

**Division as a means of increasing
a population of
Chocolate Lily,
(*Arthropodium
strictum*) in
remnant
grassland**



**Merri Creek
Management
Committee**

**Brian Bainbridge
August 2013**



Reinforcing Grassland
Ecological Values
in the Merri Valley
North of Melbourne



CARING
FOR
OUR
COUNTRY



This project is supported by Merri Creek Management Committee through funding from the Australian Government's Caring for our Country and Darebin City Council, Parks Victoria and Merri Stock Pty. Ltd.

Acknowledgements

Michael Longmore, Ben North, Katrina Roberg (MCMC), Uncle Dave Wandin, Aunty Alice Kolasa, Ash Firebrace, Glenn Clapton, Fiona McConachie (Wurundjeri Tribe Land Cultural Heritage Council Inc.).

Flora interventions for this project were done under Flora and Fauna Permit Number 10006218

1 Summary

A small trial was conducted to test the ability of the Chocolate Lily, *Arthropodium strictum*, growing in a remnant Volcanic Plains Grassland to survive and have its population increased through simultaneously digging, dividing and replanting. Results were poor with almost the same number of plants surviving at the end of the trial as were lifted. A number of unanticipated variables became apparent during the trial including the influence of weather, age and structure of the divided material, depth and degree of cultivation of the receiving sites and the impact of foraging by macropods and rodents.

Trials under nursery conditions are recommended to identify the importance of some of the variables before further field trials are attempted.

The cultural and plant conservation rationale for developing this technique is described.

2 Background

Records by the earliest European observers indicate that at the time of colonisation, the harvesting of roots for food on plains in Victoria by aboriginal people was extensive. There are records that it was a widespread custom for traditional custodians in southern Australia to replant some pieces of food plants to ensure ongoing availability of these species (Denham 2008, Gott 1992).

It is apparent that the digging occurred at a scale where the associated soil disturbance would have had significant ecological effects (Gott, 1992). Digging for roots may have created areas that favour the germination of a subset of plants that could not otherwise establish among the dominant grassy cover.

The near-annihilation of traditional ways of life in southern Australia that followed European invasion also disrupted the ecological role played by digging for food on the Victorian Volcanic Plain near Melbourne. At the same time, the local extinction of small digging mammals such as Pademelons, Bettongs and Bandicoots resulted in the interruption of another major source of disturbance to soils (sometimes termed 'bioturbation'). The decline of some plant species on the Victorian Volcanic Plains is thought to be consistent with the interruption to this extensive, small-scale disturbance (Robinson 2003 p 68.).

Historical records, observations of current day grasslands and trials (Robinson 2003, Reynolds, 2006, Dodd, 2009), suggest that reintroducing a degree of soil disturbance might be beneficial for increasing flora diversity in current day grassland reserves. However, the rapid dispossession of the Traditional owners around Melbourne and suppression of their culture meant that important details of their contribution to soil disturbance processes were not recorded. Destruction and fragmentation of ecosystems since colonisation along with the presence of many exotic plants and animals means that the original practices would need to be assessed and almost certainly modified if they are to be consistent with current conservation needs.

In 2010, as a part of a 3 year Caring for Our Country project, Merri Creek Management Committee (MCMC) sought a partnership with the Wurundjeri Tribe Land Cultural Heritage Council Inc.(WTLCHC) to conduct trials to begin to re-develop and update the knowledge needed to apply digging in a remnant grassland for both ecological and cultural renewal purposes.

Division as a means of increasing a population of Chocolate Lily, (*Arthropodium strictum*) in remnant grassland.

Ultimate goals for MCMC and WTLCHC include;

- establish activities of proven ecological benefit and a high degree of cultural value and relevance for this area's traditional custodians
- increase the knowledge of land management bodies on the potential of using digging activities to fulfil cultural and ecological needs.
- establish areas of native grassland with increased potential for plant regeneration
- establish reliable methods for increasing populations of a range of tuberous native food plants in grasslands

Two small trials were conducted between 2011 and 2013;

- A trial to identify the potential of a still-common foodplant (Chocolate Lily) to respond to digging and replanting treatment
- A trial to establish the potential of gap creation and soil disturbance in a grassland for enhancing the germination and survivorship of forb species, applying the work conducted by three researchers from Victoria University.

