Fire and Restoration
working with fire for healthy lands

Using Fire to Manage Priority Weeds in Cumberland Plain vegetation:

African Lovegrass

About this Guide

This Guide has been brought together by the Using Fire as a Restoration Tool in Cumberland Plain Vegetation project that was conducted in Cattai and Scheyville National Parks from late 2013 until January 2016. The booklet provides an overview of the project and discussion of the results of the field trials and related restoration works. The Guide also describes how these findings can be applied to management of weeds in the Cumberland Plain and other similar situations.

Project Collaboration

The project has been undertaken through the collaborative efforts of the following organisations:

This project has been assisted by the New South Wales Government through its Environmental Trust.

This booklet has been compiled for the Nature Conservation Council of NSW's Bushfire Program

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The Cumberland Plain

Only 12% of the original Cumberland Plain vegetation remains today due to past agricultural clearing and the growth of western Sydney. Biodiversity in this area is among the most threatened in New South Wales and has been identified as a priority for conservation. Long term development pressures have resulted in a highly fragmented and degraded landscape across the region.

No one alive today and no one even of our grandparents' generation has ever seen the Cumberland in the condition in which it existed for 100s and 1000s of years. Aboriginal people were living in the Cumberland Plain at least 30,000 years ago and probably much earlier. The Upper Hawkesbury was Darug country, with the area around these Parks occupied by the Cattai clan of the Darug people.

European settlers began using the area for grazing and farming from the early 1800s. At Scheyville, ongoing use for farming and other purposes including

Cumberland Plain Woodland. Photo: Jonathan Sanders

military training and migrant hostel facilities have led to a highly altered ecosystem, although still with Cumberland Plain vegetation. Residential development in the area continues to place pressure around the Park boundaries in the project area.

Scheyville and Cattai National Parks contain key remnants of Cumberland Plain Woodland and Shale/Sandstone Transition forest vegetation communities, listed respectively as a Critically Endangered and an Endangered Ecological Community under the NSW TSC Act 1995 and National EPBC Act 1999.

In intact remnant areas of Cumberland Plain Woodland around 85% of the plant diversity can be found in the ground layer. Species include miniature daisies, peas, lilies and orchids that form a patchwork with a wide array of native grasses. An important research area noted in the Cumberland Plain Recovery Plan (2010) is "developing and refining revegetation techniques to help re-establish understorey diversity and structure". The integrated fire and weed management approach of this project contributes to this research goal.

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Clearing, weeds and regeneration

The Cumberland Plain in Western Sydney was one of the first areas of Australia to be subjected to intensive clearing, and development for agriculture. In the ensuing two centuries and more, there has been ongoing disturbance, repeated episodes of vegetation clearing, alterations to fire regimes, and various types of soil disturbance.

On top of all of this environmental disturbance has been the introduction of new species of both plants and animals. The introduced animals have had a significant impact through grazing, and particularly overgrazing of palatable native species, as well as compaction of soils by hoofed animals, and predation of small native fauna by foxes and cats.

A number of the introduced plants apparently became naturalised soon after their introduction with relatively little impact (e.g. Dandelions) while other species survived for many years in the Australian landscape before developing the ability to multiply rapidly and invade and dominate native vegetation. These species, (such as African Olive), could be considered as "ecological transformers", since, once they are established as dominants in the vegetation, it is unlikely that the ecosystem will revert to a more natural condition without significant management intervention.

This project grew out of research that has been done over the past decade and more into the role of fire in encouraging regeneration of native vegetation at Scheyville National Park and elsewhere.

Fire and weeds in a highly altered system

Fire - The role of fire in maintaining flora diversity in Cumberland Plain has been studied by NSW National Parks and Wildlife Service (NPWS) and other land managers for at least 15 years. A study by Watson, Bradstock and Morris (2009) noted that fire plays an important role in helping to maintain the balance of plant species, and the understorey structure. Whilst the statewide fire intervals recommended for Grassy Woodlands are 5 to 40 years (NPWS 2004) studies undertaken specifically for Cumberland Plain Woodland (Watson et al 2009) recommend variable fire intervals between 5 and 12 years to help support diversity, (and occasional, even shorter fire intervals are indicated by the research described below).

