

NEFA Submission to: Remake of the Coastal Integrated Forestry Operations Approvals, Discussion Paper.

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SUMMARY

The forests of north-east NSW have been identified as being of outstanding international, national and state value for threatened biodiversity. They encompass the Gondwana Rainforests of Australia World Heritage property. They are part of one of the world's 35 biodiversity hotspots because of their exceptional species endemism and the threat of habitat loss. They include part of one of Australia's 15 recognised biodiversity hotspots, the „Border Ranges North and South (Queensland and New South Wales)“. They also contain the most plants and animals threatened with extinction in New South Wales.

While logging is of questionable economic worth to the people of NSW, north east NSW's forests provide direct economic benefit to NSW because of the extremely high economic returns from recreation and tourism, regulation of stream flows, and maintenance of water quality. Their storage and sequestration of carbon is a significant benefit to the people of NSW, with the urgent necessity of increasing carbon sequestration and storage driving a potential environmental and economic windfall from forest conservation. Public forests need to be managed to enhance these values, not just for timber extraction, and they should be accounted for in the Integrated Forestry Operational Approval (IFOA).

The IFOA and its Threatened Species (TSL), Environment Protection (EPL) and Fisheries (FL) licences are the mechanisms under the North East NSW Regional Forest Agreement (RFA) for providing needed protection for *Environment and Heritage Values*. The intent was to use this as the mechanism for protecting oldgrowth forest, rainforest, poorly reserved ecosystems, and key habitats from logging, while regulating all threatening activities on public lands, not just logging. Similarly the agreement was that the IFOA is the mechanism for protecting sites of cultural and heritage significance. The IFOA should not now exclude heritage and be limited solely to logging.

The current reserve system in north-east NSW does not satisfy the national reserve criteria, with those forests excluded from logging by the IFOA counted as contributing to the national reserve system. Even then rigorous off-reserve management is essential to provide needed protection for the numerous inadequately reserved plants and animals that are threatened with extinction, including by logging. Existing prescriptions need to be strengthened, not weakened.

The Forestry Corporation have proven time after time that they will not willingly provide the needed protection for threatened species and ecosystems, nor implement the requirements to limit soil erosion and stream pollution. More rigorous prescriptions and independent regulation are required, not less. The requirements for surveys and the identification of core habitats for threatened species and ecosystems need to be undertaken independently of the Forestry Corporation.

The current over-allocation of large and small sawlogs from north-east NSW is driving unsustainable logging and must be stopped as a high priority in order for any management system to be successful. Similarly the dieback affecting tens of thousands of hectares of north-east NSW's public forests needs to be urgently redressed in the IFOA, as it is destroying ecosystems and forest productivity.

CONCLUSIONS:

The EPA needs to recognise that north-east NSW still does not have an adequate reserve system that satisfies the ecosystem and biodiversity targets for the national reserve system. The Informal Reserves and values protected by prescriptions identified for protection in the IFOA are taken to be an integral part of the CAR Reserve system for the purposes of the Regional Forest Agreement. Management Plans for these areas are required before restrictions on detrimental activities (other than logging) are removed. Even then the poor attainment of reservation targets for numerous ecosystems and threatened species highlights the need for strengthening off-reserve prescriptions rather than weakening them.

Managing Threatened Species and Ecosystems

The Forestry Corporation have proven time and time again that they will not protect environmental values unless expressly required to do so, and even then only when they are subject to rigorous independent auditing.

The current Threatened Species Licence was developed as part of the Comprehensive Regional Assessment process as a means of adequately protecting threatened species and implementing Ecologically Sustainable Development in accordance with the requirements of the National Forest Policy Statement. It was included as part of the IFOA and adopted as an outcome of the State-Commonwealth Regional Forest Agreement.

The prescription for the nationally endangered Hasting's River Mouse was dramatically weakened in 2011 without monitoring or justification. Protection needs to be restored and made consistent with its recovery plan.

It is outrageous that by dropping survey requirements and species-specific prescriptions that the EPA is intending to allow areas already identified and protected as species-specific exclusion areas to be logged. NEFA considers it imperative that all threatened species exclusion zones already identified and mapped in harvesting and other plans as the result of current and previous prescriptions must be retained and not made available for logging.

It is important to base any system of retained habitat at a landscape scale upon those areas that have been protected for the past 15 years as part of the TSL exclusion areas, including those for rainforest, oldgrowth forest, riparian habitat, wetlands, rare ecosystems, wildlife corridors and threatened species habitat.

Application of the Forest Practices Authority's Tasmanian template to NSW will result in a major loss of existing landscape protection provisions, not an enhancement of them. The Tasmanian code is not a suitable basis for managing NSW forests.

It is evident that the current process is dysfunctional because of the Forestry Corporation's frequent failures to identify and protect areas requiring protection under current landscape provisions of the TSL. The on-ground work required to refine mapped exclusions by identifying wetlands, rock outcrops, threatened species exclusions, core Koala habitat and endangered ecological communities needs to be undertaken independently of the Forestry Corporation. This would most effectively be undertaken in conjunction with the flora and fauna surveys.

NEFA opposes EPA proposals to allow logging of Endangered Ecological Communities. These need to be mapped for protection in independent pre-logging surveys as part of a landscape approach.

NEFA recommends the EPA improve the sustainability of logging operations by requiring the retention and protection of all large old trees (>100 years old) for their outstanding biodiversity and heritage values.

The maintenance and restoration of large old hollow-bearing trees in perpetuity is the single most important requirement for ecologically sustainable forestry. Despite requirements being specified for the retention of hollow-bearing trees, and recruitments to grow into the hollow-bearing trees to replace them when they die, the achievement of requirements are often grossly inadequate and there appears to be a war of attrition being waged against hollow-bearing trees. Prescriptions need to be simplified by requiring the retention of all remaining large old trees and the retention of sufficient recruitment trees to restore a scattering of large old trees across the landscape. For ecological sustainability the exemption applied to the coastal forests from having to restore minimum densities of hollow-bearing trees needs to be removed.

The existing prescriptions aimed at protecting minimum numbers of key food trees across the landscape, notably for nectivorous species (such as honeyeaters), Koalas, and Yellow-bellied Gliders, must be maintained. Maintaining mature trees for these key food resources must remain the focus of the prescriptions. The landscape feed tree prescription for the Koala should apply to the trees larger than 30cm diameter that they actually feed on to stop the Forestry Corporation continuing to meet this need by using trees too small for Koalas to eat.

It is evident that the Forestry Corporation are often not undertaking the required surveys for threatened species and that when they are undertaken it is often by inadequately trained people. Much of the \$1.7 million per year of public money being reportedly spent on these inadequate surveys is being wasted on inferior work. Rather than abandoning pre-logging surveys and needed protections for an array of threatened species, it would be more cost-effective for an independent third party (such as OEH) to employ consultants to undertake the required surveys and identify areas to be excluded from logging. Forests could be assessed on a catchment basis, rather than in an ad-hoc manner.

Any review of prescriptions needs to be undertaken in a transparent manner using independent and balanced expert panels for each fauna group (mammals, birds, reptiles, amphibians) and plants, overseen by the EPA, to review prescriptions to improve their performance. Any reductions in prescriptions due to timber demands must be openly justified.

There needs to be explicit performance measures identified for flora and fauna prescriptions, with regular auditing of the outcomes of those prescriptions by independent experts to assess their effectiveness in achieving the intended protection, and improvements implemented. Monitoring should be a means of reviewing and improving specific prescriptions, not an alternative to them.

Managing Water Values

Regulating forestry operations to try to force compliance with erosion mitigation conditions was found to be necessary in 1992 after over 17 years of abuse by the Forestry Corporation. The exemption of over 90% of logging operations from the ambit of the EPL in 2004 during an EPA prosecution has resulted in a return to the bad old days. The EPA's intent to now make most EPL conditions variable and voluntary, and their allowance of logging on excessively steep and erodible slopes, is grossly irresponsible given that the Forestry Corporation has proven it can not be trusted to implement the prescriptions voluntarily.

It is important not to abandon the science that was intended to underpin erosion mitigation conditions. It was wrong for most forestry operations to have been excluded from the ambit of the Environment Protection Licence in 2004. Rather than further weakening of conditions the erosion mitigation prescriptions need to have their integrity restored by being subject to independent expert review, using explicit performance measures, to identify appropriate constraints to reduce erosion and stream pollution in light of contemporary logging practices, recent science and climate change.

Existing buffer requirements for mapped and unmapped streams, wetlands and swamps are grossly inadequate, most particularly on steeper slopes and highly erodible soils, and need to be significantly increased in accordance with scientific recommendations. For buffers to be effective disturbances to them must be avoided where possible.

The EPA needs to recognise that logging has significant impacts on water yields from native forests, such that:

- a. Reduction of mature and oldgrowth forest to younger growth stages will cause a significant reduction in water yields;
- b. Water yields will increase with increasing forest maturity; and,
- c. Logging should be excluded from significant water catchments.

Water yield from forests has a real value to regional communities which increases with time since logging. Managing logged forests to increase the stocking of older and larger trees over time provides for increasing water yields and benefits for downstream users, aquatic ecosystems and aquatic species. The monetary value of water depends on the downstream uses of the water, with those waters used for urban water supply being the most valuable. Because the highest value of forests within water catchments used for urban water supplies is the provision of clean and reliable drinking water the EPA should exclude such forests from logging.

Audits have revealed that, if at all, Forestry Corporation are undertaking deficient Aquatic Habitat Assessments that routinely omit endangered fish, fail to collect adequate water data, and use inappropriate sites. Forestry Corporation's continuing refusal to consider the endangered Oxleyan Pygmy Perch on the grounds that Fisheries NSW have still not provided the required distribution maps is untenable for both organisations.

To ensure that threatened fish are responsibly dealt with and treated in a more sustainable manner, an independent body (such as OEH) needs to employ suitably qualified people to prepare Aquatic Habitat Assessments and to apply the intent of the Fisheries Licence. The

Fisheries Licence needs to be amended to make its intent, to minimise eroded soil entering streams and affecting populations of threatened fish, clear and legally enforceable.

