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Hydrochemistry, water table depth and related distribution patterns of vascular plants in a mixed mire

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Abstract

The hydrological and floristic variation within a mire vegetation is mostly controlled by three ecological gradients: nutrient availability, acidity–alkalinity, and water table depth. The objectives of this study were: (a) to analyse the hydrochemistry of a mixed mire in relation to different habitat conditions; (b) to evaluate the patterns of vascular plant composition in relation to nutrient availability, acidity–alkalinity, and water table depth, and to partition the pure effects of these gradients. Within a mixed mire, we sampled 36 small plots to cover all vegetation types present. Then, the chemical water properties, and the water regime were measured during a growing season. Water chemistry proved to be significantly different between the various vegetation types. Two biological systems could be identified according to hydrochemistry and vascular plant composition: (1) several fen vegetation types lacking raised *Sphagnum* structures where the water chemistry reflected groundwater properties; (2) bog *Sphagnum*-dominated vegetation, where the convex shape of the mire surface prevented mixing with the groundwater. The results of the partitioning indicated that the acidity–alkalinity gradient was more important in controlling the patterns of plant distribution than water table depth.

Key words: *Bog, fen, small scale, ion concentration, southern Alps, variance partitioning*

Introduction

Mires can be divided into two main hydrological categories: (1) “bogs”, i.e. ombrotrophic mires in which the nutrients are of atmospheric origin, and 2) “fens”, minerotrophic mires affected by telluric water (Sjörs & Gunnarson, 2002).

The hydrochemical and floristic variation within mire vegetation is controlled by three main ecological gradients: availability of limiting plant nutrients, acidity–alkalinity, and water table depth (Malmer, 1986; Wheeler & Proctor, 2000). The mire margin–mire expanse gradient is considered a complex gradient, not related to precise ecological factors (Bragazza, 1999; Wheeler & Proctor, 2000). The availability of limiting nutrients gains in importance with the length of the analysed vegetation gradient. From rich fens to bogs, nitrogen (N) and phosphorus (P) contents in water and peat have proved to be important elements explaining differences in floristic composition along the poor-rich vegetation gradient (Vitt & Chee, 1990). In poor fens and bogs,

numerous investigations have shown that nutrient availability in water is not a key factor due to negligible concentrations, even in very different vegetation types (Wassen et al., 1990). As demonstrated by Hájek and Hekera (2004), and Vitt et al. (1995), punctual measurements are strongly affected by the time of sampling. By contrast, the reliability of single measurements of pH, electrical conductivity and principal ions has been confirmed by many studies (e.g. Vitt et al., 1995; Hájek & Hekera, 2004; Hájková & Hájek, 2004).

Several studies supported the hypothesis that local species composition is mainly affected by the acidity–alkalinity gradient and by water table depth (McNamara et al., 1992; Tahvanainen, 2004; Hájková & Hájek, 2004). *Sphagnum*-dominated vegetation is considered a natural acid ecosystem with ombrotrophic conditions. On the contrary, fen lawns, hollows and pools are mostly affected by mineral water fluxes, and have higher pH and electrical conductivity (Karlin & Bliss, 1984). The peat bryophytes shape the microhabitat of vascular

plants with their growth dynamics, and directly affect the hydrochemistry of mires with their biological interactions.

Several papers have focused on the hydrochemical descriptions of mires and the response of vascular plants and mosses to these gradients in the southern Alps (e.g. Gerdol, 1990; Bragazza, 1999; Bragazza & Gerdol, 1996, 1999). Nevertheless, only a few studies have dealt with mixed mires using a small-scale approach (Gerdol, 1990), and none have considered explicitly a variance partitioning method to highlight the relative importance of single gradients.

