Control of Japanese honeysuckle (*Lonicera japonica*), climbing dock (*Rumex sagittatus*), and bone-seed (*Chrysanthemoides monilifera*)

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Peter A. Williams, Susan M. Timmins, Nigel Mountford

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CONTENTS

Abstract

Three weeds of high conservation concern—Japanese honeysuckle (*Lonicera japonica*), climbing dock (*Rumex sagittatus*), and bone-seed (*Chrysanthemoides monilifera*)—were sprayed with a range of herbicides. The three weeds, and their associated native vegetation, were monitored to determine their response after control. Japanese honeysuckle was initially knocked back, but some plants showed signs of recovery from vegetative parts. No honeysuckle seedlings emerged, and native species recovered by vegetative means. Most of the dock was killed by the spraying, as well as a small proportion of the associated native vegetation. Sprayed dock plants failed to regenerate, but new plants emerged from seed. The native vegetation showed signs of recovery. The sprayed bone-seed plants were killed, as were a few native plants that were inadvertently sprayed. However, by the spring following the spraying bone-seed seedlings were common. By the following winter, bone-seed seedlings and small plants were abundant, many of them flowering. There was no similar flush of seedlings of native species.

1. Introduction

The response of many weeds and their associated native vegetation to weed control on conservation land is not well studied. For example, we do not know the relative contribution of soil seed banks and vegetative growth to the resurgence of weeds after control. Three weeds of high conservation concern were selected for an initial study aimed at gathering this kind of information. Japanese honeysuckle (*Lonicera japonica*) is a major weed of forest remnants and shrublands in many parts of New Zealand; climbing dock (*Rumex sagittatus*) is a relatively new weed which is spreading but has yet to have a major impact; bone-seed (*Chrysanthemoides monilifera*) is very widespread and has a major impact in several Department of Conservation (DOC) conservancies (Owen 1997). This investigation reports on the early results of weed control trials for these species.

2. Methods

2.1 JAPANESE HONEYSUCKLE

A 0.25 ha stand of Japanese honeysuckle in the lower Cobb Valley (NZMS 260 N26 924 194) was selected for study. The study site was on a roadside bank adjacent to a small portion of river terrace of the Takaka River. Japanese honeysuckle formed an almost total cover, with only a few native species emerging—karamu (*Coprosma robusta*), mahoe (*Melicytus ramiflorus*), pohuehue (*Muehlenbeckia australis*), and bracken (*Pteridium esculentum*). A dense curtain of honeysuckle also extended 10 m up into the canopy of adjacent mahoe and kanuka (*Kunzea ericoides*) trees. Other weeds present included a few plants of Himalayan honeysuckle (*Leycesteria formosa*) and patches of herbs, particularly *Lotus pedunculatus*, *Ranunculus repens*, and grasses (Poaceae).

The area of Japanese honeysuckle was subdivided into four plots, each approximately 15 m x 8 m, by clearing tracks in the shape of a cross through the study site. Plots 1 and 4 were largely on the bank, whereas plots 2 and 3 were largely on the alluvial soil of the terrace. An adjacent area of similar size was used as a control. The pre-spray vegetation was measured in February 1996 by recording the presence of the main species within 55 mm diameter circular samples measured from short poles placed at 120 points distributed regularly along transect lines in each plot.

The plots were sprayed to drip under fine windless conditions in March 1996 with a knapsack sprayer, as follows:

(1) SW plot: Roundup (glyphosate) 1 L per 100 L water
(2) NW plot: Grazon (triclopyr) 300 mL per 100 L water
(3) NE plot: Versatil (clopyralid) 500 mL per 100 L water
(4) SE plot: Escort (metasulphuron) 35 g per 100 L water

The penetrant Boost (an organo-silicone) was included with all formulations at 100 mL per 100 L water.

