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AN INTERESTING NEW FINDING OF *BETULA PENDULA* ROTH IN TUSCANY

Abstract - A new station of *Betula pendula* Roth is reported on the forest of Belagaio in the Colline Metallifere area (Grosseto Province, Tuscany). It is located in an area with Mediterranean climate, outside the main Italian distribution of the species, which is Alpine and Apennine. Palynological data, current environmental conditions and some bryophyte records suggest that the population is autochthonous.

Key words - *Betula pendula* Roth, Colline Metallifere, Grosseto.

Riassunto - Un interessante nuovo ritrovamento di *Betula pendula* Roth in Toscana. Nel presente lavoro viene descritta una nuova stazione di *Betula pendula* Roth, localizzata nella Tenuta del Belagaio, all'interno del comprensorio delle Colline Metallifere. Tale stazione è localizzata in un'area soggetta a clima mediterraneo, al di fuori dell'areale principale italiano della specie che è alpino e appenninico. In base a reperti palinologici, alle condizioni ambientali attuali, nonché alla compagine briofitica il popolamento è con buona probabilità da ritenere di origine autoctona.

Parole chiave - *Betula pendula* Roth, Colline Metallifere, Grosseto.

INTRODUCTION

Betula pendula Roth is a Eurosiberian species (Meusel *et al.*, 1965) that prefers cold climates. In Italy its optimum is in the Alps, but it also grows in the Apennines from the Parma area to the Marches, and in the Salerno region (Pignatti, 1982). Outside the Apennine area, it is regarded as unusual. By virtue of abundant seed production and easy dispersal, it is a pioneer species which colonizes open areas (Wareing, 1966; Black, 1969). Although it withstands rapid changes in temperature and humidity, it prefers very moist environments with sandy and pebbly soils, poor in nutrients and having a pH < 5 (Pignatti, 1982; Grime *et al.*, 1988).

The aim of the present report is to describe a new station of *Betula pendula* outside the Apennine distribution area of the species.

GEOGRAPHICAL LOCATION AND ENVIRONMENTAL FEATURES

The station of *Betula pendula* reported in this paper

is located in the forest of Belagaio, Colline Metallifere, Tuscany. It is situated in the hydrographic basin of the Lanzo stream, a tributary of the Ombrone river, near the watershed dividing the Lanzo and Farma valleys. Chiarucci *et al.* (1993) found some individuals of *Betula pendula* in the Farma valley, but were uncertain as to whether they were autochthonous. The station is in the municipal area of Roccastrada, Grosseto Province, coordinates: 11°12'04"E, 43°04'50"N. The geological setting is the Verrucano Formation, the lithological component of which is very heterogeneous, consisting of coarse conglomerates, schists, quartzites and phyllites, algal limestones (Servizio Geologico d'Italia, 1968). The soils reflect this heterogeneity but they are always stony, non calcareous, shallow to moderately deep, with an A-C or A-B-C profile. Soil texture is loose or sandy (Regione Toscana, 1994).

Annual average rainfall is 1000-1100 mm (Barazzuoli *et al.*, 1993) with a sub-Mediterranean pattern of the type B₂B'₂sb'₃ according to Thornthwaite (1948). Mean annual temperature is 13-14°C.

The station has three stands of *Betula pendula* and a few isolated individuals and groups of two or three. The main stand which consists of about 80 trees, is on the northern slope of Poggio i Monti; two other stands with about 30 trees each, are on the opposite side of the valley, on the southern slope of Poggio le Macine (Figure 2). Many seedlings and juvenile specimens grow along the forestry access road to Poggio i Monti.

STUDY METHODS

The distribution of *Betula pendula* in Tuscany was studied by research in various herbaria and in published literature. The herbaria of the University of Siena (SIENA), the Accademia dei Fisiocritici of Siena (SIAC), the University of Pisa (PI), (*Herbarium Horti Botanici Pisani* and the Caruel and Pellegrini collections) and the Botanical Museum of Florence (FI) were consulted. Bibliographic data was obtained from texts on the Tuscan flora (Caruel, 1860; Caruel, 1870; Baroni, 1897-1908) and from individual publications (Piccioli, 1923; Nardi, 1965; Corsi, 1973; Groppali *et al.*, 1981; Mercurio, 1984; Chiarucci *et al.*, 1993; Ferrarini & Marchetti, 1994; Bartelletti *et al.*, 1996). The data were used to create a regional distribution map based on the UTM grid with 5 Km squares, in

