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E. FEOLI, M. SCIMONE

GRADIENT ANALYSIS IN THE SPONTANEOUS REFORESTATION PROCESS OF THE KARST REGION

ANALISI DI GRADIENTI NEL PROCESSO DI RIFORESTAZIONE SPONTANEA DEL CARSO TRIESTINO

Abstract — A gradient of closeness of nuclei of reforestation in the grasslands of the Karst region by Trieste has been analysed by multivariate methods. The behaviour of syntaxonomical units and life forms are strongly correlated with the gradient as well as some parameters of diversity computed on floristic data.

Key words: Gradient analysis, Karst, Ordination, *Scorzonero-Chrysopogonetalia, Origanetalia, Prunetalia, Quercetalia pubescentis,* Reforestation.

Riassunto breve — *E' stata compiuta un'analisi di gradienti nel processo di riforestazione spontanea del Carso triestino in base alla vicinanza dei nuclei di riforestazione. Ai rilievi vegetazionali, compiuti sotto la chioma dei nuclei, sono stati applicati metodi di analisi multivariata per verificare il gradiente di chiusura. L'identificazione di tre livelli di chiusura è stata confermata dalla distribuzione delle unità sintassonomiche (ordini) e delle forme biologiche. Parametri di diversità stimati sulla base dei dati floristici sono risultati correlati al gradiente.*

Parole chiave: *Analisi di gradienti, Carso, Ordinamento, Riforestazione.*

1. Introduction

In the Karst region by Trieste, the process of spontaneous reforestation is developing in the abandoned pastures by the growing and spreading of groups of trees and shrubs. Such groups constitute the nuclei of reforestation (NR). The main components of NR are *Fraxinus ornus, Ostrya carpinifolia, Quercus pubescens, Cotinus coggygria, Prunus mahaleb, Rhamnus rupestris, Crataegus monogyna,*

Cornus mas and *Juniperus communis*. This work takes part of a series of studies on this reforestation process, to which some authors have already attended. LAUSI, PIGNATTI & POLDINI (1967) analyse the effects of the dimensions of shrubs on the vegetation of grasslands. FEOLI & FEOLI CHIAPELLA (1979) try to quantify the changements of spatial pattern heterogeneity of the grasslands along transects towards the nuclei of reforestation. FEOLI, FEOLI CHIAPELLA, GANIS & SORGE (1980) consider the effects of the closeness of nuclei of reforestation on the spatial pattern heterogeneity and on the species composition of the grasslands. The aim of this study is to analyse some vegetation patterns under the canopy of NR, with regard to their closeness. Then three different levels of closeness have been compared on the basis of vegetation relevés and by microclimatic measures of air temperature at ground level, soil temperature, pH of the soil and light intensity. The research is addressed to elicit patterns of behaviour of syntaxonomical and life form categories in the ecocline's situations like those under the canopy of the trees. The species involved are those of grasslands, (mainly *Scorzonero-Chrysopogonetalia*), those of fringe (mainly *Origanetalia*) those of edge (*Prunetalia*) and those of woods (mainly *Quercetalia pubescentis*). A syntaxonomical study of the plant communities of fringe vegetation has been done for the same region by VAN GILS, KEYSERS & LAUNSPACH (1975).

2. Data and methods

2.1. Vegetation data

The relevés (160) have been made under the canopy of NR, in the Karst region by the province of Trieste, at 300-400 m of altitude. Individual of species have been counted on homogeneous surfaces of about 3 sq.m. The relevés have been classified in 3 classes on the basis of the mean distance between NR along a gradient of closeness. By comparing the classes with those defined by FEOLI et al. (1980), class 1 corresponds to 1, class 2 to 2, 3, 4, and class 3 to 5. The sample of relevés has been stratified as in fig. 1.

The data analysis consists in the following steps:

(1) Chi-square test on the contingency tables species/classes and T-test between the classes for each species.
(2) Comparison between the classes on the basis of the frequency of syntaxonomical units (order level) and life forms. The syntaxonomical nomenclature follows HORVAT, GLAVAC & ELLENBERG (1974) and POLDINI (1980).
(3) Cluster analysis of the classes based on their floristic composition. The Soerensen's index, single linkage clustering and Minimum Spanning Tree (GOWER & ROSS, 1969) have been applied.
(4) Discriminant analysis (KLECKA, 1970) between the classes of relevés in fig. 1. This analysis has been performed by sets of 15 relevés randomly selected from each class. The pattern of the analysis is the following:
    (a) between the sets of relevés with North and South aspect
    (b) between all the classes in fig. 1
    (c) between the 3 classes of the first stratum with relevés of North aspect
    (d) between the 3 classes of the first stratum with relevés of South aspect
    The analysis is based on 10 species ranked by the information criterion of ORLÓCI (1976). 10 species account for 62% of the total mutual information.
(5) Ordination of all relevés by Intersection Analysis (FEOLI & LAGONEGRO, 1979) and definition of relevés groups on the basis of presence/absence of species.
(6) Ordination of relevés groups defined in (5). Presence/absence data and the eigenvectors of the similarity matrix given by COCHIS (LAGONEGRO & FEOLI, 1980) have been used.
(7) Ordination of species by principal component analysis based on correlation coefficient.

According to the terminology of WHITTAKER (1978) points 1, 2, 3, 4 are working for a direct gradient analysis while point 6 for an indirect gradient analysis.

2.2. Ecological data

The ecological data include:

(1) Air temperature at ground level
(2) Soil temperature at a depth of about 25 cm
(3) Air humidity recorded by an Assmann's psycrometer
(4) Light intensity in the shadow of the canopy of NR, recordered by a QUANTUM RADIOMETER LI-185 A (Lambda Instruments) at midday of September 8th, 1981
(5) pH of soil, recorded from samples taken in February 1982.

