The Control of Rhododendron in Native Woodlands

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Forest Service

woodlands OF IRELAND Coillearnacha Dúchasacha

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As an invasive species, *Rhododendron ponticum* represents one of the greatest threats facing native woodlands in Ireland. Its presence can have a dramatic impact on the woodland ecosystem, suppressing native ground flora and the natural regeneration of trees and shrubs. It is also difficult to control and eradicate, due to its profuse seeding, rapid growth rates and ability to resprout vigorously from cut stems. Control and eradication are expensive operations and require full commitment to a long-term plan incorporating initial treatment, follow-up operations and monitoring. However, with this commitment, rhododendron can be eradicated, allowing the native woodland ecosystem to recover.

This Native Woodland Information Note provides guidance regarding the control of rhododendron in native woodlands, based on international best practice and experiences gained in Ireland. Various steps are described, including initial site assessment, planning, treatments to kill and remove the rhododendron, follow-up operations, and monitoring. References are also included, providing further reading.

This note strongly complements the Forest Service Native Woodland Scheme, as many projects under the scheme involve rhododendron control. In all cases, any proposed treatment must be detailed in full in the Ecological Survey and Management Plan as part of the application process, for assessment and approval by the Forest Service.

INTRODUCTION

The introduction by people of non-native species onto the island of Ireland is a significant component of our natural history. Over the centuries, many species have been planted into woodlands for game cover, amenity and landscape. However, some species have proven to be highly invasive under certain circumstances and now require active management in order to minimise their negative impact on the woodland habitat.

Common rhododendron (*Rhododendron ponticum*) and cherry laurel (*Prunus laurocerasus*) are two of the most widespread invasive species. This Native Woodland Information Note focuses on rhododendron, but most of the management and control measures described can also be applied to cherry laurel.

ECOLOGY AND LIFECYCLE

As with all invasive species, the management of rhododendron requires an in-depth knowledge of its ecology and lifecycle.

Range and growth habit

The genus *Rhododendron* is part of the heather family (*Ericaceae*). Its main and most continuous natural distribution is in the region of the Black Sea, although it is also native in parts of Portugal and southern Spain. Many species of this

Fig.1: *Rhododendron ponticum* in flower. The copious flowers produced in late spring are very much admired, particularly by visiting tourists (Photo courtesy of Chris Barron).

genus have been introduced into Britain and Ireland, but only *Rhododendron ponticum* (hereafter referred to as rhododendron) has naturalised to any significant extent. Since its introduction to England in 1763 and soon afterwards to Ireland, rhododendron has become widespread on suitable soils throughout both Britain and Ireland.

Rhododendron is an evergreen shrub, with dark green, waxy, oblong leaves and conspicuous pinkish-purple flowers (Fig. 1). It may grow to form thick impenetrable stands over large areas, with individual shrubs reaching heights of up to five metres. It spreads rapidly by seed but can also spread by layering. Rhododendron flourishes on acid soils, particularly in mild moist conditions. Once established, it forms dense, long-lived thickets, which cast a heavy shade to the detriment of the ground flora and the regeneration of trees and shrubs. As rhododendron is very shade tolerant, it is a weed of woodlands and forests, as well as open habitats.

Seed production and dispersal

Rhododendron does not usually produce flowers until it is 10 to 12 years old. The seeds are cylindrical, c. 1.5 mm in length, with a frill of hairs at both ends. Each flower head produces between 3,000 to 7,000 seeds. The frill of hairs is thought to aid dispersal on the coats of animals in the relatively windless conditions under forest canopy. However, seeds of this size can be dispersed by wind over distances up to 1 km.

Germination and seedling establishment

Seeds germinate under favourable conditions in about five to six days. Light is essential, although the amount required is low (2-5% of full daylight). Germination will occur on a shaded forest floor but not when seeds are buried under soil or vegetation. Once seeds are released, they have a short period of viability of up to 160 days. A dense herb layer prevents establishment and bare soil also appears to be unsuitable. Moss carpets and ground disturbance resulting from trampling, burning and forestry operations (particularly scrub clearance and felling) are conducive to the germination of rhododendron seed. Other factors favourable to the formation of moss carpets, such as high humidity and rainfall, rocky slopes and intensive grazing, also favour the establishment and spread of rhododendron.