Weeds - Plant communities of the Cumberland Plain are particularly vulnerable to weed invasion due to their fragmentation, grassy understorey and relatively fertile soils. African Olive, Lantana and African Lovegrass are now widely established, and have displaced native plants and affected the regeneration of plant communities. These weeds can alter systems to such a degree that the vegetation is unlikely to recover without some interference in the system.

There is also the potential for these species to change fire behaviour and risk, because their biomass may lead to increased fuel loads which can result in higher intensity fires (which are harder to control).

Fire is essential for the long-term health of Cumberland Plain Woodland ecosystems.

Artist's impression of the Cumberland Plain 1790

Controlled burn of African Lovegrass in the Cumberland Plain 2014. Photo: Michelle Rose

Previous fire and restoration work

Initial work at Scheyville from 2002 focussed on investigating the effect of introducing fire to disturbed grassland areas, in comparison to an area of relatively intact woodland. Two planned fires, as well as a wildfire, occurred over a period of 5 years. Briefly, we found that both native and introduced species responded to the initial planned fire by vigorous re-establishment, but introduced species re-establishment was far less numerous when a second burn was done 4 years later.

There was also vigorous establishment of native species after the first planned fire, including an increase in both number of individual plants, and number of native species. Native species continued to respond with vigorous re-establishment after the second planned fire, and the wildfire, but this time with higher numbers than the introduced species.

Research by Western Sydney University also found that soils under weed-dominated grasslands had relatively high ratios of nitrogen to carbon, and so research was done to see if the addition of carbon (and resultant lowering of nitrogen) affected the balance of native and introduced species. The outcome was that some introduced species were reduced, but others, including African Lovegrass, were unaffected.

After the wildfire, there was an extended fire-free period, and when the plots were surveyed again, it was found that, in the absence of fire, introduced species started to re-assert dominance. Interestingly, analysis of the data against rainfall found that native species presence was positively correlated with rainfall in the preceding six months, and this was a major factor determining presence of natives.

Further research undertaken by Morris and DeBarse (2013) studied the role of fire, carbon and seed addition to help support restoration efforts. This study indicated fire combined with native seed addition helped to favour native species over exotics as it decreased the abundance and species richness of weeds whilst increasing the abundance and species richness of natives.

In summary, within these Cumberland Plain grassy communities, introduced species dominance increased in the absence of fire, while a greater presence of native species was observed with fire at relatively frequent intervals, mediated by the overall influence of rainfall patterns. The addition of carbon can improve the balance between native and introduced species for some species. However, for other introduced species, and particularly African Lovegrass, fire has a short-term effect, but will not achieve any lasting reduction in dominance when used on its own.

African Lovegrass in the Cumberland Plain. Photo: Michelle Rose

Fire and restoration project aims

Fire is an important natural disturbance for native species regeneration in many Australian ecosystems, including degraded environments found in the Cumberland Plain, as the research detailed above has found. However, the scientific knowledge and management experience related to the application of fire in this context remains limited. Observations and trials indicate that fire also has the potential to assist in the management of introduced species, particularly those species which are 'ecological transformers'.

This project is supporting Cumberland Plain vegetation restoration efforts by examining integrated fire and weed management treatments to determine the most effective and resource efficient ways to both:

a) decrease abundance and diversity of exotic species, and

b) increase abundance and diversity of native species.

The research has been focusing on management protocols for three priority weed species, all of which have the capacity to be 'ecological transformers':

- **African Lovegrass (*Eragrostis curvula*)**
- **African Olive (*Olea europaea* subsp. *Africana*)**
- **Lantana (*Lantana camara*)**

African Lovegrass (*Eragrostis curvula*)

African Olive (*Olea europaea* subsp. *Africana*)

