QUATERNARY HISTORY OF FAGUS IN THE ITALIAN PENINSULA

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ABSTRACT - The Upper Pleistocene and Holocene history of the genus Fagus in Italy is reviewed. Fagus was present in central Italy during the last interglacial (Eemian), when it was virtually absent from the rest of Europe, markedly expanded in the following forest phases (St Germain I and St Germain II), and persisted during the last glacial period in central and southern Italy, from where it started a new spread already in the Lateglacial. However, in the northern Apennines and at the foothills of the Alps Fagus immigrated later and expanded only in the mid-Holocene, generally with an east to west trend.

KEY WORDS - Fagus, Italy, palynology, Upper Pleistocene, Holocene

INTRODUCTION

The European vegetation of the present interglacial is characterized by a widespread diffusion of Fagus, extending from the Cordillera Cantabrica to the Caucasus and from Sicily to southern Sweden. Apart from a few special environments, this genus would be almost universally present under natural conditions in central Europe, as it can occupy a wide range of habitats, with different soil types and a wide climatic amplitude (Ellenberg, 1988). However, the Holocene history of Fagus shows that such extensive geographical distribution is very recent, dating back to the last few millennia, and that the continuous presence of beech during at least the last glacial-interglacial cycle can be traced only for restricted areas.


While it is still a matter of discussion whether the primary factor controlling Holocene migrations of Fagus was climatic change (Huntley et al., 1989) or human influence (Reille and Beaulieu, 1990; Reille and Lowe, 1993), there is general agreement that the refuge areas of Fagus during the last glacial period had a southern
location, in the Italian and Balkan peninsulas (Huntley and Birks, 1983), as happened to most forest trees which today extend to northern Europe (Bennett et al., 1991). The hypothesis has also been advanced (Lang, 1992; 1994) that Fagus followed two main paths of invasion: an eastern route from the western Balkan peninsula to the eastern Alps, the Carpathians, northern Germany, Poland and southern Sweden, and a western route from Italy to the western Alps, France and southern England.

The aim of the present paper is to review the available information, possibly from radiocarbon dated sites (Fig. 1), on the past distribution of Fagus in peninsular Italy since the upper Pleistocene, and discuss the relationship with the history of the Alpine and central European beech forests.

UPPER PLEISTOCENE

There is one site in central Italy from where the vegetational history of the last 250,000 years can be reconstructed without significant interruptions: Valle di Castiglione (44 m) near Rome (Fig. 1; Follieri et al., 1988; 1989). That record shows that Fagus has been continuously present in the Italian peninsula since at least the middle Pleistocene, with very important diffusions during the Roma II and Roma III forest periods (200,000 - 170,000 years BP) corresponding to substages 7a and 7c of the oxygen isotope stratigraphy.

The vegetation of the last interglacial (Eemian; approx. 130,000-115,000 years BP) was characterized by thermophilous taxa, including evergreen oaks, Olea and other Mediterranean elements, by appreciable diffusion of Zelkova (Follieri et al., 1986a), and by reduced presence of Fagus and Abies, slightly increasing at the end of the interglacial. The sparse presence of Fagus in Italy during the last interglacial is confirmed also by the pollen data from Lago Lungo (371 m) near Rieti (Calderoni et al., 1994), and is particularly important considering the other European records, where, apart from one site in the North Black Sea region of Bulgaria (Bozilova and Djankova, 1976) and a few other sporadic findings, beech is completely absent. This virtual absence of Fagus on such a wide scale is so remarkable as to induce Tzedakis (1994) to hypothesize that a disease suppressed the European Fagus populations and that perhaps new and more robust populations developed by the time of the first glacial interstadials. Irrespective of the possible explanations for this absence, it is important to stress that central Italy is the only European area for which an uninterrupted presence of beech is documented since the middle Pleistocene (Follieri et al., 1988).

