An Environmental Impact Assessment for Biological Control of Heather (*Calluna vulgaris*) in New Zealand

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Heather (*Calluna vulgaris*) has been identified as a serious shrubby weed in the tussock grasslands of the Central North Island of New Zealand and especially in Tongariro National Park. Heather was intentionally sown in the National Park early this century with the aim of reproducing a Scottish moorland to provide grouse shooting in New Zealand. Heather plants have since replaced extensive areas of native vegetation, overtopping tussock grassland communities. An environmental impact assessment was prepared which incorporated information provided in 22 submissions on biological control of heather, as well as selected material from the extensive literature on the ecology of heather and its fauna in Europe. A chrysomelid beetle, *Lochmaea suturalis*, has been identified as a promising potential control agent, since extensive damage to heather in Europe has been attributed in large part to the defoliating effects of this beetle. The likely impact of heather beetles on the heather communities in New Zealand was discussed. In addition, issues arising from the conflicting interests of successful biological control anticipated by beekeepers, nurserymen and gardeners were presented. It has been concluded that the severity of the weed problem warrants further investigation of biological control, and the Department of Conservation is currently funding host specificity testing of *L. suturalis* in the UK.

Introduction

It was not until 1980 that the threat posed by heather (*Calluna vulgaris* [L.] Hull; Ericaceae) to intact indigenous plant communities within Tongariro National Park (TNP) was widely recognised (Chapman and Bannister 1990). Park staff had been aware of heather's weed status since the early 1970s and Atkinson (1975, 1976 cited in Chapman and Bannister 1990) had noted its potential to spread after fire. In 1986 TNP staff convened a workshop of scientists and managers from universities and government departments to discuss the options for control of heather and, in particular, the feasibility of biological control (Department of Conservation 1988). Progress was delayed through reorganisation of the newly formed Department of Conservation (DoC) but, in 1990, DSIR Plant Protection received funding from DoC to initiate a programme for biological control of heather.

It has been the recent practice in New Zealand to prepare an *environmental impact assessment* (EIA) before initiating work towards biological control of plants where there is some doubt about their universal weediness (Hill 1990). Legislation governing the importation of new animals requires an *Importation Impact Assessment* (IIA) to be conducted before release of a new insect species in New Zealand (Clark 1990). At this stage host-specificity data must be provided, but their collection can be a wasteful expenditure of resources if the project is then rejected on the grounds that the target is unacceptable. Both the regulatory authority (Ministry of Agriculture and Fisheries—MAF) and the policy forming agency (Ministry for the Environment—MfE) have endorsed the concept of an EIA at the outset of a new project. IIAs for the release of individual agent species follow when host-specificity data and other biological information are obtained.
The objective of the work described here was to collate current relevant information on heather in New Zealand, its beneficial qualities as well as its weed status and control options, and the prospects for successful biological control, so that an informed decision could be made whether research into biological control of heather should proceed. Since the fauna of heather in Europe is well known, and a leaf beetle, *Lochmaea sutoralis* Thomson (heather beetle) (Coleoptera: Chrysomelidae), has been recorded as a serious pest of heather there, this species was identified as being the most likely initial candidate.

**Methods**

Heather is the first new target weed to be considered for biological control in New Zealand since MAF prepared a new importation procedure for exotic species (MAF Quality Management 1990). Therefore the methods used in preparation of this EIA were developed in consultation with MAF and MIE.

Forty-one government departments, regional councils, university departments, professional, producer and other bodies were identified from whom views should be sought. A letter was prepared outlining the problem of heather and the proposed biological control programme, involving the introduction of heather beetle in the first instance. Several positive attributes of heather were also mentioned, notably its value as a nectar source for bees and its use in cultivation as a garden plant. Respondents were given 4 wks in which to comment on the proposal outlined in the letter. Information and comments provided in the replies were presented in a report, together with relevant information from literature sources (Syrett 1990). Following consultation between DoC and MAF, the completed report was circulated to 13 organisations for their comments. A summary of the replies was prepared by DoC (Keys unpublished) and a notice was placed in MAF *Sentinel* (1991) to inform the public that the project was to proceed.

**Results and Discussion**

**Weed Problem and Options for Control**

Chapman (1984) described the distribution of heather throughout New Zealand. Although very localised, it was found to be present at sites from the south of the South Island to the Central North Island. The Central North Island (mainly TNP) held the only substantial infestation. Heather was planted in TNP between 1912-23 with the intention of reproducing a Scottish moorland complete with grouse for recreational shooting. Subsequent importations of grouse failed to survive, but the heather flourished. From the beginning there was vociferous opposition to the whole proposal and, by 1926, the strength of public opinion was behind preserving the natural features of the Park (Bagnall 1982). Although no more heather had been planted, its distribution in TNP increased markedly between the 1960s and 1980s (Atkinson 1981, Chapman and Bannister 1990), and it continues to spread into new areas outside the Park. In some areas where heather is invading tussock grassland at lower altitudes, tall shrubs and trees may eventually displace heather. However, both seral and climax communities are threatened by the weed (Chapman and Bannister 1990).

