Community involvement in biological control: towards the development of an improved evaluation model

Sarah Holland-Clift[1] and Raelene M. Kwong[1,2]
[1] Department of Primary Industries – Frankston, PO Box 48, Frankston, Victoria 3199, Australia
[2] CRC for Australian Weed Management

Summary Community involvement has become increasingly valued as a key to success in implementing classical biological control programs. However, to ensure success, the limitations and potential drawbacks of involving the community must also be considered. This paper evaluates the effectiveness of the different community education, awareness and technology transfer methods used in the bridal creeper, *Asparagus asparagoides* (L.) W.Wight, biological control program within Victoria, Australia, with a particular focus on agent distribution methods. Through this evaluation, a conceptual model is developed to help guide future planning and evaluation of community based biological control programs.

Keywords Biological control, community involvement, technology transfer, bridal creeper, *Asparagus asparagoides*, project planning, evaluation.

INTRODUCTION

Community involvement has become increasingly valued throughout Australia as a key element of a successful biological control program. As a result, biocontrol officers have adopted numerous approaches that aim to take advantage of the important and diverse contributions that the community can make (e.g. Swirepik and Briese 2000, Batchelor and Woodburn 2002). While the benefits of community involvement are well recognised, the limitations and potential drawbacks are often neglected. Evaluation of both the benefits and limitations of a project are essential to achieving overall success. Two primary motivations for involving the community in biological control are to foster community ownership of the weed problem and its solution (Kwong in press) and to maximise agent establishment and success (Briese *et al.* 1996). Although the utilisation of community distribution networks may increase the overall number of release sites and thus spread of the agents, if establishment rates are low, there is a risk of losing community support for the process (Swirepik and Briese 2000). Therefore, a lack of understanding of when, how and to what extent the community should be involved could be detrimental to both the program itself and to biological control in general.

The bridal creeper (*Asparagus asparagoides* (L.) W.Wight) biological control program provides an excellent case for evaluating some of the strengths and weaknesses of community involvement in biological control, having relied heavily on the community in release site identification and the rearing, release, redistribution and monitoring of biocontrol agents. Two bridal creeper biological control agents, a leafhopper *Zygina* sp. and a rust fungus *Puccinia myrsiphylii* (Thuem.) Wint., were released in Australia in 1999 and 2000 respectively as part of a collaborative program coordinated by the Cooperative Research Centre for Australian Weed Management. This paper evaluates the effectiveness of the different biocontrol agent distribution methods, each with varying degrees of community involvement, used across the state of Victoria. Through this, a conceptual model is developed to help guide future planning and evaluation of community based biological control programs.

METHODS

Releases of the bridal creeper rust fungus and leafhopper were made at 187 release sites across Victoria using four main distribution methods. Agents were sent out by post (n = 34), handed out at field days (n = 35), reared and released by schools and community groups (n = 47) (see Kwong 2002) or released by biocontrol officers themselves (n = 71). Of these, 116 sites were monitored for establishment and spread of the agents at least one year after release, with 15, 21, 16 and 64 sites monitored for the four distribution methods respectively. Details recorded for each release site included the distribution method, site manager, agent released, date of release, release technique used and establishment status of the agent. Agents were considered established if they reappeared at the site in the next growing season, having survived summer dieback of bridal creeper foliage.

For the rust fungus, two release techniques were used. In one technique the rust-infected foliage was simply rubbed onto the underside of fresh bridal creeper foliage at the site. Alternatively, rust spores were collected from infected foliage into small gelatin capsules using an aspirator; the capsules were then dissolved in water and the suspension immediately sprayed onto the underside of fresh foliage. In both methods, the newly inoculated foliage was sprayed with water and covered

with plastic for 24 h. In 2003, redistribution days were also conducted at three established rust sites, where community members collected rust infected foliage from these sites and were trained in how to release the rust to new sites using the rubbing method. This resulted in 15 more releases being made.

RESULTS

Agents became established at 64% of release sites monitored. The rust fungus established at 74% of release sites (n = 42), while leafhoppers established at 58% of sites (n = 74).

Of sites monitored, a much higher rate of agent establishment (84%) was achieved when biocontrol officers conducted releases (n = 64) than with any other distribution method used (Figure 1). In addition, agents that were sent out by post had more than twice the rate of establishment than agents handed out at field days (Figure 1), becoming established at 48% (n = 21) and 20% (n = 15) of sites respectively. Community rearing and then release of agents resulted in 38% of sites establishing (n = 16).

Field officers involved in weed management comprised 59% of the total site managers who were sent agents and 17% of the total site managers handed agents at a field day. Community members interested in bridal creeper management comprised the remaining 41% and 83% of site managers respectively.

