Case Study 1 – Improving biodiversity and regional economies – woody weed control in Qld's Lake Eyre Basin

Desert Channels Queensland Inc

Key Points

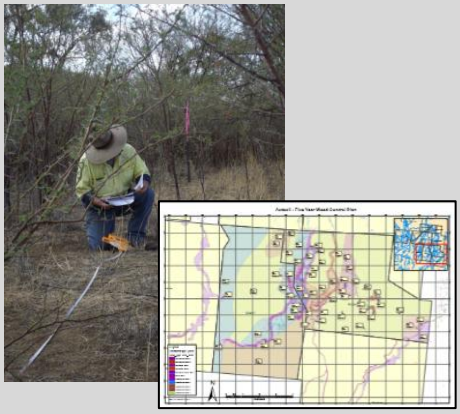
- Findings from a trial of large-scale woody weed control using emerging technology showed exceptionally high efficacy and effectiveness in target areas
- Only the combination of traditional and emerging weed control techniques offers the best-integrated and cost effective solution for property scale weed control
- Integrated control techniques provide confidence to regulatory bodies to develop supporting regulatory tools
- Pasture production from treated areas can increase 10 fold with rapid recovery of condition when combined with appropriate management
- Landscape scale change management can be achieved when integrated solutions are matched to outcome based regulatory tools and landholders will invest to support this combination.

Background

Areas with broad scale infestations of prickly acacia, a weed of national significance, have poor production values due to the shading and competition effect from this tree. These areas also pose challenges to stock mustering and general property management and the federal government estimates that weed control on properties with high densities of this weed exceed $100,000 per annum. The plant is now estimated to be present on 23 million hectares of the Mitchel Grass Bioregion, home to 25 rare and threatened species. When Prickly Acacia densities are high, especially associated with watercourses, grass production is minimal. Work by Gutteridge and Shelton in 2005 showed that at a stem density of just 650 plants per hectare perennial grass production was reduced by 50% and it is estimated that 28% of the area affected by this plant is at this density.

DCQ's progress in improving woody weed control efficiency for Prickly Acacia

Stage 1 – Data collection and mapping of prickly acacia densitiess to provide baseline information



Stage 2 –Development and integration of innovativel techniques to improve effectivness and efficiency

Stage 3 – Measuring treatment efficacy, land condition improvements and increases in economic viability

In watercourse areas, which also have the highest biodiversity values in the bioregion, Prickly Acacia stem densities are often well over 1000 stems / hectare and consequently these areas have no groundcover, very little biodiversity, are prone to erosion and harbour pest animals. Successive national strategies have prioritised the control of this weed in watercourses however traditional techniques are labour intensive and prohibitively expensive. Germination of residual seed stores following traditional treatment, often called mass germination events, make the problem worse and disillusion landholders leading to declines in participation in weed control.

In 2013 the community based natural resource management group - Desert Channels Queensland, which had funded weed control for 10 years with highly variable success determined that an aspirational target of eradication of the weed from the Lake Eyre Basin was required to clearly focus community, industry and Government attention. This was also articulated to begin the process of re-dressing declining participation rates amongst landholders controlling this weed. A program was developed with the aim of establishing a regulatory framework that balanced weed control with environmental outcomes, developed integrated techniques that reduced cost while increasing efficacy, increased production values on treated areas and reduced management costs in excess of the treatment costs. PBE Services (PBES), a company based on Longreach in Western Queensland was asked to develop the program, provide initial project management, lead the development of the regulatory tools to deliver the project, and manage the introduction of innovative solutions.

Innovation

The program introduced:

- Regional scale foliar mapping to identify extent and priority of infestations
- Innovative mapping techniques to determine property scale weed density
- Regulatory tools to allow control in watercourse areas
- New ground and aerial control techniques to support traditional techniques
- Monitoring and evaluation of effectiveness and efficacy

Foliar mapping, based on computer analysis of Landsat imagery demonstrated the true extent of the weed and the strong correlation between weed expansion and watercourses allowing regional prioritisation zones to be quickly determined

New recoding tools were introduced which allowed detailed property scale mapping and associated prioritisation to be quickly developed