The forest phases following the Eemian interglacial, namely St Germain I (ca. 110,000-95,000 years ago) and St Germain II (ca. 90,000-75,000 years ago) are characterized by very pronounced expansions of Fagus in the Italian peninsula. This is recorded not only by the pollen data from Valle di Castiglione, Lago Lungo di Rieti, Lagaccione (355 m) near Lago di Bolsena (Magri, 1998) and Magliano Romano (Follieri, 1979a), but also by fossil leaves and fruits at Torre in Pietra (Follieri, 1979b), a site on the coastal plain northwest of Rome. Diffusion of beech during the St Germain I forest period is shown also by other long pollen records in Europe, for example at Les Echets (267 m), near Lyon in France (de Beaulieu and Reille, 1984), and at Ioannina (470 m), in NW Greece (Tzedakis, 1994), where Fagus reaches 30% and 20% respectively. However, differently from central Italy, at the French and Greek sites Fagus is not a major component of the vegetation, which is characterized by Carpinus and deciduous Quercus respectively. At the same time, at the mountain site
of Lac du Bouchet (1200 m) on the French Massif Central (Reille and de Beaulieu, 1990) *Fagus* is absent; this fact induced Reille and de Beaulieu (1990) to suggest that the habitat where *Fagus* would grow naturally, in the absence of human activity, would be the collinean stage.

During the pleniglacial (75,000-13,000 years ago), the persistence of reduced populations of *Fagus* in the Italian peninsula is recorded by four pollen sequences in the Lazio region (Fig.1; Valle di Castiglione, Lagaccione near Lago di Bolsena, Lago di Vico and Stracciacappa near Lago di Bracciano; Follieri *et al.*, 1998) and by the record from Lago Grande di Monticchio (656 m) in the Basilicata region (Watts *et al.*, 1996a). Beech is generally present in low percentages, but during some weak expansion of arboreal vegetation it surpasses 10%, a value that, according to modern pollen data, may indicate the regional presence of beech-dominated woodland (Huntley and Birks, 1983). Only at Cànolo Nuovo (945 m) in Calabria (Grüger, 1977), in correspondence with and before a radiocarbon date around 37,000 years BP, were there values higher than 40%, which may indicate that beech-dominated forests were present locally. These are the highest values recorded in Europe during the last pleniglacial period: even at Ioannina, in northwest Greece (Tzedakis, 1994), where a continuous and significant presence of deciduous trees is recorded throughout the glacial period (Tzedakis, 1993), *Fagus* never exceeded 5%.

**LATE- AND POSTGLACIAL**

In southern and central Italy, the continuous presence of beech is found already during the Lateglacial (Fig. 2). At Cànolo Nuovo in Calabria (Grüger, 1977; Schneider, 1985) *Fagus* shows percentages of 3-6% close to the radiocarbon date 12,385±125, then it persisted for the whole Postglacial, although with values generally lower than 10%. At Lago Grande di Monticchio (652 m) in Basilicata (Watts *et al.*, 1996b) the pollen of *Fagus* is continuously present since slightly before the AMS date 12,540±130, reaching values of over 5% during the Lateglacial. As at Cànolo Nuovo, the Postglacial values of beech seldom exceed 10%, even if a moderate increase is recorded in the late Holocene. Also at Lagaccione (355 m) near Lago di Bolsena (Magri, 1998) the continuous presence of beech dates back to the earliest Lateglacial, before the date 12,015±115 BP. *Fagus* persists with low percentage values until the date 8215±90, when a vigorous exponential growth occurred, leading to values of over 40% about 7500 years BP. After this spread the percentages oscillate around 10-20% until a marked drop 3700 years ago. At the Piana del Fucino (650 m), an intermountain plain in Abruzzo, *Fagus* is found with low percentages in the Lateglacial and increases markedly in the Postglacial, with values often surpassing 20% (Magri and Follieri, 1991).

At other sites, as Valle di Castiglione (44 m; Follieri *et al.*, 1986b) and Lago Albano (293 m; Lowe *et al.*, 1996) near Rome, and Lago Trasimeno (258 m) in Umbria (Schneider unpublished, in Lang, 1992) *Fagus* puts in its first appreciable appearances at the beginning of the Holocene: around 10,800 BP at Valle di Castiglione and around 9500 BP at Lago Trasimeno. At the sites near Rome, during the Holocene only occasionally does *Fagus* exceed 10%, whereas at Lago Trasimeno there is a clear expansion around 8,000 BP, similar to that of Lagaccione.

