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TYPOLOGY AND ECOLOGY OF MAPLE-LINDEN AND MAPLE-ASH FOREST COMMUNITIES: PRELIMINARY CONSIDERATIONS IN NORTH-EASTERN ITALIAN PREALPINE RANGES

Typologie und Ökologie der Ahorn-Lindenwälder und Ahorn-Eschenwälder: Vorläufige Betrachtungen über den nordöstlichen Voralpenraum Italiens

von

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Key words: Maple-ash, maple-linden woods, ravine, typology, recolonization.

Schlagwörter: Ahorn-Lindenwälder, Ahorn-Eschenwälder, Waldschlucht, Wald-Typologie, Waldbesiedlung.

Abstract: Some mixed broad-leaved ravine woods (maple, ash and linden) of south-eastern Alps were investigated. Typological, ecological and dynamic considerations are discussed on the grounds of phytosociological and community structure analyses. Results of cluster analysis on floristic relevés suggested the distinction between **maple-linden** and **maple-ash** woods, each divided in different types.

A synchronic survey at site level showed that forest recolonization proceeds very rapidly and that its rate can be influenced by previous land use; this last factor together with the time of abandonment seem to affect the actual structure of these woods.

Introduction

The present work is the integrated result of two studies that, although different for approach and geographic scale, are both intended as a contribution

to widen the scarce knowledge on maple-ash-linden woods of south-eastern Alps. One is a geobotanical study conducted at regional scale for a typological analysis of forest vegetation of Veneto and prealpine areas of Friuli Venezia Giulia. The other is a synchronic survey at site scale about recolonization dynamics of maple-ash woods on old fields.

In the first case, from several floristic relevés and statistically processed phytosociological data a preliminary vegetation typology is outlined, referred to different ecological situations (riparian woods were not considered) and without a precise syntaxonomic correspondence. At this regard proposals of new syntaxa, that could add controversial issues to the yet complex classification frame, have been purposely neglected. Nonetheless useful indications for large scale synthesis are here provided.

In the second case main objectives were the following, each needing a different level of analysis:

1. to determine time and space patterns of recolonization by forest vegetation;
2. to define a chronological and structural variability within the community in relation to some ecological factors and to site conditions before the abandonment;
3. to appraise growth dynamics of individual trees in relation to some site factors.

Methods

A. regional scale

Eighty-three (83) phytosociological relevés (over 500 in total) have been specifically carried out on maple-ash-linden communities (from Vicenza area to the Natisone river valley), following the Zurich-Montpellier method, but omitting the sociability index.

MEASURED PARAMETERS	Wooded areas (rectangular plots of 300 m^2)		Regeneration areas (Plots of 80x80 cm)
	Detailed	Standard	
topographic position	X		
N. of individuals	X	X	X
species composition	X		X
origin (gamic or agamic)	X	X	
d.b.h.	X	X	
height	X*	X*	X
crown dimension	X*	X*	
age	X*	X*	X

* not on all individuals

Tab.1 - Stand parameters measured within the different types of sample plots.

The floristic data have been processed by using relevés similitude matrices (ORLOCI, 1978; WILDI, ORLOCI, 1988) and minimum variance methods. The rank of relevés listed on the phytosociological table (see Tabelle 1) partially differs from that obtained from the cluster analysis because of ecological considerations drawn from field work.

B. site scale

Within the specific study area[1] different methods were employed according to the level of analysis (URBINATI, 1992). The first level required the use of old and actual maps and aerial photos, processed with a GIS package, named WODITEM (Watershed Oriented Digital Terrain Model), (CAZORZI, DELLA FONTANA, 1990) to obtain a likely representation of the natural reforestation process throughout the last century (1886-1989).

The following operations were then implemented:

- scale standardisation (1:10.000) and set-up of the cartographic material;
- digitisation of main topographic elements (contour lines, study area perimeter, areas of different land use) of each map and aerial photo;
- surface determination of areas with different land use classes and calculation of a reforestation ratio (forested areas/agricultural areas);
- overlays of the previous areas with three morphometric parameters computed by the GIS: altitude, slope and aspect.

The second level implied a comparative analysis of some forest parameters to confirm, at the chronological and structural level, the physiognomic variability and to define preferential distribution trends of the main tree species during the recolonization process. Fifteen (15) plots were selected within the study area and in each of them basic site factors were determined.

A tree inventory (where only trees higher than 1.30 m were counted) was carried out in 12 wooded areas and a seedling count in 3 regeneration areas. Within the wooded ones, the level of analysis was distinct in detailed (4 plots) and standard (8 plots) (Tab.1).

The third level was aimed to determine the growth dynamics of individual trees and of the stands and implied the use of dendroecological methods (HENRY, SWAN, 1974; FRITTS, SWETNAM, 1989). Cores from 85 trees of the two main species *(Acer pseudoplatanus, Fraxinus excelsior)* were then extracted with an increment borer and polished for an adequate reading. The skeleton plot technique was used to graphically represent the tree-ring features.

This non-statistical method allows an optical synchronisation of ring sequences regardless of the age trends or other long term growth variations (most of the trees were however relatively young) (SCHWEINGRUBER, 1988). Analysis of single samples, later reported on general master plots, led to the

definition of event years[2], pointer years[3] and of abrupt growth changes[4].

Results

A. regional scale

The phytosociological relevés were done in areas of different elevation, from river plains with potential vegetation of oak-hornbeam woods to the submontane zone with beech forests; but most of the investigated region was comprised between colline and submontane zones.

Areas with different natural conditions were found: some highly natural featured ravine woods (primary origin or scarcely disturbed ones) and secondary woods at different ontogenetic stage on old fields. These stands have now reached a very distinct structure and floristic composition which enabled a clear dynamic interpretation necessary to guide eventual reclamations to increase their natural features.

From a typological viewpoint 7-8 vegetation units (Fig.1) have been identified but only a few are clearly distinct and correspondent to precise phytosociologically significant syntaxa. The boundary between maple-linden and maple-ash woods has been traced only for typological purposes and is mainly based on the role played, in each situation, by the dominant tree species.

- **Maple-linden** woods with *Ostrya carpinifolia.*

They thrive best on well drained soils, where *Fraxinus excelsior* and hygric species are absent. The OSTRYO-CARPINION and other thermophile species dominate on those of FAGETALIA; *Quercus pubescens* is found in this group only. They have rather natural features, despite of human impact that however has not determined significant changes of the present flora. Similarities with maple-ash woods with *Ostrya carpinifolia* are evident, even though they are more thermophile, provide more protection from wind and cold air accumulation.

Most of the relevés ascribed to this group show affinities with ORNITHOGALO PYRENAICI-CARPINETUM BETULI OSTRYETOSUM, MARINCEK, POLDINI et ZUPANCIC 82. An interesting variant, though less natural, has strong dominance of *Tilia* sp. in the Pordenone province (relevés n. 40-41).

- Mesic **maple-linden** woods.

They are clearly of secondary origin and grow on acidified soils, frequently associated to *Castanea sativa, Quercus petraeae* and sometimes *Fagus sylvatica.* Presumably they have established on potential sites for CARICI UMBROSAE-QUERCETUM PETRAEAE; among differential

species are *Lathyrus niger, Potentilla alba, Molinia arundinacea, Betonica officinalis, Melampyrum pratense, Vaccinium myrtillus, Homogine alpina.*

- Standard (sub-hygric) **maple-linden** woods.

They are mostly of secondary origin and develop close to urban settlements. One typical feature is the regular and abundant presence of *Quercus robur, Fraxinus excelsior, Carpinus betulus.* They are similar to common hornbeam woods with *Fraxinus excelsior* and maple-ash woods with *Alnus glutinosa* (the latter type is found only in Friuli Venezia Giulia). Good differential species are absent, while those belonging to TILIO-ACERION or LAMIO-ACERENION are rare (*Phyllitis scolopendrium* is missing even in favourable sites).

They can be referred to the potential vegetation of ORNITHOGALO PYRENAICI-CARPINETUM BETULI subass. CARICETOSUM PILOSAE. Together with the mesic type they can both be considered as *Tilia* sp. variants of that association.

- **Common hornbeam** woods with *Fraxinus excelsior.*

They have typical hygric features, therefore *Acer pseudoplatanus* and *Tilia cordata* are rare, but *Quercus robur* is frequently showing affinity with oak-hornbeam woods of river plains. The ALNO-ULMION species are as frequent as those indicating perturbation. At local levels interesting situations are with *Epimedium alpinum* or *Impatiens noli-tangere* that dominate in the grass layer. Exclusive reference species are *Ranunculus ficaria, Leucojum vernum.*

Most of the relevés, regardless of the evident effects of human impact, can be ascribed to the ORNITHOGALO PYRENAICI-CARPINETUM BETULI subass. CARICETOSUM PILOSAE.

- **Maple-ash** woods with *Ostrya carpinifolia.*

These have interesting, highly natural features and are often found on well draining rocky soils in ravines of the sub-montane zone. They show the highest concentration of species indicating water supply variation (Wechselfeuchtigkeit) inducing to a possible summer drought (Sommertrockenheit) (Fig.2). Reference species are: *Taxus baccata, Philadelphus coronarius, Arabis turrita.* A rare variant with *Ulmus glabra* (and without ash) is worth a more accurate analysis.

The group of relevés is quite diverse and of difficult syntaxonomical classification, but of clear ecological interpretation. These sites, maybe for microclimatic reasons, have been occupied by azonal and transitional communities, where strong competition takes place between CARPINION, LAMIO-ACERENION and OSTRYO-CARPINION species. Their flora is

A1: MAPLE-LINDEN WOODS with *Ostrya Carpinifolia*
A2: MESIC MAPLE-LINDEN WOODS of acidified soils
B: HORNBEAM WOODS with *Fraxinus excelsior*
C + D MAPLE-ASH WOODS with *Ostrya carpinifolia*
E: STANDARD MAPLE-LINDEN WOODS
F: MAPLE-ASH WOODS with *Alnus glutinosa*
G: MAPLE-ASH WOODS with *Alnus incana*
H: STANDARD MAPLE-ASH WOODS

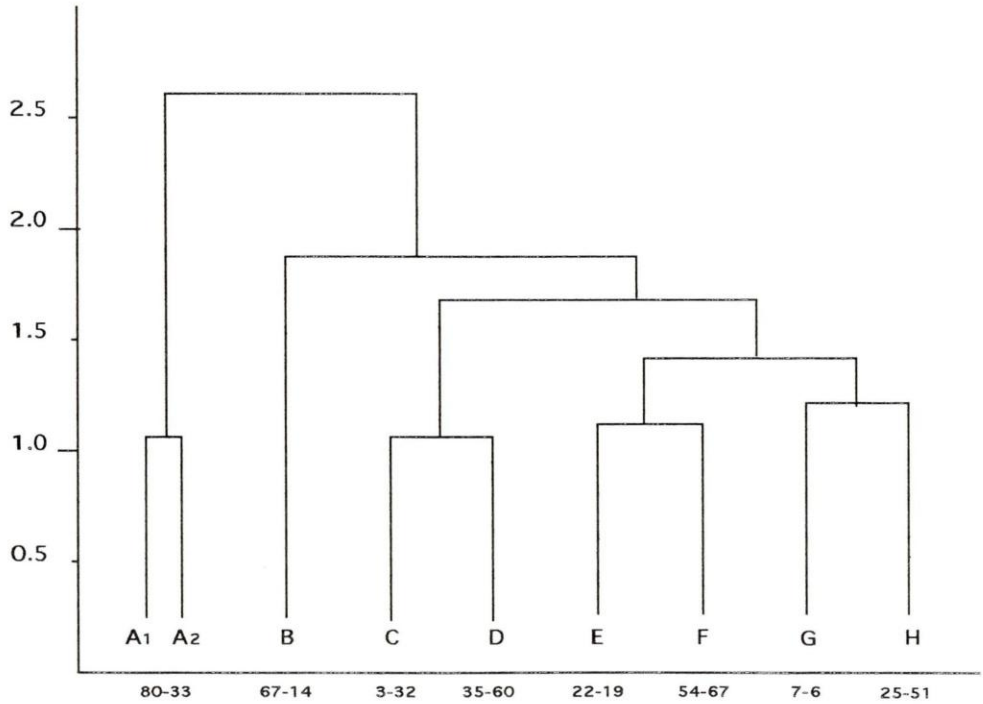

Fig. 1. Dendrograms obtained with cluster analysis based on euclidean distance and on minimum variance.

composed of ravine woods species, but differential hygric species are absent; in fact *Carpinus betulus* plays a marginal role whereas *Ostrya carpinifolia* and *Fagus sylvatica* are frequently dominating together with *Acer pseudoplatanus* and *Fraxinus excelsior*.