Maintaining and Enhancing Carbon Storage

Forests recovering from logging will sequester carbon and increase the volume stored in both living biomass and soils. Most importantly the retention of older trees is of utmost importance in maintaining and enhancing a forest's carbon storage and sequestration.

The EPA needs to recognise that logging has significant impacts on carbon storage in native forests, such that:

- a. Loss of mature and oldgrowth trees will cause a significant reduction in carbon storage and sequestration in forests;
- b. Carbon storage and sequestration will increase with increasing forest maturity;
- c. Large trees are particularly important for carbon storage and sequestration; and,
- d. Forests should be managed so that they are carbon sinks.

The EPA needs to recognise that using the forests to generate carbon credits will generate greater aggregate net benefits to the community than harvesting. Prescriptions that require increased retention of core habitat across the landscape, large old hollow-bearing trees, the enhanced food resources provided by mature trees, and the restoration of multi-age forests, enhance the carbon storage within native forests. The avoidance of emissions from retaining these trees, and their ongoing carbon sequestration, provides a higher benefit to the people of NSW than logging them.

Dealing with Dieback

Despite the clear recognition of Bell Miner Associated Dieback as a serious threat to the survival of numerous forests and ecosystems across NSW, the Forestry Corporation continue to refuse to identify affected areas in their harvest plans and deliberately target such areas for increased logging intensity to remove the surviving trees. The EPA have repeatedly refused to force the unwilling Forestry Corporation to recognise and manage these areas in accordance with the ESFM requirement to maintain healthy ecosystems. Now they are proposing removing the unmet need for weed management plans, along with silvicultural restrictions on logging intensity in affected areas.

Bell Miner Associated Dieback is a major threat to the sustainability of many forest ecosystems over large areas of north-east NSW, and appears to be rapidly worsening. Tens of thousands of hectares of forest in north-east NSW are affected and millions of hectares are vulnerable. It is a serious threat that has been procrastinated over for far too long.

The EPA need to recognise that Bell Miner Associated Dieback is associated with logging opening up the canopy and understorey disturbance promoting lantana (or other low vegetation), which in turn favour Bell Miners who aggressively exclude other birds and thereby facilitate outbreaks of sap-sucking insects which kill the trees. BMAD is degrading, and increasingly destroying, both forest ecosystems and forest productivity.

For over 60 years the growing problem of Bell Miner Associated Dieback has been procrastinated over despite the clear evidence that it is being facilitated by the opening of the canopy by logging and the consequent spread of lantana facilitated by machinery disturbance and burning. BMAD affected forests are being targeted for increased logging intensity without monitoring or rehabilitation works.

The EPA is requested to support a sustainable approach to the key threatening process Bell Miner Associated Dieback by recommending an urgent moratorium on logging in and adjacent to BMAD areas until such time as rehabilitation strategies for restoration of ecosystem health are implemented.

Forestry Corporation are targeting Bell Miner Associated Dieback Areas for removal of all healthy remaining trees and then abandoning them to their fate as destroyed ecosystems. A sustainable response to Bell Miner Associated Dieback involves:

- a. Identifying and mapping all affected and susceptible areas;
- b. Placing all affected and susceptible areas under a logging moratorium until such time as appropriate management responses that restore ecosystem health and functioning are identified;
- c. Undertaking rehabilitation works (i.e. lantana control) in affected stands; and,
- d. Monitoring effects of any treatment and refining methods before repeating it.

Implementing Sustainable Yields

The available supplies of both large and small sawlogs from north-east NSW's public forests are grossly overcommitted, and the current policy of liquidating the large sawlog resource and over-logging small sawlogs is severely compromising the future productivity of public forests and their ability to provide high-value products. This gross over-commitment is also driving the frequent breaches of existing prescriptions and the wind back of prescriptions now underway.

NEFA recommends that the NSW Government make two fundamental changes in timber resource allocation from State Forests to improve its sustainability;

- The urgent reduction in allocations of sawlogs down to the estimated long-term sustainable yield and the refocus of silviculture from liquidating the large sawlog resource to sustaining it in multi-aged forests.
- A reduction in yields commensurate with the additions necessary to establish a truly Comprehensive Adequate and Representative reserve system and the establishment of truly ecologically sustainable management practices.

The EPA is now proposing that existing limits on clearfelling and intensive logging be removed, along with prohibitions on the logging of slopes over 30 degrees. These are major losses for sustainability and long sought wins for the loggers after short-term windfalls.

In order to improve the sustainability of logging it is necessary to prohibit clearfelling and have a prime silvicultural objective for state forests of maintaining or restoring structurally diverse forests, with trees through a natural range of size classes and species, including those trees needed to meet standards set for wildlife habitat, food and recruitment trees.

Non-logging Activities

The IFOAs were always intended to appropriately regulate all activities being undertaken on public lands as this is a basic premise of ESFM and a requirement of the RFA, it is reprehensible that the EPA are intending to remove regulation from all activities conducted on State Forests other than logging.

It is not acceptable for the EPA to now remove cultural heritage from the ambit of the IFOA as it is a requirement of the Regional Forest Agreement. The onground activities of the Forestry Corporation have been found to have significant impacts on sites of cultural and heritage significance, and it is these on-ground operations that need to be appropriately regulated through the IFOA.

The EPA needs to recognise that grazing has significant impacts on streams, vegetation, threatened plants and the habitat of many native animals. Instead of removing grazing from the ambit of the IFOA the EPA should ensure that existing requirements to prepare grazing management plans are honoured (better late than never), ensure that existing requirements for no expansion of grazing on public lands are maintained, and that grazing is excluded from riparian areas and wetlands.

Forest Regulation

Allowing the Forestry Corporation to undertake their own environmental assessments has been a costly failure. There is a need to separate the environmental requirements from the commercial objectives of the Forestry Corporation. One way of achieving this is to task a separate body with undertaking the required flora and fauna surveys and mapping areas required for exclusion or modified harvesting before logging. Regulatory and audit functions could still be undertaken by the EPA, though there need to display more professionalism and independence.

There had been a regulatory failure on behalf of the EPA to redress the frequent and repeated flouting of NSW's environmental laws by the Forestry Corporation. They are a failed regulator. Their current proposal to reduce regulation will compound existing problems and significantly worsen outcomes.

Stronger deterrents and more effective regulation are required to stop the Forestry Corporation from routinely causing environmental harm. The EPA needs to recognise that, for Forestry Corporation to implement them, and EPA to enforce them, logging prescriptions need to be made clearer, unambiguous, capable of auditing, and clearly enforceable. The penalties applied to breaches of the Threatened Species Licence are not commensurate with the environmental harm caused and are grossly inadequate to act as a deterrent. To be effective penalties need to be increased to reflect the gravity of the offence. There is also a need to require active rehabilitation of illegally logged areas and protection of compensatory habitat.

It is suggested that the IFOA review consider the issue of public forest management arrangements and recommend further separation of policy and regulation from forestry operations. It would be far more efficient and effective for the threatened species assessments to be undertaken by a separate body. Any such system would be enhanced by allowing members of the public third party appeal rights.

It is already open to the Forestry Corporation to take action against contractors for not complying with the conditions of the IFOA, licence requirements and Harvesting Plans through their contracts, though they rarely do. Contracting companies can simply go bust to avoid any penalties. It is essential that the Forestry Corporation remain responsible for breaches committed under their supervision if there is an intent to improve supervision of forestry operations.

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1. Introduction

The forests of north-east NSW have been identified as being of outstanding international, national and state value for threatened biodiversity. They encompass the Gondwana Rainforests of Australia World Heritage property. They are part of one of the world's 35 biodiversity hotspots because of their exceptional species endemism and the threat of habitat loss (Williams *et.al.* 2011). They include part of one of Australia's 15 recognised biodiversity hotspots, the „Border Ranges North and South (Queensland and New South Wales)“. They also contain the most plants and animals threatened with extinction in New South Wales. The Environment Australia website notes;

This sub-tropical and temperate hotspot is one of Australia's most diverse areas - and it is the most biologically diverse area in New South Wales and southern Queensland. It has a variety of significant habitats: subtropical rainforest, wet sclerophyll forest, mountain headlands, rocky outcrops and transition zones between forests.

These habitats support a huge variety of bird and macropod species. Many are rare or threatened: the Richmond Bird-wing Butterfly, Fleay's Frog, Hastings River Mouse, Long-nosed Potoroo, Spotted-tailed Quoll, Eastern Bristle Bird, Rufous Scrub-bird and the critically endangered Coxen's Fig parrot. Notable birds such as Albert's Lyrebird and the Paradise Riflebird make their home here, and in the south-east Queensland rainforests live a rich variety of primitive plant species, many of them similar to fossils from Gondwana.

There is a need to manage forests on an ecologically sustainable basis. This is particularly true of forests that are part of the common property of all Australians – the public forest estate. This principally requires sustaining the natural values of the commons in perpetuity. So that values such as stream health and water yields, the viability of the diversity of ecosystem and species, and the aesthetic appeal and grandeur of large old forests, are maintained and enhanced for our great grandchildren.

There are many competing uses for public forests of which conservation needs to be paramount. Some uses, such as passive recreation and water yields, can be relatively benign, while other extractive uses, such as logging and mining are in direct conflict with conservation and need to be tightly controlled.

The community needs to get fair payment for use of public resources, the uses need to be appropriately constrained, and the use needs to be of net social and economic benefit to the whole community.

The primary requirement for ecologically sustainable management of the natural environment is the establishment of truly comprehensive, adequate and representative reserve systems. These are intended to be the areas needed to be protected from extractive uses in order to safeguard biodiversity, functional ecosystem processes and our natural heritage.

Outside the reserve system, extractive uses need to be constrained so as to minimise environmental impacts and retain natural processes. The forests of north-east NSW have been identified as part of one of the world's 35 biodiversity hotspots because of their exceptional species endemism (at least 1,500 endemic plant species, i.e., 0.5% of all known species) and habitat loss (70% or more of an area's primary vegetation cleared) (Williams *et.al.* 2011). Too much has already been lost, all remaining native forests, and other ecosystems, in north east NSW need to be managed to limit impacts and retain or regain natural processes.