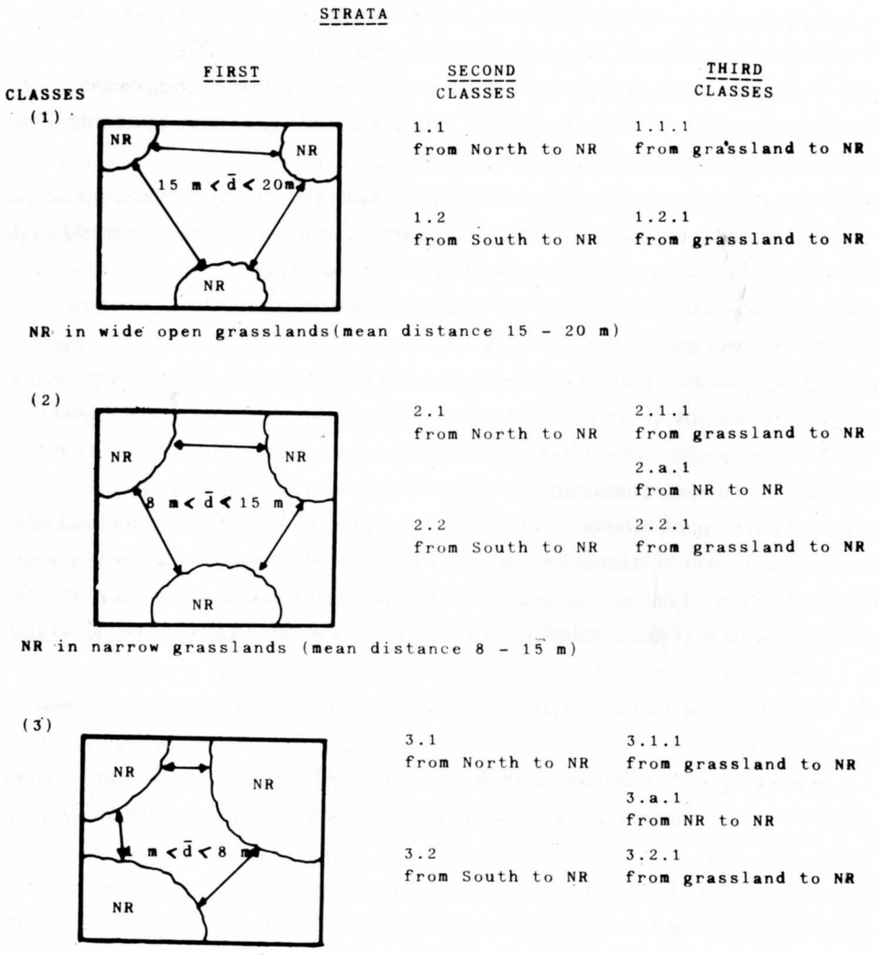


Fig. 1 - Sample stratification.
- *Stratificazione dei campioni di rilievo.*

3. Results

3.1. Vegetation comparisons

The species on which the data analysis was performed are listed in tab. I with corresponding life forms and frequency in the classes. Tab. II shows the results of chi-square test, and tab. III the results of T-test. The tests present significant differences between the classes. The species of *Scorzonero-Chrysopogonetalia* have the highest frequency in class 1, the species of *Quercetalia pubescentis* in class 3, while the species of *Origanetalia* and *Prunetalia* in class 2 (tab. IVa). Therophytes and Hemycryptophytes have the maximal frequency in class 1, while Chamaephytes, Phanerophytes and Geophytes in class 3 (tab. IVb). The distribution of the syntaxonomical units and the life forms in the classes proves quite clearly the effects of a gradient of closeness. The species of fringe and edge vegetation find their optima in the intermediate situation of closeness. The chi-square test with data in tab. IV indicates that the syntaxonomical units are more significant related to the classes than the life forms. Fig. 2 shows that the highest floristic similarity is between groups of relevés (see fig. 1) belonging to the same class. This is a further prove of the effects of closeness of NR on the vegetation under the canopy of trees. The most significant results of discriminant analysis correspond to (c) and (d) comparisons. The species used are presented in tab. V. All of them, excluded *Ferula ferulago* and *Quercus pubescens* are significantly related with a class (see tabb. II, III). The ordination given by the first two canonical discriminant variates given in figg. 3a and 3b confirms the gradient along the first canonical variate. The significance of the differences between the classes is given in tabb. VIa and VIb. From these tables we can conclude that the classes of relevés with South aspect are more differenciated than the classes with North aspect. The North aspect seems to produce more mesophylous conditions leading to a lower separation between the three classes of closeness. On the basis of Intersection Analysis four sets of relevés have been defined. The composition of the sets in terms of classes of closeness and aspects is presented in tab. VII. The ordination of the sets according to the 2nd and the 3rd eigenvector of the similarity matrix given by COCHIS is presented in fig. 4. The sequence of the sets along the 2nd eigenvector proves again a regular gradient of closeness. The species ordination obtained in (7) produced a semicircular belt in which the species of *Scorzonero-Chrysopogonetalia* occupy the extreme left side, and the most important arboreal species of *Quercetalia*

	1 N	1 S	2 N	2 nr	2 S	3 N	3 nr	3 S
1 N	-							
1 S	90	-						
2 N	77	83	-					
2 nr	78	84	89	-				
2 S	82	85.33	85.36	81	-			
3 N	80	83	83	82	85.36	-		
3 nr	77	80	80	83	82	84	-	
3 S	75	81	78	79	83	89	80	-

