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Observations on two non-native Alder species (*Betulaceae*) naturalising in Ireland

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Abstract
Non-native *Alnus* species are widely planted in Ireland for landscaping purposes, such as roadside plantings, amenity plantings and revegetation of quarries. This paper gives details of nine locations in Ireland where natural regeneration of *A. cordata* and *A. rubra* has been observed. The potential impacts on native habitats, should these species naturalise more widely, are discussed.

Keywords: invasive species; brownfield sites; novel ecosystems; forestry.

Introduction

Alnus glutinosa (Alder) is the only native member of the Genus *Alnus* in Ireland (Parnell and Curtis, 2012). It is widespread and occurs naturally on a range of sites but with a preference for wet and fertile sites, including sheltered mountain sides, lake shores and river banks, wet sandy soils and gravels (Fennessy, 2004). *A. glutinosa* is increasingly being planted in commercial forestry due to its fast growth rates and breeding programmes are in place to grow so-called "plus-trees" to produce trees suitable for timber production (Teagasc, 2019). It is also an important component of the Irish government's native woodland afforestation and conservation programme, particularly in riparian areas (Little *et al.*, 2008).

A number of non-native *Alnus* species have been planted in Ireland, principally for landscaping purposes, such as roadside plantings, amenity plantings and revegetation of quarries. There has recently been increasing interest in the use of non-native *Alnus* species in Britain for short rotation biomass production or as nursery species for other commercial species due to their ability to fix nitrogen into soil via colonies of the bacteria *Frankia alni* living in root nodules (Wilson *et al.*, 2018). Planting trials of non-native *Alnus* also exist in Ireland for their forestry potential (McCarthy, 1979; Wilson *et al.*, 2018). *Alnus* species produce huge volumes of seeds in cones that are dispersed by wind and water, some species also spread via clonal suckering. This makes them strong candidates for naturalising where suitable site conditions allow. Parnell and Curtis (2012) only list *A. incana* (Grey Alder) as a naturalised *Alnus* species in Ireland where it has mainly been observed spreading via suckering.

This paper details locations in Ireland where two other non-native *Alnus* species, *A. cordata* (Italian Alder) and *A. rubra* (Red Alder) have been observed by the author to be naturalising. Where useful, the land history of the site is described

based on historical aerial photos available via the Ordnance Survey Ireland Online Mapviewer (http://map.geohive.ie/mapviewer.html). Potential ecological impacts on native ecosystems, should these species become more widespread in the wild, are discussed.

Alnus cordata

This European species (Fig. 1) has a very limited native range, being confined to the southern Apennine mountains in Italy and north-eastern mountains of Corsica where it is a pioneer tree species of *Fagus sylvatica* and *Castanea sativa* woods, growing as pure stands in gaps (Ducci & Tani, 2009). Unlike native *A. glutinosa*, *A. cordata* can grow in much drier conditions (Wilson *et al.*, 2018). *A. cordata* is frequently planted in parks, streets and shelter belts (Johnson, 2004).

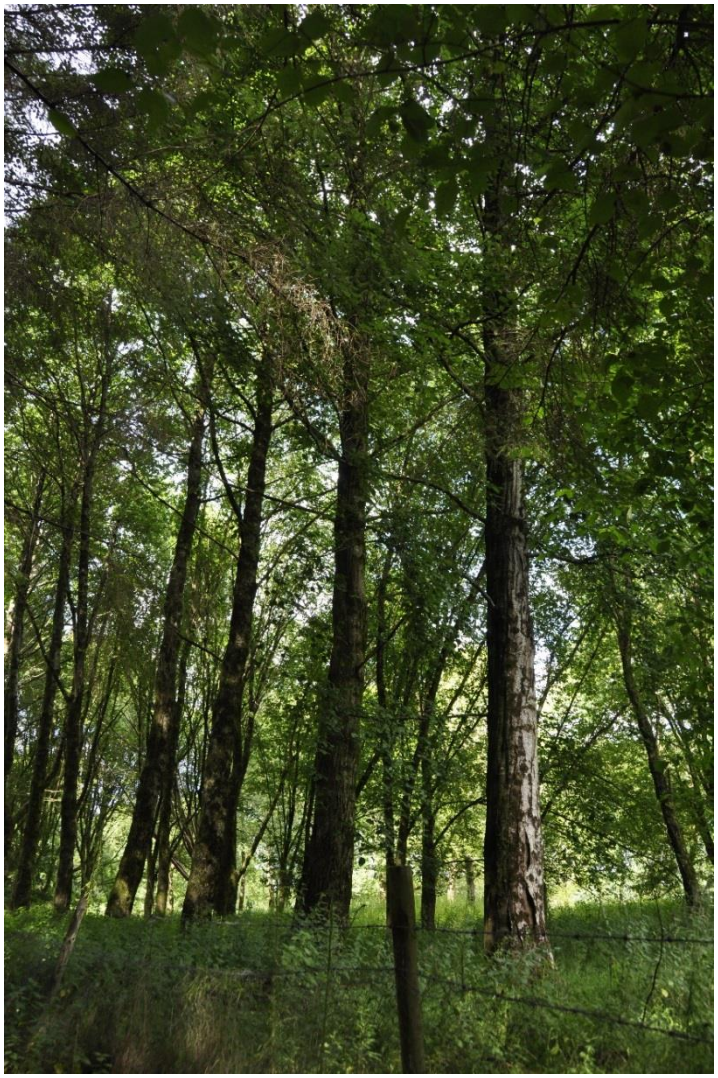

Figure 1. Planting trial of *Alnus cordata* at JFK Arboretum, Co. Wexford

1) *v.c.H15 East Galway*

Townland: Menlough; M 29306 30055; year observed:2014.