- **Maple-ash** woods with *Alnus glutinosa*.

They are young secondary stands often invaded by *Castanea sativa*, with presence of non nemoral species. Their diffusion is limited to areas

with high rainfall in Friuli-Venezia Giulia and where *Alnus glutinosa* was previously grown. Character species are missing in this group (which is not strictly hygric) and presence of acidification indicators suggests connections with mesic maple-linden type, which is however at a lower evolutionary stage.

- **Maple-ash** woods with *Alnus incana*.

  Their distribution is limited to the Agordo valley (Belluno province) on hygric siliceous slopes of the sub-montane zone. Nearly pure pioneer patches of *Matteuccia struthiopteris* are likely to start colonization, followed by a phase with *Alnus incana* which tends to be progressively replaced by ash and maple. Considering that LUZULO-FAGION is the potential vegetation type and that typical illyrian species are absent, these cenoses can not be considered typical sub-illyrian ravine woods.

- Standard **maple-ash** woods.

  They are the main and most common forest communities of the investigated region and mainly correspond, from an ecological viewpoint, to PHYLLITIDO-ACERETUM s.l. and LUNARIO-ACERION. They grow at higher altitude than the maple-ash with *Ostrya carpinifolia* type. Compared to this one, the rather thermo-xeric species are replaced by nitrogen-demanding ones and tall herbs, typical of ADENOSTYLETALIA. LAMIO-ACERENION and FAGION species prevail on CARPINION ones.

  They can be found within a broad range of environmental conditions, from hygric featured submontane zones (Valli del Pasubio) to more continental montane areas, in narrow valleys of mixed conifer and broad-leaved woods (Salesei).

  Very interesting are also nearly pure ash stands with remarkable tree-height (Rio Lerada, Brusà, M. Brat), that could be ascribed to HACQUETIO-FRAXINETUM MARINCEK 92, and considered the reference association of ravine woods (POLDINI, oral communication), though accepting the hypothesis of its westward diffusion on southeastern Prealps, within a geographic race with *Anemone trifolia*.

C. table structure

Clustering of relevés, to form the above listed types, was possible by processing the floristic data and taking into account the adjustments derived from field experience. For instance 2 groups (A1 and A2) have been separated within the maple-linden type, whereas they have been clustered (C and D) within the maple-ash type, although the global variance was giving opposite indications. Similarly relevés where *Matteuccia struthiotperis* was dominant,

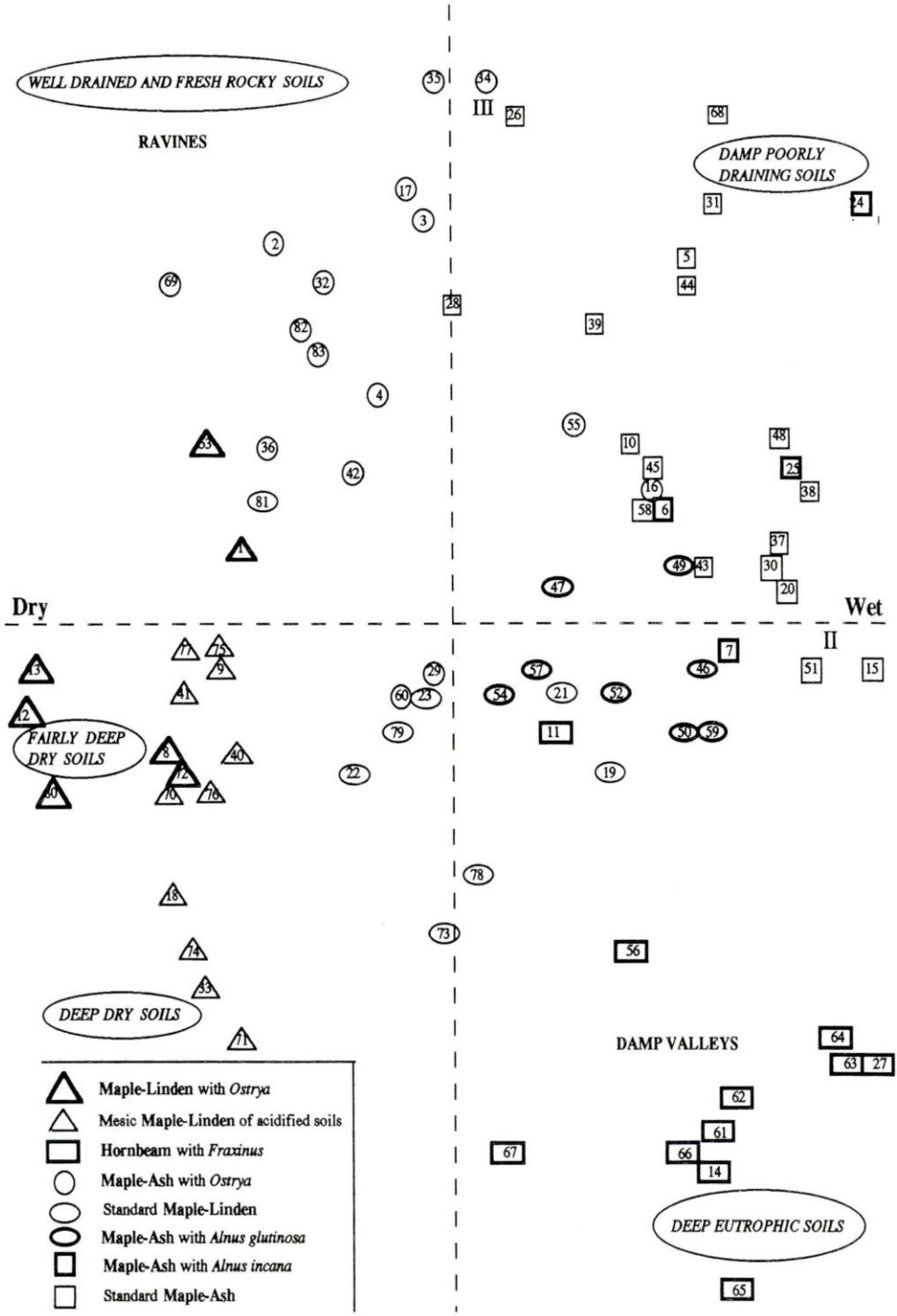

Fig. 2. Distribution of phytosociological relevés with analysis of principal components (2nd and 3rd).

were easily attributed to group G.

Acer pseudoplatanus, Fraxinus excelsior and *Tilia cordata* have been considered "reference species" (besides of their phytosociological value) and therefore placed on the first row of the table to favour the typological approach and to emphasise their distribution frequencies within the different vegetation layers. For the other tree species the greater canopy density value of the layers was indicated.

The character and differential species of LAMIO-ACERENION are those considered as TILIO-ACERION and/or LUNARIO-ACERION indicators by central European authors. Differences between alliances depend upon chorological and ecological criteria while between sub-alliances only on ecological ones. Phytosociological significance of the single types is variable for the change of species behaviours, often remarkable from central European to external mountain ranges.

A comprehensive type description for south-eastern Alps is not available and the Mitteleuropean or Slavic models (ELLENBERG, 1972; HORVAT et al., 1974; OBERDORFER, 1983, 1992; SCHWABE, 1987; CLOT, 1990.) are not adequately fitting the ecological situations found in the investigated area.

Epimedium alpinum for instance, that is commonly considered a character species of FAGION ILLYRICUM (this name has been purposely used regardless of its recent change), it is mostly found in hornbeam and chestnut (often in acidified soils) woods and seldom in sub-montane thermophile beech woods.

D. site scale

The recolonization pattern of forest vegetation on old fields does not seem remarkably influenced, at a spatial distribution level, by site factors such as elevation, slope, aspect and micro-morphology. This process is equally diffused in areas with different previous land use and soil types, suggesting that the main limiting factor is of anthropogenic nature: cultivation (Tab. 2 and 3).

Following the re-establishment phase, forest communities appear to have a very rapid ontogenetic process that leads to a remarkable canopy development, as indicated by the great change, in short times, of the reforestation coefficient. Between 1935 and 1954 cultivated land decreased from 63.4% to 28.0% of the total area surface, while forest increased from 26.2% to 72%. This caused a significant modification of the anthropogenic landscape features that for centuries have been characteristic in these rural areas.

The forest community has a rather homogeneous composition, structural and chronological diversity, that lead to a physiognomic variability (Tab.4). It is clear that the recolonization process has taken place indifferently throughout the investigated site apparently regardless of topographic factors. Time of

LAND USE TYPE	DOCUMENT TYPE			LAND USE TYPE	DOC. TYPE
	IGM 1886	*IGM 1927*	*IGM 1971*		*CM 1935*
Cultivate fields	65.6%	60.5%	12.5%	Settlements	3.9%
Vineyards		5.2%	16.7%	Crops	17.5%
Woods	34.4%	34.3		Crops with trees	5.3%
Open woods			55.6%	Meadows	20.2%
Dense woods			15.2%	Pastures	13.3%
LAND USE TYPE	*AP 1954*	*AP 1984*		Shrubby pastures	7.1%
Crops	13.5%	12.7%		Fallow land	0.3%
Vineyards	9.7%	1.0%		Waste land	2.7%
Range lands	4.8%	2.9%		Chestnut woods	2.9%
Open woods	58.4%	14.2%		Coppice woods	23.3%
Dense woods	13.6%	64.8%			

Tab. 2. Percent surfaces of different land use types from 1886 to 1984 (IGM = topographic maps of Military Geographic Institute; CM = Cadastral map; AP = aerial photos).

LAND USE TYPES	1886	1927	1935	1954	1971	1984
agro-pastoral areas	65.6	65.7	63.4	28.0	29.2	16.6
forested areas	34.4	34.3	26.2	72.0	70.8	79.0
Reforestation coeff.	*52%*	*52%*	*41%*	*257%*	*242%*	*475%*

Tab. 3. Percent variations of forested areas and relative reforestation coefficient (forested/agro-pastoral areas).

Sample plots	*Elevation m a.s.l.*	*Aspect*	*Slope %*	*Treeeha*	*G /ha m^2*	*Previous land use type***
1	500	NE	34	6067	25	Pasture
2	540	NE	25	7734	11	Meadow
3	555	NE	14	1600	14	Coppice wood
4*	510	E	3	290000	-	Crop
5	520	NO	18	2000	30	Coppice wood
6	537	E		5318	18	Pasture
7	485	N-NO		11337	18	Pasture
8	534	NO		8184	22	Shrubby pasture
9	443	E-SE	40	2866	28	Coppice wood
10	560	SE		9458	16	Meadow
11	610	N	50	2834	24	Shrubby pasture
12	565	N	21	2197	24	Coppice wood
13	573	N	62	5541	28	Coppice wood
14*	530	E	13	335000	-	Pasture
15*	567	N	15	280000	-	Meadow

Tab. 4. Synoptical table of sample plots main features.

* Regeneration areas

** According cadastral map and documents.

abandonment and, mainly, previous land use are instead rather significant.

In order to understand some of the mechanisms controlling the recolonization process, sample plots located in areas with different previous land use have been compared. Within the wooded areas two main types were defined in relation to the time of recolonization according to the cadastral map (1935):

a) "previously" wooded plots, located in sites classified as wood;
b) "recently" wooded plots, located in sites recorded as non-wooded areas (mainly meadows and pastures).

