i>Geum montanum</i>	Geumont	128	40%	0.30
<i>Geum rivale</i>		1	0%	1.03
<i>Globularia bisnagarica</i>		8	2%	2.45
<i>Globularia cordifolia</i>		14	4%	6.24
<i>Gnaphalium hoppeanum</i>		2	1%	0.65
<i>Gnaphalium norvegicum</i>		2	1%	1.56
<i>Gnaphalium supinum</i>		17	5%	0.52
<i>Gnaphalium sylvaticum</i>		4	1%	0.41
<i>Gymnadenia conopsea</i>	Gymcono	26	8%	1.94
<i>Gymnocarpium dryopteris</i>		1	0%	0.30
<i>Gypsophila repens</i>		5	2%	10.97
<i>Hedysarum hedysaroides</i>		6	2%	0.30
<i>Helianthemum apenninum</i>		2	1%	4.69
<i>Helianthemum nummularium</i>	Helnumm	85	26%	3.05

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Helianthemum oelandicum</i> aggr.	Heloela	32	10%	14.45
<i>Helictotrichon parlatorei</i>		16	5%	3.59
<i>Helictotrichon pratense</i>		16	5%	1.45
<i>Helictotrichon pubescens</i>		12	4%	4.24
<i>Helictotrichon sedenense</i>	Helsede	23	7%	0.30
<i>Helictotrichon sempervirens</i>		1	0%	2.32
<i>Helictotrichon versicolor</i>	Helvers	19	6%	0.30
<i>Helleborus foetidus</i>		1	0%	4.24
<i>Heracleum sphondylium</i>		7	2%	1.18
<i>Hieracium angustifolium</i>	Hieangu	23	7%	0.30
<i>Hieracium aurantiacum</i>		1	0%	0.61
<i>Hieracium cymosum</i>		5	2%	1.04
<i>Hieracium glanduliferum</i>	Hieglan	56	17%	1.40
<i>Hieracium lactucella</i>	Hielact	55	16%	1.07
<i>Hieracium murorum</i> aggr.	Hiemuro	26	8%	0.30
<i>Hieracium peletierianum</i>		2	1%	1.98
<i>Hieracium pilosella</i>	Hiepilo	55	17%	0.54
<i>Hieracium piloselloides</i>		5	2%	0.54
<i>Hieracium pilosum</i>		2	1%	0.35
<i>Hieracium prenanthoides</i>		5	2%	1.06
<i>Hieracium pseudopilosella</i>		2	1%	0.89
<i>Hieracium saussureoides</i>		1	0%	0.30
<i>Hieracium tomentosum</i>		8	2%	0.49
<i>Hieracium valdepilosum</i>		3	1%	0.30
<i>Hieracium villosum</i>		1	0%	1.27
<i>Hippocrepis comosa</i>	Hipcomo	39	12%	0.57
<i>Holcus lanatus</i>		3	1%	1.54
<i>Homogyne alpina</i>	Homalpi	35	11%	0.30
<i>Huperzia selago</i>		1	0%	2.02
<i>Hypericum maculatum</i>		13	4%	0.79
<i>Hypericum perforatum</i>		11	3%	0.48
<i>Hypericum richeri</i>	Hyprich	66	20%	0.30
<i>Hypochaeris maculata</i>		10	3%	1.15
<i>Hypochaeris radicata</i>		1	0%	0.77
<i>Hypochaeris uniflora</i>	Hypunif	25	8%	0.30
<i>Jasione montana</i>		1	0%	3.96
<i>Juncus articulatus</i>		2	1%	3.85
<i>Juncus filiformis</i>		1	0%	0.89
<i>Juncus jacquinii</i>		5	2%	2.59
<i>Juncus trifidus</i>	Juntrif	53	16%	4.71
<i>Juncus triglumis</i>		1	0%	0.30
