Monitoring *Spyridium obcordatum* at Hawk Trap Hill, Hawley Results and Recommendations 2011 to 2013

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Figure 1 *Spyridium obcordatum* plant in full flower, protected by a cage at Hawley Nature Reserve

Summary

This paper reports on the monitoring of caged and uncaged plants of *Spyridium obcordatum* (Figure 1) from 2011 to 2013. The results over this period are:

1. There is evidence of a significant decline in uncaged plants on the rock plate at Hawley Nature Reserve;
2. Plants growing in tussocks of *Lepidosperma viscidum* at Hawley Nature Reserve are doing much better than those exposed on the rock plate. There is little evidence of significant grazing pressure for these plants;
3. At the Latrobe Council property, the caged plants have increased in size and have significantly more flowers than the uncaged plants;
4. New counts of the total population at both sites reveal a reduction in live adult plants at Hawley Nature Reserve and provide a more accurate estimate for the population at the Latrobe Council Reserve; and
5. There is currently (October 2013) a large population of very small seedling plants at Hawley Nature Reserve.

We recommend that:

1. A substantial part of the "lower" rock platform at the Hawley Nature Reserve be fenced urgently to protect adult plants and seedlings from grazing pressure. There is a window of opportunity with a large population of seedlings being present this spring. This enclosure would be monitored for three years by volunteers from the Central North Field Naturalists;
2. The *Spyridium* plants at the Latrobe Council Reserve continue to be monitored by volunteers for three more years to determine the effect of caging plants over an extended period; and
3. Counts of *Spyridium obcordatum* plants at both sites to be conducted again in 2015 or 2016.

Background

In August/September 2011, Phil Collier circulated a "Proposal for monitoring *Spyridium obcordatum* at Hawk Trap Hill, Hawley" (Collier 2011). Landowners, PWS and Latrobe Council, approved an experiment that aimed to determine reason(s) for the apparent decline in the population of *Spyridium obcordatum* at Hawley Nature Reserve, Port Sorell. The two sites for the experiment are:

- the Hawley Nature Reserve (HNR), where the *Spyridium* plants are growing on an exposed rock plate habitat and nearby amongst tussocks of sticky sword sedge (*Lepidosperma viscidum*); and
- a Latrobe Council property (LCP) at Lot 9, Summerhill Drive, where *Spyridium* plants are growing in a casuarina (*Allocasuarina verticillata*) woodland.

In October 2012, the Landowners were provided with a report "Monitoring *Spyridium obcordatum* at Hawk Trap Hill, Hawley Results 2011 to 2012" that provided results from the first year of monitoring. This report replaces the 2012 report and provides results from the two years of monitoring to date.

Method

The method outlined in the Proposal has been followed as far as possible. Appendix 1 describes the experimental set up in 2011 and provides details about the monitoring visits in 2012 and 2013. The displacement of cages and loss of plant markers at HNR between 2011 and 2012 was a set-back for the proposed method of analysis.

In 2011, we conducted a population count at HNR, and an estimate of the population at the LCP. We repeated the population count in 2013 at HNR and conducted a more detailed population count at the LCP. Details are included in Appendix 2.

Analysis

The Proposal (Collier 2011) specified a paired design for the experiment. As detailed in Appendix 1, in 2011 pairs of caged and uncaged plants were selected appropriately for a paired design, as confirmed by finding no significant difference between the caged and uncaged samples within each habitat type. The Proposal anticipated that the same analysis would be repeated each year to determine whether differences in the two samples appeared over time. This plan has been affected by unanticipated events since 2011. Following the displacement of cages and loss of plant markers at HNR in 2011-12, we no longer have a paired design at that site, nor do we have much systematic data for the period 2011-12. Secondly, we did not anticipate that plants would die during the experiment. If one of a pair of plants dies then the other plant is no longer usable in the analysis.

With this discussion, we propose the following procedure to analyse the data, considering each habitat separately:

1. Determine whether there are significant differences in the distribution of dead plants, where present, between the caged and uncaged treatments;
2. Conduct a paired t-test analysis for pairs of living plants in the casuarina habitat at LCP; and
3. Conduct a t-test analysis on differences between measurements in 2011 (LCP) or 2012 (HNR) and the same measurements in 2013, for all live plants

The difference between caged and uncaged plants is constrained by the diameter of cages, with little growth evident beyond the outside perimeter of the cage.