Regulatory tools built on the foundation of property scale weed plans and with the aim of protecting mature native vegetation and providing the conditions for recovery were approved. Rather than prescriptive these tools are outcome based. Not only does this future proof the legislation, it allows sequential incorporation of innovation. To date it is estimated that this shift in regulatory thinking increased efficiency by 3 times but reduced costs by 10 times. A major gain for the delivery of the project. The program utilised the widespread use of the chemical Tebuthiuron, a nonselective broad-spectrum herbicide that is absorbed by the roots and transported to the leaves, where it inhibits photosynthesis. The chemical has a long half life (360 days) meaning that it offers residual control of germinating seedlings. Its lack of selectivity meant that application accuracy was a priority as was the development of control techniques to protect native plants. The greater use of Tebuthiuron has reduced overall chemical costs by 10 fold.

The program has pioneered the introduction of innovative ground equipment and the use of agricultural unmanned aerial vehicles for the application of chemical to high weed density sites and sites with significant work place health and safety issues. When integrated with traditional techniques, costs for weed control have been reduced significantly. Site-specific application of chemical based on weed density, rather than the broad scale application of chemical, such as by aerial application, has reduced chemical usage by 40% helping to protect the wider environment.

The program has established 27 bio-condition monitoring sites and established the Auteuil Monitoring site. The Yamaha Rmax, the UAV chosen to support the project, treated the Auteuil monitoring site. This site also served to test the efficacy of chemical application from the UAV, land condition recovery and the recovery rate of the weed. It also provided much of the data required for the development of economic models to determine costs and benefits.

Project Outcomes

The three-year program has delivered the following;

Output Monitored	**M&E Target**	**Completed under project**
Improved stream bank riparian vegetation	200 km	217 km
Terrestrial native vegetation with reduced weed threat	1,250,000 ha	1,138,000 ha
Integrated weed control measures implemented	450,000 ha	468,593 ha
Weed control plans developed with land managers	24 plans	34 plans

In achieving these milestones it is estimated that over 50 million mature weed trees have been killed reducing seed production by 4 million tons per year. Landholders, aided by the chemical application training undertaken as part of the program have rapidly expanded on the control work undertaken as part of the project.

Extraordinary people supported by a re-energized community delivered this achievement. The level of engagement in the community is evident by the necessity for landholder to pay 50% of chemical costs, rather than the traditional valuation of in-kind support. The average investment by landholders has been over $20,000 with some investing as high as $60,000. Not only does this investment greatly add to the total funds available for the project, it ensure that landholders have skin in the game, but that they value and protect the investment made.

There is now growing community support for more effective strategies for the management of stock moved from infested to further reduce weed spread and protect investment to date. This is a major shift in community attitude.

Auteuil Treatment area outcomes

The property Auteuil, south of Aramac in western Queensland has had serious infestations of prickly acacia since the 1970's. As part of this program, large areas on the property have been extensively controlled. A trial was established in 2014 to determine how pasture production could be rapidly reintroduced in heavily degraded treated areas and the management techniques most applicable. Healthy pasture production for the area is normally 2500 kg / hectare and a groundcover of about 70%. Two sites were established, one that was fenced off, and the other unfenced. The fenced site replicates the ability to do wet season spelling, which removes any grazing that occurs in the area and is the technique recommended by the Queensland Government to aid in recovery of these degraded sites. Figure 1 and figure 2 show the changes in grass production over the measured timeframe and the changes in groundcover. Table 1 indicates the efficacy of the weed control by the unmanned aerial vehicle that treated the site.

Since data recording began in late 2014, both ground cover and biomass has increased in both the fenced, and unfenced areas. It is however much more significant in the fenced off site. The fenced off area is currently at approximately 1500 kg/ha of biomass or 40% ground cover. This is compared with 500 kg/ha of biomass or 10% ground cover for the unfenced site. The changes in biomass or ground cover over time are shown below in figures 1 and 2.