<i>Juniperus communis</i>		6	2%	1.14
<i>Juniperus nana</i>	Junnana	40	12%	0.88
<i>Knautia arvensis</i>		11	3%	0.30
<i>Knautia dipsacifolia</i>		1	0%	1.52
<i>Knautia mollis</i>		10	3%	0.30
<i>Koeleria hirsuta</i>		1	0%	0.30
<i>Koeleria macrantha</i>		1	0%	1.60
<i>Koeleria pyramidata</i>		8	2%	2.21
<i>Koeleria vallesiana</i>		2	1%	1.10
<i>Lactuca perennis</i>		3	1%	0.30
<i>Larix decidua</i>		13	4%	1.12
<i>Laserpitium gallicum</i>		3	1%	1.32
<i>Laserpitium halleri</i>		3	1%	0.80
<i>Laserpitium latifolium</i>		16	5%	2.90

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Laserpitium siler</i>		3	1%	1.14
<i>Lathyrus heterophyllus</i>		2	1%	1.63
<i>Lathyrus pratensis</i>	Latprat	28	9%	3.28
<i>Lathyrus sphaericus</i>		2	1%	2.49
<i>Lavandula angustifolia</i>		8	2%	1.28
<i>Leontodon autumnalis</i>		3	1%	1.81
<i>Leontodon crispus</i>		6	2%	5.05
<i>Leontodon helveticus</i>	Leohelv	77	24%	0.30
<i>Leontodon hirtus</i>		1	0%	2.51
<i>Leontodon hispidus</i>	Leohisp	89	27%	0.57
<i>Leontopodium alpinum</i>		9	3%	1.33
<i>Leucanthemopsis alpina</i>	Leualpi	21	6%	0.77
<i>Leucanthemum atratum</i> aggr.	Leuatra	19	6%	0.62
<i>Leucanthemum vulgare</i> aggr.	Leuvulg	56	17%	6.53
<i>Ligusticum mutellina</i>		17	5%	2.23
<i>Ligusticum mutellinoides</i>		6	2%	0.30
<i>Lilium bulbiferum</i>		4	1%	0.30
<i>Lilium martagon</i>		6	2%	0.53
<i>Linum alpinum</i>		7	2%	1.29
<i>Linum strictum</i>		7	2%	0.30
<i>Linum tenuifolium</i>		1	0%	0.30
<i>Listera ovata</i>		1	0%	1.41
<i>Lloydia serotina</i>		2	1%	1.10
<i>Loiseleuria procumbens</i>		7	2%	1.51
<i>Lolium multiflorum</i>		2	1%	1.91
<i>Lotus corniculatus</i>	Lotcorn	185	57%	5.35
<i>Luzula alpinopilosa</i>	Luzalpi	23	7%	1.22
<i>Luzula campestris</i> aggr.	Luzcamp	88	27%	2.76
<i>Luzula lutea</i>	Luzlute	44	14%	1.17
<i>Luzula luzuloides</i>		4	1%	2.42
<i>Luzula nivea</i>		13	4%	1.30
<i>Luzula sieberi</i>		16	5%	0.71
<i>Luzula spicata</i> aggr.	Luzspic	42	13%	0.61
<i>Maianthemum bifolium</i>		3	1%	0.30
<i>Malus domestica</i>		1	0%	2.44
<i>Medicago lupulina</i>		6	2%	0.30
<i>Medicago sativa</i>		1	0%	1.93
<i>Meum athamanticum</i>	Meuatha	36	11%	0.30
<i>Minuartia austriaca</i>		1	0%	1.19
<i>Minuartia capillacea</i>		3	1%	0.46
<i>Minuartia laricifolia</i>		4	1%	1.54
<i>Minuartia recurva</i>		1	0%	0.96
<i>Minuartia sedoides</i>		10	3%	0.80
<i>Minuartia verna</i>	Minvern	23	7%	43.12
