Institute of Foresters of Australia

SUBMISSION ON CYPRESS FOREST MANAGEMENT IN THE BRIGALOW AND NANDEWAR STATE CONSERVATION AREAS

For the Natural Resources Commission assessment of Cypress Forest Management

in the Brigalow and Nandewar State Conservation Areas.

SUBMISSION BY THE INSTITUTE OF FORESTERS OF AUSTRALIA (IFA)
NEW SOUTH WALES DIVISION

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The Institute of Foresters of Australia (IFA) welcomes the opportunity to provide a submission to the Inquiry into Cypress forest management in the Brigalow and Nandewar State Conservation Areas.

The Institute of Foresters Australia (IFA) is the peak professional body for forest scientists, forest educators and forested land managers in Australia. We are a non-profit organisation with 1200 members who are committed to the principles of sustainable forest management and the processes and practices which translate these principles into outcomes.

The IFA has a long history of involvement and interest in the science and sustainable management of the public and private native forests in NSW. Our submission includes contributions from IFA members who are senior foresters from the public and private sectors who are working or have worked in these forests for many years, both in management and scientific research capacities.

The IFA particularly acknowledges the major contribution made to this submission by Ron Wilson, Vic Jurskis, Nick Cameron and Ross Peacock.

The Institute would be pleased to make a member available to discuss the submission, provide supplementary advice or meet with your technical review panel.

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1. EXECUTIVE SUMMARY

The most appropriate form of adaptive and active management for the Brigalow and Nandewar State Conservation Areas (Zone 3) will be one that seeks to optimize environmental, economic and social values through an integrated landscape approach. The management activities that are adopted should be complementary to the adjoining National Parks, State Forests and private forest estates and incorporate the community vision that is detailed in the Community Conservation Area Agreement.

In assessing the options the NRC should fully embrace the principles of *ecologically sustainable development* by giving preference to the adoption of market-based mechanisms to achieve cost-effective solutions.

Active and adaptive management options should focus on the following key areas:

i. Enhancing the protection of select mature trees that have large spreading crowns and or hollows by removing surrounding competition using commercial thinning;

ii. Spacing out larger trees that have potential for structural development using commercial thinning;

iii. Reducing the canopy cover and basal area of small trees and enhancing the growth of small ground layer plants by actively pursuing the development of new markets for small trees to improve the landscape in a cost effective manner;

iv. Better managing the risks of wildfire which are currently unacceptably high by undertaking a cross tenure review of grazing and prescribed burning practices with a view to enhancing their role in fuel hazard reduction.

v. Preventing dense ingrowth in future using fire and or grazing in conjunction with commercial thinning;

vi. Harvesting small trees including eucalypts, cypress and bulloak to improve vegetation structure, biodiversity and resilience.

vii. Educating the public that passive management (no thinning, high intensity infrequent fire, no grazing) is detrimental to biodiversity, cultural and socioeconomic values.

2. BACKGROUND CONTEXT

The NRC has explicitly stated *that cypress forests across all tenures should be actively managed to support a variety of environmental, social, cultural and economic values*. It has also recommended *that all cypress forest managers on public land, including those managing cypress forests as reserves, should actively manage all cypress forests* (NRC 2010). The IFA strongly supports this position and in preparing this submission has assumed that 'passive management' is not under consideration and, as such, not in need of specific comment or critical review.

What is the most appropriate form of adaptive and active management for Zone 3 that embraces the principles of *ecologically sustainable development*?

A first step to addressing this question is to consider the current ecological condition and values of the Brigalow and Nandewar area**.** To do this requires an appreciation of the bioregion's ecological history. There is a wealth of empirical evidence to show that the Brigalow and Nandewar landscape use to look very different than it does today.

It is generally recognized that the area was maintained as open woodlands by Aboriginal burning but there remains some debate about densities of trees and understoreys because theoretical ecologists mostly prefer to use quantitative data from highly modified ecosystems having relatively little recent disturbance rather than reliable qualitative information about unmodified vegetation available from detailed accounts of colonial officials (Jurskis 2009, 2011; Gammage 2011, Jurskis and Underwood *in press*).

Historical information (e.g. Oxley 1820, Sturt 1833, Mitchell 1839, 1848, Wallis 1878, Curr 1883, Curby 1997, Donovan 1997, Noble 1997, Lunt *et al*. 2006, Jurskis 2009, 2011, Gammage 2011) and ecological information (Jacobs 1955 Ch VI Sec 7, Lacey 1973) provide a very informative qualitative picture of the nature of pre-European woodlands and ecological processes.

The flat and gently undulating lands west of the dividing range carried grassy woodlands. Eucalypts dominated the more humid areas and they occurred in mixtures with cypress and bulloak or belah in drier areas. Sandhills mostly grew cypress.

As soon as grass cured, Aborigines burnt it, killing cypress and bulloak seedlings and reducing eucalypt seedlings back to the ground. Aborigines kept woodlands open with wide spaced large trees, scattered lignotubers, and light grassy fuels interspersed with bare ground.

Cypress seedlings grew deep roots rather than tall shoots. They had a competitive advantage on sandhills where they quickly accessed moisture deep underground. Eucalypt seedlings (excepting river red gum) developed lignotubers. This gave them an advantage on heavier plains soils which hold water longer at the surface and grow more grass to carry fires. Cypress produces negligible ground fuel whereas eucalypts produce much flammable litter. Aborigines burnt mixed woodlands every year but cypress stands on sandhills were burnt less frequently because growth of herbage was usually sparse and there was minimal litter to carry fire.

