In Focus – Managing Forests in Europe

Introduced tree species in European forests: *opportunities and challenges*

Frank Krumm and Lucie Vítková (eds.)

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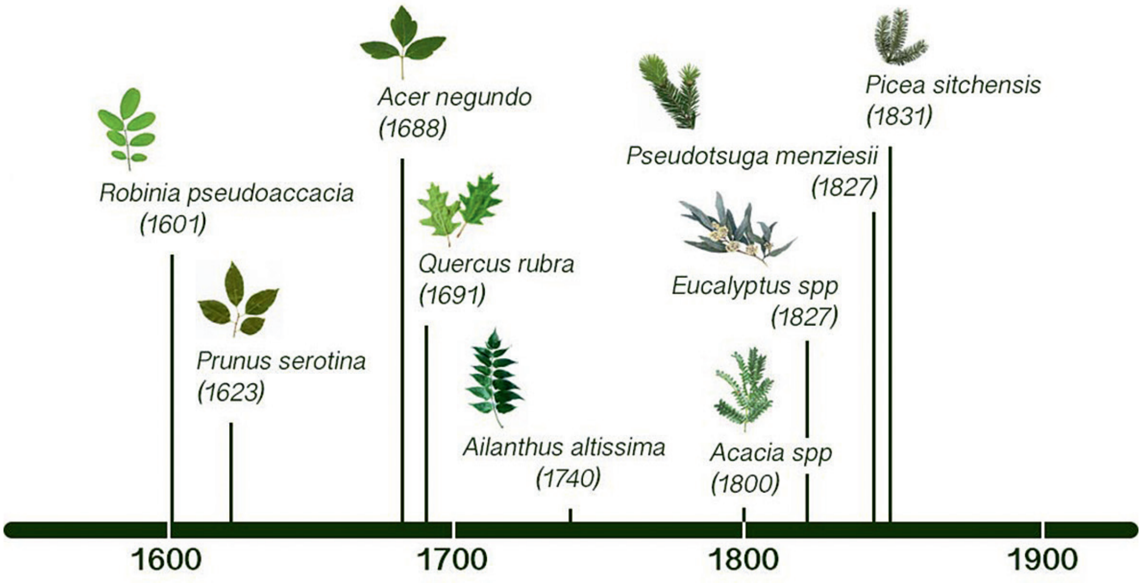

Figure 1. Time line of introductions of some of the important non-native tree species introduced to Europe.

3.6 Silvicultural strategies for introduced tree species in northern Italy

Fabio Meloni, Renzo Motta, Etienne Branquart, Tommaso Sitzia and Giorgio Vacchiano

> *More than 1000 non-native plant species have been introduced to Italy since 1492; this equates to more than 13 % of the total number of native species.*

Italy has a long history of human impact; the destruction of the former lowland forests and the country's position at the center of the main trade routes since ancient times greatly facilitated towards introduction and establishment of many non-native plant species in the country, which dates back thousands of years. A recent survey in Italy listed 1023 introduced plant species, 163 of which classed as permanently established having negative impacts on ecosystems or society (Celesti-Grapow et al. 2009). More than half of these species are found exclusively in man-made habitats such as artificial surfaces, agricultural land, forest plantations and artificial water bodies. Human disturbance plays an important role in increasing the richness of non-native flora and promoting its establishment. Artificial habitats, particularly cities, act as sources of introduced (both deliberately and accidentally) species that can be further spread by humans, for example through planting for ornamental purposes in parks and gardens (Kowarik 2003). Infrastructures, such as roads and railways, also provide opportunities for secondary dispersal of introduced species (Von der Lippe and Kowarik 2008). Some of the species introduced and facilitated by the above-mentioned means can cause negative impacts including toxicity to animals or humans, modifications of nutrient cycling and disturbance regimes, reduced provision of ecosystem services, or direct damage to man-made structures (e.g. Celesti-Grapow and Blasi 2004).

The bio-deterioration of the historical heritage (Figure 45) by fast growing and vigorous introduced tree species, and the reduction of native diversity, mostly in riparian, forest, wetland, and coastal habitats are considered amongst particularly relevant impacts for Italy. According to a recent survey of EU Life+ projects (Silva et al. 2014), the introduced tree species most often targeted for eradication by conservation projects across Europe are black locust (*Robinia pseudoacacia* L.), tree of heaven (*Ailanthus altissima* (Mill.) Swingle), red oak (*Quercus rubra* L.), and black cherry (*Prunus serotina* Ehrh.) (Silva et al. 2014). In this chapter, we report on the few field experiences and success stories of silvicultural control of these introduced tree species in urban and natural habitats in northern Italy.