At the end of the first growing season, the seedlings are small (2-5 cm tall), with a simple root system, and they are very susceptible to drought. At this stage, therefore, desiccation is considered to be the main cause of death, with seedlings most likely to survive in moist, sheltered sites where the roots have access to mineral soil (Cross, 1981; Shaw, 1984; Tabbush & Williamson, 1987).

Shade tolerance

Once established, rhododendron can grow under heavy shade. The plants possess characteristics adapted to shade, including a low metabolic rate, resistance to disease, and the ability to increase leaf area in response to a reduction in light intensity. Being evergreen, rhododendron has the ability to make use of winter light conditions when the overhead deciduous canopy is leafless.

The ecological impact of rhododendron

Mature rhododendron invariably develops into an impenetrable understorey, with large, waxy leaves blocking out and reflecting sunlight and thereby preventing other vegetation from growing beneath. Rhododendron only allows approximately 2% of the total daylight to reach the woodland floor, compared with *c.* 9% for an oak/holly canopy. Light exclusion by rhododendron prevents regeneration, patterns of succession, and colonisation by other plant species, thus lowering plant diversity in any community where it becomes established (Becker, 1988; Cross, 1975). Changes in soil chemistry induced by rhododendron have also been reported. These include a reduction in cation mobilisation and the production of polyphenols, both of which inhibit recolonisation by seedlings of other species (Rotherham & Read, 1988).

Table 1: Assessing the degree and extent of rhododendron infestation (after Cross, 1973).

Criteria for Assessment	Approx. Age of Rhododendron	Degree of Infestation
No rhododendron present.	Not applicable	1 – Absent
Some rhododendron, but plants scattered and mostly small and not flowering.	Up to 12 years	2 – Slight
Rhododendron frequent but not clumping. Some flowering, many seedlings present.	Up to 24 years	3 – Moderate
Rhododendron abundant, some forming dense clumps, many seedlings.	Up to 30 years	4 – Severe
Plants forming dense thickets with almost total absence of ground flora.	More than 30 years	5 – Very severe

It is widely accepted that populations of fauna are also negatively influenced by rhododendron (Barron, 1998). Bird numbers are lower in mature oak forests dominated by rhododendron (Becker, 1988; Freeman, 1988). Very few insect species are associated with rhododendron. Due to its toxic nectar and poisonous leaves, the species is thought to be of little value as a food source. In addition, the leaves of rhododendron contain andromedo toxin that is highly poisonous if ingested by mammals. Hence, plants are generally avoided by grazing animals, thus giving rhododendron a significant advantage over native vegetation (Cross, 1981; Shaw, 1984; Tabbush & Williamson, 1987). Dead stems are also very resistant to decomposition and persist for many years.

MANAGING RHODODENDRON

Its poisonous nature, vigorous reproductive strategy and affinity for acidic soils combine to make rhododendron a highly effective invader of natural habitats on acid soils. It has already infested many native woodlands and is widespread on blanket bogs and heaths. Rhododendron is one of the biggest conservation issues facing Irish native woodlands today.

The eradication of rhododendron from an infested habitat is a major challenge and can only be carried out effectively by understanding the ecology of the species and by strategically planning the clearance work. In order to rid a habitat of rhododendron, a number of steps should be followed, including cutting all standing rhododendron and killing the stumps by uprooting or herbicide treatment. All habitats cleared of rhododendron must be regularly and systematically re-visited to remove any seedlings that have germinated and become established.

Rhododendron clearance is an expensive and time-consuming task, and should therefore be well planned before any action is taken. Two main issues must be considered.

- **Rhododendron is a prolific seed producer.** A medium sized plant is capable of producing *c.* 1 million seeds per year. However, a naturally seeded plant does not flower until it is 10-12 years old. In newly infested woodlands, this provides a window of opportunity to prevent serious infestation, through the immediate removal of young plants.
- **Rhododendron regrows vigorously when cut.** As a result, some method of stump killing or removal is always necessary. Also, any plant that regrows from a cut stump will in most cases flower and subsequently seed within 3-4 years.