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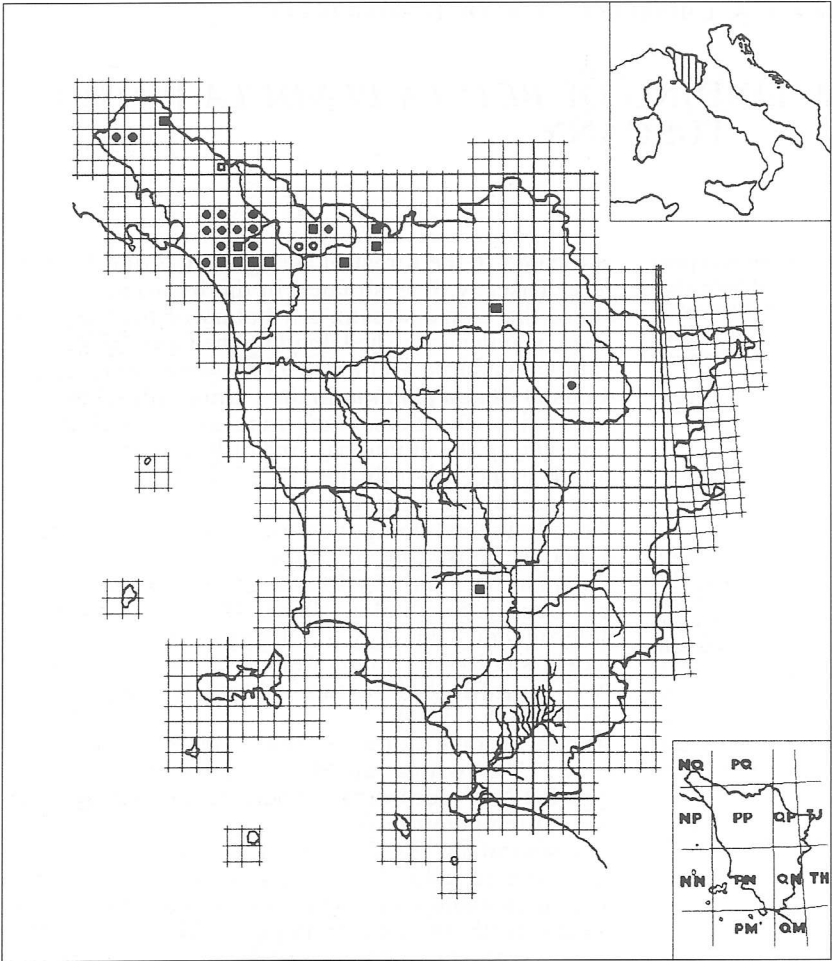


Figure 1 - Map of the distribution of *Betula pendula* in Tuscany.
■: herbarium specimens collected after 1950;
□: herbarium specimens collected before 1950;
●: bibliographic data since 1950;
○: bibliographic data from before 1950.