To achieve ecologically sustainable management of native vegetation in north east NSW the primary requirements are:

1. Retention and enhancement of all remnant native vegetation.
2. Establishment of a truly comprehensive, adequate and representative reserve system in accordance with national reserve criteria targets as a minimum;
3. Limiting logging to a sustainable (in perpetuity) yield obtained outside the reserve system in a manner that adequately protects soils, streams, fauna, flora, and ecosystem processes.
4. Appropriately limit where all other uses are undertaken and manage them so as to minimise impacts.

The Commonwealth Government (CoA 1990) identified five general principles of ecologically sustainable development:

- *Integrating economic and environmental goals in policies and activities*
- *Ensuring that environmental assets are appropriately valued*
- *Providing for equity within and between generations*
- *Dealing cautiously with risk and irreversibility*
- *Recognizing the global dimension*

The ESD Working Group on Forest Use (CoA 1991) concluded:

The principles of ecologically sustainable forest use will require the development of a policy framework and approaches which recognise three requirements:

- *maintaining ecological processes within the forests;*
- *maintaining biodiversity; and*
- *optimising benefits to the community from all uses within ecological constraints.*

The ESD Working Group on Forest Use (CoA 1991) also noted that:

–The protection of biodiversity and the maintenance of ecological systems and processes underpins economic activity. Thus, by taking an ecologically sustainable approach to development, all species, their genetic diversity and their habitats would be conserved such that the natural processes of evolution and ecosystem functioning can continue forever. This requires a recognition that there are fundamental biophysical limits to natural resource use.”

The Resource Assessment Commission Inquiry (RAC 1992) proposed that a national forest strategy should incorporate the following policy goals:

- *to ensure that the reserve system is fully representative of forest ecosystems and viable populations of species in both national and regional contexts;*
- *to improve the structure and connectivity of the reserve system;*

- *to maintain ecosystems, populations of species and ecological processes in all tenures, including production tenures;*
- *to minimise the risk of extinction of all species;*
- *to conserve rare and endangered species across all tenures, including wood production tenures;*
- *to minimise the impacts of human use on natural ecosystems and species.*

The National Forest Policy Statement adopts as the basis for ecologically sustainable development the Ecologically Sustainable Development Working Group on Forest Use's three requirements:

...maintaining the ecological processes within forests (the formation of soil, energy flows, and the carbon, nutrient and water cycles); maintaining the biological diversity within forests; and optimising the benefits to the community from all uses within ecological constraints."

The State Forests 1992-1995 Corporate Plan committed State Forests *"To manage State forests in an ecologically sustainable manner and encourage community understanding and support of forest management."* State Forests notes that *"At this time, it considers that ecologically sustainable forest use will maintain, in perpetuity, the productive capacity and ecological diversity of the forest ecosystem."*

It was not until the NSW forestry reform process began to be implemented in 1995 that the framework for ecologically sustainable development envisioned by the National Forest Policy Statement (1992) began to be holistically implemented through the establishment of a Comprehensive Adequate and Representative (CAR) reserve system and the application of prescriptions designed to minimise impacts of forest operations on soils, streams and biodiversity.

The process leading to the 2000 Regional Forest Agreement (RFA) for North East NSW did result in a significant increase in the reserve system in north-east NSW and did result in a comprehensive suite of off-reserve exclusions and prescriptions aimed at reducing impacts on rainforest, oldgrowth forest, threatened species, soils and streams. Despite north east NSW's forests being one of Australia's and the world's biodiversity hotspots, the reform process still left us with one of the worst forest reserve systems in Australia, and many of the national reserve targets unmet. There remains an urgent need to expand north east NSW's reserve system to achieve the basic requirements of a comprehensive, adequate and representative reserve system, particularly in light of the accelerating impacts of climate change.

It is evident that the reserve system in north-east NSW does not satisfy the minimal national criteria for inclusion of 15% of the pre-European extent of each ecosystem, nor does it incorporate the minimal populations of most threatened plants and animals identified as requiring reservation.

For the Comprehensive Regional Assessment (CRA) reserve targets were established strictly in accordance with the JANIS (1996) national forest reserve criteria. Expert panels in various disciplines oversaw and reviewed the data analyses and established targets for all entities. The expert panels placed each entity on a scale from 1 to 5 (from highest to lowest priority) according to its relative vulnerability to threatening processes (such as logging and associated forestry activities) and its need for incorporation into the reserve system. Data on environmental entities including 240 forest ecosystems, populations of 152 fauna species, 444 plant species, oldgrowth forest and wilderness was applied in the north-east NSW CRA process. Due to the years of systematic collection of environmental data in the north-east forests, these data

(though not without their problems) were the most comprehensive and reliable available for any regional forest assessment in Australia.

For forest ecosystems the base target was set at 15% of their pre-1750 distribution. Rare and endangered forest ecosystems were given a 100% target and vulnerable forest ecosystems a target of 60% of their remaining extent. . The NSW Government limited its Summary of Achieved Targets (Anon. 1999c, Attachment 2) to forest ecosystem and oldgrowth targets, stating:

In the Upper North East Region there are 162 forest ecosystems and 144 old growth ecosystems. If the additions to the formal reserve system are adopted, as outlined in this Cabinet Minute, a total of 59 forest ecosystems and 26 old growth ecosystems will achieve conservation targets. This will leave 103 forest ecosystems below target, of which 74 are ranked highly vulnerable, and 118 old growth forest ecosystems below target, of which 76 are ranked highly vulnerable (see attachment G).

In the Lower North East Region, there are 198 forest ecosystems and 169 old growth ecosystems. If the additions to the formal reserve system are adopted, a total of 83 forest ecosystems and 59 old growth ecosystems will achieve conservation targets. This will leave 115 forest ecosystems below target, of which 87 are ranked highly vulnerable, and 110 old growth ecosystems below target, of which 56 are ranked highly vulnerable (see attachment H).

Since the 1998 decision there have been a number of areas added to reserves as part of the resolution of outstanding areas and as a consequence of the Icon Decision. This process has resulted in most larger areas of mapped oldgrowth forest and wilderness on public land being protected and significant improvements in forest ecosystem, fauna and flora target achievement. Despite this there are still significant shortfalls in many reservation targets. The inadequate reserve system is supplemented by patches of forest with special values, particularly wilderness, oldgrowth and rainforest, excluded from logging across the public forest estate, mostly in Special Management Zones. Even with inclusion of these informal reserves the national criteria are far from satisfied.

An assessment of overall achievement of reserve targets for the upper and lower north-east shows that there is still a shortfall of over 670,000 ha (36%) in the attainment of the JANIS reserve targets for ecosystems within the formal reserve system. 282,000 ha of these unmet targets could be satisfied from public lands if the Government wanted to, though the balance would need to be sourced from private lands. If allowance is made for informal reserves on state forests and logging prescriptions then the shortfall in ecosystem protection is still over 410,000 ha, of which some 115,000 ha could be protected on public lands. Across both UNE and LNE 202 ecosystems (56%) remain below target, with 119 (33%) not even achieving 50% of their targets. Even with allowance for off-reserve protection it is likely that some 172 ecosystems (48%) remain below target.

In the whole of north east NSW 52% of fauna species fail to meet the reserve targets set for any of their populations and only 31% of the CRA reserve targets for viable populations of fauna species have been achieved to date (Flint et. al 2004). The combination of extensive clearing, inadequate reservation and high biodiversity puts even greater emphasis on the need to appropriately constrain threats.

Forestry operations have a large variety of impacts on our natural environment, including:

- Interference with ecosystem processes and functioning;
- Causing ecosystem dysfunction, weed invasion and dieback;
- Degrading and removing habitat for a large variety of mammals, birds, reptiles, frogs and plants;
- Causing erosion, nutrient loss and stream pollution;
- Reducing stream flows;
- Reducing carbon storage; and,
- Reducing aesthetic values.

Of those species identified as being of particular conservation concern in north-east NSW (Environment Australia 1999, Appendix 1), a total of 7 mammals (excluding bats), 27 bats, 31 birds, 16 frogs, 5 turtles, 15 lizards and 8 snakes were identified as being specifically vulnerable to logging, with many of these species, and a number of others, also vulnerable to the associated fire regimes, hydrological changes, stream pollution and weed invasions. For 41 of these 109 species logging is identified as a primary (number 1) threat.

Forestry operations on public lands in north east NSW are governed by the Integrated Forestry Operations Approvals (IFOA) for Upper North East Region and Lower North East Region, and the licences they contain. These are referred to as Environmental Protection Licence (EPL), Threatened Species Licence (TSL) and Fisheries Licence (FL). Together with various clauses of the IFOA these constitute the regulatory regime applied to forestry operations on the public's state forest lands in north-east NSW

The Integrated Forestry Operations Approval is one of the means by which NSW implements obligations and undertakings given in the North East NSW RFA (CI 36,48) and is the principal vehicle by which Environment and Heritage Values that are impracticable to include in reserves can be considered. The IFOA, along with the CAR reserve system, is required to provide for the protection of rare or threatened flora and fauna species and ecological communities (CI 60). A key requirement is to monitor and review the sustainability of forest management practices (ie CI 53), which includes the IFOA (CI 52).

The EPA needs to recognise that north-east NSW still does not have an adequate reserve system that satisfies the ecosystem and biodiversity targets for the national reserve system. The Informal Reserves and values protected by prescriptions identified for protection in the IFOA are taken to be an integral part of the CAR Reserve system for the purposes of the Regional Forest Agreement. Management Plans for these areas are required before restrictions on detrimental activities (other than logging) are removed. Even then the poor attainment of reservation targets for numerous ecosystems and threatened species highlights the need for strengthening off-reserve prescriptions rather than weakening them.

NOTE: The Forestry Corporation has undergone many name and structural changes since the Forestry Commission of NSW was first formed. Most recently they have called themselves State Forests of NSW and Forests NSW. These names are used interchangeably throughout this submission, though to avoid confusion attempts have been made to use the name Forestry Corporation to apply to all incarnations.

