Rhododendron ponticum (rhododendron) Management and Control

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1.0 Introduction

Rhododendron ponticum is a large evergreen shrub which grows up to 8 m tall and is tolerant of a wide range of conditions and soil types (Maguire *et al.*, 2008). It has been widely distributed as an ornamental species due to its attractive flowers, and can subsequently become naturalised through the large number of seeds produced as well as its ability to propagate through vegetative means (Maguire *et al.*, 2008). The toxicity of *R. ponticum* gives it a competitive advantage over native species through herbivore avoidance and later helps suppress the regeneration of other species through the accumulation of toxic leaf litter (Maguire *et al.*, 2008). This aids in the creation of dense impenetrable thickets which have been reported reduce the diversity of both plant and animal communities (Edwards, 2006; Maguire *et al.*, 2008). In Northern Ireland, *R. ponticum* is also known to host the fungus-like pathogen, *Phytophthora ramorum* which has the potential to attack a variety of native woody plant species and is the causative agent of 'Sudden Oak Death' (Maguire *et al.*, 2008).

Control of *R. ponticum* is known to be expensive and very labour intensive due to its prolific seeding, rapid growth rate and ability to resprout vigorously from cut stems (Barron, undated) and as such it is essential to properly plan management programs taking into account the ecology and infestation age of *R. ponticum* as well as the surrounding environment (Maguire *et al.*, 2008).

2.0 Preventative Measures

In different environments, *R. ponticum* is able to successfully use a different predominant reproduction type; in the United Kingdom (UK) and Ireland, colonisation takes place mainly through seed dispersal whereas in the Black Sea Region (BSR) of Turkey, colonisation takes place mainly via vegetative processes (Erfmeier & Bruelheide, 2004; in Esen *et al.*, 2006a). Prevention methods should vary according with the major colonising strategy and thus for the UK and Ireland, short term prevention may be achieved through the eradication of major seed sources along the most common wind direction, minimising soil disturbance and reducing moss formation in uninvaded sites (Esen *et al.*, 2006a); moss provides an opportunity for *R. ponticum* to establish in areas with an existing ground cover (Esen *et al.*, 2006a; Stephenson *et al.*, 2006).

For the BSR of Turkey, branch layering is the primary means of invasion by *R. ponticum*; this vegetative expansion is triggered by disturbance which activates dormant adventitious buds (Tabbush & Williamson, 1987; in Esen *et al.*, 2006a). As such, the regulation and planning of firewood utilisation by local communities and other forest operations can provide short term prevention through reducing disturbance (Colak, 1997; in Esen *et al.*, 2006a). Longer term prevention may be able to be achieved through relaxing strict fire-exclusion policies present in the region as well as preserving native plant cover (Esen *et al.*, 2006a).

Harris *et al.* (2009) determined that corridors of unsuitable habitat could be used to contain infestations of *R. ponticum*; undisturbed corridors of open grassland at least 150 m wide were suggested to be able to achieve this depending on the prevailing wind direction and wind speeds in the area. However, as rare long distance dispersals are possible, this would best be carried out in conjunction with monitoring of the uninfested area (Harris *et al.*, 2009).

Esen *et al.* (2006a) also report on the use of shade from conifers in preventing the establishment of *R. ponticum* in commercial forests, however, other accounts have stated that *R. ponticum* is very shade tolerant (Barron, undated; Rotherham, 2001; Maguire *et al.*, 2008) and as such shading may not be the most effective prevention tool. The recruitment of *R. ponticum* seedlings can however be reduced by maintaining a dense ground cover which can be controlled by managing grazing pressure to allow the natural regeneration of native ground flora (Barron, undated).

As there are presently no specific legal provisions associated with its growing on Ireland, to further reduce the risks of invasion here, discussions with adjacent garden or land owners may be neccessary to either remove or to not plant *R. ponticum* as an ornamental species (Maguire *et al.*, 2008).

3.0 Prioritisation

It is important that a management plan for *R. ponticum* be drawn up before control operations begin, with a number of factors needed to be considered to prioritise infested areas and determine what control techniques are used (Edwards, 2006).