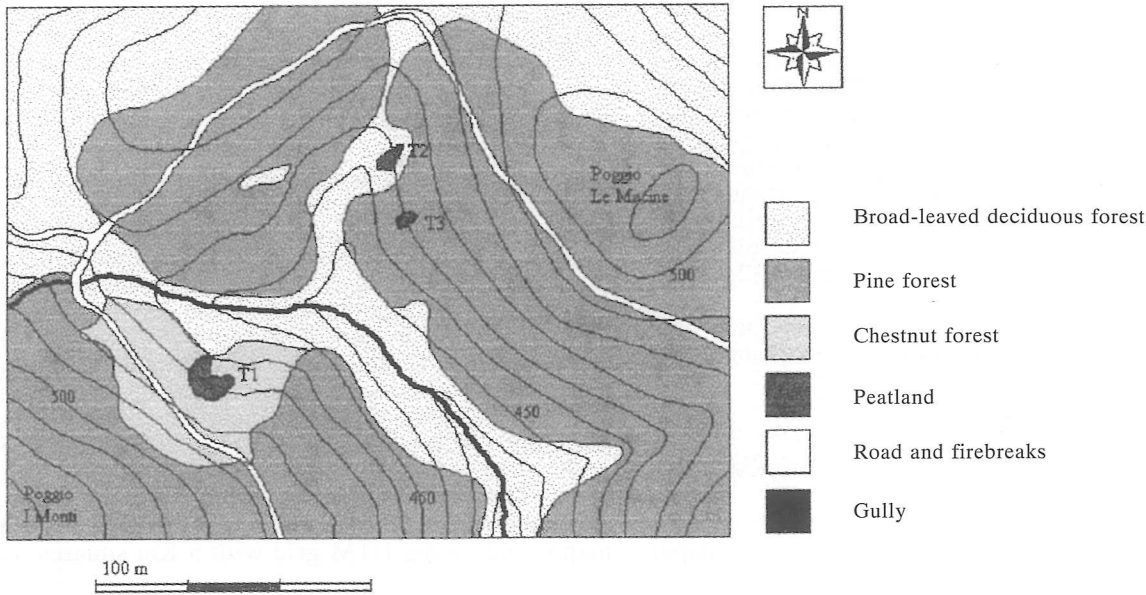


Figure 2 - Vegetation map of the permanent plot showing stands of *Betula pendula*.

