

# *Larix decidua* Mill. – European larch

KAZIMIERZ SZCZEPANEK, WOJCIECH GRANOSZEWSKI AND DOROTA NALEPKA

## PRESENT DISTRIBUTION IN THE WESTERN CARPATHIANS

The genus *Larix* Mill shows a circumpolar distribution, divided into smaller and larger areas of occurrence. The centre of larch distribution is located in North-Eastern Asia. Most species are to be found in mountain regions.

European larch, in a broad sense, is a highly variable species including two subspecies, i.e. *Larix decidua* Mill subsp. *decidua* and *L. decidua* subsp. *polonica* (Racib.) Domin. The typical subspecies, *L. decidua* subsp. *decidua*, occurs exclusively in the Alps and Tatra Mountains, near the upper forest limit and at higher altitudes of the upper montane forest zone. In the Tatra Mountains, its native distribution is in an altitudinal zone of (800) 1000–1500 (1900) m a.s.l. This vertical distribution, European larch *sensu stricto* occurs nearly 1000 m higher than that of Polish larch (*L. decidua* subsp. *polonica*). Near the upper forest limit in the Tatra, at altitudes of 1130–1500 m a.s.l., European larch locally forms small patches of stone pine-spruce-larch forests. This relict forest community was described as a distinct association, *Cembro-Piceetum* (Myczkowski 1969). Below 1130 m a.s.l. European larch is represented mainly by single trees, particularly on rock cliffs. In Poland this subspecies of larch does not grow as a native plant beyond the Tatra Mountains (Pawłowski 1956, Boratyński 1986).

Polish larch, *Larix decidua* subsp. *polonica*, is recorded at scattered sites within the entire Carpathians, mainly in their foothills and in the lower montane forest zone, rarely in the upper montane forest zone. The region of the Świętokrzyskie Mountains is considered the centre of occurrence of this subspecies in Poland. In the lowlands, Polish larch forms small groves but is more frequently found as an admixture in mixed stands. As a heliophilous and pioneer tree, it is occasionally displaced by trees more tolerant of shade (Pawłowski 1956, Boratyński 1986).

## ECOLOGY

Both subspecies of European larch, including the Polish larch, differ only slightly in their ecology and show a rather broad range of tolerance to particular habitat

components. Both are strongly heliophilous; however Polish larch is resistant to periodic or temporary shading (Zarzycki et al. 2002).

The taxa under discussion have similar temperature requirements and inhabit moderately cold areas (mainly subalpine and upper montane forest zones; particularly *Larix decidua* subsp. *decidua*), as well as moderately warm regions (part of the lowlands and foothills; *Larix decidua* subsp. *polonica*). Larches show great thermal tolerances, particularly to high summer temperatures; however they are also insensitive to early or late slight frosts. Both subspecies are typified by the highest transpiration rates of all native Polish trees (Olaczek 1986).

Soil requirements of both taxa are similar. They grow on moderately fertile (oligo- and mesotrophic) soils and show greater response to their physical properties than to the content of nutrients. European larch is likely to occupy shallow and stony soils, rock debris, gravels, as well as sandy, loamy and mineral-humid acidic soils (pH 4.5–5.5). Polish larch is known to prefer fresh, mesotrophic soils, poor in humus, either acidic (pH 4.5–5.5), neutral or alkaline (pH 6.6). Both subspecies avoid soils with a high groundwater level, particularly with stagnant waters (Olaczek 1986).

In the Tatra Mountains, *Larix decidua* subsp. *decidua*, accompanied by stone pine and spruce, forms the *Plagiothecio-Piceetum* association (Matuszkiewicz J.M. 2008). Locally, near the upper forest limit, these trees form patches of the *Cembro-Piceetum* association (Bednarczyk 1969, Myczkowski 1969).

At lower altitudes (foothills and lowlands) Polish larch is found within several plant associations (Olaczek 1986, Zarzycki et al. 2002). Larches are monoecious trees with dioecious, wind-pollinated cones. Pollen grains of both subspecies are similar and indistinguishable by means of pollen analysis. Intensity of flowering depends on climatic conditions and whether they are advantageous to the formation of flower buds. In Poland larch flowers early, usually in March or April before its leaves are developed. Low percentage values of larch in pollen spectra already indicate its local occurrence.