Results: Hawley Nature Reserve

Rock plate habitat

We consider the plants tagged and caged in September 2012, with the exception of plant 88 that had its cage displaced prior to May 2013. Plant 88 had obviously been grazed as a result of the cage being displaced, and we therefore assume that this plant was uncaged throughout for the purpose of analysis.

In September 2013, we found that four of the eight uncaged plants were dead, while all of the six caged plants were alive. Using a χ^2 test we find a significant difference in the survival rate of caged and uncaged plants ($p<0.05$), with the uncaged plants being significantly more likely to have died during the year. This result is reinforced by evidence in 2012 at HNR that two uncaged plants had died during the previous year. Additionally one uncaged plant had died at the LCP in 2012. We have no records of caged plants having died.

With the death of four uncaged plants from the experiment, there are only four caged and four uncaged plants to compare for differences with live plants. We consider the differences between measurements in 2013 and 2012. Table 1 provides a summary of the mean differences and the result of applying a two-tailed t-test assuming unequal variance to the sample of uncaged and caged plants. A mean measurement with a negative sign denotes a measurement that has reduced between 2012 and 2013. There is a very significant difference ($p<0.01$) for all differences except grazing. On average between 2012 and 2013, uncaged plants became smaller with fewer flowers and more grazing, while caged plants became larger with more flowers and less grazing. Uncaged plants managed a small increase in height.

Table 1 Means differences between measurements of rock plate plants at Hawley Nature Reserve in 2013 compared with 2012. Flower categories: 0=0, 1=1-10, 2=11-100, 3=101-1000, 4=1001-10 000, 5=10 000+; Grazing categories: 1=<5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-100%

	Mean difference (2013 measurement–2012 measurement)					
Treatment	**Max extent**		**Area of ellipse (m^2)**	**Max height (mm)**	**Flowers**	**Grazing**
	x (mm)	**y (mm)**				
Rock plate uncaged (n=4)	-45	-33.75	-0.011	2.5	-0.25	0
Rock plate caged (n=6)	142	100	0.039	55.2	0.8	-0.4
t-test (p)	0.008	0.005	0.000	0.000	0.009	0.185

The stark difference between the caged and uncaged plants is most evident in the number of flowers. No more than 10 flowers were seen on any of the uncaged plants whereas flowers were more plentiful on caged plants, including two caged plants that had 1001–10000 flowers.

Tussock habitat

We consider the plants tagged and caged in September 2012 for this analysis. All ten tussock plants were alive in 2013. Table 2 provides a summary of the mean differences and the result of applying a two-tailed t-test assuming unequal variance to the sample of uncaged and caged plants. There are few significant differences between the tussock plants, although the uncaged plants tend to be smaller in 2013 while the caged plants tend to be bigger. The height of caged plants is very significantly higher than uncaged plants ($p<0.01$), presumably because the uppermost tips of branches lack the natural protection from the tussocks and are accessible to grazing animals.

Table 2 Means differences between measurements of tussock plants at Hawley Nature Reserve in 2013 compared with 2012. Flower categories: 0=0, 1=1-10, 2=11-100, 3=101-1000, 4=1001-10 000, 5=10 000+; Grazing categories: 1=<5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-100%

	Mean difference (2013 measurement–2012 measurement)					
Treatment	**Max extent**		**Area of ellipse (m^2)**	**Max height (mm)**	**Flowers**	**Grazing**
	x (mm)	**y (mm)**				
Tussock uncaged (n=5)	-104	-33	-0.020	15.2	0	-0.2
Tussock caged (n=5)	-1	9	0.000	124	0.2	0.4
t-test (p)	0.077	0.384	0.395	0.004	0.374	0.229

Results: Latrobe Council property

Appendix 3 includes images of the pairs of plants in 2013 and Appendix 4 illustrates the changes to the caged plants between 2011 and 2013. We consider the plants tagged and caged in October 2011 in the casuarina habitat, with the exception of uncaged plant 14 that had been observed to have died in September 2012. Using a χ^2 test we find no significant difference in the survival rate of caged and uncaged plants.