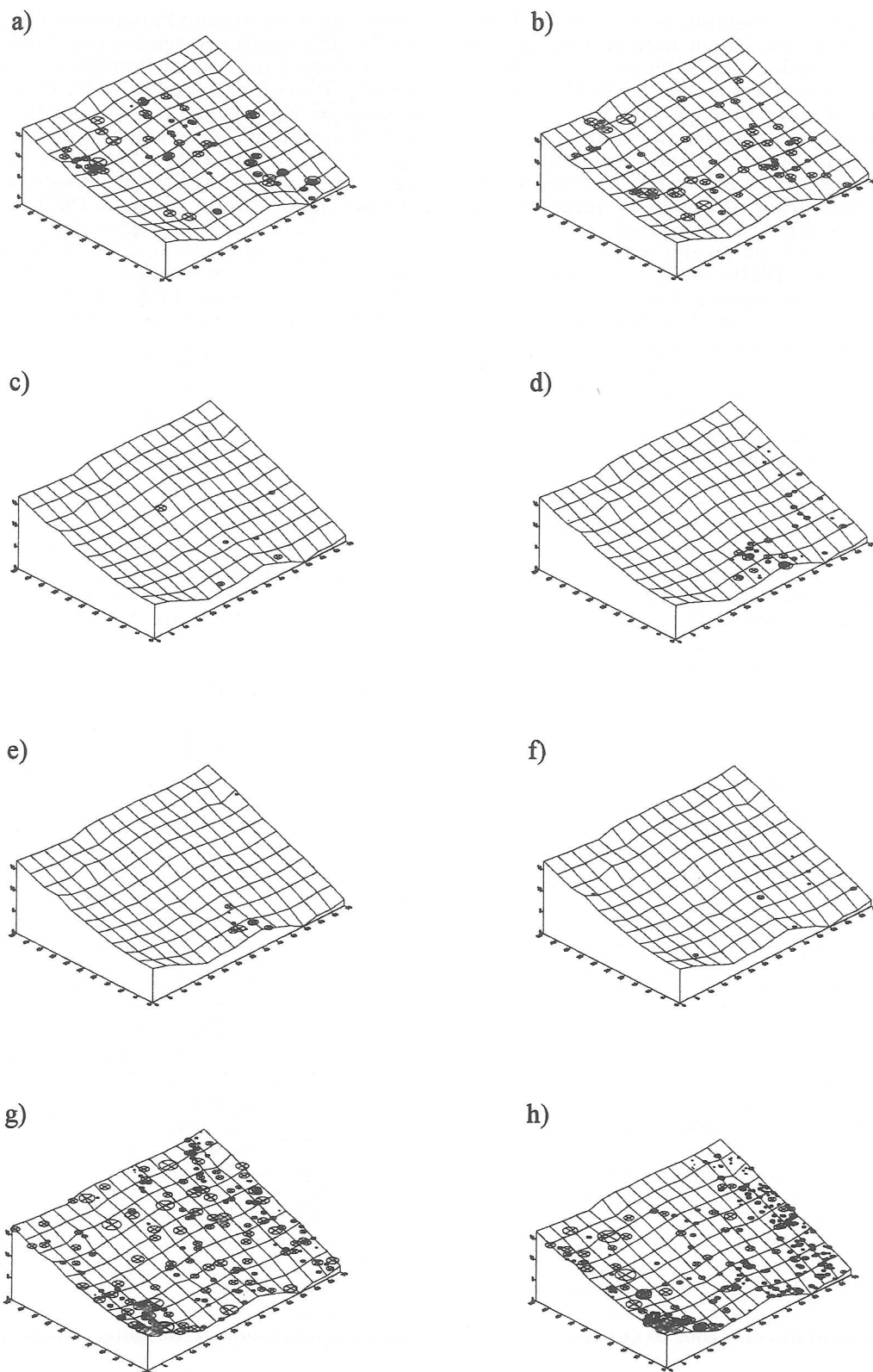


Figure 3 - Distribution of woody species in the permanent plot in relation to land morphology, showing crown diameter. Vertical scale is magnified 10 fold times with respect to horizontal scale; a) *Betula pendula*; b) *Alnus glutinosa*; c) *Frangula alnus*; d) *Arbutus unedo*; e) *Erica arborea*; f) *Quercus ilex*; g) *Castanea sativa*; h) *Fraxinus ornus*.

line with the flora cartography project of the Flora Working Group of the Italian Botanical Society. A 1:5000 scale vegetation map of the area where *Betula pendula* was found was created by field work and interpretation of aerial photographs.

In order to study the structure and floristic composition of the main stand of *Betula pendula*, and to monitor any changes in the course of time, a permanent plot measuring 70 x 50 m, divided into 5 m squares, was established. All woody plants in the plot were numbered and given Cartesian coordinates. For plants with a DBH > 6 cm, total height, crown projection in four orthogonal directions, trunk diameter, height above ground of first live branch, presence of suckers, sucker height and mean diameter of sucker crown were recorded. Stumps with more than one well established trunk were regarded as a single tree, and the number of trunks arising from the stump was recorded. Stumps of *Betula pendula*, on the other hand, were treated as multiple specimens, but note was made that they belonged to a single stump. For plants with a DBH < 6 cm, maximum height, mean crown diameter and number of suckers were recorded. The morphology of the plot was recorded in terms of differences in level on a grid with 5 m squares.

In this paper we report the distribution of the woody species in the plot with an indication of their crown width and the list of plants recorded within the plot.

RESULTS AND DISCUSSION

Distribution of Betula pendula in Tuscany *Herbarium specimens*

Lunigiana: Sub *Betula alba* L.: In castagneto di Cubbio sopra Pracchiola, Lunigiana, 20 Luglio 1858, *Caruel* (PI). **Apuan Alps:** Sub *Betula alba* L.: Pratali di Pescaglia, Lucchesia, 9 Luglio 1848, *Caruel* (PI); Loc. Pian di Lago sopra Terrinca, 1863, *Caruel* (PI); M. Sella (Alpi Apuane), Agosto 1888, *C. Rossetti* (PI); Loc. Colle Tecchione presso Massa, Settembre 1889, *Pellegrini*, (PI); Canale della Rocca a Massa, Settembre 1890, *Pellegrini* (PI); Alpi Apuane nel Monte Mezzaluna sopra Serravezza, Maggio 1890, *C. Rossetti* (PI); Alpi Apuane nel M. Mezzaluna sopra Serravezza, Maggio 1890, *Rossetti* (FI); Boschi di collina ai Tecchioni (Massa), 14 Settembre 1891, *Pellegrini* (PI); Poggio di Baldozzano, casa del pastore, m. 1100, 5 Agosto 1965, *E. Ferrarini* (FI). Sub *Betula pendula* Roth: Castagneti su verrucano a q. 400m. a Basati sopra Serravezza (Lu), Versilia, Alpi Apuane, 7 Luglio 1975 *D. Marchetti* (SI); Sulla torretta del M. Freddone a q. 1350m. circa, gruppo del M. Corchia, Alpi Apuane, Garfagnana, su Verrucano, 8 Settembre 1981, *D. Marchetti* (SI). **Garfagnana:** Sub *Betula alba* L.: Valle della Fegona: Foce al Cavallaio, m. 1100, 25 Giugno 1955, *P.V. Arrigoni* (FI). Sub *Betula alba* L.: a Vianova, nel M. Porretta sopra Careggine in Garfagnana (Baroni, 1897). **Appennino Lucchese-Pistoiese:** Sub *Betula alba* L.: In Appennino Pistoiese al Teso, 1830, *Narducci* (FI);