<i>Molinia arundinacea</i>		1	0%	24.20
<i>Molinia caerulea</i>		3	1%	0.58
<i>Myosotis alpestris</i>	Myoalpe	69	21%	0.60
<i>Myosotis arvensis</i>		16	5%	0.30
<i>Myosotis ramosissima</i>		1	0%	0.30
<i>Myosotis sylvatica</i>		1	0%	0.30
<i>Myrrhis odorata</i>		1	0%	0.56
<i>Narcissus radiiflorus</i>		3	1%	13.68
<i>Nardus stricta</i>	Narstri	175	54%	0.30
<i>Nepeta nepetella</i>		1	0%	0.33
<i>Nigritella rhellicani</i>	Nigrhel	26	8%	2.04

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Odontites luteus</i>	Onomont	1	0%	7.84
<i>Onobrychis montana</i>		39	12%	0.76
<i>Onobrychis viciifolia</i>		1	0%	1.58
<i>Ononis cristata</i>		3	1%	1.20
<i>Ononis natrix</i>		5	2%	0.30
<i>Orchis mascula</i>		1	0%	0.30
<i>Orchis militaris</i>		1	0%	0.30
<i>Orchis tridentata</i>		4	1%	0.30
<i>Orchis ustulata</i>		7	2%	1.37
<i>Oreochloa seslerioides</i>		2	1%	1.02
<i>Ornithogalum umbellatum</i>	Ornumbe	35	11%	2.73
<i>Oxytropis campestris</i>		4	1%	0.96
<i>Oxytropis helvetica</i>		12	4%	0.39
<i>Oxytropis lapponica</i>		4	1%	3.05
<i>Oxytropis neglecta</i>		5	2%	1.56
<i>Paradisea liliastrum</i>		13	4%	0.34
<i>Parnassia palustris</i>		5	2%	0.30
<i>Pastinaca sativa</i>		1	0%	0.61
<i>Pedicularis cenisia</i>		7	2%	0.99
<i>Pedicularis comosa</i>		1	0%	0.30
<i>Pedicularis foliosa</i>	Pedgyro	2	1%	0.61
<i>Pedicularis gyroflexa</i>		37	11%	0.77
<i>Pedicularis kernerii</i>		7	2%	0.63
<i>Pedicularis rosea</i>	Pedrost	2	1%	0.64
<i>Pedicularis rostratospicata</i>		20	6%	0.44
<i>Pedicularis tuberosa</i>		5	2%	0.62
<i>Pedicularis verticillata</i>	Peuostr	3	1%	41.28
<i>Petasites hybridus</i>		1	0%	0.53
<i>Peucedanum oreoselinum</i>		2	1%	1.31
<i>Peucedanum ostruthium</i>		18	6%	0.89
<i>Phleum phleoides</i>		2	1%	2.68
<i>Phleum pratense</i>		4	1%	4.61
<i>Phleum rhaeticum</i>	Phlrhae	112	35%	0.91
<i>Phyteuma betonicifolium</i>	Phybeto	89	27%	2.53
<i>Phyteuma globulariifolium</i>	Phyglob	18	6%	1.23
<i>Phyteuma hemisphaericum</i>	Phyhemi	21	6%	1.19
<i>Phyteuma michelii</i>	Phymich	30	9%	0.85
<i>Phyteuma orbiculare</i>	Phyorbi	43	13%	0.38
<i>Phyteuma ovatum</i>	Plaalpi	5	2%	0.30
<i>Phyteuma scheuchzeri</i>		1	0%	0.62
<i>Phyteuma scorzonrifolium</i>		6	2%	0.30
<i>Phyteuma spicatum</i>		1	0%	0.30
<i>Picea abies</i>		1	0%	0.30
<i>Picris hieracioides</i>		1	0%	0.66
<i>Pimpinella major</i>		9	3%	1.36
<i>Pimpinella saxifraga</i>		14	4%	0.64