Table 3 Mean measurements of paired plants at the Latrobe Council property in 2013. Flower categories: 0=0, 1=1-10, 2=11-100, 3=101-1000, 4=1001-10 000, 5=10 000+; Grazing categories: 1=<5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-100%

	Mean measurement					
Treatment	**Max extent**		**Area of ellipse (m^2)**	**Max height (mm)**	**Flowers**	**Grazing**
	x (mm)	**y (mm)**				
Uncaged (n=6)	250.2	211.7	0.057	80.8	0.2	4.3
Caged (n=6)	406.7	310.0	0.113	279.2	3.0	1.2
Paired t-test (p)	0.122	0.270	0.176	0.001	0.005	0.001

In order to conduct a paired t-test, we have to set aside caged plant 13 from the analysis, which is paired with plant 14 that is now dead. Table 3 shows the mean measurements for the remaining six paired plants, together with the results of a paired two-tailed t-test. There is a very significant difference between the height, flowering and grazing of caged and uncaged plants ($p<0.01$), with caged plants being taller, with more flowers and less grazing. Two factors mitigate against finding a significant difference in the area of caged and uncaged plants. Firstly, the plants in the sample were quite large in 2011, albeit uncaged plants are larger on average. This limits the increase in size available to caged plants before they fill the cages. Secondly, one pair of plants (12 and 13) in weak

tussocks of *Lepidosperma viscidum* have few branches. A large fall of casuarina needles in 2012-13 has partially buried the branches of these plants. Removing plants 11 and 12 from the analysis in Table 3, and using a paired two-tailed t-test, creates a significant difference in x and y dimensions of the plants ($p<0.05$).

We also analyse the data by considering the differences between measurements in 2013 and 2011 for all 13 of the living plants in 2013. Table 4 provides a summary of the mean differences and the result of applying a two-tailed t-test assuming unequal variance to the sample of uncaged and caged plants. A negative sign on a mean difference occurs when measurements were greater in 2011, i.e. the mean measurement has reduced over the two years to 2013. Once again there is a very significant difference between the differences in height, flowering and grazing of caged and uncaged plants ($p<0.01$), with caged plants gaining rather than losing height, having more rather than less flowers and less rather than more grazing. A significant difference is also present for the differences in plant area ($p<0.05$), with the average caged plant increasing in area and uncaged plant decreasing.

Table 4 Means differences between measurements of plants at the Latrobe Council property in 2013 compared with 2011. Flower categories: 0=0, 1=1-10, 2=11-100, 3=101-1000, 4=1001-10 000, 5=10 000+; Grazing categories: 1=<5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-100%

	Mean difference (2013 measurement–2011 measurement)					
Treatment	**Max extent**		**Area of ellipse (m^2)**	**Max height (mm)**	**Flowers**	**Grazing**
	x (mm)	**y (mm)**				
Uncaged (n=6)	-68.8	-67.0	-0.025	-25.0	-0.8	0.8
Caged (n=7)	160.8	128.3	0.067	187.5	2.5	-2.8
t-test (p)	0.033	0.035	0.035	0.000	0.001	0.001

Population estimates

Hawley Nature Reserve

In 2013, a large group of Naturalists assisted with a detailed population count at HNR (Appendix 2). Of the 364 live plants seen, only 128 were mature adult plants. The number of mature plants has decreased by 24% from the 169 mature plants seen in 2011. Therefore, the decline from the earlier count of 200–250 plants at Hawley Nature Reserve in 2008 (Threatened Species Section 2010) is continuing. It is heartening to see a very healthy population of seedling plants, which suggests that there remains a viable seed bank that can germinate in good conditions like those in the recent years. The challenge is how to convert the seedlings into mature plants.

Latrobe Council property

In 2013 four volunteers conducted a systematic count of *Spyridium obcordatum* plants at LCP (Appendix 2). While the numbers cover different areas with different degrees of accuracy, it can be seen that the LCP contains healthy population of plants that is a secure representative population from a wider area. The 2013 count is considerably fewer than the estimate of 620 in 2012 which suggests the need for additional counts to gain a more accurate assessment of the total population. In 2013, a thick blanket of fallen casuarina needles seemed to be supressing the growth of some plants, and may have reduced the overall population count.

Table 5 shows a comparison of the 2013 population count with previous known counts.

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Table 5 Population estimates of *Spyridium obcordatum* plants at the Latrobe Council Reserve from 1996 to 2013. The 1996 and 2002 counts are sourced from Threatened Species Section (2010).

Year	Number of Plants	Who?	Notes
1996	1970	Threatened Species Section, DPIPWE	Possibly includes the complete sub-division at Summerhill Drive.
2005	540	Threatened Species Section, DPIPWE	"Private land" of 0.5 Ha, but exact area covered is unclear
2011	620	Two CNFN volunteers	Estimate
2013	345	Four CNFN volunteers	Systematic count

Conclusions

The decline in *Spyridium obcordatum* plants on the rock plate at HNR is the cause for serious concern. There is evidence of a significant reduction in size and flowering of uncaged plants and an overall decline in population of mature plants in the last two years. In contrast, there is currently a large population of very small seedling plants.