Disused limestone quarry, approximately 10 ha in size on the south eastern shore of Lough Corrib. Vegetation in the quarry is predominantly bare and recolonising

ground with areas of *Salix cinerea* and isolated plants of *Fraxinus excelsior* and *Crataegus monogyna*. A stand of mature *A. cordata* was located by one of the ponds and natural regeneration was observed in close proximity.

2) *v.c.-H16 West Galway*
Townland: Rahoon; M 26621 24992; year observed:2018.
0.6 ha of waste ground on the Western distributor surrounded by sub-urban sprawl and industrial estates. The site was formerly an area of small fields enclosed in stone walls but the surrounding area was urbanised from the early 2000s based on historical aerial photos. *A. cordata* regeneration is widespread on the site, growing alongside *Buddleja davidii*, *Salix cinerea* and *Ulex europaeus*, forming a "novel" urban scrub community. Seed source is trees planted for landscaping on the Western Distributor Road.

3) *v.c.H21 Dublin*
Townland: Tolka; O 13998 37917; year observed: 2018.
0.3 ha of derelict land adjoining the River Tolka in an urban area. Half the site is bare and recolonising ground. *A. cordata* has self-seeded on a part of the site where a building was demolished after 2012. The seed source was an adjacent stand of mature trees. The regeneration is mixed with *B. davidii* bushes but has now overtopped the latter and is entering a thicket stage, again another "novel urban" emergent woodland community (Fig. 2).

Figure 2. A "novel" urban emergent woodland community with a canopy of *Alnus cordata* and a shrub layer of *Buddleja davidii* on a derelict site in Dublin City

4) *v.c.H4 Mid Cork*
Townland: Lehenagh Beg; W 67275 68828; year observed: 2019.

2.9 ha of an abandoned building site located in an urban setting, formerly pasture and hedgerows, based on historical aerial photos from the early 2000s, but now consisting of bare and re-colonising ground. A high density of saplings was observed regenerating at the edges of the site on bare ground with a scattering of saplings in the centre. Seed source is from trees planted for landscaping in surrounding housing estates and the adjacent Kinsale Road.

5) *v.c.H27 West Mayo*
Townland: Garryduff; M 14295 90406; year observed:2019.
0.07 ha of rank wet grassland on the north bank of the Castlebar River in an urban environment. A dense stand of *A. cordata* saplings was observed regenerating in the grassland. The seed source was adjacent mature trees planted on the roadside. *A. cordata* has been extensively planted in Castlebar, particularly as plantations along the N5 road.

Alnus rubra
One of the largest *Alnus* species in the world, this North American species is native to the Pacific Northwest (Johnson, 2004). It is principally found in forests below 750 m ASL within 200 km of the coast where it is a pioneer and riparian species that grows alongside *Picea sitchensis*, *Thuja plicata*, *Aibies grandis*, *Pseudotsuga menziesi* and *Tsuga heterophylla* (Wilson *et al.*, 2018), conifers that dominate commercial forestry in Britain and Ireland. It is planted much less frequently than *A. cordata,* usually as a specimen tree or as a shelterbelt (Johnson, 2004). However, in Southwestern Ireland it has also been planted in commercial forestry plantations in riparian areas or edges (see below).

1) *v.c.H3 West Cork*
Townland: Kealkil; W 08586 58967; year observed: 2013.
A. rubra saplings are growing on an overgrown forestry track, along with *Betula pubescens* and *S. cinerea* in a forestry plantation (Fig. 3). The seed source for regeneration on the track was a single mature tree growing next to the barrier gate, which may itself have originated from seed blown from mature trees growing in a nearby garden centre.

2) *v.c.H4 Mid Cork*
Townland: Muinganine; R 14420 07430; year observed: 2020.
This area is predominantly commercial forestry plantations and *A. rubra* saplings are growing on the edges of forestry roads. The seed source is mature stands planted along the roads and plantation edges.

3) *v.c.H2 North Kerry*
Townland: Cummeenavrick; W 10112 81916; year observed: 2020.
There are mature roadside plantings of *A. rubra* on both sides of the N22 at this location, planted when the road was upgraded in the 1980s and 1990s. A small amount of natural regeneration was observed on the roadside verges. This location is heavily afforested so there is potential for roadside stands to seed into clear-fell sites and forestry tracks.