<i>Pinguicula alpina</i>		1	0%	0.30
<i>Pinguicula vulgaris</i>		1	0%	0.30
<i>Pinus mugo</i>	Plafusc	5	2%	0.30
<i>Pinus sylvestris</i>		3	1%	4.27
<i>Plantago alpina aggr.</i>		130	40%	1.89
<i>Plantago atrata</i>	Plalanc	7	2%	3.27
<i>Plantago fuscescens</i>		32	10%	1.09
<i>Plantago lanceolata</i>		21	6%	0.91
<i>Plantago major</i>		8	2%	2.11

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Plantago media</i>	Plamedi	25	8%	0.39
<i>Platanthera bifolia</i>		4	1%	0.30
<i>Platanthera chlorantha</i>		1	0%	4.82
<i>Poa alpina</i>	Poaalpi	175	54%	3.00
<i>Poa annua</i> aggr.		9	3%	1.52
<i>Poa bulbosa</i>		1	0%	0.30
<i>Poa cenisia</i>		1	0%	3.42
<i>Poa chaixii</i>	Poachai	27	8%	0.30
<i>Poa minor</i>		1	0%	0.30
<i>Poa nemoralis</i>		3	1%	3.01
<i>Poa pratensis</i>	Poaprat	27	8%	2.33
<i>Poa trivialis</i>		6	2%	4.85
<i>Poa variegata</i>	Poavari	68	21%	0.51
<i>Polygala alpestris</i>	Polalpe	23	7%	0.30
<i>Polygala alpina</i>		1	0%	0.30
<i>Polygala amarella</i>		2	1%	1.79
<i>Polygala chamaebuxus</i>		3	1%	0.37
<i>Polygala vulgaris</i>	Polvulg	21	6%	0.30
<i>Polygonatum verticillatum</i>		2	1%	1.23
<i>Polygonum alpinum</i>		4	1%	0.30
<i>Polygonum aviculare</i>		1	0%	3.28
<i>Polygonum bistorta</i>	Polbist	85	26%	3.20
<i>Polygonum viviparum</i>	Polvivi	84	26%	0.30
<i>Populus tremula</i>		1	0%	0.30
<i>Potentilla alba</i>		2	1%	0.30
<i>Potentilla argentea</i>		2	1%	2.97
<i>Potentilla aurea</i>	Potaure	36	11%	2.83
<i>Potentilla crantzii</i>	Potcran	49	15%	3.37
<i>Potentilla erecta</i>	Poterec	51	16%	0.30
<i>Potentilla fruticosa</i>		1	0%	1.76
<i>Potentilla grandiflora</i>	Potgran	115	35%	0.97
<i>Potentilla intermedia</i>		2	1%	1.35
<i>Potentilla neumanniana</i>	Potneum	19	6%	1.64
<i>Potentilla reptans</i>		2	1%	0.53
<i>Potentilla rupestris</i>		3	1%	0.69
<i>Potentilla valderia</i>		2	1%	0.95
<i>Primula farinosa</i>		1	0%	0.30
<i>Primula hirsuta</i>		1	0%	2.24
<i>Primula pedemontana</i>		2	1%	0.74
<i>Primula veris</i>	Priveri	42	13%	0.30
<i>Pritzelago alpina</i>		1	0%	0.45
<i>Prunella grandiflora</i>		7	2%	1.83
<i>Prunella laciniata</i>		1	0%	1.28
<i>Prunella vulgaris</i>		9	3%	0.30
<i>Prunus avium</i>		1	0%	0.30
<i>Prunus domestica</i>		1	0%	0.30
<i>Prunus spinosa</i>		2	1%	0.36
<i>Pseudorchis albida</i>	Psealbi	28	9%	2.73
<i>Pteridium aquilinum</i>		5	2%	0.39
<i>Pulmonaria australis</i>		6	2%	0.30
<i>Pulmonaria officinalis</i>		1	0%	1.19