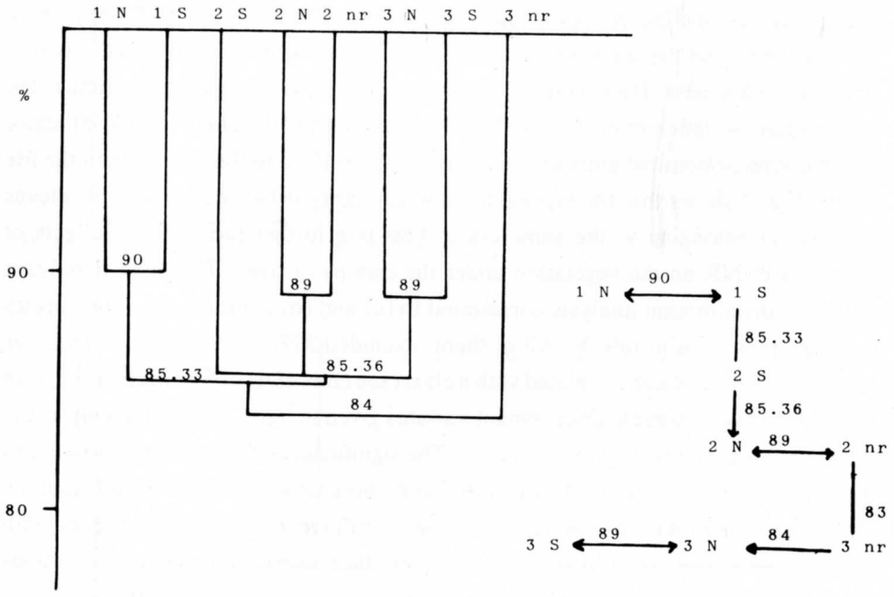


Fig. 2 - Similarity matrix and hierarchic classification of the classes of the third stratum (see fig. 1) by single linkage. The minimum spanning tree is also presented in order to show the maximal similarity pattern.
- *Matrice di somiglianza e classificazione gerarchica secondo il metodo del legame singolo delle tre classi di rilievi al terzo livello di stratificazione (fig. 1). Viene riportato anche il minimum spanning tree per presentare il pattern di massima somiglianza.*

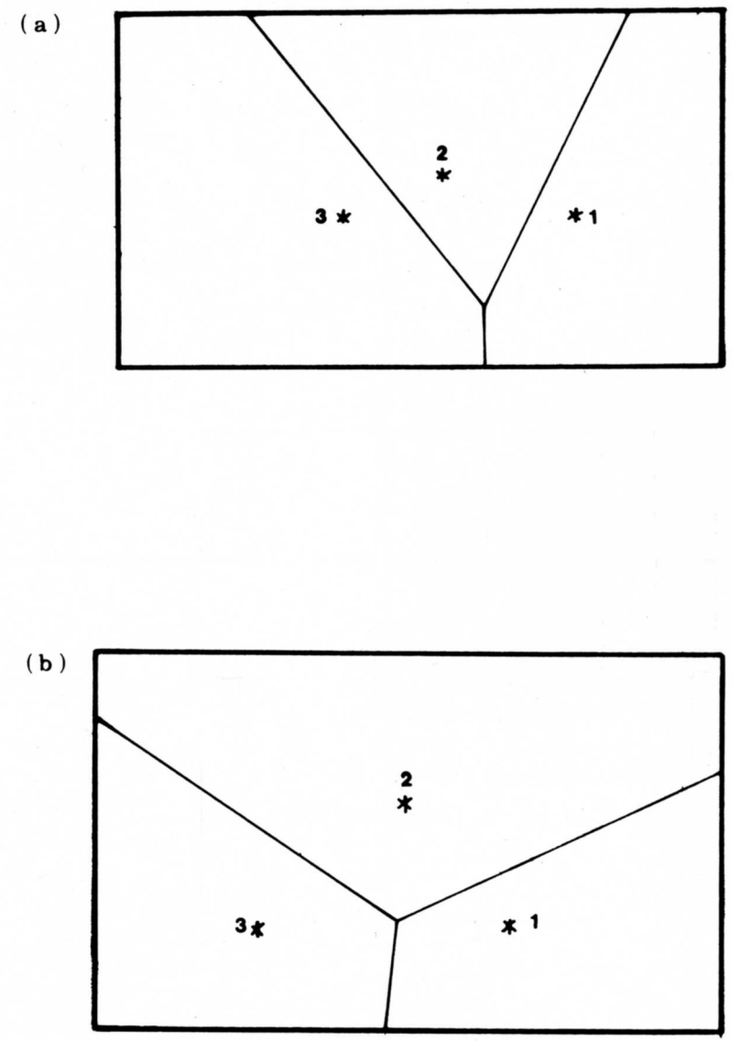


Fig. 3 - Ordination of the centroids of the three main classes with relevés of North aspect (A) and South aspect (B). Discrimination lines on the plane of the first two canonical discriminant functions are drawn.
- *Ordinamento dei centroidi delle tre classi principali di rilievi con esposizione Nord (A) e con esposizione Sud (B). Vengono riportate le linee discriminanti sul piano delle prime due variabili canoniche dell'analisi discriminante.*

