Introduction to *Rhododendron ponticum* and its management

2.1. History of *Rhododendron ponticum* in the British Isles

Native to areas of the Middle East and the Mediterranean, *Rhododendron ponticum* (*R. ponticum*) is an evergreen shrub that was first introduced to the British Isles in 1763 (Cross, 1975). Soon after its introduction it became very popular and was widely planted on wealthy estates as an ornamental shrub and as cover for game birds (Dehnen-Schmutz and Williamson, 2006). However, *R. ponticum* escaped the grounds of these estates and became established in the surrounding native habitats, through the release of small, wind-dispersed seeds. Each *R. ponticum* bush can potentially produce over a million seeds every year (Cross, 1975) which can be blown up to 50 metres from the parent plant (Tackenberg, 2003)a trajectory model for wind dispersal of plant diaspores under field conditions. The model considers the effects of topography, turbulence (including thermal updrafts, or potentially even further during high winds (Edwards, 2006). At the time, little was known of the invasive nature of *R. ponticum* and its potential for further expansion. *R. ponticum* was therefore allowed to grow unmanaged for decades, with its rate of spread accelerating in the latter half of the 20th century as a result of changes in land use and grazing pressures (Dehnen-Schmutz and Williamson, 2006).

R. ponticum thrives in the British Isles for several reasons. The moist, temperate climate and acidic soils of upland areas such as Snowdonia allows for greater *R. ponticum* seedling survival than in its native range (Erfmeier and Bruelheide, 2004). Woodland habitats are particularly susceptible to invasion, as the moist, moss covered fallen branches and rocks provide the perfect surface for *R. ponticum* seed germination and seedling growth (Cross, 1975) (see Figure 2.1.). Additionally, there are very few animal species in the British Isles which can graze on *R. ponticum*, due to the toxic compounds contained in its leaves (Judd and Rotherham, 1992). As a result, *R. ponticum* has very few “natural enemies” in the British Isles which would control its growth. Hybridisation with other *Rhododendron* species may also have made *R. ponticum* more suited to the conditions of its introduced range; genetic analysis suggests that British *R. ponticum* populations often contain genes associated with *Rhododendron catawbiense*, a North American species, which may have conferred faster growth rates and greater cold tolerance, thus allowing *R. ponticum* to colonise upland areas of Britain (Erfmeier and Bruelheide, 2005).

Figure 2.1. *R. ponticum sapling establishing in a woodland area with fragile bryophyte and lichen communities. Moist, bryophyte covered rocks, branches, and tree stumps provide an ideal surface for R. ponticum seed germination.*

By now, *R. ponticum* is one of the most problematic and costly invasive alien species in the British Isles. In a 2008 survey, it was estimated to cover around 2000 hectares of land within Snowdonia National Park (Jackson, 2008). To this day, the densest areas of *R. ponticum* invasion are concentrated around the estates and gardens where it was historically introduced (Gritten, 1995).

2.2. Why we wish to eradicate *Rhododendron ponticum*

Whilst it may be difficult to argue against the aesthetic attractiveness of *R. ponticum* when in bloom, its negative impacts on key ecosystem services far outweigh the positive aspects of its presence. When established, *R. ponticum* dominates the understorey vegetation of British habitats such as the globally recognised Celtic Rainforests, forming a dense canopy which shades out competing native species. Very few species can grow beneath *R. ponticum* canopies, resulting in a loss of the characteristic and rare plant, bryophyte, and lichen species (see Figure 2.2.). A recent study in Scottish Atlantic oak woodlands found that bryophyte and lichen diversity can take up to 15 years to recover following *R. ponticum* removal, with vascular plants and tree communities still not fully recovered even 30 years after its removal (Maclean et al., 2018). This is as *R. ponticum* invasion prevents young trees from naturally replacing older trees, and if allowed to persist in the longer-term, this will lead to habitat degradation and a loss of tree cover.

Figure 2.2. *An area of woodland dominated by R. ponticum. Note how very few native plant species can survive in the heavily shaded environment beneath its canopy.*

By reducing native plant diversity, *R. ponticum* invasion also negatively affects the animal populations which rely on these communities for food or shelter. Pollinators are particularly affected, as *R. ponticum* is only in flower for a short window during late May to early June. Nectar availability in invaded habitats is therefore limited to this period of the year, due to the absence of native plants which may flower during other parts of the year. Furthermore, not all pollinators can feed on *R. ponticum* nectar as it contains grayanotoxins. This group of chemicals is toxic to many species, including the honeybee, which is the most important pollinator species in the British Isles (Tiedeken et al., 2016). Pollinator populations can therefore be directly negatively affected by consuming toxic nectar, or indirectly as a result of native plants being displaced by *R. ponticum* (Tiedeken et al., 2016). This is of particular concern, given the importance of pollinating as an ecosystem service, and the fact that pollinators such as the honeybees are already threatened worldwide by habitat loss and intensive agricultural practices.

As well as having ecological impacts, invasive species such as *R. ponticum* also affect rural economies. Whilst quantifying the economic impact of individual plant invasions is difficult, it has been estimated that Invasive Alien Species (IAS) as a whole cost the Welsh economy approximately £7 billion per annum (National Assembly for Wales, 2013). *R. ponticum* is most likely responsible for a large proportion of this sum, given that it is one of the most widespread IAS in Wales. The agricultural and forestry sectors are particularly affected, due to a loss of productive land where dense *R. ponticum* displaces grazing pasture and planted trees, and prevents access for livestock, machinery, and the contractors involved in the felling and restocking of forestry plantations. Additionally, *R. ponticum* is

a major threat to commercially important tree species such as larch, given that it may contribute to the spread of the pathogen *Phytophthora ramorum*. Finally, reclaiming invaded land for agricultural, forestry, or conservation purposes can be expensive, particularly in areas of dense invasion.

The ecological and economic impacts of invasion described above outline the importance of eradicating *R. ponticum* from our landscapes. This requires a concerted effort, given that *R. ponticum* invasion is very difficult to contain. The high seed production, and the vast distances they can travel, mean that the presence of even a few well-maintained *R. ponticum* bushes in gardens also pose a threat, since the seeds they produce each year will allow dispersal into the surrounding habitats. This highlights the importance of conducting *R. ponticum* eradication work on a broad range of scales, from landowner-led work to remove individual bushes from small gardens, to large scale projects co-ordinated by land managers or conservationists to remove *R. ponticum* from broadleaved woodlands, heathlands, and forestry plantations (see Figure 2.3.). Both are equally important in achieving an ultimate ambition of 100% eradication, which is essential in maintaining an area free from *R. ponticum* in the long-term.

Figure 2.3. *An example of the different scales that R. pontricum eradication can be carried out, from a few bushes in a garden to large-scale works in a heavily invaded woodland or hillside.*

2.3. Managing *Rhododendron ponticum*

Managing *R. ponticum*, with the ultimate goal of full eradication, is a process which takes a number of years and requires several phases of intervention. Based on over 30-years of experience in *R. ponticum* eradication, the Snowdonia National Park Authority (SNPA) and partners have developed a 'three-phase' approach to achieving full *R. ponticum* eradication. Full details on the three-phase methodology are given within this toolkit (Section 6). However, a brief introduction to the method is outlined in Figure 2.4. (below).

Several factors should be considered when planning an appropriate programme of work for eradicating *R. ponticum* from an infested site, the majority of which will be identified during a pre-works site assessment (see Section 3).

Figure 2.4. *Outline of the three-phase approach to managing R. ponticum as developed by SNPA and partners*.