Plants growing in tussocks of *Lepidosperma viscidum* at HNR are doing much better than those exposed on the rock plate. There is little evidence of significant grazing pressure on these plants that have some natural protection.

At LCP, the caged plants have increased in size and have significantly more flowers than the uncaged plants. There is no evidence of systematic decline in the population at LCP.

Recommended actions

1. A substantial part of the "lower" rock platform at the Hawley Nature Reserve be fenced urgently to protect adult plants and seedlings from grazing pressure. There is a window of opportunity with a large population of seedlings being present this spring. This enclosure would be monitored for three years by volunteers from the Central North Field Naturalists;
2. The *Spyridium* plants at the Latrobe Council Reserve continue to be monitored by volunteers for three more years to determine the effect of caging plants over an extended period; and
3. Counts of *Spyridium obcordatum* plants at both sites to be conducted again in 2015 or 2016.

Reference

Collier, P (2011) Proposal for monitoring *Spyridium obcordatum* at Hawk Trap Hill, Hawley, manuscript.

Threatened Species Section (2010) *Spyridium obcordatum* Flora Recovery Plan. Department of Primary Industries, Parks, Water and Environment, Hobart.

Appendix 1: Method 2011–2013

Hawley Nature Reserve "Lower" population

The experiment was installed at Hawley Nature Reserve on 2 October 2011, by 9 volunteers from the Central North Field Naturalists Club. Volunteers formed into teams and took responsibility for finding pairs of similar *Spyridium obcordatum* plants, one of which was caged. It is a challenge to adequately secure the cages to the rock plate at this site and the volunteers devised their own sometimes innovative methods, see Figure 2. Each plant was identified by flagging tape with a number written using a permanent marker pen. A total of 22 plants were included in the experiment, with seven pairs of plants unprotected on the rock plate; while another four pairs of plants were growing amongst tussocks of *Lepidosperma viscidum*. Unfortunately one plant growing in a tussock was caged in error as the records show 5 caged and 3 uncaged plants.

Figure 2 Volunteers installing a cage at HNR in October 2011.

Five measurements for each plant were recorded as per the proposal: spatial extent (three measurements), number of flowers and perceptions of grazing. Table 6 shows the average value for each of the measurements partitioned by habitat and caged/uncaged treatment. A two-tailed t-test with unequal variances to compare the measurements for each habitat reveals that there are no significant differences between the caged and uncaged samples. Despite no significant difference being detected, at the start of the experiment the uncaged plants in both habitats were on average larger (x, y, area and height measurements) than caged plants, with the exception of the height of plants growing in tussocks.

Table 6 Average values for measurements of rock plate and tussock plants at HNR in 2011. Flower categories: 0=0, 1=1-10, 2=11-100, 3=101-1000, 4=1001-10 000, 5=10 000+; Grazing categories: 1=<5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-100%.

Habitat and treatment	Ave. max. extent x (mm)	y (mm)	Area of ellipse (m^2)	Ave. max. height (mm)	Average flowers	Average grazing
Tussock_uncaged (n=3)	266.7	190.0	0.152	216.7	1.7	1.7
Tussock_caged (n=5)	208.0	138.0	0.072	224.0	1.6	1.4
t-test (p)	0.571	0.409	0.261	0.924	0.880	0.627
Rock plate uncaged (n=7)	234.7	135.7	0.173	44.9	0.4	2.4
Rock plate caged (n=7)	149.3	95.4	0.124	31.9	0.4	2.9
t-test (p)	0.340	0.437	0.658	0.338	1.000	0.613

Comparing all of the plants growing on the rock plate against all of those growing amongst tussocks reveals that the two samples occupy an area of ground which does not differ significantly. Conversely, plants in tussocks are very significantly higher ($p<0.001$), have very significantly more flowers ($p<0.001$) and are significantly less grazed ($p<0.05$) than those growing on the rock plate. These results confirm an expectation that plants growing amongst tussocks are more protected than those growing on the exposed rock plate.