Plots were visited in September 1996, when areas 1 m square were cleared of dead Japanese honeysuckle in each plot as well as in the control plot to allow for the possible emergence of seedlings. General observations were made in December 1996 and the plots were re-sampled along the transect lines in April 1997.

2.2 CLIMBING DOCK

The study site for climbing dock was in the sand dunes towards the base of Farewell Spit (NZMS 260 M24-N24 910 771). Climbing dock is present as widely spaced, individual plants. It climbs up through adventive species of marram grass (*Ammophila arenaria*) and gorse (*Ulex europaeus*), and the indigenous small-leaved pohuehue (*Muehlenbeckia complexa*), and sand coprosma (*Coprosma acerosa*). It is also found in association with the margins of the very small scrub and forest remnants of akeake (*Dodonaea viscosa*), mahoe, and bracken.

Sixteen individual dock plants were marked with numbered stakes, and notes were taken of the vegetation within a 2 m radius of the stake. At four of the sites associated with the tall bracken and forest, areas 1 m square were cleared prior to spraying to record the possible emergence of seedlings.

Plants were sprayed to drip in fine conditions in autumn 1996 with knapsack sprays containing Escort (10 g) and 15 mL of penetrant Boost per 20 L of water.

The sites were visited in September and November 1996, and February and April 1997, and notes were taken of the state of the dock and associated vegetation. At several of the sites associated with the forest, notes were also taken on the emergence of seedlings from the areas cleared of vegetation.

The ability of seeds to germinate was tested by gathering the previous autumn's seed capsules from the vines in November 1996 and February 1997. On each occasion, 100 seeds extracted from the capsules were placed on moistened filter paper in a covered petri dish kept in the light at normal room temperature. Germinated seeds were removed when the radicle was 2 mm long.

2.3 BONE-SEED

A 0.25 ha stand of coastal shrubland in Queen Elizabeth Park, near the Raumati South Esplanade entrance (NZMS 260 R26 760 270), was studied. The site was on the foredunes, with a northerly aspect. The shrubland was dominated by bone-seed (1–2 m tall) in association with taupata (*Coprosma repens*) and mahoe, with mounds of small-leaved pohuehue and patches of bracken and rank exotic grasses in more open areas.

The bone-seed at the site was sprayed on 10 December 1996 under calm, slightly overcast weather conditions with a knapsack sprayer applying Grazon (6 mL per 1 L) with the penetrant Boost (1%). Grazon has been found to be effective against other woody weed species. It is slightly residual (1–2 months), although it would have quickly dispersed in the loose sand at this site.

The spray operator was not able to reach into the centre of some of the bone-seed plants because of their sprawling shape and size, and thus the occasional branch was missed. Because the site was very visible to the public, dye was not added to the spray solution; consequently it was harder to keep track of which foliage had been sprayed. The operator was further constrained in achieving good coverage by his attempt to skirt around native shrubs such as mahoe and taupata.

Two 30 m permanent transects were established across the slope, starting at an old fenceline and running to the seaward end of the dune. The vegetation was measured by recording the presence of species, as described for Japanese honeysuckle, at 0.5 m intervals along the transect lines. Woody seedlings were also recorded within 1 m square plots at 5 m intervals along the transect lines, in three height categories: <10 cm; ≥ 10 cm, <30 cm; ≥ 30 cm, <1 m. The transects were sampled six days prior to the spraying then at approximately seven week intervals until April 1998 (but excluding the winter months of April – August 1997).

3. Results

3.1 JAPANESE HONEYSUCKLE

The cover of Japanese honeysuckle ranged from 63.7 percent to 80.5 percent in the plots. The only other species with more than 10 percent cover was the native fern *Hypolepis ambigua*, with 18.1 percent cover in plot 3 and 11.6 percent cover in plot 4.

At the first post-spray inspection the Japanese honeysuckle appeared dead in all four plots, with the exception of a few stems; these were marked with tape for later inspection. At the second inspection (December 1996) there was very little regrowth from surviving stems, although there was ingress of stems from the unsprayed areas of the cut tracks.