The Department of Conservation (Keys, J.R., personal communication, 1990) has expressed particular concern for the Moawhanga Ecological Region, which has the highest concentrations of plants with unusual distribution limits for any region in New Zealand (Rogers 1989). The New Zealand Army occupies a large area around Waiouru, adjacent to TNP. Heather up to 1.5 m high greatly impedes the Army's training activities, and there is serious concern at the rate of invasion into the 70,000 ha training area. Heather is also a hindrance to hikers (Keys, J.R., personal communication, 1990).

Three possible strategies for control of a weed were identified by Atkinson (1988): do nothing and live with the problem; contain the problem through control; or eradicate the weed. Keys (personal communication, 1990) suggested that for heather in TNP the first has been practised for so long that the third is no longer possible. Therefore heather should be
contained through manual, chemical or biological control.

Mechanical control strategies have been labour intensive, expensive and not generally effective (Green, P., personal communication, 1990). Chemical control of 1,000 ha of heather has been estimated to cost up to $3 million p.a., and this is likely to be an on-going expense (Keys, J.R., personal communication, 1990).

A number of submissions supported the view that biological control offered the possibility of environmentally safe, sustainable long term control. A suggestion was also made that, in certain situations, heather could be accelerating the natural succession from grassland to shrublands and forest and that it need only be controlled in areas where it is aggressively colonising natural non-forest habitats. Bannister (University of Otago submission, Syrett [1990]) believed introduction of heather beetle to be the only feasible option for control of heather.

Impact of Biological Control Agents

Unlike many other biological control of weeds projects where extensive literature searches and field surveys have been required to identify potential candidates for introduction, the fauna of heather in its native Europe is well known. Heather and heathlands comprise one of the most intensively studied ecological systems (Gimmingham 1989) and, from the community of insect species feeding on heather in Europe (Webb 1989), the heather beetle, L. suturalis, has been a particular focus of attention because of the severe damage it can inflict on its host plant (Brusting 1982). This beetle is also reported to be strictly monophagous (Brunsting 1982). Nevertheless, a number of submissions expressed concern regarding specificity of heather beetle, and a section of the EIA (Syrett 1990) was devoted to discussion of host-screening tests and their interpretation.

The widely held view that any new animal introduced into the New Zealand environment is inherently bad (Sheppard and Urquhart 1991) is probably based on experiences of the past when inappropriate decisions have been made; e.g., the introduction of mustelids for control of rabbits. Mustelids and the like are (and were) well-known generalist predators. They were known to be generalists at the time of their introduction and the severe depredations suffered by native birds were predicted before the event (Buller 1876). It is therefore important for us to explain the difference between specialist insects subjected to detailed host-specificity testing for biological control of weeds and better known pest species which are usually generalist phytophages.

Heather is the first introduced weed confined to an otherwise indigenous ecosystem for which there has been a proposal to introduce an insect for biological control. New Zealand’s natural ecosystems are highly valued by a large sector of the population and TNP has recently become a World Heritage Area. Therefore this project has raised particular concerns whether biological control by the heather beetle would be effective in reducing heather populations, and what vegetation would replace heather, assuming control was successful. An argument has been put forward that complete answers to these questions should be obtained before consideration be given to importing the beetle.

However, biological control of weeds is still an experimental science, and it is unrealistic to suggest that the introduction of biological control agents be made only when full knowledge of efficacy is available. About biological control of weeds in general, Crawley (1986) said: "no matter how protracted the modeling effort, we are still a very long way from possessing the kind of ecological sophistication that might allow us to make predictions about the probable success of a proposed introduction."

Concerning heather, specifically, Chapman (1984) was cautious about extrapolations from Europe: "the plethora of environmental influences and sampling techniques within and between hemispheres make any comparisons between countries dubious." Even after decades of concentrated research on heather in Europe, Gimmingham (1989) remarked that there is still more to be learnt in order to use, manage and conserve the plant effectively. The benefits of lengthy experimental investigations must be weighed against the risks of not proceeding with control strategies (including biological control) in terms of increasing spread of heather.

Nevertheless, as Harris (1991) has recently pointed out, some prediction of probable
effectiveness is both desirable and possible. He identified "impact in native region" as an important factor in assessing probable effectiveness. The heather beetle has achieved pest status in Europe where the reversion of heathland to grassland in the Netherlands has been attributed mainly to heather beetle (Berdowski and Zeelinga 1987). The beetle is attacked by several organisms thought to limit its populations in Europe (Webb 1989, Waloff 1987). It could therefore be expected to reach even higher populations in New Zealand where most of those controlling organisms are absent.