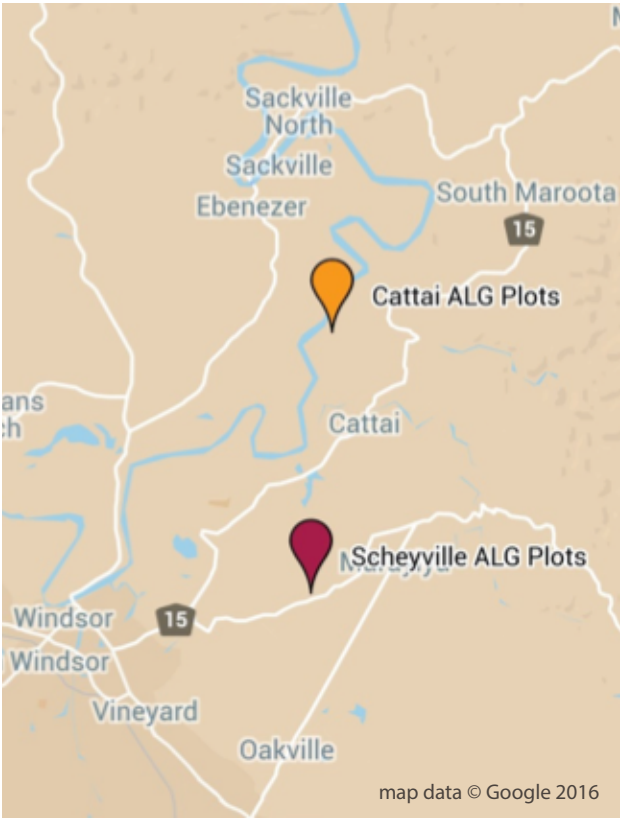
Lantana (*Lantana camara*)

The field trials are directly contributing to restoration of the area under investigation and will guide future management of weed-affected remnants of Cumberland Plain. National Parks and Wildlife Service has already made use of the results of these trials and related projects in the region to treat more than 50 hectares of land with integrated fire and herbicide treatments, and plans to use these methods in further areas targeted for restoration and hazard reduction activities.

The guide has been produced to support other land managers interested in applying these integrated methods for fire and weed management. More detailed information on the results of the trials and recommended methods are provided below.

Project location

The field trials were conducted at sites in Scheyville & Cattai National Parks which are identified as Priority Conservation Lands within the Cumberland Plain. The Parks are near Windsor, close to the Hawkesbury River in north-western Sydney. These lands are a high priority for conservation efforts because they present some of the best remaining opportunities in the region to maximise long-term biodiversity benefits.



African Lovegrass

African Lovegrass (*Eragrosits curvula*) (ALG) is an introduced perennial tussock grass. It is highly invasive and resilient, and readily forms monocultures in grassland and woodland systems, thereby acting as an ecological transformer. The impacts on native flora and fauna can be significant. It produces high nitrogen, low carbon mulch, decreasing microbes in the soil and increasing the soil nitrogen content. Swards that grow up to knee height are very dense, allowing little light to reach the soil and outcompeting any small natives that are attempting to emerge. It seeds prolifically and spreads rapidly. When ALG dominates a system wildlife suffer through habitat loss, for example, very few bird species can utilise the litter for nesting and birds cannot access the seed from seed heads.

It should be noted that, while ALG is highly invasive, observations indicate that it is most invasive in ecosystems that are already disturbed, and it is relatively slow to invade native vegetation that is in good, undisturbed condition. Long-term control of ALG therefore has much higher likelihood of success if resilient native vegetation can be established in its place.

"Lovegrass - no good for the environment, no good for farmers, and no good for fire."

Dense African lovegrass swards smother other plants

Integrated fire and herbicide trials

Lovegrass fires tend to be extremely hot, and may be difficult to control. Management protocols for ALG generally recommend avoiding fire as it readily regenerates after fire. However fire may be valuable when used as part of an integrated approach, as it provides a 'resetting' of the system which can be used as an opportunity to change the vegetation dynamics.

This project has trialled a range of treatments involving fire and herbicide to determine the most effective approach to help shift the dynamics of this system. There are a total of 48 trial plots for African Lovegrass, with 24 plots in Scheyville National Park and 24 plots in Cattai National Park, totalling approximately 6 ha.

The area at Cattai NP (Hope Farm) had been subject to past clearing and grazing, and possibly some light cultivation at some stage in the past, but was generally in a matrix of native vegetation, and with a higher presence of native species evident in the vegetation before the treatment.