The second group has an almost even-aged structure since age is distributed only in three frequency classes (10-30 years) while the first is rather structured in even-aged groups with a broader age range (up to 70 years).

Recent communities are mainly of gamic origin, have a poorly structured canopy layering and a higher frequency of *Acer pseudoplatanus*. The older ones have a higher percentage of agamic individuals, a better canopy layering and higher presence of *Fraxinus excelsior*.

In recently wooded areas (1, 2, 6, 7, 8, 10, 11), globally, maple is more abundant than ash (70% vs. 30%), without significant differences among land use type (grasslands, pastures, shrubby pastures); while in previously wooded areas (3, 5, 9, 12, 13) ash is predominant (57% vs. 30%) (Figg. 3, 4).

Also the individual trees heights have been grouped in 4 frequency classes[5] and great differences were expected between the two plot clusters. In older woods 36% of the trees belong to the dominated layer (class 1), 52% to the intermediate (class 2-3), 12% to the dominant (class 4). Ash is strongly predominant in the first (28% vs. 8%) and fourth (9% vs. 2%) class and moderately in the other two (16% vs 10% and 13% vs. 12%).

Within the recent ones, where only three height classes are represented, the situation is remarkably different: The values of three layers are respectively 68%, 28% and 4%. Maple is in this case more frequent 57% vs.11% in first class, 20% vs. 7% in the second and third, 7% and 1% in the fourth.

A dispersion index (KERSHAW, 1964, ODUM, 1971) frequently used in ecological analysis has been applied to appraise the non-randomness or contagion degree of tree distribution. The algorithm is very simple:

$$D = V / M$$

Where V is the variance and M the mean of individuals present in each sub-area of the plot. For this purpose the four detailed sample plots (two were "previously" wooded and two "recently" wooded) have been divided in sub-areas of 5x5 m, where trees were counted and measured. Values of D around 0, 1 and well over 1 indicate respectively a uniform, random a contagious

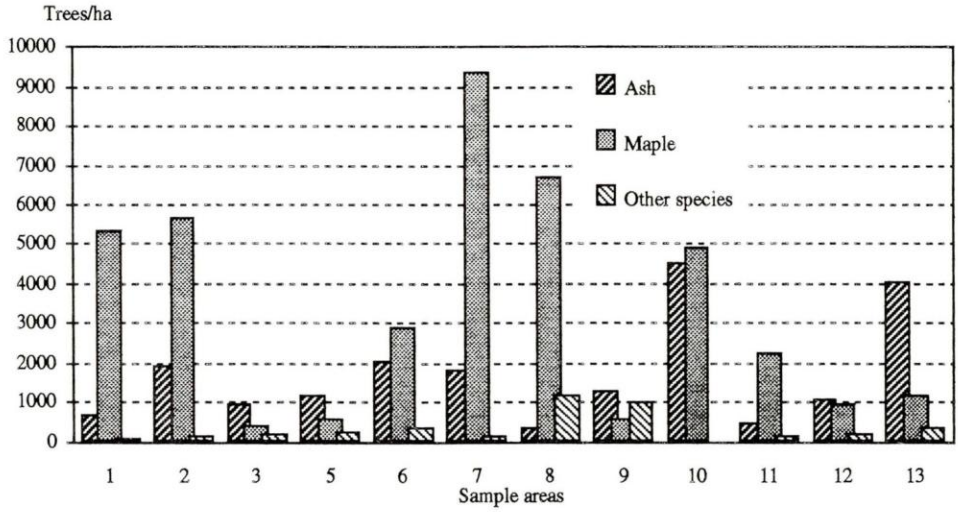

Fig. 3. Number of trees per hectare in the different sample areas.

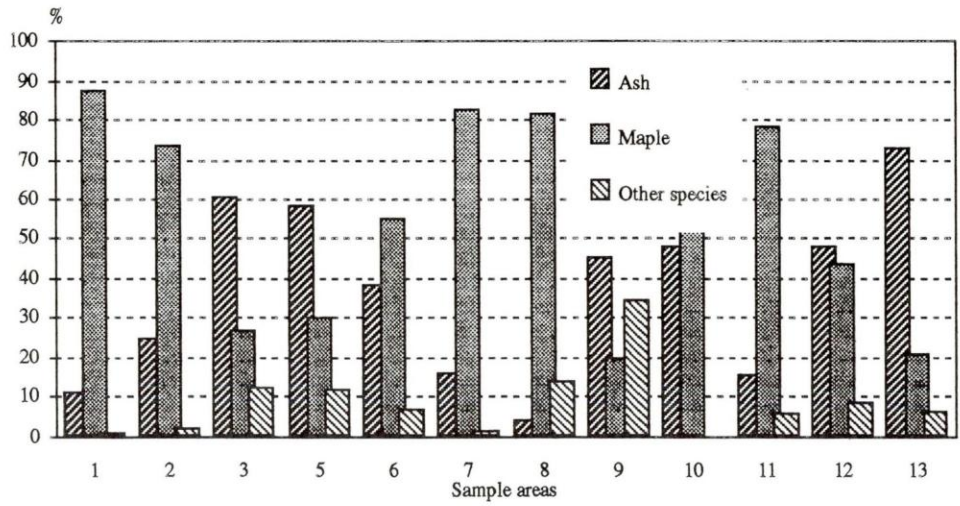

Fig. 4. Percent distribution of the three species within the sample areas.

distribution.

In previously forested areas the contagious trend of distribution is very evident (Total D is 4.09 and 5.40) whereas in recent woods index values indicate a uniform-random pattern of distribution (D is 0.44 and 1.84). Ash in general seems a more sociable species then maple in all sample plots (Tab.5).

Finally in regeneration sample plots it was observed that recolonization process had started 10 years ago, with maple for 3-4 years was the only tree species present.

In two of the plots, previously free of forest vegetation, maple and ash seedlings frequency is increasing and then gradually decreasing favouring the entrance and development of ash, which also decrease numerically a couple of years later; this phenomenon is probably due to the very high density of stems. In the third plot - a gap generated by felling - birth rate assumes a more irregular trend, ash is more abundant within the lower age classes.

Maple, in this case, seemed to act as a pioneer species showing a better diffusion on open areas, whereas ash seems to prefer sites with denser canopy cover.

The use of dendroecological methods has been significant to determine exactly the time of land abandonment and to detect some of the main environmental factors affecting the dynamic process of recolonization in the investigated area.

By means of the skeleton plot technique, used to outline pointer years and abrupt growth variation, it was possible to assess the great auxological variability, especially in older communities. In younger ones, due to a lower number of rings in each sequence and to the different establishment patterns, the intensity and frequency range variation was definitely lower.

Area n.1	*Maple*	*Ash*	*Total*	*Area n.3*	*Maple*	*Ash*	*Total*
M	13.30	1.66	15.33	**M**	0.5	2.00	2.83
SD	6.21	2.25	5.32	**SD**	0.26	0.74	3.41
D	2.9	3.05	1.84	**D**	1.63	3.27	4.09
Area n.2				*Area n.5*			
M	14	4.8	19.16	**M**	1.66	2.5	4.75
SD	4.23	3.43	2,90	**SD**	1.82	3.20	5.06
D	1.28	2.45	0.44	**D**	2.00	3.89	5.40

Tab. 5. Values obtained by distribution analysis (M= mean of individual in each square of sample area, SD= standard deviation, D=dispersion index).

Significant negative and positive pointer years have been matched with values of some climatic parameters to find eventual relationship on growth patterns. The influence of these factors, in this particular case is not evident. It can be assumed that biotic factors (i.e. competition) and human activity play an important role in affecting growth variability.

Discussion

Different authors have been dealing with typological aspects of maple, ash and linden communities in central Europe (OBERDORFER, 1957, 1983, 1992, ELLENBERG, KLÖTZLI, 1972, MOOR, 1973, 1975, 1976; MAYER, 1974; OZENDA, 1985; ELLENBERG, 1988; CLOT, 1990) where others have had a more regional approach (ISSLER, 1926; TÜXEN, 1937; ETTER, 1947; NOIRFALISE, 1960; ANTONIETTI, 1968; PFADENHAUER,1969; LAUSI, 1978; POLDINI, 1982; SALBITANO, 1987; MARINCEK, 1989; CLOT, 1989; DEL FAVERO et al., 1990; GUIDI, 1990).

The ecological features of ravine woods in south-eastern Alps are relatively easy to outline, (rather eutrophic and drained soils, mesic climatic conditions, ecc.), but their syntaxonomic interpretation appears rather difficult.

They are mainly azonal communities of the submontane zone located between hornbeam and beech woods (in south-western Alps maple and ash reach the timberline with *Sorbus aucuparia* and *Alnus viridis*, in competition with *Larix decidua)* and according to PIGNATTI (1979) they can be ascribed to the capital mitteleuropean and sub-atlantic area.

A preliminary distinction is necessary between secondary woods, where maple, ash, linden communities can be a dynamic, often durable, stage and those strongly influenced by geomorphologic factors and therefore scarcely evolved, that can be considered near-natural and stable.

The presence in these forests of *Ostrya carpinifolia*, surely fostered by previous felling, should not always be interpreted as a degrading symptom. Some of the most natural and interesting sites are actually those where *Ostrya* plays an important role and is an indicator of well drained soils and summer drought.

In some areas of northern Veneto (mainly in Val Belluna) interesting hornbeam woods are found up to 1000 m a.s.l. on favourably exposed slopes. These are the sites where CARPINION and OSTRYO-CARPINION ORIENTALIS species are merging, while LAMIO-ACERENION species can be found only in ravines.

Elsewhere, like in most of prealpine ranges of Veneto and in M. Grappa, *Carpinus betulus* is not widely distributed and it appears quite difficult to ascribe the relevés of groups A1, A2, E to ORNITHOGALO PYRENAICI-CARPINETUM BETULI. A broader ecological value should otherwise be attributed to this association, or at least new sub-associations (i.e. TILIETOSUM

for relevés correspondent to the typical maple-linden woods) should be introduced.

In relation to maple-ash woods two main problems arise. One concerns the syntaxonomy at alliance and sub-alliance level and can be solved using the MARINCEK's sub-alliance LAMIO-ACERENION that can be included in what used to be FAGION ILLYRICUM (ACCETTO, 1989 proposed AREMONIO-FAGION as a new name) because of the good participation of Illyrian species (it is advisable to review this chorological attribute and propose a south-eastern alpine northern Illyrian district).

All relevés of the table can be included in this chorological frame, except for maple-ash woods with *Alnus incana* (potential vegetation of LUZULO-FAGION) established on metamorphic soils (Basso Agordino).

The second problem is related to the definition of associations. Typical maple-ash woods, without *Ostrya*, and even more the pure ash high forests of Friuli, can be somehow defined as HACQUETIO-FRAXINETUM[6]. According to POLDINI (oral communication) it is possible to propose a prealpine race with *Anemone trifolia*, distinct from the more common with *Hacquetia epipactis*.

In fact a good correspondence is found at eco-chorological level, taking into account a regular westward decrease of steno-illyrian species. On the other hand, maple-ash woods with *Ostrya*, - that have more xeric features and are lacking differential species of ALNO-ULMION - could be classified as transitory communities and therefore interpreted either as hornbeam woods "enriched" with LAMIO-ACERENION[7]species or as LAMIO-ACERENION with lesser hygric species. But this frame is unsuitable if morphological and topographic site features are considered.

These communities have a wide range throughout the whole prealpine area, on southern slopes of outer Dolomites in Veneto and are typically found in protected sites, such as steep ravines sheltered by massive rocky walls, out of reach from hornbeam woods.

At this regard it is worth saying that *Ornithogalum pyrenaicum*, which is considered a typical CARPINION[8] species, is present in other communities, even at 1600 m of altitude, close to high grass meadows and xeric communities with *Genista radiata*.

It is the authors' opinion to include the nearly natural featured types with *Phyladelphus coronarius* and *Taxus baccata*, in a well distinct association within the CARPINION sub-alliance[9].

Attempts to frame the maple-ash-linden communities within syntaxa proposed for central Europe have always offered interesting ecological solutions, but chorological and specific composition correspondences have shown scarce or no reliability, making these attempts unfeasible.