## EXPANSION IN EUROPE DURING THE LATE GLACIAL

Following Środoń, fossil macroscopic remains and pollen grains found in Pliocene and Early Pleistocene sediments appear to show the early presence of *Larix* in European forests (Środoń 1986).

During the last glaciation (Vistulian), particularly in its interstadials, forests included a high proportion of larch, which is recorded at numerous fossil sites with abundant macrofossil remains and pollen grains of this genus.

Many arguments provide a basis for the assumption that *Larix decidua* s.l. (including *L. polonica*) originates from Siberian larch, *L. sibirica* (Wulff 1943), as climatic conditions at the end of Pliocene and beginning of Miocene already enabled a broad expansion of the species within Central Europe and farther to the west. In younger geological periods, with climatic conditions disadvantageous to *Larix sibirica*, its distribution was withdrawn to the east. Some of its populations remained in refugial areas of European mountains (the Alps and the Tatra Mts.) and most likely gave origin to European larch (*L. decidua*). Isolation and reexpansion of Siberian larch during younger periods, particularly into refugia of Central Europe, may have been favourable for the development of new forms, including Polish larch. From the distribution of fossil sites bearing a record of larch in Vistulian, Late Glacial and Holocene sediments it may be concluded that the present-day occurrence of the species at particular Polish sites (the Tatra Mountains, the Pieniny Mountains, the Beskid Niski range, region of the Świętokrzyskie Mountains) is of an initial and then continuous type (Środoń 1986, Starkel 1988).

## HISTORY OF EXPANSION IN THE WESTERN CARPATHIANS DURING THE HOLOCENE (Fig. 19)

Fossil sites, with Vistulian sediments comprising macrofossil remains and pollen grains of larch, confirm the presence of this taxon in the broad periglacial zone of the Western Carpathians (Środoń 1986, Starkel 1988).

**10 000 BP**

Isopolls of the 10 000 BP map show low values for larch but, however, cover the entire area of Polish Western Carpathians. Slightly higher frequencies (up to ca 2%) are recorded exclusively in the Bieszczady Mountains. The Tatra Mountains and their surroundings, as well as vicinities of the Przełęcz Dukielska Pass, are marked by only trace amounts of *Larix*.

**9500 BP**

Trees with higher temperature requirements and, which are more competitive than pioneer trees, began their expansion. This process initiated a decrease in the proportion of larch in forests, particularly in the western part of the Carpathians, to the west of longitude 21°E.

**9000 BP**

Forests of the eastern part of the Carpathians, including the foothill zone, from longitude 22°E, appear to comprise only minor amounts of larch. In the western part of the Carpathians, to the west of the Biała Tarnowska river (from the longitude of ca 21°E), hardly any larches are found within forests.

**8500 BP**

The Bieszczady Mountains and particular Tatra Mountains sites are the only areas in which occurrence of larch is confirmed – by trace amounts of pollen in the sediments examined.

**8000 BP**

Apart from infrequent sites in the Tatra Mountains, bearing a record of trace amounts of larch pollen, the entire area of the Western Carpathians and their foothill zone seem likely to be devoid of larch.

**7500–6000 BP**

Exclusively to the east of the Wisłoka river, in areas of the Carpathian Foothills and the Bieszczady Mountains, infrequent occurrences of larch have been observed.

**5500–500 BP**

Remains of larch are recorded only as single pollen grains and exclusively in a few sites in the Tatra Mountains.

**0 BP**

Presence of larch is confirmed only in the Beskid Niski range, by trace amounts of pollen. Figure 19 (last part) presents the occurrence of the tree based on present-day floral data (Zajac & Zajac 2001).

## CONCLUSIONS

In the area of the Western Carpathians, larch occurred most frequently in the periglacial zone of the Vistulian glaciation, particularly during its interstadials and the Late Glacial, as well as at the beginning of the Holocene, i.e. until ca 9000 BP. Because of its high sensitivity to shading, larch was eliminated from forests by the expansion of more shade-tolerant trees. These processes were more intensive in the north-western part of the Western Carpathians.