There is broad evidence that silvicultural practices can either enhance or hamper biological invasions. Planting introduced tree species for uses such as wind breaks, biomass production, or fire protection and erosion control increases the probability of invasion (Cierjacks et al. 2013). Management practices such as clearcutting, group cutting, and coppicing can also promote the regeneration of some introduced tree species (Radtke et al. 2013).

Forest managers can apply silvicultural options to alter interspecific competition to suppress unwanted regeneration of introduced species at a local level and thus support the desired tree species composition.

Figure 48. Tree of heaven on roofs of the Alessandria Citadel (18th century), a monument in the Tentative list for UNESCO World Heritage sites(photo: T. Tobia, released under Creative Commons Attribution-Share Alike 3.0 Unported license. https://commons.wikimedia.org/wiki/File:La_Cittadella_di_Alessandria_04.JPG).

However, shelterwood or selection systems may be considered as a promising means towards reducing invasion risks while preserving native communities (Sitzia et al. 2012). Even the simple maintenance of continuous tree cover can prevent, or at least slow down, the spread of some introduced tree species (Table 20). While there is a wealth of information available to forest managers on some species such as black locust, the effect of silvicultural strategies has been much less studied for other equally, or even more aggressive species, such as tree of heaven or black cherry, which suggests a large research potential.

Table 20. Silvicultural measures aimed at reducing the spread of introduced tree species in Italy (modified from Sitzia et al. 2016)

Species	Examples of silvicultural measures
Tree of heaven (*Ailanthus altissima* (Mill.) Swingle)	Avoid coppicing (Radtke et al. 2013) Cut seed trees (Skowronek et al. 2014) Underplant or seed shade-tolerant native species (Skowronek et al. 2014) Prescribed burning (Rebbeck et al. 2014) Protective belt of native trees (ECORICE 2015)
Black cherry (*Prunus serotina* Ehrh.)	Avoid clearcutting and openings (Terwei et al. 2013) Mowing suckers (Caronni 2009) Conversion of coppice to high forest (Caronni 2009) Underplant or seed shade-tolerant native species (Skowronek et al. 2014) Ageing with absence of treatments (allowing other tree species to follow in the succession without any other treatment) (Starfinger et al. 2003) Maintain or facilitate closed canopy (Annighöfer et al. 2015) Promote native species (Annighöfer et al. 2015) Girdling (Annighöfer et al. 2012) Single tree selection or group selection (Annighöfer et al. 2015)
Red oak (*Quercus rubra* L.)	Underplant or seed shade-tolerant native species (ECORICE 2015) Repeated spring or summer coppicing Soil tillage (ECORICE 2015)
Black locust (*Robinia pseudoacacia* L.)	Avoid coppicing (Radtke et al. 2013) Coppice ageing (Motta et al. 2009) Promote native species Conversion of coppice to high forest Release high number of standards in coppices (Radtke et al. 2013) Drill-and-fill (holes are drilled into trees and filled with herbicide) (Michigan Department of Natural Resources 2012) Avoid clearcutting and openings (Terwei et al. 2013) Girdling (Maetzke 2005) Protective belt of native trees (Giambastiani et al. 2005) Single tree selection or group selection (Terzuolo and Canavesio 2010) Pollarding (Maltoni et al. 2012)

Prevention: in the initial stages of invasion, an uneven-aged, multilayered forest structure with high permanent canopy cover can slow down and push back the invasion.

Promoting the growth and crown expansion of native species, especially if fast-growing, helps to prevent invasion by most of the introduced tree species, as they are light-demanding and their growth is limited by shading (with the exception of black cherry). Highly competitive native species, e.g. fast-growing, root-sprouting aspen (*Populus tremula* L.), white poplar (*Populus alba* L.) or willows (*Salix* spp.) in lowland forests, or slower-growing but shade-tolerant hornbeam (*Carpinus betulus* L.), maples (*Acer* spp.), and hazel (*Corylus avellana* L.) in upland mixed hardwood forests, can be planted in gaps, under the cover of introduced species or in dense protective belts around sites that have been invaded. In Natura 2000 areas and other sites of high conservation values, prevention can be achieved by avoiding opening of canopy gaps and ensuring regeneration of native species by under-planting.