For instance within the TILION PLATYPHYLLI-ACERION PSEUDO-PLATANI, that includes the ravine mixed broad-leaved woods, OBERDORFER

(1992) describes 3 sub-alliances and 10 associations; therefore it is hard to conceive that all the south-eastern alpine woods are included in just two main associations.

It is worthwhile to outline the relationships between maple-ash, maple-linden woods, and beech woods. Beech dominated communities have been purposely excluded from the relevés reported on the phytosociological table, because they are easily classified as DENTARIO PENTAPHYLLI-FAGETUM, subass. LUNARIETOSUM, typically found on northern aspects of ravines.

Lunaria rediviva, regarded as the most stable among TILIO-ACERION species and differential species of ravine forest communities, has frequently shown a scattered distribution, often on southern slopes, provided a durable snow pack. Furthermore it tends to copiously establish on tall-herbs communities along snow slides; it is therefore more frequently found in gaps or clearings, or sometimes at the foot of rocky walls, rather than in standard forest communities.

In addition to the listed relevés, several observations were done on the distribution of ash and other broad-leaved species. Within the Boite river valley (Cadore), that has continental climatic features, ash recolonization has been noticed starting from meadows hedgerows, where this species was confined due to the regular mowing. Its progressive invasive trend takes place in sites where conifers are predominant and beech is scarce.

Maple and ash woodlots have also established along eutrophic narrow river valleys situated nearby urban settlements; this phenomenon is observed throughout the Dolomites area, up to 1300-1400 m of elevation.

This recolonization process, performed by these two species, is widespread also to more xeric sites. Further research is needed in order to relate this fact to a feed-back mechanism of nature in response to the heavy eutrophication of mountain ecosystems.

Conclusions

This integrated study on maple, ash, linden communities, allowed to define a clearer typological, but not syntaxonomical definition. It also enabled a closer vision of some natural recolonization dynamic patterns in sub-montane areas, but many are the questions arising from these first results.

The investigated communities appear to be azonal and limited to extreme sites (mainly ravines) especially in area with precipitation lower than 1600-1800 mm/year, but over this threshold, in more humid sites with no risks of summer drought, they are rather stable and even climax.

These communities can be included within Illyrian alliances of CARPINION and FAGION, and their relationship with the different sub-

associations ORNITHOGALO PYRENAICI-CARPINETUM BETULI and HACQUETIO-FRAXINETUM (it is considered a geographic race with *Anemone trifolia* at westbound range) have been dicussed and defined.

This preliminary layout is not completely correspondent to the ecological differentiation observed in the field, but the purpose of the study was not to supply final conclusions at this regard. However results of floristic relevés and discussion on ecological features concerning scarcely investigated areas should be regarded as a base to foster further research and synthetic interpretations.

Summary

Maple, ash, linden mixed woods have been yet scarcely investigated in south-eastern Alps. Typological analysis conducted on forest vegetation of Veneto and in prealpine areas of Friuli Venezia Giulia enabled to carry out several floristic relevés. At a site level spatial analysis and sample plots have been set up for the chronological and structural analysis of vegetation.

A preliminary vegetation typology based on several floristic relevés and statistically processed phytosociological data is presented, in relation to different ecological situations (riparian woods were not considered) and without a precise syntaxonomic correspondence.

At this regard, proposals of new syntaxa that could add controversial issues to the yet complex classification frame, have been purposely neglected. Nonetheless useful indications for large scale synthesis are here provided. Some of the most natural ravine forest communities, due to the presence of many illyrian species could be ascribed to LAMIO-ACERENION, therefore close to CARPINION and in more hygric features, to FAGION.

The secondary origin of these woods, not always identified as maple-ash or maple-linden types, can interfere with a precise phytosociological interpretation, but at the same time it should promote further investigations of these communities.

Results of cluster analysis of floristic data are indicating a first subdivision between maple-linden and maple-ash woods, that have connections in the type with *Ostrya carpinifolia*, which corresponds to nearly natural ravine forests.

Different types have been defined:

- **maple-linden** woods: Standard, mesic, with *Ostrya carpinifolia;*
- **maple-ash** woods: Standard, with *Ostrya carpinifolia*, with *Alnus glutinosa*, with *Alnus incana;*
- **hornbeam** woods with *Fraxinus excelsior*.

A synchronic study on typical maple-ash woods established on old-fields of a prealpine area of central Veneto was also undertaken with a three-

fold purpose:

1) to determine time and patterns of recolonization by forest vegetation;
2) to find a chronological and structure variability within the community in relation to some ecological factors and to site conditions before the abandonment;
3) to observe growth dynamics of individual trees in relation to some site factors.

By means of spatial analysis (GIS), field analysis on specific sample plots, and dendroecological techniques it was possible to implement this study. Results are indicating a very fast rate of forest recolonization, partly influenced by previous land use; this last factor together with the time of abandonment can play an important role in determining the structure of these woods. Two main responses, in terms of composition were noted: predominance of sycamore maple on recently wooded areas, of common ash in previously wooded ones. Dendroecological analysis results indicate a great auxological variability in the sample plots, due apparently not to climate, but to competition, disturbed by felling.

The authors' hope is that these first data, regardless of the syntaxonomic implications, could be a contribution to wide knowledge on these communities of great ecological and sylvicultural interest.

Their increasing diffusion, in quite natural sites, as well as in more anthropogenic areas can be interpreted as a reaction of nature to continuous "eutrophication", phenomenon that we should more accurately assess.

Riassunto

Le comunità vegetali caratterizzate dalla prevalenza di aceri, frassini e tigli sono ancora scarsamente conosciute nelle Alpi sudorientali. Nel corso di indagini tipologiche sulla vegetazione forestale del Veneto e di analoghe ricognizioni nella fascia pedemontana del Friuli V.G. sono stati eseguiti diversi rilevamenti fitosociologici. A livello stazionale si è anche proceduto all'analisi strutturale e cronologica di alcune cenosi predisponendo aree campione ed utilizzando metodi di analisi spaziale.

Sulla base dei rilievi di campagna e della successiva analisi multivariata delle tabelle fitosociologiche è possibile prospettare una provvisoria articolazione dei tipi corrispondenti alle diverse situazioni ecologiche (non sono stati indagati i boschi ripari) che solo in parte trovano una precisa corrispondenza a livello sintassonomico. Tale aspetto sintassonomico non è stato volutamente approfondito in questa sede, in attesa dell'estensione dei rilievi, del dibattito che potrà scaturire da queste prime informazioni, e per non contribuire a complicare un quadro che già presenta situazioni non semplici e controverse a livello di categorie superiori dell'associazione. Considerata la consistente

partecipazione di entità a gravitazione illirica, alcune cenosi dei boschi di forra a maggiore naturalità potrebbero essere inquadrate nella suballeanza LAMIO-ACERENION, in contatto con CARPINION e, negli aspetti più freschi, con le faggete.

Il fatto che frequentemente le formazioni dominate da *Acer pseudoplatanus, Fraxinus excelsior, Tilia cordata,* che non sempre sono riferibili agli aceri-frassineti o aceri-tilieti, siano di carattere secondario rende complessa l'interpretazione fitosociologica, ma non giustifica completamente il fatto che siano state finora così trascurate. Dalle osservazioni di campagna e dall'elaborazione automatica dei rilievi (cluster analysis e ordinamento secondo le componenti principali) emerge una prima ipotesi di suddivisione, che conduce nella separazione tra aceri-tilieti e aceri-frassineti con punto di contatto negli aspetti a carpino nero, cioè negli ambienti di forra presumibilmente più prossimo naturali. Sono stati individuati i tipi seguenti:

- **aceri-tilieti :** tipici, con carpino nero, mesofili;
- **aceri-frassineti** : tipici, con carpino nero, con ontano nero, con ontano bianco;
- **carpineti:** con frassino.

Nell'ambito dell'indagine è stato anche predisposto uno studio sincronico su aceri-frassineti insediati in terreni abbandonati dell'area prealpina veneta, con i seguenti obiettivi:

1) determinare tempi e modalità di ricolonizzazione da parte della vegetazione forestale;
2) segnalare eventuali variazioni cronologico-strutturali a livello di fitocenosi in relazione ad alcuni fattori ecologici ed alle condizioni precedenti l'abbandono;
3) osservare la dinamica di accrescimento dei singoli individui in relazione ad alcuni fattori stazionali.

L'uso di un sistema geografico informativo e la conseguente analisi spaziale, le indagini di campagna effettuate su specifiche aree campione e l'applicazione di tecniche dendroecologiche ha consentito l'esecuzione della ricerca. I risultati confermano alcune osservazioni preliminari, e cioè che la ricolonizzazione procede a ritmi molto elevati ed è solo parzialmente condizionata dall'uso pregresso del suolo. Quest'ultimo fattore, insieme al periodo di abbandono, pare avere invece un ruolo notevole nella determinazione della struttura di queste cenosi. Due risposte in senso compositivo sono emerse: predominanza di acero montano su aree in recente abbandono e di frassino maggiore in aree già da tempo boscate. L'analisi dendroecologica infine indica una forte variabilità nelle aree campione, dovuta verosimilmente non al clima, bensì all'azione congiunta e non facilmente separabile di competizione e

disturbo antropico. Questi dati preliminari, suscettibili di nuove acquisizioni e di approfondimenti, vorrebbero rappresentare, indipendentemente dai problemi nomenclaturali e di inquadramento sintassonomico, un contributo alla migliore comprensione di cenosi che presentano un notevole interesse a livello ecologico, vegetazionale e selvicolturale, la cui diffusione, sia in ambienti naturali che degradati, può interpretarsi come una risposta della natura alla progressiva eutrofizzazione.

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AUFNAHMENLISTE MIT STANDORTLICHEN ANGABEN

N°	Standort (Prov.)	Seehöhe	Hangneigung	Exposition	Deckungsgrade % A1	A2	B	C	Datum
1	Valda (TN)	540	5	SSO	95	35	30	60	30.08.90
2	Val d'Ardo (BL)	750	45	ESE	90	40	50	85	20.06.86
3	id.	760	30	E	100	20	20	70	id.
4	M. Terne (BL)	950	30	ESE	100	20	20	60	01.08.91
5	id.	1020	10	NNE	100	30	10	90	id.
6	Mattiuzzi di Sagron (TN)	1220	25	N	-	60	10	100	08-06.84
7	Sagron-Mis (TN)	1160	20	NNE	-	90	10	100	id.
8	Val Cordellon, Mel (BL)	500	35	ENE	60	80	50	50	26.06.86
9	Lantrago, La Valle Ag. (BL)	890	12	ONO	95	10	20	80	04.08.88
10	Torrazzo, Valdagno (VI)	520	5	NE	90	30	35	80	13.09.88
11	Fagarè, Cornuda (TV)	260	12	NNO	85	-	25	90	06.07.87
12	San Mamante (BL)	810	25	SSO	95	-	40	40	22.05.87
13	id.	770	20	SO	100	-	30	35	id.
14	Villiago (BL)	350	2	S	90	-	30	85	23.04.89
15	Valli del Pasubio (VI)	480	15	ONO	75	30	35	98	10.05.89
16	id.	530	40	NO	80	35	40	70	id.
17	Val d'Olier, Valstagna (VI)	730	25	SE	90	35	25	75	30.05.89
18	Nate, Trichiana (BL)	680	5	NNE	90	30	20	95	10.06.89
19	Pieve d'Alpago (BL)	380	35	OSO	70	35	25	90	15.06.89
20	Valzella di Pieve d'Alp. (BL)	520	45	NO	85	25	15	100	id.
21	Torch, Pieve d'Alpago (BL)	620	20	NNO	80	20	30	100	id.
22	id.	600	30	ONO	85	20	30	90	id.
23	id.	560	5	NO	90	15	20	100	id.
24	Tos, Rivamonte (BL)	860	30	ENE	95	10	20	90	04.07.89
25	id.	850	20	NO	90	25	40	100	id.
26	Val dei Nass, Longarone (BL)	900	35	ESE	75	25	40	90	03.08.89
27	Colvago, S.Giustina (BL)	280	15	NE	60	30	25	98	27.04.90
28	Salesei, Livinallongo (BL)	1250	40	SSE	80	20	35	65	27.08.87
29	Val dei Campini, Possagno (TV)	760	30	NNE	75	40	35	60	25.05.88
30	id.	870	35	NE	65	40	35	75	id.
31	Val di Seren (BL)	920	20	ONO	85	15	25	95	06.08.91
32	Val di Prada, Quero (BL)	1250	45	E	85	15	25	85	id.
33	Colderù, Lentiai (BL)	620	20	NO	70	50	30	85	20.05.91
34	Carpen-Le Croci, Quero (BL)	500	35	NNE	60	70	15	85	17.05.91
35	id.	470	60	NO	70	60	10	60	id.
36	Val Ornich, Alano (BL)	570	45	NO	85	30	20	50	13.05.91
37	Brusà, Meduno (PN)	560	20	E	95	15	15	100	19.07.91
38	id.	570	20	ESE	80	10	15	100	id.
39	Runcis, Cavasso (PN)	410	35	N	90	15	20	95	id.
40	id.	430	15	ENE	98	5	15	100	id.