Figure 3. *Alnus rubra* saplings growing on a forestry track, Kealkil, Co. Cork

4) *v.c.H2 North Kerry*
Townland: Annagh Banks; Q 83161 03371; year observed: 2020
0.9 ha of an abandoned residential construction site just outside Castlemaine village. Natural regeneration of *A. rubra* was patchy but quite dense in the wetter parts of the site (Fig. 4). Natural regeneration of *A. glutinosa* and *B. pendula* was mixed in with *A. rubra*. Seed source was mature roadside plantings on the southern property boundary.

Discussion

The locations where *A. cordata* and *A. rubra* have been observed to be naturalising are sites that have been highly modified by human activities i.e. urban waste ground, roadsides, forestry plantations. Urban brownfield sites typically host a number of alien pioneer and later successional species, with species composition determined by history of the site, soil structure and composition and seed sources in the surrounding environment (Lososová *et al.*, 2016). They often offer a unique opportunity to study how plant species from vastly different parts of the world interact when growing together in what have become known as "novel ecosystems" (Hobbs *et al.*, 2009). The conservation value of these ecosystems is currently being hotly debated in the field of conservation biology. The short lived nature of brownfield sites, such as the one found with *A. cordata* and *B. davidii* on the River

Tolka in Dublin often mean that it is not possible to study how these sites develop in the long term, particularly sites with emergent woodland communities. As brownfield sites are generally isolated blocks of habitat, they offer an interesting opportunity to study interactions of alien species and native species without a high risk of invasive species spreading.

Figure 4. *Alnus rubra* saplings growing in an abandoned residential construction site, Annagh Banks, Co. Kerry

What would the impact on native semi-natural habitats be should *A. cordata* and *A. rubra* become more widespread as naturalised species? Both species act as pioneer woodland species in their native ecosystems so would likely be easily replaced by later successional native or non-native tree species. These species could compete with native pioneer tree species, such as *B. pubescens*, *B. pendula*, *Salix* spp. but in particular, the native *A. glutinosa*. The amount of niche overlap between the native and non-native *Alnus* species would need to be determined but the natural range of *A. cordata* and *A. glutinosa* overlap in Corsica and southern Italy (Kajba & Gračan, 2003; Ducci & Tani, 2009), which might suggest niche partitioning between these species. The ability of *A. cordata* to grow in much drier site conditions than *A. glutinosa* lends credence to this. There may be greater overlap between *A. rubra* and *A. glutinosa*, both of which are principally found in wet soils in their native ranges (Kajba & Gračan, 2003; Wilson *et al.*, 2018). Being a much larger tree, *A. rubra* seedlings could out-compete *A. glutinosa* seedlings through direct competition for space. *A. rubra*, however, does not seem to do well in areas with late frosts and tends to show better growth in Britain in areas with an oceanic climate (Forest Research, 2018; Savill, 2019) so may only be able to thrive in Ireland along the western seaboard, where the climate is very similar to its native range in the Pacific Northwest. Indeed, it has been proposed that *A. rubra* could be planted in mixed stands with *P. sitchensis* in upland plantations in Britain and Ireland in order to enhance their structure and biodiversity potential by recreating the natural temperate rain forests in their native range where both species grow together (Deal *et al.*, 2014).

The genetic integrity of *A. glutinosa* could also be threatened through hybridisation with non-native *Alnus* species (Wilson *et al.*, 2018). Hybridisation between *A. glutinosa* and the non-native *A. incana* has been recorded in Ireland (Parnell 1994; BSBI Distribution Database, https://database.bsbi.org/). Hybridisation however, is thought to be uncommon in other parts of Europe where both species coexist, due to differences in flowering times and low seed production of hybrids (Banaev *et al*., 2007). A study to determine the presence of hybrids under natural conditions in Ireland at sites where *A. glutinosa* and *A. cordata* and/or *A. rubra* are growing together would be worthwhile. Such a study should look at the potential of hybridisation in these populations based on the overlap of flowering times between these species and the frequency of hybrids in natural regeneration.

The invasiveness of both *A. cordata* and *A. rubra* could also possibly be kept in check by the pathogen *Phytophthora alni* (Bjelke *et al*., 2016). The ability of *Alnus* species to fix nitrogen in soil could have impacts on native plant communities in Ireland that require low nitrogen levels and where the native *A. glutinosa* doesn't naturally occur but where *A. cordata* or *A. rubra* could grow, however, neither species does well in peat soils (Wilson *et al.*, 2018). A similar issue has been found with *Gunnera tinctoria* in western Ireland (Mantoani *et al*., 2020). Long term studies on naturalised stands of *A. cordata* and *A. rubra* would be useful in determining both their invasiveness and their potential to either enhance or hinder the biodiversity of both semi-natural and human-made habitats. Impacts on *A. glutinosa* could be determined by establishing trials of mixed stands with *A. cordata*, *A. rubra* or both, by setting seeds in controlled conditions that replicate those where the native species is found in the wild, in order to study competitiveness. Similar trials could be conducted with other native pioneer trees species. It would also be useful to investigate the value of *A. cordata* and *A. rubra* for native wildlife in comparison to native *A. glutinosa*. The author has observed large roving flocks of *Carduelis spinus* (siskin) foraging for seeds from cones in mature plantations of *A. cordata* in Castlebar, Co. Mayo.

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