Control: removal of seed trees (using the drill-and-fill technique, felling, or girdling and applying subsequent stump chemical treatment where necessary) and avoiding the creation of large gaps are very important in avoiding the natural regeneration of introduced tree species.

Chemical treatments can be a reasonable complementary method to silvicultural measures, depending on the situation. The drill-and-fill technique involves drilling a hole into a tree at a downward angle (towards the pith), and filling the hole with herbicide. The bigger the tree, the more holes and herbicide are needed. This technique can be applied on a limited number of stems since its application is expensive.

Girdling (Figure 49) has provided diverse results (e.g. 30–50 % of girdled trees still produced root shoots; Silva et al. 2014) and has been considered more effective on larger trees. A ring of bark must be completely removed from the whole circumference of the tree; local experience showed that the ring should be at least 15–20 cm wide for this technique to be effective. The removal of the ring, especially if carried out at the beginning of the growing season, prevents movement of water and metabolites around the tree, blocking first root growth and then water and nutrient uptake. The tree wilts and the part of the tree above the ring-barking zone dies. However, the technique may induce a large seed crop in the last year before the tree death occurs (Maetzke 2005). Mechanical treatment to control regeneration of introduced species (e.g. uprooting seedlings and repeated mechanical cleaning of suckers) is feasible only in low-invasion areas.

No management at the last invasion stage; i.e. refraining from management by allowing other tree species to follow in the succession without applying any other treatment in areas with low propagule pressure.

Figure 49. Girdling on black cherry (photo: Wisconsin Dept. of Natural Resources, released under Creative Commons 2.0 License. https://www.flickr.com/photos/widnr/6588710907).

In heavily invaded forests, silviculture can be less effective and more expensive; a viable option is to refrain from management; i.e. letting the invasion cohort mature and grow old (assuming that propagule pressure is not high). The following control strategies are applicable only at small scales, and should always be complemented by planting native species:

1. **Seed trees:** cutting or girdling, supplemented by chemical treatment where necessary (e.g. drill-and-fill, stem injection or stump spraying).

2. **One to two year-old:** mechanical removal or coppicing, repeated as often as necessary during the growing season in order to deplete carbohydrate reserves in the stump and roots. The best timing for this technique to be applied is in spring or summer when the reserves are concentrated in the shoots.

3. **Seedlings (< 2 m height):** uprooting (manual or mechanical) or chemical treatment; dense regeneration clumps can be removed by soil chopping or mastication, but only for species incapable of root-sprouting (e.g. red oak; Table 20).

4. **Pole stage or coppice:** shorten coppice rotation, i.e. 5–15 years, or shorter than the age of sexual maturity (Figure 50) followed by 1) or 2) to suppress stumps and shoots.

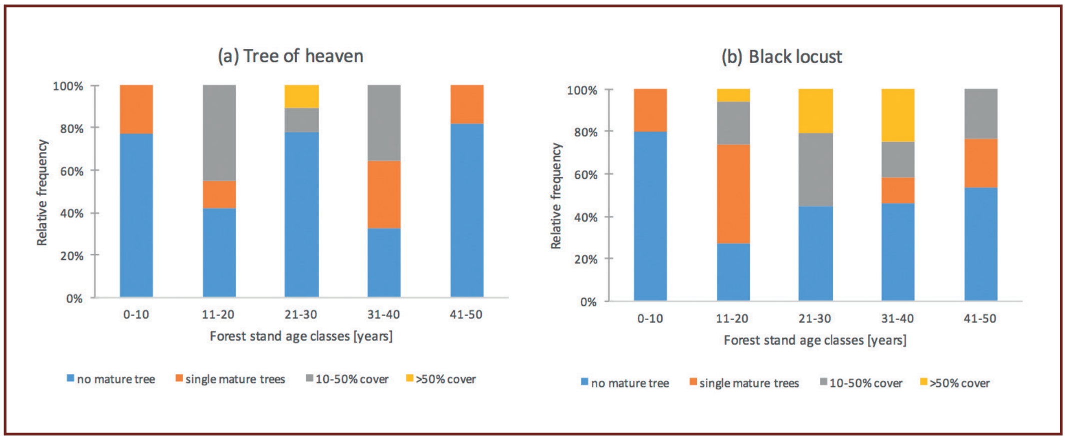

Figure 50. Abundance of tree of heaven (a) and black locust (b) in the canopy (in classes) per forest stand age class, frequency of cases over 113 plots in the upper Etsch Valley in South Tyrol, northern Italy (amended from Radtke et al. 2013).