N°	Standort (Prov.)	Seehöhe	Hangneigung	Exposition	Deckungsgrade % A1	A2	B	C	Datum
41	id.	450	10	NNE	95	5	20	100	id.
42	Clodig, Drenchia (UD)	380	30	NE	95	10	15	75	18.07.91
43	Val Codariana, Grimacco (UD)	430	35	N	85	25	30	70	id.
44	id.	430	35	NO	98	10	15	85	id.
45	Larcs, Forgaria (UD)	800	20	E	90	10	15	98	17.07.91
46	Plazzaris, Montenars (UD)	480	10	ONO	90	10	15	60	id.
47	Borgo Jouf, Montenars (UD)	500	20	O	95	15	35	90	id.
48	Rio Selva, Clauzetto (UD)	420	30	N	75	5	70	95	08.07.91
49	Flaipano, Montenars (UD)	580	20	N	85	60	60	95	21.06.91
50	Planeces, Montenars (UD)	600	20	NNO	85	60	25	85	id.
51	Rio Lerada, Faedis (UD)	450	20	NO	90	5	40	100	20.06.91
52	Porzus-Cavallaro, Attimis (UD)	600	15	NO	90	15	75	95	id.
53	M. Forcis, Torreano (UD)	440	45	E	98	15	40	90	18.06.91
54	Reant-M. Forcis, Torreano (UD)	500	30	E	90	15	35	95	id.
55	Tarcetta, Pulfero (UD)	350	35	NNE	95	15	30	95	17.06.91
56	Carcòs, S.Pietro Natis. (UD)	170	10	NO	95	20	5	100	id.
57	Platischis, Taipana (UD)	700	20	NNE	70	10	15	100	07.07.90
58	Colvera, Frisanco (PN)	390	20	NNE	90	20	25	95	06.07.90
59	Mad. di Stangada, Frisanco (PN)	550	10	NNO	100	30	25	75	id.
60	Toschian, Cesiomaggiore (BL)	460	45	NO	90	20	35	80	01.05.84
61	S. Vito, Cesiomaggiore (BL)	470	20	NNO	85	25	30	95	05.05.84
62	Val Lusa-Marsiai, Cesiom. (BL)	280	45	SO	90	20	40	80	09.05.84
63	Pian de la Val, Anzaven, id.	350	30	E	90	-	50	100	17.05.81
64	id.	340	30	NE	90	30	10	95	id.
65	Zimia-Ronch, Menin, id.	400	5	E	90	20	40	90	26.04.84
66	Bosch, Menin, id.	370	30	O	80	20	40	95	id.
67	Case Bianche, Feltre (BL)	350	0	-	95	20	35	90	06.07.80
68	Igne, Longarone (BL)	1220	5	SO	75	15	10	100	15.07.91
69	S.Felice (Valscura), S.Giustina	920	60	ONO	95	15	30	80	04.07.91
70	Col Balcon, Trichiana (BL)	840	15	SE	90	20	25	90	07.06.91
71	Pellegai, Mel (BL)	450	10	N	65	15	50	95	id.
72	id.	470	30	SE	90	25	30	85	id.
73	Col Frontal, Lentiai (BL)	540	25	NNO	85	35	40	90	id.
74	Col d'Ongia, Limana (BL)	730	10	N	95	20	15	80	14.06.91
75	Col de la Pita, Limana (BL)	700	25	ONO	100	15	15	50	id.
76	id.	640	25	N	95	15	20	95	id.
77	id.	650	10	NO	100	10	20	98	id.
78	Val d'Ardo, Belluno	500	35	ONO	80	25	30	98	27.07.91
79	Tisoi, Belluno	800	15	SSE	85	15	20	75	id.
80	id.	790	25	ESE	95	15	20	50	id.
81	M. Terne, Belluno	850	35	ENE	85	15	35	80	id.
82	id.	1000	45	E	95	15	20	80	id.
83	id.	960	60	ONO	90	15	25	80	id.

ZUFÄLLIGE ARTENLISTE

Aufn.

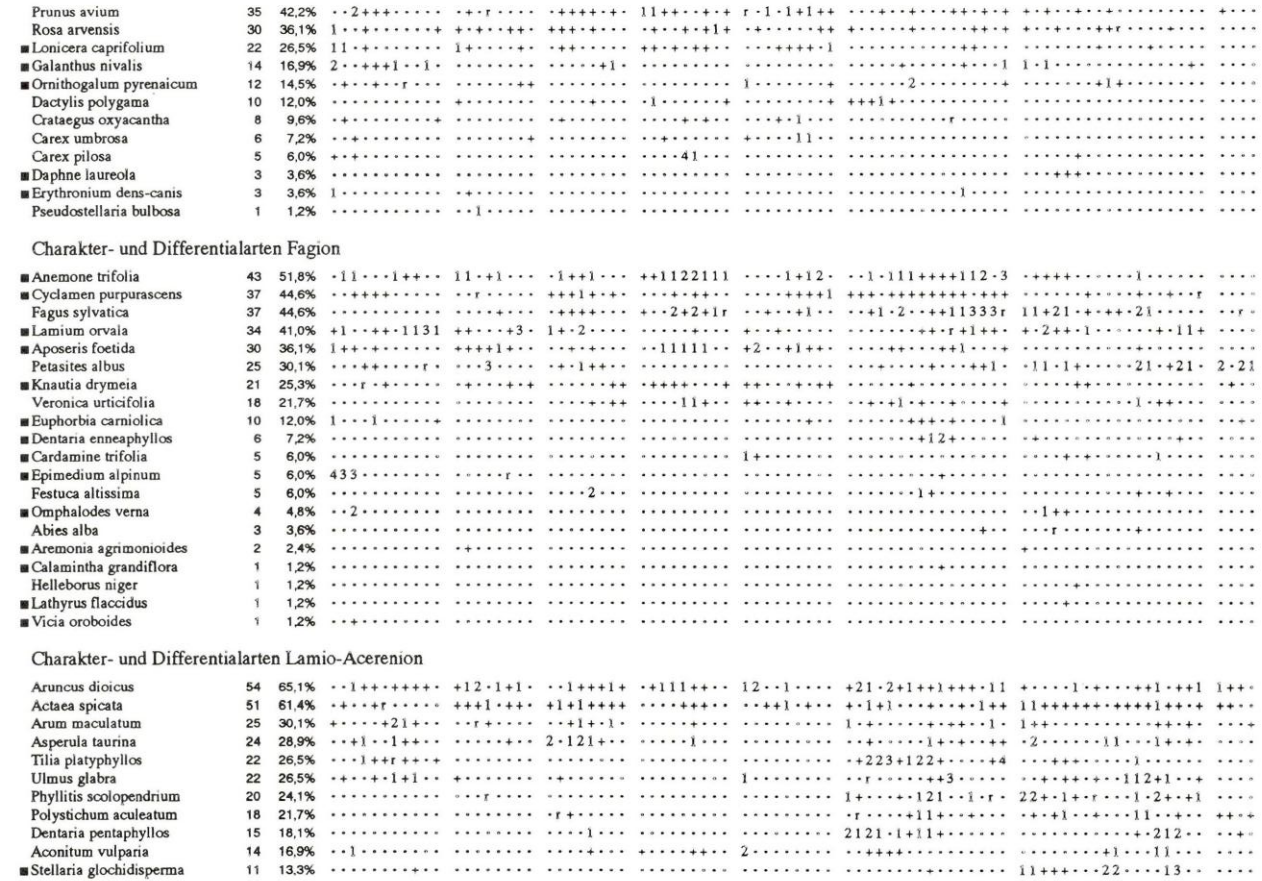
11: Hypericum androsaemum +, Prunella vulgaris +
66: Allium carinatum +
64: Chelidonium majus +, Stellaria media +
63: Chelidonium majus +
27: Anthriscus sylvestris +
54: Prunus domestica +
49: Carex pallescens +
47: Phyteuma zahlbrückneri +
46: Pyrus communis r, Buxus sempervirens 1, Ilex aquifolium +
59: Arctium sp. +, Valeriana collina r
57: Brachypodium cespitosum 3, Campanula carnica r
21: Poa trivialis 1
33: Narcissus radiiflorus +
71: Viscum album +
18: Pyrola rotundifolia r
74: Pyrola rotundifolia r, Potentilla erecta +
77: Larix decidua r
9: Pyrola media +, Betula pubescens +
70: Thesium bavarum +, Platanthera bifolia +, Phyteuma orbiculare +, Paradisia liliastrum +, Filipendula vulgaris +, Carlina vulgaris +, Asphodelus albus +, Anthoxanthum odoratum +, Polygala vulgaris +, Hieracium pilosella +, Genista tinctoria +, Calluna vulgaris +, Avenella flexuosa +, Arnica montana +, Peucedanum verticillare +, Peucedanum oreoselinum +, Potentilla erecta +, Hypochoeris maculata +, Carex pallescens +, Prunella vulgaris +, Cirsium pannonicum +
1: Primula veris +
72: Pimpinella major r, Carex flacca r, Peucedanum oreoselinum +, Allium carinatum +, Hypochoeris maculata r
80: Peucedanum verticillare r
2: Asplenium ruta-muraria +, Gymnocarpium robertianum +
69: Selaginella helvetica +, Saxifraga hostii +, Saxifraga cuneifolia 2, Phyteuma scheuchzeri +, Asplenium ruta-muraria +, Valeriana collina +, Campanula carnica +, Brachypodium cespitosum +
35: Campanula carnica +
34: Gymnocarpium robertianum +
17: Polypodium interjectum +
36: Gymnocarpium robertianum +, Festuca rubra +, Phyteuma scheuchzeri +
29: Stachis alpina +
30: Hypericum perforatum +, Senecio gaudinii +, Aethusa cynapium +, Myrrhis odorata +
51: Stellaria media +, Doronicum austriacum +
44: Doronicum austriacum 1

45: Lamium maculatum 2
58: Lamium maculatum +
37: Festuca rubra +, Lapsana communis +, Digitalis grandiflora +
38: Lathyrus sylvestris r, Lathyrus pratensis +, Astragalus glycyphyllos 1, Polygonum persicaria +, Medicago carstiensis 1, Cirsium vulgare +, Lapsana communis +, Digitalis grandiflora r, Anthriscus sylvestris r, Prunella vulgaris +
28: Galium album +, Orthilia secunda +, Brachypodium cespitosum +
31: Stachys alpina +
68: Senecio cacaliaster +, Sambucus racemosa +, Rumex alpestre +, Carduus personata +, Myrrhis odorata 1
20: Poa trivialis +
24: Lathyrus occidentalis +
25: Lathyrus occidentalis 1, Ribes petraeum +
7: Viola biflora 1