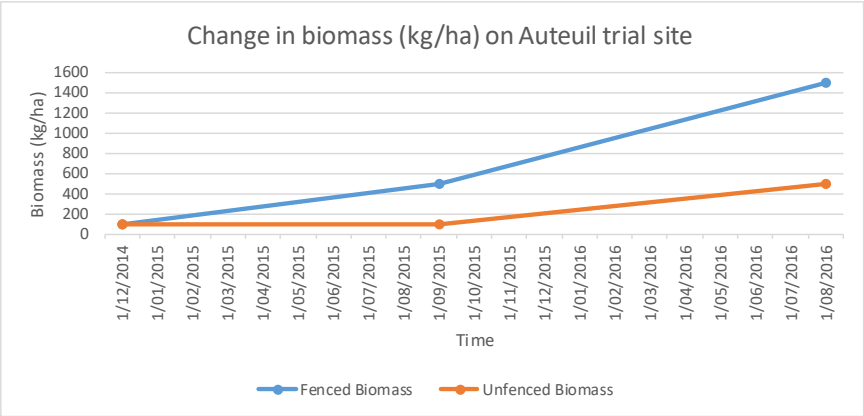


Figure 1

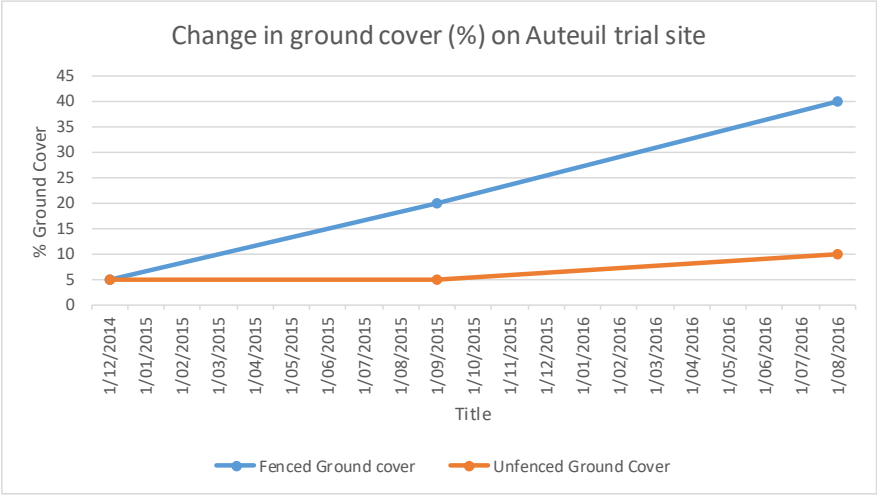


Figure 2

Initial pasture recovery modelling undertaken in 2015 suggested a much longer duration for pasture recovery however the data from the trial area suggests that, with the correct management, rapid recovery of production is possible. With application of the recommended pasture management grass production has increased from less than 200kg/ha, which represents a stocking rate of 1 steer to 30 ha to 1500kg/ha, representing a new stocking rate of 1 steer to 10 hectares per animal. Such a change in stocking rate has a dramatic impact on economic return.

Although less dramatic, the unfenced area has gone from requiring 30 hectares per animal, to about 1 animal for every 18 hectares.

Table 1 – Efficacy of UAV treatment

Tebuthiuron treatment December 2013 - Fenced December 2014	**Tebuthiuron treatment December 2013 – Fenced December 2014 – re-measurement August 2016**
Initial Prickly Acacia Density – 2500 stems / ha	Initial Prickly Acacia Density – 2500 stems / ha
Prickly Acacia kill rate – 99.96%	Prickly Acacia Kill rate – 99.96%
Germination rate of Prickly Acacia – 2 PA / ha	Germination rate of Prickly Acacia – 4 PA / ha
Bio Mass – 50kg /ha	Bio Mass – 1500 kg / ha
Ground Cover – 5%	Ground Cover – 40%
Biodiversity – 1 grass sp	Biodiversity – 6 grass sp, 6 Forbes
erosion observed in channel	Siltation observed in channel

The application of chemicals from the UAV has been a series of firsts. PBES was the first company to be licenced by the Civil Aviation Safety Authority to undertake Agricultural Operations, it was the first time a UAV was used to control this weed type, the first in such remote areas and the first at heights required to apply chemicals to a tree in such a high hazard environment. Flight patterning specific to the control of this weed was developed and now is fundamental to efficacy.

Integration of Unmanned Aerial Vehicles

The aim of the integration of the control techniques was to eliminate high-density areas, beyond the capability of the landholder, and to establish a control buffer around this work to protect investment. This then allows the landholder to sequentially expand on this control over an agreed period.

