SESSION 10

Private Sector Activities of Classical Biological Control

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Agent Release Techniques: What is Appropriate for Redistribution Projects That Involve Community Groups?

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Abstract

Strategies used to involve a network of community groups in the release of two biological control agents against *Onopordum* thistles in Australia are described and their success rates are compared. While the use of groups of landholders can lead to faster and more efficient redistribution of agents, the methods for release need to be kept as simple as possible and be tailored to accommodate the conflicting demands placed on a landholder's time. The need for continued monitoring of sites following initial releases cannot be overemphasised.

Introduction

Initial release and redistribution are critical phases for the success of a biological control project. Briese *et al.* (1996) recently described a strategy to maximise the redistribution of the univoltine weevil *Larinus latus*, a seed feeder released in Australia for the control of *Onopordum* thistles. Initial establishment from field releases had been made in 1992 by free-releases of ca. 300 ovipositing adults, but this weevil has a slow rate of increase and, in the early post-release years, numbers remained too low to harvest these sites for redistribution. The strategy, "multiplying cages", involved caging small numbers of agents (20-40), harvesting their progeny and recaging them over a number of years. At each cycle of the process, the number of cages and release sites is multiplied. The strategy was subsequently used for redistribution of another univoltine weevil, *Lixus cardui*, a stem-borer first released in Australia in 1993.

In addition to facilitating the rapid distribution of the agents, the strategy aimed to give ownership of the redistribution process to a community network, consisting of 13 local government groups, 11 Landcare groups and four groups coordinated by officers working for NSW Agriculture and Agriculture Victoria. Field days were held for each group at previously established sites to demonstrate cage management and biocontrol agents to co-operators in an interactive format. To reinforce the verbal/visual presentation, information packages, including weed biology, agent biology, release/redistribution calendar and herbicide/cultural control, were provided to each co-operator. The co-operators were then given a cage and insects, ready to oviposit, for release on their properties.

Each spring, previous releases were monitored and the results used as decision support for any necessary modifications to release procedures. As a consequence, two other release techniques were subsequently adopted:

- reversion to free release of ovipositing adults directly on to field *Onopordum* plants, but with smaller numbers (ca 100), and
- short-term caging of similar numbers of adults for one week to ensure mating and initial concentrated oviposition at the release site, before removing the cage to allow normal behaviour.

Agent redistribution

Larinus latus

While the original four free-releases of 300 adult *L. latus* in 1992 proved to be successful (Table 1 and 2), the release strategy for *L. latus* has been modified several times to balance conflicting demands for a high number of releases and a high success rate of individual releases (Fig. 1). In order to increase the number of releases the "multiplying cages" strategy was adopted for the species between 1993 and 1995. However, by 1996 it proved difficult to field collect *L. latus* for further releases, as only 5 of the 38 releases made using the strategy established (Table 2). While 27 *L. latus* cages were removed according to instructions, 11 cages were left on a release for 2 years or more (Table 3). While the proportion of successful releases was much lower in "multiplying cages" strategy than in the original free releases (13% vs 100%), a similar number of established sites (5 vs 4, respectively) were obtained from a similar total number of adults released (ca. 1050). However, considerably less time and resources were needed for the free-releases, and populations produced by them developed and spread more quickly, due to their initial larger sizes. During 1997, free-release (3 times) and short-term caging (5 times) of ca. 50

Table 1.
***Larinus latus* releases using three different techniques between 1992 and 1997.**

Year	Free-release		Multiplying cages	Short-term caging
Agent numbers	ca. 300	ca 100	(20-40)	ca 100
1992	4			
1993		1	13	
1994			19	
1995			6	
1996				
1997		3		5
Total	8		38	5

Table 2.
Success of the three *L. latus* release techniques employed between 1992 and 1997.

Release type	Established	Failed
Free-release	8	0
Multiplying cages	5	33
Short-term caging	5	0