The area at Scheyville NP (Pistol Range) had not only been cleared and grazed, but had been levelled and converted into playing fields by the Australian Army (from 1965-73), and has since been subjected to irregular slashing and one hazard reduction burn. As a result, these plots sit within a matrix of disturbed areas covered by introduced grasses, with relatively few native species in evidence.

Lovegrass readily regenerates after fire

The treatments applied in the trial plots include:

- **Control (no treatment)**
- **Herbicide only**
- **Fire only**
- **Herbicide + Fire**
- **Fire + Herbicide**
- **Herbicide + Fire + Herbicide**
- **Sugar application (within each plot)**

Monitoring:

The ALG trial plots are 10m x 14m and are marked by mown grass perimeters and star pickets. Initial flora surveys were conducted in October/November 2013 to establish baseline data. They were surveyed again in May 2015 and October/November 2015 following the treatments. The surveys included recording of cover abundance (using a modified Braun-Blanquet scale) of all vascular plant species within the plot and levy pole data for 14 points along two randomly selected, 7-metre transects across the plot. Photos were taken of the NW and NE corners of each plot. Sugar trials were also applied in small areas of each plot within two 2m by 2m randomly selected sections, which were surveyed for cover abundance of plant species.

Herbicide only treatment:

The initial herbicide treatment was applied in December 2013. The herbicide selected was flupropanate (e.g. 'Taskforce') as local experience in this context has shown it to be more effective than Glyphosate. Flupropanate is extremely slow acting and is recommended to be applied during an active growth stage (i.e. not during cold season when frosts may be affecting the plants). The chemical was sprayed at the standard recommended concentration of 300ml Taskforce per 100L water.

The method used for application was to spray the grass when it is just about to rain or during light rain. This washes the herbicide off the leaves into the soil as the main mode of uptake is through the roots. Applying the herbicide in light rain also reduces off-target kill of species such as *Themeda* (Kangaroo Grass) from being affected as they can only absorb the chemical through their foliage. Lovegrass seeds in the soil also appear to be affected with this method as the herbicide has a residual effect in the soil for 2-5 years depending on rainfall and soil conditions. However, the overall impact on seeds is unclear. NPWS local experience with this application method indicates that this herbicide preferentially controls Lovegrass with less impact on other species, particularly the native grasses and also other weeds.

Refer to www.apvma.gov.au for further herbicide details and current permissions/protocols.

Fire only treatment:

The fire treatment plots were burnt once only in October 2014. The original plan was to conduct the burn in autumn, but this was delayed due to wet weather and other strategic burning priorities. As Flupropanate takes months to kill the Lovegrass this delay was not expected to have a significant impact on the study results.

The burns were undertaken on a mild to warm day (temperature range in the mid-20s degrees Celsius), with humidity varying around 35-40 % and light and variable winds of up to 10-15 km/ hour.

The burns were conducted so as to achieve the highest burn intensity safely possible under the prevailing conditions. This involved two people lighting from one corner on the downwind side (if wind was present at the time), who both then moved rapidly away from each other to the next corner, and then along to the last two sides to meet at the opposite corner to the start. This lighting pattern meant that the fire drew in towards the middle and most of the plot received a similar fire intensity. The resulting fire was short but fairly intense, with the fuel consumed rapidly. The aim of this method of ignition was to replicate the hazard reduction conditions in a large grassy block that would typically be undertaken by land managers.

Herbicide + Fire treatment:

The plots receiving this treatment were treated according to the descriptions above (herbicide applied in December 2013 and fire in October 2014). A minimum of 3-6 months is recommended between herbicide and fire treatments depending on the uptake of herbicide, which is visible through its effects on the grass.

Fire + Herbicide treatment:

The plots receiving this treatment were treated with fire according to the descriptions above in October 2014 and follow-up herbicide treatment was applied in late December 2014.

Herbicide + Fire + Herbicide treatment:

As described above the plots were treated with herbicide applied in December 2013, fire in October 2014 and follow-up herbicide treatment in late December 2014. Note: hand weeding may be a possible alternate to a second application of herbicide if resources are available, initial treatments have been effective, and the area treated is very small.