In highly invaded Natura 2000 sites, small scale eradication could be attempted by the removal of all individuals (including as many the roots as possible), tillage, planting and seeding of a native herbs-shrubs-tree mixture, and intensive tending for the duration of five years. A slower but more extensive control measure is single tree thinning combined with under-planting using e.g. poplar (*Populus* spp.) or shade-tolerant species also utilising mechanical control of natural regeneration. If eradicating invasive species proves impossible or too expensive, a novel ecosystem might therefore be acknowledged and managed for any ecosystem services it may provide; this may be referred to as potential integration stage (see Box 17: Silviculture of black locust).

Species-specific strategies based on experiences in northern Italy – black locust

Black locust is a highly light-demanding species (Huntley 1990). Disturbances like clearcutting may result in suckering of black locust's stumps or in the germination of seed-banks (the seeds of black locust are particularly long-lived in forests). The replacement of native temperate forests by black locust is usually associated with tree felling, clearcutting, coppicing, forest decline or other perturbations (Motta et al. 2009).

However, the competitiveness of black locust is much less pronounced in closed canopy forests as well as in various habitats on mesic and nutrient-rich soils (Sitzia et al. 2012). For this reason, although capable of altering natural ecosystems, invasion can be effectively contained by silvicultural practices. Thirty-three EU LIFE projects that were carried out between 1997 and 2014 in stands invaded by black locust yielded some common experiences (Silva et al. 2014):

- Mechanical control is difficult and costly; simple cutting of the aboveground parts aggravates the sprouting of shoots. Cutting or burning generally increases sucker and sprout production and it should be therefore avoided, unless a repeated treatment is applied. However, this is an expensive option and the sites are often treated only once and the problem of invasion at the site is assumed to have been solved. Follow-up treatments are required for all these operations.

- Cutting and chemical control was often extremely effective (Riparia-Ter LIFE08 NAT/E/000072 and Proyecto Estany LIFE08 NAT/E/000078). The application of herbicides to live standing young trees has shown best success. However, sprouting may occur after chemical application; therefore, a follow-up treatment is usually necessary.
- Cutting and grazing by goats or sheep was effective in some projects (GrassHabit LIFE05 NAT/H/000117 and HUNVIPURS LIFE04 NAT/ HU/000116); in North Carolina (USA), for instance, after four seasons of browsing by a combination of cattle and domestic goats, all black locust died (Michigan Department of Natural Resources 2012). Goats have been reported to be a better grazing animal for the control (Stone 2009). Since black locust can be toxic to cattle, caution is thus advised.

BOX 17. Silviculture of black locust

Black locust is a widespread species in northern Italy (where it covers 233 000 ha, which equates to 2.3 % of forests nationwide, but up to 11 % in some regions; e.g. Piedmont) and a potentially important source of timber and energy.

In severely invaded stands where no ecosystem service is at risk, management can be oriented towards timber production (using coppice and/or high forest with long rotations), especially in stands dominated by black locust and where its annual growth can exceed 12 m^3/ha (Terzuolo and Canavesio 2010).

Other potential uses include biomass, poles for agriculture and slope stabilisation works, and honey production (with yield exceeding 400 kg/ha in 10–20 years old forests). Even nature conservation goals can be attained by e.g. managing linear formations and riparian belts as ecological corridors (coppice with 6–10 year rotation) or lowland stands as bird nesting areas (coppice with 15–20 year rotation and release of 200 reserves trees/ha). In invaded stands where no treatment has been applied for 40 years and where the shrub layer of elder (*Sambucus nigra* L.) and hazel, is well developed (1500 stems/ha), such sites are considered to be ideal for e.g. bird foraging due to light canopy cover by black locust (Pividori and Grieco 2003). Shrubs may also act as nursing sites for more shade-tolerant herbaceous species, which are otherwise absent in black locust stands.

The opportunities offered by black locust, as well as the relative facility of its control, require that management strategies are differentiated according to specific objectives in terms of resource exploitation, habitat conservation or local eradication goals, which do not necessarily contradict each other.

