MONITORING THE EFFECTIVENESS OF ACACIA PATACZEKII (WALLYS WATTLE) MANAGEMENT FOLLOWING PARTIAL HARVESTING IN NORTHEASTERN TASMANIA

Anne Chuter1, Amelia J. Koch1,2, Fred Duncan1,3

1Forest Practices Authority, 30 Patrick Street, Hobart, Tasmania, anne.chuter@fpa.tas.gov.au, amy.koch@fpa.tas.gov.au; 2University of Tasmania, School of Biological Sciences, Private Bag 55, Hobart, Tasmania 7001; 3386 Richmond Road, Cambridge, Tasmania 7170, fredericotas@gmail.com

ABSTRACT

In areas subject to forestry activities in Tasmania, threatened flora species are taken into consideration through the Forest Practices Code and the development of site-specific management prescriptions if required. In 2005 a threatened species, Acacia pataczekii (wallys wattle), was found during planning of a proposed logging coupe in northeastern Tasmania. A management approach was developed to minimise the long-term risk to the population of Acacia pataczekii within the coupe by maintaining a portion of the large Acacia pataczekii trees on site and monitoring the implementation and effectiveness of the management prescriptions. Ten plots with ten adult (mature) plants each were assessed before logging, immediately after logging and again eight years after logging. Regeneration surveys were undertaken eight years after logging. This study found some damage to the unmarked study plots after logging, but the majority of plots remained intact. High levels of regeneration were found eight years after logging, particularly in plots that did not contain adult plants. This study concluded that the management approach had been implemented correctly and was effective in maintaining this species within the harvested area.

INTRODUCTION

Acacia pataczekii (wallys wattle) is a small tree found mostly in northeastern Tasmania where it occurs in dry sclerophyll forest. It is endemic to Tasmania and listed as a rare (Schedule 5) species on the Tasmanian Threatened Species Protection Act 1995. Only a limited amount of research has been undertaken on Acacia pataczekii but the research available to date suggests this species may be tolerant of, and even be benefitted by, disturbance such as forest harvesting. The species generally recruits from seed in even-aged stands following fire and other gap-forming disturbances (Lynch 1993; TSS 2008). However, this species also has the ability to regenerate vegetatively from rhizomes at sites that are naturally open or subject to disturbance that creates light gaps (Lynch 1993; Duncan & Roberts 2008). In forest patches with a dense scrub canopy and lacking light gaps Acacia pataczekii plants flower less and produce neither fruit nor vegetative regeneration (Lynch 1993).

As a threatened species, Acacia pataczekii is taken into consideration during the planning of forestry activities as required under the Forest Practices Code (FPB 2000) and in accordance with a set of procedures agreed between the Forest Practices Authority and the Department of Primary Industries, Parks, Water & Environment (FPA & DPIPWE 2014). In 2005, Forestry Tasmania began planning the partial harvesting of a coupe within the Roses Tier area in northeastern Tasmania.
During the planning process large ‘old-growth’ trees of *Acacia pataczekii* were found occurring in locally dense populations in *Eucalyptus delegatensis* (gumtopped stringybark) forest within the coupe. ‘Old-growth’ trees of *Acacia pataczekii* are taller (to nine metres height) and have a greater girth (to 20 cm diameter at breast height) than individuals typically found at other sites in northeastern Tasmania. In addition, ‘old-growth’ trees of *Acacia pataczekii* carry a diverse cargo of lichens on their trunks and branches.

Forestry Tasmania sought management advice from the Forest Practices Authority (FPA) and the Threatened Species Section of the Department of Primary Industries, Parks, Water & Environment (DPIPWE). Based on the results of the work by Lynch (1993) and expert knowledge within the FPA and DPIPWE, it was decided that partial harvesting (shelterwood retention) of the coupe could proceed as long as a management approach was implemented to assist with the maintenance of *Acacia pataczekii* on site over the long-term. The management approach included constraints to reduce the damage to patches containing dense stands of ‘old-growth’ *Acacia pataczekii* plants. The success of the management approach has been monitored by FPA, DPIPWE and Forestry Tasmania. This paper presents the results of the monitoring and assesses how effective the management was for maintaining the species. We also discuss future management of *Acacia pataczekii* in areas subject to forestry activities.

