

Monitoring *Spyridium obcordatum* at Hawk Trap Hill, Hawley Results 2011 to 2012

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Summary

In August/September 2011, Phil Collier circulated a “Proposal for monitoring *Spyridium obcordatum* at Hawk Trap Hill, Hawley”. Landowners, PWS and Latrobe Council, approved an experiment that aimed to determine reason(s) for the apparent decline in the population of the threatened plant species *Spyridium obcordatum* at two sites on Hawk Trap Hill, Port Sorell. The experiment was conducted according to the proposal at the Latrobe Council site, while at the Hawley Nature Reserve small setbacks precluded the tracking of individual plants from 2011 to 2012 and several cages were displaced, which resulted in a loss of statistical power in the analysis of results.

The results of the monitoring indicate that caging of individual plants of *Spyridium obcordatum* leads to a significant increase in the number of flowers and a significant decrease in the amount of grazing. Caged plants are generally larger than uncaged plants and look much healthier. An updated population estimate is also provided for the two sites, which is broadly similar to earlier estimates when taking into account reasonable assumptions.

With the increase in flowering after a single-year of caging of individual plants, there appears to be scope to use this technique to create a “pulse” of new seeds into the ecosystem. Should a lack of seedling recruitment be determined to be a threat to species survival following disturbance, this may be a useful technique to use periodically and/or prior to any planned disturbance. However, it may be that natural grazing assists with drought-proofing or otherwise assists the plants to survive over the longer term.

It is recommended to continue this monitoring for a further season, as per the original proposal. It would be interesting to learn more about the life history of *Spyridium obcordatum*, including the lifespan of plants and levels of recruitment in different habitats and environmental conditions. A rich understanding of these effects would require an extension of monitoring over the medium term of 10+ years.



Figure 1 Flowering plant of *Spyridium obcordatum*, September 2012

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 two sites on Hawk Trap Hill, Port Sorell. This document describes the experimental set up in October 2011 and subsequent re-visit to the site in September 2012. The experiment has been conducted according to the details outlined in the proposal, and the method and other details from the proposal are not repeated here.

Hawley Nature Reserve “Lower” population

Installation, 2 October 2011

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. The rock plate at this site is very challenging for adequately securing the cages and the volunteers devised their own methods that would hopefully be successful. 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 4 pairs of plants were growing amongst *Lepidosperma viscidum*. Unfortunately one plant growing amongst *Lepidosperma* was erroneously recorded as being caged when it was not caged as the records show 5 caged and 3 uncaged plants.

Five measures/observations about each plant were recorded as per the proposal: spatial extent (3 measurements), number of flowers and perceptions of grazing (both categories). Table 1 shows the average value for each of the measurements/observations partitioned by habitat and caged/uncaged treatment. A two-tailed t-test with unequal variances to compare the measurements/observations for each habitat reveals that there are no significant differences between the caged and uncaged samples. We use a threshold of $p < 0.05$ as indicating a significant difference (denoted with ‘*’) and $p < 0.001$ for a highly significant difference (denoted with ‘**’). Despite no significant difference being detected, at the start of the experiment the uncaged plants in both habitats were on average larger (x, y and height measurements) than caged plants, with the exception of the height of plants growing in *Lepidosperma*.

Table 1 Average values for measurements and observations of *Lepidosperma* and rock plate plants at Hawley Nature Reserve 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)	Ave. max. extent y (mm)	Ave. max. height (mm)	Average flowers	Average grazing
<i>Lepidosperma</i> uncaged (n=3)	266.7	190.0	216.7	1.7	1.7
<i>Lepidosperma</i> caged (n=5)	208.0	138.0	224.0	1.6	1.4
t-test (p)	0.571	0.409	0.924	0.880	0.627
Rock plate uncaged (n=7)	234.7	135.7	44.9	0.4	2.4
Rock plate caged (n=7)	149.3	95.4	31.9	0.4	2.9
t-test (p)	0.340	0.437	0.338	1.000	0.613

Comparing all of the plants growing on rock plate against all of those growing amongst *Lepidosperma* reveals that the two samples occupy an area (x,y) which does not differ significantly. Conversely, plants in *Lepidosperma* are significantly higher ($p < 0.001^{**}$), have more flowers ($p < 0.001^{**}$) and are less grazed ($p < 0.05^*$) than those growing on the rock plate. These results confirm an expectation that plants growing amongst *Lepidosperma* tussocks are generally more protected by the coarse *Lepidosperma* leaves in a vertical dimension, than those growing on the exposed rock plate.