Traditional weed control, centred largely on hand application of chemicals is time consuming, costly and has limited long term effect. The logical conclusion of the work by Gutteridge and Shelton in 2005, suggesting a half life of only 10-12 months for Prickly Acacia seeds, was that if effective control could be achieved at a site for three years, seed germination rates would be well within the capability of the landholder, leading not just to control but eradication. The requirement by Government as a condition for approval of the Area Management Plan for no soil erosion or disturbance to bed and banks of watercourses excluded mechanical options and centred thinking on chemical control. The use of Tebuthiuron, with its residual control of over three years was the logical chemical of choice however it was prohibited from use within 100 m of watercourses and within 30 m of native trees. Regulatory approval for the use of the chemical was granted in 2014 after PBES demonstrated UAV flight data from a range of weather conditions and a consistent drop accuracy of +/- 1 m. This remains the only permit of its kind in Australia and would not have been possible without the accuracy of the UAV.

Folia mapping, supported by on ground mapping showed that high-density weed areas were associated with watercourses but that these sites also often contained elevated safety risks. Lighter density buffer areas and then paddocks of low density surround these high-density areas. Economic analysis of control options found that UAV application of chemical was cost effective at densities higher than 800 st / ha and that hand application from ATV's was the most efficient techniques at densities below this. The application rate for the UAV is 1 ha every 8 minutes and application of Tebuthiuron making it most efficient in high density areas and application of Tebuthiuron from an ATV represented an 8 fold efficiency gain over traditional basal bark or foliar spraying.

Weeds close to mature native trees, where Tebuthiuron cannot be used can now be controlled with vehicle-mounted misters reducing the cost of treatment of these sites by 10 fold however significant work remains to increase efficacy.

When added with ATV mounted spreaders for long linear feature such as roads, bore drains and fence-lines these tools working collectively radically reduce costs and increase efficiency.

Economic Value

The trials indicate how quickly land can move from low land condition (class d), into condition type B when management follows the principles of wet season spelling. Full exclusion, and therefore the ultimate regeneration technique can result in the area back to condition B within 2 years. Such a restoration significantly improves carrying capacity and the production value of the property.

Using data from Stocktake manuals, improving the pasture condition from D to B will improve the production value by a factor of 10. This will greatly improve the financial viabilty for the landholder, as well as ensure that the property is sustainable into the long term. In addition to having good pasture for stock, good ground cover will also assist in supporting native species and improving water quality.

The impact regionally when the weed affects 23 million hectares is substantial. The 2011 National Strategy suggested that a property with high densities of Prickly Acacia was spending $100,000 per year on weed control. The 2005 work by Gutteridge and Sheldon suggested that 28%, or 15.4 million hectares of the Mitchell Grass Bioregion had densities of Prickly Acacia of medium and above, the range where perennial grass production is halved. These figures suggest a direct regional cost of over $49,000,000 per year on control activities alone and a reduction in regional stocking equivalent to 100,000 head of cattle. The annual impact on the regional economy therefore exceeds $100,000,000.

Innovating Equipment Introduced.

Rmax IIG UAV – introduced 2013

ATV Mounted Spreader – introduced 2013

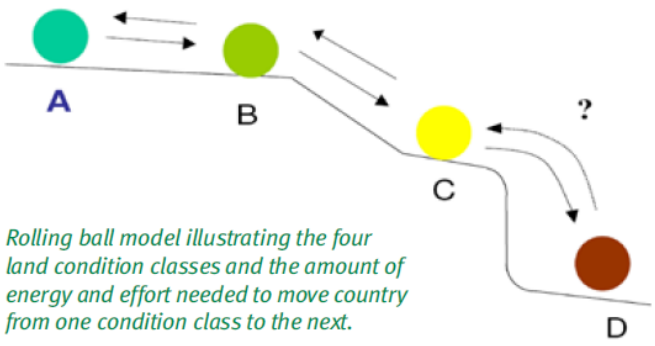
Trailer Mounted Mister – Introduced 2016

The next wave of Innovation perhaps?

Options for landholders

The trial indicates that to rapidly restore pasture, effective weed control is essential but must be followed by structured decisions about management of the treated area.