To prevent invasion, edges of native forests and openings in a close proximity to black locust stands can be planted with native species and maintained by irrigation and mowing in order to create protective belts that are at least 20 m wide (Giambastiani et al. 2005). The canopy of these forest stands makes it more difficult for the light-demanding black locust to naturally regenerate and become established.

Refraining from all management may be the most effective strategy to induce a decline of black locust and facilitate the recovery of local tree species. Monitoring of the stand dynamics in invaded forests in northern Italy showed that the relative stand basal area represented by black locust decreased – after no treatment being applied – from 100 % to only 28 % (Figure 51) (Pividori and Grieco 2003). In invaded forests, when other species occur and can disperse, refraining from cutting can be more effective and less expensive as opposed to an active removal of black locust. In turn, however, no management may lead to mechanical instability of trees, especially if competition for light is intense, and thus lower the soil protection.

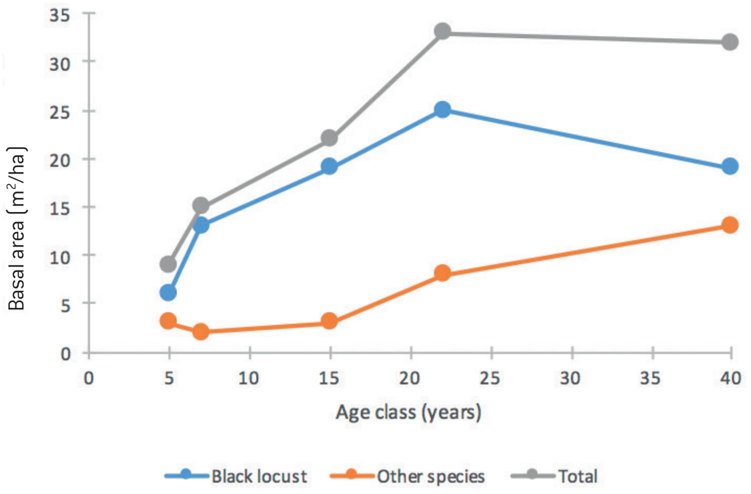

Figure 51. Basal area of black locust and native species in a chronosequence of invaded coppices in Piedmont, Italy (amended from Pividori and Grieco 2003).

In areas that are particularly significant for biodiversity (e.g. nature parks) or recreation, local eradication can be favoured by irregular thinning or selection cutting to promote native species and driving the forest towards an uneven-aged, continuous cover stand structure, accompanied by underplanting of shade-tolerant species (Terzuolo and Canavesio 2010). Large openings should be avoided or planted with native fast-growing species such as hop-hornbeam (*Ostrya carpinifolia* Scop.), hazel, maples, black poplar (*Populus nigra* L.) and white poplar; seed trees around openings could be treated mechanically (cutting/girdling) and/or chemically (if allowed).

In coppice stands dominated by black locust, clearcutting of black locust may enhance its vegetative regeneration; it is important to note that vegetative offsprings are more shade-tolerant than black locust seedlings (Knapp and Canham 2000). Their growth can be hindered by avoiding clearcuts and reducing the light availability by conversion into high forest by applying 2–3 selection thinnings on individual shoots at 20 and 30 years. The second possibility could be to prolong the rotation as much as possible, then release a high number of standards at clearcut (Radtke et al. 2013). In mixed-species coppices or mixed coppice and high-forest stands, black locust should be coppiced 0–10 years before the thinning of the dominant native canopy to limit invasive potential by maintaining some cover formed by the native species. A highly effective method to reduce the cover of black locust is to maintain the vegetation cover, especially where such management is a priority in order to provide protection against landslides and rock fall (e.g. on slopes) (Jancke et al. 2009). As sprouting is regulated by auxins, coppicing in June is the most effective way of reducing the number of vegetative sprouts since auxins are at high concentrations and located in the shoots with carbohydrate reserves in the roots being at the lowest point (Sterrett and Chappell 1967). An effective form of control is pollarding at the height of 2.5–3 m. This reduces crown vigor and root sucker production (Maltoni et al. 2012).