<i>Pulsatilla alpina</i>	Pulalpi	37	11%	0.30
<i>Pulsatilla halleri</i>		1	0%	0.90
<i>Pulsatilla vernalis</i>		7	2%	1.26
<i>Pyrola minor</i>		1	0%	0.30
<i>Pyrola rotundifolia</i>		1	0%	0.30

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Quercus pubescens</i>		1	0%	0.30
<i>Ranunculus aconitifolius</i>		3	1%	2.02
<i>Ranunculus acris</i>	Ranacri	18	6%	1.49
<i>Ranunculus bulbosus</i>		12	4%	2.07
<i>Ranunculus kuepferi</i>	Rankuep	53	16%	2.26
<i>Ranunculus montanus</i> aggr.	Ranmont	168	52%	0.37
<i>Ranunculus platanifolius</i>		2	1%	0.62
<i>Ranunculus repens</i>		1	0%	0.76
<i>Ranunculus seguieri</i>		1	0%	0.30
<i>Rhamnus alpina</i>		1	0%	0.30
<i>Rhamnus pumila</i>		1	0%	2.71
<i>Rhinanthus alectorolophus</i>		16	5%	1.15
<i>Rhinanthus glacialis</i>	Rhiglac	34	10%	0.92
<i>Rhodiola rosea</i>		3	1%	0.97
<i>Rhododendron ferrugineum</i>	Rhoferr	45	14%	0.30
<i>Rorippa islandica</i>		1	0%	0.42
<i>Rosa</i> aggr.	Rosaggr	25	8%	0.30
<i>Rubus</i> aggr.		1	0%	1.93
<i>Rubus idaeus</i>		8	2%	0.71
<i>Rumex acetosa</i>	Rumacet	72	22%	0.59
<i>Rumex acetosella</i>		13	4%	2.15
<i>Rumex alpestris</i>		9	3%	6.42
<i>Rumex alpinus</i>		15	5%	1.35
<i>Rumex obtusifolius</i>		6	2%	2.15
<i>Rumex scutatus</i>		8	2%	0.74
<i>Sagina saginoides</i>	Sagsagi	20	6%	0.30
<i>Salix breviserrata</i>		2	1%	0.30
<i>Salix foetida</i>		1	0%	0.30
<i>Salix glaucosericea</i>		1	0%	0.30
<i>Salix hastata</i>		1	0%	0.30
<i>Salix helvetica</i>		2	1%	6.90
<i>Salix herbacea</i>	Salherb	35	11%	4.93
<i>Salix reticulata</i>		5	2%	5.08
<i>Salix retusa</i>		11	3%	2.30
<i>Salix serpyllifolia</i>		4	1%	2.52
<i>Salvia pratensis</i>		13	4%	0.92
<i>Sanguisorba minor</i>		13	4%	1.29
<i>Sanguisorba officinalis</i>		6	2%	0.50
<i>Saponaria ocymoides</i>		7	2%	1.99
<i>Satureja montana</i>		2	1%	0.30
<i>Saxifraga aizoides</i>		1	0%	1.55
<i>Saxifraga bryoides</i>		2	1%	0.30
<i>Saxifraga exarata</i> aggr.		2	1%	0.30
<i>Saxifraga oppositifolia</i>		1	0%	0.36
<i>Saxifraga paniculata</i>		9	3%	0.30
<i>Saxifraga purpurea</i>		3	1%	0.67
<i>Scabiosa columbaria</i> aggr.	Scacolu	42	13%	0.49
<i>Scilla bifolia</i>		4	1%	23.40
<i>Scirpus sylvaticus</i>		1	0%	0.30
<i>Scorzonera austriaca</i>		1	0%	0.30
<i>Scrophularia canina</i>		1	0%	1.41
<i>Scutellaria alpina</i>		5	2%	1.40
<i>Securigera varia</i>		3	1%	0.37
<i>Sedum acre</i>		4	1%	0.30
<i>Sedum album</i>		1	0%	1.87
