

**VEGETATION CHANGES IN A RESTORED AREA CONTAMINATED BY THE DIOXIN: THE BOSCO DELLE QUERCE OF SEVESO**

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**Introduction**

Aim of this work is monitoring the vegetation evolution of the area occupied by the Bosco delle Querce. This wood is located between the municipalities of Meda and Seveso, at the northern border of the Milan province, about 20 km from Milan. It is sited in the high Po plane, where the water-bearing stratum is about 35 m deep, and it is close to the low Po plane, where the water-bearing stratum is few metres deep. The yearly average precipitations reach about 1300 mm and the climate can be defined moderate continental.

The Bosco delle Querce has a surface of about 43 hectares. It was created after the Seveso accident with the aim of restoring the A zone, corresponding to the most TCDD-polluted zone. On this area about 40 cm of upper ground were removed and 15 cm of fresh land were placed.

In 1984-85 the recovery operations began with the creation of a grassland on which the first generation of trees was planted. Such trees were 2 to 4 m high and had a circumference of 14 to 20 cm. About 220 individuals per hectare were planted. Since 1986 up to now, several agronomic interventions were carried out, directed by the Forest Regional Agency, coordinated by the dr. Lassini (Ramondetta and Repossi, 1998). New plantings, realized according different methods and with trees and shrubs of different size, were experimented. Up to 1996 about 6.000 developed trees, 22.000 young woody plants and 18.500 shrubs, belonging to 50 different species, were planted.

Up to 1987 the grassland was regularly cut once a month and irrigated. Then the cuttings and the irrigations were reduced in intensity and extension, but since 1992 part of the area is cut and irrigated no more. The presented research was realized in this area subject to vegetation changes.

**Material and methods**

The area was studied in 1992-93 (Sartori *et al.*, 1994) and in 1998 by means of phytosociological relevés (Braun-Blanquet, 1964) realized in the summer period and in 25 points well recognizably.

In 1992-93 only herbaceous species were noted, because the planted woody species were still young, little and premature for the riproduction. In 1998 also the woody species, now tall and big with closed canopies, were noted, distinguishing them according the growing layer. Four principal layers were distinguished: tree layer (A), high shrub layer (B), low shrub layer (C) and herb layer (D). They constitute the vertical structure of the vegetation communities.

The numbers of species, life forms, chorological types and ecological indicator values for each species were analyzed in each relevés. The ecological indicator values were attributed by Landolt (1977) to the Swiss flora, but they have been considered applicable to the Bosco delle Querce because it is few kilometres from the Swiss border (about 20 Km as the crow flies). The ecological

indicator values used for the most of the vascular plantes are: humidity, pH, nutrients, humus, soil aeration, light, temperature and continentality.

The ratio between the cover values of the low shrub layer and the herb layer was calculated. The ratio between the cover values of the tree and high shrub layers and the herb layer was calculated too.

Relatively to the 1998 relevés the ecological indicators values were calculated for the A and B layers together and for the C and D layers together. In this way the values of the C and D layers were comparable with the 1992-93 data. Further the average ecological indicator values of the A-B layers and of the C-D layers were compared for understanding if the planted woody species were consistent with the ecological conditions of the site, inferred by the spontaneously grown herbaceous vegetation.

## Results

### *Biodiversity*

In almost all the 1998 relevés the species number is decreased. However, if we consider the total number of the species present in the 1992-93 relevés and in the 1998 relevés, about the 43 % of them is not changed, while the remaining 57 % is formed by species which are disappeared or appeared *ex-novo*. In the Tab. 1 these results are reported.

### *Life forms*

New life forms have not appeared in the 1998 relevés, while their percentages are changed. The most sensible variations regard both the Terophytes, which are considerably decreased, and the Phanerophytes, which are increased.

### *Chorological types*

Light modifications in the percentages of the chorological types were observed in the 1998 relevés. Particularly they regard the Boreal species and the Wide distribution species, which are decreased.

### *Vertical structure*

The typical stratification (with the A, B, C and D layers together) of the natural wood was observed only in the 32% of the relevés. However the covers of the tree and high shrub layers seldom exceed the 50%, while the herb covers are often high (more than 60%).

The ratios between the cover values of the tree and high shrubs and the cover values of the herbs are very low, with exception of two relevés, and are comprised between 0 and 1.

The ratios between the cover values of the low shrubs and the cover values of the herbs are always comprised, with exception of one relevé, between 0 and 0.45.

### *Ecological indicator values*

The most important variations occurred since 1992-93 up to 1998 deduced by the application of the ecological indicator values regard the moisture, the light, the pH and the continentality.

In the 1998 relevés species which indicate constant humidity decrease, while species which indicate variable humidity increase.

In the 1998 relevés species which indicate low light appear, while species which indicate high light disappear.

In the 1998 relevés species which indicate acidity of the soil disappear in favour of species which indicate a middle-high pH or species which have not particular exigence for the soil pH.

In the 1998 relevés the species which indicate middle continentality are constant, while the extreme continental species decrease lightly and the oceanic species increase.

The comparison between the average ecological values expressed by the planted woody species (A-B layers) and the spontaneous species (C-D layers) indicates that at least the 20% of the relevés present a considerable difference for the following ecological factors: light, nutrients, soil aeration and temperature.

### Discussion

The most of the observed and described variations are the consequence of two main facts:

1) the decreasing of the human influence, coinciding with the interruption of the cuttings and irrigations;

2) the development of the planted tree vegetation which produces a diversification in the microclimate.

The comparison between the average ecological values expressed by the planted woody species (A-B layers) and by the spontaneous species (C-D layers) gives value to the starting plan based on the use of a wide variety of tree species, certainly higher than the average diversity of a natural wood in balance with the environment. Thus the evolution opportunities of the system increase.

Nevertheless it is important to emphasize the considerable scarcity of woody species in the underbrush. The observed variations rise from autogenic floristic readjustments because there are not allogenic floristic increases. This is due to the isolation of the area which is completely surrounded by human sites, mostly of urban type.

The increase of the complexity of the layered structure indicate a clear evolution of the physiognomy.

If, by one side, the vegetation structure indicates an evolution of the system, by the other side, the floristic composition still depends on the starting conditions.

The increase of woody species or species coming from habitats linked to the forest depends on the effectiveness of the present slender biological passageways. A future development of this research will just aim at the verifying of the biological carrying capacity of such systems. In this way it will be possible making an hypothesis on the future evolution of the Bosco delle Querce or deciding for a probable *ex-novo* introduction of the woody species.

### References

Braun-Blanquet J., 1964. Pflanzensoziologie. 3. aufl. Springer, Wien. 865 99.

Landolt E., 1977. Ökologische Zeigerwerte zur Schweizer Flora. Veröffentlichungen des geobotanischen Institutes der Eidg. Techn. Hochschule, Stiftung Rübel, in Zürich, 64.

Ramondetta M., Repositi A. eds., 1998. Seveso 20 years after. Fondazione Lombardia per l'Ambiente.

Sartori F., Terzo V., Cazzani P., 1994. Il Bosco delle Querce di Seveso. Relazione geobotanica. Rapporto interno per l'Azienda Regionale delle Foreste: 1-40.