The first trial is the subject of this report. The second is the subject of another report by MCMC, '*Applying gap and disturbance treatments for establishing forbs in a remnant Native grassland*'.

3 Aim

Identify whether divisions of Chocolate Lily (*Arthropodium strictum*) will re-establish when lifted, divided and re-planted in a native grassland north of Melbourne.

4 Objectives

- Identify whether the main plant of a Chocolate lily will re-establish successfully after having been lifted then replanted after having divisions removed from its rhizome.
- Identify whether divisions of Chocolate lily will grow after having been replanted close to the original plant
- Identify whether there is a difference in establishment of divisions when they occur in early winter or early spring
- Identify whether weeds increase to a significant degree in the area of digging.

Once digging of plants commenced, numerous tubers became detached from the rhizomes fragments that formed the main divisions. The opportunity was taken to test another hypothesis;

- Identify whether detached tubers are capable of regrowing.

5 Method

Volcanic Plains Grasslands are listed under Victoria's Flora and Fauna Guarantee act so all plants at this publicly owned site are protected. Works to collect and replant took place under Merri Creek Management Committee's Permit number 10006218.

Choice of dates

Two dates, 13th June 2012 (winter) and 25th September 2012 (spring) were chosen for these attempts based on the accessibility and visibility in a post-burn grassland.

A summer treatment was not able to be taken up. There are lines of evidence from horticulturalists that summer digging when plants are dormant may be the most

Division as a means of increasing a population of Chocolate Lily,
(*Arthropodium strictum*) in remnant grassland.

appropriate time to undertake this kind of propagation. Locally aboriginal people spent time winters in the ranges (Ellender and Christiansen 2001)

Choice of plants and sites

10 Chocolate lily plants for were located through the grassland. Plants were either isolated or on the edge of patches of lilies to help avoid confusion with existing plants.

Sites were chosen within areas where ecological burns had been conducted in the summer for the following reasons,

- This timing would replicate the practice of Traditional owners recorded by early observers where burning was carried out partly to make it easier to search for food plants (Gott 1992 p 42)
- Holland, McDonnell and Williams (2007) positively identified that burning reduces exotic mollusc populations in grasslands. These researchers did not record high palatability for *Arthropodium strictum* in a laboratory trial with one slug species however the authors often see *Arthropodium strictum* leaves damaged by molluscs
- the more open structure of burnt areas have larger inter-tussock gaps that would be suitable for plant establishment, partly due to lower mollusc activity

Digging up and division

Plants were dug up using 'hand-mattocks' and shovels, digging approximately 30 cm around and below the base of the plant in an effort to encompass the whole root system (see Figure 10-1 Partially uncovered *Arthropodium strictum* plant showing typical structure of underground plants at Ngarri-djarrang). Soil was removed from the root ball to allow the root structure to be accessed. Notes on what was observed are included as Appendix 10.1. The rhizome of each plant was broken into lengths, approximately 1-2cm in length with attached tubers. These were termed 'divisions'. The actively growing part of the lily with attached tubers was designated the 'donor'. Tubers that became detached from the root mass were collected and are described as 'loose tubers'.

The numbers of tubers attached to each division and donor plant was recorded, as was the number of rosettes and number of leaves on the donor plant or divisions (where present).

Replanting

Donor plants were re-planted into the original hole.

Inter-tussock gaps were selected from up to 2 metres from the donor plant, holes were dug and the divisions replanted at approximately the same depth as they had been taken. Collections of loose tubers were planted together and the number of tubers in the hole recorded.

Donor plants and divisions were watered in with approximately 0.5 litres of water.

Marking plants

A short 'star-type' picket was inserted approximately 30cm to the north of the donor plant and the location recorded with a Garmin GPS unit. The location of each division and loose tuber planting was recorded as a distance (in centimetres measured with tape measure) and estimated direction relative to the stake. Anodised aluminium tags with codes incised were pinned to the soil a few centimetres from where each planting took place.

