DENDROBIOLOGY

2022, vol. 89, 20–26

https://doi.org/10.12657/denbio.089.002

Ingo Kowarik

The Mediterranean tree *Acer monspessulanum* invades urban greenspaces in Berlin

Received: 8 November 2022; Accepted: 19 December 2022

Abstract: Because biological invasions by some introduced tree species pose a major threat to biodiversity, early detection of invasion risks is important for managing existing and future plantings and mitigating negative impacts of invasions. *Acer monspessulanum* is a European tree species with a large Mediterranean and sub-Mediterranean range. Due to its high drought resistance, it is considered well adapted to climate change and a promising future tree for urban plantings. This study aimed to determine whether invasion risks are associated with plantings in cities outside the species' natural range. Rare old plantings of *A. monspessulanum* in Berlin, Germany, were used as a model to investigate whether urban plantings can be invasion foci in cities with a temperate climate. For this purpose, the surroundings of cultivated trees were examined with regard to natural regeneration and the number and height of naturally regenerated individuals and their distance from the parent tree were determined. *Acer monspessulanum* started to spread 273 years after the first cultivation in Berlin. Each of the sampled four plantings had local spontaneous populations, mostly colonizing loose, semi-shaded anthropogenic hedges and forest patches. A total of 814 spontaneous individuals were detected, with a maximum height of 4.5 m. The maximum distance to the next parent tree was 106 m. However, most individuals grew below or close to the canopy of parent trees. The results indicate that increased planting of *A. monspessulanum* can induce invasion processes in cities beyond its native range. However, negative invasion impacts from urban plantings are not to be expected in cities with similar environmental conditions as Berlin. Therefore, the species is not considered invasive. Despite a decades-long spread period, the spontaneous populations were confined to the adjacency of propagule sources and the invaded urban greenspaces had a low conservation value. As a positive effect, natural regeneration of *A. monspessulanum* in such settings could increase the resilience of urban forest patches to climate change. However, further spread should be monitored and plantings near rocky sites with dry grasslands of conservation concern should be avoided.

Keywords: assisted migration, tree invasion, natural regeneration, introduced species, urban forestry

Address: I. Kowarik, Department of Ecology, Technische Universität Berlin, Rothenburgstr. 12, 12165 Berlin, Germany, e-mail: kowarik@tu-berlin.de

Introduction

Invasions by some introduced tree species pose a significant threat to biodiversity worldwide (Richardson & Rejmánek, 2011). Cities are an important focus of the introduction and cultivation of non-native trees and escape from urban plantings has greatly changed many urban floras (Chocholoušková

& Pyšek, 2003; Kowarik et al., 2013). In Berlin, for example, the proportion of non-native species in the spontaneous woody flora increased from 16% at the end of the 18th century to 67% two hundred years later (Kowarik et al., 2013). Escape from cultivation can result in conflicts with biodiversity conservation (Potgieter et al., 2017), which have been described from Central Europe, for example, for *Robinia pseudocacia* (Vítková et al., 2017).

As climate change poses an increasingly pressing challenge for urban trees, the use of species from warmer distribution areas is recommended because the supply of suitable native species is often limited, particularly for harsh urban sites (Sjöman et al., 2016). Urban plantings are also discussed in terms of assisted migration and can provide stepping stones for the dispersal of species from adjacent warmer areas (Han et al., 2021). However, new risks could also arise if new plantations function as invasion foci. Therefore, early detection of invasion risks is essential to adequately manage current and future tree plantings and to prevent potential negative consequences of spread at an early stage (Brundu et al., 2020).

Recommended new trees for urban sites include French or Montpellier maple (*Acer monspessulanum*; Vogt et al., 2017; Böll, 2018). This species has a large Mediterranean and sub-Mediterranean native range and its high drought resistance is well documented (Tissier et al., 2004; Sjöman et al., 2015). Experimental plantings along streets in German cities have demonstrated satisfying growth characteristics and a sufficient frost tolerance, even in climatically less favored cities such as Kempten (Böll, 2018; Schönfeld & Böll, 2021). Whether urban plantings of *A. monspessulanum* can serve as invasion foci in cities with a temperate climate is unknown so far. This is a relevant question because the onset of fruiting has been reported as early as the fifth year after planting as a street tree (Böll, 2018) – and the amount of seeds available (i.e., propagule pressure) is a powerful predictor of invasion success (Pyšek et al., 2009).