<i>Sedum alpestre</i>		5	2%	0.49

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Sedum anacampseros</i>		17	5%	0.66
<i>Sedum rupestre</i> aggr.		6	2%	0.30
<i>Selaginella selaginoides</i>		2	1%	0.42
<i>Sempervivum arachnoideum</i>	Semarac	23	7%	1.38
<i>Sempervivum montanum</i>		11	3%	0.70
<i>Sempervivum tectorum</i>		12	4%	0.52
<i>Senecio doronicum</i>	Sendoro	29	9%	0.64
<i>Senecio incanus</i>	Seninca	33	10%	0.30
<i>Senecio jacobaea</i>		1	0%	0.30
<i>Senecio ovatus</i>		1	0%	0.30
<i>Senecio viscosus</i>		1	0%	1.40
<i>Seseli annuum</i>		1	0%	0.63
<i>Seseli libanotis</i>		4	1%	9.34
<i>Sesleria caerulea</i>	Sescaer	39	12%	1.13
<i>Sibbaldia procumbens</i>	Sibproc	22	7%	1.01
<i>Silene acaulis</i>	Silacau	37	11%	0.60
<i>Silene dioica</i>		4	1%	0.30
<i>Silene flos-cuculi</i>		1	0%	0.48
<i>Silene flos-jovis</i>		16	5%	0.30
<i>Silene latifolia</i>		1	0%	0.64
<i>Silene nutans</i>	Silnuta	59	18%	0.30
<i>Silene otites</i>		3	1%	0.37
<i>Silene rupestris</i>		9	3%	0.30
<i>Silene saxifraga</i>		1	0%	0.50
<i>Silene viscaria</i>		2	1%	1.25
<i>Silene vulgaris</i>	Silvulg	28	9%	1.27
<i>Soldanella alpina</i>	Solalpi	49	15%	0.55
<i>Solidago virgaurea</i>		16	5%	0.30
<i>Sorbus aria</i>		10	3%	0.30
<i>Sorbus aucuparia</i>		5	2%	0.98
<i>Stachys officinalis</i>		6	2%	0.69
<i>Stachys pradica</i>	Staprad	28	9%	0.63
<i>Stachys recta</i>		9	3%	1.09
<i>Stellaria graminea</i>		4	1%	0.97
<i>Stellaria holostea</i>		1	0%	1.57
<i>Stellaria media</i>		1	0%	20.33
<i>Stipa pennata</i> aggr.		3	1%	0.30
<i>Tanacetum vulgare</i>		2	1%	0.52
<i>Taraxacum laevigatum</i> s. l.		8	2%	1.03
<i>Taraxacum officinale</i> aggr.		13	4%	4.46
<i>Taraxacum officinale</i> s. l.	Taroffi	47	15%	0.30
<i>Tephrosia aurantiaca</i>		1	0%	5.85
<i>Teucrium chamaedrys</i>		13	4%	1.54
<i>Teucrium montanum</i>		4	1%	0.53
<i>Teucrium scorodonia</i>		4	1%	0.30
<i>Thalictrum aquilegifolium</i>		1	0%	0.50
<i>Thalictrum minus</i> aggr.		6	2%	0.36
<i>Thesium alpinum</i>		7	2%	0.79
<i>Thesium linophyllum</i> aggr.		1	0%	0.45
<i>Thlaspi alpestre</i>	Thlalpe	19	6%	2.24
<i>Thymus serpyllum</i> aggr.	Thyserp	151	47%	0.30
<i>Tofieldia calyculata</i>		1	0%	0.30
<i>Tragopogon dubius</i>		1	0%	0.45
<i>Tragopogon pratensis</i>		15	5%	0.30
<i>Traunsteinera globosa</i>		3	1%	6.49
<i>Trichophorum cespitosum</i>		2	1%	2.49
<i>Trifolium alpestre</i>	Trialpe	25	8%	12.62

Table A2. Cont.