The trial areas also showed that unstructured decision making and continued grazing can still lead to an increase in land condition however full recovery is significantly delayed.



Rolling ball model illustrating the four land condition classes and the amount of energy and effort needed to move country from one condition class to the next.

A compromise between the two trail areas is;

1. Using existing paddock infrastructure and implementing only wet season spelling. This will lead to results in between the 2 trial sites.
2. For degraded areas treated for woody weeds, erecting temporary fencing just for those areas to exclude stock. This can result in reduced area being totally excluded, but comes with greater temporary costs.

Options for the Region

The project demonstrated the value of integrated weed control techniques, supported by outcome based legislative instruments and effective pasture management. The potential regional economic gains of eradication, a minimum of doubling of stocking rates from degraded areas, are well worth pursuing.

The introduction of innovative equipment can be quickly achieved when clearly focused on project aims and outcomes. The value of the innovation is not just in cost efficiency gains however; it can also be in the increased confidence of regulatory authorities. The change management process associated with introduction of innovation should not just be focused internally, it must include external parties be they community or regulatory authorities. This will maximise the value to the innovation beyond simple onground deliverables.

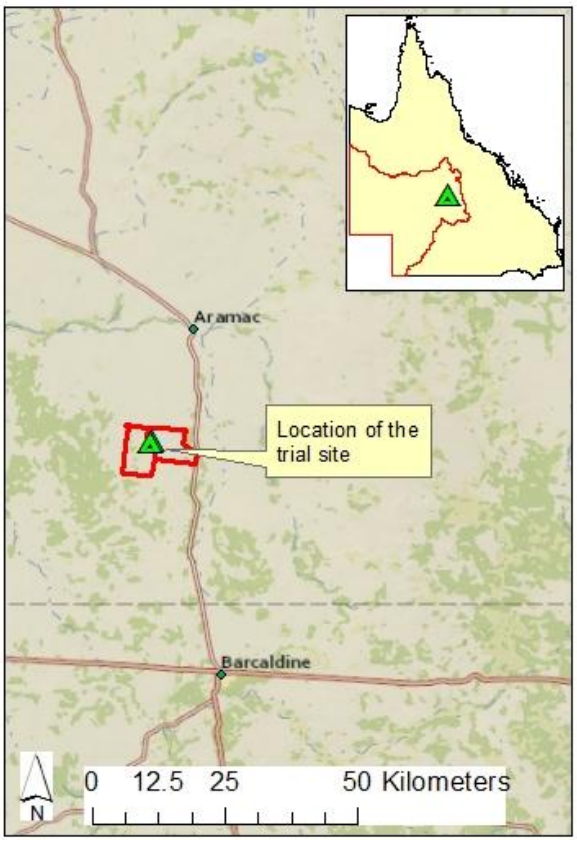
Project management associated with adoption of innovative techniques must be agile and highly responsive. The expectation of change throughout the introduction must be planned for and expected.

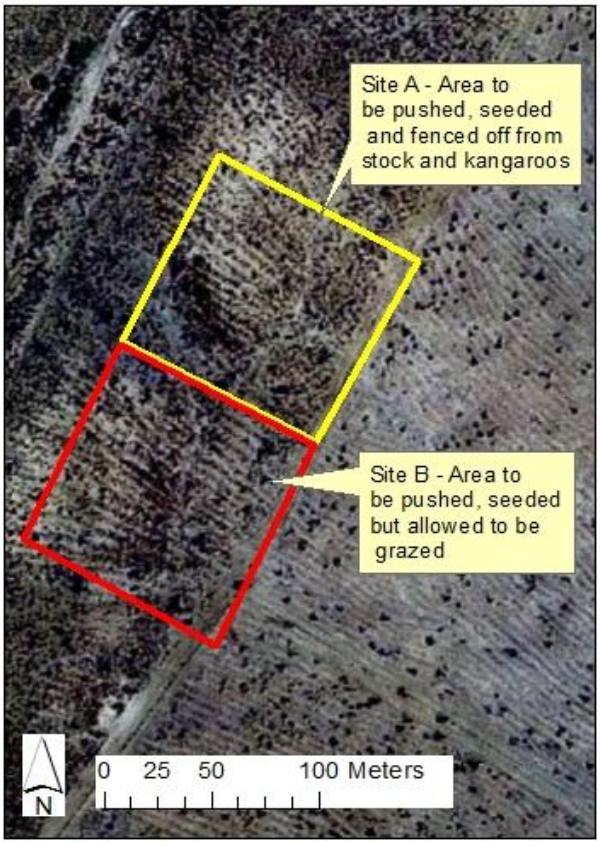
Many of the innovations have been developed as solutions to onground issues encountered. This highlights the need for collaborative multi-disciplinary teams but where the focus is based on finding solutions to quantifiable issues. The introduction of a range of data collection tools throughout the project has, in this project, been the foundation to continued innovation.