This study addresses the question of whether the increased planting of *A. monspessulanum* expected in the future could be associated with invasion risks in urban environments. To answer this question, the few known old *A. monspessulanum* plantings in Berlin, Germany, were taken as a model to examine the relationship between the availability of propagule sources and natural regeneration. The study questions were (1) whether natural regeneration occurred in the vicinity of cultivated old *A. monspessulanum* trees, (2) how large any spontaneous populations were, (3) which growth heights naturally regenerated individuals reached, and (4) to what distance they were able to spread from the nearest cultivated tree as propagule source.

Materials and Methods

Study species

Acer monspessulanum L. is a slow-growing, medium-sized and often multi-stemmed tree with small, three-lobed leaves. The large natural range covers regions with Mediterranean and sub-Mediterranean climate in Europe, Western Asia and North Africa (Mai, 1988). In Europe, the tree is a typical component of mixed deciduous forests (*Quercetalia pubenscentis*) and hedges (Horvat et al., 1974; Botineau et al., 1998). *Acer monspessulanum* had been part of the Tertiary flora of today's Germany (Mai, 1988). In the warmest regions of this country, there are natural outposts from the sub-Mediterranean range on south-facing, shallow slopes along the Rhine and its tributaries. *Acer monspessulanum* here is a component of thermophilic forest communities (*Aceri monspessulani-Quercetum petraeae;* Oberdorfer, 1992) and also colonizes abandoned vineyards (Streitz, 2001).

From Berlin, first *A. monspessulanum* plantings were documented 276 years ago from the then famous garden of Christian Ludwig Krause (Roloff, 1746). Although the natural regeneration of non-native woody species has long been studied in Berlin (Bolle, 1886; Kowarik, 1992), Berlin's current flora does not report spontaneous occurrences of *A. monspessulanum* (Seitz et al., 2018). Apart from few recent plantings of young trees along roads, only a few old trees are known that could function as invasion foci.

Study sites

In Berlin, four sites with cultivated *A. monspessulanum* trees were sampled, spanning rural, sub-urban and urban environments (Table 1). Two trees were legally protected as natural monuments (heritage trees; sites A, B). The estimated height of cultivated trees ranged from approximately 8–20 m, and the circumference measured at 1.3 m from 64–178 cm. The exact age is unknown, but was likely more than 70 years at sites A–C. Site C harbored nine closely spaced, partially multi-stemmed trees in an area of about 6 × 32 m, located between a railroad corridor and a lawn. This dense stand was multilayered and interspersed with other tree and shrub species, some planted and some from natural regeneration, with *Acer platanoides* as most abundant among the latter.

Natural regeneration

At all sites, the area surrounding the planted trees was visually inspected for natural regeneration in October 2022 and the number of spontaneous individuals was determined. The distance of the searched area from the initial planting depended on

Table 1. Study sites A-D in Berlin and characteristics of planted *Acer monspessulanum* trees, related spontaneous populations and invaded habitats

Site	District of Berlin (coordinates)	Location in urban matrix, major land uses	Planted trees c: circumference [cm], h: height [m]	Size of spontaneous population	Maximum distance to parent tree [m]	Invaded habitats
A	Treptow-Köpenick (52.45198198344655, 13.467360409252821)	Suburban agricultural remnant, vacant land, road corridor	1 tree (h: 12)	7	45	Hedges, shrub planting
B	Mitte (52.54987358493827, 13.358946398408566)	Urban core, late 19th century residential area, backyard with ornamental plantings	1 tree (c: 178, h: 20)	4	4	Ornamental planting
C	Steglitz-Zehlendorf (52.43771992432515, 13.277550339977385)	Suburban residential area from the 1930s, greenway along a railway corridor with lawns, hedges and woodland patches	9 trees (h: 12-14), including 1 three-trunked (c: 126, 107, 99), 3 two-trunked (c: 133, 110; 88, 83; 115, 81) and 6 one-trunked (c: 130, 118, 117, 104, 87, 64) trees	781	106	Hedges, shrub plantings, woodland patches
D	Steglitz-Zehlendorf (52.45662701003276, 13.304484720575791)	Suburban, Botanical Garden, tree and shrub plantings in grassland	1 tree (h: 8, c: 138)	22	11	Shrub/ grassland complex

