

**5. Working at the level of landscape components**

Maintaining diversity and returning it to the landscape must really act together with the landscape, its history, function and potential. We should prepare conservation measures comprehensively, at the level of components like mountain ranges, catchment basins, river valleys and large-size protected areas (National Parks, Protected Landscape Areas, Nature Parks). Regional Action Plans (RAP) prepared by the Nature Conservation Agency of the Czech Republic for integrated conservation of species and populations, for which the national scale is unnecessarily large but the scale of particular sites is too small, are becoming an excellent new instrument.

**6. Assisted colonisation: making room for translocations**

If a species disappears for climatic reasons, it does not mean that no suitable climate for it has emerged somewhere else, on the opposite side of a river canyon slope, higher up in the mountains or further north. The state of the current landscape and of endangered populations unfortunately prevents new habitats to be colonised even when they are created somewhere else. For several years, the authors have warned about ill- conceived insect reintroductions and have absolutely refused transfers outside historic distribution ranges. However, climate and habitats change so quickly that translocations are gaining more and more importance for the maintenance of the Czech Republic’s natural heritage (Sedláček & Kadlec, *Živa* 6/2019, 306–308). It is high time to increase the capacity of recovery breeding, to support genetic screening of Central European biota, and to make reintroductions and transfers an effective tool for biodiversity conservation. Reintroductions and translocations must of course not be performed in a ‘wild’ manner. The objective should not be ill-conceived ‘enrichment’ of the natural world, but survival of most endangered species in the country.

If we want to protect butterflies in this time of fast climatic change, we need more and larger protected areas (or areas which we will treat as protected ones), more diversified, broadminded and generous management imitating the prehistoric pasture landscape, and greater effort to preserve populations, including reintroductions and transfers to suitable though unoccupied sites. All this may make insect conservation more expensive, but in the situation when climate change has hit a landscape



The Scarce fritillary (*Euphydryas maturna*). © Václav John



The Rock grayling (*Hipparchia alcyone*). © Václav John

heavily affected by intensification, there is no other way but to take it. It is becoming increasingly clear that refaunation of habitats by large herbivores is one of the biologically and economically most efficient approaches. When Donlan et al. (*The American Naturalist*, 168, 1–22) described refaunation plans as an ‘optimistic agenda for the 21<sup>st</sup> century’, they consider that the restoration of completely functional ecosystems can give them back their

dynamics and return species their evolutionary potential. These are aspects which come to the forefront during rapid change in climatic conditions.

The project was supported by Technology Agency of the Czech Republic grant SS01010526 and from the Academy of Sciences of the Czech Republic Strategy AV21 Programme *Záchrana a obnova krajiny (Landscape Preservation and Restoration)*.

# Targeted Application Methods or a New/ Old Tool for Controlling Invasive Alien Woody Plants: the First Experience from the Podyjí/Thaya River Basin

Robert Stejskal

Invasive alien woody plants are a significant long-term problem of protected nature. Although we have been trying to control invasive alien woody plants, e.g. the most common Black locust (*Robinia pseudoacacia*), in many Specially Protected Areas in the Czech Republic, an effective management tool has been missing yet. In practice, there are various approaches differing in their philosophy and effectiveness

and very often repeating mistakes, thus making sometimes the state of the art even worse instead effectively solving the problem. In this contribution, divided into several parts, the author would like to introduce the first experience from applying new measures in controlling the Black locust and other invasive trees and shrubs in the Podyjí/Thaya River Basin National Park (South Moravia).

## The Podyjí/Thaya River Basin – a paradise of invasive woody plants

The Podyjí/Taya River Basin National Park (NP) is rich in invasive alien trees and shrubs. The most important is the Black locust, occurring on a total area of approx. 150 ha as continuous forests but also hundreds of isolated patches of various size and density in a broad range of habitats. It is an almost ubiquitous species in the NP’s eastern part. Old locust monocultures/plantations showing some stability as well as recent outbreaks with often stormy dynamics can be found in the area. The strongest threat to biodiversity is posed by black locust stands on steep slopes of the Dyje/Thaya River canyon, where it spreads into rock steppe and thermophilous oak forest habitats, not only vegetatively but thanks to the favourable conditions also by means of seed.

