Towards ecologically based noxious weed proclaimations and management strategies

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Summary
Two fundamental questions about weeds are "where can they spread to?" and "what harm will they cause there?"
A proposed system for indicating the potential distribution, impact and management options for noxious and other weeds is described. It uses the climate matching model BIOCLIM, and a geographically based land classification system to indicate broad areas that are suitable for the establishment of a species, by extrapolation from the locations of known infestations. Further details of situations within the land systems, and of land use, land management and agricultural productivity can be used to specify the nature of threat of a species, economic impact and management options.

Introduction

Noxious weeds legislation has the particular objective of preventing the introduction or spread of species which could adversely impact on the productivity or conservation values of any area they might infest. The management of species that are proclaimed impose financial and operational commitments on governments and landholders. As such, administrators look to objective assessments of risks of weeds and the benefits of programs, on which to base their decisions and actions. Historically, most weed assessments have focussed on individual species. Subjective classifications have been based on attributes believed to be associated with "weediness", while ecological assesments have been based on measurements of physiological responses to environmental conditions. In practice, such species centred investigations have rarely enabled reliable predictions to be made, although they often explain the processes that underlie the establishment of infestations or the failure of a weed to persist. The alternative approach is to look at the susceptibility of situations to invasion. Orians (6) suggests that in part, the lack of progress (in studies of biological invasions) has been caused by a shift of attention away from the receiving environment to the nature of the colonising species themselves. He proposed an approach that combines information on the invading organisms and the environment into which they are being introduced. Crawley (2) also emphasises the importance of understanding the attributes of communities that make them more likely to be invaded, when considering the spread of alien plants. Both Orians (6) and Crawley (2) demonstrate the role of disturbance in making an existing community susceptible to invasion.

The communities that agricultural weeds invade are crops and pastures. The growth, and therefore the productivity and competitive ability of crops and pastures is determined by environmental conditions and management. Environmental

conditions include both climatic and land factors. Kemp and Dowling (3) observed associations between pasture composition (including weed species) and rainfall and altitude. McKinney et al. (4) found that pasture composition and carrying capacity differences, within a heterogeneous area, were attributable to differences in soil depth, aspect, slope, soil moisture and nutrient characteristics. Management may enhance or reduce the local environmental conditions, particularly soil structure and fertility. Cultivation and grazing are disturbances of the community or the situation in which it is growing. It is proposed therefore, that as communities, crops and pastures will have an inherent productive capability and a resistance or susceptibility to invasion, depending upon the degree to which they are able to persist and compete in the environment in which they are being grown. This inherent resistance or susceptibility may be continuing, seasonal or arise occasionally, as in periods of drought or flooding. In addition, the way in which they are managed (grazing pressure, fertilizer application etc) may induce susceptibility. For decisions about potential spread, it is important to distinguish infestations resulting from inherent risk, from those which are symptomatic of innappropriate management of the affected area. The focus on situations being invaded has several advantages. It gives an indication of the potential for further spread. The productive capability of areas at risk help to quantify weed impact. The nature of inherent and induced risk will help in the development of more effective options for weed management

The proposed procedure

The proposed procedure has been developed around various information sources and computer facilities available within the Department of Conservation and Environment of Victoria, but which are of types becoming generally available. It allows for a hierarchy of levels of detail, depending on the information available.

Details of the location, situation and land use affected and severity of existing infestations, as observed by the Department's field staff, are recorded in the Pest Management Information System (PMIS) which has been developed by Lane et al. (5). The locations are defined geographically as a map reference, which enables their distribution to be plotted on base maps, using Geographic Information Systems (GIS) software.

The BIOCLIM model, Busby (1) indicates areas with similar climatic conditions to locations where existing infestations occur. This model gives the broad climatic limits within which the species is likely to spread.

The land systems of Victoria, Rowan (7), provides a classification of land types, based on geology, topography, climate and vegetation. Each land system represents a broadly uniform physiographic unit, but can be further sub-divided into components. Land systems have been mapped for the whole State, at a scale of 1:250 000. If infestations recorded in PMIS show an association with land systems, the boundaries of those, and similar land systems, within the climatic area defined by BIOCLIM, will be taken as the possible extent of

risk. Details from PMIS may be used to qualify situations at particular risk, within the land system boundaries.

BIOCLIM and Land systems will also be used to interpret the suitability of areas for particular agricultural uses, and to indicate the productivity of crop and pasture species. Comparisons between land systems should indicate the inherent susceptibility of crops and pastures to weed infestation. Comparisons of infested and non-infested farms within land systems may provide a guide to weed impact and practises which reduce the risk of invasion, or induce susceptibility.

Support to weed assessment and strategy development
The procedure gives a valid basis for the integration and extrapolation of existing information. By giving a geographic definition to potential risk, the future benefit of eradication and containment programs can be evaluated. Small infestations in large areas with a high level of susceptibility will be identifiable as primary targets. Contingency plans can be made to reduce spread when seasonal or occasional conditions increase inherent risk. Modification of practices which induce susceptibility will decrease risk and lead to the more effective control of existing infestations.

References

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