local conditions. At sites A and C, sites potentially suitable for regeneration were searched to a distance of 160–230 m along the main wind direction. The search radius in other directions was smaller, as regeneration occurred here only in close proximity to the parent trees. At site B, the search was limited to the yard, which was surrounded by tall buildings on three sides and the adjacent yard was not accessible to the fourth side. At site D, the search radius covered the adjacent grassland/shrub complexes because no regeneration occurred in the adjacent intensively maintained beds and dense beech woodland.

Individuals were counted except of site C, which had a large number of small individuals below the canopy of planted trees. Here, the number of individuals up to 60 cm in height was estimated on a cohort basis. In addition, the height of naturally regenerated individuals was determined. Individuals shorter than 90 cm were assigned to three height classes (1–30 cm, 31–60 cm, 61–90 cm). The individual height of taller growing saplings was determined, and these individuals were assigned to three height classes as well (91–180 cm, 181–360 cm and 361–540 cm). Finally, the distance of each naturally regenerated individual to the nearest crown edge of a planted old tree was determined.

To compare how the distribution of the height of naturally regenerated individuals differed as well as their number among sites, Pearson's Chi-squared tests were undertaken. To understand whether there was a relationship between distance to the parent plant and the number of regenerated individuals, a generalized linear model (GLM) with quasipoisson (due to overdispersion) was undertaken.

Results

Natural regeneration was found under the canopy or in the vicinity of all planted trees. The invaded vegetation types included hedgerows, multi-layered woody patches, ornamental horticultural plantings, and semi-shaded shrub/grassland complexes in urban greenspaces (Table 1). Grassland fallows and disturbed sites in the vicinity of site A were not colonized.

A total of 814 naturally regenerated individuals were detected. The distribution of these individuals

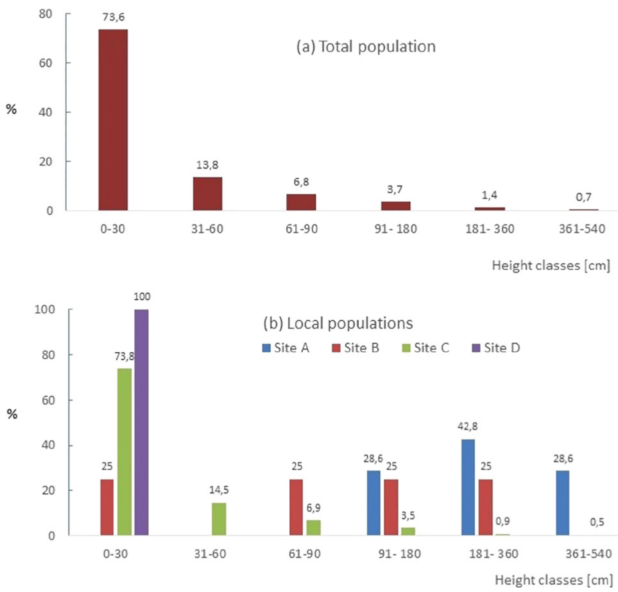

Fig. 1. Percentage distribution of naturally regenerated individuals of *Acer monspessulanum* across height classes: (a) total population (n = 814), (b) local populations per site (n = 7, 4, 781 and 22 for sites A–D, respectively)