Woody thickening has been a primary consequence of the disruption of Aboriginal burning and the resultant loss of the pre-European landscape mosaic of woody and non-woody vegetation patches. The pre-European forests were a mosaic of plains, scrubs and open and dense forests (Allen 1998). Woody thickening or an increase in the stand density of cypress and *Allocasuarina* has been a widespread phenomenon across the Pilliga forests since the 1940s (Whipp *et al*. 2005). The cascading consequences of woody thickening and shrub encroachment for biodiversity (Thompson and Eldridge 2005a), ecosystem resilience (Thompson and Eldridge 2005b) and fire safety are recognized nationally and internationally (Eldridge *et al*. 2011) but have proven challenging to address and understand and have consequently been largely ignored by Australian conservation agencies (Jurskis 2005, 2009, 2011; Jurskis *et al*. 2011). The primary reason for the difficulty of management agencies implementing robust prescriptions is the complexity of the interaction between past land management practices, the cessation of Aboriginal burning, rainfall seasonality and grazing effects. When land management trials have been implemented to test the ecological outcomes of different combinations of stand density manipulation and grazing (eg Andrews 2003, Cameron 2003) the results have often been variable and attributed to the legacy of past land management practices (Thompson and Eldridge 2005b, McHenry *et al*. 2006). The reliance of many of these ecological studies on using space for time substitution and broad correlative landscape surveys has meant there will always be a degree of uncertainty in the interpretation of their results until replicated control and treatment experiments are initiated and monitored. Such studies will need to also account for climate variability on a decadal scale increasing their cost and complexity further. The growth and dynamics silvicultural studies initiated in NSW from the 1940s took this approach however they lacked the measurement of the ecological response variables required to address broader sustainability criteria. Resourcing the necessary adaptive management experiments will a require a re-assessment of existing state government science priorities and a suite of co-operative land managers.

At its meeting with the NRC on 24 October 2013 the IFA discussed the concept of restoring the landscape to its natural 'pre-1750 condition'. This concept was considered likely to be unrealistic by the NRC. As a consequence the IFA has not pursued it as an option within this submission. Should the community or government express a view that restoring the landscape to its 'pre-1750 condition' is something to aspire to then the IFA is willing to offer further advice on active and adaptive options that would support such. In light of this context, debate is invited on what exactly are we trying to conserve and what type of forest values do we wish to generate in the future? Answers to these questions are not found in the scientific literature nor can they be readily agreed by forest ecologists because they are social constructs set within a political context.

There is some consensus amongst ecologists that the current Brigalow and Nandewar cypress forests are a product of European influences and that the landscape is now less resilient. The cypress forests of the Brigalow and Nandewar bioregion must be recognized as artifacts of post-European management, altered by fire suppression and introduction of exotic pests and weeds. They have been shaped by human management for forty thousand years, firstly by Aboriginal burning and recently by thinning, grazing and clearing. In the absence of active, adaptive management the new cypress forests are highly susceptible to megafires, drought, pests and diseases, loss of biodiversity and chronic tree decline.

Guidance on the adaptive and active management options that may be socially palatable for the Brigalow and Nandewar forests is available from the region's *Community Conservation Area Agreement* (CCAA) signed in 2009. The CCAA is designed to provide a coordinated framework for the management of all the land in Zones 1, 2, 3 and 4 in consultation with the community. Its vision is:

That everyone in our community is co-operating to rebuild a resilient and functioning landscape system, where people enjoy living, visiting and working, into the future.

The CCAA's vision neither highlights nor embraces the concept of Zones (Zones are an artificial construct arising from a former State Government whose focus was on the dedication of new National Parks). Instead there is recognition that the forests occupy a single landscape that should be subject to common active management principles which improve ecological resilience and enhance socio-economic values.

These concepts are fleshed out in the CCAAs nine strategic objectives. The three (arguably) most important objectives are:

1. *To manage all land for social, economic and environmental sustainability, based on the principles of inter-generational equity;*
2. *To maintain and seek to improve the landscape function, ecological processes and natural diversity of the land;*
3. *To accommodate sustainable commercial activities that are consistent with the other strategic aims*

These concepts are endorsed by the IFA and have been endorsed in an unpublished paper titled the Tenure Trap (NSW Forest Industries Taskforce, 2012) which highlights that forest values may be more readily optimized when social, economic and environmental considerations are kept in balance (refer Figure 1). This theme of balance and integration has been embraced in the final report of the 2013 Legislative Council General Purpose Standing Committee No. 5 Inquiry into Management of public land in New South Wales.

The review of the management in Zone 3 within the Brigalow and Nandewar bioregion represents a timely and unique opportunity to look beyond the traditional approach of passive management of environmental values and to choose an outcome that can effectively integrate and optimize environmental, economic and social values through active and adaptive management.