The initial percent cover values and the changes a year after spraying are shown in Table 1.

There was a large reduction in the cover of Japanese honeysuckle in all plots, particularly plots 1 and 4. In plot 1, dead honeysuckle remained the largest cover class at 70 percent, but this material was largely covered by a dense growth of pohuehue and exotic grasses in plot 1. Honeysuckle was replaced largely by grasses, ferns (bracken and *Hypolepis ambigua*), and minor amounts of montbretia (*Crocosmia* x *crocosmiiflora*) in plots 2 and 3. Mahoe increased

TABLE 1. SPECIES PERCENTAGE COVER OF FOUR JAPANESE HONEYSUCKLE (*Lonicera japonica*) SPRAYED PLOTS AND A CONTROL PLOT, BEFORE SPRAYING IN 1996 AND AFTER SPRAYING IN 1997.

	PLOT 1		PLOT2		PLOT3		PLOT4		CONTROL	
	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Major classes										
Lonicera japonica	80.5	13.8	64.8	27.5	67.6	22.5	63.6	3.8	91.0	86.0
Dead *L. japonica*		70.0		8.8		3.8		17.5		
Exotic grasses	0.8	5.0	10.0	18.8	8.3	16.3	6.6	31.3		
Pteridium esculentum	3.8	1.3	9.7	17.5	0.8	1.3	3.3			
Muehlenbeckia australis	1.7		3.5	2.5	2.8	3.8	5.0	35.0		
Hypolepis ambigua			3.3	11.3	18.1	35.0	11.6			
Minor classes										
Ranunculus repens	5.8	2.5				1.3	5.0			
Lotus corniculatus	6.6	5.0	0.8	5.0	0.8		4.1			
Coprosma robusta	0.8		2.6							
Mentha spicata		2.5								
Melicytus ramiflorus			1.7	2.5		10.0	0.8	2.5	9.0	14.0
Leycesteria formosa			3.6	2.5						
Crocosmia x *crocosmiiflora*				3.8		3.8	3.8			
Solanum aviculare					1.6	1.3				
Cirsium vulgare						1.3		1.3		
Galium aparine								2.5		
Solanum nigrum								6.3		

to 10 percent after the spraying in plot 3 in an area previously covered with honeysuckle. No other woody plants increased in any of the plots.

After a year, the five cleared areas were dominated by Japanese honeysuckle resprouts and adventive weeds (*Cirsium vulgare*, *Solanum nigrum*, and exotic grasses). No honeysuckle or native woody seedlings appeared in these subplots.

There was no change in the cover of the control plot over 12 months.

Abundant flowers of honeysuckle were produced in 1996–97, but no fruits were observed in either that year or the previous autumn.

3.2 CLIMBING DOCK

In the study area dock was climbing over two structurally different kinds of vegetation, and this was reflected in the post-spray response (Table 2). Fifteen of the original 16 dock plants were killed, as evidenced by the lack of resprouts. The single resprouting plant may actually have been a new plant growing from near the base of the original plant.

TABLE 2. VEGETATION COVERED BY 16 CLIMBING DOCK (*Rumex sagittatus*) PLANTS AND RESPONSE TO SPRAYING OF CLIMBING DOCK AND ASSOCIATED VEGETATION 12 MONTHS AFTER SPRAYING.