Review, September and October 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 2011 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 tape/marker on uncaged plants had disappeared. Additionally, three cages were displaced 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 was allocated in 2011.

In 2012 the volunteers (1) re-erected displaced cages; (2) found new plants to replace those that could not be identified; (3) installed aluminium tags embossed with ID numbers at all plants in our sample; (4) added a new caged-uncaged pair of plants growing in *Lepidosperma*; and (5) two plants that were uncaged in 2011 had disappeared and these were replaced by new uncaged plants.

It has not been possible to reconcile the individual plants that were observed in 2011 with those plants observed in 2012. We report on an analysis of the 2012 data with knowledge about whether plants were measured/observed in 2011 and whether they were adequately caged in the intervening 12 months. In this analysis two of the plants that were caged in 2011 but had their cages displaced are included in the uncaged analysis. Statistical power is reduced because of the loss of information about the pairs of plants 2011. We can compare distributions of measurements taken in 2011 and 2012, but our inability to study the difference between measurements and observations in 2011 and 2012 will further reduce our ability to report significant differences.

Given the evidence from 2011 that the *Lepidosperma* plants and the rock plate plants are significantly different on several measures/observations, we analyse plants from these two habitats separately. We include in the analysis all plants that were tagged in 2011 and re-discovered in 2012, plus additional plants added to the sample in 2012. Two of the 2011 plants that are known to have had their cages displaced are included as uncaged plants, as are all five plants that were added to the sample in 2012. We also include in the sample the two 2011 uncaged plants that had completely disappeared in 2012.

Table 2 shows that the number of plants in some cells is much smaller than desirable. However, compared with Table 1, significant differences have emerged between the caged and uncaged plants. For both habitats, caged plant support significantly more flowers and suffer significantly less grazing. Caged plants growing in the *Lepidosperma* have attained significantly more height than uncaged plants; presumably the tips of stems can be reached and grazed by animals when these plants are uncaged. The other dimensions of the plants are not significantly different in caged or

uncaged treatments, but this may be partly due to the fact that on average larger plants were caged in 2011. In contrast, by 2012 the larger measurements were mostly associated with caged plants.

Table 2 Average values for measurements and observations of *Lepidosperma* and rock plate plants at Hawley Nature Reserve. 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)	Ave. max. height (mm)	Average flowers	Average grazing
<i>Lepidosperma</i> uncaged (n=6)	392.5	223.3	225.0	2.0	1.8
<i>Lepidosperma</i> caged (n=4)	401.3	347.5	406.3	3.0	0.8
t-test (p)	0.871	0.194	0.020*	0.012*	0.026*
Rock plate uncaged (n=11)	181.8	88.2	41.8	0.5	4.0
Rock plate caged (n=5)	180.0	117.0	74.4	2.4	1.4
t-test (p)	0.974	0.345	0.085	0.015*	0.001**

When the analysis is repeated only for plants that were identified in 2011 and re-discovered in 2012 (n=21), the results are broadly similar. There are only 3 uncaged plants in the *Lepidosperma* uncaged treatment, which reduces the level of significance for two of the results for plants growing in *Lepidosperma*.

Hawley Nature Reserve population estimate

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 3.

Table 3 *Spyridium obcordatum* plants counted by the nine observers and total counts (in bold) at Hawley Nature Reserve “Lower” (left) and “Upper” (right).

Dead	Alive	Seedling	Total alive	Total	Dead	Alive	Seedling	Total alive	Total
1	21	10	31		0	10	7	17	
0	19	1	20		3	18	0	18	
2	8	0	8		3	2	0	2	
2	10	1	11		0	0	1	1	
6	7	0	7		0	2	3	5	
3	14	3	17		0	1	0	1	
2	5	3	8		2	3	1	4	
6	5	1	6		4	5	0	5	
5	29	0	29		0	0	1	1	
27	118	19	137	164	12	41	13	54	66
16%	72%	12%	84%		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 is easy to see amongst the twiggy skeletons of dead plants. It is 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.