Determining the age and the condition of infestation is an important initial step as while *R. ponticum* is a prolific seed producer, a naturally seeded plant will not produce seed until at least 10 – 12 years old; this provides a window of opportunity to prevent serious infestation (Maguire *et al.*, 2008). Edwards (2006) includes a descriptive flowchart using different ages of *R. ponticum* and also taking into account the presence of flowers or seeds, the receptivity of sites to *R. ponticum* seedling recruitment, the height or density of bushes and the presence of stumps with regrowth. This flowchart prioritises sites for control, assigning them a rank ranging from 0 (low) to VIII (high) with the highest priority placed on resprouting stumps from prior control efforts and mature sites which act as major seed sources (Edwards, 2006). This document can be accessed from the Forestry Commission of Great Britain website or through following this link.

Barron (undated) in a best practice control guide for the native woodlands of Ireland, has also used the age of *R. ponticum* stands to prioritise control efforts however, in contrast, the priority here is placed on younger, less seriously infested stands. This is because more mature (25 – 30 years old) are likely to have little or no native vegetation remaining, whereas less seriously infested stands will have not yet lost their native ground cover (Barron, undated).

The recommended objectives of both are to reduce the reinvasion of *R. ponticum* with Edwards (2006) suggesting to achieve this by eliminating seed sources, and Barron (undated), while also recognising the importance of considering nearby seed sources, prioritising the development of ground cover to achieve the same goal. This document can be accessed from the Woodlands of Ireland website or through following this link.

Spatial modelling carried out by Harris *et al.* (2009) which simulated seed movement and wind dispersal determined that an age-dependant control strategy for *R. ponticum* is the most effective, where the oldest plants are removed each year. This perhaps supports the recommendation made by Edwards (2006) to prioritise the control of mature plants.

4.0 Physical Control

Young or small *R. ponticum* seedlings can be hand pulled easily by gripping at the base of the stem and then pulling at an oblique angle; this alone is sufficient to achieve control but only if the area controlled is small, the density of seedlings is low or sufficient workers are available (Edwards, 2006). Larger seedlings or small bushes can also be pulled but winches and other tools such as mattocks are required (Edwards, 2006).

If there is sufficient access to the stem, these can be cut using handtools or chainsaws as close to the ground as possible with the cut material then removed, chipped or burnt to enable follow-up work to continue (Barron, undated; Edwards, 2006; Maguire *et al.*, 2008). Removed plant material can be used to create barriers to exclude grazers and subsequently encourage regrowth of the ground cover if the terrain and layout of the control site is suitable (Barron, undated). Additionally, if the removed material is chipped, it can be used to provide a good weed barrier around ornamental garden areas (Maguire *et al.*, 2008). The cut material of *R. ponticum* has been reportedly able to be burnt green immediately after cutting in Ireland, but should be carefully located so as to not damage any of the surrounding vegetation (Barron, undated). However, other accounts from the British Isles state that freshly cut material is difficult to ignite and benefits from being allowed to dry first (Edwards, 2006). This is likely to be dependant on both site and weather conditions.

If there is sufficient access, heavy machinery can be used for the removal of *R. ponticum* stands. Woody material can be flailed or mulched used hydraulically powered flail heads mounted on tracked excavators (Edwards, 2006). These flail heads are mounted on horizontal or vertical shafts and are capable of shattering or grinding plant material in the excavators path (Edwards, 2006). Although unsuitable for steeply sloped or wet sites and requiring road access (Edwards, 2006), mechanical flailing has been effectively used to treat young or immature growth in Ireland (Maguire *et al.*, 2008). White noted to be quick, mulching is also an expensive option costing £1,000 a day in a control operation in England and also having a high potential of damaging the soil and coppice stools (Walter, 2005).

A number of other common mechanical methods of removing *R. ponticum* from the British Isles are listed by Esen *et al.* (2006a) and include; brush raking, brush lading, winching, excavating and chopping. The effectiveness of these are not investigated but as mechanical methods reportedly prepare the site for forest regeneration and enhance the short-term silvicultural goals of minimising nutrient loss and enhancing natural seedling regeneration, they have gained popularity in Turkish forest management (Esen *et al.*, 2006a).

Regardless of whether the above ground parts are removed by manual or mechanical means, if the stump and roots of *R. ponticum* are not treated, resprouting will occur (Edwards, 2006;

Maguire *et al.*, 2008). Most of the recommended stump treatments involve herbicide application and will be explored in greater detail below (see Chemical Control), however digging the stumps out either manually or mechanically can be a feasible option in some cases (Barron, undated; Maguire *et al.*, 2008). Manual removal of the stumps and roots is a very labour intensive process (Barron, undated), and requires as much soil as possible to be removed from the root system and then burned to prevent regrowth (Barron, undated; Maguire *et al.*, 2008). Although found to be one of the more effective treatments for *R. ponticum* (Esen *et al.*, 2006b), this process also results in a high degree of soil disturbance, especially if heavy machinery is used and as such may not be suitable for more sensitive sites (Barron, undated).