NO.	SUPPORTING PLANTS	DOCK	DOCK REGENERATION	VEGETATION RESPONSE
1	*Dodonaea viscosa* 4 m tall, *Pteridium esculentum*, *Ulex europaeus*	dead	seedlings established early in spring and grew 1 2 m in summer	*Solanum chenopodioides*, grass, dock seedlings on ground in openings. *P. esculentum* and *U. europaeus* in canopy
2	*P. esculentum*, *U. europaeus*	dead	similar to 1	similar to 1
3	*P. esculentum*	dead	No	*P. esculentum* regrowth
4	*P. esculentum*, *U. europaeus*	dead	No	surrounding *U. europaeus* dead, *Melicytus ramiflorus* increasing
5	*U. europaeus*, *Muehlenbeckia complexa*	dead	No	*S. chenopodioides* seedlings, no visible response
6	*U. europaeus*	dead	No	*S. chenopodioides* seedlings, no visible response
7	*U. europaeus*	dead	original plant killed, new one emerged and seeding	spray-killed *Coprosma acerosa*, replaced by *M. complexa*
8	*U. europaeus*	dead	No	gorse dead
9	*U. europaeus*	dead	No	gorse dead
10	*M. complexa*	dead	no	*M. complexa* resprouting after initial dieback
11	*M. complexa*, *C. acerosa*	dead	No	*C. acerosa* considerably damaged but recovering from margins, *M. complexa* recovering
12	*M. complexa*	dead	No	Increased cover of *M. complexa*
13	*U. europaeus*	dead	No	*U. europaeus* otherwise no change
14	*U. europaeus* and *M. complexa*	dead	No	*U. europaeus* dead, *M. complexa* recovering
15	*C. acerosa*, *Ammophila arenaria*	dead	No	Decreased cover of *C. acerosa*, *A. arenaria* and *Calystegia soldanella* increase
16	*C. acerosa*, *Ammophila arenaria*	dead	No	*C. acerosa* decrease

In short vegetation, where the dock was growing on *Coprosma acerosa* (sand coprosma) or *Muehlenbeckia complexa* (small-leaved pohuehue), various proportions of the native species were defoliated by spraying. *C. acerosa* did not recover, while *M. complexa* did, and often covered the dead parts of the *C. acerosa*. In these situations there were no seedlings of native species observed in the vicinity of the dead dock.

Tall woody vegetation growing in association with dock was was generally killed, especially gorse. Opened areas resulting from the death of dock or woody plants were occupied to a minor extent by an increase in small-leaved pohuehue, but in most instances the canopy gaps remained. The perennial herb *Solanum chenopodioides* (velvety nightshade) occupied these light pools. In one instance, where bracken had been damaged by trampling to reach the dock, a small area of grass sward intermixed with young dock plants developed. The dock plants had stems up to 60 cm long after one summer.

At least 20 dock seedlings were present on three of the cleared 1 m square plots at the beginning of spring. None were present on a fourth plot located slightly within the edge of a scrub patch. It was not possible to trace these seedlings individually because of an upsurge in the growth of exotic grasses that occurred as the summer progressed. No further seedlings were identifiable at the time of the last observations in March 1997, a year after spraying.

Most of the capsules collected in spring (September) were filled with viable seed (Table 3). These began to germinate 3 days after being placed in petri dishes, and 39 percent had germinated after 42 days when the experiment was terminated. Only 40 percent of capsules collected in late summer (February) contained viable seed and 80 percent had germinated after 42 days (Table 2).

TABLE 3. PERCENTAGE OF CLIMBING DOCK SEEDS GERMINATING AFTER TWO COLLECTING DATES.

	% WITH VIABLE SEED	NO. OF SEEDS	% GERMINATED IN 14 DAYS	% GERMINATED IN 42 DAYS
20 September 1996	84	81	34	39
27 February 1997	40	96	56	80

3.3 BONE-SEED

Bone-seed dominated the study site prior to control, contributing about half the canopy cover. Taupata was the only other common shrub (10% cover). Bracken and small-leaved pohuehue were common in transect 1 and exotic grasses, particularly *Ehrharta erecta* (veld grass) were common in patches (Tables 4).

A large reduction in live bone-seed cover and a concomitant rise in **dead** bone-seed present was recorded in both transects at the first post-spray inspection. Most of the bone-seed crowns were black and dead. However, because of the logistical constraints explained earlier, the centres of a few bone-seed bushes in the spray swath and a couple of whole bushes were not sprayed. Such bushes contributed some of the live bone-seed cover recorded (Table 4).