The exact approach to rhododendron management will vary depending on certain site factors. In woodlands isolated from infested sites, and with well-defined boundaries and a relatively simple topography, it is possible to remove all rhododendron. On larger, more complex sites, the control of the rhododendron population to a manageable level may be a more realistic goal, at least in the short to medium term. Where sites are large and finances are limited, those areas with the oldest plants, which are likely to flower the soonest, should be removed first to minimise any risk of seed being produced prior to completion of the primary clearance work.

Planning rhododendron control

For all sites, the following steps should be followed.

1. The entire site and adjacent area must be **surveyed** and the **level of infestation assessed** and **mapped** (see Table 1). An accurate map will help to save time and resources later.
2. The **age**, **condition** and any **previous treatments** of all stands should be noted and mapped.
3. **Areas to be worked in should be prioritised.** Prioritisation should take into account the level of infestation. For example, an area that has been seriously infested for the past 25-30 years will have little or no native vegetation beneath the canopy. In this case, it may be prudent to first clear any areas less seriously infested, which have not yet lost their native ground cover. Also, ideally work with the prevailing wind rather than against it, to help minimise seed dispersal into recently cleared areas.

Fig. 2: Recently cut rhododendron bushes re-sprouting from the stumps, Glengarriff, Co. Cork. Note how the area has been cleared of all cut material to facilitate follow-up spraying.

4. Suitable conditions for the **recovery of the ground flora** must be created. This will reduce **'safe sites'** for rhododendron establishment and thereby **minimise reinfestation**.
5. **Write a Rhododendron Management Plan.** The plan should encompass the entire site and include projections over a suitable timeframe. All work to be carried out in the area should be mapped and clearly dated and detailed in an accompanying schedule, along with a timeframe for follow-up work.
6. In all sites, **follow-up** work will be necessary to ensure that any small plants or seedlings which were either missed on the previous visit or have entered the site subsequently from adjacent seed sources, are removed before they reach the flowering age (10-12 years). Ideally remove them when they are *c.* 0.5 m tall. At this stage, they are more easily seen, and any young seedlings likely to die naturally through desiccation will have done so. The systematic checking of a woodland habitat for reinfestation is tedious but necessary if the area is to be maintained free of seed-producing rhododendron. Also, reinfestation brought about by poor follow-up will negate the considerable time and cost invested in the initial clearance.

METHODS OF RHODODENDRON CLEARANCE

Cutting and removal

The first operation in clearing rhododendron is the cutting of individual stems with hand or chainsaws. Stems should be cut as close to the ground as possible. The cut material will need to be removed from the area to allow for effective follow-up work, subsequent tree planting, etc., (Fig. 2). If the terrain and layout of the woodland are suitable, the material can be used to build a "dead hedge" around the area as a barrier to exclude grazing animals[1].

Burning under the supervision of personnel with fire experience is another option. Rhododendron material can be burnt green immediately after being cut. Fires should be carefully located so as not to damage any trees or other vegetation close by, and old tyres or diesel should not be used. If burning is not an immediate option, the cut material can be piled neatly outside the treated area, allowing them to be dismantled easily to facilitate burning at a later stage (ideally 1-2 years later). Where burning is envisaged, contact should be made with the Local Authority to obtain permission.

Flailing is another method of rhododendron clearance and has recently been applied in Ireland. This involves the flailing of the thickets down to ground level, using a mechanical flail head mounted on a tracked machine. Although not suitable on all sites, especially those that are steeply sloping or very wet, it is a very effective as it mulches the material upon contact.

Killing rhododendron

Some method of killing must be used as rhododendron invariably grows back vigorously when cut. There are four main approaches.

1. Digging out

Digging the stumps out of the ground is an effective way of killing rhododendron. Its effectiveness is maximised by removing all viable roots, although this is also very labour intensive. Digging out can be carried out manually or, if the terrain allows, by machine (e.g. a tractor and chain). To prevent regrowth, as much soil as possible should be knocked off the root system, and the stumps should be turned upside down to expose the roots to the air and to allow the rain to wash off any remaining soil. Stumps that are dug out should be burnt along with the cut material. Digging out results in a high degree of soil disturbance, and so may not be an option on more sensitive sites. Note that burning stumps that are still rooted will not kill the plant.