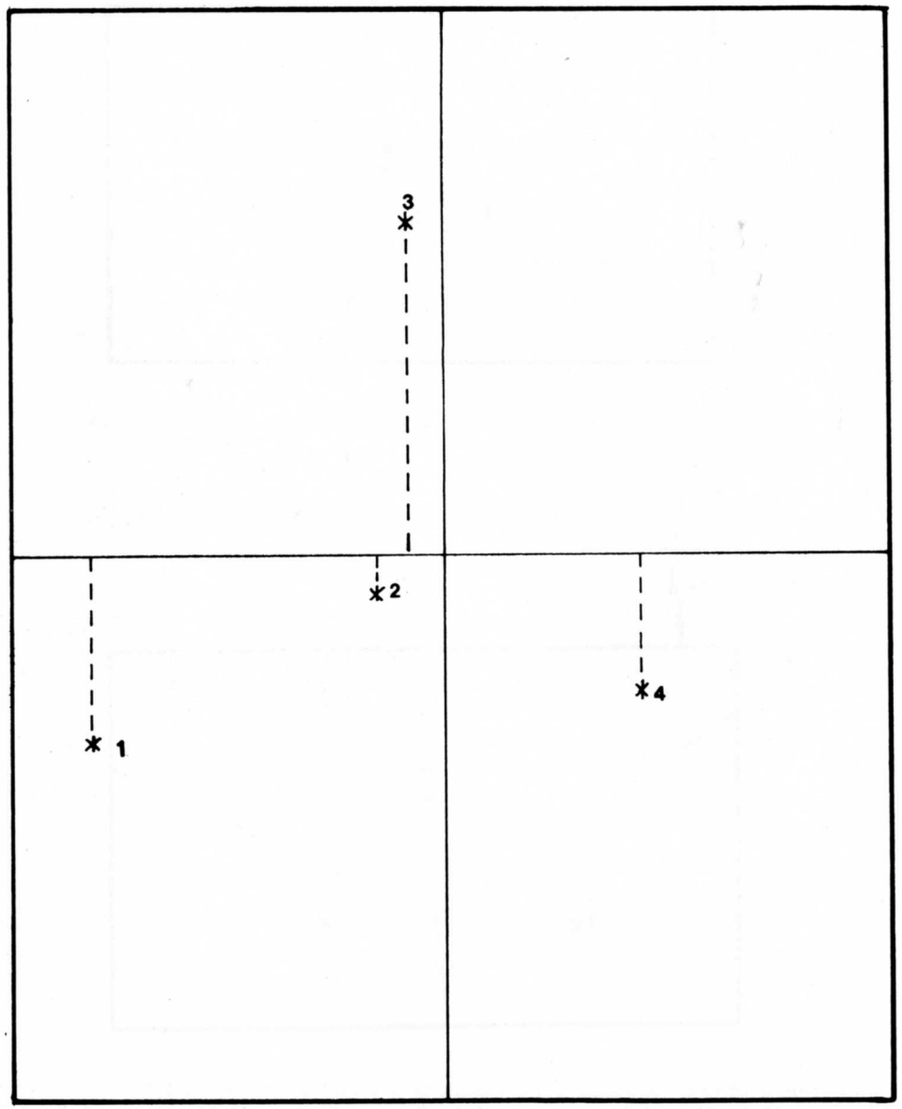
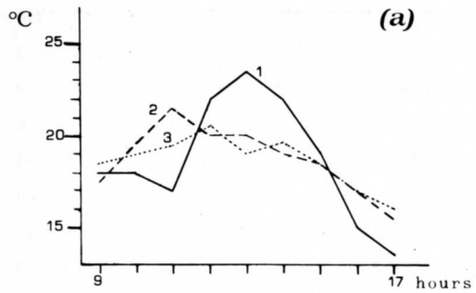
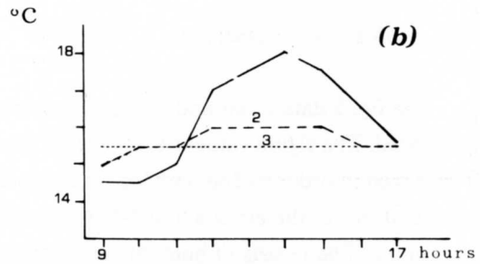


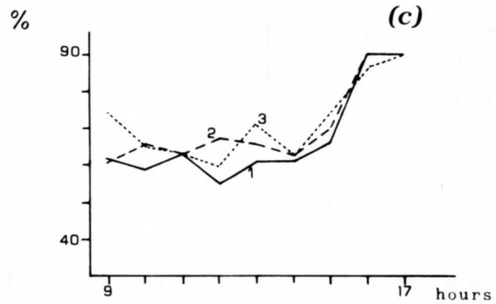
Fig. 4 - Ordination of the sets, defined by intersection analysis, according to the second and third eigenvector of the similarity matrix given by COCHIS.
- *Ordinamento degli insiemi definiti dall'analisi dell'intersezione sulla base del secondo e terzo autovettore della matrice di somiglianza prodotta da* COCHIS.



class 1 - mean = 18.7 °C s = 3.35
class 2 - mean = 18.7 °C s = 1.82
class 3 - mean = 18.6 °C s = 1.36



class 1 - mean = 16.2 °C s = 1.37
class 2 - mean = 15.7 °C s = 0.35
class 3 - mean = 15.5 °C s = 0



class 1 - mean = 67.4% s = 13.13
class 2 - mean = 70.7% s = 11.27
class 3 - mean = 71.8% s = 10.51

Fig. 5 - Air temperature (A), soil temperature (B), and humidity (C) recorded on October 10th, 1981.
- *Temperatura dell'aria (A), del suolo (B), e umidità (C) misurate il 10 ottobre 1981.*

pubescentis (*Quercus*, *Ostrya*, *Fraxinus*) occupy the extreme right side. The seriation of species according to the angle enclosed by species vectors (FEOLI & FEOLI CHIAPELLA, 1980) is presented in tab. VIII. It shows that the species of *Origanetalia* and *Prunetalia* have an intermediate position and that the species of *Origanetalia* are in great percentage preceeding the species of *Prunetalia*. The process of reforestation is then quite well summarized by the species seriation. In such seriation the most important arboreal species of *Quercetalia pubescentis* follow the order *Fraxinus-Quercus-Ostrya*. From this we can argue that *Ostrya carpinifolia* prefers more closed situations that the other two species.

3.2. Ecological comparisons

In fig. 5 data of air and soil temperature and humidity recorded on one day are presented. The sigma values (S) show that the highest variability corresponds to class 1 and then in order to 2nd and 3rd. The soil temperatures are meanly lower than the temperatures of the air of about 4-5 degrees and obviously they are less subjected to variations. The means of humidity regularly decrement from class 3 to class 1. The light intensity (tab. IX) regularly decrement from class 1 to 3, with very remarkable differences between the three classes. Only pH data are almost regular in their values.