Tabelle 1

Acer- Fraxinus- Tilia reiche Wälder

			Hainbuchwälder mit Esche	Bergahorn-Eschewälder mit Schwarzerlen	Bergahorn-Lindenwälder (typische)	Bergahorn-Lindenwälder (sekundäre, +/- versauern)	Bergahorn-Lindenwälder mit Ostrya	Bergahorn-Eschewälder mit Ostrya	Bergahorn-Eschewälder (typische)	Bergahorn-Eschewälder mit Grauerlen
	Gruppe		B	F	E	A2	A1	C+D	H	G
	Aufnahme		65166666621 76161524374	55544455 42097697	17778222 93891312	371777707 318465790	440501178 011382320	00808633313254 16 3224392547695260	345441453322330612 0813405878861958 50	2200 4567
Kennarten	Stetigkeit									
Acer pseudoplatanus A1	61	73,5%	··2····1+r·	23+2332·	+1+11433	·+·1122··	1+·2···2·	1111223222··111+	·+1131··+121342432	4121
Acer pseudoplatanus A2	60	72,3%	···+·····+··	1133112+	+++++111	·+·++1++·	++·1···+·	1++++11111··1·1+	·++1·1+++111+++112	·1+·
Acer pseudoplatanus B	59	71,1%	··2····+··	1222+21+	++1++++1	++·+++++·	++·1···++	1++·+1+++···+·11	·++1·+r1+1++++·11+	·2+·
Acer pseudoplatanus C	26	31,3%	··1·····	2211211·	·+++····	+·r·+·+··	1+·1·+++r	·····1·	·····+·····	+·3·
Fraxinus excelsior A1	64	77,1%	23122232231	21531342	33321+1+	····11+··	+···+····	22111·1··+·32·+1	345324545411113·23	14++
Fraxinus excelsior A2	60	72,3%	1+·11+11++·	+++++21	+1++++1+	·+·+++++·	···++····	+1+++·+···+·1+·11	1+++·211·++++++·2+	·1··
Fraxinus excelsior B	60	72,3%	·++1121+1+1	12+++211	++++++11	·1++++1+·	+···+····	1++·+·+····1+·11	++++·1++111+++··2+	·1··
Fraxinus excelsior C	35	42,2%	·11·····1	321+2114	11+++11·	··r·1·2··	+·····	··+·····3+·1·	2··r·2····1+++····	2·+·
Tilia cordata A1	44	53,0%	·1·····+	1·····	+2234213	335443443	443323423	1231131·····+1··	····+·r2·····1+··+	····
Tilia cordata A2	41	49,4%	·1·····	+·····	+1111+11	112111·11	1+113··11	+21++1+·····+···	··r++·+1+····1+···	····
Tilia cordata B	44	53,0%	·+·····+	1·····	+1111++1	11++1++11	1·+122111	+11++1+·····+···	··+++·r+·····++··+	····
Tilia cordata C	6	7,2%	·····	·····	····+···	·····+	+··+···+·	·····	·····+·····	····
Charakter- und Differentialarten Carpinion										
■Primula vulgaris	54	65,1%	1+++·++++··	1++1+++·	+·1+++++	11++·++·+	++··11+1+	····+1+·++·+++++	1++++1···r···+····	····
Carpinus betulus	53	63,9%	31+12+·2212	+·+r+r··	+1+2+++·	21·+++···	1++·11·++	1·121r····+·+11·	·+r1+·++1+···++····	····
■Helleborus odorus	52	62,7%	11+213111·1	·11·+·+·	221+1+11	+211+++··	+···+·+1+	···+++···+···++·+1	1++·+···+···1+·++	····
Vinca minor	38	45,8%	1+11++21111	1·1+1+··	·24·····	·1·2112··	····+··2·	·····+1+··11+	··121+·2·····r·	····



Prunus avium	35	42,2%	
Rosa arvensis	30	36,1%	
■ Lonicera caprifolium	22	26,5%	
■ Galanthus nivalis	14	16,9%	
■ Ornithogalum pyrenaicum	12	14,5%	
Dactylis polygama	10	12,0%	
Crataegus oxyacantha	8	9,6%	
Carex umbrosa	6	7,2%	
Carex pilosa	5	6,0%	
■ Daphne laureola	3	3,6%	
■ Erythronium dens-canis	3	3,6%	
Pseudostellaria bulbosa	1	1,2%	

Charakter- und Differentialarten Fagion

■ Anemone trifola	43	51,8%	
■ Cyclamen purpurascens	37	44,6%	
Fagus sylvatica	37	44,6%	
■ Lamium orvala	34	41,0%	
■ Aposeris foetida	30	36,1%	
Petasites albus	25	30,1%	
■ Knautia drymeia	21	25,3%	
Veronica urticifolia	18	21,7%	
■ Euphorbia carniolica	10	12,0%	
■ Dentaria enneaphyllos	6	7,2%	
■ Cardamine trifolia	5	6,0%	
■ Epimedium alpinum	5	6,0%	
Festuca altissima	5	6,0%	
■ Omphalodes verna	4	4,8%	
Abies alba	3	3,6%	
■ Aremonia agrimonioides	2	2,4%	
■ Calamintha grandiflora	1	1,2%	
Helleborus niger	1	1,2%	
■ Lathyrus flaccidus	1	1,2%	
■ Vicia oroboides	1	1,2%	

Charakter- und Differentialarten Lamio-Acerenion

Aruncus dioicus	54	65,1%	
Actaea spicata	51	61,4%	
Arum maculatum	25	30,1%	
Asperula taurina	24	28,9%	
Tilia platyphyllos	22	26,5%	
Ulmus glabra	22	26,5%	
Phyllitis scolopendrium	20	24,1%	
Polystichum aculeatum	18	21,7%	
Dentaria pentaphyllos	15	18,1%	
Aconitum vulparia	14	16,9%	
■ Stellaria glochidisperma	11	13,3%	

Lysimachia vulgaris	1	1,2%	····	····	····	····+	····	····	····	····	····	····	····
Myosotis scorpioides	1	1,2%	····	····	····	····	····	····	····	····	····	····	····
Salix alba	1	1,2%	····2	····	····	····	····	····	····	····	····	····	····
Succisa pratensis	1	1,2%	····	····	····	····+	····	····	····	····	····	····	····
Valeriana officinalis	1	1,2%	····	····+	····	····	····	····	····	····	····	····	····
Fagetalia													
Salvia glutinosa	54	65,1%	++++·+·····	1111+++·	·1+++1++	·21·111++	+++++··+1+	·1···+2++++1++++	·+1···+1+··211·····	···+			
Dryopteris filix-mas	51	61,4%	···+1····+·	++++·+++	r+1+1·+·	·····+···	··1++·+···	+·1+·1+·+·+++++·	1·11+++1+··1++21++	21·+			
Symphytum tuberosum	51	61,4%	++1++···+···	+11++++·	1···1111	+++1+1+···	11·++++++·	·+++++···+++1·1·+	1···++···+···+···1	····			
Lamiastrum flavidum	50	60,2%	+1++···+++··	++++1···	1·+++121	··········	··2+·····	21+++·+111·+1+··	1+211·11++1++111·1	1···			
Paris quadrifolia	49	59,0%	··1++++++++	+++····+·	·++++++·	·+·+···+··	++·+·····	·····+···+·+·++++	+++++···+···++++·1++	++++			
Pulmonaria officinalis	49	59,0%	+++++21++·+	111++2··	+12+11++	·1···+11··	1+·+·····	·++···+···++++·1··	··1+1···+·+···+++·++	····			
Polygonatum multiflorum	47	56,6%	+11+111++1·	·+++1+++	·1+·+++1	+++····++	+++·····	···++·····+1·++·	·+++·+·····r·+····	···+			
Daphne mezereum	45	54,2%	···+····+····	++++···++	·+·++····	++++111·+	++·+11+·+	++++·+····+·++··	···++++·++·+·+····	··++			
Galium cfr. aristatum	43	51,8%	++1·+·····	1+·····	+++++++1	·++1111··	21·2111··	+1+++1+·+11+1+··	····+·····1++····	····			
Asarum europaeum	42	50,6%	12···+·····	1111211·	·1···+1·+	1···111··	1+·12·1+·	···+++···+1···11+1	··1+1·+1···1+++·+·	····			
Euphorbia dulcis	39	47,0%	1+++·1+++··	+·+++++·	+1+++·++	·1+++····	++····+··	·····1···+···++1	·+·····+···+···+··	····			
Senecio fuchsii	34	41,0%	·++·········	11+++·+·	····+····	····+++··	··········	+++++1+·1····++·	++1+++···++1++·+···	····			
Phyteuma spicatum	31	37,3%	···+·····	····+···	+++11····	··111++·1	+1·+·1+++·	·+1+11···+·+····+·	·····+····+···+····	·1··			
Mercurialis perennis	28	33,7%	+·1·····	·1+·····	1···1···	·····+···	1+·····	1111211++12+····	·1+··1++···1·2····	····			
Angelica sylvestris	27	32,5%	·+····+++··	·++···++·	··++++··	·+++·++++	·+····+··	·+···r···+·····	·····+·+···+·····	····			
Lathyrus vernus	26	31,3%	+··········	++·····+	····+····	·····+··	1+++·····	1·1+1++·++++···+	··········+++·+··	····			
Prenanthes purpurea	22	26,5%	··········	···++····	·+·····	··+++++++	21·+···+·+	·++···+·+·++·····	···········+····	····			
Geranium nodosum	20	24,1%	·2·····+	1·····	·1··2···	·111221··	·····+2··	··+1·1·11·····	···1+··········	····			
Lilium martagon	20	24,1%	1·+·····	+·····	1·+·+····	+···r····	++···+··r	++++·····+····	···········+···+	····			
Carex sylvatica	18	21,7%	2+1····++··	+++++++··	·····1··	·····+····	···+·····	·····+·····+····	·++···1···+·+·····	····			
Luzula nivea	17	20,5%	··········	·····	·····	+·····+··	111·+····	··1+++···+·+·+··	·r·····1+·····	·r··			
Allium ursinum	14	16,9%	·12··+·22·3·	·····	+····3··	··12·+····	·····	·····	··2·····42	····			
Cardamine impatiens	13	15,7%	·····+++··	·····	+··+·····	·····	·····	+·····	··+···++++····+··	++··			
Anemone ranunculoides	11	13,3%	1··1++++··	·+·····	·····	·····	·····	·····+	··+···········+···	····			
Euphorbia amygdaloides	11	13,3%	··++·····	+·····	·····	····++··	·····	·····+···+·+···+	·····++·····+····	····			
Melica uniflora	11	13,3%	··1·····	····11+·	·····	·····	·····	+·····111··	···++·1·····	····			
Rubus hirtus	11	13,3%	·····	···111··	·····	·····	···1·····	·····+1··+·····	·····1·42·-+·····	····			
Dentaria bulbifera	10	12,0%	·+·1+·····	·····	·+··2···	·····	·····	··1+···+·····	·1···+·····	····			
Laburnum alpinum	10	12,0%	·····	+·····	·····	·····1·	·····+···	·+··1·1·····	·····+++·····+··	····			
Adoxa moschatellina	9	10,8%	·····	·····	·····	·····	·····	·····	2+1·1···+···+····	++·+			
Leucojum vernum	8	9,6%	1··21+1++··	·····	·····	·····	·····	·····	··········1·····	····			
Lonicera alpigena	8	9,6%	·····	·····	····+···	··+··r···	·····	····+·····	··········++1·+···	····			
Dryopteris pseudomas	7	8,4%	··+·····	·····	·····	·····	·····	·····+·····	·+··+·····rr·····	···+			
Gagea lutea	7	8,4%	+···+++····	·····	·····	·····	·····	·····1····	1·····+····	····			
Milium effusum	7	8,4%	·····+	·····	·····	·····	+·····	·····	·····2·23··+·····	·+··			
Neottia nidus-avis	7	8,4%	·····	·····	·····r·	····++r··	·····+	·····+····	·····+·····	····			
Ranunculus lanuginosus	7	8,4%	·····	·····	·····	·····	+·····	·····	·11+·····+···+·+	····			
Sanicula europaea	7	8,4%	·····	·····+·	·+·····	·+1+····+	·····	·····+··	·····	····			
Scrophularia nodosa	7	8,4%	··1·····	·+·····+	·····	·····	·····	·····	···+···+···+·····	+···			
Dryopteris dilatata	6	7,2%	·····	+·r·····	···+····	+····+····	·····	·····	·····	····			
Bromus benekenii	4	4,8%	·····	·····	···+····	·····	·····	··+·+·····	··········+····	····			