TABLE 4. PERCENTAGE COVER OF SPECIES RECORDED ALONG TWO TRANSECTS AT QUEEN ELIZABETH REGIONAL PARK 1996–1998, I.E.,BEFORE, AND AT INTERVALS AFTER, SPRAYING ON 10 DECEMBER 1996 TO CONTROL BONE-SEED (*Chrysanthemoides monilifera*). WHILE MEASUREMENTS WERE MADE AT 7-WEEK INTERVALS, FOR SIMPLICITY DATA ARE ONLY PRESENTED FOR THREE-MONTH INTERVALS.

TRANSECT 1					
SPECIES	DEC 96	MARCH 97	SEPT 97	DEC 97	MARCH 98
Chrysanthemoides monilifera	44	7	5	7	19
Chrysanthemoides monilifera (dead)	5	14	2	2	-
Exotic grasses	15	31	53	65	55
Pteridium esculentum	12	31	8	10	2
Muehlenbeckia complexa	8	3	2	3	7
Muehlenbeckia australis	-	-	2	3	5
Rumex sagittatus	3	10	12	3	5
Exotic herbs	-	2	8	-	2
Melicytus ramiflorus	3	-	-	-	-
Coprosma repens	10	-	-	-	-
Pittosporum crassifolium	-	1	-	-	-
Solanum chenopodioides	-	1	8	5	3
Lupinus arboreus	-	-	-	2	2
TRANSECT 2					
SPECIES	DEC 96	MARCH 97	SEPT 97	DEC 97	MARCH 98
Chrysanthemoides monilifera	54	32	23	24	36
Chrysanthemoides monilifera (dead)	7	39	26	3	7
Exotic grasses	15	15	41	56	41
Pteridium esculentum	7	4	6	2	-
Muehlenbeckia complexa	-	-	-	-	-
Muehlenbeckia australis	-	-	-	-	-
Rumex sagittatus	-	2	2	-	-
Exotic herbs	-	-	-	-	2
Melicytus ramiflorus	2	-	-	-	-
Coprosma repens	10	3	-	-	-
Pittosporum crassifolium	-	-	-	-	2
Solanum chenopodioides	-	-	2	2	-
Lupinus arboreus	3	-	-	12	12
Sand	2	5	-	1	-

The cover of dead bone-seed gradually decreased over time as the black foliage weathered to grey sticks. The fully sprayed bushes did not resprout whereas there was a resurgence of bone-seed from new foliage sprouting on partially sprayed bushes. Seedlings germinating from the seed bank also contributed to the cover of bone-seed.

The fate of the partially sprayed bone-seed bushes varied. Where only a small proportion of a bush was missed it subsequently died, sometimes having flowered and set seed the following summer. Where about half the foliage was missed on a small bush this portion survived for the duration of the experiment, and flowered and fruited. This shows the importance of good spray coverage, even with a translocating spray such as Grazon. While the incomplete spray coverage of bone-seed clearly influenced the results, this was probably representative of a normal operation; the spray operator was very experienced.

New bone-seed seedlings had emerged in bare sandy patches in March 1997, three months after the spraying. By the following spring (September 1997), seedlings were much more common, as might have been expected from the abundant seed, both old and new, observed earlier in and on the sand. By the end of the following summer (March 98) they were abundant on bare sandy patches (Table 5). Some had grown to 1 m tall and one at this height had flowered and fruited. There were no seedlings under *Pteridium esculentum* or dense litter, but occasionally some emerged through loose grass. The abundance of bone-seed seedlings is promoted by disturbance (Weiss 1986) but may have been depressed in some sandy patches by foot passage through the area.