Therefore, this paper focuses on the description of the hydrochemistry in a mixed mire, and on the vascular plant species composition using a small-scale approach. The coexistence of different vegetation types provides an experimental setting that enables the evaluation of the direct effect of water chemistry and of water table depth. It also avoids the potential “noise” of data arising when different sites are compared. In particular, the different atmospheric chemistry, climate, and bedrocks can explain a large part of the compositional species variation between mires. The objectives of this study were: (a) to analyse the hydrochemistry of a mixed mire in relation to different habitat conditions; (b) to evaluate the patterns of vascular plant composition in relation to water chemistry and water table depth at a small scale. We hypothesised that species composition could vary on a small spatial scale due to variation of water chemistry and water table. In particular, we tested if nutrient availability, water acidity–alkalinity, and water table depth had significant influences in shaping vascular plant species composition and, with the use of partitioning methods, the independent effects of the significant ecological gradients.

Materials and methods

Study area

The study area was a small mixed mire of ca. 75 m × 50 m in the SE Alps, near Danta di Cadore, province of Belluno, Veneto (NE Italy; 46°34' N, 12°29' E). The mean altitude was 1325 m a.s.l. The geological substrates were homogeneous, being composed of sandstone rocks and glacial sediments. The climate was sub-continental with a mean precipitation of ca. 1000 mm year⁻¹. The vegetation indicated a gradient from small bogs to different fen types. The different vegetation types formed a patchy structure at the meter scale characterised by hummocks, hollows, lawns and pools. This small-scale pattern was related to the surface microtopography, which was largely affected by the growth dynamics of

peat mosses, and by the presence of pools. Seven vegetation types (six fen and one bog type) could be identified, based on dominant vascular plants and indicator species. According to Sjörs and Gunnarson (2002), we retain the terms “fen” and “bog” to indicate minerotrophic and ombrotrophic conditions, respectively. The phytosociological units followed Gerdol and Tomaselli (1997).

The six fen types were mainly dominated by vascular plants and brown mosses:

- (a) Car_las: hollows dominated by *Carex lasiocarpa* [*Caricetum lasiocarpae*],
- (b) Car_ros: hollows and pools with *Carex rostrata* [*Caricetum rostratae*],
- (c) Rhy_alb: hollows with *Rhynchospora alba* [*Sphagno tenelli–Rhynchosporetum albae*],
- (d) Tri_cae: lawns dominated by *Trichophorum caespitosum* [*Drapanoclado revolventis–Trichophoretum caespitosi*],
- (e) Sch_fer: lawns dominated by *Schoenus ferrugineus* [*Schoenetum ferruginei*],
- (f) Utr_min: pools with *Utricularia minor* [*Scorpido–Utricularietum minoris*].
- (g) The bog vegetation was characterised by *Sphagnum* hummocks:
- (h) Sph_dom: *Sphagnum*-dominated hummocks [*Sphagnetum magellanicum*].

Vegetation sampling

Over the whole mire expanse, 36 plots (40 × 40 cm) were chosen according to a preferential sampling design in order to cover the seven vegetation types. Due to the patchy distribution of the vegetation, standardised transects were not considered appropriate. The number of plots per vegetation type was proportional to its spatial extension. In each plot, a complete floristic survey was carried out, and species cover was evaluated by the van der Maarel scale (1979). The *Sphagnum* cover and the water surface were also visually estimated. Nomenclature of species followed Wisskirchen and Haeupler (1998).

Water sampling and chemical analyses

In each plot, a water sample was taken on 16 July 2005, following the method proposed by Tahvanainen et al. (2002) for obtaining comparable water samples from different types of mire surface. The samples were put into sterilised polyethylene bottles, taken to the laboratory within 4 h, and stored at 4°C. All analyses were carried out within 24 h. The following anions and cations were analysed: Cl⁻, NO₂⁻, NO₃⁻, SO₄²⁻, Na⁺, NH₄⁺, K⁺, Ca²⁺, and Mg²⁺. Ion concentrations were measured following the standard methods described in APHA Inc.

(1992). Electrical conductivity (EC) and pH were directly measured in the field by portable instruments. In the centre of each plot, the water table depth from the mire surface was measured manually in PVC tubes perforated throughout their length six times, at intervals of two weeks from 4 June to 13 August 2005. Positive values indicate that the water table is above the mire surface. For the statistical analyses the mean values were used.