These gains will however be negligible if not placed into a strategic framework. As part of this project DCQ has proposed a pathway to eradication. They have developed:

1. A strategic plan with prioritised zones
2. Best Management Practices for landholders, Local Authorities and NRM groups
3. Developed scalable work practices with on farm training modules for landholders and contractors
4. Developed a community based governance model
5. Prioritised resolution of knowledge gaps
6. Developed procedures to integrate new innovations; and
7. Socialised the eradication of the weed by placing linked groups of landholders as the key proponents for delivery.

Appendix 1 - Area subject to the trial





Integrated weed control – Prickly Acacia Trees controlled, native tree protected and thriving and grass recovery

Factsheet

PA and PACTs (DCQ facts)

Prickly Acacia

- declared Class 2 pest plant in Queensland
- Weed of National Significance
- one of the worst weeds in Australia
- landholders sometimes welcome it in low densities
- provides shade and some livestock nutrition
- immature seedpods very palatable and high in protein
- under good conditions, 170,000+ seeds per tree per year
- approximately 40% still viable after passing through cattle
- chokes out more grass than the feed value it provides
- eventually replaces all grass cover
- mass germinations with early rain and no competing grass
- average wet season sees most seedlings survive
- exploded in good seasons bracketing 2010
- requires increasing investment by landholders
- control needs significant and strategic action
- unchecked, could dominate 95% of Mitchell Grass Downs by 2030
- primary spread agent now is cattle
- rated by landholders as the number one issue

The Cost of Doing Nothing

Independent case study analysis undertaken by Bush Agribusiness showed treatment costs of $100,000 when Prickly Acacia is at low density but, when left untreated for six years, costs increase to $420,000.

What DCQ is doing

- sponsoring new regulatory tools
- harnessing science and technology
- identifying priority areas through satellite image analysis
- developing, trialling and introducing new techniques
- improving efficiency
- reducing costs
- meeting production and environmental expectations
- targeting weed outliers to stop spread
- eradicating core infestations
- informing stock owners of the need for weed hygiene
- developed the DCQ PACT: a group approach to control
- developed the supporting DCQ Weed Plan

What is a PACT?

- Prickly Acacia Control Team
- collaborative approach to Prickly Acacia control
- approaches control at a landscape level
- DCQ Weed Plan at its core
- the key aims are to:
    - clean watercourses, bore drains and dams
    - clean paddocks
    - keep their properties clean
    - recover grass
    - sustainable and economically viable stocking rates
    - stop weeds to and from neighbours
    - sets out respective obligations
- DCQ support dependent on landholders meeting their obligations

How does it work?

- satellite imagery used to identify priority areas
- prioritisation based on rate of spread and strategic location
- landholders in priority areas encouraged to form PACT groups
- group agrees on priority actions and techniques to be used
- planning is simple and accurate with satellite imagery
- DCQ provides support to PACT group for 5 years max
    - subsidised chemicals in years 1 and 3
    - labour as required in years 1 and 3
    - technical support as required
- DCQ support dependent on landholders meeting their obligations

Spray or pellets? (pros and cons)

Spraying by hand	**Applying pellets by hand**
● most common technique ● basal bark with diesel and chemical ● very effective - results within 2 weeks ● slow and dirty ● health and safety issues ● 1 litre per tree ● $2.20 per litre of mix (2014) ● re-treat for seedlings every year	● not widely used previously ● heavily used by DCQ for 2 years ● slow results – rain activated ● 50% faster than spraying ● quick, easy and safe to handle ● 7 grams per metre of tree height ● average tree height 2 metres ● average $0.18 per tree ● up to 3 years of seedling control