Review 2012

A review of the experiment was timed to coincide with peak flowering which was slightly earlier in the season than the experimental set up in 2011. On 15 September 2012 four volunteers from the Central North Field Naturalists Club aimed to repeat the data collection from each plant marked in 2011. Unfortunately the numbers on the flagging tape had become unreadable, and in some cases the flagging tape on uncaged plants had disappeared. Additionally, three cages were knocked over and for one of these it was not possible to identify the plant that had been caged in 2011. One other cage was partially open, but the plant inside appeared to have been protected from grazing. As a result three of the previously marked plants could not be identified (one caged, two uncaged) and very few of the plants could be associated with their ID number that had been allocated in 2011. We also found that two uncaged plants that had completely disappeared in 2012, and had presumably died.

In 2012 the volunteers (1) re-erected displaced cages; (2) found new plants to replace those that could not be identified or had died; (3) installed aluminium tags embossed with ID numbers at all plants in our sample; and (4) added a new caged-uncaged pair of plants growing in tussocks. Measurements were made of all plants in the renovated installation.

Review 2013

Compared to 2012, the review of plants in 2013 was more straightforward. During an inspection of the site on 12 May 2013, the cage of plant 88 was found to be displaced and was re-installed, but the plant within had been heavily grazed. On 21 September 2013, CNFN volunteers returned to the site and repeated the measurements that had been made previously. All the plants were rediscovered with their aluminium tags still visible and all cages remained in place.

Table 7 Measurements of plants at LCP on 5 October 2011, plus means for all caged and all uncaged plants. Habitat: L=*Lepidosperma* tussock; C=Casuarina woodland; Flower categories: 0=0, 1=1-10, 2=11-100, 3=101-1000, 4=1001-10 000, 5=10 000+; Grazing categories: 1=<5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-100%. A paired two-tailed t-test suggests that the caged and uncaged plants do not differ significantly at the start of the experiment.

Plant ID	Caged? Y/N	Habitat	Max extent x (mm)	Max extent y (mm)	Area of ellipse (m^2)	Max height (mm)	Flowers	Grazing
2	N	C	440	380	0.525	200	2	3
4	N	C	115	135	0.049	50	0	5
6	N	C	440	340	0.470	110	2	3
8	N	C	80	90	0.023	50	0	4
10	N	C	420	330	0.435	90	1	4
12	N	C,L	290	260	0.237	240	3	1
14	N	C	420	130	0.172	70	2	3
1	Y	C	480	450	0.679	120	2	3
3	Y	C	135	110	0.047	50	0	5
5	Y	C	275	195	0.168	75	2	3
7	Y	C	160	140	0.070	40	0	4
9	Y	C	305	305	0.292	90	1	4
11	Y	C,L	280	160	0.141	150	1	1
13	Y	C	280	40	0.035	75	0	4
Mean (n=7)	N	C(,L)	315.0	237.9	0.3	115.7	1.4	3.3
Mean (n=7)	Y	C(,L)	273.6	200.0	0.2	85.7	0.9	3.4
t-test (p)			0.302	0.253	0.269	0.094	0.172	0.356

Latrobe Council population

Installation on 2 October 2011

The experiment was installed at the Latrobe Council property, Lot 9, Summerhill Drive, Port Sorell, on 5 October 2011 by 2 volunteers from the Central North Field Naturalists Club. All the plants selected at this site are in casuarina woodland (*Allocasuarina verticillata*), with two plants also associating with weak tussocks of *Lepidosperma viscidum*. A total of 14 plants were selected in seven pairs, each of which had broadly similar size and situation. As shown in Table 7, a paired two-tailed t-test suggests that the caged and uncaged plants do not differ significantly at the start of the experiment.

Review, September 2012

In contrast to Hawley Nature Reserve, all cages and labels were still in place in September 2012. Updated measurements were recorded. An immediate impression was that many of the caged specimens had grown extensively and supported a fine display of flowers (Figure 3).

Figure 3 Marked plants of *Spyridium obcordatum* in 2012: the uncaged plant 10 on the left and caged plant 9 on the right.

Review, September 2013

On 21 September 2013, four volunteers found all cages and labels still in place. Updated measurements were recorded. The impression from 2012 was reinforced; many of the caged specimens have grown extensively and once again support a fine display of flowers.

Appendix 3 includes images of the paired caged-uncaged plants in 2013. The left hand column, with its images of caged plants, illustrates the more healthy looking plants, with generally many more flowers than those in the right hand column that are uncaged. Appendix 4 illustrates the transformation of the caged plants from 2011 to 2013. For consistency with Appendix 2, the left hand column shows caged plants in 2013; the right hand column shows the same plants in 2011.