Additionally for forest systems, mechanical methods can reduce long term site productivity, with heavy traffic compacting forest soils, diminishing macroporosity and organic matter; this can cause rutting or puddling in mesic or waterlogged soils which enhances sedimentation and nutrient leaching rates which can result in eutrophication or nutrient pollution in nearby rivers (Childs *et al.*, 1989; in Esen *et al.*, 2006a). Furthermore, a Turkish study determined that mechanical control methods reduced soil organic matter, nitrogen, phosphorous, calcium, potassium, sulfur and magnesium by 75 – 91% when compared to hand-pulled control methods (Sarginci, 2005; in Esen *et al.*, 2006a).

While burning as a control tool may be cost-efficient and rapid when compared with other methods as reported by Romancier (1971; in Esen *et al.*, 2006a) for the related *R. maximum*, burning alone is ineffective for *R. ponticum* and may lead to more vigorous regrowth than other methods of control (Esen *et al.*, 2006a). Repeated low-intesity burns can be used to exhaust root food reserves and subsequently reduce the density of *R. ponticum* stands over time, however there is always the potential of escaped fires and the risk of damaging the soil which may negatively impact long-term soil productivity (Esen *et al.*, 2006a).

5.0 Chemical Control

Chemical control methods for *R. ponticum* are commonly used, either alone or in combination with physical removal techniques as a more cost effective, rapid and longer lasting form of control (Dehnen-Schmutz *et al.*, 2004; Esen *et al.*, 2006a). A number of different methods of application and herbicide formulas have been found to be effective with factors such as population density, size and accessibility as well as economic and social factors determining the preferred chemical treatment (Edwards, 2006; Esen *et al.*, 2006a).

While herbicide use is generally negatively perceived by the public because of the potential effects on the environment and human health and safety (Esen *et al.*, 2006a; Bremner & Park, 2007), these risks can be reduced by proper herbicide use and choice (Guynn Jr. *et al.*, 2004).

5.1 Applications

Many herbicide applications for the control of *R. ponticum* are carried out for the treatment of stumps. Given sufficient access, cut stump applications involving the painting or spot spraying of freshly cut surfaces is known to be effective in killing stumps and preventing resprouting (Edwards, 2006; Esen *et al.*, 2006a; Maguire *et al.*, 2008). All cut stumps should be treated, with the inclusion of a vegetable-based indicator dye helping to identify which ones have already been treated (Maguire *et al.*, 2008). Furthermore, the drilling of an additional reservoir on the stump surface to contain the herbicide has been shown to be a highly effective technique (Edwards, 2006).

Live stems and branches still attached to the stump after cutting will not be killed by cut stump herbicide applications and should be treated with a foliar heribicide application (Edwards, 2006). The same applies to any regrowth of treated stumps which may occur and may include spraying with a knapsack sprayer at a low pressure using a flood jet or solid cone nozzle, or forestry spot gun with a solid stream nozzle (for small seedling treatment only) (Edwards, 2006). Spraying should only be carried out on plants under the height of 1.3 m; the safe height for spraying without undue risk to the operator (Edwards, 2006). All live foliage for the entire plant needs to be sprayed until the instant just before run-off, i.e. foliar wetness (Edwards, 2006) with each individual leaf needing to be thoroughly wetted with herbicide in order to kill the plant (Maguire, *et al.*, 2008).

Weed wiping is another technique which has been used to apply herbicide to the foliar growth of *R. ponticum* and involves the direct application or 'wiping' of the herbicide directly onto the plant; this can be done either manually or mechanically. Walter (2005) used weed wiping in less accessible areas of *R. ponticum* infestation in England and found that while it was slower than spraying, it was also more effective; 70 % control was achieved with weed wiping compared to the 40 – 50% control achieved by knapsack spraying (Walter, 2005).

A variation of the cut stump application, is the stem injection application which involves treatment of the main stem by cutting into it using a drill or other appropriate hand tool and applying herbicide into the wound (Edwards, 2006). This technique has been shown to be effective in treating plants in areas where roped access is required such as cliff faces and ravines (Edwards, 2006). Smaller trees will usually die within 9 months of treatment whereas larger (>10 cm diameter) may take up to 31 months to die (Edwards, 2006). Dead trees are usually left in situ, especially on inaccessible sites (Edwards, 2006) and may persist for 10 – 15 years (Maguire *et al.*, 2008).

