Betula pendula, Betula pubescens and other birches in Europe: distribution, habitat, usage and threats

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Silver birch (Betula pendula Roth) and downy birch (Betula pubescens Ehrl.) are short-lived, relatively small broadleaved trees that occur throughout most of Europe, particularly in northern regions. In southern Europe, birch trees are confined to mountainous areas, as they do not tolerate prolonged summer drought. Birch has a light canopy of small serrated leaves, and characteristic smooth, white to grey bark. In northern regions, birch trees can dominate the landscape up to the tree-line, whereas in the centre of their range they often occur early in secondary succession because of their abundant seed production, low demands on soil quality, and intolerance of shade. Birch trees provide the predominant hard wood source in northern Europe, and some varieties of Betula pendula produce highly priced venners, while Betula pubescens is mostly used for pulp and fire wood. Other rarer species of birch are endemic to Europe contributing to the continental biodiversity even at high elevations and latitudes.

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Betula pendula Roth is a medium-sized tree, growing up to 30 m, while Betula pubescens Ehrl. is relatively shorter, rarely growing beyond 20 m and also less towards its northern range limits, up to dwarf trees in extreme habitats in the northern tundra and on mountains. The bark of young trees is brown in colour, when mature it turn to silvery-white, with horizontal dark grey lenticels, that with age darkens and develops fissures. The bark of the Betula pendula is a brighter white and shiner than that of Betula pubescens, and its branches characteristically droop, whereas those of Betula pubescens grow upwards or horizontally. In addition, Betula pubescens shoots are covered with a smooth fine down, as oppose to the hairless shoots of Betula pendula. Betula pendula leaves are coarsely and unequally double-serrated, larger than those of Betula pubescens (3-7 cm vs. 2-5 cm), and end in a fine point. Betula pubescens leaves are egg shaped, with a finely serrated margin and end in a shorter point. Both species are monoecious with male and female inflorescences developing as **unisexual** catkins, wind pollinated. Male catkins develop in summer, shedding pollen the following spring, a few days after female flowers have emerged. Female catkins are smaller, shorter and more erect than the longer, hanging, and clustered, male ones. Female catkins develop into fruits that are 1 to 4 cm long and 6 mm wide cylinder-shaped aggregates that eventually each disperse hundreds of small, winged fruits around August, with the amount varying with tree age and site conditions. In denser stands, birch trees do not flower until they are 20-25 years old but free-standing trees can already flower at the age of ten. While it flowers every year, the production of viable seeds usually peaks every 2-3 years.

**Distribution**

Betula pendula and Betula pubescens occur naturally throughout most of Europe up to central Siberia. Betula pubescens has a more northerly and easterly distribution, growing further north in Europe than any other tree species, whereas Betula pendula can reach southern regions such as Iberian Peninsula, South Italy and Greece. Given their wide distribution, these two birches show a high morphological variability and different subspecies and varietals have been described. Moreover, in most parts of Europe they are **sympatric** and can naturally hybridise, generating plants with intermediate characteristics. There is a high probability of hybridisation in areas where the geographical distributions of both species overlap. In several cases, hybridisation has led to the emergence of novel genetic strains that differ from the parental ones in various biological traits, such as growth rate, flowering time, and tolerance to environmental stresses. These hybrid forms are often more adaptable and can thrive in a wider range of habitats than their parental species, which has implications for forest management and conservation strategies. For example, hybridization can result in the formation of novel genetic strains that are more tolerant to climate change or more resistant to pests and diseases.
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Habitat and Ecology

Birch trees commonly live for 90-100 years, and, more rarely, up to 150 years. They are light-demanding, can grow rapidly also on poor soils, their winged fruits are very efficiently distributed by wind and its roots are easily associated with a large number of ectomycorrhizal fungi [10]. These characteristics combine to make birch trees thrive as pioneers during early stages of secondary vegetation succession. They are valuable in the natural or anthropogenic regeneration of woodlands, particularly in the centre of their distribution range [10-12]. Betula pendula grows best on fairly fertile, light, well-drained soils, particularly when soil conditions are acidic, while Betula pubescens tolerates damper soils and poorly drained heaths [11]. Betula pendula shows a moderate soil-acidifying ability [12]. Birches are most abundant in the boreal zone of northern Europe, where they can co-dominate or dominate in late-successional vegetation [13]. Owing to its cold-hardiness, Betula pubescens also has a higher elevational limit than Betula pendula, often forming the alpine tree-line in Nordic countries. Both the northern and elevational distribution limits of Betula pubescens appear to be determined by exposure to cold, dry north-easterly winds in winter, since the species is not particularly wind resistant. Southern distribution limits appear to be set by summer drought, which both species, and particularly Betula pendula, do not tolerate [14].

