Development of strategies for the control and eradication of Japanese knotweed

Submitted by James Macfarlane to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Engineering.

I certify that all material in the thesis which is not my own work has been acknowledged and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Name in full_____

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Abstract

This work has investigated a range of aspects of the physiology and management of *Fallopia japonica* (Ronse Decraene) and closely related invasive introduced plant species, colloquially referred to as Japanese knotweed. Prior to this work very little detailed scientific research had been done into the nature of the plant and its related species or into the effectiveness of control methods over the long term.

This work has highlighted the need for education of the public to prevent further spread by inappropriate disposal, and advice on suitable and practical methods of control in a wide range of environments. The creation of an online GIS database has led to an increase in reporting of sites on private land by the public and this has in turn strengthened the Cornwall database which is the most comprehensive of its type ever created. This database has enabled detailed analysis of distribution, identification of likely areas of colonisation and indicated mechanisms of spread. It has also provided a basis for targeting of resources and prioritisation of treatment.

Initial field observations also prompted research on physiological aspects of the plant which have particular implication for determining methods for its control. The work has shown that much smaller fragments of rhizome than those previously tested are capable of regeneration (down to 0.01g) and that there is a significant likelihood of fragments of 0.06g regenerating in suitable conditions which has implications for separation techniques. It has demonstrated that typical rhizome material is capable of survival for at least three months under saline conditions thus highlighting a risk of marine spread along coasts. Extension rates of above ground material of up to 13.8 cm over a 24 hour period have been recorded. Cutting of above ground material caused a stimulation of new above ground stems – thus any proposed treatment should continue consistently over a number of years. A temperature of 40C maintained over a period of 7 days removed rhizome viability in chopped fragments of up to 10cm thus suggesting that temperature controlled in-vessel composting may be a possible disposal route for chopped rhizome. Main underground extension growth has been shown to occur in the Autumn with no particular orientation to the growth. Up to 50kg (wet weight) of underground material has been discovered in a

cubic metre of excavated material. Rhizome disturbance has been shown to promote underground extension. The way in which rhizome desiccates, leaving viable buds separated by necrotic material, means that underground connections within an area cannot be assumed. This has implications for the effectiveness of chemical treatment. The suggested regeneration from leaf material has not been demonstrated, nor has a reliable chemical method of testing the viability of rhizome material.

The implications of these physiological aspects on a wide range of treatment methodologies have been considered and control methods have been tested. Excavation and separation of material can be effective in appropriate soil conditions. The need to use glyphosate based herbicides primarily in the Autumn has been demonstrated. This work has called into question the current methods of assessment of effectiveness of control and the use of viability assessments on sites. It has highlighted that monitoring of treated sites needs to be continued over a number of years in order to determine whether eradication has been achieved. In view of the legal proscriptions about the plant, it is considered that some control measures currently deployed could have the potential to breach current legislation by being likely to cause the plant to spread.