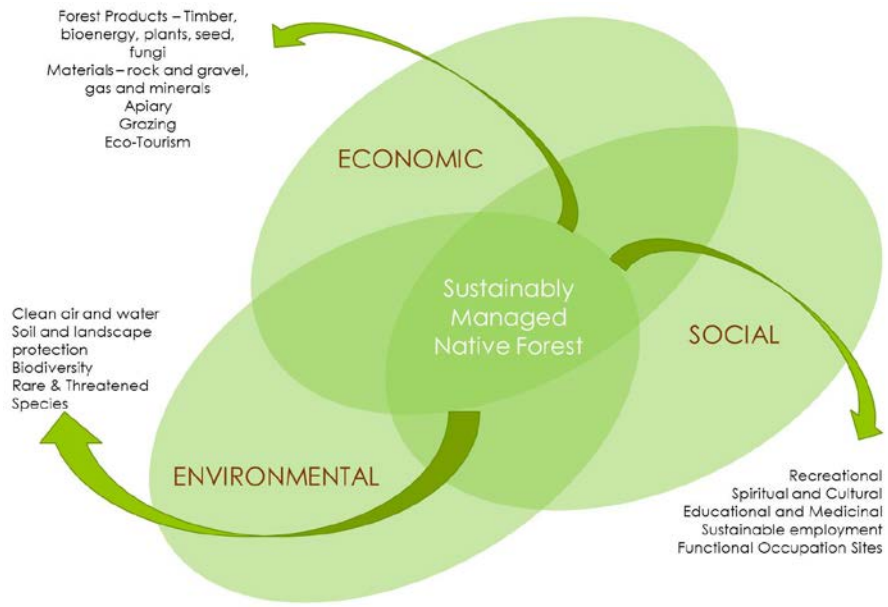

Figure 1: Optimizing native forest values from sustainably managed forests

3. NON-COMMERCIAL THINNING AS AN ADAPTIVE AND ACTIVE MANAGEMENT TOOL

Non-commercial thinning was recognized historically as having socioeconomic benefits associated with maintaining grazing values, improving timber values, providing unemployment relief and generally supporting rural industries and communities. Around the start of the 20th Century, in the Western Division, Chinese labourers were employed to ringbark cypress ingrowth. The suppression of biodiversity by scrub can still be seen in firebreaks twenty meters wide which were left along the boundaries of many leases. The firebreaks are effective because nothing grows under the dense canopy. In the 1930s depression, labour was transported from large population centres to the Pilliga to undertake large-scale non-commercial thinning programs. These resulted in the development of commercial forests supplying cypress timber for the post-war building boom and beyond. Unemployment relief programs were reintroduced in the 1970's, 1980's and 1990's and more recently during 2006-2011 under the Brigalow Industry Assistance funding.

Methods of non-commercial thinning were initially manual cutting with axes or brush hooks. During the 1980's motor-manual thinning using large brushcutters was introduced and as a result of its success continued right up to the cessation of non-commercial thinning in 2011. Mechanised thinning of strips using "chopper-rollers" towed behind a large dozer, with follow-up thinning between the rows with brushcutters, was used to thin significant areas of Zone 4 forest under the Brigalow Funding Program. Non-commercial thinning in the future is likely to involve specialized small machinery (like that used in Europe) that is capable of efficiently handling small cypress trees. The Forestry Corporation's Western Region is currently trialing the use of such a machine with an accumulating feller-buncher head . This machine is not expected to be commercial on small cypress trees.

A significant issue for non-commercial thinning is that the trees which are cut down are left on site. These create increased fire hazard. One purported aim of non-commercial thinning has been to enhance diversity of structure. However there is limited opportunity to enhance biodiversity because there are no native plants or animals that rely on dense ingrowth of cypress or bull oak for habitat. Committing to costly non-commercial thinning in such forests (which have such limited inherent diversity) is an unwise ecological investment. Active adaptive management should instead focus on the prevention of dense ingrowth and enhancing habitats that have been reduced consequent to European settlement. These are old trees, large trees, eucalypt trees of woodland form, small ground cover plants and bare ground. This can be done in a socioeconomically effective manner by enhancing the overall size class diversity in the new forests to improve the economics of thinning.

Enhancing large-crowned and hollow bearing trees and promoting potential recruits can provide ecological benefits. Recruit trees will develop best in freedom from competition from neighboring trees. Large hollow bearing trees and potential recruits are being lost to chronic decline as a consequence of changes in soils and nutrient cycling in the absence of frequent mild fire (Jurskis 2005, Turner et al. 2008, Jurskis *et al*. 2011). An additional and related problem is drought death where these trees are engulfed by ingrowth.

Thinning operations (whether non-commercial or commercial) should seek to remove all ingrowth of any species within two crown diameters of large or old trees. Thinning operations in stands with relatively few large or old trees should minimize basal area retention of smaller/younger trees as far as possible to maximize diameter growth of retained trees. It takes “exceptionally long periods” to restore cypress ecosystems to a mature state (Ngugi *et al*. 2013) in the absence of heavy thinning.

The current cost of non-commercial thinning is in the order of $300-$500 per ha. If money is borrowed at 5% p.a. “real” rate, the cost at $300 per ha to be recovered after say 40 years is $2,100 per ha in current dollars. There is negligible prospect of fully recovering such an amount from the sale of cypress logs.

For reasons of costs, the IFA cautions against any major reliance on non-commercial thinning as a practical management tool. Non-commercial thinning is uneconomic and is not a current practice of the Forestry Corporation of NSW.

4. NON-COMMERCIAL THINNING VERSUS COMMERCIAL THINNING

Non-commercial thinning has been singled out by the NRC and others as an ecologically appropriate form of active management for regrowth forests which have been afforded a conservation priority. It is thought to be favoured over commercial thinning because it is free of commercial business interests and the potentially ecologically adverse influences that they can bring to bear.

The justification for keeping commercial interests at bay may warrant some weight if there were adverse environmental consequences. The current assessment however is about the active

management of a 'man-made forest' which is widespread and which has developed within the last 150 years as a direct consequence of European settlement and its influence on fire regimes.

5. COMMERCIAL THINNING AS AN ADAPTIVE AND ACTIVE MANAGEMENT TOOL

Brigalow Nandewar Zone 3 comprises 95,000 ha of cypress and hardwood (largely ironbark) forests (see Figure 2) which are slow growing by Australian standards (< 0.3cm diameter per year for cypress (Ngugi et al 2013)) and remote from major population centres. Much of these forests were State forests prior to the 2005 decision. The areas that went into Zone 3 were stands which had high standing volumes of merchantable cypress. In particular the standing volume of cypress on many of the Zone 3 areas is likely to be higher than many of the Zone 4 forests that are planned to be harvested for timber over the next 5 years (Forestry Corporation, 2013). Interestingly, the NPWS classifies the vegetation of Pilliga West (a 34,415 hectare State Conservation Area within the region) as eucalypt forest with a cypress component. This description is one that may have been applicable in the past but does not accurately describe the forests which exist today.

Figure 2. White Cypress Pine (*Callitris glaucophylla)* - Tumbledown Red Gum (*Eucalyptus dealbata*) - Silver-leaved Ironbark (*E. melanophloia*) shrubby open forest of Brigalow Belt South and Nandewar Bioregions (Peacock *et al*. 2009). Photograph Ross Peacock. These forests are typically slow growing and low in terms of productivity in their un-managed state.