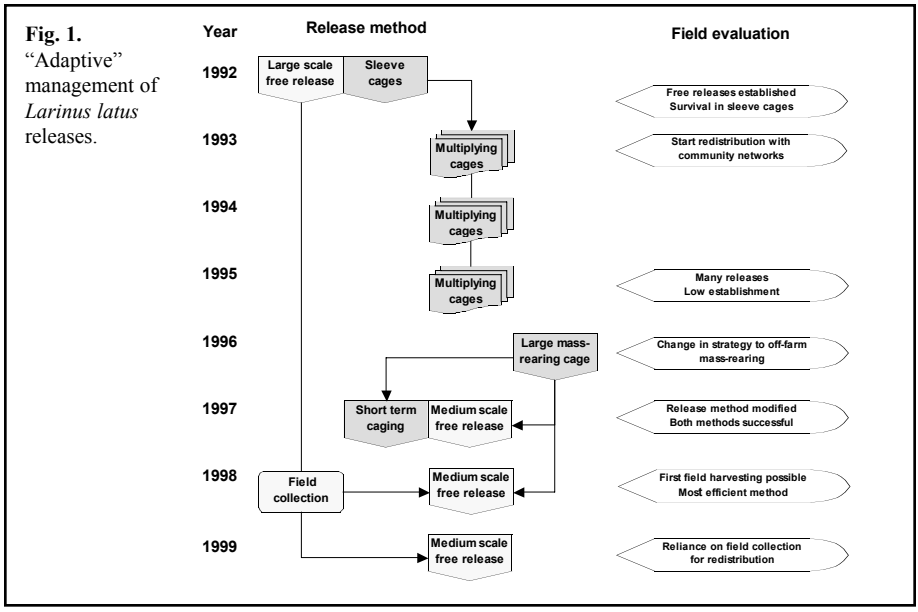

Fig. 1. "Adaptive" management of *Larinus latus* releases.

Table 3.
Time from *Larinus latus* caged release until removal.

Year of release	No. of caged releases	Cage removed after 1 year	Cage removed after 2 years	Cage removed after 3 years
1993	13	8	4	1
1994	19	15	3	1
1995	6	4	2	0

Table 4.
"Caged" and "Free" releases of *Lixus cardui* 1993-1997.

	No. of releases	Monitored	Established	Failed
Multiplying cages	181	152	140	12
Free release	63	24	24	0

Fig. 2. Releases of *Larinus latus* from 1992-1998.

Table 5.
***Lixus cardui* caged releases between 1994 and 1996.**
Time from cage set-up to removal

Year	Total releases	Cage removed same year	After 1 year	After 2 years	After 3 years
1993	6	2	4	0	0
1994	14	0	13	1	0
1995	63	0	18	4	1
1996	98	2	52	1	0

adult weevils resulted in nine establishments (Table 2). These strategies have proved a good compromise between certainty of establishment and speeding up redistribution, and have continued since 1997. Successful release sites are shown in Fig. 2.

Lixus cardui

Lixus cardui proved to be well suited to the "multiplying cages" strategy, with 92% of releases establishing (Table 4 and Fig. 3). Of the 12 failures, eleven occurred when instructions were not followed and the cage was left on for one or more years (Table 5). The remaining release failed as a result of drought and over grazing. However, 100% of later free releases established.

Fig. 3. Releases of *Lixus cardui* from 1993-1998.

Discussion

The use of "multiplying cages" as a strategy for the rapid redistribution of slow-increasing biocontrol agents has produced mixed results. In the case of *L. latus*, it proved to be less effective than free releasing or short-term caging (13% establishment *vs* 100%). The limitations of caging were twofold. The first was attributable to agent biology, by restricting the ability of newly emerged progeny to select a suitable overwintering site. The second was due to human nature, as 29% of these releases were caged for two or more years, contrary to instructions. This led to starvation of subsequent generations as *Onopordum* plants were outcompeted by other vegetation in caged conditions. With a better understanding of agent biology, behaviour and interaction with the host-plant in its new environment through the monitoring process, there has been subsequent change in strategy to short-term caging, which is less reliant on landholder cooperation, and free-releases, involving smaller numbers than were used originally.

"Multiplying cages" proved to be a successful strategy for *L. cardui*, establishing in 92% of cases. One reason for this is that the weevils overwintered inside the dead stems of *Onopordum*, reducing the biological limitations of caging. Most failures could be attributed to lack of care by the cooperators. Subsequent trials showed that *L. cardui* established in all cases when free-released. Given the cost of caging, both in time and for materials, redistribution of this weevil has been by free release since 1997. This frees resources for better monitoring of releases. Many landholders participate enthusiastically and successfully in the release of biological control agents. However, when involving community groups directly in the redistribution of a biocontrol agent, one needs a release strategy that can be effective while minimising the degree of hands-on input by co-operators. This will reduce the inevitable losses due to human error, limited attention periods and altered priorities. If establishment rates are low, there is a risk of losing community support for the process, as evidenced in 1996 for *L. latus* when no new releases of the species were made.

The strategy should be as simple as possible, preferably involving the free- release of ovipositing agents. If a cage is required to ensure mating and limit initial dispersal of the agents, the period must be kept to a minimum. In these cases, project staff need to take responsibility for the removal of the cages at the appropriate time, or allow for a certain proportion of co-operators failing to do so and decreasing the chances of establishment.

Monitoring of releases should receive equal resources to the release process to identify any biotic or abiotic factors that influence the success of a release. As shown here, this information may then be used in an adaptive management system to improve the efficiency and success of the process.

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