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## Highly invasive horse-chestnut leaf miner found living in the Balkans by 1879

Scientists discover ancient caterpillars in herbaria, new facts about origin



The horse-chestnut leaf miner was living on native stands of the horse-chestnut in Greece by 1879 and was already present in the Balkans more than a century before its scientific description. The present study by an international and interdisciplinary team around David Lees (Institut National de la Recherche Agronomique, France and Natural History Museum, London) and H. Walter Lack (Botanic Garden and Botanical Museum, Freie Universität Berlin) is based on herbarium analysis. They resolve a two decade-long debate about origin and invasion of the horse-chestnut leaf miner. A Balkan origin for this leaf-mining moth is now certain. Results are now published in *Frontiers in Ecology and the Environment*, the scientific journal of the Ecological Society of America.

### Known timeline of the horse-chestnut leaf miner invasion

The small but highly invasive horse-chestnut leaf-mining moth (*Cameraria ohridella*) was only discovered in 1984 from an outbreak on planted trees bordering Lake Ohrid in Macedonia. It was described in 1986, as a genus new to Europe and managed to invade almost all Europe since 1989. Its larvae are leaf miners on the white flowering horse-chestnut (*Aesculus hippocastanum*), causing significant damage to their summer foliage. The area of origin of horse-chestnut is the Balkans (Albania, Greece, and Macedonia). Since the 17<sup>th</sup> century, the trees have been cultivated in parks, gardens and streets throughout Europe for their ornamental foliage and flowers.

### Travel back in time to leaf-mining larvae in herbaria

For this study, herbarium specimens of the leaf miner's host plant horse-chestnut from several botanical institutions throughout Europe have been examined. Surprisingly, many horse-chestnut leaf miner larvae were found which were unintentionally pressed within the leaves of horse-chestnut. The oldest caterpillar was found in a herbarium specimen collected in 1879 in Greece, over a century before the genus *Cameraria* was suspected to exist in Europe. By genetic analysis of the caterpillar's mitochondrial and nuclear DNA the scientists confirmed the identity of the horse-chestnut leaf miner. They could also compare genetic diversity among present populations of the moth and historic specimens from herbaria. This study demonstrates that herbaria are greatly underutilized in studies of insect-plant interactions, herbivore biodiversity, invasive species' origins, and for documenting past distributions. Herbaria are a relevant source of information to solve modern day problems of invasive species including pests and diseases, and for looking at temporal changes in biodiversity.

## New facts about origin of horse-chestnut leaf miner

Scientists had been long debating whether the moth was a possible introduction from Southeast Asia or an example of a recent host switch from sycamore or maple trees. The present study reveals that the horse-chestnut leaf miner is even more genetically diverse in the Balkans than previously reported. The herbarium samples uncovered previously unknown mitochondrial haplotypes and locally undocumented nuclear alleles. This surprising genetic diversity and the antiquity of the caterpillar specimens, found only on natural stands of horse-chestnut from the earliest botanical explorations of remote sites in central Greece and Albania, shows a Balkan origin for the moth, thus contradicting the introduction and host switch theories. The study further reveals local outbreaks of the horse-chestnut leaf miner back to at least 1961, long before the species was first discovered. The team found that late development of roads in the Balkans probably accelerated the dissemination of leaf miner populations which were previously living in isolated populations in remote canyons. The leaf-mining moths are able to travel as stowaways in vehicles, increasing their mobility between natural and ornamental stands of horse-chestnut. The long time window offered by the new data from herbaria also indicates that the most invasive race of the moth, known as haplotype A, has been increasing in frequency, even within the Balkans.

### Publication:

Lees, D. C., Lack, H. W., Rougerie, R., Hernandez-Lopez, A., Raus, T., Avtzis, N., Augustin, S. and Lopez-Vaamonde, C. 2011. Tracking origins of invasive herbivores through herbaria and archival DNA: the case of the horse-chestnut leaf miner. *Frontiers in Ecology and the Environment* doi:10.1890/100098 (available via <http://dx.doi.org/>)

### More:

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<http://eolspecies.lifedesks.org/pages/8675> –Horse-chestnut leaf miner

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