Latrobe Council population

Installation, 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 *Lepidosperma viscidum*. A total of 14 plants were selected in pairs with broadly similar

Table 4 Measurements and observations of plants at the Latrobe Council property on 5 October 2011. Habitat: L=Lepidosperma; C=Casuarina; 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) y (mm)		Max height (mm)t	Flowers	Grazing
2	N	C	440	380	200	2	3
4	N	C	115	135	50	0	5
6	N	C	440	340	110	2	3
8	N	C	80	90	50	0	4
10	N	C	420	330	90	1	4
12	N	C,L	290	260	240	3	1
14	N	C	420	130	70	2	3
1	Y	C	480	450	120	2	3
3	Y	C	135	110	50	0	5
5	Y	C	275	195	75	2	3
7	Y	C	160	140	40	0	4
9	Y	C	305	305	90	1	4
11	Y	C,L	280	160	150	1	1
13	Y	C	280	40	75	0	4
t-test (p)			0.302	0.253	0.094	0.172	0.356

Review, 15 September 2012

On reviewing the marked plants nearly one year later, the immediate impression is that many of the caged specimens have grown extensively and support a fine display of flowers (Figure 2). Appendix 1 includes images of the paired caged-uncaged plants. The left hand column, with its images of caged plants, illustrates the more healthy looking plants, with many more flowers than those in the right hand column that are uncaged. Appendix 2 illustrates the transformation of the caged plants from 2011 to 2012. For consistency with Appendix 1, the left hand column shows caged plants in 2012 while the right hand column shows the same plants in 2011.

Table 5 shows the measurements and observations from each of the marked plants in 2012. We are interested in possible differences between caged and uncaged plants in 12 months, so we calculate the differences between measurements and observations for each plant in 2012 and 2011 by subtracting the values in Table 4 from those in Table 5, as shown in Table 6. We now determine whether the differences between uncaged and caged plants are significantly different using a two-tailed paired t-test. The results from these t-tests show that all characters considered are significantly

different in the uncaged and caged treatments, leaving little doubt that the caging has a significant effect on plant growth after only one year. The difference in flowering is highly significant, which confirms the immediate impression of the plants. Given the small sample size, these results are particularly remarkable.



Figure 2 Marked plants of *Spyridium obcordatum*: the uncaged plant 10 on the left and caged plant 9 on the right.

Table 5 Measurements and observations of caged and uncaged plants at the Latrobe Council property on 15 September 2012 after one year of caging. Habitat: L=*Lepidosperma*; C=*Casuarina*; 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%.

Plant ID	Caged? Y/N	Habitat	Max extent		Max height (mm)	Flowers	Grazing
			x (mm)	y (mm)			
2	N	C	460	380	225	2	3
4	N	C	125	120	65	1	1
6	N	C	440	400	80	1	3
8	N	C	70	55	43	0	1
10	N	C	410	320	65	1	3
12	N	C,L	270	220	150	0	2
14	N	C	0	0	0	0	5
1	Y	C	450	405	210	4	1
3	Y	C	450	160	105	4	1
5	Y	C	370	300	55	4	1
7	Y	C	330	180	110	2	1
9	Y	C	510	400	220	4	1
11	Y	C,L	500	340	260	2	1
13	Y	C	290	60	85	1	1

Table 6 Differences between the 2012 and 2011 measurements and observations of plants at the Latrobe Council property. A paired two-tailed t-test suggests that the differences are significant on all of the characters considered.