In the case of forests like Merriwindi (north of Coonabarabran) and Biddon (between Coonabarabran and Gilgandra) significant amounts of non-commercial thinning were carried out. While they will have areas of small diameter regrowth they also contain significant stands of more mature trees which contain the recruits that may develop into large trees with spreading crowns and hollows. The promotion of these trees through the use of fire and or through natural attrition is considered too imprecise and risky so deliberate thinning is warranted. Commercial thinning can retain the dominant trees and enhance their drought tolerance whilst removing others as merchantable sawlog timber.

There is an extensive data archive from silvicultural research in cypress (eg Lacey 1972, Johnston 1975, Johnston 1979, Horne and Robinson 1987, Horne 1990 and Knott 1995) which can guide ecological prescriptions for both productivity enhancement and ecological restoration of these areas. For example, regenerative capacity of cypress as indicated by seed production is inversely proportional to stand basal area with negligible production above $18m^2/ha^{-1}$ and massive production at $5m^2/ha^{-1}$ (Lacey 1973). Active, adaptive management should use a combination of thinning to a low to moderate basal area and grazing to promote the growth of retained trees and control the density of ingrowth. While there is probably insufficient data to develop a prescriptive guide to ecological thinning, any guide should probably use as its basis a spacing and density guide proven to promote stand increment (see review by Kerle 2005).

The case for thinning was clearly established by Knott (1995) who summarized more than 50 cypress thinning trials conducted over more than half a century since 1940. More recent process based modelling has emphasized again the role of thinning in increasing total stand basal area (Ross *et al*. 2008, 2012) and the risk of ingrowth simply infilling gaps created during thinning. These data can guide active adaptive management to maximize ecological enhancement of habitat and socioeconomic benefits. Growth rates of individual trees, as well as residual stocking and basal area provide a direct measure of habitat values accruing from various thinning regimes. Habitat value is directly proportional to basal area of large trees and hollow trees and inversely proportional to basal area of small trees/saplings which suppress ground cover and interfere with mobility and foraging of woodland species. Listed species from the subject area that would benefit from opening of habitat by active intervention include barking owl, glossy black cockatoo, mallee fowl, masked owl and squirrel glider. Encouraging the growth of large individual trees of cypress will also have direct positive effects on nest selection and breeding activity in wedge-tail eagles (Sharp *et al*. 2001) especially where they provide habitat for hollow dependent fauna (Date *et al*. 2000). Where these mature trees are interspersed with open grassy or shrub communities they also have the potential to arrest the decline of woodland bird species (Date *et al.* 2002).

Any proposed thinning program will need to maintain and enhance forest health and ecological values and may be undertaken in accord with workable regulatory conditions. A combined commercial harvest of cypress sawlogs, along with thinning of trees that are too small for sawlogs, is expected to have the best cost effective ecological outcomes. Thinning in stands which only have small trees can be a cost effective way of achieving ecological objectives where markets can be developed for small wood.

6. FIRE AND/OR GRAZING AS AN ADAPTIVE AND ACTIVE MANAGEMENT TOOL

Our understanding of European history provides some salient lessons in the ecological role that fire and grazing have played in the Brigalow and Nandewar bioregion.

Disruption of Aboriginal burning by European settlers allowed woody seedlings to escape their natural controls. Natural ecological processes were disrupted (e.g. Jurskis 2005, 2009, 2011, Turner et al. 2008, Jurskis et al. 2011).

Open woodlands were heavily grazed until droughts reduced domestic and feral animal populations. Drought breaking rains caused massive germination of cypress and bulloak. In the absence of Aboriginal burning dense scrubs grew, and shade tolerant cypress and oaks prevailed over intolerant eucalypts. The District Surveyor in the Central Lachlan-Murrumbidgee District saw scrubs booming after the 1866 drought (Curby 1997). The Pilliga Scrub grew after drought break in 1878 (Rolls 2011). Subsequently thinning to promote grass and/or timber created the new forests. Eric Rolls was incorrect in stating "Where the fires ran years of pine seed came to life". In fact cypress seed lasts only a season (Lacey 1973). The fires and the prolific growth of cypress seedlings were separate results of a wet season with low grazing pressure promoting plant growth.

In the western division lack of mild fire was compounded because sheep, rabbits and drought virtually eliminated fuels, and some topsoil's on hard country were blown away by winds. Dense scrubs developed on the subsoil's and prevented regeneration of grass. Invasive native scrub is just the extreme case of woody thickening with lack of mild fire (e.g. Noble 1997).

Ancient cypress woodlands are now very rare, but there are some examples in grazing paddocks (e.g. **Figure 3**). In contrast, cypress does not reach old age in unmanaged public forests because dense ingrowth of cypresses and/or bull oak out-competes mature trees during drought and the mature trees die (refer **Figure 4**).

Figure 3 An example of a rare ancient cypress woodland in a grazing paddock. Photograph David Barnes.

Figure 4 Drought and competition induced death of mature cypress and eucalypt trees amongst a dense ingrowth of cypress in an unmanaged stand. Photograph David Barnes.

In today's cypress forests the main fire problem is three dimensionally continuous fuels in dense vegetation without much grass. Grass fuels also pose a fire hazard but not one that supports megafires. Complex flammability feedbacks exist between the fuel traits of dominant trees which can improve fire survivability under moderate fire conditions but not severe conditions (Cohn *et al*. 2011). After a fire ,cypress stands remain vulnerable to future fires, until the recruited trees grow large enough to modify fuel levels and reduce stand flammability again (Cohn *et al*. 2011).

The Forestry Corporation does not use fire to reduce fuels in this area as it considers the risk of damage to timber too great. Grazing is its preferred management tool and it uses it extensively to reduce fire hazard. The Forestry Corporation is comfortable that it has a sustainable grazing policy whose benefits in reducing fire hazard more than balance any adverse environmental impacts that the grazing might have.