No significant differences between the soil in open grasslands and the soil under the canopy of NR, neither between the soil samples under the main species of trees (*Fraxinus*, *Ostrya*, *Quercus*) have been proved. In tab. X the mean values of pH in open grasslands and under the canopy of the main trees are reported.

4. Conclusions

A description of the reforestation process in function of the closeness of NR can be given by the tables II to XI. Along the gradient of closeness there is an increment of species number by species of *Origanetalia*, *Prunetalia* and *Quercetalia pubescentis*. The species of *Scorzonero-Chrysopogonetalia* don't reduce their number in a remarkable way. This fact produces a reduction of the floristic homogeneity of vegetation and an increment of diversity (tab. XI). The belt of mean distances between the NR of 1 to 8 m (class 3) includes therefore the ecoclines grassland-wood with the

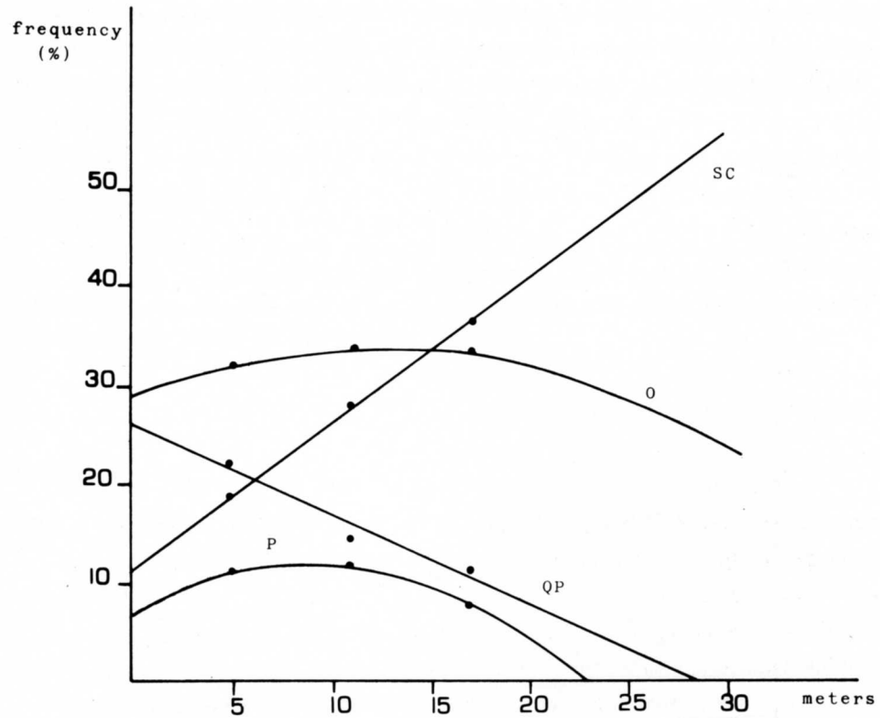


Fig. 6 - Empirical models of the behaviour of syntaxonomical units along the closeness gradient.
- *Modelli empirici del comportamento delle unità sintassonomiche lungo il gradiente di chiusura.*

maximal tension between the species of the four orders, *Scorzonero-Chrysopogonetalia*, *Origanetalia*, *Prunetalia* and *Quercetalia pubescentis*. At this values of closeness the wood may be considered restored at least in its younger states of the secondary succession. This accords with the results obtained by FEOLI et al. (1980) for spatial pattern analysis of species in open grasslands surrounded by NR. The process of reforestation may be described by the species of *Origanetalia*, *Prunetalia*, *Quercetalia pubescentis* and *Scorzonero-Chrysopogonetalia* as summarized in fig. 6. The behaviour of the species of *Origanetalia* (O) and *Prunetalia* (P) may be fitted by quadratic functions ($O = -0.031x^2+0.75x+29.5$; $P = -0.058x^2+1.09x+6.72$). The empiric models show that the species of *Origanetalia* reach their maximal frequency before the species of *Prunetalia*. This accords with the results of the species

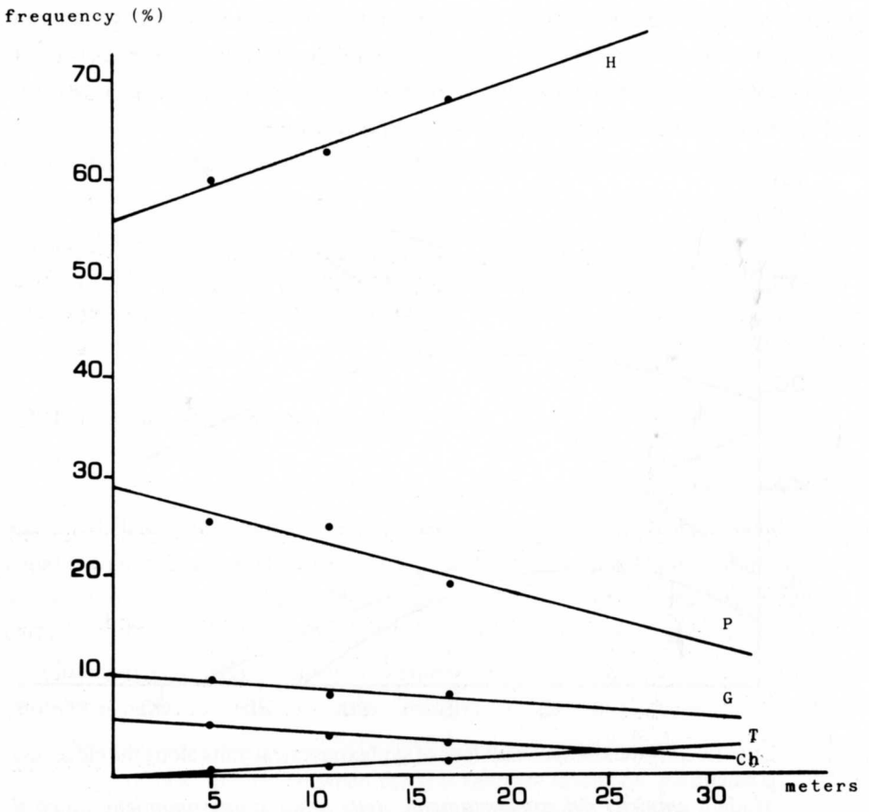


Fig. 7 - Empirical models of the behaviour of life forms along the closeness gradient.
- *Modelli empirici del comportamento delle forme biologiche lungo il gradiente di chiusura.*