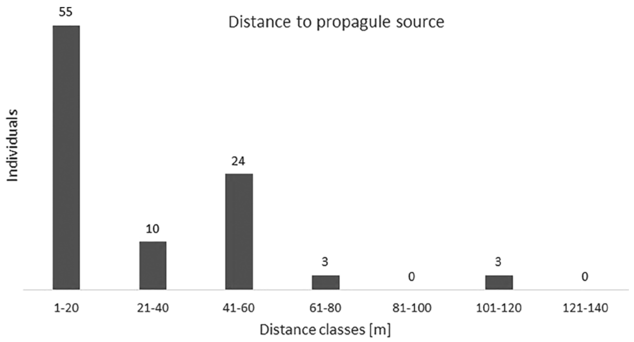

Fig. 2. Distance of naturally regenerated individuals of *Acer monspessulanum* to the nearest parent tree. Individuals growing outside the canopy of cultivated trees (n = 95) were assigned to distance classes. Individuals below the canopy of a parent tree (n = 719 with distance = 0) are not show

differed significantly among sites (x-squared = 47.2, df = 30, p = 0.02) with most trees found on site C (n = 781) and least on site B (n = 4). The maximum height was 4.5 m at site A and site C, each for a young tree growing close to a fence. Maximum height at site B was 1.4 m, and 0.3 m at site D. Figure 1 shows the distribution of naturally regenerated individuals among height classes for the total population and for local populations at each site. Although height class 0–30 cm occurred the most, there were no significant differences among height classes (x-squared = 48, df = 50, p = 0.55).

Figure 2 shows the distribution of naturally regenerated individuals among distance classes in relation to the next propagule source. The maximum distance to the next parent tree at the four sites ranged from 4–106 m (Table 1). Most individuals (n = 719) occurred at a distance of 0 m to the parent tree (i.e. growing under its canopy), followed by a distance of 8 m (n = 31) and 45 m (n = 11), whereas other individuals ranged within a distance from 3 m to 106 m to the parent tree. Here, no significant relationship between distance to parent tree and the number of regenerated individuals was found (-0.22 ±52.40, p < 1.00).

Discussion

All cultivated trees of *A. monspessulanum* investigated in Berlin were associated with natural regeneration, and spontaneous populations have so far spread up to 106 m from the propagule source. Therefore, this species is to be considered a new neophyte (post-1492 introduction) of the flora of Berlin. Its status is that of a casual non-native species, as evidence of a permanent population establishment by the emergence of a second generation of naturally regenerated individuals is still pending.

But is *A. monspessulanum* invasive? Concepts in invasion ecology usually describe several phases of an invasion process, which starts with the human-mediated introduction of a species and includes further stages such as reproduction, establishment and further spread (Richardson et al., 2000). This study thus demonstrates a beginning invasion of urban greenspaces by *A. monspessulanum*. Whether the species is considered invasive depends on the definition used. There are two fundamentally different approaches to define invasive species. According to Richardson et al. (2000), species that reproduce continuously and spread far from their original habitat are considered invasive, whereby possible positive or negative consequences do not matter. According to an IUCN definition, which also guides many legal regulations, invasive alien species are those that trigger significant negative impacts on biodiversity or ecosystems (see Pyšek et al., 2020). According to neither definition, *A. monspessulanum* is considered invasive. The species has overcome the reproduction barrier in the course of its invasion process, but cannot be considered established due to the lack of sustainable population establishment. As no negative ecological effects can be observed, *A. monspessulanum* is also not to be addressed as invasive according to the IUCN definition.

Acer monspessulanum has a long residence time in Berlin as a cultivated tree. The time lag between reports of the first cultivation (Roloff, 1746) and the first spontaneous natural regeneration (this study) is 276 years, and thus markedly higher than the 170 years calculated as the mean time lag between introduction and spread of 66 non-native tree species in the Berlin region (Kowarik, 1995). The late start of invasion by *A. monspessulanum* in Berlin can be explained by the fact that not only residence time but also the amount of plantings determines invasion success (Pyšek et al., 2009). Only few trees were planted in Berlin thus far. As a mutually non-exclusive explanation, climate warming in recent decades may have reduced frost damage to seedlings of this Mediterranean to sub-Mediterranean species, which are generally more susceptible than older developmental stages. Therefore, the delayed spread of *A. monspessulanum* may also reflect changing environmental conditions. With increasing plantings in urban areas, increased regeneration and spread can therefore be expected.