The chemical composition of the rainwater was retrieved from a data set provided by the Regional Agency for Environmental Prevention and Protection in Veneto (ARPAV). The methods of analysis follow the standards cited above. The data were obtained from the closest meteorological station (Monte Chertz, 2082 m a.s.l., 35 km E Danta di Cadore). The data were considered adequate to describe the general composition of the rainwater of the mire, as reported in Bragazza et al. (2004).

Data analysis

The mean values of the chemical parameters of bog and fen were calculated and tested for differences with the Mann–Whitney U test. These values were also compared with those found in the rainwater. The data on the chemical composition of the rainwater was computed by calculating the mean ion concentrations referred to 460 precipitation events. A Spearman's correlation matrix was calculated for the mire water chemical parameters.

Using the computer package CANOCO 4.5 (ter Braak & Šmilauer, 2002), the species-by-samples matrix of the floristic abundance data was subjected to (a) a Detrended Correspondence Analysis (DCA) to evaluate the species' response to ecological gradients, (b) a Correspondence Analysis (CA), and (c) several Canonical Correspondence Analyses (CCA). Due to the high multicollinearity of the chemical variables, the effect of the three gradients was tested by considering the following variables: (1) NO_3^- and NH_4^+ for the nutrient availability gradient, (2) pH and Ca^{2+} for the acidity–alkalinity gradient (electrical conductivity and the other bases were highly correlated with Ca^{2+} , and thus could not be used in CCA), and (3) water table depth. These variables were used in different combinations in the final models. As suggested by Legendre and Legendre (1998), the significance of the individual canonical axes was tested using the Monte Carlo Permutation test with 499 permutations. The significance test of the second axis was performed using the sample scores of the first canonical analysis as covariable. The operation was repeated to test the third axis, using the new first axis sample scores of the previous analysis as covariable. Furthermore, the pure effects of the significant gradients were deter-

mined using a variance partitioning method based on the CCAs and partial CCAs (Borcard et al., 1992).

Results

Water chemistry

Bog water had a lower pH, and Ca^{2+} and Mg^{2+} contents in comparison with the fen, while it showed higher values for K^+ , NH_4^+ and SO_4^{2-} (Table I). The general chemical composition of the mire waters was, in several cases, different from that of rainwater. The Ca^{2+} , Mg^{2+} and Na^+ contents were almost always higher in mire water. On the contrary, NO_3^- , NH_4^+ , and SO_4^{2-} contents were considerably lower in mire water than in rainwater. Bog vegetation showed Ca^{2+} and Mg^{2+} contents close to those of rainwater, but higher Cl^- and K^+ concentrations. The fen vegetation had higher values of Ca^{2+} , Mg^{2+} and Na^+ than those of rainwater. The Spearman's correlation analysis indicated several significant ($P < 0.05$) relationships between ions in mire water. Except for NH_4^+ , which was positively correlated with SO_4^{2-} ($r_s = 0.42$) and K^+ ($r_s = 0.63$), inorganic N did not show any other significant correlation. Both in bog and fen types, N availability was too low to reveal a significant relation with the main chemical gradient. pH was negatively correlated with SO_4^{2-} ($r_s = -0.35$) and K^+ ($r_s = -0.50$), and positively correlated with Mg^{2+} ($r_s = 0.85$), Na^+ ($r_s = 0.49$), and Ca^{2+} ($r_s = 0.86$). The electrical conductivity was strongly linearly correlated ($r_s > 0.95$) with Cl^- , Mg^{2+} , Ca^{2+} , and Na^+ , while it was not correlated with SO_4^{2-} and K^+ .

Patterns of species composition

In total, 46 vascular plants were found. The synthetic table of the seven vegetation types is given in the Appendix. The DCA revealed a gradient length, expressed in standard deviation units of species turnover, of 4.77 SD. Thus, plant species showed a clear unimodal response along the environmental gradient, and unimodal-based ordination methods were therefore appropriate for these data. The first three eigenvalues of the unconstrained CA ordination accounted for 15.6%, 13.1% and 10.0% of the total variance, respectively, and expressed the compositional gradient of the floristic data (Table II).