Insignificant in area, but more dangerous is the occurrence of the Tree of Heaven (*Ailanthus altissima*) and the Box elder (*Acer negundo*), which have recently spread precariously. Xerothermic habitats are locally threatened



Havraníky Heath – stand with hundreds of black locust trees, caused by felling approximately ten full-grown trees and repeated cutting of root shoots in the following ten years. © Robert Stejskal



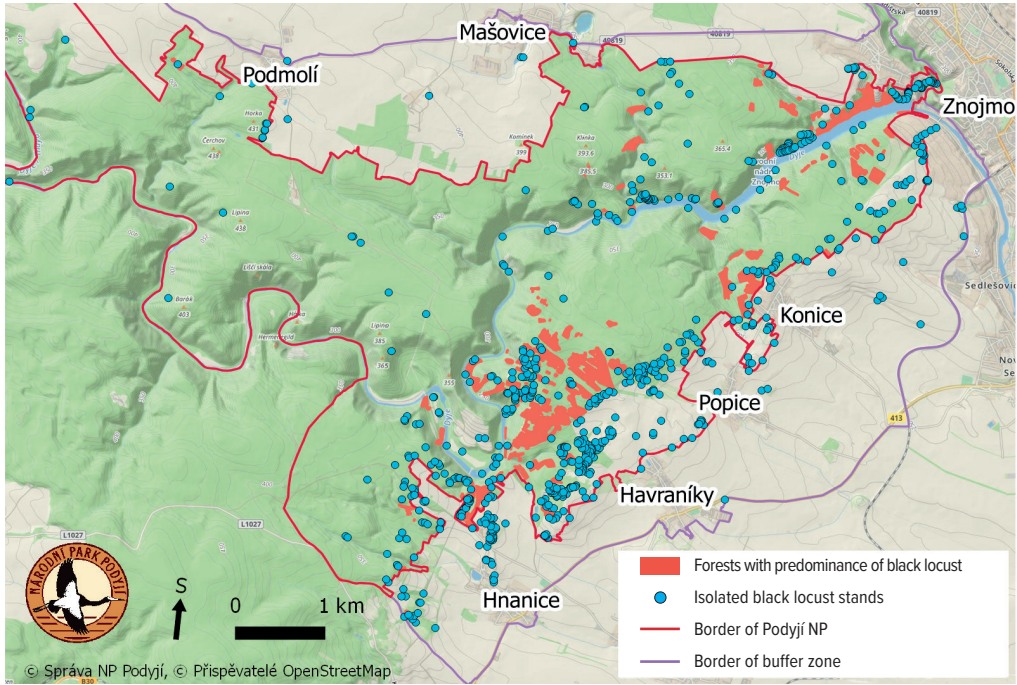
by the Lilac (*Syringa vulgaris*) and the Chinese wolfberry (*Lycium barbarum*), whereas humid forests are invaded by the overlooked Green ash (*Fraxinus penssylvanica*). The Oregon grape, also known as the Holly-leaved Berberry (*Mahonia aquifolium*) has so far gone unnoticed. It is locally invasive, similarly to Virginia creeper (*Parthenocissus* spp.). Less dangerous, though important in terms of size of the area of their occurrence, are the Norther red oak (*Quercus rubra*), Austrian or black pine (*Pinus nigra*) and te Douglas fir (*Pseudotsuga menziesii*). In the following text we will mainly focus on the issue of the Black locust.