2. Managing Threatened Species and Ecosystems

Data on environmental entities including 240 forest ecosystems, populations of 152 fauna species, 444 plant species, oldgrowth forest and wilderness was applied in the north-east NSW CRA process. Due to the years of systematic collection of environmental data in the north-east forests, these data (though not without their problems) were the most comprehensive and reliable available for any regional forest assessment in Australia. Many of the reserve targets were never met, and the current Threatened Species Licence (TSL) is intended to protect areas counted as contributing to unmet targets, while at the same time providing for protection of key landscape features and the most vulnerable species.

The current species and ecosystem requirements of the TSL results in special components of the landscape being protected from logging, ideally retaining a mosaic of unlogged areas across the landscape, comprising : rainforest, high conservation value old growth forest , riparian exclusions, wetlands, heathlands, rock-outcrops and caves, rare non-commercial forest types, Endangered Ecological Communities, excessively steep and erodible areas, and corridors (ridge and headwater habitat). Most of these were mapped for protection as an outcome of the Regional Forest Agreement and zoned for protection as Forest Management Zones (FMZ) 1, 2, or 3A. These zones, along with “rare-non-commercial forest types” were identified as “informal reserves” and counted as contributing to ecosystem targets as part of the North East Regional Forest Agreement (RFA) between the NSW and Commonwealth Governments. Even with their inclusion there remain major shortfalls in national ecosystem targets, meaning more of our forests need to be reserved..

In 2004, an additional 20,000 hectares of mapped oldgrowth forest in north-east NSW was identified for protection, and included with FMZs 1, 2, 3A, in the 310,000 hectares of State Forest in the region identified as Special Management Zones which are protected from logging under the Forestry Act 1916.

Despite the major increases in the reserve system in north-east NSW as a result of the Forest Reform process, most forest types, animals and plants remain well below the national reserve targets. North east NSW still does not have a reserve system that satisfies the criteria of comprehensive, adequate or representative, nor the national reserve criteria. The Government’s attempts to improve the outcomes by counting informal reserves and “values protected by prescription” towards reserve targets, still leaves north east NSW with the worst forest reserve system in Australia. This is a shameful outcome for a forest area identified as one of the world’s 35 biodiversity hotspots and, in part, one of Australia’s 15 biodiversity hotspots.

The TSL reinforces protection for many of these landscape features, and is the means of providing legal protection to a variety of others, such as rare non-commercial forest types, riparian areas, wetlands, heathlands, rock outcrops and caves, ridge and headwater habitat (corridors) and additional areas of rainforest. Endangered Ecological Communities are specifically excluded from the TSL and thus protected under the NPWS Act, though remain unmapped.

The TSL assumes that most threatened animals are adequately catered for by these exclusions, though “*for those species that have been assessed as not being adequately protected by the general conditions*” the need for additional measures is identified, most

particularly those species inhabiting eucalypt forests that are known to be vulnerable to forestry activities or are poorly known. To help cater for these species on a landscape level the TSL specifies the retention of important trees scattered across the forest, this includes 10 hollow-bearing trees (and a mature recruit), along with 10 eucalypt feed trees, per 2 hectares. This is supplemented by the IFOA's intended limitations on logging intensity, allowing only Single Tree Selection (limiting logging to less than 40% of the basal area) and Australian Group Selection (medium) (limiting the size of cleared patches to 0.25 hectares, and their extent within a compartment to 90% in a staged process over a 28 year time frame).

For those species still considered to be inadequately protected the TSL includes a variety of species specific prescriptions that are triggered by records or the presence of suitable habitat. Records of some animals and most plants trigger the creation of exclusion areas around them, for some (such as Powerful Owl, Masked Owl, Barking Owl, Brush-tailed Phascogale, Squirrel Glider) this requires the protection of minimum sized patches of suitable habitat within a catchment, for others (such as most frogs, Hastings River Mouse, Koala High Use Areas, Golden-tipped Bat, Marbled Frogmouth, Albert's Lyrebird, and most plants) a record triggers the protection of an area of suitable habitat around the record. Records of a few species (Yellow-bellied Glider, Koala records) trigger requirements for retention of additional feed trees in their vicinity.

These prescriptions are supplemented by requirements to protect identifiable feed trees (Yellow-bellied Glider and Squirrel Glider sap-feed trees, Glossy Black Cockatoo feeding trees) and the roost, den and nest trees/sites of most threatened species, if found.

The current Threatened Species Licence recognises that:

An integral part of the licence is the requirement for SFNSW to conduct operational and pre-logging and pre-roading surveys to assess presence of species requiring species-specific or site-specific conditions.

The current Threatened Species Licence evolved over a long time and through a lengthy process. As well as focussing on protecting rainforest and oldgrowth forests, NEFA battled hard to get the plight of our native species recognised and measures taken to limit the impacts of logging on them. The Forestry Corporation have fought every step of the way, while at the same time proving the need for external regulation of their activities. The TSL is informed by expert opinion, though is a political compromise between the NPWS and the Forestry Corporation. Now the EPA want to dismantle it by getting rid of most species-specific requirements and rewriting the landscape requirements. This time the EPA do not have the expertise of the NPWS (in 1998) and are allowing the Forestry Corporation to gut the licence in what appears to be a political process aimed at opening up more habitat of threatened species for logging.

Following a major campaign by environment groups to stop rainforest logging, on 26 October 1982 the Government of Premier Wran made its historic „Rainforest Decision“, with decisions on Barrington Tops and Werrikimbe being deferred until 1984. The end result was 118,000ha being transferred to National Parks and 1,800 hectares to flora reserves. The intent of the Rainforest Decision was to phase out rainforest logging by 1990.

In 1989 NEFA had a blockade to stop rainforest logging in North Washpool. It transpired that the Forestry Corporation had failed to undertake the archaeological investigations required by the 1980 EIS and the road was being pushed through significant Aboriginal sites. The roading was thus illegal. Logging and roading activities were suspended in North Washpool to enable assessment of areas of Aboriginal significance and consideration of the Wilderness nomination

that had been made. The assessment showed that there were many significant Aboriginal sites in the Desert Creek valley, with some having been severely damaged. A 1,000 hectare Aboriginal Place was subsequently identified for protection and in 1990 the Forestry Corporation attempted to resume logging. NEFA immediately established another blockade to buy us time to seek a legal injunction.

In October 1990 our case was heard in the Land and Environment Court. NEFA presented evidence that they were logging stands that had been expressly protected in the EIS, logging compartments they had not prepared the required harvesting plans for, logging well in excess of the 50% canopy retention required by the EIS, not retaining buffers free from logging along roads as required by the EIS, and not implementing the required erosion mitigation conditions.

In his judgement on 29 October (Corkill vs Forestry Commission of NSW, 1990) granting an injunction preventing further works in North Washpool Justice Hemmings commented:

However, it is obvious that since 1982 the Commission has approved logging of rainforest areas in North Washpool in breach of the provisions of the E.P.&A.Act. . It was ultimately conceded by Counsel for the Commission that all rainforest areas of North Washpool were expressly excluded from areas to be logged in the 1980 environmental impact statement. When logging was approved in December 1982, it was limited to the strategies and prescriptions in the said environmental impact statement.

Notwithstanding such express exclusion, the Commission authorised rainforest logging within North Washpool. I am satisfied that, until the institution of these proceedings, it was the intention of the Commission to authorise such logging in rainforest areas to resume.

In my opinion, the lawfulness of approvals to log rainforest areas which were expressly excluded from the only environmental impact statement prepared for the North Washpool area is a most serious matter for determination at the final hearing. I have no hesitation in determining that there are a number of serious issues raised in these proceedings as to the lawfulness not only of the 1990 approval to resume and subsequent harvesting plan, but also of the previous decisions upon which they were based. I am of the opinion that, subject to the exercise of the Court's discretion, such activities should be restrained pending further orders.

... Regrettably, there is conceded to be a history of departure by the Commission from not only its own approvals in the logging of this area, but apparently a continuous avoidance of the obligations imposed by the E.P.&A.Act. In such circumstances, it is difficult to have confidence that, unless restrained, the Commission will observe its statutory duties.

The Forestry Commission had illegally logged 200ha of rainforest. In order to avoid a final judgement, in April 1991 the Forestry Commission agreed to the North Washpool Agreement which was to establish 2 expert committees to oversee rehabilitation of areas of soil erosion and logged rainforest. Logging of rainforest, as mapped, was finally stopped, and rehabilitation begun.

In 1990 NEFA held a blockade to stop logging of oldgrowth forest at Chaelundi in the Guy Fawkes River Wilderness. This was part of a concerted campaign by NEFA to ensure Environment Impact Statements were prepared before oldgrowth forest could be logged. A

concurrent court case established that an EIS was required before this oldgrowth could be logged. Logging had been stopped by an injunction granted by the Land and Environment Court. This became a major political issue. On the 24 June 1990 Premier Greiner launched 'Meeting the Environmental Challenge: A Forestry Strategy', which was an undertaking to prepare Environmental Impact Statements (EISs) for some 180 000 ha of forest before it could be logged.

The EISs were to be carried out progressively over the next five years. A roughly drawn map accompanied the document which indicated the areas. The Forestry Commission omitted enough old growth forest to maintain supplies to industry while the E.I.S.'s were being prepared. Premier Greiner's announcement included commitments for the adoption of a variety of basic forestry principles which included decision making based on a comprehensive information base, ecologically sustainable management, economically viable and efficient forestry, balanced and open decision making, and publically accountable management. Unfortunately these were hollow promises.

After the Forestry Corporation had prepared a shoddy EIS for part of Chaelundi, NEFA re-established a blockade in 1991. During that blockade John Corkill, on behalf of NEFA, launched an application in the court alleging breach of ss 98 & 99 of the National Parks and Wildlife Act 1974 seeking declaratory and injunctive relief. The case was that the forestry operations would inevitably include the 'taking or killing' of listed endangered fauna without a licence and contrary to the law.