**METHODS**

**Study site**

The study site was located in the Roses Tier area in northeastern Tasmania in the coupe TY042N (Figure 1). The 42 ha coupe is dominated by *Eucalyptus delegatensis* with *Acacia pataczekii* occurring in dense patches in the shrub layer across the coupe (Duncan & Roberts 2008).

![Figure 1. Location of forestry coupe TY042N](image)

**Management approach**

The aim of the management approach for *Acacia pataczekii* was to minimise the damage to dense patches or individual ‘old-growth’ plants. To achieve this aim, management prescriptions were incorporated into the Forest Practices Plan for TY042N. These management prescriptions included the following actions:

- locating landings and snig tracks to avoid or minimise disturbance to dense patches and individual plants of *Acacia pataczekii* greater than 5 m in height;
- locating wildlife habitat clumps and other retained areas over dense patches and individual plants of *Acacia pataczekii* greater than 5 m in height;
- using directional falling in operational areas to avoid or reduce disturbance to...
dense patches and individual plants of *Acacia pataczekii* greater than 5 m in height; and

- applying a top disposal burning (preferably) and/or mechanical heaping of slash (rather than a high intensity regeneration burn) to create a seed bed for eucalypt regeneration.

**Survey methods**

Prior to logging, ten monitoring plots (WW plots) were established within the area of the coupe known to contain large (greater than 5 m tall) individuals of *Acacia pataczekii*. Within each WW plot, ten large *Acacia pataczekii* trees were tagged in an inconspicuous manner, so that the harvesting contractor would not be biased towards retaining tagged trees when harvesting the coupe. Each tagged tree had the following attributes recorded:

- height (cm);
- damage – *minor* (twig or minor branch snapped), *moderate* (major branch damage but some crown remains), *severe* (flattened, uprooted or crown missing); and
- health – *poor* (less than one third of canopy alive), *moderate* (between one third and two thirds canopy alive), *good* (greater than two thirds canopy alive). Some adjustment of health score was made on a few trees for the condition of their canopy.

The coupe was logged in the winter and spring of 2007 under a shelterwood retention silvicultural prescription. Shelterwood retention involves the retention of evenly-spaced shelterwood trees (trees with good crowns) at an average basal area of 9-12 m²/ha on dry sites (Wilkinson 1994).

![Figure 2. Plot sites within TY042N (all plots were located within the mapped extent of *Acacia pataczekii* occurrence within TY042N)](image-url)
The WW plots were re-surveyed after logging in 2007 and again in 2015. During these post-logging surveys the attributes of each tree were re-scored, with two additional categories added to the health score: lost (tree not found, presumed dead) and dead (tree found and confirmed dead). All trees that scored a dead or lost health rating after logging in 2007 were given a damage rating of severe.

In 2015 additional data was collected on the recruitment of *Acacia pataczekii* across the coupe. Circular plots of 5 m radius were established in the centre of each of the ten WW plots, in ten plots in the logged area (harvest plots) and ten plots on snig tracks (snig track plots). Harvest plots and snig track plots were randomly located across the coupe (Figure 2). Table 1 lists the attributes recorded in each plot.