How to defeat the Black locust

Efforts to control the Black locust began soon after the establishment of the NP in the early 1990s and have been a great conservation challenge to this day. Like anyone else who has dealt with the woody plant, also we had initially believed that black locust can be ‘overcome’ by ordinary felling. It soon became clear that the invasive alien speciesforming dense stands of unpleasant shoots, requires a special approach.

During the past 20 years, various mechanical, chemical, biological and combined methods have been used. The most frequent method was felling and smearing the saw cut in autumn, followed by yearly shoot elimination by applying a leaf herbicide for several years. Despite its high effectiveness, the method poses the risk of affecting the surrounding with the spray: it not only leads to a possible threat to valuable vegetation, but also to exposure of the soil surface, which increases the chance that invasive alien species or other undesirable vegetation re-establish there.

In order to minimize or completely ban herbicides in a valuable area, particularly the high-stump method followed by breaking off shoots over 3–5 years has been recently practised. In addition to high labour and time demands, the method is limited by the fact that it can only be applied at sites with sufficient shade, thus it is not recommended in black locust monocultures/plantations or at non-forest sites. Besides, a relatively high survival rate of the root system has been observed and black locusts creep by means of root shoots to surrounding clearings and ve-



Distribution map of black locust in Podyjí NP. Compiled by Robert Stejskal and Jaroslav Willmann



Dead black locusts (after injections) on loess among a rich population of *Alcea biennis* in the undergrowth. © Robert Stejskal

getation gaps. In rainy years, seemingly dead stumps rejuvenate.

On valley slopes and in the Dyje/Thaya River floodplain, technically and physically demanding girdling, otherwise practically ineffective in non-forest habitats, has locally proved to feasible.

In some places sheep and goat grazing has suppressed the black locust on heathland, but it has resisted grazing pressure in dense thickets and extensively grazed margins. Nevertheless, grazing can be recommended as an ideal management tool at sites where black locust has been removed successfully, since it reliably eliminates germinating -

Targeted control methods in a nutshell

These methods are a targeted treatment of invasive trees in which a herbicide is applied in a wound of the stem or trunk of each treated individual. The herbicide gets directly into the conductive tissues of the tree. If the treatment is performed correctly, the herbicide is distributed throughout the plant, stopping its growth until the plant dies off completely, moreover without forming unpleasant shoots. It is not enough to kill the above-ground part. The objective is to affect especially the root system, which is the brain of the plant. In practice, most often glyphosate preparations are used. The distinguished methods differ in the technique used and the trunk dimensions of the treated trees.

- 1. Drill-fill:** Basic method for the treatment of full-grown and middle-aged trees, in which the herbicide is applied into openings drilled at regular intervals on the circumference of the trunk.
- 2. Hack-and-fill:** Method for the treatment of young trees with approximately 3–5 cm thick stems which are too thick to peel off the bark and too thin to drill effectively. This method can also be applied to thicker trees (trunks up to 15 cm in diameter) with thin bark.
- 3. Partial bark stripping:** Basic method for the treatment of young individuals with 2–3 cm thick stems. The herbicide is applied in places after the bark has been peeled off on half the circumference of the stem.

Basic principles

- The methods allow regardful treatment of invasive trees of any size at the most valuable natural sites.
- They are especially intended for the treatment of small to medium-sized stands of invasive trees (single trees to a few hundred individuals).
- They are ideal in places where trees can be left to die gradually after treatment and the wood can be retained at the site temporarily or left to natural decay.
- They concentrate on killing mother plants while minimalising or completely eliminating shoot formation.

plants from the seed bank and sporadically appearing shoots. On a larger scale, grazing is unfortunately hindered by high technological and organisational demands.

Simply cutting shoots has shown to be completely inappropriate. Even after cutting for several years, the black locust not only remains, but rejuvenates even better when more is cut. Similarly, grubbing and digging up stumps or milling shoots were rejected. Just when the roots are disturbed, young shoots are formed in very high density.