Since 1974 section 99 of NPWAct made it an offence to take or kill any endangered fauna. Based on reams of the Forestry Corporation's own documents, and abundant expert opinion, Justice Stein found that, even with wide riparian exclusions and 50% canopy retention, roading and logging would take or kill 22 endangered and protected species, commenting:

Imminent breaches of s.99 and also s.99 of the NPWA, have been proven in relation to a large range of endangered and protected species of fauna. This is not surprising given the extraordinary wildlife values of the compartments. The high species diversity of arboreal marsupials and the presence of numerous significant species listed in Schedule 12 of the NPWAct makes it a veritable forest dependent zoo, probably unparalleled in south-eastern Australia. Every species of forest dependent marsupial is present. It contains prime or critical habitat for numerous species of endangered fauna or "faunal hot spots". Special pleading for individual areas as exhibiting particular value relating to flora or fauna is not uncommon. However, the evidence before me is overwhelming that this portion of forest is significantly unique in Australia for its natural wildlife values."

Disturbance and injury to many individual animals and their species by the forestry prescriptions (given the best will in the world by the Forestry Commission officers) is in some cases highly likely if not inevitable. The faunal or wildlife corridors provided in the harvesting plans are at least a temporary refuge for fauna able to escape the forestry activities. They are long and narrow, some dead end and they provide at best only remnant habitats incapable of supporting large populations. While containing some hardwood they are predominately rainforest. This affects their habitat suitability for animals.

The additional prescriptions – including 50% canopy retention, tree marking and fauna observations – can do no more than mitigate the disturbances to the endangered and protected fauna. Reduced populations of endangered species – some classified as

Vulnerable and Rare, some Threatened and one in Imminent Danger of Extinction – are likely to occur. Predators will inevitably increase and the prime habitat for many species will be lost.

The unique wildlife values of the area will be destroyed as larger populations become fragmented into small comparatively isolated groups. The present abundance and diversity of unique and endangered wildlife will likely be severely eroded. Disturbance of fauna in the indirect sense as opposed to direct injury, interference or death, is just as dangerous to the future of the species. In so far as it has an impact which destroys habitat the forestry operations will likely disturb essential aspects of continuity of a species – especially breeding, feeding, nesting and social interaction. The proposed forestry prescriptions, even assuming a great deal of skill and care by Commission officers and the loggers, will spell the death knell of the “truly exceptional” wildlife values of these compartments of the Chaelundi State Forest.

As an outcome of the political furore that resulted, on December 5 Shadow Environment Minister Pam Allan introduced the Endangered Fauna (Interim Protection) Bill into Parliament. On December 12 the Endangered Fauna (Interim Protection) Act 1991 passed the NSW Parliament and became law.

The National Parks and Wildlife Service issued licences to the Forestry Corporation in February 1992 as part of a mass temporary licensing operation for the whole of NSW under section 120 of the *National Parks and Wildlife Act 1974*. These licences were issued on a management area basis during the concerted attack on the Endangered Fauna (Interim Protection) Act and prior to its licensing provisions coming into full force.

The licences were only meant to last 120 days as a temporary measure until the NPWS managed to get a more responsible licensing process together. They were issued for over a thousand compartments that the Forestry Corporation maintained they then had to log in the next few months. While initially the National Parks and Wildlife Service insisted that the Forestry Corporation certify that all compartments had complied with the EPA Act, they soon had to cave into the pressure to licence all compartments submitted. There was no assessment of the compartments by the NPWS and only a few token conditions put on all the licences.

The State Government and timber industry used a contrived crisis over the Endangered Fauna (Interim Protection) Act to get the ill-conceived Timber Industry (Interim Protection) Act through parliament. It required EISs to be prepared for whole Forestry Commission Management Areas, prevented the application of stop work orders by the Environment Minister, and made the Minister for Planning the determining authority. The catch was that all areas outside the moratorium areas could be logged and cleared in the interim without EISs. The Act specified a schedule for completion of EISs for 21 management areas, with the last one due in September 1994, and most provisions of the Act expiring in December 1994.

Once again the Forestry Corporation had found a way of rorting the system to be excluded from the requirements of environmental law. The NPW Act Section 120 licences were termed “lollypop licences” by the NPWS. These licences were then repeatedly renewed with no further assessment. An administrative process was eventually established where individual compartments were added to the licence, by way of a licence variation. Rarely approval to log compartments was withheld.

The Forestry Corporation was required to prepare Fauna Impact Statements as part of their preparation of Environmental Impact Statements, the intent was to issue licences in accordance with the Endangered Fauna (Interim Protection) Act as an outcome of that process.

Five of these Management Area EISs were completed before the Government was forced to abandon the intended process. One was refused by the Minister for Planning as failing to meet the legal requirements (Mt. Royal), three should have been refused but were determined by the Minister with numerous conditions (Wingham, Glen Innes, Kempsey-Wauchope), and one was hastily withdrawn by the Forestry Corporation when they learned that the DoP was in the process of refusing it (Drielsma withdrew it after Kibble had already signed a letter to Webster stating it should be refused) – prompted by legal action commenced by NEFA (Dorrigo).

Only one of the seven forestry FISs prepared for north-east NSW was determined by the Director General of the National Parks and Wildlife Service (NPWS) (Wingham), 17 months after it went on public exhibition. Political interference prevailed to force the NPWS to determine an FIS they considered "*inadequate in almost every respect*" (Stein 1993) in south-east NSW, and this appears to be the case with Wingham. NPWS submissions made it clear that they held the same poor view of FISs in north-east NSW, but were unable to refuse them for political reasons or determine them for fear of legal action by conservation groups.

In 1994 the Wingham Forest Action appealed against the decision of the NPWS to grant a licence to the Forestry Commission of New South Wales to take or kill any protected fauna in the course of carrying out forestry operations within the Wingham Management Area. Despite not being legally trained, they represented themselves in the ensuing case. Despite the FIS only considering 24 of the 33 threatened species occurring in the area and containing "*admitted inaccuracies and misleading statements*", Justice Talbot took a liberal definition of what was reasonably practicable "*in terms of time and cost*". While Justice Talbot made a few modifications to the licence, such as requiring habitat trees to be permanently marked and prohibiting the issuing or renewing of grazing permits, he naively considered the licence to be an evolving document subject to review and improvement, stating:

... The inspections proposed by the Director General recognise that further information obtained on habitat and impacts of logging and roading will be utilised to amend and update the conditions of licence. It is reasonable to expect that, following inspection, carried out jointly by representatives of Forestry and NPWS, that the Director General will respond in an appropriate and responsible way. It is also reasonable to expect that the Director General may, in exercise of her discretion, requisition the surveys the applicant specifies. That will depend on circumstances as they evolve. The applicant's arguments in this respect do not take sufficient account of the dynamics of the situation and the unfettered power and discretion left with the Director General as the statutory umpire. The Director General has the capacity, the power and a duty to act promptly and effectively. This is recognised by the Endangered Fauna (Interim Protection) Act stated object to give the Director General and the Minister an emergency power to stop work where protected fauna is at risk (s 2(h)). The Court expects and relies upon the Director General to fulfil her duties in accordance with the statutory framework.

The passage of Threatened Species Conservation Act in 1995 changed the law, though still required the preparation of Fauna Impact Statements while allowing the "temporary" licensing to continue. While threatened plants were theoretically protected with the passage of Threatened Species Conservation Act in 1995, it again required a blockade by NEFA to force realisation by Government that pre-logging surveys for threatened plants were required and that some protection needs to be provided to them.

The 1936 type locality for the nationally endangered Minyon Quandong (*Elaeocarpus sedentarius*, previously known as *Elaeocarpus sp. "minyon"*) is Minyon Falls. A single tree, with infertile seeds, was located on the margin of Rock Creek Dam in the then Whian Whian State Forest in 1992. This remained the only known individual until 1995.

In August 1992 Friends of the Forest was formed by local residents concerned about logging in compartment 96 of Whian Whian State Forest. Increased logging intensity in 1994 led to the formation of the Whian Whian Heritage and Environment Network, a network of 10 local environment including NEFA, and a blockade. A key requirement of conservationists was the undertaking of pre-logging flora and fauna surveys before logging resumed. In 1995, after the Forestry Corporation had undertaken its pre-logging flora and fauna surveys of compartment 79 adjacent to the Rocky Creek Dam, and after logging had commenced, an assessment by conservationists found a new population of Minyon Quandong within the area proposed for logging. Further investigations revealed a population of 30 individuals.

Independent botanists (Quinn *et al* 1995) subsequently recommended:

–Logging in parts of Whian Whian SF may have depleted numbers of this species”... –An immediate moratorium should be placed on logging in the Whian Whian SF compartment in which this species occurs”... –further searches for additional populations should be conducted” (

After conservationists stopped logging in compartment 79 Forestry Corporation shifted logging to compartment 61 of the adjacent Nullum State Forest where protests by concerned locals once again stopped logging. A subsequent inspection of that area (Pugh 1995) notes:

–Fifty seven Elaeocarpus sp. "minyon" were found that were dead or severely damaged and a further 3 moderately damaged. Fifty of these were 1-10 cm dbh, 7 10-20 cm dbh and 3 20-40 cm dbh. Nineteen appeared to have been directly damaged by machinery, 38 by having trees dropped on them (including where trees were dropped across creeks) and 3 had been felled with a chainsaw (for no apparent reason). This list is likely to be conservative due to the difficulty of finding plants amongst the piles of logging debris. A significant majority of the population within the area inspected appears to have been destroyed or severely damaged. Many of the survivors had tree crowns on or near them. Any fire, fuelled by the logging debris, is likely to virtually eliminate the survivors.”

Forestry Corporation had not only trashed a population of a nationally endangered species, they illegally cut down trees on creek banks, deliberately felled trees into creeks, bulldozed tonnes of soil into creeks, roaded and logged rainforest, ignored fauna prescriptions and clearfelled large areas. They were unable to be prosecuted for the endangered plants because they were not protected by the lollypop licence, though were successfully prosecuted for by the EPA for three breaches of a Pollution Control Licence . On 9 November 1995 NEFA called *–upon the public to go out into the forests and peacefully stop all logging in the Murwillumbah Management Area until such time as the Government takes action to stop the wanton vandalism being practiced by State Forests”*. Blockades followed in Mebbin and Wollumbin State Forests and all logging operations in the Murwillumbah Management Area were stopped.