When biocontrol officers conducted a release, paperwork was filled in straight away so that permanent records could be kept. Only 6% of 34 participants who were sent agents and 9% of 47 participants who reared and then released agents did not return their paperwork. In contrast, no paperwork was received from 29% of 35 participants who were handed agents at field days, despite repeated requests. Of these 10 participants, nine were community members and only one was a regional field officer. Timing of releases also varied between methods, with 62% of agents reared by schools and community groups being released between September and January, compared with 24% when agents were sent by mail, 10% when released by biocontrol officers and 3% when handed out at field days.

The rust fungus established at 100% of release sites using the rubbing method (n = 12) compared with only 63% of sites using the spray method (n = 30). All 15 rust redistribution sites established.

DISCUSSION

The community has a key role to play in a successful biological control program, however community involvement can also be fraught with weaknesses. The community can become involved in the site selection, release, monitoring and/or redistribution phases of a program. The strengths and weaknesses of involving the community clearly differ according to which of these different phases they are involved in and also who in the community we are trying to involve. The term 'community' can encompass a wide range of people, including field officers involved in regional weed management, conservation and Landcare group members and other local landholders affected by bridal creeper.

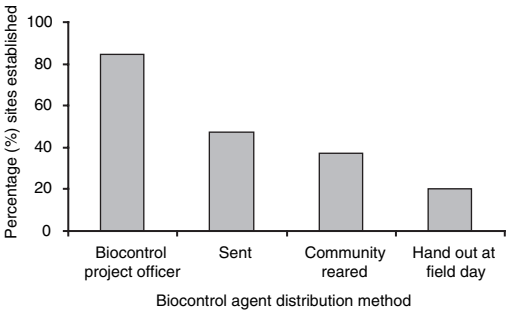

Figure 1. Effectiveness of different agent distribution methods at achieving bridal creeper biocontrol agent establishment. Columns show the proportion (%) of sites monitored that have become established for each distribution method used separately.

Site selection Community participation in site selection is critical for providing local knowledge of where weed infestations are located and identifying local management priorities. The person selecting the site, however, must also understand the principles of integrated weed management and how biological control most appropriately fits in. Biocontrol agents can also differ in their site requirements. For example, leafhoppers are generally more active in shaded areas, whereas the rust fungus disperses more quickly in wind-exposed areas (S.H. Clift pers. obs.). Such knowledge can increase the rate of agent establishment by targeting these types of areas accordingly. By working with the community to select sites and then conducting the releases themselves, biocontrol officers can ensure that agents are released at appropriate site locations. When the responsibility is handed to the community, releases are more likely to be made at less appropriate sites and less suitable times. Not only does this reduce the chance of agent establishment, it can potentially create conflict where there are external pressures to use alternative control methods.

Release A much higher rate of establishment was achieved when the biocontrol officer conducted the releases. However, this method required a much greater investment of biocontrol staff time and resources than did the other three methods. Given funding limitations, this method is generally not optimal to achieve broad scale releases.

Agents handed out at field days surprisingly achieved the lowest rate of success, considering that greater staff time and resources were required for this method compared with sending agents out, and that the field day enabled hands-on training and personal interaction with the biocontrol officer. However, people who were sent agents were primarily field officers already familiar with the biocontrol process, whereas people given agents at field days were primarily community members with little to no experience in bridal creeper biological control. This also explains the high return rates of paperwork from people sent agents, compared with those that received them at field days.

Sent agents are also simpler to track, as basic contact details are automatically recorded and participants interact directly with biocontrol officers over the phone. Sending agents via mail could therefore be a valuable release strategy once field officers and community members have been trained in their release.

Entrusting the community to select appropriate sites and to release biocontrol agents on their own, however, can result in failed releases due to incorrect application. For example, due to the constraints of school terms, some schools that were involved in the rearing and release of agents either did not rear sufficient numbers of agents, or the release was conducted too late in the season to enable the agents to establish prior to summer dieback of bridal creeper foliage. Some site managers have also admitted to holding onto agents for too long or even spilling the contents of the rust capsule prior to release. Thus, no matter which distribution method is used, follow up is necessary to ensure that the agents have established, that release sites are being managed appropriately and to address any issues or misunderstandings that site managers may have.

Deciding upon which release methods to use is further complicated by risk. Given the substantially lower establishment rate using the spray method, and the added time it takes to collect the spores, the rubbing method appears to be far superior. However, sending out rust infested potted plants for rubbing onto new foliage has the potential risk of transferring soil-borne pathogens. Despite recommendations to site managers, old pots have been found at sites many months after the release of agents. Thus the spray method was adopted as a safer release technique. It is, therefore, important to weigh up both the environmental and social risks when developing and refining release strategies.