1 *If piled appropriately, rhododendron brash can be used to build a very effective temporary barrier (which may last for 10-15 years) to deter sheep, cattle and deer from entering an area in which, for example, trees have been planted or natural regeneration is being encouraged. However, on sites with a risk of fire, ordinary fencing may be more suitable.*

Fig 3: Cherry laurel regrowth suitable for foliar herbicide application, Clonbur, Co. Mayo.

2. Direct stump treatment

Rhododendron kill can be achieved by direct stump treatment, whereby freshly cut stumps are painted or spot sprayed with a herbicide solution. Ideally this should be carried out when rain is not imminent, to avoid the solution from being washed off. Stems are cut as close to the ground as possible, and the fresh stump surfaces treated with herbicide immediately, i.e. within minutes. A vegetable dye is used to clearly identify which stumps have been treated. Painting of stumps with glyphosate solutions (25-100%) was found to be 100% effective when carried out between May and March at an experimental site in Scotland (Tabbush and Williamson, 1987). This method is regarded as being most effective outside the time of spring sap flow.

The following are herbicides (including application rates, methods and timing) used in the control of rhododendron by stump treatment (after Willoughby and Dewar (1995)).

- **Glyphosate:** Apply 'Roundup' in a 20% solution in water to all freshly cut stump surfaces using one of the following: a knapsack sprayer at low pressure; a forestry spot gun fitted with a solid stream nozzle; a cleaning saw fitted with a suitable spray attachment; or a paint brush. Best results can be obtained during the period October to February.
- **Tryclopyr:** Apply 'Garlon 4' in an 8% solution in water using one of the following: a knapsack sprayer at low pressure; a forestry spot gun fitted with a solid stream nozzle; a cleaning saw fitted with a suitable spray attachment; or a paint brush. Apply at any time between cutting and the appearance of new growth.
- **Ammonium sulphamate:** Apply as a 40% solution between April and September. Optimum control resulting from treatments applied between June and September.

Surfactant additives are not appropriate for stump application. It is important to ensure that all cut surfaces are treated.

In Ireland, trials in Killarney using stump treatment resulted in extremely successful kill rates among a range of plant sizes throughout all months of the year (O'Toole, in press). Chemical concentrations from 10% to 20% have been used effectively and further trials are ongoing. A major advantage of stump treatment is that all initial clearance work can be carried out in a single sweep. Also, as the application of the herbicide is carried out with a hand-held applicator, spray drift is avoided and the impact to the surrounding non-target area is minimal. In addition, small volumes of herbicide are used.

Although stump treatments can result in total kill, regrowth from the cut stumps can occur. This regrowth is usually slow and stunted. Carefully timed foliar application of herbicide to the regrowth will subsequently achieve full kill.

3. Spraying of regrowth and large seedlings

Stumps and large seedlings (less than 1.5 m in height) can be effectively killed by spraying the regrowth with a suitable herbicide, typically glyphosate[2]. Usually the cut stumps are allowed to regrow for 1-3 seasons before being sprayed (Fig. 3). Glyphosate is the most common herbicide used. Other suitable herbicides include Ammonium sulphamate, Imazapyr and Triclopyr (Table 2).

There are a number of important considerations to bear in mind when spraying regrowth. Firstly, glyphosate must be applied in dry weather, which obviously poses a challenge under Irish conditions! Success is dependent on the plants being dry at the time of herbicide application and remaining dry for a sufficient time thereafter to allow the herbicide to be absorbed into the plant (at least 6 hours, preferably longer). The addition of a surfactant (e.g. Mixture B) can increase the rate of herbicide absorption and reduce the amount of 'dry-time' required after foliar herbicide application. Surfactants are often more environmentally damaging than the herbicides themselves and must be used with great care, especially adjacent to aquatic habitats.

Spraying should be carried out in near windless conditions, to maximise herbicide contact and absorbance of the chemical into the plant. Conversely, spraying in windy conditions should be avoided at all costs, as this will lead to herbicide drift, resulting in 'collateral damage' which will kill nearby native flora, including herbaceous species and young regenerating trees. This delays the establishment of a ground cover and facilitates further rhododendron establishment.

2 *See also Ward (1998) and the Pesticide Control Service, Department of Agriculture & Food, (***www.pcs.agriculture.gov.ie***) regarding current recommendations for chemical control.*

Table 2: Herbicides (including application rates, methods and timing) used in the control of rhododendron by foliar application.