The growth rate of certain native tree species must also be carefully considered; sweet chestnut (*Castanea sativa* Mill.) can produce a fast growth after coppicing and thinning is applied with oak species usually growing much slower. If possible, there should be a dominant oak canopy prior to cutting (e.g. when converting to high forest) and black locust should be coppiced before the oak component is thinned. The interval between subsequent treatments should be prolonged considering under-planting with native species as a useful method. In Mediterranean areas, holm oak (*Quercus ilex* L.) and pines (*Pinus* spp.) usually show rapid growth with the former being particularly effective in outcompeting black locust due to casting high shade and creating a competitive shrub layer (Maltoni et al. 2012).

Species-specific strategies based on experiences in northern Italy – tree of heaven

Tree of heaven is a ubiquitous species (see chapter 5.7) currently established from the lowland area to the montane belt in northern Italy, with a preference for warmer sites. Tree of heaven tolerates dry and saline soils but it does not grow well on sites that are prone to flooding. Although capable of very fast growth rates (height increment up to 4 m per year), it is not particularly light-demanding and it is therefore able to establish in even small gaps under a closed forest canopy. Seed production starts between 3 to 5 years of tree's age and is considered rather abundant every year. Sprouts are promoted by allelopathic root exudates produced by the parent tree.

Suggested control strategies include the manual removal of individual trees in the earliest phases of the development, which is recommended in less intensively invaded areas when the native vegetation can still benefit and out-compete the invader. The application of girdling is considered to be more effective if carried out in spring on mature trees and when combined with slash disposal or burning (Box 18).

Prescribed burning can reduce competitiveness of tree of heaven relative to more fire-resistant native species (Rebbeck et al. 2014). Biological methods such as grazing, natural competitors or enemies or enhancement of native species competition are generally not effective due to tree of heaven's resistance to parasites, low palatability of its foliage, and its ability to rapidly surpass its competitors. In invaded riparian forests in Natura 2000 site (Habitat 91E0), control measures were successfully combined with the planting and tending of 'protective' belts of native tree species and shrub vegetation (Figure 49) around invasion nuclei in order to prevent further spread (ECORICE 2015).

Experience on silvicultural management of tree of heaven is still rather limited with most management measures showing only partial effectiveness. Prevention of spread to uninvaded areas and monitoring of invasion below a closed canopy are the only experience-based recommendations that can be formulated at this point.