Assessment

Assessments of regrowth of the donor, divisions and loose tubers were carried out on 13th November 2012 (5 months after treatment of winter cohort, 7 weeks after

Division as a means of increasing a population of Chocolate Lily, (*Arthropodium strictum*) in remnant grassland.

treatment of spring cohort) and 18th June 2013 (12 months after treatment of winter cohort and 9 months and three weeks after the treatment of the spring cohort).

The species is deciduous and generally only re-shoots from underground parts in April so assessment dates were chosen for times when surrounding untreated Chocolate Lilies were in an advanced stage of regrowth.

During each assessment the presence of active growth considered to have originated from the donor, division or loose tubers was recorded. Assessors recorded the number of living leaves, the number of rosettes and number of active (or recently active) flower stems. Notes on plant health were also taken.

One plant dug up for the winter cohort was later discovered to be a Yellow Rush-lily (*Tricoryne elatior*) and was excluded from further analysis. A plant from the spring cohort could not be re-located in the second assessment period as its stake had been removed and plants could not be relocated. The data for this plant has also been excluded from the analysis. So, excluding these two plants, the following figures relate only to 18 original plants, 9 from each cohort.

6 Results

6.1 Regrowth

From the 18 plants treated and assessed in the following analysis, only six ‘donor’ plants were actively growing in June 2013. Of 46 divisions with attached rhizome, only 11 were actively growing at the end of the trial. None of the replantings of 14 collections of loose tubers regrew. There was thus a net loss of one plant compared to the original population during this exercise.

The number of plants that regrew of all three replanting types (donor, division and loose tubers) as a percentage of the original lifted *Arthropodium strictum* plants is included as Figure 6-1 Regrowth as a percentage of original planting at two different assessment dates.

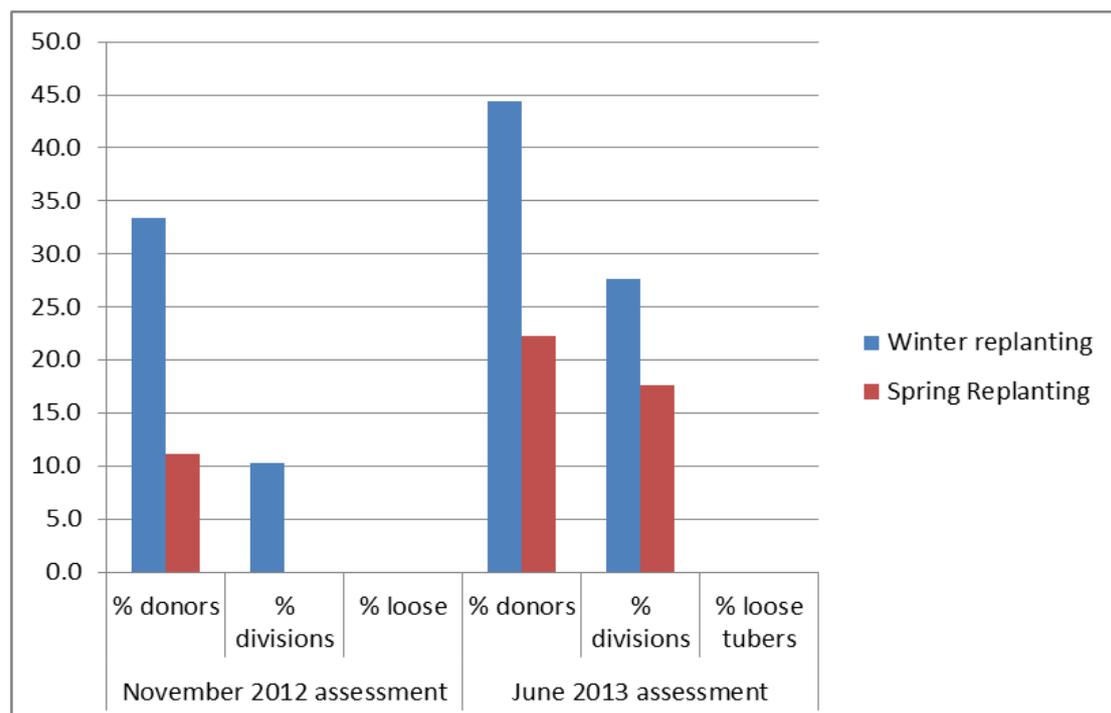


Figure 6-1 Regrowth as a percentage of original planting at two different assessment dates