Appendix 2: Population estimates 2011–2013

Hawley Nature Reserve

2011

The 9 volunteers present on 2 October 2011 conducted two line counts of the "lower" and "upper" populations of *Spyridium obcordatum*. At both sites the count covered the rock plate and closely adjacent habitats, with an attempt to include any plants that had been discovered during informal searches of the sites. The volunteers formed a line at arm's length from each other and walked through the populations. As they walked, each person counted the number of plants in their swathe, noting whether plants were dead, alive or juvenile (seedlings). Total counts are presented in Table 8.

Table 8 *Spyridium obcordatum* plants counted by the nine observers on 2 October 2011. Total counts (in bold) at Hawley Nature Reserve "Lower" (left) and "Upper" (right).

Dead	Alive	Seedling	Total alive	Total
1	21	10	31	
0	19	1	20	
2	8	0	8	
2	10	1	11	
6	7	0	7	
3	14	3	17	
2	5	3	8	
6	5	1	6	
5	29	0	29	
27	**118**	**19**	**137**	**164**
16%	**72%**	**12%**	**84%**	

Dead	Alive	Seedling	Total alive	Total
0	10	7	17	
3	18	0	18	
3	2	0	2	
0	0	1	1	
0	2	3	5	
0	1	0	1	
2	3	1	4	
4	5	0	5	
0	0	1	1	
12	**41**	**13**	**54**	**66**
18%	**62%**	**20%**	**82%**	

The total number of live plants counted, 191, is a small decrease on the most recent count of 200–250 at Hawley Nature Reserve in 2008 (Threatened Species Section 2010). Evidence of larger plants in the past was easy to see from the twiggy skeletons of dead plants. It was heartening to see a reasonable population of seedling plants, which suggests that there remains a viable seed bank that can germinate in good conditions like those in the previous two years.

2013

On 13 October 2013, a large group of Field Naturalists who were attending the Federation of Tasmanian Field Naturalists camp at Port Sorell, visited the Hawley Nature Reserve to inspect the caging experiment. A group of volunteers assisted with a second count of the population of *Spyridium* plants. The count again covered the "lower" and "upper" rock plates and closely adjacent habitats. The volunteers formed a line at arm's length from each other, see Figure 4, and walked and/or crawled from one side of the rock plate to the other. As they progressed, each person counted the number of plants in their swathe, noting whether plants were dead, alive or juvenile (seedlings). Total counts are presented in Table 9.

Figure 4 Marshalling part of the line count at HNR "lower" rock plate on 13 October 2013.

The total number of live plants counted, 364, is a substantial increase on the number counted in 2011. Unfortunately, the increase is all in the seedling plants, with the number of mature live plants decreasing by 24% to 128. This decrease is consistent with the observed death of several uncaged plants our experiment over the two years. The fact the fewer dead plants were counted in 2013 is possibly because the badly grazed plants are more likely to have died, and these are less likely to leave much evidence.

Table 9 *Spyridium obcordatum* plants counted by a group of observers on 12 October 2013. Total counts (in bold) at Hawley Nature Reserve "Lower" (left) and "Upper" (right).

Dead	Alive	Seedling	Total alive	Total
	10	8		
	2	14		
1	4	33		
	5	9		
	5			
1	4	1		
	7	1		
	5	17		
	1	40		
	17			
1	4	38		
	4	2		
3	1	12		
	3	16		
2	5	4		
1	12	11		
9	**89**	**206**	**295**	**304**
3%	**29%**	**70%**	**97%**	

Dead	Alive	Seedling	Total alive	Total
4	4	23		
1	11	27		
	1	4		
	8	3		
		20		
	8	23		
		1		
		6		
		14		
	2			
2	5			
		3		
		3		
		3		
7	**39**	**130**	**169**	**176**
4%	**22%**	**74%**	**96%**	

Latrobe Council property: population estimate

2011

The 2 volunteers present on 5 October 2011 conducted a search of the Latrobe Council property for plants of *Spyridium obcordatum*. GPS waypoints were recorded to correspond with localised groups of plants, together with a rough estimate of plants at each of these sites, see Figure 5. Very approximately, a total of 620 plants were located.

Figure 5 A map of Lot 9, Summerhill Drive, Port Sorell, the Latrobe Council property. Unlabelled white circles represent the 14 marked plants of *Spyridium obcordatum*. Labelled yellow circles represent localised groups of plants, including a rough estimate of the number of plants present in each group.