Despite the precautions taken by the spray operator, a few individuals of the native species *Coprosma repens*, *Macropiper excelsum, Melicytus ramiflorus*, *Muehlenbeckia complexa*, *Pteridium esculentum*, and *Pittosporum crassifolium* (karo) were killed by the spray. There were also some partially damaged *M. ramiflorus* plants, one of which subsequently resprouted.

Over the time of this study there was no resurgence of woody natives. The cover of *M. ramiflorus* and *C. repens* did not increase. Nor were any seedlings of these species recorded in the seedling plots, despite the availability of adjacent mature plants. A very occasional seedling was noted off the transect lines (and more started to appear in the warm wet winter of 1998). The lack of native seedlings was probably due to the density of rank exotic grasses which pre-

TABLE 5. NUMBER OF BONE-SEED SEEDLINGS OBSERVED ALONG TWO TRANSECTS AT QUEEN ELIZABETH REGIONAL PARK, SEEDLINGS RECORDED IN THREE HEIGHT CATEGORIES: SMALL <10 cm; MEDIUM ≥10 cm, <30 cm; LARGE ≥30 cm, <1 m.

TRANSECT 1					
	MARCH 97	SEPT 97	DEC 97	MAR 98	AUG 98
Small	6	2	13	11	3
Medium	0	6	13	10	12
Large	0	0	3	21	25
TRANSECT 2					
	MARCH 97	SEPT 97	DEC 97	MAR 98	AUG 98
Small	11	57	29	10	21
Medium	3	29	23	21	26
Large	0	0	0	8	22

vented germination. By contrast, several exotic woody species, in addition to bone-seed, were recorded in the seedling plots: *Lupinus arboreus*, *Solanum chenopodioides*, *Rhamnus alaternus* (evergreen buckthorn), *Sambucus nigra* (elderberry), and *Hedera helix* (ivy). Seedlings of the weedy native *Pittosporum crassifolium* were also noted.

Exotic grasses increased dramatically in cover in the year after spraying, particularly in transect 1 (20 in January 1997, 81 percent in January 1998; Table 4). The percentage cover, and height, of exotic grasses tapered off after summer but was still about a third of the cover in April 1998. The dominant grasses were *Ehrharta erecta*, *Arrhenatherum elatius* (tall oat grass) and *Dactylis glomerata* (cocksfoot). The cover of exotic herbs increased a little in bare areas and included *Fumaria officinalis* (fumitory), *Galium aparine* (cleavers), *Rumex acetosella* (sheep's sorrel), *Taraxicum officinale* (dandelion) and *Senecio elegans*. Native *Pteridium esculentum* and exotic climbing dock also became more abundant in part of the area. This partly reflected the seasonal flush of these species and also a response to more open ground as a result of the bone-seed control.

4. Discussion

4.1 JAPANESE HONEYSUCKLE

Recovery of Japanese honeysuckle was greatest in plots 2 and 3. This could have reflected differences in the efficacy of the four sprays. Alternatively, it may have been as much to do with the very moist soil, and the fact that the plots were effectively surrounded on all sides by honeysuckle. The assessment of the former was not a primary objective of this study. The absence of any recovery from a soil seed bank (consistent with the observed absence of fruiting at this site) and the very low frequency of seedlings are both common features of this species in New Zealand (Williams & Timmins 1997). The ability of Japanese honeysuckle to recover from spraying has often been reported (Williams & Timmins 1997), indicating that follow-up spraying will usually be essential.

The absence of any resurgence of native species from seed in all plots is not surprising in view of the essentially early successional stage of the vegetation. Ferns arising from underground rhizomes were able to exploit the absence of dense honeysuckle growth on the two alluvial sites. *Muehlenbeckia australis* exploited the decline of honeysuckle in only one plot, and this may have been because of the greater opportunity for it to climb up and on to the dead honeysuckle. Growth of woody native species apart from *M. australis* was very limited. Overall, the response of associated vegetation to the decline of honeysuckle varied according to the vegetation present before the spraying began.