In a recent review of the vegetational history of the northern Apennines, Watson (1996) argues that *Fagus* appeared earlier in the eastern than in the western part of
the region during the mid Holocene and became dominant in the northern Apennine forests post 3000 BP. In particular the beginning of a rise in the levels of *Fagus* pollen is dated at 5780±40 BP at Pratignano (1307 m, 50 km SW of Modena), at 5260±55 at Lago Padule (1187 m, ca. 40 km NE of La Spezia) and at 5035±50 at Prato Spilla A, 60 km south of Parma (1550 m, Lowe and Watson, 1993), whereas at sites of eastern Liguria (Lago delle Lame, Prato Mollo and Lago Nero) located at over 1000 m, the ages for the same event range from approximately 4600 BP to 3000 BP (Macphail, unpublished, in Watson, 1996).

The palaeovegetational data from the Po plain (Accorsi et al., 1996) show that *Fagus* was very sparse (<2.5%) during the Atlantic, and became significant only in the Subatlantic, after about 4700 BP.

Also the data from the southern border of the Alps seem to indicate an immigration of *Fagus* from the east (Schneider, 1978), even if a real expansion is recorded at almost all sites around 5000 BP. Beech was presumably present already around 7500 BP at Lago di Ledro (655 m; Beug, 1964) and at Castellaro (100 m; Bertoldi, 1968), but only around 6000 BP at Lago d’Alice (580 m; Schneider, 1978) and Lago di Viverone (220 m; Schneider, 1978).

These data are confirmed by the findings outside the Alpine chain, generally much older towards Slovenia than towards France. In Istria, at Secovlje (1 m, Ogorelec et al., 1981; Sercelj, 1996) pollen of *Fagus* is already present in a sample dated 9160±120, and charcoal fragments of beech from Sandalja, near Pula, are dated at 21,740±45 and 25,340±170 (Culiberg and Sercelj, 1995). In Slovenia, in the Luknja cave (150 m) near Novo Mesto, two fragments of *Fagus* have been found (Culiberg, 1991), dated 12,580±250. As opposed to this early eastern distribution, on the French Alps beech generally appeared around 6000 BP and its mass expansion occurred around 5000 BP, although on the Dauphiné foothills it appeared already about 6500 BP, possibly spreading from refuge areas near the Rhône valley (de Beaulieu et al., 1994).

**Discussion**

The data hitherto collected from the Italian peninsula are still scanty, and do not represent adequately all the geographic and vegetational situations of such a diversified country. It is however clear that the history of *Fagus* differed considerably in Italy from region to region and that a wide range of situations has taken place during the last tens of thousands of years.

The Italian peninsula appears to have been a privileged area for the survival of beech not only during the glacial periods, but also during previous interglacials, when *Fagus* was virtually absent from the rest of Europe. In this sense, looking at the vegetational history of periods when the impact of human activity on the landscape was negligible, *Fagus* can be viewed as a genus typical of the wettest countries of the Mediterranean region, and not of the mid-European forests, where it has a very recent and transient history.

Differently from central Europe, the Holocene spread of beech in central and southern Italy appears less pronounced than in previous forest periods (e.g. St Germain I and St Germain II), although an early and continuous diffusion of beech is recorded at all sites (Fig. 2). On the contrary in northern Italy, without excluding the possibility of local refuge areas, it seems clear that the *Fagus* populations did not spread at the beginning of the Holocene, but generally had marked increases around or after 5000
years ago.

The start of *Fagus* during the earliest Lateglacial both at Cànolo Nuovo, and at Lago Grande di Monticchio as well as at Lagaccione indicates that populations of beech may have survived during the last glacial period at different locations in the peninsula,

so that no clear large scale migrational trends can be recognized in southern and central Italy. On the contrary the data from northern Italy suggest that migrations took place from the eastern toward the western part of the country. However, based also on the scarcity of beech in the Po plain, it seems reasonable to suppose that the origin of the Alpine and Apennine populations of *Fagus* was different (Fig. 2): although there are no data from Tuscany confirming this hypothesis, it seems most likely that the populations of the northern Apennines originated from the central Apennine, while Slovenia might have been the starting point for at least some of the Alpine populations.

It is worth noticing that *Fagus* spread earlier on the foothills of the Alps than on the northern Apennines. This contradicts the hypothesis that the populations that survived during the last glacial period in central and southern Italy may have expanded to central and northwest Europe: the late arrival of beech on the Ligurian Apennine would indicate that this was the northwestern limit of the Apennine populations, at a time when a large part of the vegetation of Europe was already beech-dominated.

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