On charcoal, the increased intensity of logging and a flawed Environmental Assessment process

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ABSTRACT

Emerging forest industries, such as charcoal-making (for silicon production) and biomass burning for power generation, pose a significant threat to the ecological integrity of native forests. These industries require large amounts of wood and, where extracted from native forests, will lead to an increase in the intensity of logging. An outcome will be the cumulative loss of stand structural complexity—a problem that has had serious consequences for the conservation of biodiversity in northern hemisphere forests and would have similar deleterious impacts in Australia. It also runs counter to the notion of ecologically sustainable forest management (ESFM), which lies at the core of the Regional Forest Agreements. These fundamental ecological issues, which were not identified in the Environmental Impact Statement (EIS) for a recent proposal to log native forests to produce charcoal in southern New South Wales, point to a seriously flawed EIS process.

Introduction

There was an intense public debate over a charcoal-making facility that had been proposed for Mogo on the south coast of New South Wales. Over 1590 public submissions were received—a record for any development proposal in the state (P. Toni, Solicitor, Environmental Defenders Office, personal communication). By April 2003, the company responsible for the construction of the plant had withdrawn from the project, but was reportedly seeking a new location. From an ecological perspective, the problems associated with the proposal run much deeper than simply the location of the plant (which was the focus of the Environmental Impact Statement [EIS] for the Mogo proposal). Instead they lie primarily with the large volumes of additional timber (often termed 'waste') removed from native forests to meet the new demand and the associated effects on forest biota. Similar issues have arisen in areas where large-scale woodchipping was introduced to supply pulpwood markets. In this paper we identify ecological issues associated with the increased intensity of forestry practices in native forests. In addition, comments are made on the inherent problems with the NSW EIS process.

The intensification of logging, logging 'waste' and stand simplification

There has been a general expectation in some elements of the wood products industry that there will be an "intensification of harvesting operations" following the signing of Regional Forest Agreements (Bauhaus 1999). The increased intensity of logging operations may occur in two ways: (1) the removal of greater timber volume per unit area, predominantly by making greater use of previously unmerchantable wood through the development of new industries or technologies (e.g. woodchipping for pulp, charcoal production, biomass burning,) [1] and (2) managing the forest with silvicultural treatments such as gap creation, thinning, shorter rotations or the sowing or planting of selected tree species to enhance forest productivity. For example, the charcoal-making facility, recently abandoned in southern NSW, proposed an increase in wood production from the existing quota struck under the Regional Forest Agreement of approximately 150,000 tonnes per year (Commonwealth of Australia and State of New South Wales 1999) to about 350,000 tonnes per year to meet additional demand for the charcoal-making plant (Environment Resources Management Australia 2001). Thus, over double the volume of timber would have had to be found from within the same area of forest. Notably, the EIS for this proposal did not address this issue.

The suggestion that large volumes of additional wood can be removed from forests with minimal impact ignores the key values of large, old or decaying trees (that are "defective" from a timber production viewpoint) and large logs as habitat for wildlife. It also ignores their values as integral components of forest productivity and important stores of carbon (to mitigate the impacts of global warming). Defective trees (or habitat trees from an ecological

[1] In the case of the proposed charcoal plant on the south coast of NSW, initially it was claimed that only the butts and lateral branches of trees (so-called forest waste) would be taken to supply wood to the charcoal-making factory (Environmental Resources Management Australia. 2001). However, it was questionable whether there was sufficient volumes of material available to meet the factory's requirements. In addition, the wood transport infrastructure (conventional log trucks) did not appear to be suited for moving the butts and lateral branches of trees; nor was the planned specifications for the factory (see Environmental Resources Management Australia. 2001) geared toward storing this type of material. It was not surprising then that documents subsequently obtained from the relevant organisations indicated that whole logs and not just so-called logging waste was to be used in charcoal-making (P. Toni, Chief Solicitor, Environmental Defenders Office).