One wound should be made for every 7.5 cm around the trunk with around 2 ml of herbicide applied to each; wounds should also be equally spaced apart (Esen *et al.*, 2006a). More modern tools have been developed for stem applications including the 'hypo-hatchet'; a tool which automatically injects a calibrated amount of herbicide while simultaneously wounding the stem (Esen *et al.*, 2006a), and the 'Sprout-Less Herbicide Applicator (SLHA)' which attaches to a bottom of a circular brush-saw (also known as a 'weed wacker') blade, and achieves the same purpose (Kirdar & Ertekin, 2009). Usage of the SLHA in Turkey was found to be highly effective in controlling *R. ponticum*, reducing competition and enhancing the establishment of commercial forest species (Kirdar & Ertekin, 2009). Again indicator dye should be used to indicate which plants have been treated and is especially important in areas where there are many operators or if the control area is too large to treat in one day (Edwards, 2006).

5.2 Herbicides

A number of different herbicides have been shown to be effective for the applications described above. These include 2, 4-D, ammonium sulphamate, glyphosate, imazapyr, metsulfuron-methyl and triclopyr (Edwards, 2006; Esen *et al.*, 2006a; Tyler *et al.*, 2006). Imazapyr based herbicides have been shown to be effective as a foliar spray when used against *R. ponticum* (Dixon & Clay, 2002; Tyler *et al.*, 2006), with studies demonstrating better results when compared with triclopyr ester based herbicides (Esen *et al.*, 2006b). However, imazapyr has been banned from use in Europe and North America and so alternatives must be considered (Tyler *et al.*, 2006).

Edwards (2006) has included a descriptive key in a best practice guide which recommends control methods based on the plant type (eg. stumps, seedlings, bushes), their age, and accessibility. For each application method, a number of herbicides are recommended for use, includng the rate at which it should be used and the optimal time of year for treatment. This document can be accessed from the Forestry Commission of Great Britain website or through following this link. Furthermore, detailed information for many of the different herbicides listed above can be found in Esen *et al.* (2006a).

The use of a surfactant additive may help circumvent the waxy barrier present on the leaves of *R. ponticum*, thus increasing the rate of absorption and improving control (Barron, undated; Esen *et al.*, 2006a). These surfactants however, are often more environmentally damaging than the herbicides themselves and as such great care must be used, especially near aquatic habitats (Barron, undated).

6.0 Follow Up Work

If the initial infestation of *R. ponticum* was of flowering age, or if a seed source is nearby, then follow-up seedling removal work will be necessary (Maguire *et al.*, 2008). This work may involve either manual removal via hand-pulling or foliar application of herbicide; the intensity of work will vary according to the severity and duration of infestation (Maguire *et al.*, 2008). Systematic checking for reinfestation or missed seedlings is a tedious but necessary task to achieve control, with any reinfestations of *R. ponticum* brought about by poor follow up negating the considerable time and cost likely to have been invested in the initial clearance (Barron, undated).

7.0 Biological Control

Releasing a biological control agent for the control of *R. ponticum* would be undesirable in the UK as there are many other cultivated ornamental and non-invasive *Rhododendron* spp. which may suffer off-target damage (Evans, 2003; in Esen *et al.*, 2006a). Therefore any biological control undertaken must include a controlled distribution (Green, 2003). As such, there is the potential to use bioherbicides for the control of *R. ponticum*; these generally consist of fungal spores in simple liquid formulations which are then sprayed using conventional spraying equipment (Green *et al.*, 1998; in Green, 2003).

A potential candidate for this use in the UK is the indigenous wood-rotting fungus, *Chondrostereum purpureum* which can only colonise through wounds and has previously been associated with die backs of *R. ponticum* (J. Webber, pers. comm.; in Green, 2003). A commercially available product using *C. purpureum* is already available in Europe as BioChon®; a Dutch product marketed as a wood decay promoter (Green, 2003). This particular bioherbicide would be used simlarly to existing herbicide applications such as painting or spraying freshly cut stumps (Green, 2003). Green (2003) reports that the registration process for biological pesticides was still under development in Europe at the time of writing and that further investigation could also be put into other endemic fungi which are pathogenic on *R. ponticum* and their potential as biological control agents. The use of bioherbicides is believed to have the potential of providing a sustainable and economical form of control for *R. ponticum* (Green, 2003).

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