

# FLEE THE FOREST TO SURVIVE

History and threats, research and future prospects: how much do we really know about the majestic horse-chestnut tree?



Blooming chestnut trees  
alongside a country path

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**T**he horse-chestnut tree, also known as the conker tree, is a sizeable, well-known tree that many children can recognize very early on – its seeds (chestnuts), which fall in September and October, are often collected and used for constructing various animal and human figures in kindergarten art classes. Chestnuts are also collected by older children as food for forest or zoo animals. This beautiful tree is also associated with graduating from high school. The horse-chestnut trees in Central Europe usually bloom at the beginning of May or a bit earlier, just in time for the final exams, reminding students that spring may be here but this is nevertheless the time to study. For those who suffer from leg pain, chestnuts provide a raw material, escin, a mixture of saponins, from which ointments for varicose veins are produced that have anti-inflammatory properties, improve blood flow, as well as help seal and make tissues and blood vessels more flexible.

## The beginning

The popularity of the horse-chestnut tree and the versatile use of its seeds is due to the fact that this species has been widely planted in parks for centuries, along city streets or field lanes throughout most of Europe. The history of this tree as an ornamental species dates back to the mid-16th century. The horse-chestnut tree is first mentioned in a letter by Willem Quackelbeen written in Istanbul in 1557 to Pietro Andrei Mattioli, a botanist and doctor living in Prague. The first seedlings reached Europe several years later (1576) sent to Vienna, to the most famous botanists of that time Carolus Clusius. They were transported illegally by the Habsburg ambassador in Istanbul, David von Ungnad. Prior to that there were attempts to bring chestnut to Europe, but in those times transport took a long time, and horse-chestnuts are very sensitive to drying out, so after a long period of improper storage they lost their ability to germinate. It was therefore necessary to transport seedlings, which was a difficult task because chestnut trees were of strategic importance at that time. The Ottoman Empire, which ruled a large part of Southeastern Europe in the 16th century, closely guarded this important commodity.

The chestnuts were used at that time to make medications for horses with respiratory problems, and cavalry forces were very important to a country with imperialist aspirations.

The link between this chestnut tree and horseback riding as a combat formation was reflected in its Latin species name bestowed on it by Linnaeus in the mid-eighteenth century (*Aesculus hippocastanum*). “Hippo” is Greek for horseback riding (ἵππασία), and “castanum” is a reference to the well-known edible chestnut species at that time (*Castanea sativa*), because the leaves and seeds of both species look alike. The same link is preserved in the English name, the “horse-chestnut.”

The horse-chestnut tree began to gain popularity all over Europe. Relatively quickly, at the end of the sixteenth century, it also reached Poland, and so it became well-known as a beautiful park and lane tree throughout the continent. It was admired for its decorative qualities, especially during the flowering period, which lasts a long time and is usually abundant, especially in trees growing in well-sunlit areas. Chestnut trees provide a lot of shade, which is important in urban conditions, especially in warmer areas. In addition, chestnuts were used as animal feed.

Botanists in those days wondered about the origins of the horse-chestnut tree. It was hypothesized that this species originated from the Indian Peninsula or even further regions of Asia. It was not until the 19th century that it became clear that it was in fact native to Europe. It was found in the mountain forests of the Balkan Peninsula, where it grows to this day. There are now relict populations of this species there today, scattered and small, some consisting of only a few trees. In the European Red List of Trees published in September 2019, this species was classified, depending on the region, as either vulnerable or critically endangered. The natural threats these chestnut trees are mainly due to their small populations and the disappearance of optimal habitats for this species. The horse-chestnut grows on steep slopes near mountain rivers and streams.