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standpoint) are often decayed and contain hollows—a vital habitat resource for approximately 300 vertebrate species in Australia's forests and woodlands (Gibbons and Lindenmayer 2002). There also is an unknown, but undoubtedly large number of invertebrates dependent on these sorts of trees. They must be retained at a relatively high density to conserve wildlife in wood production zones (Gibbons and Lindenmayer 2002). Indeed, recent studies have found that the number of trees with hollows that occur, and will be perpetuated, on logged sites is negatively associated with such inter-related factors as the intensity of logging, the total number of trees retained after each logging, the length of the logging rotation, and the intensity of post-logging fire used to treat the site after harvesting (Gibbons and Lindenmayer 2002).

Similarly, there are many important ecological roles of logs and fallen branches in native forests. It has been estimated that dead wood (including logs) provides habitat or has other functions for more than 20% of all forest-dependent organisms worldwide (Hunter 1990; Grove 2001) and such structures are likely to be similarly important in Australian forests (Grove *et al.* 2002; Lindenmayer *et al.* 2002). Some of the roles of logs and fallen branches include (after Lindenmayer *et al.* 2002): **(1)** providing nesting and sheltering sites for wildlife, **(2)** providing foraging substrates for such vertebrate predators as snakes and predatory invertebrates such as velvet worms, **(3)** providing basking and hibernation sites for reptiles, **(4)** facilitating animal movement, **(5)** providing places for key animal social behaviour, **(6)** acting as plant germination sites, **(7)** providing substrates to promote the growth of fungi, **(8)** providing mesic refugia for organisms during drought and/ or fire, **(9)** contributing to heterogeneity in the litter layer and patterns of ground cover, and, **(10)** playing significant roles in nutrient storage and nutrient cycling.

Although existing fallen trees would not be used to make charcoal or to fuel biomass burning plants, the associated increased intensity of logging is a potentially major threatening process for log resources for several reasons. The most important one is that the limited number of large senescent trees from intensively harvested stands would impair the recruitment of large logs to the forest floor. In addition, more extensive movements across harvesting areas by logging machinery to collect more timber, as well as the application of intensive broadcast regeneration burns, have the potential to significantly alter the characteristics of forest floor environments including fallen tree and decaying log resources (reviewed by Lindenmayer *et al.* 2002). Notably, Lindenmayer *et al.* (2002) found few well developed harvesting prescriptions for the maintenance of log habitats in wood production forests anywhere in Australia (but see Department of Conservation and Land Management 1995; Forestry Practices Board 1998).

Defective trees, and logs on the forest floor, are key components of what is termed stand structural complexity. Lindenmayer and Franklin (2002) define stand structural complexity as: the presence of key structural attributes in stands (e.g. large diameter trees and logs, thickets of understorey, and canopy gaps) and the spatial arrangement of those attributes. Stand structural complexity is a feature characteristic of all natural temperate forests throughout the world (Franklin *et al.* 1981; Berg *et al.* 1994; Noel *et al.* 1998; Lindenmayer *et al.* 2000). The increased intensity of harvesting practices can significantly reduce stand structural complexity (see Linder and Östlund 1998 for a Swedish example).

Stand simplification is a major problem for biodiversity conservation for several ecological reasons (Lindenmayer and Franklin 2002). They are: **(1)** it can result in the reduction or removal of structural attributes that are essential nesting, sheltering and foraging sites for elements of the biota and thereby eliminate organisms from logged areas that might otherwise persist there; **(2)** it can prolong the period that logged and regenerated stands remain unsuitable habitat for displaced species; and **(3)** it can impair the dispersal of some animals through logged areas.