Herbicides for Rhododendron Management

Treatments, as recommended by Willoughby and Dewar (1995), are as follows.

FOLIAGE SPRAYS AND TREATMENTS

Product	Rate	Date of application	Method
Glyphosate	10 litres 'Roundup' per ha Zor 8 litres per ha with 'Mixture B' as 2% by volume. Alternatively, spray so that all the foliage is wetted, but the herbicide solution does not run off, with a 2% solution (i.e. 2 litres of product in 100 litres water).	June-September.	Most types of spraying equipment, i.e. Knapsack sprayer, tractor mounted equipment, etc.
Triclopyr	8 litres 'Garlon' per ha.	June-September.	Knapsack sprayer.
Ammonium sulphamate (AMS)	40% in water.	April-September. Most effective May and June.	Knapsack sprayer.

Note: Translocation within rhododendron stems is particularly poor in a tangential direction. In effect, spraying one part of a bush results in the death of that part only. It is therefore important to ensure full coverage of all foliage. It is usually necessary to retreat small pockets of regrowth for 2-3 years following initial spraying.

Ensure at all times that chemical solutions do not enter watercourses, as this can have a severe impact on the aquatic habitat and on aquatic life. At all times, adhere to best practice regarding safety and environmental protection, as set out in the manufacturer's guidelines, Ward (1998), and the Forest Service *Forestry and Water Quality Guidelines and Forest Protection Guidelines*.

As spraying is not 100% effective, some plants may require two or more applications before they are killed. Since cut stumps generally produce multiple shoots of regrowth, delaying the spraying for more than three years after the initial stump cutting can actually result in the infestation becoming even more severe. At this stage, the regrowth is likely to be too tall to be sprayed effectively, forming dense impenetrable thickets. Regrowth is also likely to flower more vigorously than naturally regenerated rhododendron.

4. Stem injection

Stem injection, using the 'drill and drop' method (Edwards, 2006), can be used for the control of established rhododendron bushes, where access to the main stem is possible and where the stem is large enough for a hole to be drilled into it. One of the main advantages of this technique is that it facilitates the controlled application of herbicide to target plants, thereby reducing damage to other flora adjacent to treated bushes. It is a particularly useful method on difficult, sloping terrain, where other methods may be impractical. A handheld cordless drill with several re-chargeable batteries and a spot gun are the only tools required. A 25% solution of glyphosate (i.e. 1:3 mix with water) is recommended. No additives are required. Applications during March, April and October have been successful in giving complete control of target bushes.

Treated bushes can be left standing on site to rot. However, bear in mind that standing, dead rhododendron may persist for 10 to 15 years, is unsightly and can inhibit access to the woodland for management operations. Therefore, it may be better to cut and remove the treated bushes at a later date. The effectiveness of control should be assessed initially every 12 months following the treatment.

The main steps involved in stem injection are as follows.

1. Stems to be treated should be greater than 3 cm in diameter. In order to maximise the potential of killing the entire plant, choose a position on the stem as close to the main root system as possible, and at least below the lowest fork.
2. Drill as vertically as possible into the stem to create a hole that will hold the herbicide solution. The drill bit used should be 11-16 mm in diameter, depending on the stem diameter. There is no upper limit to the size of stem that can be treated.
3. Apply the herbicide to the hole immediately after drilling. The recommended amount is 2ml of herbicide solution per stem. Do not allow the herbicide to overflow from the hole. The use of a forestry spot gun with a calibrated 10ml chamber is recommended, as this allows for the accurate application of a calibrated 2ml of herbicide per hole.
4. It is recommended that each plant be marked immediately after treatment, to track progress. Treated plants can be marked with a spray of coloured paint or by attaching coloured biodegradable tape.
5. Applications can be made in light rain, provided that rainwater is not running down the stem into the application hole and washing the herbicide solution out into the surrounding area.
6. Bush death should occur between 9 and 31 months, depending on application date and bush size.

Fig 4: A native woodland formerly infested with rhododendron, subsequently cleared and now recovering successfully, Glengarriff, Co. Cork.

