

## ALPECOLE – Lesson D1c: Quaternary Paleoenvironments – Results

### Tree species of the Holocene

**Alder (*Alnus*):** Three alder species can be distinguished in the Alps: Common alder (*Alnus glutinosa*), grey alder (*Alnus incana*) and green alder (*Alnus viridis*). Alder species often occur on wet soils as pioneer species. The green alder in particular, forms coppice forests (*Alnetum viridis*), which occur on subalpine pastures and forest edges. Alder species outlasted the Würm glacial in the northern and southern Alpine forelands, e.g. in the Po plain (IT), where there were ideal conditions in flood-plain woods with wet soils. At some Swiss sites green alder pollen could be found in deposits of the Alleröd and Younger Dryas. An intensive immigration of common and grey alder started during the Atlantic. During the Subboreal green alder spread reached its maximum, because of forest clearings (pastures as alder habitats) and colder climate conditions (drop of Swiss stone pine and larch).

**Ash (*Fraxinus*):** Due to the bad conservation of ash pollen, there is little information about this tree species. Ash, together with elm, oak, linden and maple, formed the Holocene mixed forest (*Quercetum mixtum*). After the Hypsithermal, shadow-tolerant trees (especially beech) partly supplanted ash.

**Beech (*Fagus sylvatica*):** The beech occurs today in the colline and montane belt where it reaches its upper limit. During Würm *Fagus sylvatica* survived in glacial refuges like the Balkan Peninsula and the Carpathian mountains. During the Atlantic beech immigrated at around 6000 B.P. from the North East to the Lake Constance Lake Zurich areas. At the southern border of the Alps, *Fagus sylvatica* immigrated later (after 5000 B.P.) via a separate south/southeastern path. During the Subboreal, beech attained its widest spread in Switzerland. Due to human impact, beech has since recessed in several regions.

**Birch (*Betula*):** Birch is a typical pioneer tree of late/postglacial reforestation. During the Bölling-/Alleröd-Interstadial it often formed a birch-tundra similar to the today's vegetation in northern Scandinavia or Siberia.

**Elm (*Ulmus*):** The elm occurred together with oak (*Quercus*), lime (*Tilia*) and maple (*Acer*) and formed a mixed oak forest (*Quercetum mixtum*) during the Preboreal, Boreal and Atlantic. During the Pre-boreal, the elm (and oak) often immigrated as first deciduous trees. During the Atlantic the so called "elm decline" can be noted. The reasons given for this elm decline have been subject to much discussion and debate. Reasons proposed include:

- Immigration of shadow tolerant tree species such as beech, silver fir or spruce, replaced elm
- Anthropogenic influences, e.g. cutting or pruning ("schneiteln")
- Climate changes
- Changes of soil and groundwater conditions
- Elm diseases
- Combination of natural and anthropogenic parameters.

**Hazel (*Corylus avellana*):** This light-demanding wood even occurs on locations without very good soil conditions. A first hazel-maximum can be recognized during the Boreal, when pine or mixed oak forests with hazel-undershrubs existed all over Central Europe. During the Atlantic hazel was pushed away due to the immigration of shadow-tolerant species like Norway spruce, silver fir, and beech. A second hazel-peak can be noted during the Subboreal, due to anthropogenic impacts (forest clearing) and probably also due to cooler climate conditions (Löbben coldphase, Göschenen coldphase I) that resulted in new concurrence-relations in forests.

**Hornbeam (*Carpinus betulus*):** Similar to beech, *Carpinus betulus* outlasted the Würm glacial on the Balkan Peninsula, in the Carpathians and in Anatolia. Even if the immigration distance from glacial refuges of hornbeam to Switzerland is approximately the same as for beech,

*Carpinus* did not reach Switzerland before the Subboreal at around 4000-5000 B.P. Possible reasons for this delay could be beech concurrence and climatic/pedologic factors. Today *Carpinus* occurs mostly in colline areas and only rarely in montane areas of the Northern and Southern Swiss Plateau.

**Joint pine (*Ephedra helvetica*):** This small shrub derives from East-European and West-Asian half-deserts. Today *Ephedra helvetica* exists in Switzerland, in a very small area in the canton of Valais only. During Late Würm *Ephedra* was a wide-ranged species.