Subsequent negotiations with the Minister for Forests in December 1995 reached an agreement that pre-logging flora and fauna surveys would be undertaken throughout the Murwillumbah Management Area and that a Harvest Planning Advisory Panel for the Management Area would be established. The Forestry Corporation immediately broke the agreement by logging outside agreed areas in Wollumbin SF, despite this deliberate provocation conservationists stuck to the agreement.

Forestry Corporation’s (1996) belated audit of compartment 61 in Nullum SF reported:

—A significant proportion of the population of [Elaeocarpus sp. minyon] in compartment 61 had been damaged or destroyed by the logging. ... The survey indicated that there were about 200 plants with 329 stems found so far in the compartment. 96 stems have been damaged. 33 stems were damaged to the extent that they were considered unlikely to recover.”, and —. a significant proportion of an isolated population of an apparently rare species of flora has been destroyed or damaged.”

This did initiate the adoption of prescriptions for threatened plants and for a while thereafter there were pre-logging surveys for threatened plants undertaken by competent botanists, at least in the northern rivers.

After the Forestry Corporation burnt an exclusion area for the Smokey Mouse in south-east NSW, Justice Pepper (2011) of the NSW Land and Environment Court commented:

However, in my view, the number of convictions suggests either a pattern of continuing disobedience in respect of environmental laws generally or, at the very least, a cavalier attitude to compliance with such laws.

... Given the number of offences the Forestry Commission has been convicted of and in light of the additional enforcement notices issued against it, I find that the Forestry Commission's conduct does manifest a reckless attitude towards compliance with its environmental obligations ...

The Forestry Corporation have proven time and time again that they will not protect environmental values unless expressly required to do so, and even then only when they are subject to rigorous independent auditing.

The current Threatened Species Licence was developed as part of the Comprehensive Regional Assessment process as a means of adequately protecting threatened species and implementing Ecologically Sustainable Development in accordance with the requirements of the National Forest Policy Statement. It was included as part of the IFOA and adopted as an outcome of the State-Commonwealth Regional Forest Agreement.

Since then the TSL has been progressively weakened by a series of amendments, most recently the EPA removed the requirements to protect habitat within 800m of Hastings River Mice records, expand filter strips in the vicinity of Fishing Bat records, establish exclusion zones around numerous plant records and undertake surveys for a variety of species.. The EPA's intent is to abolish survey requirements and remove or reduce protections for yet more species, stating their new outcomes-based regulation *—involves moving away from a reliance on detailed and prescriptive rules towards more high-level, broadly-stated principles”* with the primary intent to *—reduce the prescriptive nature of licence conditions”*.

A logging prescription for the nationally endangered Hastings River Mouse was identified by the Recovery Team after commissioning research and lengthy debates and site inspections. The prescription was included in the State-Commonwealth Recovery Plan and was applied to many forest operations from around the mid 90s. A reduced version was adopted as the species-specific prescription in the TSL. The TSL was amended on 7 November 2011 to dramatically reduce the retention of habitat around Hastings River Mouse records from an exclusion area encompassing all habitat of moderate or high suitability within 800m (a potential maximum of 200ha) and all land within 200m (12.5ha) down to a 12ha exclusion area encompassing as much habitat as practical around a record. The chances of locating HRM through surveys have

also been reduced with the required trapping effort of a minimum of 400 trap nights per 50ha halved to 200 trap nights. This decision was not based on science or monitoring of the consequences, it was a political decision.

The prescription for the nationally endangered Hasting's River Mouse was dramatically weakened in 2011 without monitoring or justification. Protection needs to be restored and made consistent with its recovery plan.

Not only does this remove protection for new records, it also means that most of those areas identified for protection since this prescription began to be applied almost 20 years ago, are now available for logging, The EPA intend to now make many more areas previously protected for a variety of threatened species available for logging, identifying that current mapped owl exclusion areas will be redone or removed, and that exclusion areas already identified for threatened species may be opened up for logging.

Through the TSL numerous exclusion areas have been identified and mapped in harvesting planning for owls, Marbled Frogmouth, Albert's Lyrebird, Rufous Scrub-bird, Hastings River Mice, Koala high use areas, Brush-tailed Phascogales, Spotted-tailed Quolls, Squirrel Gliders, Fishing Bat, Golden-tipped Bat, a variety of frogs and numerous plants. The location of these exclusion areas has been based upon habitat assessments and species records and thus should be a high priority for permanent protection. The records need to be collated into a single database and be applied in future operations.

It would be more efficient and effective to have to have such exclusion areas identified independently of the Forestry Corporation in future.

It is outrageous that by dropping survey requirements and species-specific prescriptions that the EPA is intending to allow areas already identified and protected as species-specific exclusion areas to be logged. NEFA considers it imperative that all threatened species exclusion zones already identified and mapped in harvesting and other plans as the result of current and previous prescriptions must be retained and not made available for logging.

2.1. Landscape Protection

The Threatened Species Licence (TSL) is required to regulate activities so as to protect State and national threatened species of terrestrial animals and plants. Within State Forests logging is excluded by the TSL from a variety of important habitats – mapped rainforest, “high conservation value” oldgrowth forest, riparian habitat along mapped streams, wetlands, heathland, rock outcrops, ridge and headwater habitat (wildlife corridors) and a variety of additional areas around records of threatened fauna and flora. Such areas are counted by the TSL as providing adequate protection for most threatened species. They are also counted by the Regional Forest Agreement as contributions towards the national reserve system to improve the poor achievement of reserve targets in the formal reserve system.

Rainforest had been identified for protection in extensive public campaigns in NSW in the late 1970s and early 1980s, with logging of mapped rainforest on public land being finally stopped by NEFA blockades and a court challenge over North Washpool in 1989/90. Rainforest was

remapped across all tenures as part of the CRA, with those stands on public land being protected by the TSL.

Oldgrowth forest was the focus of public campaigns in the late 1980s and 1990s. The Federal Reserve (JANIS 1997) criteria specified the protection of a minimum of 60% of the remaining extent of oldgrowth forest (across all tenures) should be included in the reserve system. Those areas of mapped oldgrowth on public land excluded from the reserve system were assessed in the CRA, with thresholds being applied by the agencies to identify the High Conservation Value Oldgrowth Forest now protected by the TSL. Additional areas of mapped oldgrowth were also protected in 2004, thereby protecting most larger patches of remaining oldgrowth forest on State Forests.

Rare, non-commercial, forest types are mapped occurrences of inadequately reserved forest types that the Forestry Corporation allowed to be protected to better satisfy ecosystem targets for the Regional Forest Agreement. They are, by definition, only those ecosystems of low timber value.

Ridge and Headwater habitat are 80m wide wildlife corridors, linking major streams, identified at a landscape scale by the Forestry Corporation in accordance with the TSL. The TSL also requires protection of wetlands, heathlands, caves, cliffs and rock outcrops. Riparian areas requiring protection are those areas also required to be protected by the EPL.

Taken together these exclusions, along with habitat tree retention, constitute the General Conditions of the TSL. They are effectively landscape provisions. And for the purposes of the TSL these are taken as providing adequate protection for a suite of threatened forest species.

Species records also trigger the creation of exclusion zones for a variety of threatened animals, and most threatened plants. These vary from patches of habitat for owls, Brush-tailed Phascogales and Koalas, through wider riparian buffers for frogs, bats and Alberts Lyrebirds, along streams near records, to the small exclusions around records of most threatened plants.

Endangered Ecological Communities are excluded from Forestry Corporation's licence, making the undertaking of forestry operations within them a direct offence under the *National Parks and Wildlife Act 1974* where it is an offence to pick or harm endangered ecological communities.

The EPA's claimed aim is to get rid of most species specific prescriptions for threatened species and focus on a landscape based approach to reduce *the need to locate threatened species through costly surveys*, though this is likely to be very different from the landscape protections currently applied for most species. The EPA maintain that *Existing RFA commitments to the protection of old growth, rainforest, rare non-commercial forest types and the Forest Management Zone (FMZ) layer will be maintained unchanged*. Though for how long? There will be "simplified" prescriptions for wetlands and rock outcrops. Current owl exclusion areas will be redone or dumped and exclusion areas already identified for threatened species will be up for grabs. Threatened Ecological Communities will be opened up for logging.

It is important to base any system of retained habitat at a landscape scale upon those areas that have been protected for the past 15 years as part of the TSL exclusion areas, including those for rainforest, oldgrowth forest, riparian habitat, wetlands, rare ecosystems, wildlife corridors and threatened species habitat.

The EPA are relying on the Forest Practices Authority of Tasmania (FPA) to be their authority in determining their new landscape approach. Logging practices in Tasmania are nothing to be proud of. The FPA have 7 Directors appointed by the Tasmanian logging Minister; the position for the person with expertise in biological science or nature conservation is vacant, one position is filled by someone who used to work for the Tasmanian Farmers and Graziers Association, one by an ex- District Forest Manager, one the ex-CEO of the Forest Industries Association of Tasmania and senior advisor to the Tasmanian Farmers and Graziers Association, and another is a trained forester. This is not an independent or balanced organisation. Given that NSW's forests are totally different ecosystems from Tasmanias, with totally different species and threatening processes, far higher biodiversity and far more hollow-dependant species, these people do not have the required expertise.

The FPA's Tasmanian code only has pathetic landscape restrictions relating to some streams, stating that aside from erosion mitigation prescriptions:

the reservation of other significant natural and cultural values. This will be at a level of up to 5% of the existing and proposed forest on the property for areas totally excluded from operations. In circumstances where partial harvesting of the reserve area is compatible with the protection of the values, the level will be up to 10%. The conservation of values beyond the duty of care is deemed to be for the community benefit and should be achieved on a voluntary basis or through compensation mechanisms where available.