In Appennino, loco dietro Pratofiorito, Giugno 1841, *Savi* (FI); Pratofiorito, Settembre 1842 *Giannizzi* (FI); In Appennino Lucchese al Pratofiorito, 1844, *Bec-cari* (FI); Boscolungo, Luglio 1847, *Parlatore* (FI); Andando da Boscolungo a Libro Aperto, 1 Luglio 1847, *Parlatore* (FI); Teso alla casa dei Cavallari, 11 Luglio 1855, *O. Grilli* (FI); Sotto il Rondinaio, 10 Luglio 1858, *Caruel* (PI); App. Pistoiese nella regione del faggio al Teso, 17 Luglio 1859, *Caruel* (PI); Teso, sine die, *Caruel* (PI); Teso, Appennino Pistoiese alla Pullevraia m. 1900, 1904, *S. Sommier* (FI); Boschi, Maresca, m. 800, Giugno 1929, *M. Tani* (FI); M. Battifolle, vetta, m. 1109. 18 Maggio 1964, *E. Nardi* (FI); Castagneto presso Stiappa, da m. 670 a 900, 2 Luglio 1964, *E. Nardi* (FI); Faggeta, quota m. 1000, sotto la vetta del M. Bastia Esp. N, 21 Agosto 1964, *E. Nardi* (FI); Valico m. 1000 sul crinale ad Ovest del M. Lischeta 2 Luglio 1964 *E. Nardi* (FI); Sub *Betula alba* L. var. *laciniata* Fr.: Monte Battifolle sopra Pescia, l.d. Vallini, Maggio 1893, *D. Rossetti* (PI); Valle Pizzarne al M. Battifolle sopra Pescia, Maggio 1893, *C. Rossetti* (FI). **Firenze:** Sub *Betula alba* L.: Madonna del Sasso (Firenze), 27 Maggio 1947, *R. Pichi Sermolli*, *A. Contardo* (SI). **Colline Metallifere:** Sub *Betula pendula* Roth: Loc. Toscana Colline Metallifere, Val di Farma, Bosco del Belagaio, alt. m. 430, esp. Nord, bosco umido su verrucano, 27 Maggio 1992, *A. Chiarucci* (SI).

Bibliographic records

Lunigiana: Sub *Betula pendula* Roth: M. Orsaro (Piccioli, 1923); valle del torrente Gordana (Grop-pali *et al.*, 1981); nel M. Orsaio in Lunigiana sopra Pracchiola a Cubbio e ai Piani (Caruel, 1860). **Apuan Alps:** Sub *Betula alba* L.: Alpi Apuane nei colli sulla destra del fiume Gramolazzo e sotto il paese omonimo; presso Serravezza nel M. della Mezzaluna e nell'Alpe di Pruno (Baroni, 1897); in Versilia alle case dei pastori d'Arni, e nella pendice dell'alpe Pian di Lago (Caruel, 1860). Sub *Betula pendula* Roth: Lunigiana media, Lunigiana costiera (sotto Giuncano), Carrara (?), Massa, Versilia, Piana Lucchese (?), Piana Pisana (fra Torre del Lago e Migliarino), Medio Serchio, Bassa Garfagnana, Alta Garfagnana (Ferrarini & Marchetti, 1994); Torbiera del Monte di Roggio (Bartelletti *et al.*, 1996). **Garfagnana:** Sub *Betula alba* L.: a Vianova, nel M. Porretta sopra Careggine in Garfagnana (Baroni, 1897). **Appennino Lucchese-Pistoiese:** Sub *Betula alba* L.: Val di Nievole, ove al Battifolle incontrasi una forma a foglie profondamente divise (Baroni, 1897); nell'App. lucchese all'imboccatura della Turrte cava nel Serchio; a Foce Cavallaio presso Terreglio, e a Pratofiorito; nell'App. pistoiese tra Boscolungo e il Libro Aperto; a Maresca e al Teso (Caruel, 1860). Sub *Betula pendula* Roth: Preappennino Lucchese Pistoiese (Nardi, 1965). **Pratomagno:** Sub *Betula pendula* Roth: in località Badiavecchia, Comune di Talla, Arezzo (Mercurio, 1984). **Colline Metallifere:** Sub *Betula pendula* Roth: nel bosco del Belagaio (Chiarucci *et al.*, 1993). **Monte Amiata:** Sub *Betula pendula* Roth: nel M. Amiata (Cassi, 1973).