## Climate change, insect invasions and other threats

Alpine areas are some of the most vulnerable environments due to human activity and climate change. Most climate change scenarios predict a decrease in the size of areas where horse-chestnut trees can grow in natural conditions. Acquiring new areas, and especially moving upwards, is much more difficult for species with heavy seeds. Such species spread barochorically, meaning their seeds fall to the ground (gravitational force), and can be spread further by waterways (hydrochory) or up using animals (zoochory). In the ca-



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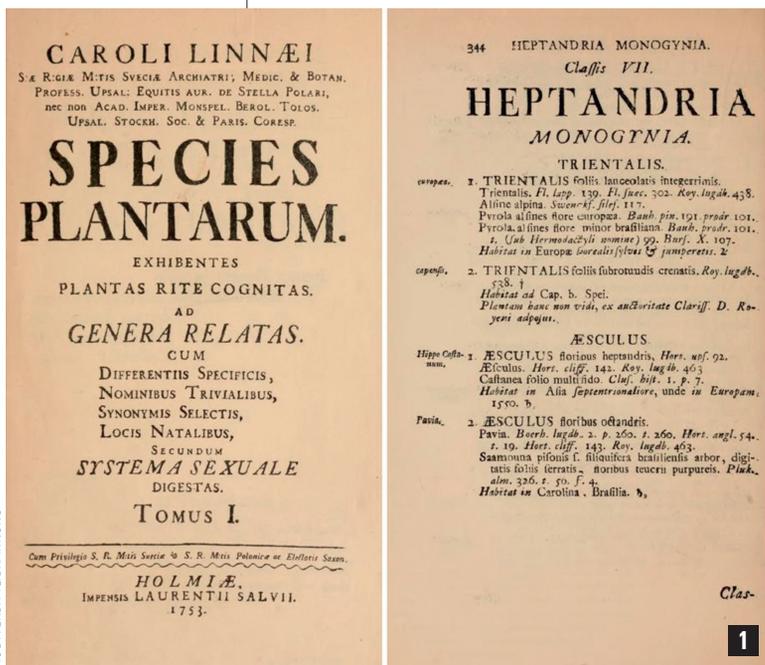


Fig. 1. Title page and an excerpt from the work of Carl Linnaeus (*Species Plantarum*) with a description of the horse-chestnut (*Aesculus hippocastanum*)

Fig. 2. A naturally-occurring chestnut tree in a mountain forest, Pindus Mountains, Greece

Fig. 3. A horse-chestnut leaf miner, seen here on chestnut bark



se of horse-chestnuts, however, there are few animal species large enough to carry chestnuts weighing over 10g, so this way of spreading is very limited. The future of chestnut trees growing in natural conditions is therefore not looking very bright, though it would seem that this species will survive and thrive in human-created conditions, since it has now existed alongside us for centuries.

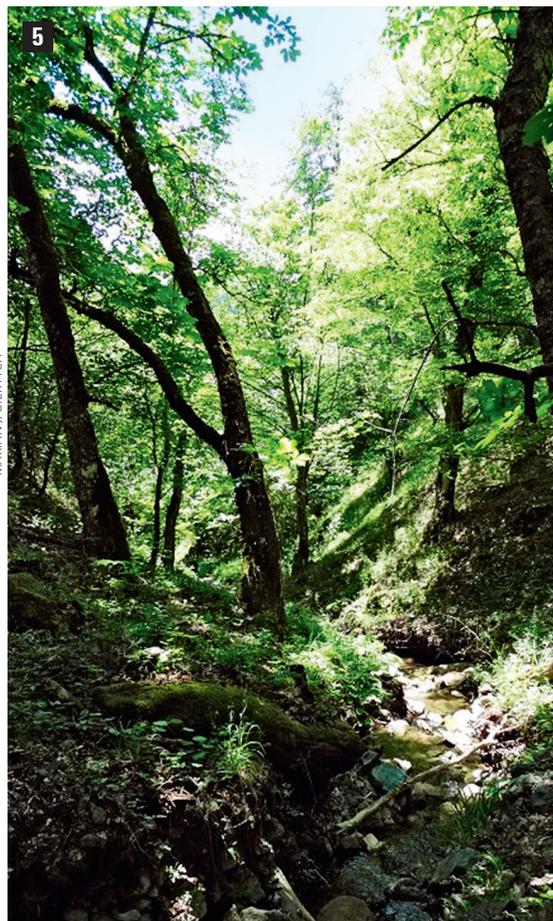
There was never much interest in the horse chestnut tree as a forest species. Its wood does not make good raw material, and its role in the forest is mainly biocenotic, enriching the food base of forest animals. However, in the last 30 years interest in this species has grown tremendously. The horse-chestnut tree's long-time role in the urban and rural landscape has begun to lose its aesthetic value. The reason for this is the invasion of a small moth, known as the horse-chestnut leaf miner, which damages the leaves, causes leaves to fall prematurely, disturbs the flowering process and causes the tree to produce fewer seeds of lesser quality. Prior to that, damage caused by a fungal pathogen was noticeable in the form of brown spots on leaves, but this did not arouse as much scientific and social interest as the horse-chestnut leaf miner.