In some stands we have relied on stand ‘aging’, i.e. leaving selected old black locust stands to natural decay. Unfortunately, when dead trees uproot, they start regenerating from the roots. Black locust thus does not even seem to recede in the competition of heliophobe sciophilous trees and shrubs, as is described by some authors (e.g. Vítková 2014), because even the smallest vegetation gap is enough for the successful rejuvenation.

Time for a change

Although the black locust has been successfully suppressed, comprehensive assessment has shown that removed stands not only regenerate, but also the number of new outbreaks rapidly increases. The exact data is not available, but the black locust is clearly spreading faster than we can control it applying the available management measures. Its spread is supported not only by human interventions but also by natural factors.

The Black locust spreads most often vegetatively when it is felled without using herbicides, either out of ignorance or in the naïve faith that shoots will later be eliminated by repeated cutting. A frequent problem is also insufficient management following up on deliberate felling. Black locust easily spreads when paths and tourist trails are maintained by shrub and tree cutting. A certain role maybe played by selective felling and tree theft.

The Black locust also finds good spreading conditions in oak forests where coppicing

has been resumed. It occupies fresh clearings there, often together with the Tree of Heaven. Recently, it has been spreading considerably in pine stands which massively die as the result from long-term droughts. Uprooted pine trees damage admixed black locusts, which evokes a production of lots of shoots. The spread is also supported by roe deer shaking out their antlers. Black locusts girdled that way then rejuvenate vegetatively. In recent years, the spread of other invasive trees has also accelerated in a certain way, either as a result of climate change or by increasing populations of invasive alien trees, e.g. the Tree of Heaven, Box elder or Green ash, in the open landscape.

In an effort to change the negative trend, we have started to look for new ways to manage invasive alien woody plants. After a range of trials and errors made in efforts to eliminate them mechanically, we have come to the conclusion that effective black locust management requires the use of herbicides, which is a fact on which a broad group of professionals agree (e.g. Vítková & Sádlo 2018, Pergl et al. 2016, etc.). But can the herbicide also be used without the risk of damaging the natural environment?

We have found the answer in Hungary, where our colleagues have been dealing with the regulation of invasive woody plants for several decades. The results of their efforts can be seen not only in Hungarian national parks, but also in other protected areas. All methods used in Hungary are clearly summarised in the publication *Practical Experiences in Invasive Alien Plant Control* by Csiszár & Korda (2017). Exactly their elaborate measures, verified by extensive field experiments, have become the basis for our further activity.

What are targeted control methods?

After thorough checking and considering all details by conservationists, broad discussions with many foreign experts and professional internships just ‘at the scene’ in the Kiskunság NP, we concluded that the Hungarian methods of controlling invasive trees and shrubs are worth trying out, at least experimentally. Management successes achieved with applying these methods in other countries such as



Slovakia, Italy, Cyprus and Israel were of great inspiration. The methods are also widespread in both parts of the American continent and in New Zealand.

The Hungarian methods are collectively referred to as targeted (direct) chemical control methods (TCCM). They basically are various modifications of herbicide injections directly into the invasive alien woody plant trunk, therefore combining a mechanical and a chemical treatment. Herbicide injections are not new to the Czech Republic. They have been known for decades and are included in the standard methodology *Likvidace vybraných invazních druhů rostlin* (Management of the Selected Alien Plant Species, Pergl et al. 2016). Here and there, injections were experimented with, but for unknown reasons the method has never been applied more and hardly any reports on practical experience in the Czech Republic have been published.

TCCM have been specially developed to control invasive alien plants at natural sites and in protected areas without negatively impacting sensitive habitats and non-targeted organisms, but their possible use is very universal in all types of the environment. TCCM eliminate the herbicide application on woody parts of a plant and exclude the spraying of its leaf surface because even very careful spraying affects the surroundings.