Overview of observational results

These observations are broadly based on the results noted at Cattai National Park. As noted above, the Cattai plots have much more native resilience than the Scheyville plots, which are quite heavily disturbed and affected by various weeds due to previous uses including as playing fields.

Please note that this research is still in early stages and NPWS intends to conduct a further flora monitoring survey of the sites in November 2016.

Control:

The area remains dominated with African Lovegrass and is also supporting other weeds. Only low levels of natives are present, as they are crowded out by ALG.

Fire only:

There has been a large recruitment and resprouting of burnt African Lovegrass which is dominating the plot and outcompeting natives as well as other weed species. The ALG appears to be 'over-topping' the recruiting / resprouting natives.

Herbicide only:

95% of the African Lovegrass has been killed, creating a dead thatch layer over the ground that has reduced germination of all other plants. The plots have been taken over by very large amounts of other invasive weeds (especially Flea Bane), (particularly in Scheyville plots due to high initial level of disturbance). Weed abundance appears higher than the control plots but with significantly less ALG.

Herbicide + Fire:

Weed treatment has killed 90% of the ALG. After the fire there is almost no ALG recruitment and no resprouting. There is significantly less mature weed species (no Flea Bane). Grassy weeds and several natives (*Centella*, etc) are dominating the plots.

Fire + Herbicide:

Fire treatment has kick-started both native and ALG recruitment. Weed treatment appears to have killed 90% of ALG and inhibited further ALG germination. Natives have started to dominate (forbs and *Hibbertias*), though other weeds are also present (flea bane, etc).

Herbicide + Fire + Herbicide:

Herbicide treatments have completely removed ALG from the plots. These plots now appear to have more short-lived, broad-leaf species such as Fleabane and *Senecio* and there are very few native plants present (due to large amounts of other weeds, and possibly also due to herbicide treatments).

Note on sugar treatment results - All plant species within the plots show signs of inhibited growth (due to reduced soil nitrate). There is also a greater amount of bare earth evident in fire treated plots as the sugar has inhibited the spread and growth of the grasses. Species composition has also been affected on the clay soil site (Scheyville National Park) only and not on the sandy soil site (Cattai National Park). Most notably, the weed species Verbena was common outside the sugar plots, but absent within the sugar plots.

Analysis of Survey Data to Date (December 2015): Effects on African Lovegrass

In Spring 2013 the cover of African Lovegrass was high across all survey plots at both sites (Fig. 1). The cover averaged 68% at Scheyville, and 63% at Cattai (Figure 1). The cover did not differ statistically amongst the treatments plots at this stage.

In the Autumn 2015 survey, following the treatments, African Lovegrass cover remained high on the control plots, and the fire plots at both sites. Cover was at least halved in two of the treatments (herbicide + fire, and fire + herbicide) at both sites, and effectively reduced to zero in the remaining two treatments (herbicide, and herbicide + fire + herbicide; Fig. 1). African Lovegrass cover now differed significantly amongst treatments at both sites. In the Spring 2015 survey these trends largely continued. Cover of African Lovegrass continued to be high on the control plots and the fire plots, and close to zero on the herbicide, and herbicide + fire + herbicide plots (Fig. 1). Differences appeared between Cattai and Scheyville for the herbicide + fire treatment; cover of African Lovegrass remained at 40% at Scheyville, but declined to 14% at Cattai (Fig. 1). In the fire + herbicide treatment, cover of African Lovegrass ranged from 8% at Cattai to 22% at Scheyville. Differences between the treatments were statistically significant.