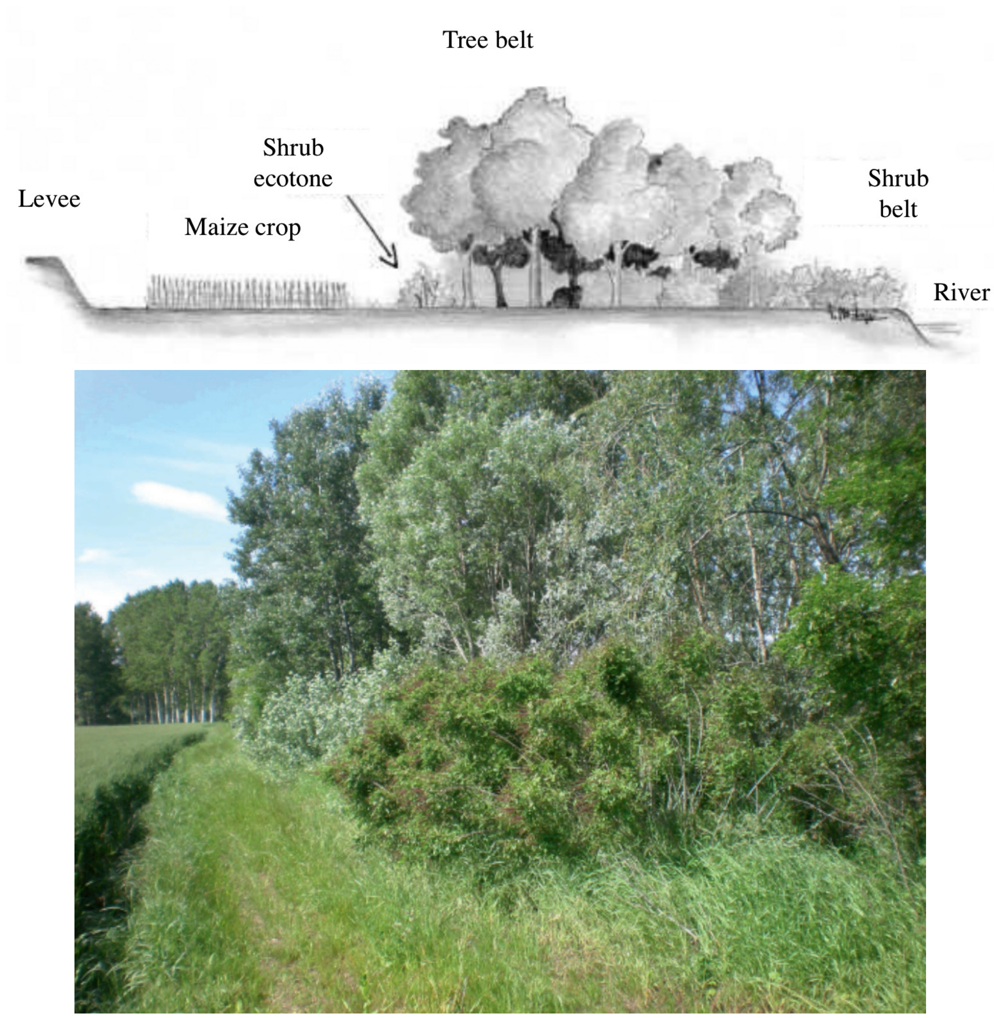

Figure 52. Protective shrub and tree belt to prevent spreading of introduced tree species to river ecosystems (a); protective tree belt in Piovera (AL, Italy) along the Po river (b).

BOX 18. Managing slash to contain introduced tree species

Management of slash is a complex and sensitive part of the process of cutting and mowing operations that are used to control the spread of introduced and invasive tree species. If not correctly disposed of, vegetative parts, fruits, or seeds of introduced tree species can be transported to uninvaded sites and facilitate future colonisation (Figure 53).

Slash can be effectively piled and burned on site or at wood production facilities provided that all regulations for fire prevention and smoke emissions are carefully followed (LIFE09 NAT/IT/000118 2015). Incinerating the disposed slash is considered to be the safest strategy for destroying the vegetative parts, seeds, and fruits of introduced and invasive species. Disposal at dumps must be avoided since the waste is not always properly sealed and the seeds or vegetative parts can be spread by the wind into the surrounding areas.

Other methods include anaerobic digestion or composting (never for tree of heaven), which must be carried out in authorised industrial facilities that comply with existing regulations (e.g. D.M. 5-2-1998 in Italy). Aerobic transformation must be ensured in such case; i.e. the thermophilic stage must take place (55°C must be maintained for > 72 hours). This process stabilises organic matter and completely decomposes the seeds and vegetative parts of the invasive plants. Unintentional dispersal of slash during temporary storage and transport should be avoided.

Figure 53. Tree of heaven re-sprouts even after herbicide use (photo: released under Creative Commons Attribution-Share Alike 4.0 International license. https://en.wikipedia.org/wiki/File:Tree_of_Heaven_Re-sprouting.jpg).

Species-specific strategies based on experiences in northern Italy – red oak

Red oak thrives on acidic sites and it is able to tolerate compacted and seasonally flooded soils. However, it does not grow well in clay, limestone soils and on drier sites. Its seedlings are shade-tolerant and can establish below a closed canopy. Red oak acorns are produced in mast seeding years that occur every 3 to 5 years after the age of about 25 years with a limited viability of the seeds between the age of 25 and 50.

The natural regeneration of red oak is denser closer to the parent trees, where the accumulation of litter is greater as it favours the preservation and germination of the acorns (Garcia et al. 2002). The thick litter of dead leaves is essential for protection of the acorns against weathering; it further inhibits regeneration of other tree species. The natural regeneration of red oak is hampered under the canopies of tree species with particularly dense canopies such as hornbeam. Forests most threatened by red oak invasion are bottomland oak-hornbeam forests of the plains and interior hills (EU Habitat 9160), sweet chestnut forests, mixed floodplain and alluvial forests of alder (*Alnus* spp.) and willow species.

Repeated and frequent coppicing of sprouts in spring or summer (at least 1–2 cuts per year) can exhaust the stump. The possibility of vegetative growth from the stump increases with the size of the tree to up to the age of 60 years. The ability to produce sprouts is reduced by 50 % at the age of 80 years. These measures may be accompanied by tillage and under-planting or seeding with fast-growing native species such as aspen or birch (*Betula pendula* Roth) (ECORICE 2015). Based on these experiences, repeated coppicing and underplanting is recommended in order to avoid natural regeneration from seed and to gradually deplete red oak's capacity to vegetatively regenerate.

