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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 CHIAPPELLA (1979) try to quantify the changes of spatial pattern heterogeneity of the grasslands along transects towards the nuclei of reforestation. FEOLI, FEOLI CHIAPPELLA, 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 pycnometer
- (4) Light intensity in the shadow of the canopy of NR, recorded 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.