The distribution of spontaneous individuals among height classes indicates a growing population with a dominance among small individuals. The age of the individuals could not be determined but due to the slow growth of *A. monspessulanum*, an age of more than 10 years can be assumed for the few plants over 4 m tall. The different population sizes between the sampled sites can be well explained by specific site features. At site C, with by far the largest population, nine old planted trees led to a much higher propagule pressure than at the other sites, each with only one old tree. In addition, numerous hedgerows and semi-shaded, multi-layered forest patches at site C have proven to be suitable habitats. These were moderately maintained as part of a public greenway and semi-public greenspaces, allowing for spontaneous vegetation development. At site A, similar structures were limited to a narrow hedge with dense understory along a road, where a few tall individuals of *A. monspessulanum* were able to establish. Site B is spatially confined to a small backyard of a large residential building, with impervious surfaces and ornamental plantings. In this case, a lack of space combined with greenspace maintenance did not exclude the emergence of spontaneous populations, but obviously limited their size. At site D in the Botanical Garden, natural regeneration of *A. monspessulanum* is quite common according to information from the gardeners, whereby the larger individuals are deliberately weeded. Therefore, despite a large colonizable area, only a few small individuals were found many of which showed traces of mowing in the grassland. These results indicate that *A. monspessulanum* can establish large populations in urban greenspaces under favorable conditions, but these populations can be well contained by horticultural practices.

As with *Ailanthus altissima* in Poznan (Paź-Dyderska et al., 2020), most *A. monspessulanum* individuals in Berlin grew less than 10 m from the propagule source, with 88% growing directly under the canopy of parent trees. Although three individuals growing 106 m from the propagation source indicate the ability of long-distance dispersal, this process seems to be a rare event in *A. monspessulanum*. Dispersal limitation is well demonstrated in site A, which had a large old-growth tree directly adjacent to a busy road. The road follows the main wind direction, which is favorable for seed dispersal. In addition, samara-type propagules can be moved hundreds of meters in road corridors by secondary wind dispersal (Kowarik & von der Lippe, 2011). Nevertheless, the distance of the natural regeneration from the parent tree was limited at this site to up to 21 m for six individuals and 45 m for one individual, although the colonizable hedgerow along the road extended much further.

Conclusions

What conclusions can be drawn from the observed invasion patterns of *A. monspessulanum* for its use as an urban tree? Generally, trade-offs between ecosystem services and disservices should be considered for non-native tree species (Dickie et al., 2014). In the case of *A. monspessulanum*, no conservation conflicts are expected with the predominant colonization of semi-shaded woody stands on anthropogenic urban sites, as these habitats usually have no particular conservation value and strong competitive effects on rare species by the slow- and small-growing *A. monspessulanum* are not foreseeable. Weeding of young plants in horticultural plantings may become necessary, but does not represent a novel challenge, as other maple species (*A. platanoides, A. pseudoplatanus, A. negundo*) already spread strongly on urban sites (Kowarik et al., 2013). Moreover, *A. monspessulanum* grows significantly slower than its congeners.

From today's perspective, however, plantings should be avoided in near-natural settings and particularly adjacent to rocky sites with dry grasslands, which rarely occur in some cities. Such habitats of conservation concern may be colonized by *A. monspessulanum* as in its native range. However, for the vast majority of cases, this study indicates no limitations to urban plantings of this species, well adapted to climate change.

Given the challenges of climate change, exacerbated by urban heat island, non-native trees will increasingly be needed in cities that are better adapted to new environmental conditions (Sjöman et al., 2016). In this respect, urban plantings of *A. monspessulanum* can be part of the solution – and are successful in German cities (Schönfeld & Böll, 2021).

Regarding further opportunities that might be associated with natural regeneration of *A. monspessulanum*, its incorporation into anthropogenic urban woody stands could increase their resilience in times of climate change. Therefore, it would be promising to incorporate natural regeneration of *A. monspessulanum* into maintenance and development approaches for urban sites if the invasion of habitats of conservation concern can be excluded.

Due to low migration rates most tree species from warmer regions lag behind climate change. From a conservation perspective, their planting in areas further north is thus discussed as an assisted migration, and cities with their heat islands can be precursors of later dispersal into rural areas (Han et al., 2021). Given that the distance of Berlin to natural outposts of *A. monspessulanum* in south Germany is about 400–500 km, urban plantings of this species and its generative offspring can be considered a case of unintentional assisted migration. This process can be supported as an adaptation strategy to climate change if, at the same time, risks to vulnerable ecosystems can be limited.

