AUSTRALIAN CENTRE FOR BIODIVERSITY
ANALYSIS POLICY MANAGEMENT

Forests Assessment

Natural Resources Commission

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Sydney NSW 2001

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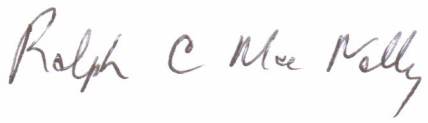
To whom it may concern

We are encouraged by the Natural Resource Commission's investigation of how best to conserve, protect, use and manage the river red gum forests of the Riverina in New South Wales. These forests are not sustainable under current management practices. Increases to environmental flows, and removal of logging, firewood collection and grazing from many areas will help ensure the sustainability of this important, unique ecosystem. We have a long history of research within river red gum forests and woodlands. Below we provide a summary of relevant research that will inform the management of these forests.

Yours sincerely



Dr. Shaun Cunningham

Professor Ralph Mac Nally (ACB Director)

Australian Centre for Biodiversity
School of Biological Sciences
Monash University 3800

Forest Condition

We recently mapped the condition of river red gum stand along the Victorian Murray River Floodplain (Cunningham *et al.* 2007a). This involved development of a quantitative method for assessing stand condition (Cunningham *et al.* 2007b) , which has since been adopted by the Murray-Darling Basin Authority to assess the condition of forest in the Living Murray Icon Sites (Souter *et al.*, 2009). We surveyed stand condition 140 sites on the floodplains of the Victorian Murray River, used this survey data to build a model that predicted stand condition from remotely-sensed environmental variables and tested the predictions of the model with a follow-up survey. This approach is cited in the Preliminary Assessment Report (p.51) by the statement "Based on the results of 140 sites surveyed", which suggests it was simply a field survey and not a landscape map based on remote sensing and rigorous modelling. Predictions of the model were robust and the model was used to produce a map of stand condition across the whole Victorian Murray River floodplain (103 000 ha of forest). The map indicated:

- only 30% of river red gum stands across the Victorian Murray River Floodplain are in 'good' condition.
- a downstream decline in the stand condition of river red gum forests and woodlands along the Victorian Murray River Floodplain.
- the Victorian Riverina is the only region where the majority of river gum stands are in good condition.

We have been contracted by Murray-Darling Basin Authority to use a similar approach to build a tool that will predict stand condition of river red gum and box woodlands in the Living Murray Icon Sites annually, using current ground assessments and remotely-sensed data. The current results of this work will soon be released in a report to the MDBA. This year we conducted a survey of stand condition across the whole Murray River floodplain, including Millewa, Perricoota and Koondrook forests, and the River Murray channel in New South Wales. These assessments were successfully predicted from Landsat imagery using an artificial neural network. This is the first of three years (2009-2011) of modelling required to build the above tool. The 2009 Stand Condition Model was then used to map stand condition across the Murray River floodplain in 2003 and 2009.

Environmental water

Our stand condition map of the Victorian Murray River Floodplain suggests that current watering regimes (rainfall and flooding) below the Yarrawonga Weir are insufficient to maintain the majority of river red gum stands (76% of the area) in good condition. The change in stand condition predicted by the 2009 Stand Condition Model between 2003 and 2009 showed improvements in areas that have received environmental watering over this period. A field experiment in the Mallee has shown that survival of river red gum saplings (1 m high) is significantly higher in flooded creeks (83% survival after 25 weeks) than unflooded creeks (27% survival after 25 weeks) after flooding (Horner et al., unpublished) We have also found that the abundance of the yellow-footed antechinus (a small marsupial carnivore) dramatically increased (222%) in the first breeding season following an environmental water allocation and continued to increase (391%) after flooding the following year (Lada *et al*., 2007). Regular flooding is critical to the survival of both animal and plant species within these forests and woodlands.