Within the National Park and Conservation Areas estates the NPWS has been unwilling to allow grazing. In its stead it is using fire, albeit infrequently (the only other available hazard reduction tool). The NPWS's Pilliga West fire plan provides that an interval between fire events of less than 20 years should be avoided, and that after a 30 year fire free period high intensity fire is permitted. Under this management regime biodiversity and society are clearly disadvantaged. From the IFA's perspective, the NPWS prescriptions and the ecological consequences of them are completely unacceptable. The IFA recommends that the NRC review this issue as a matter of priority.

Practicable application of more frequently prescribed mild fire in cypress has been demonstrated in southwestern Queensland within timber production areas.

The IFA is concerned at the current disjuncture between the practices employed by the Forestry Corporation and the NPWS. Open debate is urgently needed if there is to be an alignment of their long term objectives and the on ground practices that are used to achieve them.

The disjuncture also exists at a federal level. Under the National Forest Policy Statement it states that grazing in native forests can have a significant impact and severe implications. This statement contrasts strongly with the document's reference to the 'potentially harmful' effects of wildfire. When applied to cypress these policy statements create an unresolvable management dilemma.

The IFA is unaware on any clear evidence to justify the exclusion of grazing in the Brigalow and Nandewar cypress forests.

In the river red gum, Lunt *et al.* (2007) assumed that native plant species had been depleted by grazing and predicted that exclusion of grazing would not promote 'recovery' because of the 'high degree of initial degradation' and the low site productivity. However the studies they cited to show degradation did not indicate loss of plant species as a result of grazing. Lunt et al. (2007) found no difference in species richness after exclusion of grazing for 12 years and differences in composition between grazed and ungrazed did not increase over time. Species richness was naturally low in regularly flooded areas such as their study site and increased where flooding was reduced (Stokes et al. 2010). Lunt's et al. (2007) study provided no support for their assumption of 'initial degradation'.

Another study showed no difference in species richness between areas that were heavily grazed and areas that had been ungrazed for more than half a century (Robertson and Rowling 2000). Red gum saplings, other vegetation and litter (fuel) were much more prevalent and there was less bare

ground in ungrazed areas whilst species richness was lower where tree canopies were denser (Robertson and Rowling 2000). This indicates that grazing can substitute for the natural fire regime and maintain biodiversity and fire safety. It is clear that exclusion of grazing can have negative consequences for fire management, forest health and biodiversity (e.g. Jurskis 2005, 2008, 2009, 2011).

There are a number of examples where exclusion of fire and or grazing from newly dedicated reserves has led to loss of biodiversity including some rare and endangered species. Hastings River Mouse occurs only in grazed and burnt forests and not in similar ecosystems within reserves on NSW northern tablelands' escarpment (Tasker and Dickman 2004). Species richness of non-floodplain river red gum woodlands has declined since grazing was withdrawn and tea tree proliferated after dedication of additions to Grampians National Park (Price and Morgan 2008, 2010). Eastern brown tree creeper was lost after grazing and burning was excluded from two new reserves in north western NSW (Ford et al. 2009). According to Parks Victoria, grazing of sheep in Terrick Terrick National Park after the recent floods restored habitat for the critically endangered plains wanderer (The Age 21st October 2013).

In summary, if well managed, fire and/or grazing can again be highly effective tools for enhancing biodiversity in cypress. Grazing can be used as an alternative or as a complement to burning and thinning to restore ecosystem function and to enhance natural values. The importance of grazing should not be underestimated to the extent that if an area has been historically grazed the grazing should not ideally be removed without first monitoring exclusion plots to see what happens. More specifically, fire and/or grazing can be used to maintain resilience and biodiversity by minimizing the occurrence of dense ingrowth of seedlings.

7. SOCIOECONOMIC IMPACTS AND BENEFITS OF UNDERTAKING ADAPTIVE AND ACTIVE MANAGEMENT PROCESSES

The body of this submission has described the ecological benefits of undertaking adaptive and active management processes. The IFA believes there are considerable socioeconomic benefits as well. The key activities discussed involve thinning, fire management and grazing management.

Extensive casual monitoring and very limited deliberate monitoring have clearly shown the environmental and socioeconomic degradation resulting from the passive management of reserves under National Forestry Policy Statement (Jurskis 2013).

8. THINNING

Finding markets for thinnings has been an ongoing challenge for Forestry Corporation staff who have responsibility for the marketing of timber resources on adjoining State forests.

The softwood plantation industry was faced with similar difficulties in the mid-1950s but markets based on woodchips, including panelboards and pulp and paper are now an important part of the

overall industry. This has enabled commercial thinning of plantations of species (mainly *Pinus radiata*, *P. elliottii*) with good commercial results for the plantation owner and timber industry.

A new opportunity is currently emerging worldwide – biomass for energy. Europe, particularly Germany and the Scandinavian countries, US, Canada and China are increasing their proportion of renewable energy each year. Biomass is a significant part of the programs in those countries. Germany has a policy of increasing its proportion of renewable energy from currently 15% to around 50% in 20 years.

A major development in recent years has been the use of small scale biomass plants in communities where there is a demand for heat and/or electricity and there is a local reliable supply of biomass. In Europe there are numerous small to medium size biomass plants in the cost range $1m to $5m. Europe has a cold winter so heating is a significant need. One fairly significant combined heat and power plant recently inspected by an IFA member in Bayreuth used around 12,000 tonnes/year of woodchips, cost around $5 million and employed 4 people. Harvesting and transport were extra.

In the US there is a new program to put biomass plants in schools in those areas where there is a reliable timber supply and the biomass has a significant cost advantage over other sources of energy. This is reported by the US Forest Service which is a major contributor to the program.

There are a number of bioenergy developments underway in Australia as reported in the Bioenergy Australia newsletters. Many of these relate to other than timber applications, such as biogas from municipal waste.