Division as a means of increasing a population of Chocolate Lily, (*Arthropodium strictum*) in remnant grassland.

Of the 78 donor plants, divisions and loose tubers tracked for the duration of the study, only 9% appeared active by November 2012 with plants from the spring replanting having particularly low levels of regrowth (2.7%). However, by June 2013 the overall activity of replanted *A. strictum* had increased to 21.8%. Regrowth increased from 14.6% to 29.3% for the Winter and 2.7 to 13.5% for the Spring cohorts.

Plants of the winter-planted cohort fared better than spring cohort, and this was the case for both donors and divisions. Regrowth of the Winter cohort was almost 5 times that of the Spring cohort by November and twice that of the Spring cohort by the following June. Seventy one percent of plants observed to be active in November 2012 were again active in June the following year. This is most likely to indicate that mortality has occurred over the summer period, however it is possible that some regrowth may re-emerge as some plants still appeared in an early stage of regrowth in June.

6.2 Donor plants vs. divisions

Replanted donor plants fared better than divisions. No spring divisions had regrown by November 2012, 6 weeks after replanting, while 9.4% of winter divisions had regrown at this point. By June 2013, the winter cohort of donors had a regrowth rate of 44.4% twice that of the spring cohort.

6.3 Loose tubers

Three of the 32 winter cohort and 11 of the 28 Spring cohort consisted of replantings made up solely of loose tubers – tubers broken off from or unconnected to the root mass of a plant. No ‘loose tuber’ replantings were found to be to have re-grown at either the November or June assessment period.

6.4 Numbers of tubers retained

An analysis was carried out to determine whether there was any correspondence between the number of tubers retained on a division or donor and the likelihood of it regrowing.

No relationship was evident for divisions and donors from the winter cohort (median 7.5 attached tubers for plants showing regrowth versus 7 for no regrowth). However, the spring cohort, suggested a slight relationship with a median of eight tubers attached to regrowing plants compared to four attached to non-regrowing plants.

7 Discussion

7.1 Underground structure

Photographs and notes on the structures observed are included as Appendix 10.1. Unearthed plants at Ngarri-djarrang typically had a single growing point at the end of a rhizome in contrast to potted or cultivated plants which commonly have multiple growing points arising from a branching rhizome. Plants grown in loose soil, with a good amount of nutrients and that are allowed to dry out in summer are more likely to produce healthy tubers (N. Sunner 2013, pers. comm. 1st August 2013)

It is possible that the heavy clay soil at Ngarri-djarrang influences the structure of the plants. Regular cultivation of soil by Traditional Owners could have resulted in a

Division as a means of increasing a population of Chocolate Lily, (*Arthropodium strictum*) in remnant grassland.

phenotypic response of tuberous food plants to produce more lush and productive growth. (Denham 2008 p.246). Lusher, more vigorous Chocolate lilies with a greater number of growing points would make division a more effective means of increase. A long-term trial on the effectiveness and impacts of modifying soil structure through repeated cultivation would be needed to assess the role that this may have played in food harvesting in native grassland and its application for the current day.

7.2 Regrowth

Some plants observed in November 2012 showed little or no living foliage however signs of recent flowering and fruiting, and subsequent regrowth in in 2013 indicated they had commenced seasonal senescence.

7.2.1 Donors

Only a third (6 of 18) donor plants were actively regrowing at the end of the trial.

7.2.2 Divisions

Just under a quarter of the divisions (11 of 42) were regrowing at the end of the trial.