Monitoring Community distribution networks allow the possibility of feed-back on simple measures, such as agent establishment and spread, over a much broader scale than was previously possible (Briese 2000). In whatever capacity they are collected, community-monitoring results must be approached with caution, as their reliability may vary. For example, one site manager thought that leafhoppers had completely eradicated the bridal creeper within just one season, when in fact he was just observing the natural senescence of bridal creeper foliage over summer. Other site managers have thought that agents were not present, when in fact they were established and spreading well. Other people have assumed that agents were present and so employed no other control strategies at the site, when in fact there was no sign of any agents and the weed problem was worsening.

Redistribution While a low establishment rate was achieved when agents were handed out at field days, redistribution of agents in a similar manner from already established sites has so far achieved 100% success. When agents were handed out at field days, release techniques could be demonstrated, but the impacts of agents could not be seen. By being able to see the agent active in the field, it is easier for the community member to visualise and learn how to redistribute and monitor that agent and to gain a realistic expectation of the agent's potential. In addition, the biocontrol officer can be more confident of receiving reliable feed back on the agent's activity from participants. Since the agent has established in an area, agents redistributed to other local sites may also be more likely to establish due to a favourable environment. Furthermore, if the participant's new site does not successfully establish, they still maintain positive perceptions of biological control having already seen it working effectively.

The redistribution phase offers the most potential for positively engaging the community in a bridal creeper biocontrol program. However, some element of community participation throughout the previous three phases is also necessary in order to select appropriate sites and to refine release and monitoring protocols relevant to the community members' skills and knowledge.

A conceptual model Based on this study, a conceptual model was developed to illustrate the potential process of evaluation for a community-based biocontrol program following approval for release of the agent

(Figure 2). The model shows the required inputs and desired outcomes for each phase of the program, in order to achieve the long-term aims of maximising agent effectiveness and gaining community ownership of biological control.

A biological control program can be limited by both unrealistic expectations of its potential and by a researcher's limited capacity to follow up with participants (Batchelor and Woodburn 2002). Thus the initial site selection, release and monitoring phases of the model are considered development phases that involve a small 'pilot' group of regional field officers and nursery site managers. If the agents either do not establish or fail to impact upon the weed, close communication with these people can ward off negative perceptions of the program and also highlight the need to adapt their weed control strategy. On the other hand, if the agents do show evidence of impacting upon the