ordination (tab. VIII), in which the species of *Origanetalia* are preceeding the species of *Prunetalia*. The behaviour of *Quercetalia pubescentis* and *Scorzonero-Chrysopogonetalia* may be described by linear functions (QP = 26.29—0.93x; SC = 11.16+1.535x). If the life forms are considered, the process may be summarized by fig. 7. The behaviour of life forms may be fitted by linear functions (H = 56.12+0.68x; CH = 5.57—0.13x; G = 9.97—0.13x; T = —0.24+0.092x; P = 29.04—0.525x). The fitting models may be considered as approximations valid at least to an upper limit of distances between NR of 20-25 m. Such empirical models

represent only a first approximation in the description of the process. They could be considered only a basis to start with a future research in modelling the process in its spatial meaning towards and till the closeness of the wood. After this point dynamical models in which the time is meaningful should be considered.

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Tab. I - Life forms and frequency (%) of the species in the three classes of the first stratum (see fig. 1).
- *Forme biologiche e frequenza delle specie nelle tre classi di chiusura dei nuclei di riforestazione.*

LIFE FORM	SPECIES	CLASSES 1	2	3
H	*Dictamnus albus* L.	73.8	90.3	73.7
H	*Viola hirta* L.	73.8	66.1	73.7
H	*Stachys officinalis* Trevis.	76.2	54.8	47.4
H	*Ferula ferulago* L.	54.8	62.9	49.1
H	*Euphorbia verrucosa* L.	38.1	59.7	59.6
H	*Thalictrum minus* subsp. *minus* L.	52.4	45.2	36.8
P	*Quercus pubescens* Willd. pl.	50.0	43.6	40.4
H	*Salvia pratensis* L.	69.0	43.6	22.8
P	*Rhamnus rupestris* Scop.	23.8	40.3	45.6
G	*Polygonatum officinale* All.	14.3	27.4	47.4
P	*Fraxinus ornus* L. pl.	11.9	32.3	42.1
G	*Iris illyrica* Tommasini	40.5	37.1	12.3
H	*Trifolium rubens* L.	35.7	35.5	15.8
P	*Prunus mahaleb* L. pl.	23.8	37.1	12.3
H	*Sesleria autumnalis* (Scop.) F.W. Schultz	9.6	16.1	45.6
CH	*Teucrium chamaedrys* L.	28.6	8.1	29.8
H	*Plantago media* L.	38.1	12.9	12.3
H	*Thalictrum minus* subsp. *maius* (Crtz.) Rouy et Fouc.	11.9	21.0	22.8
P	*Juniperus communis* L.	14.3	21.0	21.1
H	*Cynanchum vincetoxicum* Pers.	4.8	17.7	24.6
P	*Ostrya carpinifolia* Scop. pl.	14.3	12.9	19.3
H	*Cnidium silaifolium* (Jacq.) Simk.	9.6	19.4	15.8
H	*Centaurea triumfetti* All.	14.3	6.5	24.6
CH	*Dorycnium pentaphyllum* Scop.	2.4	21.0	17.5
H	*Euphorbia nicaeensis* All.	14.3	21.0	7.0
P	*Cotinus coggygria* Scop.	14.3	11.3	15.8
H	*Peucedanum oreoselinum* Moench.	21.4	9.7	12.3
H	*Centaurea rupestris* L.	11.9	16.1	10.5
H	*Melittis melissophyllum* L.		1.6	29.8
G	*Pulsatilla montana* Hoppe (Rchb.)	14.3	4.8	14.0
G	*Asparagus tenuifolius* Lam.	4.8	9.7	15.8
P	*Hedera helix* L.	4.8	4.8	17.5
P	*Crataegus monogyna* Jacq.	2.4	6.5	17.5

LIFE FORM	SPECIES	CLASSES 1	2	3
H	*Euphorbia cyparissias* L.		8.1	10.5
T	*Melampyrum barbatum* W. et K.	11.9	8.1	1.8
P	*Evonymus europaea* L.		12.9	5.3
P	*Cornus mas* L.	9.6	4.8	5.3
P	*Rosa canina* L.		4.8	12.3
H	*Filipendula hexapetala* Gilib.	7.1	4.8	5.3
P	*Cornus sanguinea* L.	2.4	4.8	7.0
H	*Helleborus viridis* L.			10.5
H	*Stachys recta* L.	11.9		1.8
G	*Allium montanum* F.W. Schmidt		1.6	7.0
P	*Quercus petraea* (Matt.) Liebl. pl.	4.8	4.8	
H	*Coronilla varia* L.		4.8	1.8
CH	*Satureja variegata* Host		3.2	3.5
P	*Cytisus nigricans* L.		3.2	1.8
H	*Scabiosa gramuntia* L.		4.8	
P	*Acer campestre* L.		3.2	
P	*Acer monspessulanum* L.			3.5
G	*Anthericum ramosum* L.			3.5
H	*Galium lucidum* L.		1.6	1.8
H	*Geranium sanguineum* L.			3.5
H	*Asperula cynanchica* L.	2.4		
H	*Lathyrus niger* Bernh.			1.8
H	*Primula vulgaris* Huds.			1.8
P	*Quercus cerris* L.		1.6	
H	*Senecio jacobaea* L.			1.8
H	*Veronica spicata* L.	2.4		
H	*Pulmonaria officinalis* L.			1.8
P	*Robinia pseudoacacia* L.	2.4		
H	*Campanula pyramidalis* L.			1.8