Many questions arose that were difficult to answer. Why was the horse-chestnut leaf miner so successful in colonizing the chestnut tree throughout Europe? Had it previously appeared in natural chestnut populations? Can chestnuts become resistant to it? Can anything limit outbreaks, i.e. mass occurrences, of the horse-chestnut leaf miner? Will the occurrence of two parasites in the same area lead to the disappearance of one of them? What are the effects of annual defoliation, i.e. premature leaf fall, on chestnut physiology? And many others.

Thirty years of research has brought answers to many of these questions. We know, for example, that the horse-chestnut leaf miner always occurred in the natural Balkan chestnut populations before it was discovered in the 1980s. We know that it was road transport that helped it colonize Europe within a short period of time. We also know more about the biology of the insect itself, its genetic variability, fertility and egg laying strategies. Recent studies at the Institute of Dendrology, Polish Academy of Sciences, have shown that the female of the species dissipate the risk of the survival of their offspring by laying eggs on many leaves.



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Fig. 4.

Chestnut leaves with visible damage caused by horse-chestnut leaf miners

Fig. 5.

A mountain stream – the natural habitat of the horse-chestnut tree, Pindus Mountains, Greece

Fig. 6.

A chrysalis of the horse-chestnut leaf miner moth



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The results of research on the horse-chestnut tree's defense responses were also surprising. It turns out that the horse-chestnut leaf miner, occurring simultaneously with the fungal infection, causes the leaves of the host plant to increase its defense mechanisms that can fight the fungal pathogen and not be affected much by the preying butterfly larvae. Research has also uncovered an interesting phenomenon of the summer diapause, which, combined with the occurrence of many generations during the growing season, creates enormous adaptation possibilities for this species.

We also know the extent of the negative impact of annual defoliation on chestnut tree growth and its fruiting. We have learned more about the competition for food, the chestnut leaves, between the horse-chestnut leaf miner and the fungal pathogen that causes the brown patches on the leaves. It has also been observed that the emergence of a new food source, which is the larvae and pupae of the horse-chestnut leaf miner, changes the behavior of insectivorous birds, such as the tits, who have learned how to find pupae hidden among the leaves. The number of parasitic insect species that feed on the larvae and pupae has also in-

creased. However, none of these limiting factors is sufficient enough to effectively reduce outbreaks of the insect.

Man-made solutions, such as raking and removing the leaves, sticky bands on the trunks, or spraying, have also proved ineffective. One fairly effective method involves injecting powerful insecticides into the shoots, but due to enormous environmental effects, and above all the adverse effect on pollinating insects, this is far from an advisable solution.

## Looking into the future

The future of the horse-chestnut tree in Europe remains impossible to forecast with accuracy, because on one hand the areas of its natural habitat are shrinking, and on the other, the annual defoliation caused by leaf-damaging insects may lead to the tree being replaced by other species in other habitats. Considering the dangers to the horse-chestnut tree in its natural habitat, as well as in new anthropogenic habitats, we should ask whether this tree will actually manage to save itself by “escaping” from the forest, so to speak, even if just beyond its natural geographical range.