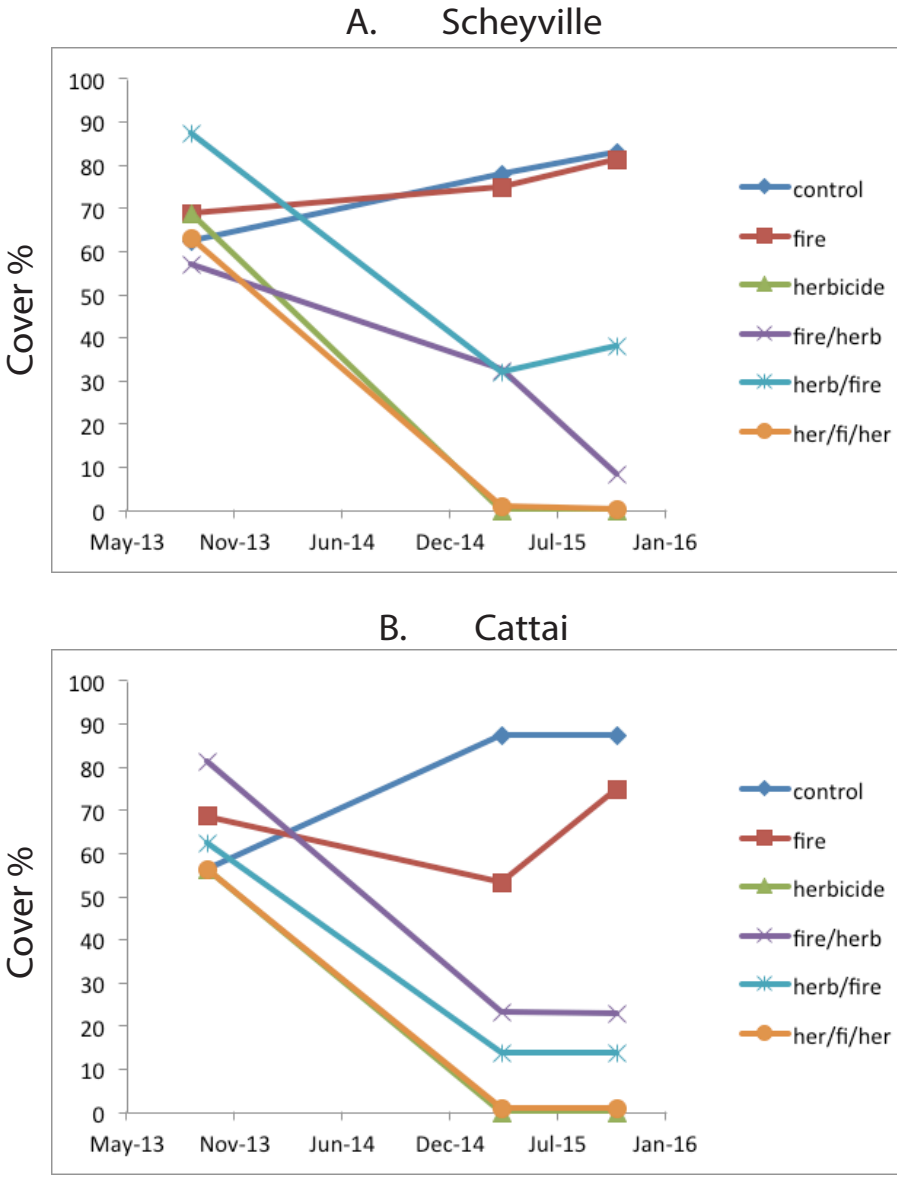


Fig. 1: Mean cover over time of African Lovegrass (*Eragrostis curvula*) in each treatment at the A. Scheyville, and B. Cattai sites.

Effects of treatments on species composition and cover

Overall, the six weed control treatments had statistically significant effects on species composition and cover at both sites. A two-way design test was undertaken to help determine the independent effect of the different treatments as well as any possible interaction of treatments. When a sub-set of treatments was tested as a two-way design with fire and herbicide application as factors, both were significant at Scheyville and at Cattai. The interaction between fire and herbicide was not significant at both sites; thus the effects of fire and herbicide combined independently to affect species composition and cover in the same way at both sites. In other words, the fire and herbicide treatments are additive in their effects, rather than interacting to affect each other.

The way in which fire and herbicide application combined to affect species composition was apparent when the similarity between the controls, and the range of treatments applied singly or in combination, was compared. Similarity in species composition between the controls, and the treatments decreased somewhat if they were either burnt, or had herbicide applied as single treatments. If both treatments were applied, in either of the herbicide + fire or fire + herbicide treatments, the similarity with the controls decreased further (Table 1). The greatest decrease in similarity with the controls occurred when the herbicide + fire + herbicide treatment was applied (Table 1).