Application of the Forest Practices Authority's Tasmanian template to NSW will result in a major loss of existing landscape protection provisions, not an enhancement of them. The Tasmanian code is not a suitable basis for managing NSW forests.

NEFA's limited audits have found a variety of incursions into required exclusion areas. It is concerning that so many have been revealed by such a small sample of operations. It is apparent that incursions into exclusion areas are common, and that required exclusion areas are often not being established. It is assumed that they occur so frequently because Forestry Corporation often get away with it and because when action is taken it is tokenistic. For example:

- Two wetlands at Yabbra that were required to be protected with 10m buffers were trashed (Pugh 2009). As they were likely habitat for the endangered Richmond's Frog a survey was required. Forestry Corporation were issued with two Penalty Infringement Notices (PINs) and fined \$600 for "timber felling within a wetland and wetland exclusion zone" and "machinery entry within a wetland and wetland exclusion zone". Forestry Corporation were issued a warning letter for not identifying habitat and surveying for Richmond's Frog. No rehabilitation was required.
- A 2.7ha stand of mapped rainforest at Yabbra was logged, primarily to remove flooded gum planted for rehabilitation when it was last logged, though mature rainforest trees were logged and hundreds of rainforest trees were bulldozed into piles in an apparent attempt to maximise damage to the rainforest (Pugh 2009, 2010a). Forestry Corporation were issued with a PIN and fined \$300 for "harvesting timber within IFOA mapped rainforest". No rehabilitation was required.
- A wetland at Doubleduke that was required to be protected with 10m buffer had trees felled into it and tracks bulldozed through it (Pugh 2010c). The impacts also affected a large population of the endangered fern, *Lindsaea incisa*, that was required to be protected with a 50m buffer. The EPA refused to assess this complaint while auditing

logging of Endangered Ecological Communities in the vicinity. No rehabilitation was required.

- Koala High use Areas, required to be protected with 20m buffers, were being logged at Royal Camp SF until stopped by NEFA (Pugh 2012), though continued in another part of the forest. Forestry Corporation were issued with a 3 PINs.

It is evident that the current process is dysfunctional because of the Forestry Corporation's frequent failures to identify and protect areas requiring protection under current landscape provisions of the TSL. The on-ground work required to refine mapped exclusions by identifying wetlands, rock outcrops, threatened species exclusions, core Koala habitat and endangered ecological communities needs to be undertaken independently of the Forestry Corporation. This would most effectively be undertaken in conjunction with the flora and fauna surveys.

An ecological community is a group of plants and animals that occur together in a particular area including trees, shrubs and understorey plants. An Endangered Ecological Community is an ecological community listed under the *Threatened Species Conservation Act 1995* as being at risk of extinction unless threats affecting these areas are managed and reduced.

At Doubleduke Forestry Corporation failed to take adequate measures to identify and protect the Endangered Ecological Community (EEC) *Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion* that was known to occur but was not mapped (Pugh 2010b). A NEFA audit initially identified 20 trees logged at one location within the EEC and a range of other breaches (Pugh 2010b). A subsequent inspection of a nearby area found a further 46 trees to have been logged and 1,387 other trees and shrubs bulldozed out of the ground, trampled by machinery, or had trees dropped on them within the EEC (Pugh 2010c). EPA commenced legal proceedings against Forestry Corporation for logging 120 trees in 7.5 ha of the EEC Subtropical Coastal Floodplain Forest, only to later drop the case.

Following complaints from conservationists Forestry Corporation were fined \$3,000 for logging 0.5 ha of the Lowland Rainforest EEC in Grange SF, no rehabilitation was required. The EPA's inspections of NEFAs complaints about logging into the boundary of the Lowland Rainforest EEC at Wedding Bells SF found that the EECs had been damaged but that because the logging was so severe up to the boundary it was not possible to determine to what extent logging had intruded into the EEC, so they took no regulatory action despite their botanist identifying that *ongoing deleterious impacts will continue to damage the EEC communities into the future*", no rehabilitation was required.

NEFA opposes EPA proposals to allow logging of Endangered Ecological Communities. These need to be mapped for protection in independent pre-logging surveys as part of a landscape approach.

2.2. Habitat Trees

Within those areas available for logging a range of silvicultural methods and tree retention requirements are mandated to reduce logging impacts on a variety of the threatened species not adequately accommodated within exclusion areas. The evidence is that these are inadequate to achieve sustainable management and that their intent is being deliberately subverted.

A key requirement for ecologically sustainable management of native forests is the retention and restoration of a natural distribution of tree age classes in those areas available for logging.

A plethora of forest animals depend upon the trunk and branch hollows provided by big old trees for their survival. Approximately 20% of the Australian bird fauna, 75% of arboreal marsupial fauna and an undetermined proportion of the bat, reptile and invertebrate fauna are dependent on the hollows provided by old trees for roosts, nests and shelter. The loss of the hollows provided by large old trees has been identified as a primary threat to a variety of priority species in north east NSW (Environment Australia 1999, Appendix 1); 4 mammals (non-flying), 20 bats, 3 birds, 2 frogs, 3 reptiles and 4 snakes. Numerous other species have been identified as threatened by the loss of other resources (i.e. seeds, nectar, nest sites) provided in greater abundance by older trees and many by the increased transpiration of young trees and consequent reduction in water availability (Environment Australia 1999).

Oldgrowth trees are the primary storehouses of carbon, provide essential hollows for animals to nest and den in, provide the most abundant nectar and seed, and are of the highest aesthetic appeal. These values appreciate with age. Oldgrowth forests are those with a high proportion of relatively old trees, though are usually multiaged.

It is important to recognise the outstanding contribution of big old trees to storage of carbon in forests. For example Roxburgh *et.al.* (2006) found:

In mature forests, large diameter trees greater than 100 cm d.b.h. comprised 18% of all trees greater than 20 cm d.b.h. and contained 54% of the total above-ground carbon in living vegetation. ... The influence of large trees on carbon stock therefore increases with their increasing size and abundance.

The NSW Scientific Committee has identified *Loss of Hollow-bearing Trees* as a Key Threatening Process. The highest priority action for this KTP is “*Adopt appropriate policies for recruitment tree ratios with a stipulated minimum retention density in areas of forestry operations*”.

Hollow-bearing trees, and with them hollow-dependent species, have already been decimated within vast tracts of forests. The problems such fauna are facing is expected to exponentially worsen as the few remaining large old hollow-bearing trees (in both forests and pastoral lands) die-out without replacement trees being available. The full ramifications of irreversible changes already set in place will take a century or more to become fully manifest.

Generally speaking, small hollows begin to develop once a eucalypt is over 100 years old, and the large hollows required by many species after a tree is over 200 years old. Depending on the species and site conditions trees may live for 300 to over a thousand years, providing their lives are not cut short. For blackbutt forests Mackowski (1987) found (p118) that only hollows in trees greater than 100 cm. dbhob (144 years old) were utilised by wildlife and that larger

species "such as ducks, cockatoos and owls ... are probably restricted to nesting in blackbutt > 140 cm dbhob as larger hollows mainly occurred in these trees.", (p115) "... these hollows were not suitable for large hollow dependant wildlife unless the blackbutt was > 224 y.o." and (p119) "Arboreal marsupials the size of yellow-bellied glider and larger appear to require hollows > 100 cm² entrance size, these hollows only occur in blackbutt > 100 cm dbhob and are most abundant in blackbutt > 140 cm dbhob". Mackowski found that the large hollow bearing trees would only persist for 80 or so years, necessitating replacement large hollowing-bearing trees to become available.

On public lands trees over 100 years old have survived the worst ravages of the industrial logging and widespread clearfelling that has increasing occurred on State Forests since the 1950s. Such trees are in the stages of developing hollows and are a rare and valuable wildlife resource. As well as being important for sustaining populations of hollow-dependent fauna, such trees are part of our natural heritage and the relatively few that remain should be retained.

NEFA recommends the EPA improve the sustainability of logging operations by requiring the retention and protection of all large old trees (>100 years old) for their outstanding biodiversity and heritage values.

In order to provide for hollows through time it is necessary to protect those trees with existing large hollows, as well as sufficient trees in the next age class to replace them when they die, and trees in the next age class to replace the replacements. Successional planning is an essential requirement of ecologically sustainable forest management, particularly as most logged forests have a deficit of large hollow-bearing trees and the next age class required to replace the few that are left as they die out.

It has long been recognised that to mitigate the impact of logging operations upon some hollow-dependent fauna it is necessary to manage for provision of habitat trees in perpetuity (i.e. Saunders 1979, Recher, Rohan-Jones and Smith 1980, Mackowski 1984, 1987). This requirement focuses on the need to retain the big old trees with abundant and large hollows suitable for denning and nesting by a plethora of vulnerable fauna (such as owls, cockatoos, parrots, possums and gliers), along with sufficient mature trees (likely to survive and develop hollows in the future) to replace the old trees when they die.

The need to protected these old hollow-bearing trees was recognised by the Forestry Corporation, with management plans in the late 1980's including prescriptions varying from retention of clumps of 5 habitat trees per 15 ha to 5 per 5 ha. Retention rates was the focus of much debate during the preparation of EIS's, with the stalemate broken by the Minister's determination of the Wingham EIS in 1994, which required that in Dry Hardwood forest, an average of four habitat trees per hectare shall be retained and in Moist and New England Hardwood forest, an average of six habitat trees per hectare shall be retained. It also required that clusters of vegetation around the habitat trees shall be retained and that sufficient recruitment trees shall be retained in order to sustain the prescribed density of habitat trees in perpetuity. This prescription was applied in all subsequent EIS determinations.

This outcome was a trade-off between the science and the resource demands of the Forestry Corporation. It still envisions a major loss of hollow-dependent animals, as noted by Smith (2000);

Current prescriptions require the maintenance of at least 5 habitat trees per hectare. This is less than 30% of the average stocking of habitat trees in unlogged native forest. Loss of habitat trees is the single greatest cause of biodiversity reduction in logged forests. If all habitat trees in unlogged native forest were fully utilized a 70% reduction in abundance of hollow dependent fauna could be expected in logged forest under current standards. ... This finding suggests that current standards for habitat tree retention are inadequate to maintain the natural diversity of hollow dependent fauna in logged forests. However, retention of higher densities of habitat trees is likely to significantly reduce timber yields.