### Table 1. The variables assessed in the 30 recruitment plots

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground cover</td>
<td>% bare ground and % bracken cover</td>
</tr>
<tr>
<td>Impact of logging</td>
<td>Estimate of % of plot impacted by logging in 2007</td>
</tr>
<tr>
<td>Live adults</td>
<td>Count of live adult (mature) <em>Acacia pataczekii</em></td>
</tr>
<tr>
<td>Live recruits</td>
<td>Count of live seedlings (established post-2007) <em>Acacia pataczekii</em></td>
</tr>
<tr>
<td>Distance to adult</td>
<td>Distance (m) to nearest live adult (mature) <em>Acacia pataczekii</em></td>
</tr>
</tbody>
</table>

### Data analysis

The initial impact of logging on the health and survival of adult *Acacia pataczekii* was assessed by an examination of the raw data.

To determine if the number of *Acacia pataczekii* recruits was related to the attributes of the plot (Table 2) we used generalised linear models with a quasipoisson distribution. We used Spearman’s rank correlation to test for independence between variables and found the impact of logging was positively correlated with distance to adult and number of live adults; % bracken cover was correlated with % bare ground; and distance to adult was correlated with the number of live adults. We therefore created a variable ‘PresAdult’, which indicates if adults were found within the plot or not, and excluded ‘LiveAdult’, and ‘% ground’ from further analyses and did not fit impact of logging in the same model as distance to adult. Interactions were considered between the type of plot being examined (WW plot, harvest or snig track) and the degree of impact by logging and the amount of bracken. A full model was fitted and stepwise model reduction was undertaken using ANOVA to assess for significant differences between models. Residual plots were examined to test model assumptions. Analysis was undertaken in the program R (R Development Core Team 2010).

### Table 2. Results of the final quasipoisson GLM between the number of recruitment trees and the attributes of the plot

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>Std Error</th>
<th>T value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.49</td>
<td>0.42</td>
<td>3.55</td>
<td>0.001</td>
</tr>
<tr>
<td>Adult presence</td>
<td>0.98</td>
<td>0.47</td>
<td>2.10</td>
<td>0.046</td>
</tr>
</tbody>
</table>
RESULTS

Survival and health of *Acacia pataczekii*

Of the 100 trees initially assessed and tagged, 78 were re-located after logging. Of these 78 re-located trees, 93.6% (73) were alive immediately after logging. If the 22 lost *Acacia pataczekii* trees are presumed dead then the survival rate of the 100 tagged trees drops to 73%. The number of trees assessed as having poor, moderate and good health prior to logging all decreased immediately after logging due to the loss and death of a number of trees (Figure 3). The amount of damage to the adult trees from the logging operation varied between plots. Some plots (e.g. WW Plot 3) had a high level of damage with 6 out of 10 trees scoring a damage rating of severe due to a large amount of logging slash (coarse and fine logging debris). Construction and use of snig tracks also contributed to the damage to some WW plots, with most trees in WW Plot 7 being severely damaged or lost due to construction and use of a primary snig track junction.

By 2015 59% of the original 100 trees were still alive, with 30 out of the 41 dead trees being recorded as lost and therefore presumed to be dead (Figure 3). The number of trees assessed as being in moderate or good health in 2015 increased marginally compared to the 2007 post-logging survey, but nine of the trees that were in poor health in 2007 were either lost or dead by 2015 (Figure 3). However, not all *Acacia pataczekii* trees with severe damage after logging in 2007 were recorded as dead or lost in 2015.

Plates 1 & 2 show a typical patch of adult *Acacia pataczekii* trees retained through implementation of the management prescription immediately after logging in 2007 and then again in 2015.

Recruitment of *Acacia pataczekii*

The number of recruits recorded across the WW, harvest and snig track plots was highly variable and ranged from none to 37 with an average of 7.7 recruits per WW plot, 8.7 recruits per snig track plot and 9 recruits per harvest plot (Figure 4). WW plots (except one at a snig track junction) had between 0 and 50% of the plot impacted by logging (average 34%), while all harvest and snig track plots (except one) had >80% of the plot impacted by logging (average of 87% and 96% respectively) (Figure 5). There was one outlier in the harvest plots, which appeared to be an old snig track from a previous logging operation. This plot had a relatively low level of impact (c. 20%) from the current logging when compared to the rest of the harvest plots, and a moderate number of recruits (Figure 5).