Aconitum paniculatum	10	12,0%	+·1········	········	········	·········	·········	··+···1··1·+····	···········+·2+2··	····
Polystichum braunii	9	10,8%	···········	··+1····	········	·········	·········	···········+····	··+1+·········+···	1··+
Senecio nemorensis	9	10,8%	···········	········	·····+·+	·········	++·······	·········++·····	·+···········+····	···+
Euonymus latifolius	7	8,4%	···········	········	········	·····+···	··1······	+·········+·····	·····+·+···+······	····
Veratrum nigrum	7	8,4%	··1········	········	····r···	·········	·········	··21+++·········	··················	····
Acer platanoides	5	6,0%	··1········	········	········	·········	·········	·······r++······	·············+····	····
Philadelphus coronarius	4	4,8%	···········	········	········	·········	·········	·······1+1+·····	··················	····
Taxus baccata	3	3,6%	···········	········	········	·········	·········	·······2+2······	··················	····
Lunaria rediviva	3	3,6%	···········	········	········	·········	·········	················	····+·········33··	····
Vicia dumetorum	3	3,6%	·+1········	········	········	·········	·········	················	·········+········	····
Hesperis candida	2	2,4%	···········	········	········	·········	·········	1·+·············	··················	····
Adenophora liliifolia	1	1,2%	···········	········	········	··+······	·········	················	··················	····

Charakter- und Differentialarten Alno-Ulmion

Ulmus minor	16	19,3%	1+1··22·+··	+····2··	······1·	·········	+·+······	·········+···+··	·········++······+	····
Rubus caesius	15	18,1%	···········	211···1·	++······	·········	++·····+·	·········+··1···	·+121·············	····
Thalictrum aquilegifolium	12	14,5%	···········	···r··+·	·++·····	·····+··+	·+·······	··+···+·········	+············+····	··+·
Cerastium sylvaticum	11	13,3%	·+·+·······	········	+·1+·11·	·········	+········	················	··2············++·	····
Chrysosplenium alternifolium	11	13,3%	·······++··	········	········	·········	··+······	················	··+···+·····+··++·	++·+
Impatiens noli-tangere	11	13,3%	·······322·	········	········	·········	·········	················	···········+···115	12++
Circaea lutetiana	10	12,0%	···+·+·····	········	········	·········	·········	················	·1·+1+··++·+····+·	····
Dryopteris carthusiana	10	12,0%	···········	········	········	·······+·	·········	···············+	·++···+·······+··+	·+++
Ranunculus ficaria	9	10,8%	+··1+12113+	········	········	·········	·········	················	··················	····
Alnus incana	6	7,2%	···········	······+·	···+····	·········	·········	················	··················	++14
Festuca gigantea	5	6,0%	··+········	········	·····1+·	·········	·········	················	··················	+·+·
Stellaria nemorum	4	4,8%	···········	········	········	·········	·········	················	··················	1211
Equisetum maximum	3	3,6%	·······++··	········	········	·········	·········	················	·····+············	····
Ranunculus auricomus	3	3,6%	·······++·3	········	········	·········	·········	················	··················	····
Carex remota	2	2,4%	···········	········	········	·········	·········	················	·+···+············	····
Matteuccia struthiopteris	2	2,4%	···········	········	········	·········	·········	················	··················	··44
Agropyron caninum	1	1,2%	···········	········	········	·········	·········	················	···············+··	····
Circaea intermedia	1	1,2%	···········	········	········	·········	·········	················	+·················	····

andere hygrophile Differentialarten

Alnus glutinosa	16	19,3%	···r+++···1	+2·++1·3	········	·········	·········	·············+··	·+r+··············	·+··
Chaerophyllum hirsutum	11	13,3%	··+····11··	········	········	·········	·········	······+·········	·············+··+1·	+11+
Deschampsia caespitosa	10	12,0%	·······++··	·+++·+··	··+·····	·········	·+·······	················	······1··+········	····
Cystopteris fragilis	9	10,8%	···········	········	········	·········	·········	··++·+··········	+·············++·+	++··
Solanum dulcamara	7	8,4%	···········	········	········	·········	·········	················	·+···+·+++·r+·····	····
Cirsium oleraceum	5	6,0%	·······++··	······+·	··+···+·	·········	·········	················	··················	····
Eupatorium cannabinum	5	6,0%	··+········	········	········	·········	·········	················	········+1·2+·····	····
Cardaminopsis halleri	4	4,8%	···········	········	········	·········	·········	················	·······1·1·····+··	·+··
Petasites hybridus	4	4,8%	·······++··	········	········	·········	·········	················	·····+·········+··	····
Trollius europaeus	4	4,8%	···········	········	········	+··+1····	·········	················	··················	·+··
Caltha palustris	1	1,2%	······r····	········	········	·········	·········	················	··················	····
Crepis paludosa	1	1,2%	···········	········	········	·········	·········	················	··················	·1··
Lysimachia nummularia	1	1,2%	···········	········	········	·········	·········	················	·····+············	····

Epilobium montanum	4	4,8%	····
Epipactis helleborine	4	4,8%	····
Galium odoratum	3	3,6%	····
Streptopus amplexifolius	3	3,6%	·+1r
Corydalis cava	2	2,4%	····
Stachys sylvatica	1	1,2%	····
Prunetalia			
Crataegus monogyna	33	39,8%	····
Tamus communis	27	32,5%	····
Cornus sanguinea	17	20,5%	····
Viburnum lantana	9	10,8%	····
Berberis vulgaris	5	6,0%	····
Ligustrum vulgare	5	6,0%	····
Rhamnus catharticus	4	4,8%	····
Prunus spinosa	2	2,4%	····
Clematis recta	1	1,2%	····
Quercetalia pubescentis			
Fraxinus ornus	31	37,3%	····
Ostrya carpinifolia	24	28,9%	····
Clematis vitalba	24	28,9%	····
Tanacetum corymbosum	24	28,9%	····
Melittis melissophyllum	18	21,7%	····
Cornus mas	16	19,3%	····
Euonymus europaeus	13	15,7%	····
Laburnum anagyroides	9	10,8%	····
Aristolochia lutea	6	7,2%	····
Aristolochia pallida	6	7,2%	····
Ruscus aculeatus	6	7,2%	····
Asparagus tenuifolius	5	6,0%	····
Arabis turrita	4	4,8%	····
Cephalanthera longifolia	4	4,8%	····
Lathyrus niger	4	4,8%	····
Quercus pubescens	4	4,8%	····
Potentilla alba	3	3,6%	····
Arabis brassica	2	2,4%	····
Calamintha sylvatica	2	2,4%	····
Campanula persicifolia	1	1,2%	····
Chamaecytisus hirsutus	1	1,2%	····
Euphorbia angulata	1	1,2%	····
Hypericum montanum	1	1,2%	····
Pulmonaria australis	1	1,2%	····
Sommertrockenheitzeiger			
Carex alba	13	15,7%	····

Calamagrostis varia	9	10,8%	···········	········	········	·····11··	·······12	··++1·······1···	··········1·······	····
Sesleria varia	6	7,2%	···········	········	········	·········	·········	·2··21+··+1·····	··················	····
Valeriana tripteris	6	7,2%	···········	········	········	·········	·········	·1···1·++++·····	··················	····
Adenostyles glabra	5	6,0%	···········	········	········	·········	·········	·+···1··+++·····	··················	····
Rubus saxatilis	5	6,0%	···········	········	········	···+·++··	·········	·····+··········	··········1·······	····
Hierochloë australis	3	3,6%	···········	········	········	···+·····	···+·····	··········+·····	··················	····
Molinia arundinacea	3	3,6%	···········	········	········	11······3	·········	················	··················	····
Erica herbacea	2	2,4%	···········	········	········	········+	·······+·	················	··················	····
Anthericum ramosum	1	1,2%	···········	········	········	·········	·····+···	················	··················	····
Betonica jacquinii	1	1,2%	···········	········	········	·········	········r	················	··················	····
Carex austroalpina	1	1,2%	···········	········	········	·········	·········	·····+··········	··················	····
Polygala chamaebuxus	1	1,2%	···········	········	········	········1	·········	················	··················	····
Polygonatum odoratum	1	1,2%	···········	········	········	·········	·········	················	··········+·······	····

Querco-Fagetea

Corylus avellana	74	89,2%	1+12++2111+	11+221·+	211+2111	1111+1+1+	+11+1+111	121+112+1+1+1+·1	2211+·11+r12111··1	····
Acer campestre	56	67,5%	+++++++1+++	1+·+·++·	+++1+·+·	····+·+·+	+++·+++++	+++1+···+·++++·+	·++++·r1++··1·1·+·	·r··
Carex digitata	51	61,4%	++++·++····	++·2+++·	++11+·+1	+1·+·++··	++1+1111+	++·21·+··++1·++1	·+···1+·+··1····+·	·+··
Lonicera xylosteum	47	56,6%	···+··++···	······1·	·+·+++·+	+++··1+··	++1++++1+	+·+·++··++1+++++	·+++++·+··+++·++·r	····
Hepatica nobilis	42	50,6%	1···+++++·1	········	+111++++	·1+1+·1++	++1·11·11	+·+·+1···+++···1	·····+·····+++···+	····
Hedera helix	40	48,2%	·1·1···++·+	1···+++·	+·1··+··	·········	12222·+··	111+1··++1··1122	+1+··21+···++1+···	····
Sorbus aria	27	32,5%	··r········	··+···+·	····+···	+++++++·+	++·+11·++	·+++++1···++····	··················	····
Brachypodium sylvaticum	27	32,5%	+··+·······	·····+··	+1+1+1+2	·111·····	····1++1·	12++············	··+··2···+·+·····+	····
Anemone nemorosa	23	27,7%	1··4412++32	·121····	·+····+1	41+21····	·········	···············+	··················	··23
Viola reichenbachiana	23	27,7%	··1+·+·····	···+·++·	+·····+·	··+·····+	··++·+···	······+···++··++	+·····++··········	·+·+
Viburnum opulus	22	26,5%	···r+······	+·····+·	·++·····	+1·1+1+++	+···+··++	·····r·····+···+	··············+···	····
Festuca heterophylla	19	22,9%	·····+·····	++···r·+	·····11+	++·····1·	++···+··+	+·++·+··········	··················	····
Campanula trachelium	16	19,3%	···+·······	·+······	+····++·	·········	··+·+····	1+·+··+····+····	········++·++·····	····
Convallaria majalis	15	18,1%	+··········	·+·····2	········	1·11++2+·	+1····+··	·········+······	··················	·+··
Melampyrum nemorosum agg.	8	9,6%	···········	········	········	·+·11··2·	·····+·+·	·····r···+······	··················	····
Viola mirabilis	5	6,0%	······+····	········	+·+·····	·········	·········	·········+······	···········+······	····
Scilla bifolia	3	3,6%	+···+······	········	········	·········	·········	················	+·················	····
Viola hirta	3	3,6%	···········	········	········	··+·····+	·········	················	··········+·······	····
Viola riviniana	3	3,6%	·····+r····	········	········	·········	·········	················	···········+······	····
Lathraea squamaria	2	2,4%	·····++····	········	········	·········	·········	················	··················	····
Silene livida	1	1,2%	···········	········	········	·········	·······+·	················	··················	····

Querco-Fagetea (schwache)