Lessons from forests of the northern hemisphere

Stand simplification has been recognized as a major problem for the conservation of biodiversity and the maintenance of ecological processes in managed forests all over the world (Recher 1985; Franklin *et al.* 1997; Linder and Ostlund 1998; Bunnell 1999), and in some places such as Germany for more than 100 years (Gayer 1886). Sweden is a classic example. The forests have been altered radically as a result of years of highly intensive and often inappropriate forest management (Angelstam 1996). Swedish forest ecologists now take Swedish forest managers to Russia (where the history of harvesting is shorter and harvesting has been much less intensive) (Angelstam *et al.* 1995) to show them what Swedish forests used to look like and highlight the types of structural complexity that needs to be restored to conserve a raft of endangered species (P. Angelstam personal communication).

The enormous task of restoring the complexity of degraded and highly simplified native forests is not confined to Sweden; there are equivalent projects in an increasing number of other European nations as well as in many parts of north-eastern and north-western North America (e.g. Carey *et al.* 1999). For example, thousands of artificial nest boxes have now been erected in European and North American forests in the absence of natural hollows. Nest boxes added to forests in Germany throughout the 1950s to provide habitat for insectivorous birds to assist the control of defoliating insects. This resulted in a 5-20 fold population increase in some bird species (Bruns 1960). Approximately 5000 nest boxes have been erected in Manitoba since 1959 in an attempt to recover declining populations of Bluebird (*Sialia*) species (Munro and Rounds 1985). The erection of nest boxes comes at great cost: McKenney and Lindenmayer (1994) estimated that the cost of providing artificial hollows in a forest could exceed the revenue obtained from extracting timber.

In parts of north-western North America it has been recognised that intensive logging operations can have serious negative impacts on stand structural complexity. Consequently, alternative silvicultural systems to such traditional ones as clearfelling (e.g. the Variable Retention Harvest System) have been recommended (Franklin *et al.* 1997). Major timber companies such as Weyerhauser Ltd. have now made a transition from widespread clearfelling toward more ecologically-sensitive harvesting regimes, even within important wood production areas such as Vancouver Island in British Columbia. Under these harvesting regimes, significant numbers of key structural elements (including trees, understorey and fallen decayed trees) are retained within harvested areas to promote biodiversity conservation and other environmental values – while still extracting timber and pulpwood (Beese and Bryant 1999; Dunsworth and Beese 2000). Similar approaches to less intensive methods of harvesting forests are being embraced in many other parts of the world including the USA (Forest Ecosystem Management Assessment Team 1993), Sweden (Fries *et al.* 1997), Chile and Argentina (Arroyo *et al.* 1996; Franklin in Lindenmayer and Franklin 2002). Reduced Intensity Logging (RIL) is also being adopted in an increasing number of tropical wood production areas (Putz *et al.* 2000). The problems of stand simplification are not confined to the northern hemisphere, as the example from Eden, NSW, illustrates.

Increased logging intensity and the simplification of stand structure at Eden

Part of the rationale given for large-scale industrial projects like charcoal-making and pulp mills is that they utilise unmerchantable wood that is left on the forest floor as a byproduct of existing logging practices. However, this is clearly not the case in Eden, in south-eastern New South Wales, where a large woodchip market opened in 1968 (Dargavel 1995). Increased commitment of timber at Eden forced forest managers to extract a greater volume of wood from each unit area. This necessitated the adoption of modified clearfelling over the predominant silvicultural system of single-tree and group selection logging that was previously employed in these forests—and remains the predominant silvicultural system elsewhere in New South Wales' forests.

The consequences of this increased intensity is reflected in the availability of tree hollows—a key habitat resource to approximately 45 vertebrate taxa in this region. An average of 22 hollow trees per hectare occur on unlogged sites dominated by Messmate *Eucalyptus obliqua*, Brown Barrel *E. fastigata* and Mountain Grey Gum *E. cypellocarpa* in the Eden region compared with three per hectare on comparable logged sites (Gibbons 1999) (Figure 1). It was estimated that 7-14 hollow-bearing trees per ha are utilised by vertebrate fauna in these forests (Gibbons 1999).