Analysis 2a indicated that inorganic N availability (NO_3^- and NH_4^+) did not affect the floristic composition. The water table depth alone accounted for 13.3% of total variance (analysis 2b), which represented the highest value obtained for a single variable. The acidity–alkalinity gradient was the other main factor affecting floristic composition (analyses 2c and 2d). The pH accounted for 12.4%

Table I. Mean values and standard deviation (in parentheses) of the water chemical characteristics and water table depth in the seven vegetation types. The means of the fen and bog plots were compared with a Mann–Whitney U test. The values followed by different letters are significantly different ($P < 0.01$).

No. Vegetation type ^a	2 Car_las	8 Car_ros	4 Rhy_alb	4 Sch_fer	5 Tri_cae	5 Utr_min	28 Fen type mean	8 Sph_dom	460 Precipit. ^b
NO ₃ ⁻ (μg l ⁻¹)	0.10 (0.02)	0.05 (0.03)	0.13 (0.18)	0.05 (0.05)	0.18 (0.15)	0.03 (0.03)	0.09 (0.10)	0.06 (0.05)	2360 (2850)
NO ₂ ⁻ (μg l ⁻¹)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	–
NH ₄ ⁺ (μg l ⁻¹)	0.10 (0.07)	0.12 (0.27)	0.04 (0.08)	0.62 (0.99)	0.15 (0.11)	0.05 (0.06)	0.17 (0.41)	0.47 (0.90)	610 (670)
Cl ⁻ (mg l ⁻¹)	8.10 (8.34)	6.34 (11.30)	0.45 (0.57)	8.84 (10.07)	1.61 (1.58)	2.42 (0.57)	4.43 (7.54)	3.76 (1.92)	0.61 (1.18)
SO ₄ ²⁻ (mg l ⁻¹)	0.24 (0.31)	0.34 (0.37)	0.45 (0.35)	0.53 (0.32)	0.37 (0.14)	0.62 (0.08)	0.43 (0.29)	1.04 (0.35)	7.02 (8.11)
Ca ²⁺ (mg l ⁻¹)	30.00 (21.21)	22.94 (26.84)	6.55 (3.67)	28.75 (23.60)	10.62 (4.79)	15.40 (1.67)	18.39 ^a (18.34)	3.39 ^b (0.79)	3.40 (3.33)
Mg ²⁺ (mg l ⁻¹)	8.15 (7.28)	5.67 (7.14)	1.74 (0.89)	7.63 (5.87)	3.02 (1.08)	5.76 (0.73)	5.11 ^a (4.86)	1.04 ^b (0.31)	0.50 (0.56)
Na ⁺ (mg l ⁻¹)	4.90 (4.81)	4.16 (6.79)	0.78 (0.35)	0.81 (0.42)	1.21 (0.69)	1.26 (0.27)	2.71 (4.19)	0.93 (0.87)	0.19 (0.38)
K ⁺ (mg l ⁻¹)	0.85 (0.78)	0.70 (1.20)	0.44 (0.71)	0.23 (0.04)	0.73 (0.52)	0.31 (0.27)	0.72 ^a (1.07)	4.60 ^b (2.40)	0.30 (0.96)
PH	6.84 (0.52)	6.53 (0.49)	5.54 (0.83)	6.55 (0.64)	6.01 (0.28)	6.63 (0.11)	6.34 ^a (0.61)	4.58 ^b (0.42)	5.65 (0.80)
EC (μS cm ⁻¹)	205.0 (141.4)	159.8 (203.8)	42.3 (12.3)	182.0 (145.7)	70.8 (28.4)	109.2 (5.9)	124.5 ^a (130.1)	50.5 ^b (16.9)	–
WTD (cm)	-0.6 (3.4)	3.1 (13.2)	-2.3 (2.6)	-9.3 (5.5)	-8.1 (10.5)	15.3 (2.27)	0.5 ^a (5.75)	-28.3 ^b (3.91)	–

Mean and SD were not calculated for NO₂⁻ that had a concentration below the detection limit.