Plant ID	Caged? Y/N	Habitat	Max extent		Max Height	Flowers	Grazing
			x (mm)	y (mm)			
2	N	C	20	0	25	0	0
4	N	C	10	-15	15	1	-4
6	N	C	0	60	-30	-1	0
8	N	C	-10	-35	-7	0	-3
10	N	C	-10	-10	-25	0	-1
12	N	C,L	-20	-40	-90	-3	1
14	N	C	-420	-130	-70	-2	2
1	Y	C	-30	-45	90	2	-2
3	Y	C	315	50	55	4	-4
5	Y	C	95	105	-20	2	-2
7	Y	C	170	40	70	2	-3
9	Y	C	205	95	130	3	-3
11	Y	C,L	220	180	110	1	0
13	Y	C	10	20	10	1	-3
t-test (p)			0.013*	0.032*	0.011*	0.000**	0.037*

Latrobe Council property: population estimate

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. Appendix 3 shows the location of these localised groups of plants (the yellow circular icons on the map). Very approximately, a total of 620 plants were located. The most recent estimate of 200 plants in 2002 (Threatened Species Section 2010) possibly refers only to the rock plate at this site (Protected Areas on Private Land 2003), and if so this is broadly similar to the current count. An earlier count of 1970 plants in 1996 (Threatened Species Section 2010) seems likely to refer to the broader sub-division at Summerhill Drive.

Conclusion

All of our results confirm that caging plants of *Spyridium obcordatum* results in an increase flowering coupled with a perceived decrease in grazing over a 12 month period. The grazing result is consistent with Coates (1991). There is substantial evidence that caged plants grow to become larger than uncaged plants, except that our inability to reconcile 2011 plants with 2012 plants at Hawley Nature Reserve means that our statistical evidence is drawn mainly from the Latrobe Council site. The overall results are consistent with earlier discussion that points to grazing as a threat to *Spyridium obcordatum* populations (Threatened Species Section 2010).

With the increase in flowering from a single-year of caging of individual plants, there appears to be scope to use this technique to create a “pulse” of new seeds into the ecosystem. Should a lack of seedling recruitment be determined to be a threat to species survival following disturbance, this may be a useful technique to use periodically and/or prior to any planned disturbance.

Anecdotally, the current population of *Spyridium obcordatum* plants at Hawley Nature Reserve are more heavily grazed than in natural conditions that occurred the past (Coates, pers. comm.). If this is

correct, then plants may be able to sustain some increased growth and flowering in perpetuity. However, further work is required to establish whether this is the case. It may be that natural grazing assists with drought-proofing or otherwise assists the plants to survive over the longer term. Drought-proofing may become more significant in the future if higher temperatures act to enhance the drying effects of droughts.

Future actions

This monitoring project was proposed for a three-year initial period 2011 to 2013 (Collier 2011). This may need to be extended to 2014 at Hawley Nature Reserve to account for our inability to reconcile 2011 data with 2012 data as had been planned. At the conclusion of the current monitoring project, it is desirable to estimate population size again. At the Latrobe Council site, this should be done more systematically than previously.

Of particular interest over the coming year of monitoring and perhaps beyond is the differential impact of caging on the three habitat types: rock plate, *Lepidosperma*, and casuarina woodland. It may be that the plants growing in *Lepidosperma* clumps are naturally more protected from grazing and form a fall-back population should grazing pressure or drought become extreme. Plants grow amongst *Lepidosperma* near or at both the rock plate and casuarina sites.

It would be interesting to learn more about the life history of plants, including the lifespan of plants and levels of recruitment in different habitats and environmental conditions. A rich understanding of these effects would require an extension of monitoring over the medium term of 10+ years.

References

Coates, F. (1991) The Conservation Ecology and Management of Five Rare Species in the Rhamnaceae Family, Wildlife Scientific Report 91/3, Department of Parks, Wildlife and Heritage, Hobart.