Furthermore, we predict that the mean diameter of trees retained on logged sites will decline over time under the predominant silvicultural system presently employed in the Eden area. A simulation model (Gibbons 1999), parameterised with: (1) data on the rates of growth of Brown Barrel and Messmate in these forests (Gibbons *et al.* 2000a), (2) the number and diameter distribution of

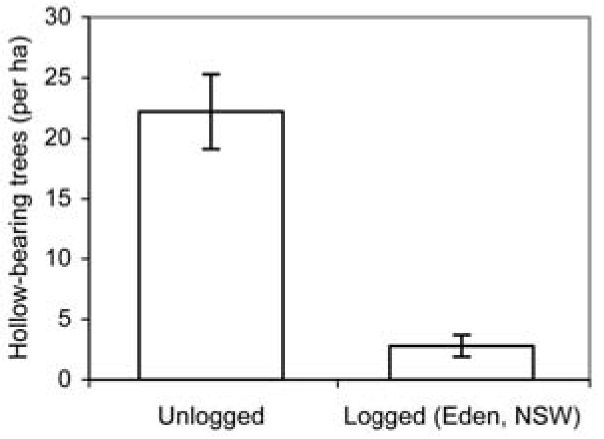

Figure 1. The number of hollow-bearing trees (mean ± 95% confidence intervals) observed on unlogged and logged sites in damp sclerophyll forest dominated by Brown Barrel, Messmate and Mountain Grey Gum in the Eden region of NSW.

trees retained on logged sites dominated by these species (Gibbons *et al.* 2000b), (3) the observed rate of mortality among these trees after logging and slash-burning (Gibbons *et al.* 2000b), and, (4) the length of the logging cycle in these forests (30 years) (SFNSW 1994) indicated a downward trend in the average diameter of trees retained on logged sites over a period of 200 years (Figure 2). Large trees are a critical habitat resource for species that depend on hollows (Gibbons and Lindenmayer 2002), they produce concentrated supplies of nectar and pollen, represent an important foraging substrate for bark gleaning species (Recher 1991) and large trees are required to perpetuate the supply of large logs to the forest floor (Lindenmayer *et al.* 2002). Thus, large trees are an important component of structural complexity in forest ecosystems.

If proposed large-scale industrial uses of Australian forests, such as charcoal plants and wood-fired power stations, become established it will be clear that policy-makers and forest managers in this country will have not learned from the mistakes made elsewhere in the world, nor will they have learned from the problems in such parts of Australia as Eden.

Logging 'waste', carbon storage and the greenhouse effect

Some advocates of projects to burn large quantities of wood from native forests (such as biomass generation plants) have argued that burning so-called forest waste would have positive outcomes for mitigating the greenhouse effect. In a forest ecosystem, carbon is stored in living plants, dead plants, and in the soil. Most carbon is found in the woody biomass of trees (i.e. in the tree trunks, branches and roots of living trees). The older a living tree, the more carbon it stores. Older forests also support large amounts of woody debris (i.e. dead wood in standing dead trees and trunks and branches on the forest floor). Commercially logged forests store much less carbon than unlogged forests (between 30-50% less depending on forest type, forest age, and the intensity of past logging