In Tuscany, *Betula pendula* occurs almost exclusively in the northwest, on the Tuscan-Emilian Apennine and in the Apuan Alps (Figure 1). Two isolated stations are found at Pratomagno and near Florence; the latter, however, might not be of spontaneous origin. The station at Belagaio is therefore quite well separated from the main distribution area of the species. Another station with *Betula pendula* outside the Apennine distributional area has also been reported from Mt. Amiata (Cassi, 1973; see also Spada *et al.*, 1996). No herbarium specimens or specific bibliographic references were found for this station. Moreover, a recent list of vascular flora of Mt. Amiata (Selvi, 1996) does not include *Betula pendula*. Mt. Amiata was therefore not included in the regional distribution map of the species.

Site description

The vegetation map (Figure 2) shows that, like most of the Colline Metallifere, a large percentage of the area hosting the *Betula pendula* stand is now invaded by *Pinus pinaster* Aiton, originally introduced by man (De Dominicis & Casini, 1979a; 1979b). Some slopes with northern exposure and moist areas host deciduous broadleaf woods dominated by *Quercus cerris* L. or *Castanea sativa* Miller, often derived from abandoned chestnut cultivation (De Dominicis & Casini, 1979a; 1979b). Adult and juvenile specimens of *Fagus sylvatica* L. are common in the deciduous woods near the valley bottom. Mediterranean evergreen sclerophyllous vegetation dominated by *Quercus ilex* L. is also present.

Betula pendula occurs in wet areas where run-off is impeded and water collects. *Osmunda regalis* L., a fern associated with suboceanic climates which has its optimum in Italy in environments characterized by the constant presence of surface moisture, is abundant in these areas, sometimes in contact with xerophytic vegetation (Bizzarri, 1963). Large tufts of *Osmunda regalis* impede the run-off, leading to the creation of a series of permanent ponds. The high moisture excludes soil aeration, slows the break-down of organic material and favours acidification, leading to peat formation. These unusual ecological conditions prevent other forest species from growing, but are particularly favourable for *Betula pendula*.

The three stands are presently much disturbed by an over abundance of wild ungulates (roe deer and boars) in the area; in summer, when water is scarce, they are drawn to this area, where the boars take mud baths. Intense disturbance of the surface soil means that only a few herbaceous species survive in the wet area, where the birches are most abundant. Besides *Osmunda regalis*, one of the few surviving species is *Narcissus poeticus* L., which forms a thick carpet. At the edges of the main stand, many dead tufts of *Osmunda regalis* show that the area is drying up. This is partly due to a recent forestry access road which deviates run-off water immediately above the wet area.

Characters of the main stand of *Betula pendula*

The graphs of species distribution in the plot in relation to land morphology (Figure 3) show that *Betula pendula*, *Alnus glutinosa* (L.) Gaertner and *Frangula alnus* Miller have similar distributions. These species establish in impluvium areas where water stagnates, moisture is highest and the soil has poor aeration. On the contrary, *Arbutus unedo* L. and *Erica arborea* L., although found in the birch stands, grow in raised positions which are therefore drier. Many young plants of *Castanea sativa* and *Fraxinus ornus* L. at the edges of the plot indicate that these two species are establishing in the area. They are abundant in the surrounding forest vegetation and are strong colonizers. Very few young plants of *Betula pendula* were observed in the plot, whereas young specimens of *Quercus ilex* were observed, suggesting again that the area is gradually drying out. If the area is becoming suitable for the most xerophilous forest species, regeneration of the birch stands is unlikely. Continuous disturbance by ungulates also destroys most of the birch seedlings that succeed in germinating.

The species found in this area are listed below. An asterisk indicated species recorded in the check-list of the wetlands of Tuscany (Tomei & Guazzi, 1993).

Osmundaceae

* *Osmunda regalis* L.

Hypolepidaceae

Pteridium aquilinum (L.) Kuhn

Blechnaceae

* *Blechnum spicant* (L.) Roth

Pinaceae

Pinus pinaster Aiton subsp. *hamiltonii* (Ten.) Huguet del Villar

Salicaceae

* *Populus tremula* L.