Rare species not included in the comparisons:
Ornithogalum tenuifolium Guss., *Scorzonera austriaca* Willd., *Scorzonera villosa* Scop., *Silene nutans* L., *Clematis vitalba* L., *Plantago argentea* Chaix, *Muscari comosum* Mill., *Mercurialis ovata* Sternb. e Hoppe, *Acer pseudoplatanus* L., *Hieracium sabaudum* L., *Knautia illyrica* Beck, *Rhamnus cathartica* L., *Sorbus aria* Crantz, *Tilia cordata* Mill., *Lathyrus pratensis* L.

Grasses and herbs not included in the comparisons:
Bromus condensatus Hackel, *Bromus erectus* Huds., *Chrysopogon gryllus* (L.) Trin., *Carex humilis* Leys., *Agropyrum intermedium* (Host) PB., *Brachypodium pinnatum* (L.) PB.

Tab. II - Significance of chi-square test for the contingency table species/classes of the first stratum (see fig. 1).
- *Significatività del chi quadrato della tabella di contingenza specie-classi al primo livello di stratificazione (fig. 1).*

SPECIES	SIGNIFICANCE LEVEL 5%	1%	MAXIMAL FREQUENCY IN CLASS
Salvia pratensis		*	1
Plantago media		*	1
Iris illyrica		*	1,2
Melittis melissophyllum		*	3
Sesleria autumnalis		*	3
Teucrium chamaedrys		*	1,3
Trifolium rubens	*		1,2
Prunus mahaleb	*		1,2
Dorycnium pentaphyllum	*		2,3
Polygonatum officinale	*		2,3
Fraxinus ornus	*		2,3
Crataegus monogyna	*		2,3
Cynanchum vincetoxicum	*		2,3
Centaurea triumfetti	*		3

Tab. III - Significance of T-test in the comparison of classes two by two.
** Significative differences between the class and the other classes at probability level $\leq 1\%$
* Significative differences between the class and the other two classes at $1\% \leq P \leq 5\%$
(*) Significative differences at 6% to 10% level
- *Significatività del T di Student nel confronto fra le tre classi di chiusura (fig. 1) a due a due. Livelli di probabilità:*
** $P \leq 1\%$
* $1\% \leq P \leq 5\%$
(*) $6\% \leq P \leq 10\%$

SPECIES	CLASSES 1	2	3
Salvia pratensis	**		
Thalictrum minus	*	*	
Iris illyrica	**	**	
Plantago media	**	*	
Teucrium chamaedrys	**		**
Stachys officinalis	*	(*)	
Euphorbia nicaeensis	(*)	*	
Dictamnus albus		*	
Prunus mahaleb		*	
Cnidium silaifolium		(*)	
Ferula ferulago		(*)	
Euphorbia verrucosa		*	*
Rhamnus rupestris		*	*
Dorycnium pentaphyllum		**	*
Juniperus communis		**	*
Cotinus coggygria		(*)	(*)
Fraxinus ornus		**	*
Viola hirta	(*)		*
Polygonatum officinale		*	**
Cynanchum vincetoxicum		*	**
Crataegus monogyna		*	**
Sesleria autumnalis			**
Melittis melissophyllum			**

Tab. IV - (A) Percentage of species of the syntaxonomical units in the three classes of the first stratum (fig. 1).
(B) Percentage of life forms in the three classes of the first stratum.
- *(A) Percentuali di specie delle unità sintassonomiche nelle tre classi principali (fig. 1).*
(B) Percentuali delle forme biologiche nelle tre classi principali (fig. 1).

SPECIES	CLASSES 1	2	3
(A) *Scorzonero-Chrysopogonetalia*	37.18	28.20	18.76
Origanetalia	33.33	34.04	32.50
Prunetalia	8.46	11.67	10.72
Quercetalia pubescentis	11.28	14.42	22.45
Others	9.73	12.15	15.24
(B) *Hemycryptophytes*	68.2	62.7	60.0
Chamaephytes	3.3	4.1	4.9
Geophytes	7.9	8.1	9.5
Therophytes	1.3	0.8	0.2
Phanerophytes	19.2	25.1	25.5

Tab. V - Species selected by mutual information criterion and used for discriminant analysis.
- *Specie selezionate secondo il criterio della mutua informazione totale e usate nell'analisi discriminante.*

RANK	SPECIES	WEIGHT	RESIDUAL
1	*Dictamnus albus*	424.80	4244.5
2	*Viola hirta*	363.27	3881.0
3	*Euphorbia verrucosa*	336.28	3544.7
4	*Stachys officinalis*	317.74	3227.0
5	*Ferula ferulago*	282.42	2944.5
6	*Thalictrum minus*	275.67	2668.9
7	*Salvia pratensis*	235.54	2433.3
8	*Polygonatum officinale*	230.59	2202.7
9	*Iris illyrica*	211.29	1991.5
10	*Quercus pubescens*	210.04	1781.4

Tab. VI - F statistics and significances between pairs of classes of relevés.
(A) with North aspect
(B) with South aspect
- *Significatività della differenza tra le classi principali sulla base dell'analisi della varianza multipla.*
(A) rilievi con esposizione Nord
(B) rilievi con esposizione Sud