Most large scale timber plants such as Visy Industries at Tumut have equipment at their sites, or are planning to install equipment, which use timber residues, including bark, for generating electricity and heat, for use in the plant. Some sawmills have installed similar equipment but at a much smaller scale. Big River Timbers at Grafton is a good example. There are a number of examples in Australia where the operators are very pleased with the financial returns and ready market for their residues.

There is considerable research and development taking place around the world with the aim of economically producing energy and materials from timber and agricultural wastes. One relevant Victorian program is the production of biochar from woody waste using a portable production plant (Regional Development Australia). There is also funding of $4.3 million allocated to a biochar plant at Ballina NSW (Bioenergy Australia).The most well-known product is ethanol, which is mainly produced from agricultural crops but can be produced from timber.

Other products which can be made include;

- Wood pellets for use in power stations and heating plants
- Liquid fuels including biodiesel and aircraft fuel
- Biogas
- A range of products in the charcoal family, including biochar from pyrolysis of wood
- Rayon

Any additional sawlogs which are harvested as part of the proposed thinning programs would most likely be allocated to the sawmills with long term wood supply agreements. This includes the sawmills at Baradine and Gunnedah.

The IFA understands that these sawmills are having difficulty with the log mix from the Zone 4 forests where there the proportion of small logs is somewhat higher than previously supplied. Any sawlogs from Zone 3 would provide opportunities to improve the log mix relating to size of sawlogs and assist those sawmills in long term viability.

If the Baradine and or Gunnedah sawmills closed as a result of reduced profitability, the sawmill workers and families would be out of work in rural communities where alternative work may be difficult to find. This would also apply to all people working in the supply chain, from foresters organising and supervising the operations, the harvesting crews and transport crews for sawlogs and sawn timber.

If a market can be found for the small trees proposed to be thinned, this would add to employment in the regions. If a biomass market was established, either at a single site or a number of regional communities the employment generated would relate to;

- The facility itself
- Harvesting and transport crews
- Foresters and other forestry staff
- Machinery suppliers and service staff

Any new facilities established also have an economic multiplier effect in the rural communities.

9. FIRE MANAGEMENT

Under the current governance arrangements fire management programs would relate to the forest management agency. To achieve the outcomes proposed it is likely that additional staff would be required, both at professional level and for field workers.

10. GRAZING MANAGEMENT

To introduce grazing would generate economic activity both with private graziers and staff from the forest management agency.

Analyses would be required from consultants to identify the expected employment numbers from the likely scenarios involving these three separate activities.

11. REFERENCES

Allen, M.R. (1998) 'Forest history projects for State Forests of New South Wales. Case studies of three cypress pine forests on the Lachlan and Bogan River catchments, Forbes Forestry District on Back Yamma, Euglo South and Strahorn State Forests.' (State Forests of New South Wales: Sydney)

Andrews, S. (2003) Regrowth white cypress pine and natural resource management, (Green Australia NSW Inc. Armidale, NSW.

Cameron P 2003 Some observations of the benefits of thinning cypress stands and discussion of management options for western forest and woodlands. A report to the western plains zoo, Dubbo, NSW, Australia. From the website of the Pilliga Land Users Group, last updated 20th July 2004. http://www.pilliga.org/Zoo/Actively%20Managing%20for%20Biodiversity.%20 Final%20Draft.pdf

Cohn, J. S., Lunt, I. D., Ross, K. A., & Bradstock, R. A. (2011). How do slow-growing, fire-sensitive conifers survive in flammable eucalypt woodlands?. Journal of Vegetation Science, 22(3), 425-435.

Curby, P. (1997) Forest History Project for State Forests of New South Wales Narrandera Study on Buckinbong, Gillenbah and Matong State Forests. State Forests of NSW, 155 pp.

Curr, E.M. (1883) Recollections of Squatting in Victoria, Then Called the Port Phillip District, from 1841 to 1851. Facsimile Edition 1968. George Robertson/Libraries Board of South Australia, Melbourne/Adelaide, 452 pp.

Date, E.M., Ford, H.A. and Recher, H.F. (2002) Impacts of logging, fire and grazing regimes on bird species assemblages of the Pilliga woodlands of New South Wales. Pacific Conservation Biology 8, 177-195.

Date, E.M., Goldney, D.C., Bauer, J. and Paull, D. (2000) The distribution and abundance of endangered vertebrate fauna in NSW White Cypress woodlands: implications of state forest management. In Saunders, D., Mitchell, N. and Craig, J. (Eds.) (2000) Conservation in Production Environments: Managing the Matrix. Surrey Beatty and Sons, Norton Chipping.

Donovan, P. (1997) A History of the Millewa Group of River Red Gum Forests. State Forests of NSW, 112 pp.

Eldridge, D.J., Bowker, M.A., Maestre, F.M., Roger, E., Reynolds, J.F. and Whitford, W.G. (2011). Impacts of shrub encroachment on ecosystem structure and functioning: towards a global synthesis. Ecology Letters 14, 709-722

Ford, H.A., Walters, J.R., Cooper, C.B., Debus, S.J.S. and Doerr, V.A.J. (2009) Extinction debt or habitat change? – Ongoing loss of woodland birds in north-eastern New South Wales. Biological Conservation 142, 3182–3190.

Gammage, B. (2011) *The Biggest Estate on Earth: how Aborigines Made Australia.* Allen and Unwin, Sydney, 434 pp.

Horne R. (1990) Stand height response following variable spacing of wheatfield White Cypress Pine regeneration in New South Wales. Australian Forestry 53, 47–54

Horne R., Robinson G. (1987) White Cypress Pine in NSW; growth patterns and optimal thinning regimes for 60–80 year old stands. Australian Forestry 50, 216–223

Jacobs, M.R. (1955) Growth Habits of the Eucalypts. A.J. Arthur, Commonwealth Government Printer, Canberra, 262 pp.