It has even been suggested that removal or reduction of heather could do more harm than good. Several scenarios have been proposed which suggest that reduction in heather may not be beneficial including: (a) invasion of tussock grasslands by heather may be accelerating a natural succession from grassland to forest; (b) removal of heather might increase the susceptibility of the community to invasion by other weeds such as Pinus contorta Loudon (Pinaceae) and exotic grasses; (c) heather might be replaced by more heather, but the cycle would be more rapid. The first presupposes that an accelerated succession is desirable. Even though it is generally accepted that much of present grassland and shrubland results from man-induced fires (G.M. Rogers, personal communication, 1991), which are no longer occurring, it has yet to be demonstrated that heather does accelerate succession and, if so, that this is beneficial.

Groves (1991) allowed that successful control of a single weed species by a single control method may result in one weed replacing another, so he advocated "ecological control" in which one or several methods of control are integrated with an understanding of the dynamics of the ecosystem in which the plant occurs. Promotion of native species could enhance the effectiveness of control methods by reducing the likelihood of invasion by other exotic weed species. Although it is difficult to accurately mimic the impact of biological control agents, careful defoliation and removal experiments could provide an indication of which plants might replace heather if it were being controlled successfully.

Potential Conflicts-of-Interest of Biological Control of Heather

Many weedy species and potential weed species are widely cultivated in New Zealand as ornamentals, although there have been efforts recently to educate the public as to the threat such plants may pose to the country's unique flora and fauna (e.g., the Auckland Regional Council's project to raise awareness of the threat posed by wild ginger; Barrett [1990]). Varieties of C. vulgaris are widely grown in New Zealand gardens, with a total annual production of 11,600 plants from 5 nurseries (Syrett 1990). By comparison, numbers of plants of Erica spp. are more than double this. Ninety percent of nursery production is in the South Island and thus unlikely to be affected by populations of heather beetle established in the Central North Island. It was noted among the submissions that cultivated heathers would be at little risk from heather beetle since they are not normally grown with damp moss or other understorey vegetation ideal for egg development, and that there was little evidence that heather beetle was a serious pest of cultivated heathers in Britain or other parts of Europe.

Several beekeepers rely for a substantial part of their income on exports of heather or "Ling" honey, which is one of the most expensive honeys in the world and has 4 times the value of any other honey produced in New Zealand. The industry is worth more than $NZ 1 million p.a. Much of the heather from which the bees collect nectar is in TNP. However, it has been pointed out that the bees themselves are an alien element in the Park.

Heather has been attributed with aesthetic qualities of attractiveness, scenic appeal and increased species diversification in New Zealand, in a similar way to Russell lupins (Lupinus polyphyllus Lindley; Fabaceae). Although Gimmingham (1989) described heathland landscapes in Scotland as "beautiful and satisfying," and as a renowned tourist attraction, in New Zealand such landscapes are unnatural and therefore discordant to many people. An increasingly strong feeling is developing here that we should conserve and appreciate our indigenous landscapes.
Summary of Opinions Expressed in Submissions

Twenty-two submissions were received in response to the initial letter outlining the case. Of these, 13 favoured biological control of heather, 4 were against the proposed project and 5 expressed no opinion. Of those opposing biological control, 3 represented beekeeping interests, and one represented growers of ornamental Calluna. Several of the submissions rated these interests minor compared with the environmental damage caused by heather: “it is difficult to accept that the economic/aesthetic benefits to a handful of beekeepers, home gardeners and ill-informed tourists justifies leaving the heather to spread;” “other uses of the plant such as a source of nectar and pollen for beekeepers must be secondary to an attempt to return the Park's vegetation to a natural state;” and “heather's value to beekeepers is of little significance when compared with the damage it is causing.”

After the EIA

Twelve of the 13 organisations to whom the EIA was circulated were in favour of the project proceeding and, subject to the results of ongoing research and assessment, it was subsequently accepted by DoC. MAF and MIE have endorsed the conservative approach being taken. Currently, the Tongariro/Taupo Conservancy of DoC, through DSIR Plant Protection, is funding host-testing of heather beetle by the International Institute of Biological Control in the UK. In addition, work is being carried out on the spread and demography of heather in the Central North Island (including the Moawhanga Ecological Region). The Science and Research Division of DoC is funding an investigation into the effectiveness of selective herbicides and hand pulling for control of heather, the role of heather in succession from tussock grassland to forest, and the response to simulated biological control. Oversowing and revegetation options will also be considered. DoC is also funding research aimed at assessing the impact of heather and the potential impact of the heather beetle on the indigenous insect fauna of TNP. Thus the proposed current research programme comprises an integrated approach aimed at achieving control of a serious weed of the natural environment.

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References