2013

The four volunteers present on 21 September 2013 conducted a more thorough count of the Latrobe Council property for plants of *Spyridium obcordatum* at the previously known general locations shown in Figure 5. The four people spread out at approximately arm's length, forming the shorter side of a rectangle. Walking parallel to the boundary fence, the line of people advanced counting plants seen in their swathe of the rectangle. GPS waypoints were taken for the corners of the search areas and these have been adjusted to create approximate search areas as shown in

Figure 6. The total count of plants was 345, with the limitation that identifying the boundary of individual plants was often difficult.

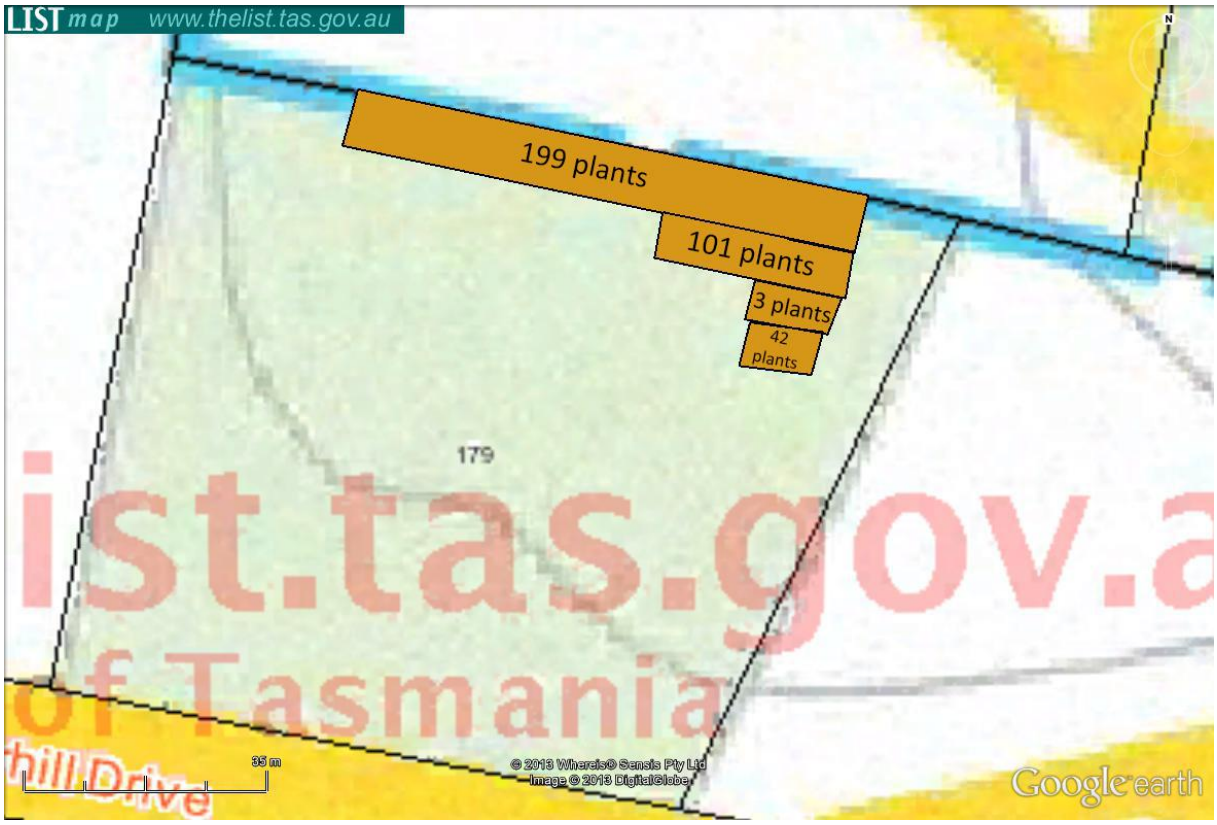


Figure 6 A map of Lot 9, Summerhill Drive, Port Sorell, the Latrobe Council property. Coloured rectangles denote approximate position of line searches for *Spyridium obcordatum* plants. The total count in each rectangle is shown.