4.2 CLIMBING DOCK

The spraying regime on Farewell Spit killed most of the dock plants targeted. With few exceptions, resurgence was clearly from seed, most of which was probably set the preceding autumn. The rapid germination of dock given suitable conditions suggests that a soil seed bank older than one year would not be formed. However, seed can survive for many months in the canopy. Seed is highly likely to form new plants the following year. Thus, spraying must be conducted every year to maximise the chance of killing plants as they develop and before they resprout. This is a fundamental requirement when dealing with highly fecund weeds. Because dock seedlings appear to prefer open conditions, ground disturbance needs to be kept to a minimum, especially in the vicinity of climbing dock plants. Control programmes should also take note of the fact that seed stored in the canopy over summer and dropped later, perhaps to germinate in autumn, would produce plants likely to become visible three years after the seed was produced. Regular monitoring of sprayed sites as currently undertaken on Farewell Spit would need to be established.

The native plant species that benefited almost immediately from the death of dock was *Muehlenbeckia complexa*. Some *Coprosma acerosa* plants were killed by the spray, but as this species is highly vulnerable to smothering by dock, the small number of bushes damaged or killed must be considered expendable. The appearance of *Solanum dulcamara* seedlings in the centre of gorse bushes killed by the spray indicates that a soil seed bank has been activated, but that it holds few native species able to exploit the gap.

4.3 BONE-SEED

There has been a marked recovery of bone-seed from the soil (sand) seed bank and, to a lesser extent, from the partially sprayed bushes. Seedlings were abundant on sandy patches and some grew up to 1 m tall and flowered and fruited in 1997/98 summer. Between 2000 and 3000 seeds per square metre of bone-seed are produced annually at this site and there are similar numbers of seeds in the soil bank (V. Reid, pers. comm.). A study in Australia, found 13 % of the seed in the seed bank was still viable after 3 years (Weiss 1986). Annual control is therefore essential for several years to kill the seedlings germinating from the seed bank.

The lack of seedlings of native species probably reflects the dominance in both transects of rank exotic grasses and the density of bone-seed bones in the clearer areas. However, in addition to the abundant bone-seed seedlings, a few seedlings of other exotic woody species were recorded.

There has also been limited growth of native woody species, except species of *Muehlenbeckia* in transect 1. *Pteridium esculentum* took advantage of the removal of bone-seed canopy by sprouting from its extant underground rhizomes. It is likely however that this site will be dominated by exotic grasses in the short term with reasonably rapid re-establishment of bone-seed as the major canopy cover in the future. Even if the bone-seed seedlings were adequately controlled, the indications are that other woody weeds could become more prominent.

The bone-seed trial showed the importance of achieving a full spray coverage of weed species, even with a translocating herbicide, and the necessity of avoiding non-target native species. The study also demonstrated that follow-up activity is essential to achieving effective control. In the case of bone-seed, the seed bank which will germinate over time needs to be catered for in any control programme.

The fieldwork described in this study used only simple recording procedures. Nevertheless, they allowed us to separate the direct effects of spraying from the overall population dynamics of the weeds. One of the elements of this was in being able to make observations at *exactly* the same place on consecutive occasions. For climbing dock, where the weed covered only small areas widely dispersed through the landscape, we used numbered stakes. Records at each stake were only of a descriptive nature, but we were able to follow the fate of individual dock plants and determine the origins of new plants. For the Japanese honeysuckle and bone-seed trials, where the weeds were dense and covered large areas, transects were located between reference points. Simple recordings were then taken between these points, such as presence/absence and numbers of seedlings in small sub-plots. Again, the fate of sprayed weeds and the response of native species were followed.

Although no precise measures were taken, each trial took about half a day to measure on each visit, i.e. a similar order to the time taken to spray each of the weeds. Where new species are being targeted or new sprays are being tested, such a time expenditure is warranted.

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