Johnston TN (1975) Thinning studies in Cypress Pine in Queensland. Research Paper No. 7. Department of Forestry Queensland, Brisbane, QLD, Australia

Johnston TN (1979) Effect of silvicultural treatment on a Cypress Pine forest. M.Sc. Thesis, University of New England, New South Wales, Australia

Jurskis, V. (2005). Eucalypt decline in Australia, and a general concept of tree decline and dieback. Forest Ecology and Management. 215, 1–20.

Jurskis, V. (2008) Drought as a factor in tree declines and diebacks. In: Sanchez, J.M. (Ed.), Droughts: Causes, Effects and Predictions. Nova Science Publishers Inc., New York, pp. 331–341.

Jurskis, V. (2009) River red gum and white cypress forests in south-western New South Wales, Australia: ecological history and implications for conservation of grassy woodlands. Forest Ecology and Management. 258, 2593–2601.

Jurskis, V. (2011) Benchmarks of fallen timber and man's role in nature: some evidence from eucalypt woodlands in southeastern Australia. Forest Ecology and Management 261**,** 2149–2156.

Jurskis, V., Turner, J., Lambert, M. and Bi, H. (2011) Fire and N cycling: getting the perspective right. Applied Vegetation Science 14**,** 433-434.

Jurskis, V. and Underwood, R. (2013 in press) Human fires and wildfires on Sydney sandstones: history informs management. Fire Ecology 9 (3), 8–24. doi: 10/4996.fireecology.0903008

Kerle, J.A. (2005) Collation and review of stem density data and thinning prescriptions for the vegetation communities of New South Wales. Report prepared for Department of Environment and Conservation (NSW).

Knott J (1995) White Cypress Pine thinning trials of the Western Region. Research Paper No. 27. Forestry Commission of New South Wales, Sydney, NSW, Australia

Lacey CJ (1972) Factors influencing the occurrence of White Cypress Pine regeneration in New South Wales. Technical Paper No. 21. Forestry Commission of New South Wales, Sydney, NSW, Australia

Lacey, C.J. (1973) Silvicultural Characteristics of White Cypress. Research Note No. 26. Forestry Commission of NSW, 51 pp.

Lunt, I.D., Jansen, A., Binns, D.L. and Kenny, S.A. (2007) Long-term effects of exclusion of grazing stock on degraded herbaceous plant communities in a riparian *Eucalyptus camaldulensis* forest in south-eastern Australia. Austral Ecology 32**,** 937–949.

Lunt, I.D., Jones, N., Spooner, P.G., Petrow, M. (2006) Effects of European colonization on indigenous ecosystems: post-settlement changes in tree stand structures in Eucalyptus–Callitris woodlands in central New South Wales. Aust. J. Biogeogr. 33, 1102–1115.

McElhinny, C., Gibbons, P. Brack, C. and Bauhus, J. (2006). Fauna-habitat relationships: a basis for identifying key stand structural attributes in temperate Australian eucalypt forests and woodlands. *Pac. Cons. Biol*. 12: 89-110.

McHenry, M. T., Wilson, B. R., Lemon, J. M., Donnelly, D. E., Growns, I. G. (2006) Soil and vegetation response to thinning White Cypress Pine (*Callitris glaucophylla*) on the North Western Slopes of New South Wales, Australia. Plant and Soil 285 (1-2): 245-255

Mitchell, T.L. (1839) Three Expeditions into the Interior of Eastern Australia; With Descriptions of the Recently Explored Region of Australia Felix and of the Present Colony of New South Wales, vol. 2., Second ed. Rediscovery Books, Uckfield, Facsimile Edition 2006, 770 pp.

Mitchell, T.L. (1848) Journal of an Expedition into the Interior of Tropical Australia in Search of a Route from Sydney to the Gulf of Carpentaria. Longman, Brown, Green and Longmans, London, Facsimile Edition 2007, Archive CD Books Australia.

Ngugi, M.R., Botkin, D.B., Doley, D., Cant, M. and Kelley, J. (2013) Restoration and management of cypress forest ecosystems in eastern Australia: Simulation of attributes of growth dynamics, growth increment and biomass accumulation. Ecological Modelling 263, 152– 161

Noble, J.C. (1997) The Delicate and Noxious Scrub: CSIRO Studies on Native Tree and Shrub Proliferation in the Semi-Arid Woodlands of Eastern Australia. CSIRO Division of Wildlife and Ecology, Lyneham, ACT, 137 pp.

NRC (2010) Regional Forest Assessment- South Western Cypress State Forests, Assessment Report. Natural Resources Commission, Sydney.

Oxley, J.J.W.M. (1820) Journals of Two Expeditions into the Interior of New South Wales Undertaken by Order of the British Government in the years 1817–18. John Murray/University of Sydney Library, London/Sydney, Etext 2002, 223 pp.

Peacock, R. J, Rolhauser, A., Thönell. J. and Law, E. (2009) Extant and potential natural vegetation of Yallaroi, Ashford, Bingara and Inverell 1:100,000 scale map sheets, NSW. Appendix 1 – Local Vegetation Community profiles. NSW Department of Environment, Climate Change and Water, Sydney.

Price, J.N., Morgan, J.W. (2008) Woody plant encroachment reduces species richness of herb-rich woodlands in southern Australia. Austral Ecology 33, 278–289.

Price, J.N., Morgan, J.W, (2009) Multi-decadal increases in shrub abundance in nonriverine red gum (Eucalyptus camaldulensis) woodlands occur during a period of complex land-use history. Australian Journal of Botany 57, 163–170.

Robertson, A.I. and Rowling, R.W. (2000) Effects of livestock on riparian zone vegetation in an Australian dryland river. Regulated Rivers: Research and Management 16, 527–541.

Rolls, E. (2011) A million wild acres. 200 years of man and an Australian forest. Thirtieth anniversary edition. Hale and Iremonger. McMahons Point.