**Juniper (*Juniperus communis*):** In the Late Würm, mainly during the Bölling, juniper and sea buckthorn formed as pioneer shrub nurse crops. Reforestation with birch and Scots pine began afterwards.

**Lime (*Tilia*):** Occurred with elm (*Ulmus*) and oak (*Quercus*) and formed a mixed oak forest (*Quercetum mixtum*) during the Holocene. Lime trees immigrated later than elm and oak, because their relatively heavy seed spread slowly. Shadow-tolerant species such as beech partly supplanted lime during the Subboreal. Today lime occurs mainly in warm (föhn) North Alpine valleys and on poorer soils.

**Mugwort (*Artemisia*):** Mugwort is a pioneer herb growing in glacier forefields and on ruderal sites. After the Late Würm dominance, *Artemisia* recessed during the early Holocene due to the spread of forests. After the young Holocene anthropogenous opening of the forests, mugwort spread again on ruderal sites.

**Norway spruce (*Picea abies*):** Norway spruce outlasted the Würm glacial in West- and Middle-Russia, in the Carpathian mountains, on the Balkan peninsula and in the Eastern and Southern Alpine Lowlands. During the Boreal, Norway spruce immigrated via Northern Tyrol and the Inn Valley into the Lower Engadine, along the Southern Alps, into Val Poschiavo and Val Bregaglia. During the Younger Atlantic, Norway spruce reached Central Switzerland (Zurich, Lucerne and Bernese Oberland). Via a separate immigration path, Norway spruce reached Lower Valais and the southwestern Jura Mountains. The spruce forest limit has been affected by man since ca. 5000 BP.

Generally, Norway spruce immigrated into the Alps from East to West by three different paths: a) Northern border of the Alps, b) crossing the Central Alps and c) along the Southern border of the Alps. Norway spruce today occurs in Europe from colline (mostly planted) up to subalpine areas.

**Oak (*Quercus*):** Occurred together with elm (*Ulmus*) and lime (*Tilia*) and other deciduous tree species and formed Holocene mixed oak forests (*Quercetum mixtum*) dominating from the Boreal to the Atlantic. During the Subboreal, shadow-tolerant trees such as beech and silver fir partly supplanted oak. During the Subatlantic anthropogenic influences let the number of oaks increase: People promoted and took care of oak for economical reasons (acorn used as mast for pigs, wood used for furniture and building material).

**Sea buckthorn (*Hippophaë rhamnoides*):** In the Late Würm, mainly during the Bölling, sea buckthorn and juniper formed as pioneer shrub nurse crops. Reforestation with birch and Scots pine began afterwards.

**Scots pine (*Pinus sylvestris*):** Scots pine is a light-demanding tree with a wide eco-physiological amplitude. It grows on unfavourable sites with dry sandy or lime-rich soil as well as on wet and acid soils. Scots pine and birch formed the first mountain forests during the Late Glacial and the early Holocene. After the immigration of the mixed oak forest species, beech and spruce, Scots pine and birch were mostly replaced.

**Silver fir (*Abies alba*):** Silver fir outlasted the Würm glacial in refuges on the Balkan and Anatolian peninsulas, and in the southern Apennin. Immigration into Switzerland started in the Preboreal, when silver fir occurred in the Ticino Alps. Later, during the Atlantic, silver fir species advanced northwards and crossed the eastern Central Alps (Lukmanier pass). Around 7000 BP,

silver fir reached the Northern Alps and during 6000 BP the northern Swiss Plateau. During the Subboreal beech and Norway spruce partly replaced silver fir, and today silver fir occurs mostly in Norway spruce-silver fir forests (*Piceo-Abietum*) and in silver fir-beech forests (*Abieti Fagion*). Pure silver fir forests occur on few sites, e.g in Tessin or Valais. In some places (southeastern edge of Swiss Eastern Alps and Northern Alps of the Grison and Saint Gallen) silver fir and Norway spruce immigrated simultaneously.

**Sweet chestnut (*Castanea sativa*):** Chestnut did not emigrate by itself from possible glacial refuges in Southern Greece, Italy and Spain. During the Subatlantic, sweet chestnut was introduced largely by the Romans and planted in the Southern Alps as well as in warm areas in the Northern Lowlands as in the Föhntäler or around several Swiss lakes.