Table 1. Percent similarity (Bray-Curtis) within the control treatment, and compared to the other five treatments, at both sites. (higher % equals greater similarity)

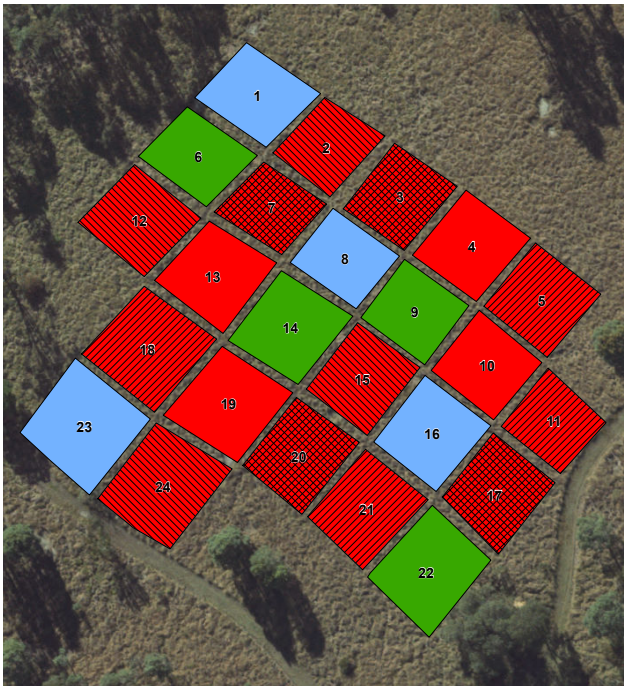
	Scheyville	Cattai
Within control	**62.4%**	**55.8%**
vs single treatments		
control vs fire	**57.8%**	**53.9%**
control vs herbicide	**57.0%**	**45.3%**
vs double treatments		
control vs herbicide + fire	**57.2%**	**47.6%**
control vs fire + herbicide	**54.0%**	**45.2%**
vs triple treatment		
control vs fire + herbicide + fire	**44.3%**	**43.9%**

The fire and the herbicide treatments were combined in three different ways in the trial, which varied the order and/or number of application(s). These three treatments were:

- **herbicide + fire**
- **fire + herbicide**
- **herbicide + fire + herbicide.**

Comparison of these three treatments for species composition and cover at the two sites showed that they were generally statistically indistinguishable from each other at a high level of probability. The exception was the herbicide + fire compared to the herbicide + fire + herbicide treatment at Scheyville; at this site, the cover of ALG in the herbicide + fire treatment remained at intermediate levels at the Spring 2015 sampling, rather than declining to lower levels as occurred in the same treatment at Cattai, and in the fire + herbicide treatment at both sites (Fig. 1).

African Lovegrass Plots December 2014 (day of spraying) Cattai National Park. Photo: J Drew



Treatments

- Control
- Fire Only
- Fire + Weed
- Weed Only
- Weed + Fire
- Weed + Fire + Weed
- NPWS Estate

Map Datum: GDA 94

Scale is 1:500 when printed in A3

Map produced by Steven Chapple

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Discussion

The initial aim of these trials was to investigate the feasibility of removing ALG from the vegetation, thereby giving other species, and especially native ground covers and grasses, a better chance of establishing and growing. The trials have demonstrated that it is feasible to control and effectively remove ALG, using a combination of fire and herbicide treatments. However, the degree to which the resultant vegetation will be an improvement depends upon the other species that are present, and their reaction to the opportunity presented by the ALG removal.

It is important to note that the two sites were specifically chosen for the predominance of African Lovegrass, and both have a significant history of disturbance, with a resultant reduction in native species presence, and an increase in presence of introduced species. As a result, the opportunity provided by the successful removal of ALG is being exploited by the species which are present. At Cattai, this is a mix of native and introduced species, while at Scheyville this is mostly introduced species.

At Scheyville, Couch (*Cynodon dactylon*) was notable for its increase in coverage over time following ALG reduction, along with a range of introduced species, which showed some variation between treatments. At Cattai, the introduced Blue

Heliotrope (*Heliotropium amplexicaule*) was a prominent beneficiary of ALG removal, but there were also benefits to resprouting natives (eg *Hibbertia*), (but with little evidence of new recruitment of these species).