Melica nutans	50	60,2%	1·++·+·····	++11···1	11+1+112	+121+111+	+1·111111	+·1·1+++++1+····	·····+····11··1··1	·+··
Aegopodium podagraria	44	53,0%	+22++313321	121+·+2·	1121··21	·········	1········	··1++·······+·1·	113+····21··11·121	+21+
Cruciata glabra	22	26,5%	·····+·····	·+·····1	·····+++	·++++++1·	··+·+1+11	·····1+·········	··················	·1··
Mycelis muralis	13	15,7%	···········	········	····+···	·········	··+······	+·······+·······	·+···+++··+++·····	+r··
Veronica chamaedrys	7	8,4%	·+·········	········	········	·········	··+······	················	······1··+·+······	++··
Moehringia trinervia	6	7,2%	··+········	········	··+·····	····+····	·········	················	······1··+········	·1··

Betulo-Adenostyletea und andere ± Nitrophilenarten

● Sambucus nigra	32	38,6%	·1+r·+·122+	++·1+·r·	·r······	·········	··+······	·······+·+··+·2·	+21+++·1··+··++·+1	+···
● Geranium robertianum	22	26,5%	··+········	········	······+·	·········	·········	+·+·····+1·······	·1··++1+11++2·++·+	21+·
Heracleum sphondylium	22	26,5%	·++··+·++··	+·····+·	+·····++	·++·+····	+····+··+	+·+··············	·····+·······+··+·	·+··
Geum urbanum	21	25,3%	·+·+···++··	+·······	+·+··+1+	·····+···	·········	+················	·++··+1·11··+·····	+1··
Myosotis sylvatica	14	16,9%	···········	········	······+·	·········	·········	··+··············	+·1···+22+·++·+·+·	11··
Silene dioica	14	16,9%	···········	········	1··++···	·········	·········	+++···+·+·····+··	+·······11·++·····	····
● Urtica dioica	14	16,9%	·+·····11··	········	········	·········	·········	·················	+··+··1212·+2·+1··	·+··
Veratrum album	11	13,3%	···········	········	········	+·+++11·+	·····+···	··········1······	··················	·+4·
● Galeopsis speciosa/tetrahit	10	12,0%	···········	········	········	·········	·········	1················	+·+··+·+12··+·····	++··
Astrantia major	7	8,4%	···········	········	·+······	1···1+1··	·········	·······+···+·····	··················	····
Salix appendiculata	7	8,4%	···········	········	········	+········	····+····	·······+·········	··········+++··+··	····
Hypericum hirsutum	6	7,2%	··+········	········	········	·········	·········	··r··············	·········+1·1+····	····
Bromus ramosus	5	6,0%	···········	········	········	·········	·········	1···········+····	·····+······+·····	+···
● Geranium phaeum	5	6,0%	···········	········	········	·········	·········	·················	+······+··+··+····	·1··
● Saxifraga rotundifolia	5	6,0%	···········	········	········	·········	·········	·········r·······	············1··++··	··+·
Alliaria petiolata	4	4,8%	··········+	········	········	·········	·········	·················	+······+··········	+···
Polygonatum verticillatum	4	4,8%	···········	········	········	·······+·	·········	·················	··············+···	··++
Salix caprea	4	4,8%	········+··	·······+	·+······	·········	·········	·················	··················	··1·
Galium aparine	3	3,6%	········++··	········	········	·········	·········	·················	·········+········	····
Parietaria officinalis	3	3,6%	········++··	········	········	·········	·········	···············r·	··················	····
Vicia sepium	3	3,6%	···········	········	········	·········	·········	+·r··············	···········+······	····

Azidophilenarten s.l.

Quercus robur	29	34,9%	11121111++·	········	·+++·+·+	++·++11··	++··21++1	·················	·············+····	····
Picea abies	25	30,1%	+··········	········	··+·····	+··+++++r	····+··r2	·········r···++·+	1·····r···2·+····+·	++++
Castanea sativa	24	28,9%	+1··1······	2r+·2+··	·+···+··	++······+3	+2++····+	·············1·+·+	···r···+··········	····
Dactylorhiza maculata	23	27,7%	·······+····	··+·++++	·+···1+·	··+1++++++	·······+·	················+	······+···········	+r+·
Maianthemum bifolium	17	20,5%	+···+····+·	··++····	·1+·····	+11+·+·1·	12·······	·················	··················	r·+·
Sorbus aucuparia	17	20,5%	···········	···r····	········	··1+++r++	·········	··+·++···········	···········+·r·++··	·++·
Phegopteris polypodioides	14	16,9%	···········	··11+···	·+······	·+··1····	·+··+····	················+	···+··············	++++
Calamagrostis arundinacea	12	14,5%	···········	··1+1·11	········	·1·······	12··+····	··············1··	···++·············	····
Luzula pilosa	12	14,5%	·++·+······	··+++···	········	·+·······	+1·······	·················	··++··+···········	····
Pteridium aquilinum	10	12,0%	··+········	········	·+······	++·++····	····+++·r	·················	··················	····
Serratula tinctoria	9	10,8%	···········	+·······	········	·1+++···2	++···+···	·················	··················	····
Betula alba	8	9,6%	+··········	··r·r···	·+······	1·++··+··	·········	·················	··················	····
Hieracium sylvaticum	7	8,4%	···········	········	········	·1···+·++	·······++	·················	··········+·······	····
Betonica officinalis	6	7,2%	···········	········	········	+++++···+	·········	·················	··················	····
Quercus petraea	4	4,8%	····+······	········	········	··1····1+	·········	·················	··················	····
Rosa pendulina	4	4,8%	···········	········	········	·········	·····+···	·····+···········	··········+·····+··	····
Vaccinium myrtillus	4	4,8%	···········	········	········	+··+···1+	·········	·················	··················	····
Frangula alnus	3	3,6%	···········	········	········	··r·····+	·······r·	·················	··················	····
Hieracium racemosum/umbell.	3	3,6%	···········	········	········	········+	++·······	·················	··················	····
Homogyne alpina	3	3,6%	···········	········	········	··+·+··+·	·········	·················	··················	····
Luzula albida	3	3,6%	···········	········	········	·······3·	··+······	·················	··················	+···
Malus sylvestris	3	3,6%	···········	·····r··	········	·········	····+r···	·················	··················	····
Melampyrum pratense	3	3,6%	···········	········	········	··+····+1	·········	·················	··················	····

antropogenische Einfluβe Zeiger

Glechoma hederacea	11	13,3%	·2·····++·1	········	+····11·	·········	·········	················	+·1···+·········+·	····
Equisetum arvense	10	12,0%	···+·1+++··	········	·····r··	·········	·········	···············r	··+···············	·++·
Juglans regia	10	12,0%	·r·········	····r···	++r·····	·r·······	r··r···r·	················	····r·············	····
Robinia pseudacacia	10	12,0%	1··+·+·11++	········	++······	·········	+········	················	··················	····
Ajuga reptans	5	6,0%	··+········	·····+··	········	··+·+····	·········	················	······+···········	····
Erigeron annuus	4	4,8%	··++·······	········	········	·········	·········	················	·········+1·······	····
Rubus fruticosus agg.	4	4,8%	···········	········	········	·········	·····+···	·············+··	+·················	·+··
Taraxacum officinalis	4	4,8%	···r·r·····	········	········	·········	·········	················	+········+········	····

Begleiter

Oxalis acetosella	52	62,7%	+1·+2+1++1+	11++++··	++2++1+·	·++··1+1·	·+·······	··+··+·1+·+·+··+	1+·+++1+···21++·++	11·1
Solidago virgaurea	47	56,6%	·+·········	++··+·++	··++++++	++++1+++1	+++++++++	+++++++··++··+·+	··+··+·····+······	++··
Athyrium filix-femina	41	49,4%	··1·+····+·	++2121··	·+··+·+·	·+++1+·++	++·······	···+··········++·	·1+14+++++·+211···	22++
Fragaria vesca	39	47,0%	·+···+·····	++·+···+	·++··+++	+++++++++	++···++++	+++·+++·········	·······+·++1++····	·+··
Listera ovata	33	39,8%	·++++++···+	+···+·++	+++··+1+	·+·+·++··	····+·++·	+·+·········+··+	+·+···········+···	·+··
Cirsium erisithales	24	28,9%	··+·····+··	·······+	·+··+···	+·+++++++	·········	·++··+++·++·····	+·········1····+··	·r··
Colchicum autumnale	24	28,9%	++·1++·++·1	1+··+1++	·+····1+	·1·+·····	···+··+··	·············+··	····+···········+·	····
Populus tremula	21	25,3%	1·11·2·····	+···+···	········	+++++·+··	++1+··1·1	···············+	·+·········+······	····
Polypodium vulgare	16	19,3%	···········	+·······	········	·+······+·	+++······	+··+++·······++·	······++·······+··	+···
Gentiana asclepiadea	15	18,1%	····r······	+·+·+···	·····+++	···++++··	····+····	·····r····+·····	··················	··+·
Asplenium trichomanes	14	16,9%	···········	········	····+···	·········	·········	++++++·+·+··+··r	·····+······+·····	r···
Aquilegia atrata	13	15,7%	···········	·······+	·+··+···	········+	····++·++	····+r···++·····	···········+······	····
Poa nemoralis	12	14,5%	·+·······1·	········	········	·····+···	·········	2·+··+··········	+·········++····+·	++··
Crocus albiflorus	10	12,0%	1··········	·21+····	·+······	···1·+··+	·········	················	··················	··1+
Lilium bulbiferum	10	12,0%	···········	········	······r+	·++······	·····+rrr	+····r··········	··················	····
Campanula rapunculoides	9	10,8%	···········	·······+	+·+·····	·········	··+······	··+······+······	·······+··++······	····
Vincetoxicum hirundinaria	9	10,8%	··+········	·+·····r	········	··++·····	·····+·+·	······+·········	······+···········	····
Laserpitium latifolium	6	7,2%	···········	········	········	+·++·····	········+	······r··+······	··················	····
Moehringia muscosa	6	7,2%	···········	········	········	·········	·········	·+·······+······	·······+···++··+··	····
Ranunculus nemorosus	6	7,2%	·····+·····	·······+	········	+++······	········+	················	··················	····
Iris graminea	5	6,0%	···········	········	········	·+·+··+··	·······+·	······+·········	··················	····
Carex montana	4	4,8%	···········	········	········	··++····1	········1	················	··················	····
Dactylis glomerata	4	4,8%	···········	·+······	········	·········	++·······	················	··············+···	····
Gymnocarpium dryopteris	4	4,8%	···········	········	········	····++···	·········	················	··················	+··+
Juniperus communis	4	4,8%	···········	r·······	········	········+	····+··+·	················	··················	····
Platanthera chlorantha	4	4,8%	···········	······+·	r····+··	·····+···	·········	················	··················	····

Zufällige	00000000000	00000000	00000000	000000002	000000000	0000000000000000	000000000100000000	0000
	00210002110	10011322	00000010	111200121	001000051	0200080111310000	402010113030100501	1201
Artenzahl	55754545523	65544553	56646454	466767747	663456465	5474575357554434	546455544647545333	4533
	75576139652	69086315	09253752	969884129	806831976	5909230571882757	391802687712631954	6954

⊠ illyrische Arten
⊗ Hacquetio - Fraxinetum Differentialarten

[1] about 35 ha of a secondary river valley with slopes densely covered by secondary TILIO-ACERION woods. Parent material is lithologically classified as pre-Permian phyllitic basement and quaternary glacial deposits rich of dolomite and limestone cobbles. The climate, sub-mediterranean according to Koppen, is mesothermic and humid.

[2] Year correspondent to a significant tree-ring size variation within a limited section of a single sequence.

[3] When many ring sequences display event years of the same type (positive and negative) in the same years.

[4] Series of at least four tree-rings, whose size is reduced by 40% or more, or increased by at least 66% in relation to the previous sequences of similar length.

[5] 1=1.30-8 m; 2=8-16 m; 3=16-24; 4=>24 m .

[6] The only problem is that *Hacquetia epipactis'* western bounds are in the central part of Friuli (Valli del Natisone).

[7] It would be useful as this regard to repeat all the relevés in the right season for better assessment of geophytes.

[8] Also in this case the term ***illyricum*** should adequately changed according to the code of phytosociological nomenclature (BARKMAN et al., 1986).

[9] Maybe the same, but of sub-mediterranean type, where *Asparagus tenuifolius* is the character species.