Follow up operations

If the initial infestation was of the flowering age, or if there is a seed source nearby, a follow-up seedling removal operation will be necessary. The intensity of this operation will vary, depending on the degree of infestation, i.e. severe, moderate or slight (see Table 1). In cases where there is a possibility of stumps resprouting and subsequentally flowering, the area should be systematically checked every 3-4 years. All woodland areas vulnerable to rhododendron establishment through seed influx should be checked every 6-8 years. Rhododendron seedlings should be pulled manually, and either piled and burnt or removed from the site altogether. If large enough, they can also be hung securely from trees and left to dry out and die.

The vulnerability of the site to infestation (or reinfestation) can be reduced by encouraging the development of a dense ground cover through the control of grazing pressure. Grazing pressure from livestock, deer and feral goats, should be reduced in the area and managed at levels that will allow the natural regeneration of the native ground flora. This helps to suppress the emergence of young rhododendron plants. Grazing pressure is typically achieved through fencing and culling.

Adjacent rhododendron seed sources

If the adjacent seed source can be cleared, this should be undertaken at the same time as clearance work on the site itself. However, if the adjacent seed source is outside the control of management, the clearance and maintenance of a buffer zone around the site will minimise reinfestation from outside seed sources via seed dispersal. The buffer zone should be as wide as is practically possible.

Adjacent domestic gardens, arboretums, etc. can also represent a seed source. If possible, the owner should be encouraged to remove flower heads after flowering. As seed maturation usually takes six months, remove the heads by December as this will prevent seed dispersal which normally occurs between January and March.

Quality control in rhododendron management

Whatever method is used to control rhododendron, there is always a risk that treatment will be only partially effective and that further action will be required to achieve total kill. The degree of success of the initial treatment method can be maximised by paying careful attention to the operational detail of whichever method is used. Even then, it is likely that some regrowth will occur in many cases, and this will require further treatment.

CONCLUSIONS

Rhododendron (and laurel) poses a serious ecological threat to native woodlands in Ireland, particularly by displacing native vegetation and by preventing the natural regeneration of native flora. This results in the disruption of woodland succession and continuity, with a consequent reduction in woodland biodiversity. The future survival of badly infested woodlands may be seriously compromised and even impossible.

The control and/or eradication of this invasive alien species requires long-term planning, a good understanding of its ecology, and a thorough application of initial clearance and follow-up activities such as stump uprooting and/or herbicide treatment (Fig. 4). Timing of herbicide application as well as weather conditions are very important factors and must be taken into account. The control of seedlings and the regrowth from cut stumps involves ongoing spot checks and monitoring.

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ADDITIONAL NOTE: PHYTOPHTHORA RAMORUM CAUSAL AGENT OF SUDDEN OAK DEATH DISEASE

Since first reported in the mid-1990s, significant numbers of oak trees and other plant species have been damaged or killed in California and other parts of the western United States by a newly described disease, commonly known as Sudden Oak Death, caused by a new species of fungus named *Phytophthora ramorum*. The same fungus had also been found in many EU countries, mainly on the shrub species *Rhododendron* and *Viburnum*.

Under the EU Plant Health Directive emergency legislation was introduced in 2002 to prevent the introduction into and the spread within the EU of *Phytophthora ramorum*.

Since 2003, annual surveys have been carried out throughout the EU including Ireland. *Phytophthora ramorum* has been found in 12 EU Member States. The vast majority of findings have been on plants of *Rhododendron* and *Viburnum* species. In relation to tree species, the fungus has been found in Britain on a range of tree species including a number of oak species, beech, ash, sycamore, Spanish chestnut and horse chestnut. In the Netherlands, the fungus has been found on beech and red oak.

In Ireland, the fungus has been found on *Rhododendron* at three forest locations, and containment/eradication measures have been implemented. The fungus has also been detected in garden centres and nurseries on *Rhododendron* and *Viburnum*. To date, there have been no findings on any tree species in Ireland. However, the concern is that if more *Rhododendron* becomes infected, the fungus could spread to susceptible tree species.

Forest owners are encouraged to report unusual symptoms of disease on *Rhododendron*, such as wilting, to their local Forestry Inspector.

Further advice is available from Forest Protection & FRM Section, Forest Service, Tel: 1890 200510 (lo-call) or 01 6072651; Email: forestprotection@agriculture.gov.ie