Further monitoring of the herbicide only plots may help to determine if there is a later pulse of germination in these plots as the thatch layer of dead ALG decays.

The levels of past site disturbance and lack of in situ native resilience on both sites is undoubtedly limiting the post-treatment recruitment of natives. Nevertheless, it is still early days in seeing how the vegetation from these trials will develop, and ongoing monitoring will be done to see if further changes occur.

The current trials have demonstrated that it is possible to break the dominance of African Lovegrass, even in the most disturbed sites. It is very likely that the benefits from applying these treatments will be greater when they are used in more intact vegetation, with better native recruitment potential. Applying these treatments in more disturbed sites may still be very beneficial when combined with additional treatments to boost native species (e.g. native seed addition).

Of course, in the most disturbed sites, other techniques such as stripping the African Lovegrass along with the topmost soil layer may be a practical alternative treatment. The approach described here of combining fire with herbicide treatment is intended for use when there is some native species presence that may benefit from the treatment.

Cattai Plots - September 2013

Cattai Plots - November 2014

Cattai Plots - December 2015

Broad acre treatments & long term goals

These Cumberland Plain vegetation systems are highly dynamic, and responsive to range of environmental factors including rainfall and fire.

Every time a fire occurs, it removes much of standing vegetation, and resets the system for both the natives and the exotics. While fire is important to create space for the natives, it is important to understand that it also stimulates weeds.

As a consequence, it needs to be understood that every fire in these systems is both an opportunity to rejuvenate native species, but also very likely to be a window for introduced weed species to invade and multiply. Every time a burn is implemented in one of these disturbed systems, a weed management program is required as well. Such a program may take advantage of the opportunity to do pre-burn herbicide treatment, but should as a minimum include a post-burn weed control program.

It should also be noted that the overall results from all the research discussed in this booklet strongly indicate that fire is an essential component of ecological management of Cumberland Plain Woodland, and this is also likely to be the case for other Cumberland Plain vegetation communities. Where fire is absolutely impossible, there may be some similar benefits from slashing, as this removes the thick grass sward, but any benefits from heat and smoke effects will be absent.

Cattai National Park burn

African Lovegrass was treated with Flupropanate

Whilst the results from these trials have been emerging, the most promising integrated treatments were applied to several broad area burns. In 2013 herbicide was applied to a hazard reduction burn and an area of wildfire (post-fire), covering 6 hectares. A total of more than 50 hectares of land have been treated with this integrated approach and will be observed over the coming months and years to determine the long-term effects and the best ongoing management protocols.

NPWS is aiming to burn most of the Woodlands in Scheyville National Park at least once and where possible to burn those areas again within ten years of the first burn. Some areas will be set aside as a reference site and other sections may have a third burn applied.

The results of this work are being actively disseminated to other land managers through a series of workshops and the distribution of this booklet.

Integrating fire into Cumberland Plain weed management is a very promising approach, supporting a shift from a highly degraded system back towards a resilient system that will resist weed invasion. As weeds are minimised through this approachit is expected that management will become much easier and require less resources.

Fire and Weeds workshop in Cattai, November 2014

An example of a restoration area

The following websites and links have further information that may be of assistance:

NSW Office of Environment and Heritage
http://environment.nsw.gov.au/

NSW National Parks & Wildlife Service
http://nationalparks.nsw.gov.au

Nature Conservation Council of NSW Bushfire Program
http://nature.org.au/healthy-ecosystems/bushfire-program

NSW Rural Fire Service
http://rfs.nsw.gov.au

Hotspots Fire Project
http://hotspotsfireproject.org.au

Australian Pesticides and Veterinary Medicines Authority
http://apvma.gov.au

For further information on the project please contact:

The Nature Conservation Council of NSW Bushfire Program
(02) 9516 0359 or (02) 9516 1488

bushfire@nature.org.au

Cumberland Area Office of the National Parks and Wildlife Service
(02) 4572 3100

npws.cumberland@environment.nsw.gov.au

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www.nature.org.au