(A)	CLASS	1	2
CLASS	2	2.8690 .0174	
	3	7.3219 .0000	1.7534 .1276

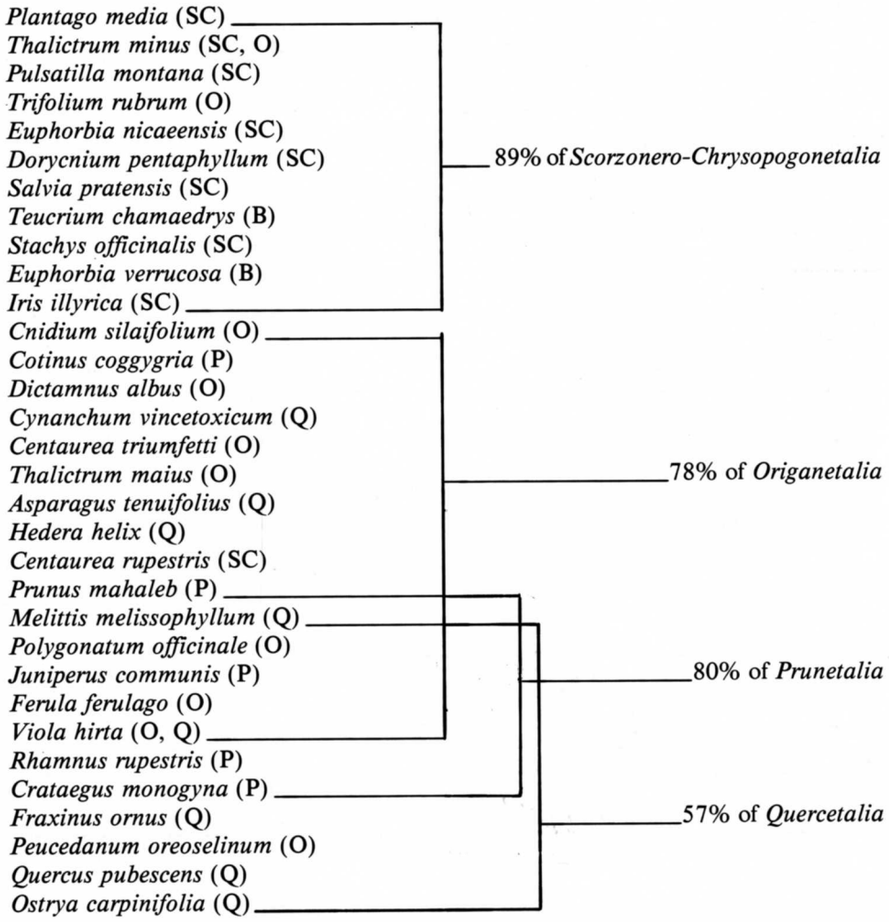
* * *

(B)	CLASS	1	2
CLASS	2	3.7091 .0191	
	3	5.5619 .0028	4.0997 .0125

Tab. VII - Composition of the sets of fig. 4.
- *Composizione degli insiemi di rilievi messi in evidenza dall'analisi dell'intersezione riguardo la loro appartenenza alle classi principali e all'esposizione.*

SETS	CLASS COMPOSITION	ASPECT COMPOSITION
1	Class 1: 47.7% Class 2: 28% Class 3: 24.3%	from North: 34.3% from South: 50% from NR to NR: 15.3%
2	Class 1: 46% Class 2: 38% Class 3: 15%	from North: 57.8% from South: 7% from NR to NR: 36%
3	Class 1: 22.2% Class 2: 42.5% Class 3: 35.2%	from North: 32% from South: 44.8% from NR to NR: 23.2%
4	Class 1: 11.3% Class 2: 43.5% Class 3: 45.2%	from North: 43.5% from South: 28.5% from NR to NR: 27.8%

Tab. VIII - Angular seriation of the species according to the first two principal component analysis based on correlation coefficient. Legend to symbols, SC = *Scorzonero-Chrysopogonetalia*, B =*Brometalia*, O = *Origanetalia*, P = *Prunetalia*, Q = *Quercetalia pubescentis.*
- *Seriazione angolare delle specie secondo le prime due componenti principali della matrice di correlazione tra le specie. Simboli: SC* = Scorzonero-Chrysopogonetalia, *B* = Brometalia, *O* = Origanetalia, *P* = Prunetalia, *Q* = Quercetalia pubescentis.



Tab. IX - Light intensity in the shadow of NR of the three classes of the first stratum (S = standard deviation). Measures made at midday of September 8th, 1981.
- *Intensità luminosa all'ombra dei nuclei di riforestazione nelle tre classi principali di chiusura. Le misure sono state effettuate a mezzogiorno dell'8 settembre 1981.*

CLASS 1	Mean = 366.7 microeinstein/m^2.sec S = 230.9 Coefficient of variation = 62.96%
CLASS 2	Mean = 100 microeinstein/m^2.sec S = 45.83 Coefficient of variation = 45.83%
CLASS 3	Mean = 60 microeinstein/m^2.sec S = 26.46 Coefficient of variation = 44.1%

Tab. X - Mean values and sigma of pH of soil in the open grasslands and under the canopy of the main trees.
- *Valori medi e deviazioni standard del pH del suolo nel prato aperto e sotto le chiome delle specie arboree principali.*

	MEAN	SIGMA
Grasslands	6.84	1.22
Fraxinus	6.99	.49
Ostrya	7.04	.65
Quercus	6.82	2.57

Tab. XI - Floristic parameters of diversity in the three classes of the first stratum.
- *Parametri floristici di diversità nelle tre classi principali di rilievi.*

	CLASSES		
	1	2	3
Mean number of species for relevé (A)	9	10	10
Species number for each class (B)	41	49	55
Floristic homogeneity (A/B)	.22	.20	.18
Shannon entropy (diversity)	3.26	3.45	3.58

Authors' address - Indirizzo degli Autori:
— Prof. Enrico FEOLI
— Dr. Mauro SCIMONE

Istituto ed Orto Botanico
dell'Università degli Studi
Sal. Monte Valerio, 14 - 34127 TRIESTE