The results of the modelling found that the number of recruits was only significantly related to the presence of adults in the plots, with fewer recruits found if there were adults present (Table 2, Figure 6).

DISCUSSION

Implementation and effectiveness of management actions

The results of this study indicate that the management prescriptions to maintain adult *Acacia pataczekii* were implemented reasonably well and effective at maintaining the species on site into the future.

However, despite a high degree of skill shown in directional falling there was some loss of adult trees, with 27% of study trees lost during operations. The majority of the dead and lost trees after logging came from two plots (WW Plots 3 & 7), which were directly damaged by logging slash and snig track construction. For the operation in TY042N, considering the plots were not
Figure 3. Health score of tagged Acacia pataczekii trees from the three sample periods

Figure 4. Number of adults and recruits recorded in each plot
Figure 5. Raw data showing the relationship between the plot type, logging impact and the number of recruits (the outlier is the isolated point in the bottom left corner of ‘harvest’ and was noted to be an old snig track).

Figure 6. The number of juvenile *Acacia pucezehii* recorded in each recruitment plot in relation to the presence of adults in the plot.
Plate 1. FPA and FT staff examining a patch of retained adult *Acacia pataczekii* immediately after logging in 2007.

Plate 2. FPA staff member examining a patch of retained adult *Acacia pataczekii* in 2015.
marked and *Acacia pataczekii* was a dominant component of the understorey. The level of loss is considered to be acceptable. However, for future operations, delineation of the ‘old-growth’ *Acacia pataczekii* patches with flagging tape would assist the logging contractors to identify the patches and reduce direct damage from snig tracks and landings.

The survival rate dropped in 2015 to 59% through an addition of six dead and eight lost trees. It is difficult to determine if the continued drop in survival was due to the logging operation, natural attrition or survey effort, but as the majority of the dead or missing trees were initially assessed as being in poor health (Figure 3) it is expected that at least some of the mortality is due to natural attrition and so the mortality due directly to logging was relatively low.

*Acacia pataczekii*, like other Australian *Acacia* species, produces high numbers of long-lived viable soil-stored seed and can also reproduce vegetatively (Lynch 1993; Gibson et al. 2011; Muir et al. 2014). These characteristics suggest that *Acacia pataczekii* is equipped for regenerating and reproducing following a disturbance event. There was abundant but patchy recruitment of *Acacia pataczekii*, with seedlings growing throughout the logged area and on snig tracks (Plate 3). The level of seedling recruitment indicated that the species can effectively regenerate after a disturbance typical of a partial harvesting operation. *Acacia pataczekii* is not unique in its ability to regenerate following disturbance from forestry activities. Leaman (2004) found that *Odixia achlaena* (golden everlastingbush) responded positively to forestry activities with high seedling regeneration found in areas that had been subject to logging and a regeneration burn. Similarly, Wapstra et al. (2004) found that forestry activities (conducted after adoption of the Forest Practices Code) did not have an impact on the occurrence or health of *Pimelea filiformis*.

In TY042N it is unknown if the retained adult *Acacia pataczekii* contributed to the seedling recruitment, or if germination was from soil stored seed. Germination trials by Lynch (1993) found that *Acacia pataczekii* produced a moderate amount of non-dormant seed (seed that contributes to that year’s crop of germinant). Therefore the seed produced by adult plants retained in TY042N may have contributed to the seedling recruitment recorded in 2015.