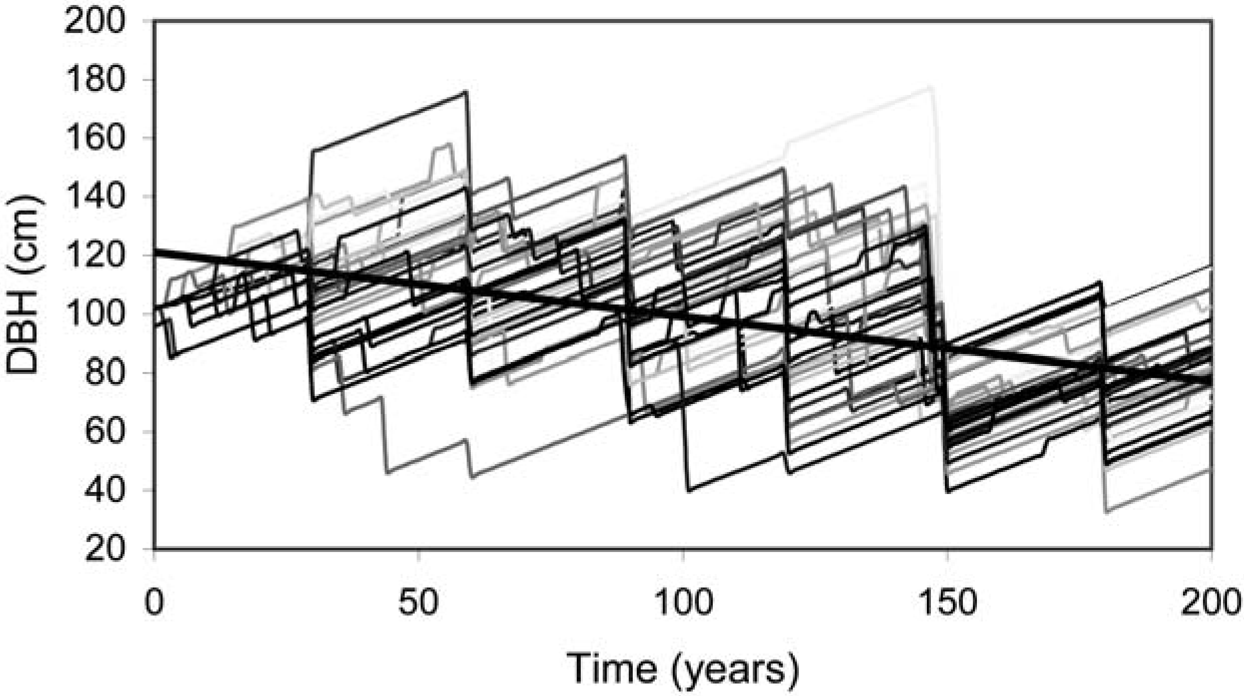

Figure 2. A simulation of the trend in mean diameter at breast height (DBH) among habitat trees retained on logged sites in forests dominated by Messmate and Brown Barrel over 200 years. The fine lines represent 30 separate runs of the model with the trend line fitted using linear regression in bold.

operations) (Woldendorp 2000). When a mature forest is logged, it takes many hundreds of years to restore original levels of stored carbon. Therefore, the greenhouse problem cannot be solved by burning biomass cut and gathered from native forests. This is not to say there is no role for biomass energy in addressing the greenhouse problem. Biomass burning can be a greenhouse-friendly source of fuel if: (1) the biomass is harvested from a plantation, (2) the land where a plantation is established was not forested (e.g. it was cleared farmland), and (3) the energy produced is a substitute for an equivalent amount of fossil fuel.

Ecologically sustainable forest management versus the intensification of harvesting

Ecologically sustainable forest management (termed ESFM) is an essential requirement of the Regional Forest Agreement process under which the terms and conditions of current forest use on the south coast of NSW were negotiated. ESFM is also a fundamental part of national and international agreements on forest management such as the National Forest Policy Statement (signed by the Commonwealth and the States in 1992) and forest certification documents like the Montreal Criteria and Indicators signed by Australia in the late 1990s (Commonwealth of Australia 1997). Lindenmayer and Recher (1998) defined ESFM as:

"perpetuating ecosystem integrity while continuing to provide wood and non-wood values; where ecosystem integrity means the maintenance of forest structure, species composition, and the rate of ecological processes and functions within the bounds of normal disturbance regimes"

As this broad definition of ESFM indicates, the notion of significantly simplifying the structure of forests so their habitat value for a wide range of biota is diminished would be contrary to the concept of ESFM. Indeed, the intensification of harvesting practices and large scale industrial forestry projects in Australian native forests ignores the fundamental importance of structural attributes of native forests and the critical ecological roles they play. The removal of so-called waste wood for these projects is neither "cleaning up the forest" nor "value-adding" (*sensu* Leech 2001), but rather is tantamount to ecological "value-subtracting" and not consistent with the principles of ESFM.