7.2.3 Loose tubers

No regrowth on loose tubers was recorded suggesting that, under this treatment, they had less capacity to produce a new plant than the divisions with attached rhizome. Propagation manager at Victorian Indigenous Nurseries Cooperative, Fairfield related that mature loose tubers are able to produce new plants under cultivation when they are at an appropriate stage of maturity (N. Sunner 2013, pers. comm. 1st August 2013).

7.3 Re-planting season

The results of the present study indicated that winter translocations had a greater likelihood of surviving. Translocating in winter appeared to provide a longer period before the onset of summer, in which plants was able to recover and re-establish their root systems before the stress of summer.

Some authorities suggest that summer digging of tubers of this species were customary Pawley, K. (in Wigney 1994 p. 47) and propagation manager N. Sunner indicates that successful regrowth will occur from loose tubers and divisions replanted in the dormant summer state. (2013, pers. comm. 1 Aug)

7.4 Browsing and digging

A number of plants recorded as dead showed signs of digging and disturbance by animals, possibly kangaroos or rats. In some cases, the replanted tubers had actually been dug up and left on the ground, and some showed signs of being gnawed or eaten. Future studies should incorporate some form of enclosure, fine enough to prevent access by rats, to reduce plants lost to animal consumption.

7.5 Weed growth

While no methodical assessment was made, observations on weed growth in the vicinity of digging were made at the assessment period. Some replanting locations showed a raised level of weed growth in the disturbed zone.

Division as a means of increasing a population of Chocolate Lily, (*Arthropodium strictum*) in remnant grassland.

Most prominent among the weeds were the annual grasses from the genus *Briza* (*B. maxima* and *B. minima*). The small depressions formed by settling of soil in the replanting areas appeared to provide places where the wind-blown seeds of *Briza* and other weeds might gather. Potentially, mounding of soil in the planting zones may counteract the tendency of the soil to sink and gather seeds.

7.6 Other limitations

Severe summer drought occurred in the months following translocation, which may have reduced the survivorship of replanted divisions.

Methods of digging and division by staff and volunteers were not closely monitored and there was potential for considerable variability in details of lifting, digging and crumbling of soil.

8 Conclusion and Recommendations

A reliable method with a higher success rate for digging and division needs to be proven before this can be recommended as a regular part of local grassland management or extended to other, rarer species.

This investigation into the translocation and division of tubers of Chocolate lilies in remnant grassland generated several questions requiring further investigation.

- What is the intrinsic capacity of wild collected Chocolate lily parts to regrow?
- Would a summer digging and replanting while plants are dormant have a greater success than treatment while plants are actively growing?
- Did herbivory by rats and kangaroos play a significant role in the failures?
- Will soil in a remnant grassland, repeatedly dug, develop a different soil structure that would cause a phenotypic change in Chocolate lilies such that they will become more vigorous and suitable for multiplication using digging and replanting?

Recommended investigations include;

1. A desk-based investigation into published information, gleaning information from practitioners of native plant propagation and nursery and field-based trials
2. A nursery-based trial to identify the intrinsic potential of sections of rhizomes and tubers of different kinds to regrow under ideal conditions.

If this investigation identifies significant potential for reproduction and multiplication using division;

3. Investigate the response of plants to summer replanting of divisions and loose tubers
4. Identify impact of herbivory by rats or kangaroos using enclosure cages on treatments
5. Identify whether repeated digging of patches of ground in a native grassland result in phenotypic responses of Chocolate lily that significantly increases its potential to be divided.
6. For above investigations, carry out detailed monitoring of responses of associated weed and indigenous plant responses in the disturbance zones.

Division as a means of increasing a population of Chocolate Lily,
(*Arthropodium strictum*) in remnant grassland.