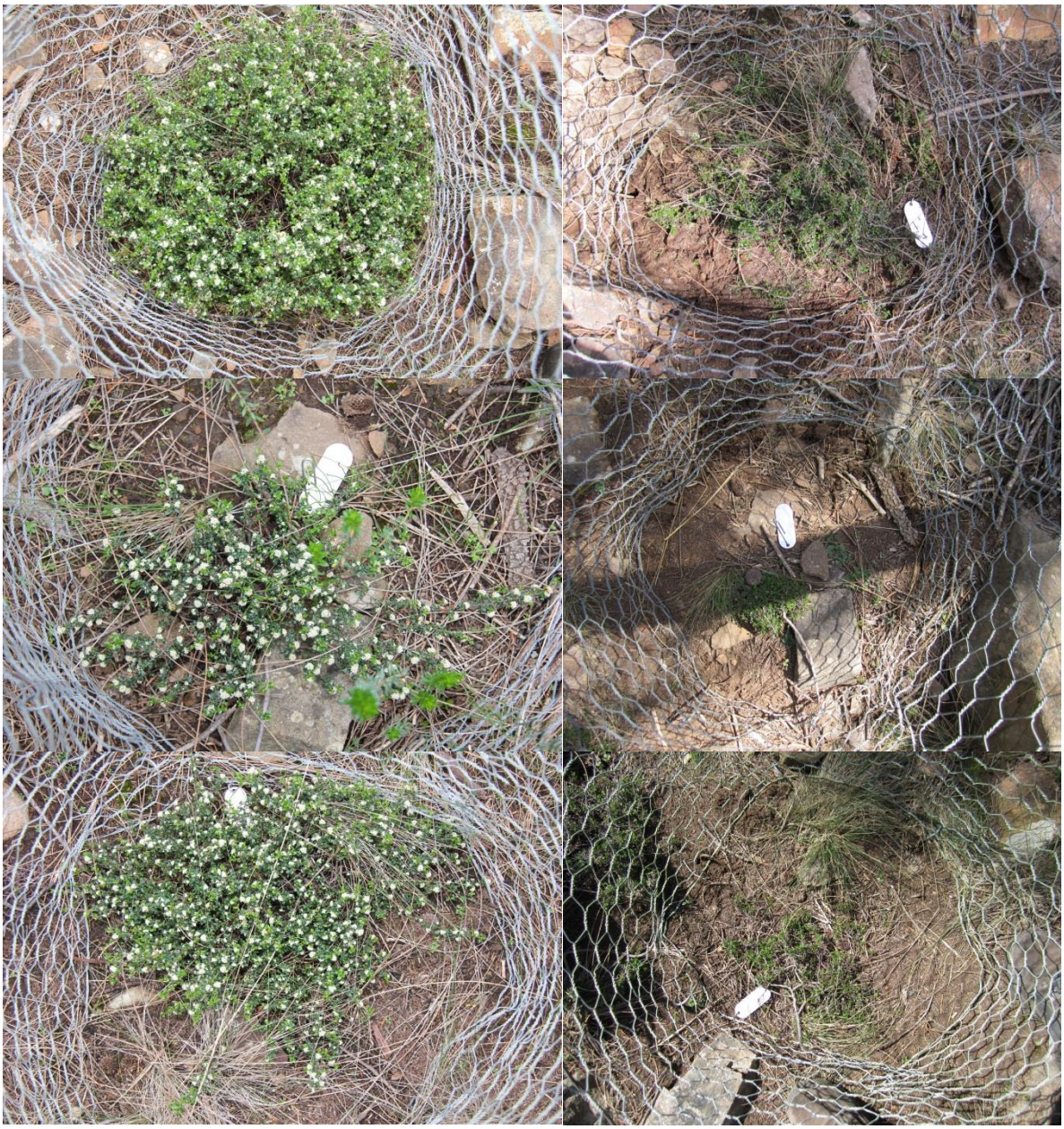
Appendix 3: Comparison of paired plants in 2013

The images in this appendix were captured on 21 September 2013; approximately two years after the cages were installed. Each row represents a pair of plants, the left hand specimen has been caged and the right hand specimen has been uncaged for the two years. Images are arranged from left to right top to bottom in number order, with plants number 1 and 2 in the first row, 3 and 4 in the second row etc.

Appendix 3continued

Appendix 4: Comparison of caged plants in 2013 and 2011

The images in this appendix were captured on 21 September 2013 (left column) and 5 October 2011 (right column). Caged plant number 1 is shown in the first row; caged plant number 3 is in the second row etc. In the right hand column, plants have just been caged, which therefore reflected their natural (uncaged) condition at the time.



Appendix 4continued