Ross, K. A., Lunt, I.D., Bradstock, R.A., Bedward, M. and Ellis, M.V. (2012): Did historical tree removal promote woody plant encroachment in Australian woodlands?. Journal of Vegetation Science 23.2 304-312.

Ross, K. A., Bedward, M., Ellis, M. V., Deane, A., Simpson, C. C. and Bradstock, R. A. (2008). Modelling the dynamics of white cypress pine *Callitris glaucophylla* woodlands in inland south-eastern Australia. Ecological Modelling, 211(1), 11-24.

Sharp, A., Norton, M., Marks, A. (2001) Breeding activity, nest site selection and nest spacing of wedge-tailed eagles (*Aquila audax*) in western New South Wales. Emu 101, 323-328

Sturt, C. (1833) Two Expeditions into the Interior of Southern Australia During the Years 1828, 1829, 1830 and 1831: With Observations on the Soil, Climate and General Resources of the Colony of New South Wales, vol. 2. Smith, Elder and Co./University of Sydney Library, London/Sydney, Etext 2002–2003, 270 pp.

Tasker, E.M. and Dickman, C.R. (2004) Small mammal community composition in relation to cattle grazing and associated burning in eucalypt forests of the Northern Tablelands of New South Wales. In: Lunney, D. (Ed.), Conservation of Australia's Forest Fauna. , second ed. Royal Zoological Society of New South Wales, Mosman, pp. 721–740.

Thompson, W.A. and Eldridge, D.J. (2005a). Plant cover and composition in relation to density of *Callitris glaucophylla* (white cypress pine) along a rainfall gradient in eastern Australia. Australian Journal of Botany 53, 545-554.

Thompson, W.A. and Eldridge, D.J. (2005b). White cypress pine (*Callitris glaucophylla*): a review of its roles in landscape and ecological processes in eastern Australia. Australian Journal of Botany 53, 555-570

Turner, J., Lambert, M., Jurskis, V., Bi, H. (2008) Long term accumulation of nitrogen in soils of dry mixed eucalypt forest in the absence of fire. Forest Ecology and Managent 256, 1133–1142.

Wallis, A.R. (1878) Redgum. Report of the Secretary for Agriculture on the Red Gum Forests of Barmah and Gunbower. John Ferres, Government Printer, Melbourne, 7 pp.

Whipp, R. K., Lunt, I. D., Spooner, P. G., and Bradstock, R. A. (2012) Changes in forest structure over 60 years: tree densities continue to increase in the Pilliga forests, New South Wales, Australia. Australian Journal of Botany 60, 1–8.

ANNEXURE A CASE STUDY - APPLICATION OF EUROPEAN BIOENERGY TECHNOLOGY IN AUSTRALIA

Based on bioenergy plants seen in Germany the target client would firstly be commercial industry needing heat and power.

Government run facilities including hospitals, schools, swimming pools and offices are suited to biomass fed heat and power sources. In Germany the furthest distance from biomass plant to client for heat was around 1 km, which related to the engineering of the piping of synthetic oil in a continuous loop.

Development of the natural gas resource in the Pilliga may become a source of heat and power for these same communities, which has significant cost advantages over timber residues and is intended for such use. If analysis shows this to be the case, then alternative options for production of energy products from forests needs to be considered. However, if the natural gas is used more profitably elsewhere, the region could benefit from both sources of energy. A similar situation may apply to the possible coal extraction from the Liverpool plains.

Annual supply

Based on German applications in 2012, a biomass plant for heat production only, would have a capital cost of $1 million with input of around 2,000 tonnes per year of woodchips. A combined heat and power plant would start at a capital cost of around $4 million for an input of 10,000 tonnes per year of woodchips. Running costs include the cost of woodchips (from harvesting and transport) and labour. From the Bayreuth plant inspected the payment for woodchips to local forest owners was higher than the payment for woodchips which could be expected in NSW. However, it is difficult to translate financial data from other countries because different GST rates (Germany 19%) and Government subsidies for renewal energy.

In addition to the capital cost of any biomass plant, there will be capital cost in the equipment for harvesting and transport of thinnings. These systems are widespread in Europe but may need adaptation to Australian western forests. Equipment used in Australian softwood plantations for biomass extraction and chipping residues from routine harvesting operations, is probably too heavy duty and costly for use in cypress. This is a further aspect needing investigation. The forestry operations research group at University of Southern Queensland is well equipped to advise on this aspect.

Estimates of the annual supply from thinnings and harvesting residues will need to be made by the Forestry Corporation and consultants. IFA understands that the mean annual increment of western forests, mainly cypress, is in the order of 0.5 M3 per ha per year. On this basis the forests of Zone 3 could produce 47,500 m3 per year of all timber products, ie sawlogs and biomass.

Thinning need not be restricted to the MAI as there is a backlog of forest which would benefit from a thinning program, over the initial period, say 15 years. However, setting the annual volume for thinning needs to take into account the long term advisable supply, and amortization of capital costs of facilities, established on the basis of a timber supply.

A supply level at 20,000 tonnes per year of biomass from Zone 3 would appear a conservative approach, which on the small scale plant strategy discussed above, could support 3 or 4 plants.

At a thinning harvest of say 30 tonnes per hectare, the annual area harvested would be in the order of around 700 ha per year. At this rate the whole area would be covered in 135 years.

Costs and returns

It may be that the cost of establishing and operating a small scale biomass plant for heat and power would by higher than the returns from sale of heat and power, under current pricing arrangements based on fossil fuel based energy. However, the expected long term trend is that renewable energy will close the cost gap with fossil fuel energy and may become the future favoured source of energy.

The potential gas supply from Pilliga is a potential competitor to the forestry initiative. The potential coal extraction from the Liverpool plains is another potential competitor.

What needs to be analysed is the trade-off between thinning the forests non-commercially versus thinning for use in a commercial biomass application, which is employment generating in rural areas, and has longer term prospects of being profitable.

The prospect of self-sufficiency for renewable energy may be quite attractive for the communities in the area under consideration.