^aFor abbreviations of the vegetation types see Materials and Methods.

^bThe mean precipitation values were retrieved from 460 analyses carried out during the period 1990–2001 (data source: ARPAV).

No.: number of observations; EC: electrical conductivity; WTD: water table depth.

Table II. Ordination summary of CA and different CCAs.

Analysis	No.	Variables	Covariables	λ ₁	λ ₂	λ ₃
CA	1	–	–	0.712 (15.6%)!	0.597 (13.1%)!	0.460 (10.0%)!
CCA	2a	NO ₃ ⁻ , NH ₄ ⁺	–	n.s.	n.s.	–
CCA	2b	WTD	–	0.605* (13.3%)	–	–
CCA	2c	pH	–	0.567* (12.4%)	–	–
CCA	2d	Ca ²⁺	–	0.374* (8.2%)	–	–
CCA	2e	pH, Ca ²⁺ , WTD	–	0.635* (13.9%)	0.324* (7.1%)	0.130* (2.8%)
pCCA	2f	pH, Ca ²⁺	WTD	0.345* (8.7%)	0.124* (3.1%)	–
pCCA	2g	WTD	pH, Ca ²⁺	0.257 (6.9%)	–	–

WTD: water table depth.

λ₁, λ₂ and λ₃ indicate the first three eigenvalues. The proportion of the total variance explained is given in parentheses. All canonical axes were tested with a Monte Carlo Permutation test with 499 permutations.

! indicates non-canonical axes; * marks a significant difference at $P < 0.01$; n.s. denotes non-significant results.

of the total variance and Ca²⁺ for 8.2%. When water table depth, pH, and Ca²⁺ were selected as explanatory variables together (analysis 2e), the model accounted for 23.8% of the total variance.

The pure effect of pH and Ca²⁺ and of the water table gradients could be determined on the basis of the results of analyses 2e, 2f and 2g (Table II). The independent effects of the water table depth and

acidity–alkalinity gradients explained 6.9% and 11.8% of total variance, respectively. The individual components shared a fraction of variation of 5.1%, obtained by subtraction [23.8 – (6.9 + 11.8)].

In the ordination diagram based on analysis 2e, the first axis can be interpreted as the acidity–alkalinity gradient, partially overlapping with water table depth (Figure 1a). With increasing Ca^{2+} , five moderately rich fen plots were well separated at the bottom of the diagram, indicating richer ion content. Plots belonging to Car_ros were scattered, whereas the other vegetation types had narrower intervals of variation. The water table depth varied strongly between vegetation types. The Sph_dom vegetation had the largest negative water table depth due to the raised structure provided by the small hummocks. Rhy_alb and Car_las developed in hollows where the groundwater reached the mire surface. Utr_min could be found only in pools with water. Car_ros could develop either in pools or directly in the peat, as pointed out by the scattered distribution of the points. pH and Ca^{2+} varied significantly between several vegetation types. Sph_dom had the lowest pH (4.58), followed by Rhy_alb, Tri_cae, Sch_fer and Car_ros, whose mean values were around 6. The alkaline extreme of the variation was found in Utr_min and Car_las with values up to 7–7.5. The Ca^{2+} content had a concentration pattern opposite to H^+ .