Flaws in the Environmental Impact Statement process

The environmental impact statement (EIS) for the proposed charcoal factory (Environmental Resources Management Australia 2001) was, in our opinion, a flawed document that failed to address key concerns relating to the intensive harvesting of the surrounding forest. Importantly, the EIS for the proposed charcoal factory could not be considered to be an independent document that fully evaluated the true array of environmental and other issues associated with the proposal. Part of the problem lies with the current EIS process *per se* – the EIS process is a proponent-managed one. That is, the proponent of a particular project either completes the assessment "in-house" or contracts a consulting company to write the EIS. The proponent-driven process often delivers the outcomes desired by the proponent and therefore often fails badly in what it is supposed to do. It is notable that a major review of EIS documents by Buckley

(1989, 1991) showed that few were accurate in their forecasts of impacts (or lack thereof). These factors give the current EIS process limited credibility and probably result in more development proposals being contested in the courts than might otherwise occur if the process was a more rigorous and independent one.

As highlighted earlier, the EIS for the proposed charcoal-making factory at Mogo did not address the impacts of intensified timber harvesting practices in the wood supply catchment. It was stated that these issues had been addressed in the Regional Forest Agreement (RFA) signed off for the Southern Region of NSW. However, the RFA had been prepared on the basis of less than half of the volume of timber than was proposed for harvesting under the charcoal proposal. This is a critical oversight because the increased intensity of logging operations would have been essentially a new form of harvesting and its impacts (although likely to be substantial) had not yet been subject to detailed assessment. Moreover, the likely unsustainability of intensified forestry practices associated with proposed charcoal-making factory (and the contravention of ESFM principles) should have been identified in the EIS process. The lack of independent and truly objective assessment in this seriously-flawed process was one of the factors that stalled this proposal.

The ecological issues raised by the EIS for the charcoal factory, together with the generic underlying problems of the EIS-process *per se*, means that a new approach to handle forestry proposals is clearly warranted. This should involve an independent body (that is not at the mercy of vested interests both within and outside government) that is required to commission truly independent environmental analyses.

In taking the term "environmental impact statement" in a literal sense, we believe that where the environmental impacts could be substantial, but have yet to be adequately quantified, there should be a mandatory requirement for long-term impact research (which is independently assessed). In the case of proposed industrial-scale forestry activities, such as charcoal-making factories and biomass burning power stations, the impacts of increased intensity of forestry operations both on stand structure and associated elements of biodiversity need to be quantified over relevant time frames (at least several decades and usually much longer). This would lead to a true environmental impact statement; that is, quantifying the impacts on the environment of a development and a rigorous evaluation of the management changes after the operation has commenced. However, to date there have been very few detailed and scientifically credible impact studies of any form of logging completed anywhere in Australia. Indeed, the Resource Assessment Commission (1992) noted that virtually every one of the more than 75+ major inquiries into the timber industry since the Second World War has concluded that not enough is known about logging impacts. This is a major knowledge gap that is thwarting the improvement of forest management practices in Australia, and in turn, contributing to ongoing conflict over the management of nation's native forests (Resource Assessment Commission 1992).

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APPENDIX I

Field lecture in southern Sweden where the role and importance of stand structure is being discussed by Swedish forest ecologists and forest managers near Grimso.

Photo: D. Lindenmayer

High-intensity mechanised logging in native forests near Grimso, southern Sweden.

Photo: D. Lindenmayer

Senior Forest Manager for the Koumi Province in Russia.

Photo: D. Lindenmayer

Post wildfire regenerating Taiga forest in the Koumi Province, Ural Mountains, Russia, showing extensive structural complexity of the forest floor environment.

Photo: D. Lindenmayer