Why exactly targeted control methods

Regulation of the Black locust with common methods usually fails because we are not able to ensure regular suppression of shoots after the mother stand has been removed. After felling, the Black locust is able to rejuvenate at an exponential rate, particularly when no herbicide is used. We have always regarded the struggle with shoots a necessary evil. In practice it is strongly underestimated. Interventions (e.g. shoot cutting) usually have just a short-term effect and the original stand regenerates, only changing its form and age structure. The Hungarian experience therefore looked like incredible sci-fi to us, as black locust individuals really die off without later forming shoots (or with just minor rejuvenation) when correctly treated with TCCM.



(Acidophilous) thermophilous oak forests in Podyjí on valley slopes are habitats most endangered by black locust invasions. Besides former incidental exploitation, erosion and activity of wild animals contribute to this. © Robert Stejskal



Young black locusts girdled by roe deer antlers successfully sprout, form low-grade stems, and send root shoots out into the surrounding. © Robert Stejskal

Another typical aspect of TCCM is leaving treated trees to die gradually or to complete decay. Such an approach is completely opposite to conventional methods, which include wood removal. Practice has shown that especially the retention of young and middle-aged individuals is without any problems. Dry thin black locust shoots disintegrate ra-

ther quickly and practically ‘merge’ with the habitat. Medium-sized trunks can be left at the site or removed when the trunks accumulate in places where this is not desired. Full-grown trees may pose a risk to the surrounding as they may eventually fall down. It is recommended to leave black locust trees in forests in case they occur singly or in small



At several sites, overmature black locust stands disintegrate naturally. The trees do not die off, unfortunately, but regenerate successfully after uprooting. © Robert Stejskal



Podyjí NP has over 100 hectares of forest in which black locust predominates. These stands are mostly found at sites of former pastures. © Robert Stejskal

groups/clusters. TCCM are particularly ideal in the above situations. For extensive black locust growths, it is usually the best to remove the dead stand and replace it with a more valuable community. We follow the simple rule that the greater the risk of dry trees for the surrounding is, the sooner they must be removed or arboristically adjusted to a safe

torso. It is usually recommended to remove dead trees in the second season after treatment with TCCM. Close to paths and in other strongly exposed places, however, the trees must be removed earlier, but not before a clear effect of the applied herbicide appears, i.e. after complete defoliation of the treated trees, which occurs roughly a month

after application. We must however count with the formation of shoots and the need to adapt the follow-up management to that. The issue of retaining dying trees is very specific, requiring a separate article, so beware of simplified conclusions.

At first sight, it looks like treating each invasive tree individually is extremely laborious and slow. It is true that, mainly when dealing with high tree densities, in low-grade multi-stem stands or there where black locust grows in dense rose and bramble thickets, it is a time-consuming and physically demanding activity. However, considering that most trees die after a single treatment, combined with minimal or no shoot formation, this ‘investment’ pays off richly. Moreover, when comparing with the commonly used approach of smearing stumps after cutting and the subsequent several-year long spraying of shoots, TCCM are actually very fast and simple.

In my opinion, the most essential for conservationists is that thanks to target control we can afford to treat black locust trees growing directly among rare and endangered plants. In Podyjí NP, black locust often grows in valuable heathland habitats, on rock steppes and in species-rich dry grasslands, as well as in forest clearings, directly between tufts of *Pulsatilla grandis*, in *Dictamnus albus* populations and at orchid sites. In these situations, it is hard to imagine that black locust would be removed in the traditional way, i.e. by smearing the stumps after felling and subsequent spraying, which would devastate the site.

In conclusion, TCCM can be regarded a very powerful (but not almighty) instrument in the invasive alien woody plant control, applicable in almost every situation, not only in natural habitats. The first experience with applying these methods in the Podyjí/Thaya River NP has provided promising results. We can only try to pass the experience gained on to others interested in this issue. Following contributions will explore how the treatment of trees by means of TCCM is carried out, which equipment is needed, and what should be respected and taken into account during the procedure.