Thinning

Our research provides insight into the effectiveness of environmental thinning in these forests. First, we conducted an extensive survey of the condition and structure (size distribution, basal area, density, etc) of stands across the whole Victorian Murray River floodplain (176 stands across 100 000 ha of forest. Stand condition was found to have little relationship to stand structure, with a slight positive influence of basal area on condition (Cunningham *et al*., in press). This is simply a result of higher basal area stands occurring on more productive sites (e.g. naturally higher flooding frequency). In contrast, longitude had a strong positive influence on stand condition, with stand condition being higher in the east of the Murray River floodplain where flooding frequencies are higher. This suggests that dieback of these floodplain forests can not be mitigated by altering stand structure and instead requires increased water availability through flooding.

Second, we have analysed a 42-year growth trial from Barmah Forest to investigate the effect of planting density on the structure and dynamics of red gum forests (Horner *et al*., 2009).

Highest density stands (8000 trees ha^{-1}) are now dominated by many slender trees, mostly < 10 cm in diameter, whereas the lowest density stands (600 trees ha^{-1}) produced size distributions with a wider range of stem diameters and higher mean and maximum stem diameter. After 1996, mortality increased dramatically in high-density stands (> 1000 trees ha^{-1}), yet remained unchanged in low-density treatments (600 and 1000 trees ha^{-1}). This elevated mortality coincided with increased temperatures and a sharp decline in water availability due to a lowering of the water-table, reduced flooding and a substantial rainfall deficit.

Third, we used a 42-year thinning trial from Barmah Forest to investigate the effects of pre-commercial thinning on long-term patterns in habitat quality, forest structure and rates of carbon storage (Horner *et al.*, in press). Early thinning (270, 560 and 750 trees ha^{-1}) of naturally regenerating stands improved habitat value by producing 20 (± 8) hollow-bearing trees ha^{-1} after 42 years, while the unthinned treatment (~4000 trees ha^{-1}) produced none. Moderately thinned stands (560 trees ha^{-1}) had the highest aboveground carbon storage rate (4 t C yr^{-1}) and the highest aboveground carbon stocks (200 ± 10 t C ha^{-1}) after 42 years, while the unthinned treatment had the lowest carbon storage rate (2 t C yr^{-1}) and an intermediate level of aboveground standing carbon (165 ± 31 t C ha^{-1}).

The long-term trials suggest that early thinning of high-density (> 1000 trees ha^{-1}) stands may improve their chance of surviving the continuing dry conditions, ensure they produce large trees (and therefore hollows) and increase aboveground carbon storage. However, our extensive study in Victoria only found stands < 800 trees ha^{-1}, suggesting that these high-density stands are rare along the Victorian Murray River. This is probably due to past logging practices and the rarity of flooding events. Furthermore, dieback of river red gum still occurs in low-density stands under the current climate and flooding regimes. Therefore, based on this research thinning of river red gum forests is ultimately unlikely to reduce their susceptibility to dieback. Instead increased water availability through flooding is required to mitigate the dieback of river red gum along the Murray River.

Harvesting of forest products

We have conducted a large-scale experiment that manipulated the amounts of coarse woody debris (fallen timber) in river red gum forests on Gunbower Island. Birds and the only understorey small mammal species, the yellow-footed antechinus were surveyed before and three years after experimental changes in the wood loads. Increasing the wood load increased the species richness of birds and the abundance of several bird species (Mac Nally, 2006; Mac Nally & Horrocks, 2007a) and the abundance and breeding success of antechinus (Mac Nally & Horrocks, 2007b). Therefore, exclusion of firewood collection from these forests will lead to an increase in animal diversity and population viability.

Domestic stock grazing

We have a project investigating the influence of flooding and grazing on the regeneration capacity of river red gum. Part of the project is a field trial in the Mallee to assess the effects of grazing and flooding on recruitment of seedlings and saplings in anabranch creeks. Grazing (feral and native) significantly reduced the survival of seedlings (from 27.5% to 1.3%) and saplings (from 69.6% to 40.8%) after 25 weeks (Horner et al., unpublished).

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