Acknowledgments

My sincere thanks to Arthur Brande for pointing out site C with old-growth trees and natural regeneration, to Tanja Straka for supporting the analyses and to Hannes Reinhard for fieldwork assistance. I also thank three reviewers for helpful comments.

References

Böll S (2018) Stadtbäume der Zukunft—Wichtige Ergebnisse aus dem Forschungsprojekt "Stadtgrün 2021". Veitshöchheimer Berichte 184: 77–87.

Bolle C (1886) Andeutungen über die freiwillige Baum- und Strauchvegetation der Provinz Brandenburg. Buchdruckerei H. Theinhardt, Berlin, Germany.

Botineau M, Delelis-Dusollier A, Wattez-Franger A, Foucault BD, Froissard D & Decocq G (1998) Contribution to the phytosociological knowledge of Aunis hedgerow landscape (France): the hedges with *Acer monspessulanum*. Acta Botanica Gallica 145: 99–108.

Brundu G, Pauchard A, Pyšek P, Pergl J, Bindewald A, Brunori A, Canavan S, Campagnaro T, Celesti-Grapow L, de Sá Dechoum M, Dufour-Dror J-M, Essl F, Flory SL, Genovesi P, Guarino F, Guangzhe L, Hulme PE, Jäger H, Kettle CJ, Krumm F, Langdon B, Lapin K, Lozano V, Le Roux JJ, Novoa A, Nuñez MA, Porté AJ, Silva JS, Schaffner US, Sitzia T, Tanner R, Tshidada N, Vítková M, Westergren M, Wilson JRU & Richardson D (2020) Global guidelines for the sustainable use of non-native trees to prevent tree invasions and mitigate their negative impacts. NeoBiota 61: 65–116. doi:10.3897/neobiota.61.58380.

Chocholoušková Z & Pyšek P (2003) Changes in composition and structure of urban flora over 120 years: a case study of the city of Plzeň. Flora 198: 366–376. doi:10.1078/0367-2530-00109.

Dickie IA, Bennett BM, Burrows LE, Nuñez MA, Peltzer DA, Porté A, Richardson DM, Rejmánek M, Rundel PW & Van Wilgen BW (2014) Conflicting values: ecosystem services and invasive tree management. Biological Invasions 16: 705–719. doi:10.1007/s10530-013-0609-6.

Han Q, Keeffe G, Caplat P & Simson A (2021) Cities as hot stepping stones for tree migration. npj Urban Sustainability 1: 1–5. doi:10.1038/s42949-021-00021-1.

Horvat I, Glavač G & Ellenberg H (1974) Vegetation Südosteuropas. Fischer, Stuttgart, Germany.

Kowarik I (1992) Einführung und Ausbreitung nichteinheimischer Gehölzarten in Berlin und Brandenburg und ihre Folgen für Flora und Vegetation. Verhandlungen des Botanischen Vereins von Berlin und Brandenburg, Beiheft 3: 1–188.

Kowarik I (1995) Time lags in biological invasions with regard to the success and failure of alien species: Plant invasions: general aspects and special problems (ed. by P Pyšek, K Prach, M Rejmánek & M Wade) SPB Academic Publishing, Amsterdam, The Netherlands, pp. 15–38.

Kowarik I & von der Lippe M (2011) Secondary wind dispersal enhances long-distance dispersal of an invasive species in urban road corridors. NeoBiota 9: 49–70. doi:10.3897/neobiota.9.1469.

Kowarik I, von der Lippe M & Cierjacks A (2013) Prevalence of alien versus native species of woody plants in Berlin differs between habitats and at different scales. Preslia 85: 113–132.

Mai DH (1988) Einige exotische Gehölze in den Interglazialfloren der Mitteleuropäischen Florenregion. Feddes Repertorium 99: 419–461.

Oberdorfer E (1992) Süddeutsche Pflanzengesellschaften. Teil IV: Wälder und Gebüsche. 2nd ed. Fischer, Stuttgart, Germany.