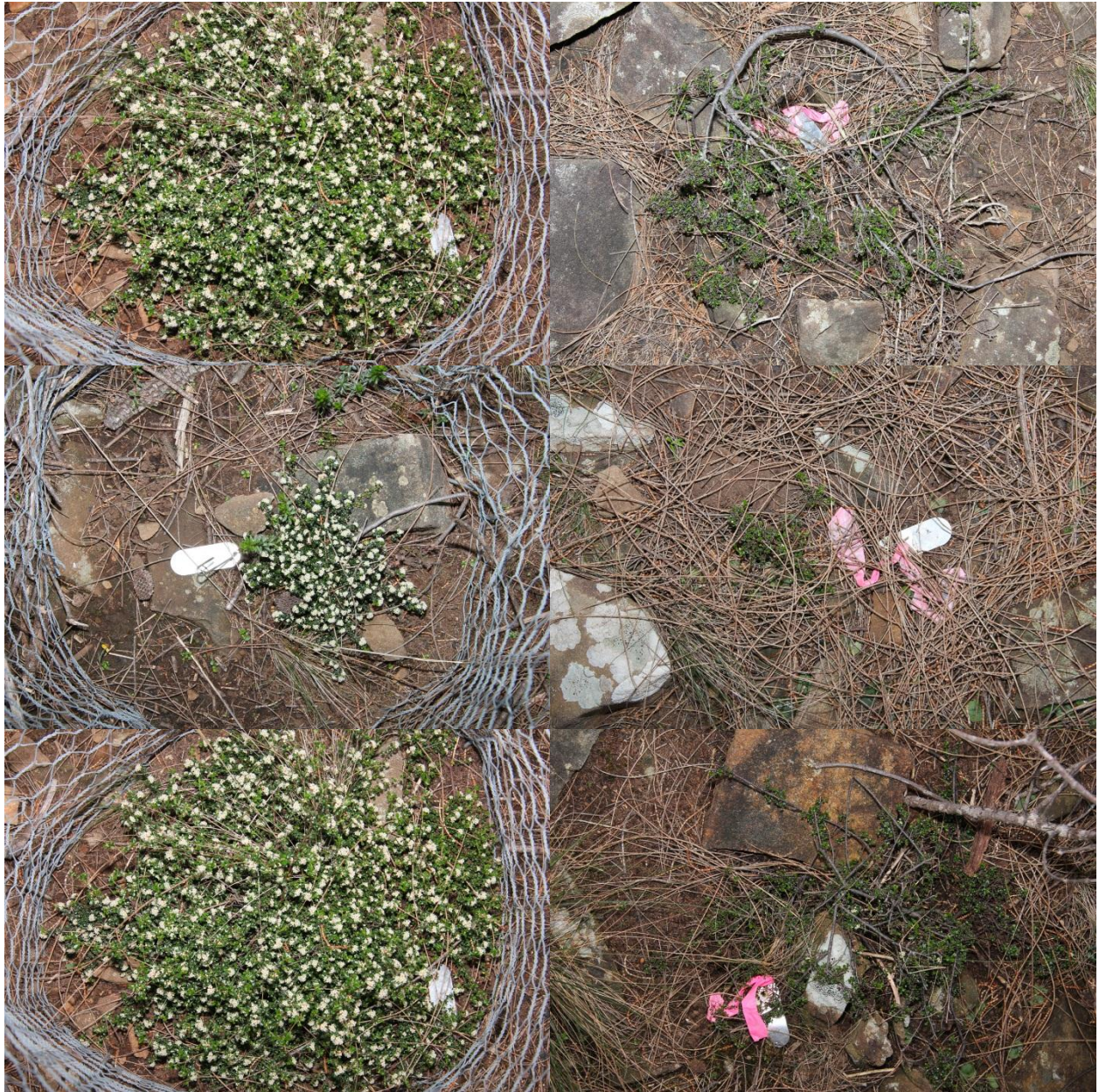
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Protected Areas on Private Land (2003) Nature Conservation Plan for Lot 3 Summerhill Drive, Port Sorell, Department of Primary Industries, Parks, Water and Environment, Hobart, manuscript.

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

Appendix 1: Comparison of paired caged and uncaged plants

The images in this appendix were captured on 17 September 2012, two days after the monitoring of the plants. 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. Each row represents a pair of plants, the left hand specimen had been caged and the right hand specimen was uncaged for nearly a year.



Appendix 1continued



Appendix 2: Comparison of caged plants in 2012 and 2011

The images in this appendix were captured on 17 September 2012 (left column) and 5 October 2011 (right column). Plant number 1 is shown in the first row; plant number 2 is in the second row etc. In the right hand column, plants have just been caged, and therefore illustrate their extent and ability to flower in the natural (uncaged) conditions at the site.



Appendix 2 continued



Appendix 3: Population estimate at the Latrobe Council property

The image below depicts a map of Lot 9 Summerhill Drive, Port Sorell, the Latrobe Council property that has been covenanted and set aside to protect its population of *Spyridium obcordatum*. 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.