In the biplot of species and environmental variables, species were clustered according to their response to the selected ecological factors (Figure 1b). The increasing CCA scores of the first axis

corresponded to an increase of pH, and a decrease of water table depth. The second axis was mostly negatively correlated with Ca^{2+} . Four main groups of species could be identified: (1) species related to the ombrotrophic conditions of the *Sphagnum* hummocks were on the left part of the plot (e.g. *Vaccinium microcarpum*, *Drosera rotundifolia*, *Andromeda polifolia*, *Carex pauciflora*). Their habitat was characterised by a high water table depth, low Ca^{2+} concentration, and low pH; (2) species typical of hollows and pools that were characterised by high CCA scores of the two main axes (e.g. *Rhynchospora alba*, *Drosera longifolia*, *Carex rostrata*, *Carex lasiocarpa*, *Carex limosa*); (3) species of moderately rich fens with high CCA first axis scores and low CCA second axis scores (e.g. *Valeriana dioica*, *Crepis palustris*, *Cirsium palustre*); (4) species with a wide ecological amplitude (e.g. *Molinia coerulea*, *Potentilla erecta*) found close to the origin of the axes.

Discussion

At a small spatial scale, the floristic composition proved to be dependent on two main gradients: water table depth and acidity–alkalinity (pH and Ca^{2+}), while nutrient availability was not significant. NO_3^- and NH_4^+ had a relatively high content in rainwater, but they disappeared in pore water probably due to uptake by plants and microorganisms. The results of the variance partitioning indicated that the water chemistry was more important in controlling the patterns of plant

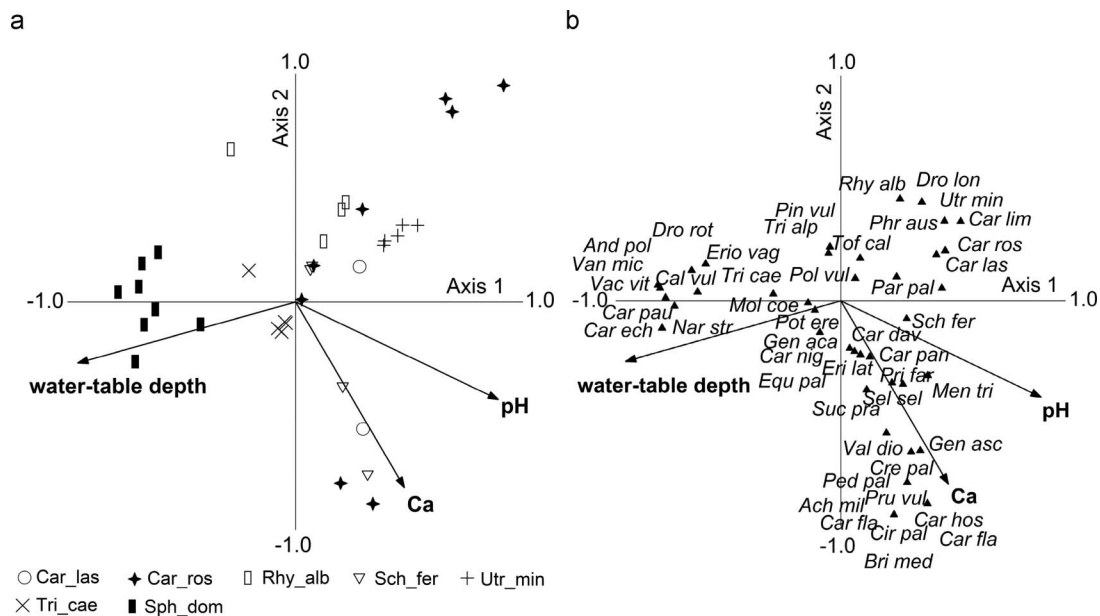


Figure 1. Ordination diagrams based on a CCA with water table depth, pH, and Ca^{2+} included as explanatory variables (analysis 2f). The first and second CCA axes are shown: (a) biplot of samples and environmental variables. The vegetation types are drawn with different symbols; (b) biplot of species and environmental variables. Abbreviations for species names are the 3 + 3 first letters of the names of the vascular plants (the full name of the species is given in the Appendix).

distribution than the water table depth. However, the rather high value of the shared component indicated that the two gradients were ecologically strictly related. The floristic pattern of the vegetation types was therefore the result of these combined factors. Two biological systems could be identified according to the hydrological characteristics and the plant composition: (1) fen vegetation types lacking raised *Sphagnum* structures where the water chemistry reflected mostly groundwater properties, and (2) bog *Sphagnum*-dominated vegetation, where hydrochemistry depended on rainwater, since mixing with groundwater was prevented by the convex shape of the mire surface.