9 References

- Denham, Tim 2008. 'Traditional forms of plant exploitation in Australia and New Guinea: the search for common ground'. *Vegetation History and Archaeobotany* 17: 2, pp 245-248
- Dodd, Amanda 2009, the 'Role of Bioperturbation on the Germination and Survival of Native Forbs (Podolepis sp.1 and Ptilotus spathulatus) in Grasslands of the Victorian Volcanic Plains'. Honours Thesis, Victoria University
- Ellender, Isabel, and Christiansen, Peter 2001 *People of the Merri Merri*. Merri Creek Management Committee. East Brunswick
- Gott, Beth 1992, 'Koorie Use and Management of the Plains. Paper presented at the Proceedings of The Great Plains Crash Grassland Conference. Victorian National Parks Association and Indigenous Flora and Fauna Association Footscray. pp 41-45 (Available from IFFA digital library <http://www.iffa.org.au/IFFA-files/GPCconf/Gott.pdf> [2nd August 2013])
- Holland, Kelly, McDonnell, Mark and Williams, Nicholas 2007 'Abundance, species richness and feeding preferences of introduced molluscs in native grasslands of Victoria, Australia'. *Austral Ecology*. Volume 32, Issue 6, pages 626–634
- Reynolds, Deborah 2006 'The ecological importance of soil disturbance on the recruitment, growth and reproduction of temperate lowland grassland forbs and implications for rehabilitation. Honours Thesis, Victoria University
- Robinson Randall, 2003 'Natural recruitment of native forbs in the grassy ecosystems of south-eastern Australia' Master's Thesis, Victoria University

Division as a means of increasing a population of Chocolate Lily, (*Arthropodium strictum*) in remnant grassland.

10 Appendices

10.1 Observations on structure of under-ground parts

Short, horizontal rhizome-like structure was usually present with current year's rosettes forming one end, with a cluster of tuberous roots descending from the growing point.

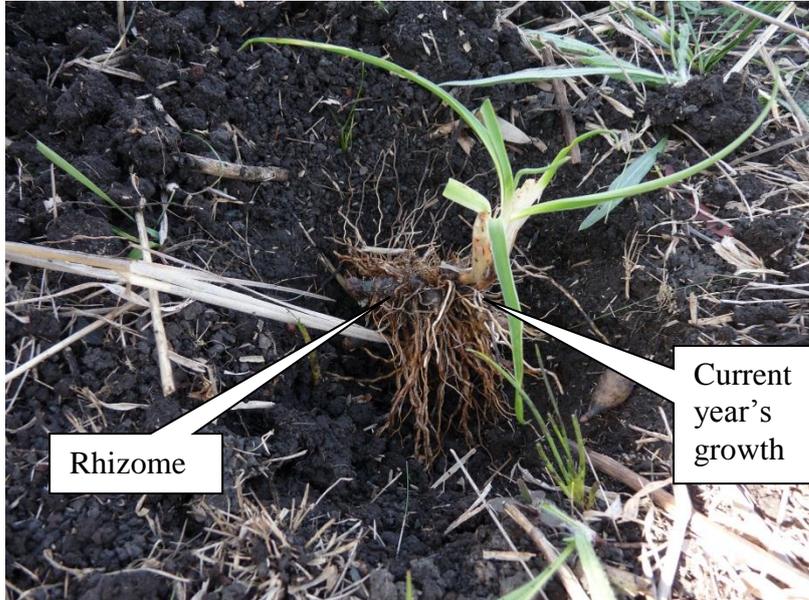


Figure 10-1 Partially uncovered *Arthropodium strictum* plant showing typical structure of underground plants at Ngarri-djarrang

Along the rhizome could be discerned a series of clusters of frayed leaf bases and clusters of older roots along the rhizome apparently representing growth from earlier years.



Figure 10-2 Unearthed *Arthropodium strictum* . Current year's growth at right and rhizome at left

Division as a means of increasing a population of Chocolate Lily,
(*Arthropodium strictum*) in remnant grassland.

Clusters of progressively older, roots appeared more shrivelled.



Figure 10-3 Divisions of rhizome broken into pieces. Left to right in order from distance from current year's growth

The recent formation of new tubers was apparent during the digging of the second cohort in late September.



Figure 10-4 *Arthropodium strictum* plant in late September with freshly grown tubers.