Betulaceae

Betula pendula Roth

* *Alnus glutinosa* (L.) Gaertner

Fagaceae

Castanea sativa Miller

Quercus ilex L.

Ranunculaceae

Anemone nemorosa L.

Rosaceae

Rubus hirtus W. et K.

Sorbus torminalis (L.) Crantz

Prunus spinosa L.

Prunus avium L.

Leguminosae

Cytisus scoparius (L.) Link subsp. *scoparius*

Aquifoliaceae

Ilex aquifolium L.

Rhamnaceae

* *Frangula alnus* Miller

Thymelaeaceae

Daphne laureola L.

Violaceae

Viola reichenbachiana Jordan ex Boreau

Araliaceae

Hedera helix L.

Ericaceae

Erica arborea L.

Erica scoparia L. subsp. *scoparia*

Arbutus unedo L.

Oleaceae

Fraxinus ornus L.

Gentianaceae

* *Centaurium erythraea* Rafn ssp. *erythraea*

Rubiaceae

Cruciata glabra (L.) Ehrend.

Rubia peregrina L.

Compositae

* *Bidens frondosa* L.

Liliaceae

Asphodelus albus Miller

Amaryllidaceae

Narcissus poeticus L.

Juncaceae

* *Juncus bufonius* L.

* *Juncus conglomeratus* L.

Graminaceae

* *Molinia arundinacea* Schrank

* *Phragmites australis* (Cav.) Trin

Cyperaceae

* *Carex remota* L.

Carex strigosa Hudson

* *Carex pallescens* L.

CONCLUSIONS AND SUGGESTIONS FOR CONSERVATION

The presence of *Betula pendula* in the area was revealed by the palynological data of Ferrarini & Marraccini (1979), who found pollen of this species at a depth of about 10 cm in the Troscia pond. They attributed this sediment level to the sub-Atlantic period of the Catathermic era. Harding (1995) more recently took a core sample in the same pond and found traces of birch pollen at various levels. Carbon-14 dating showed that the presence of *Betula pendula* pollen goes back as far as 1670. However the quantity of pollen was too small to determine whether *Betula pendula* is indigenous to the area or appeared at this stage.

A possible explanation of the late colonization of this area by *Betula pendula* is based on past environmental events. The Colline Metallifere, once completely covered in forest, have been profoundly transformed by man over the centuries, including a drastic reduction in forest. This presumably occurred in the Middle Ages, when there were many foundries in these hills for ore mined on Elba Island (Cortese, 1997). Unrestrained use of forestry resources may have led to a gradual deterioration of the soil, especially on anagenite substrates of the Verrucano Formation, with heath and Ericaceae taking over on a vast scale (De Dominicis & Casini, 1979a). These heathlands were used as pastures and were managed by controlled burning. Birch, a typically pioneer species, could have found good growing conditions in this situation, due to reduced competition from other forest species. When active management of the heathlands ceased, invasion by conifers could have reduced the area suitable for birches, restricting them to more inhospitable sites with acid and poorly aerated soils, like the one in which they have now been found.

Bryological data, however, seems to sustain the

hypothesis that *Betula pendula* has been in the area since the last ice age. The presence of *Sphagnum subnitens* Russ. & Warnst. and *Sphagnum subsecundum* Nees, together with many other oceanic and montane bryophytic species (Bonini *et al.*, in press), further sustains the hypothesis that this peat bog biotope is of natural origin. *Sphagnum subnitens*, in particular, is regarded as a relict of the Würmian ice age, confined to plain refuge areas where it established when the climate changed (Raffaelli, 1976).

The results of the present study provide useful indications for the conservation and management of this particular biotope. Proposals for the protection of the biotope and for remediation of the deterioration triggered by an over-abundance of wild ungulates, have been formulated on the basis of the present field observations. The area has been fenced to keep out ungulates and run-off is being reinstated by means of three pipes installed under the access road; the road itself will be given a slight transverse inclination to direct run-off towards the biotope. To prevent the chalky material used for the road from buffering the acidity of the biotope, this material will be removed and replaced with material with the same lithology as the area. In the main stand, some trees have been felled to open the crown cover, which was closing as a result of the drying of the soil, and to promote the birch seedlings. Stones and wood barriers have been placed to interrupt the flow of surface water, to block the erosion induced by the ungulates and to allow the wet area to expand.

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