According to Bellamy and Rieley (1967), the small *Sphagnum* hummocks in the study area behaved as true miniature bogs probably by preventing mixing with the groundwater. The large concentration of K^+ in the bog was probably associated with the metabolic activity of living *Sphagnum* (Hemond, 1980), due to the active translocation of this cation in the growing capitula. K^+ showed a non-significant relation with electrical conductivity, confirming that it did not depend on the degree of mixing with groundwater, and that some biological controls were involved. In this scenario, the small *Sphagnum* hummocks hosted mostly shallow-rooted species, which were not affected by the highly minerotrophic groundwater flowing beneath them. For example, *Drosera rotundifolia* and *Vaccinium microcarpum* have a root system that needs the water-conducting capacity of *Sphagnum* mosses (Malmer et al., 1994). The distribution of *Calluna vulgaris*, and of the other ericaceous shrubs found, was limited to these raised hummocks probably due to the dependence of the associated mycorrhizal fungi on aerated habitats (Lindholm, 1980), as indicated by the great water table depth.

In the minerotrophic part of the mire, the vegetation types presented relatively high contents of Ca^{2+} , Mg^{2+} and Na^+ of all groundwater in comparison to rainwater, indicating that these ions probably originated from bedrock weathering. The single vegetation types had rather differentiated values. The pools with *Utricularia minor* proved to be the most stable habitat, since the water chemistry, pH and electrical conductivity had narrow ranges of variation. The chemical characteristics of this habitat were similar to those found by Gerdol and Tomaselli (1997). The floristic composition of these pools was characterised by *Drosera longifolia* and *Carex limosa*, which were related to sub-neutral microhabitats. In contrast, the pools dominated by *Carex rostrata* presented a wider ecological adaptability. This common species possesses root aerenchyma (Bragazza & Gerdol,

1996) that allows it to penetrate into the anoxic layers of the peat, and to reach groundwater. This vegetation was found both in pools and in hollows without water, confirming the ecological characteristics of this common mire species. The lawns with *Trichophorum caespitosum* and lawns with *Schoenus ferrugineus* covered large parts of the mire and proved to be similar in water table, while the probable factor explaining their spatial patterns was the more alkaline water in the *S. ferrugineus* lawns. This result conforms to previous studies in the Italian Alps (e.g. Gerdol & Tomaselli, 1997). The hollows with *Rhynchospora alba* were characterised by a muddy substrate, and to a lesser extent by the presence of a *Sphagnum* layer. *Rhynchospora alba* seemed to be related to microhabitats characterised by a water table depth around zero such as less deep hollows or pool edges, and by relatively acid water chemistry. The hydrochemistry of this vegetation had transitional characteristics between fen and bog vegetation, and it was strongly related to hollow microhabitats.

In conclusion, partitioning analysis has demonstrated that the acidity–alkalinity gradient was the main ecological gradient, even though the water table had an important pure effect on the small-scale spatial patterns of vascular plant vegetation, while nutrient availability in water could not explain the vegetation distribution in this mixed mire. The response of these ecosystems to water chemistry and hydrology on a small spatial scale indicates a need for monitoring the evolution of these vegetation complexes to the current changes of land-use and climate involving the Alpine environments. In particular, pollution from vehicular traffic and increased urbanisation is one of the major threats for these rare mixed mires.

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Appendix

Table of the seven vegetation types with the percentage frequency of the species within each vegetation type. Species abbreviations are also presented.