Paź-Dyderska S, Ladach-Zajdler A, Jagodziński AM & Dyderski MK (2020) Landscape and parental tree availability drive spread of *Ailanthus altissima* in the urban ecosystem of Poznań, Poland. Urban Forestry & Urban Greening 56: 126868. doi:10.1016/j.ufug.2020.126868.

Potgieter LJ, Gaertner M, Kueffer C, Larson BMH, Livingstone SW, O'Farrell PJ & Richardson DM (2017) Alien plants as mediators of ecosystem services and disservices in urban systems: a global review. Biological Invasions 19: 3571–3588. doi:10.1007/s10530-017-1589-8.

Pyšek P, Hulme PE, Simberloff D, Bacher S, Blackburn TM, Carlton JT, Dawson W, Essl F, Foxcroft LC, Genovesi P, Jeschke JM, Kühn I, Liebhold AM, Mandrak NE, Meyerson LA, Pauchard A, Pergl J, Roy HE, Seebens H, van Kleunen M, Vilà M, Wingfield MJ & Richardson DM (2020) Scientists' warning on invasive alien species. Biological Reviews 95: 1511–1534. doi:10.1111/brv.12627.

Pyšek P, Křivánek M & Jarošík V (2009) Planting intensity, residence time, and species traits determine invasion success of alien woody species. Ecology 90: 2734–2744. doi:10.1890/08-0857.1.

Richardson DM, Pyšek P, Rejmánek M, Barbour MG, Panetta FD & West CJ (2000) Naturalization and invasion of alien plants: concepts and definitions. Diversity and Distributions 6: 93–107. doi:10.1046/j.1472–4642.2000.00083.x.

Richardson DM & Rejmánek M (2011) Trees and shrubs as invasive alien species–a global review. Diversity and Distributions 17: 788–809. doi:10.1111/j.1472-4642.2011.00782.x.

Roloff CL (1746) Index plantarum tam peregrinarum quam nascentium coelo, quae aluntur Berolini in horto celebri Krausiano. Berolini.

Schönfeld P & Böll S (2021) Forschungsprojekt „Stadtgrün 2021" – Synthese. Veitshöchheimer Berichte 190: 37–56.

Seitz B, Ristow M, Meißner J, Machatzi B & Sukopp H (2018) Rote Liste und Gesamtartenliste der etablierten Farn- und Blütenpflanzen von Berlin.

Universitätsverlag der TU Berlin, Berlin, Germany.

Sjöman H, Hirons AD & Bassuk NL (2015) Urban forest resilience through tree selection. Variation in drought tolerance in *Acer*. Urban Forestry & Urban Greening 14: 858–865. doi:10.1016/j.ufug.2015.08.004.

Sjöman H, Morgenroth J, Sjöman JD, Sæbø A & Kowarik I (2016) Diversification of the urban forest—Can we afford to exclude exotic tree species? Urban Forestry & Urban Greening 18: 237–241. doi:10.1016/j.ufug.2016.06.011.

Streitz H (2001) Zum rechtsrheinischen Vorkommen des Felsen-Ahorns (*Acer monspessulanum* L.). Jahrbücher des Nassauischen Vereins für Naturkunde 122: 83–94.

Tissier J, Lambs L, Peltier J & Marigo G (2004) Relationships between hydraulic traits and habitats preference for six Acer species occurring in the French Alps. Annals of Forest Science 61: 81–86. doi:10.1051/forest:2003087.

Vítková M, Müllerová J, Sádlo J, Pergl J & Pyšek P (2017) Black locust (*Robinia pseudoacacia*) beloved and despised: A story of an invasive tree in Central Europe. Forest Ecology and Management 384: 287–302. doi:10.1016/j.foreco.2016.10.057.

Vogt J, Gillner S, Hofmann M, Tharang A, Dettmann S, Gerstenberg T, Schmidt C, Gebauer H, Van de Riet K, Berger U & Roloff A (2017) Citree: A database supporting tree selection for urban areas in temperate climate. Landscape and Urban Planning 157: 14–25. doi:10.1016/j.landurbplan.2016.06.005.