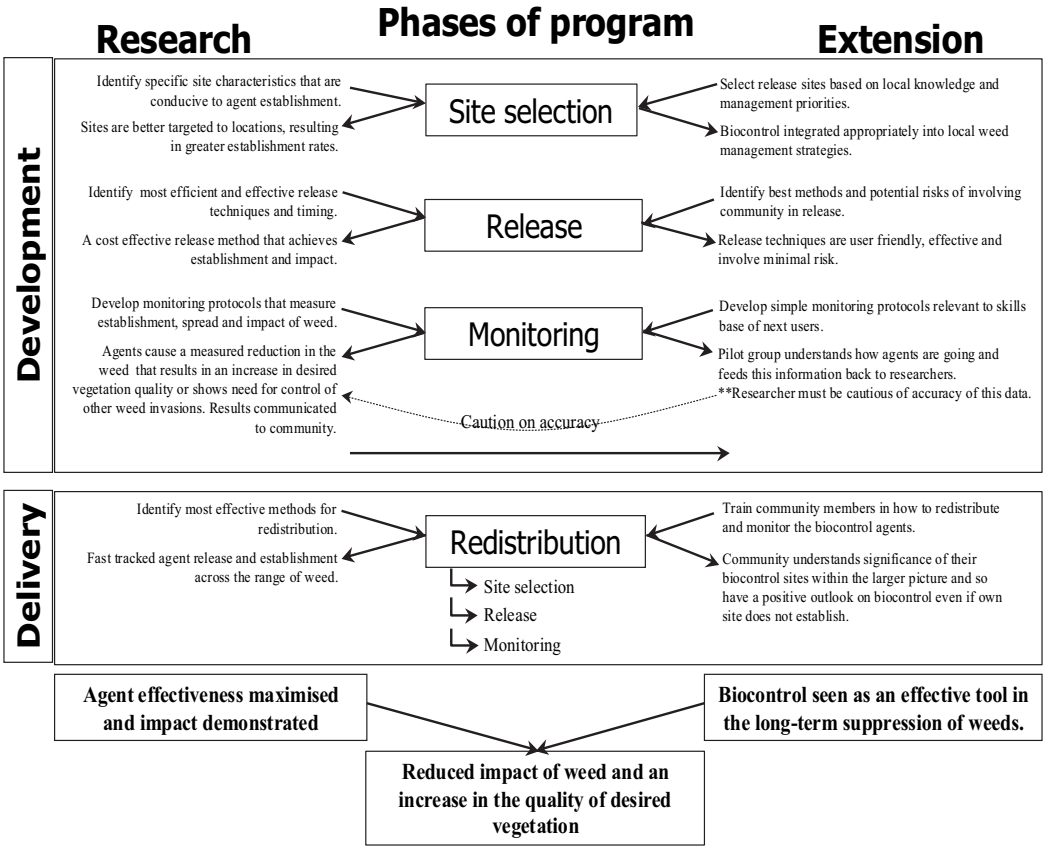

Figure 2. An improved process of evaluation in a community-based weed classical biological control program from site selection through to agent redistribution, based on evaluation of the bridal creeper biological control program in Victoria. The required inputs and desired outcomes for each phase of the program needed to achieve the longer-term goals of maximising agent effectiveness and community ownership of biological control are shown. A positive reaction to the inputs is required from both the researcher and community in order to achieve the desired outcomes at each phase. Also, while the research and extension components of evaluation are separated for simplicity, they are mutually dependent and interact at each phase of the process to achieve a shared outcome. The research and extension inputs and outcomes must both be achieved in order to reach the long-term goal of reducing the impact of the weed and increasing the quality of the desired vegetation. Further adaptation and development of this model based on other weeds, biological control agents and sectors of the community is needed for it to be of broader use to biological control in general.

weed, the evaluation and refinement of methods during these development phases will show if and how community members can redistribute agents in a simple and effective manner. Also, at this stage, the 'pilot' group's perceptions and motivations can be evaluated to determine if and how much they would want to be further involved, since this is essential to the success of the next phase.

At the redistribution phase, the program then becomes more focused on widespread delivery and seeks the active involvement of the wider community. Community members are entrusted to follow the methods already developed in order to redistribute agents rapidly throughout their local area and to feed back information on their establishment to the researchers.

While the research and extension components of evaluation are separated for simplicity, they are mutually dependent and constantly interact at each phase of the process. For example, at the monitoring phase, the researchers must demonstrate to the community the potential of the agents to control the weed, which can then motivate the community to help the researchers to accelerate the establishment and spread of the agents.

Adopting this method of involving the community can increase the overall impact of the weed by sparking greater community interest and participation in the program. It can also potentially foster greater support for and ownership of future biological control and other weed management programs.

This model is still in development and clearly needs to be tested with other weeds, biological control agents and sectors of the community in order to be of broader use.

ACKNOWLEDGMENTS

The Natural Heritage Trust and Department of Sustainability and Environment contributed funding for this project. We thank K. McArthur and I. Faithfull for their valuable comments on this paper. We would also like to thank K. Roberts, E. Wills and the many field officers and community members who have actively participated in the project.

REFERENCES

Batchelor, K.L. and Woodburn, T.L. (2002). Community involvement in distributing the bridal creeper leafhopper *Zygina* sp., a biocontrol agent for bridal creeper, *Asparagus asparagoides*. Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd and J.H. Moore, pp. 453-5. (Plant Protection Society of Western Australia, Perth).

Briese, D.T. (2000). Classical biological control. *In* 'Australian Weed Management Systems', ed. B.M. Sindel, pp. 161-86. (R.G. and F.J. Richardson, Melbourne).

Briese, D.T., Pettit, W.J. and Walker, A.D. (1996). Multiplying cages: a strategy for the rapid redistribution of agents with slow rates of increase. Proceedings of the IX International Symposium on Biological Control of Weeds, eds V.C. Moran and J.H. Hoffman, pp. 243-7. (University of Cape Town, South Africa).

Kwong, R.M. (2002). Weed Warriors – increasing awareness of weeds in schools. Proceedings of the 13th Australian Weeds Conference, eds H. Spafford Jacob, J. Dodd and J.H. Moore, pp. 442-5. (Plant Protection Society of Western Australia, Perth).

Kwong, R.M. (in press). Dispelling the myths of biological control: extension activities of the CRC for Australian Weed Management. Proceedings of the XI International Symposium on Biological Control of Weeds. (Canberra, Australia).

Swirepik, A. and Briese, D. (2000). Agent release techniques: what is appropriate for redistribution projects that involve community groups? Proceedings of the 12th Australian Weeds Conference, eds A.C. Bishop, M. Boersma and C.D. Barnes, pp. 665-6. (Tasmanian Weed Society, Devonport, Tasmania).