Species	No. relevés	2	8	4	4	5	5	8
Abbreviations	Vegetation type	Car_las	Car_ros	Rhy_alb	Sch_fer	Tri_cae	Utr_min	Sph_dom
Ach mil	<i>Achillea millefolium</i> agg.	.	14	.	25	.	.	.
And pol	<i>Andromeda polifolia</i>	.	.	.	.	.	.	67
Bri med	<i>Briza media</i>	.	14	.	.	.	.	.
Cal vul	<i>Calluna vulgaris</i>	.	.	.	.	17	.	78
Car dav	<i>Carex davalliana</i>	50	29	.	25	50	.	.
Car ech	<i>Carex echinata</i>	.	.	.	.	.	.	11
Car fla	<i>Carex flacca</i>	.	14	.	.	.	.	.
Car fla	<i>Carex flava</i>	50	14	.	.	.	.	.
Car hos	<i>Carex hostiana</i>	50	14	.	.	.	.	.
Car las	<i>Carex lasiocarpa</i>	100	.	.	.	.	80	.
Car lim	<i>Carex limosa</i>	50	.	33	.	.	100	.
Car nig	<i>Carex nigra</i>	.	.	.	.	17	.	.
Car pan	<i>Carex panicea</i>	50	14	.	25	83	.	.
Car pau	<i>Carex pauciflora</i>	.	.	.	.	.	.	56
Car ros	<i>Carex rostrata</i>	.	100	33	.	33	40	.
Cir pal	<i>Cirsium palustre</i>	.	14	.	.	.	.	.
Cre pal	<i>Crepis palustris</i>	50	.	.	.	.	.	.
Dro lon	<i>Drosera longifolia</i>	.	.	67	.	.	100	11
Dro rot	<i>Drosera rotundifolia</i>	.	.	.	.	.	.	56
Equ pal	<i>Equisetum palustre</i>	.	43	.	.	67	20	11
Eri lat	<i>Eriophorum latifolium</i>	50	57	.	50	50	.	11
Eri vag	<i>Eriophorum vaginatum</i>	.	.	.	.	.	.	56
Gen aca	<i>Gentiana acaulis</i>	.	.	.	.	17	.	.
Gen asc	<i>Gentiana asclepiadea</i>	.	.	.	50	.	.	.
Men tri	<i>Menyanthes trifoliata</i>	100	14	.	.	.	20	.
Mol coe	<i>Molinia coerulea</i>	50	57	33	100	100	.	100
Nar str	<i>Nardus stricta</i>	.	.	.	.	.	.	11
Par pal	<i>Parnassia palustris</i>	.	14	33	75	.	20	.
Ped pal	<i>Pedicularis palustris</i>	50	14	.	.	.	.	.
Phr aus	<i>Phragmites australis</i>	50	.	33	50	.	100	.
Pin vul	<i>Pinguicula vulgaris</i>	.	.	33	.	17	.	.
Pol vul	<i>Polygala vulgaris</i>	.	14	.	.	17	.	.
Pot ere	<i>Potentilla erecta</i>	50	57	67	75	100	20	78
Pri far	<i>Primula farinosa</i>	.	14	33	25	.	.	.
Pru vul	<i>Prunella vulgaris</i>	50	14	.	.	.	.	.
Rhy alb	<i>Rhynchospora alba</i>	.	.	100	.	.	80	11
Sch fer	<i>Schoenus ferrugineus</i>	50	29	33	100	17	60	.
Sel sel	<i>Selaginella selaginoides</i>	.	.	33	50	.	.	.
Suc pra	<i>Succisa pratensis</i>	.	14	.	.	33	.	.
Tof cal	<i>Tofieldia calyculata</i>	.	.	.	50	.	.	.
Tri alp	<i>Trichophorum alpinum</i>	.	29	67	75	83	20	33
Tri cae	<i>Trichophorum caespitosum</i>	.	.	.	.	100	.	100
Utr min	<i>Utricularia minor</i>	.	.	.	.	.	100	.
Vac mic	<i>Vaccinium microcarpum</i>	.	.	.	.	.	.	56
Vac vit	<i>Vaccinium vitis-idaea</i>	.	.	.	.	.	.	33
Val dio	<i>Valeriana dioica</i>	50	14	.	.	17	.	.