Importance and Usage

Birch provides the commercially most important source of hardwood in northern Europe, and is often an important component in conifer plantations, such as those of Scots pine (Pinus sylvestris) and Norway spruce (Picea abies). Birch plantations can also provide a protective habitat for seedlings of other tree species, including those that are more frost-sensitive, such as beech (Fagus sylvatica) and Norway spruce [14]. Because it can tolerate a broad range of site conditions, and poor soils in particular, birch is often used for land reclamations and revegetation, improving the soil so other broad-leaved or coniferous tree species can be planted later [15]. Birches are widely planted in urban areas, roadsides and parks [16]. Some silver birch varieties, such as Betula pendula var. cableca (curly birch), are particularly sought after for veneers and ornamental wood products because they can produce curly grains [17]. Betula pubescens is mainly grown for pulp wood and low-cost fuel wood, as its stems may be too small or poor for use as saw logs or veneers [18], even if veneer compression may be exploited [19]. In spruce plantations in Scandinavia, naturally generating birch trees increase biodiversity of birds [20] and lichens [21]. Root pressure builds in the lead up to bud burst and causes sap flow early in spring [22]. This birch xylem sap was until recently commonly tapped and consumed in Eastern Europe, either fresh as a tonic, fermented (birch beer or wine), or concentrated into a syrup [22]. Betula pubescens is used as a medicinal and aromatic plant in Croatia [23]. The leaves and bark of Betula pendula are used for their diuretic properties [24]. Ointments for eczema and psoriasis may use birch tar as an astringent ingredient [25]. Birches grow at high altitudes and in European boreal areas. Since mountainous areas in Europe show

with intermediate morphological traits [6]. Birches can also generate polyploid forms, and this aptitude, associated with the variability, the hybridisation and the more recent introduction of artificially propagated cultivars outside the natural distribution, complicate remarkably not only their identification but also the taxonomical classification of the whole genus Betula [7-9].
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a soil erosion rate higher than the average - especially in the boreal mountain system. Birches provide a particularly valuable service in watershed protection and soil stabilisation. Both birches are effective in erosion control; furthermore, Betula pendula plays a role in soil strength enhancement and is used for vegetated crib walls. The observed colonisation of boreal areas above the protection potential under climate change.

Other birches in Europe

In Europe other two main species of genus Betula are described: Betula nana (artic dwarf birch) and Betula humilis (dwarf birch). Some authors identify other birch species, often rare, endemic and at the limits of the geographical ranges, which have not explicitly a defined systematic status and are treated in some case as hybrids, varieties or subspecies. Betula nana is a shrubby birch occurring in a broad geographic range of Northern Europe, which spans from Iceland, Scotland and northern England up to Scandinavia and the Baltic area. In Central Europe it occurs at high elevations (northern Alps from Austria west to France, Carpathian mountains). This birch lives in Arctic of high-mountain exposed environments. It is found in immature or peaty soils within alpine tundra, rocky barrens and moorlands, subalpine damp meadows and open raised bogs. Betula humilis is another shrubby birch which has a very wide but scattered distribution, ranging from Western Europe with few locations in Germany, Austria, Poland, Romania and Switzerland, through Siberia up to Korea. It is a relict birch distributed from the Hill to the montane zone, preferring wet soils in forests and the edges of lakes. It may grow in shrubby pastures and alder thickets, transitional mires, on open raised or acid valley bogs and in natural/drained fens. Both these dwarf birches are diploid. They can naturally and frequently hybridise with Betula pubescens and Betula pendula in the overlapping living ranges, showing intermediate morphologies.

Threats and Diseases

The bronze birch borer (Agrilus anxius) constitutes an increasing threat to birch trees. It is a wood-boring beetle native to North America, known to attack all species of birch (with varying susceptibility). Although healthy trees are generally able to produce callus tissue around the Agrilus’ galleries, the European birches have little resistance and if the bronze birch borer were introduced in Europe no natural predators would mitigate its spread. Birch leaves are forage for the larvae of several butterflies, moths and sawfly species. In some cases, such as that of geometrid moth species that feed on the leaves from the outside (e.g. Erannis defoliator and Operophtera brumata) in northern Fennoscandia, this can cause pest outbreak conditions with cycles of mass defoliation, followed by collapse of the moth population. Larvae of other insects consume birch tissue from the inside either by burrowing through the leaf tissue, so-called leaf miners, or creating outgrowths, i.e. galls, in leaves, fruits or fruit scales. Birch trees weakened by leaf miners become more susceptible to secondary invasion by the aforementioned organisms. Fungal diseases can affect all parts of birch trees during all their life stages: birch rust (Melampsoridium betulinum) affects birch leaves, and stunts growth, and reduces life expectancy. Taphrina betulina and Taphrina nana cause abnormal shot growth (so-called witch’s broom) and leaf deformations. Yet other fungi, such as birch polypore (Piptoporus betulinus) causes wood rot, eventually killing infected trees. A range of fungal species are...
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Field data in Europe (including absences) • Observed presences in Europe

Young foliage of downy birch (Betula pubescens), which is covered by a smooth down, unlike the silver birch (Betula pendula).

Winter silver birch (Betula pendula) with covering of hoar frost in Babno Polje (Loška Dolina, South Slovenia).

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associated with more general die-back with affects crown health (i.e. Anisogramma virgultorum and Discus betulinus)***. Although the large pine weevil (Hylobius abietis) is mostly known as one of the most serious pests affecting young coniferous forests in Europe, it is also harmful for Betula pendula which partly consists with the natural niche of the large pine weevil***. Herbivory by short-snouted weevils (Srophophora melanogrammum and Otiorynchus scaber) is another threat to birch***.

References

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