We attempted to identify the factors that influenced the patchy nature of recruitment, but the only significant relationship we found was that the number of seedlings was lower when adults were present. Instead of being a causal relationship, the significant impact of adult presence on recruitment may reflect the conditions needed for juvenile recruitment. Lynch (1993) found a significant germination response was gained from a scarification test on fresh *Acacia pataczekii* seed, suggesting that physical disturbance of the ground may promote increased rates of germination. In the current study, the number of seedlings regenerating in areas that had been heavily disturbed (harvest and snig track plots) indicates that the species responds positively to the type of disturbance associated with shelterwood retention silviculture. This is supported by Lynch (1993) who also found that *Acacia pataczekii* seedling regeneration is more successful at sites with greater light availability, such as sites subject to selective logging or road construction. It is possible that our estimation of logging intensity (based on observation of physical disturbance to the understorey) was an inadequate assessment of disturbance or light intensity and therefore presence of adults is an acceptable surrogate for
disturbance or light intensity. Regardless, the levels of adult survival and juvenile regeneration found within the harvested area indicate that the management practice is effective at maintaining this species in both the short- and long-term.

**Future management**

Management of threatened flora within the Tasmanian forest practices system follows an adaptive management approach. That is, any new information from research and
monitoring projects is reviewed and then used to adapt management practices where necessary to make them more effective. The monitoring of *Acacia pataczekii* in TY042N provides useful information for the development of a future management approach.

Recent changes to the reserve estate in Tasmania have more than doubled the reservation status of *Acacia pataczekii*, with approximately two-thirds of known sites across the species’ range now in reserves (DPIPWE 2015). It could be argued that the high level of reservation is an adequate management approach for *Acacia pataczekii*. However, the results of this project and previous work by Lynch (1993) indicate that physical disturbance that increases light availability (like the disturbance created by partial harvesting) promotes *Acacia pataczekii* seedling regeneration and therefore reservation alone would not be the most appropriate management approach for this species over the long-term. There are other Tasmanian examples of threatened flora where reservation alone is not the most appropriate management approach. A project examining the ecology of threatened species of *Boronia* found a positive association between seedling recruitment and recent burning for *Boronia hemichiton* and *B. hippopala* (Chuter 2010), which supported the recommendation by Schahinger (2004) of a fire management regime of 12-20 years to maintain the species in the long-term. Gilfedder (1990) argued that reservation without management would be inadequate for some threatened inter-tussock species that are outcompeted by grass species in the absence of disturbance. Wapstra (2011) also argued that unmanaged reservation of *Sowerbrea juncea* may not be appropriate for its long-term conservation as the species appears to respond well to disturbances such as grazing and low intensity burning. These projects highlight that the response of a species to disturbance is an important factor to consider in the development of an effective management approach.

Approximately one third of the recorded *Acacia pataczekii* sites occur in areas outside the reserve system, and may be subject to forestry activities in the future. These sites are located in the Tower Hill and Roses Tier areas and provide an opportunity to establish a management approach that promotes the long-term viability of known populations. Partial harvest silviculture (e.g. shelterwood) is the most likely silvicultural system to be applied in the dry sclerophyll forest where *Acacia pataczekii* occurs. Given the success of the management examined in this study it is recommended that the same approach be adopted for any future forestry operations in areas that contain adult *Acacia pataczekii*. That is, timber harvesting in areas that contain *Acacia pataczekii* should be undertaken by partial harvesting and should include measures to retain a portion of adult plants within the logging coupe through the implementation of targeted wildlife habitat clumps (retained patches of vegetation). The results of this study confirm that adopting such an approach will help maintain this threatened species into the future.

**ACKNOWLEDGEMENTS**

This project was made possible by the support from Forestry Tasmania, Forest Practices Authority, and the Department of Primary Industries, Parks, Water & Environment. In particular, we would like to acknowledge the major contributions made by Nina Roberts assisting with the field work and writing up the initial results in 2007. Other people we would like to acknowledge for their contribution to various stages of the project include Tim Leaman, Simon Davies and Adrian Walls.
REFERENCES


TSS (Threatened Species Section) (2008). *Notesheet on Acacia pataczekii*. Department of Primary Industries Parks Water & Environment, Hobart.