Species Name	Species Code	Transects		SRA
		n	%	
<i>Trifolium alpinum</i>	Trialpi	108	33%	0.30
<i>Trifolium aureum</i>		1	0%	0.59
<i>Trifolium badium</i>	Tribadi	28	9%	3.57
<i>Trifolium hybridum</i>		1	0%	12.91
<i>Trifolium medium</i>		2	1%	1.70
<i>Trifolium montanum</i>	Trimont	30	9%	3.17
<i>Trifolium pallescens</i>		3	1%	1.22
<i>Trifolium pannonicum</i>		6	2%	2.16
<i>Trifolium pratense</i>	Triprat	147	45%	2.40
<i>Trifolium repens</i>	Trirepe	55	17%	6.03
<i>Trifolium thalii</i>	Trithal	34	10%	10.48
<i>Triglochin palustris</i>		1	0%	0.97
<i>Trinia glauca</i>		4	1%	0.80
<i>Trisetum distichophyllum</i>		1	0%	4.81
<i>Trisetum flavescens</i>	Triflav	51	16%	1.60
<i>Trollius europaeus</i>	Troeuro	30	9%	0.42
<i>Tulipa australis</i>		6	2%	1.19
<i>Tussilago farfara</i>		1	0%	1.25
<i>Urtica dioica</i>		15	5%	3.18
<i>Vaccinium gaultherioides</i>	Vacgaul	60	19%	2.36
<i>Vaccinium myrtillus</i>	Vacmyrt	68	21%	1.49
<i>Vaccinium vitis-idaea</i>		2	1%	3.16
<i>Valeriana celtica</i>		5	2%	0.30
<i>Valerianella locusta</i>		1	0%	0.52
<i>Veratrum album</i>	Veralbu	60	19%	0.88
<i>Verbascum densiflorum</i>		5	2%	0.30
<i>Verbascum lychnitis</i>		6	2%	0.38
<i>Verbascum thapsus</i>		6	2%	1.87
<i>Veronica allionii</i>	Veralli	53	16%	0.66
<i>Veronica alpina</i>	Veralpi	19	6%	0.30
<i>Veronica aphylla</i>		1	0%	0.30
<i>Veronica arvensis</i>		4	1%	2.28
<i>Veronica bellidioides</i>		5	2%	1.34
<i>Veronica chamaedrys</i>	Vercham	23	7%	0.47
<i>Veronica fruticulosa</i> aggr.		3	1%	1.50
<i>Veronica officinalis</i>	Veroffi	20	6%	0.30
<i>Veronica prostrata</i>		1	0%	0.70
<i>Veronica serpyllifolia</i>		4	1%	0.57
<i>Veronica verna</i>		1	0%	1.99
<i>Vicia cracca</i>		13	4%	0.30
<i>Vicia hirsuta</i>		1	0%	1.34
<i>Vicia onobrychioides</i>		2	1%	2.67
<i>Vicia sativa</i>		4	1%	1.44
<i>Vicia sepium</i>		2	1%	0.30
<i>Vicia villosa</i>		1	0%	0.30
<i>Vincetoxicum hirundinaria</i>		13	4%	0.30
<i>Viola arvensis</i>		1	0%	0.61
<i>Viola biflora</i>		9	3%	1.32
<i>Viola calcarata</i>	Viocalc	89	27%	2.00
<i>Viola canina</i>		4	1%	0.30
<i>Viola odorata</i>		1	0%	0.30
<i>Viola palustris</i>		1	0%	0.30
<i>Viola pinnata</i>		1	0%	0.52
<i>Viola riviniana</i>		3	1%	0.30
<i>Viola suavis</i>		2	1%	0.35
<i>Viola thomasiana</i>		5	2%	0.39
<i>Viola tricolor</i>		16	5%	0.30

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