Species-specific strategies based on experiences in northern Italy – black cherry

Black cherry displays a high resistance to drought. In Italy, this species does not grow well in waterlogged or calcareous soils. Black cherry can also tolerate high shade and its saplings often develop a 'sit-and-wait' strategy; once released by a disturbance-induced gap, they grow rapidly into the canopy also producing large amounts of seed.

In disturbed areas with low propagule pressure, the germination and establishment of black cherry can be hindered by brambles (*Rubus* spp.). In such case, although the overtopped black locust saplings die, they can subsequently re-sprout from roots and stumps. The absence of disturbances often leads to a reduction in the number of individuals during the succession process.

Silvicultural control measures have not been effective due to black cherry's high tolerance to shading and capability to reproduce vegetatively or from the seed. Black cherry has been difficult to control; in Parco del Ticino in northern Italy, for instance, black cherry successfully invaded 514 ha. Although the entire area was continuously treated over 10 years by a mix of control measures (i.e. complete stem removal, repeated mowing, simultaneous conversion of native coppices to high forests, and planting native species, which cost €830 000), the species re-appeared within the next few years (Caronni 2009). The recommendation based on the experience from Parco del Ticino is therefore to concentrate all eradication efforts on the edges of the invaded area. The following management actions can also be considered in a light of black cherry eradication: e.g. conversion of coppice to high forest, total removal of adult trees, maintenance of a closed canopy, mowing of suckers (repeated for the duration of 3 to 5 years), application of herbicide (Triclopyr), and under-planting with shade-tolerant native species.

Cutting black cherry stems proves to be ineffective as observational studies in Italy showed that re-sprouting occurred on all felled trees. In highly invaded stands, disturbances that may activate the soil seed bank should be minimised (Skowronek et al 2014). With the support of a recently developed simulation model based on diameter class demography through time, it has been suggested that felling only the largest trees could be effective in reducing the abundance of black cherry and result in positive revenues for the landowners. On the other hand, intensive harvesting should be avoided because it could lead to a substantial depletion of nutrients from the soil and produce canopy openings that would be conducive for the pioneer characteristics of black cherry (Annighöfer et al. 2015).

Regulating stand density, seedbed and microclimate by using specific silvicultural treatments can be effective in preventing or mitigating the spread of some invasive tree species causing low impact to the environmental.

The need to choose an appropriate management strategy to address invasions by introduced tree species belongs a the set of possible measures associated with each invasive species trait, invasion stage, and site and environmental condition (Simberloff 2014). This requires a systematic valuation of the methods' efficiency across different regions and ecosystem types. Furthermore, appropriate silvicultural measures applied to native forest habitats can help maintain or improve their resistance to invasions. In all cases, the most effective results are obtained when suitable prevention and eradication measures, continuous monitoring, and awareness-raising campaigns are carried out.

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In Focus – Managing Forests in Europe



In the context of forest and landscape management, the use of introduced tree species is an important and controversial topic. On one hand, the species can provide an opportunity for timber production and for adapting the species composition within forests so that forests can better cope with the changing climate while on the other hand, such species may cause biodiversity loss and/or disturbance to native ecosystems.

Introduced tree species in European forests – opportunities and challenges is a compilation of scientific and practical knowledge on introduced tree species in European forests and contains contributions from 89 authors from 18 countries.

The historical context of species introductions plays a key role in understanding the current as well as possible future distribution of tree species. There has been an intensive discussion on the interactions between the introduced tree species and their introduced environment, and also on the processes that may lead to the species becoming invasive within their introduced range. The risk of a species becoming invasive can be evaluated using suitable risk assessments that help us to predict the future behaviour of the species, and also the potential contributions of these species to ecosystem services provided by the forests where they occur. Therefore, the links between the introduced tree species and the key topics such as economics, climate change, pests and diseases and effects on biodiversity are also assessed in order to demonstrate the complexity of the issues pertaining to the introduction of tree species. Case studies of selected introduced tree species occurring in Europe are presented to demonstrate the necessity to manage ecosystems in order to fulfil certain goals; the case studies cover species-specific and site-specific experiences as sharing the application of suitable management practices is of particular interest.