This is the basis for the current Threatened Species Licence's requirement to retain a minimum of 10 large old hollow-bearing trees (where extant) per 2 hectares and the retention of a "mature to late mature" recruitment tree for each hollow-bearing tree. In the hinterland forests the intent is to restore such habitat trees where they are no longer available, though in the coastal forests the requirement is only to retain any surviving hollow-bearing trees, it is a prescription for elimination. While the requirement is clearly for retention within each 2 hectares, the EPA also allow this to be averaged across the logging area so that all retention requirements can be met in one part of the area.

While the aim of this prescription is to retain large hollow-bearing trees in perpetuity, in the absence of an intent to manage native forests so as to retain the range of size classes it can not achieve this aim.

Retained trees are more vulnerable to windthrow and post-logging burning (Saunders 1979, Recher, Rohan-Jones and Smith 1980, Mackowski 1987, Smith and Lindenmayer 1988, Milledge, Palmer and Nelson 1991, Smith 1991a). In many areas trees marked for retention as habitat trees have been found to include dead trees and trees burnt out at the base and unlikely to remain standing for long. Logging debris are often left stacked against the bases of trees which will help ensure their rapid demise.

Trees retained as potential recruits for habitat trees will also suffer premature mortality. In natural forest there is a self thinning process that results in significant mortality (Mackowski 1987). Though there is also a high likelihood of mortality due to other factors. As noted by Mackowski (1987 p124) *"the frequent occurrence of fire in this site height blackbutt forest precludes a 100% chance of survival - a proportion will be damaged, or weakened, or burnt down by each fire. These trees are also subject to the risk of lightning and windstorm damage."*

To comply with habitat tree retention prescriptions and the requirement to maintain habitat trees in perpetuity there is a necessity to detail prescriptions for potential replacement trees to be retained sufficient to maintain the prescribed number of habitat trees over long time frames (Recher, Rohan-Jones and Smith 1980, Mackowski 1984, 1987, Recher 1991, Scotts 1991, Traill 1991).

TABLE 4.5. COASTAL BLACKBUTT RETENTION RATES REQUIRED TO MAINTAIN 10 HABITAT TREES PER TWO HECTARES IN PERPETUITY. The assumption is made that there will be 50% mortality of recruitment trees every 80 years. Adapted from Mackowski 1987.

Diameter (dbhob) cm.	Age yrs	Time-span in size class yrs	Mackowski's requirements for 3 Habitat Trees per Hectare over 100cm	Requirements to retain 10 Hollow-bearing Trees per Two Hectares
20-60	16-68	52	11.5	38.3
60-100	68-144	76	4	13.3
100-140 ^A	144-224	80	2	6.6
140-180 ^B	224-304	80	1	3.3

A - stage at which hollows suitable for small wildlife form.

B - stage at which hollows suitable for large wildlife form.

Mackowski (1984) considered *"The general pattern of hollow formation in many gum type eucalypts, ironbarks, bloodwoods and stringybarks is similar to that described for Blackbutt. Tallwood and Brushbox have similar crown architecture characteristics to Blackbutt but have substantially different suites of organisms involved in the succession towards hollows, leading probably to much older age at hollow formation."*

Many forests have been denuded of habitat trees. To enhance such forests for nature conservation and maintenance of ecosystem functioning they need to be managed for the return of adequate stockings of habitat trees (Mackowski 1987). Mackowski (1987 p134) states *"where adequate hollow trees have not been retained in the past, a greater proportion of larger recruits should be selected (rather than evenly distributed between 60 & 100 cm dbhob) to facilitate the early return of hollow trees and the immigration of hollow dependant wildlife if it occurs nearby."*

Under the TSL retained hollow-bearing trees must be selected from the trees with the largest dbhob and must be live trees and should have good crown development and minimal butt damage (TSL 5.6 a, c). Recruitment trees are required to be mature to late mature growth stages, to have good crown development and minimal butt damage, and also to not be "suppressed" (TSL 5.6 b, d). Suppression occurs when trees are out competed by adjoining trees and become consequently stunted and deformed, which can persist after the competing trees are removed.

Retained trees must be scattered throughout the logging area. The TSL (5.6 g) requires damage to retained trees to be minimised and that *"logging debris must not, to the greatest extent practicable, be allowed to accumulate within five metres of a retained hollow bearing tree"* or recruitment tree. Retained trees are also required to be marked for retention prior to logging.

There is a war of attrition against hollow-bearing trees being waged. Their numbers are being depleted by continued logging, the required replacements are not being retained and funeral pyres are regularly being constructed around them in apparent attempts to burn them to the

ground. We consider that the damage being caused to hollow-bearing and recruitment trees is contrary to the basic precepts of sustainable logging.

In our first audit of Doubleduke (Pugh 2010b) we found logging underway in Compartment 146 without hollow-bearing and recruitment trees being marked. We complained at the time. When we returned after logging had finished we found that the hollow-bearing trees that had survived had subsequently been marked. Though it appeared to us that retention requirements had not been met. To quantify this NEFA has been establish plots. In Doubleduke (Pugh 2010c) it was found that an average of 1.9 hollow-bearing trees, and 1.3 recruitment trees, per hectare had been marked for retention. In an area at Girard (Pugh 2010d) only three hollow-bearing trees and two recruitment trees were marked for retention in a 3.7 ha area, giving a retention rate of one hollow-bearing tree per 1.2ha and one recruitment tree per 1.4ha

In Royal Camp State Forest (Pugh 2012e) the requirement was to retain 10 hollow-bearing and 10 recruitments trees per 2 ha. In one 5 hectare area only one tree was marked for retention. In a 2.3ha sample to assess tree retention from a randomly chosen multi-aged part of the stand, only 4 out of the 11 required hollow-bearing trees were marked and retained and only 5 out of the 11 required recruitment trees were marked and retained, none of the 11 required were marked as eucalypt feed or Koala feed trees. Of the total of 16 trees removed that were over 40 cm dbhob and thus likely to have been mature, late-mature or senescent, at least 11 should have been retained as hollow-bearing or recruitment trees and should not have been logged.

Contrary to licence requirements retained hollow-bearing trees often have butt damage. Trees retained as recruitment trees are commonly too young and too suppressed to satisfy licence requirements. At both Yabbra and Doubleduke (Pugh 2009, Pugh 2010b) it was found that marked recruitment trees were often suppressed regrowth trees with poor crown development . At one site at Girard (Pugh 2010d) 2 hollow-bearing trees and 7 recruitment trees were classed as suppressed, and one recruitment tree had 60% of its butt severely damaged. At the other site 1 hollow-bearing tree and 1 recruitment tree had significant butt damage.

In Royal Camp State Forest (Pugh 2012e) it was found that hollow-bearing trees were being marked as recruitment trees to significantly reduce tree retention, particularly of mature and late-mature trees needed as future hollow-bearing trees.

At both Yabbra and Doubleduke (Pugh 2009, Pugh 2010b) it was found that retained trees often had large amounts of debris felled and pushed around their bases. At one site at Girard (Pugh 2010d) 8 of 13 hollow-bearing trees and 7 of 10 recruitment trees had significant amounts of debris dropped or pushed around their bases. At the other site all five marked trees had significant amounts of debris left around their bases.

Most tree retention prescriptions are set “per 2 hectares” which both EPA and Forestry Corporation take to mean that this is the average density needed to be retained across a whole compartment. The original intent was that Forestry Corporation should retain the required number of habitat trees within every two hectares, where available. Now the Forestry Corporation use it both ways to minimise retentions.

There needs to be a more systematic, transparent and effective approach to protecting habit trees. Trees identified as qualifying as habitat trees need to permanently identified and

protected by recording their localities with a GPS and monitoring them over successive logging operations. This also makes them auditable. .

The maintenance and restoration of large old hollow-bearing trees in perpetuity is the single most important requirement for ecologically sustainable forestry. Despite requirements being specified for the retention of hollow-bearing trees, and recruitments to grow into the hollow-bearing trees to replace them when they die, the achievement of requirements are often grossly inadequate and there appears to be a war of attrition being waged against hollow-bearing trees. Prescriptions need to be simplified by requiring the retention of all remaining large old trees and the retention of sufficient recruitment trees to restore a scattering of large old trees across the landscape. For ecological sustainability the exemption applied to the coastal forests from having to restore minimum densities of hollow-bearing trees needs to be removed.

There are a variety of other tree retention requirements including

- 6 mature and late mature eucalypt feed trees for nectivorous species in every two hectares of the net logging area where they occur (increased to ten eucalypt feed trees near records of the most vulnerable nectivores);
- 10 primary Koala browse trees per 2 hectares of any size in identified “intermediate habitat”;
- 15 mature and late mature feed trees within 100 metres of a Yellow-bellied Glider sap feed tree, observation or den site record, or within 200m of a call detection record;
- Yellow-bellied and Squirrel Glider sap feed trees;
- roosts, dens and nests of various bats, owls and gliders (if found);
- all hollow-bearing trees and stags within 100m of Pale-headed Snake; and,
- ten stags (dead trees) per 2 ha where they occur and are not considered dangerous.

The evidence from our audits is that the retention requirements for such trees are often ignored, except where they happen to also qualify as a hollow-bearing or recruitment tree. For example, following our complaint of inadequate tree marking and retention in Royal Camp SF (Pugh 2012), the EPA (2013) assessed an 8.4ha area, within which 42 hollow-bearing (H) and 42 recruitment (R) trees should have been marked for retention, and found 2H trees and 3R trees marked. These same trees were the only ones marked of the 42 trees required to be marked as Koala Feed Trees or 25 required to be marked as Eucalypt Feed Trees. Neither were the required Yellow-bellied Glider sap and feed trees identified. This was the same area where the Forestry Corporation hadn't done the required Koala scat searches and hadn't identified Koala High Use Areas (which they were logging).

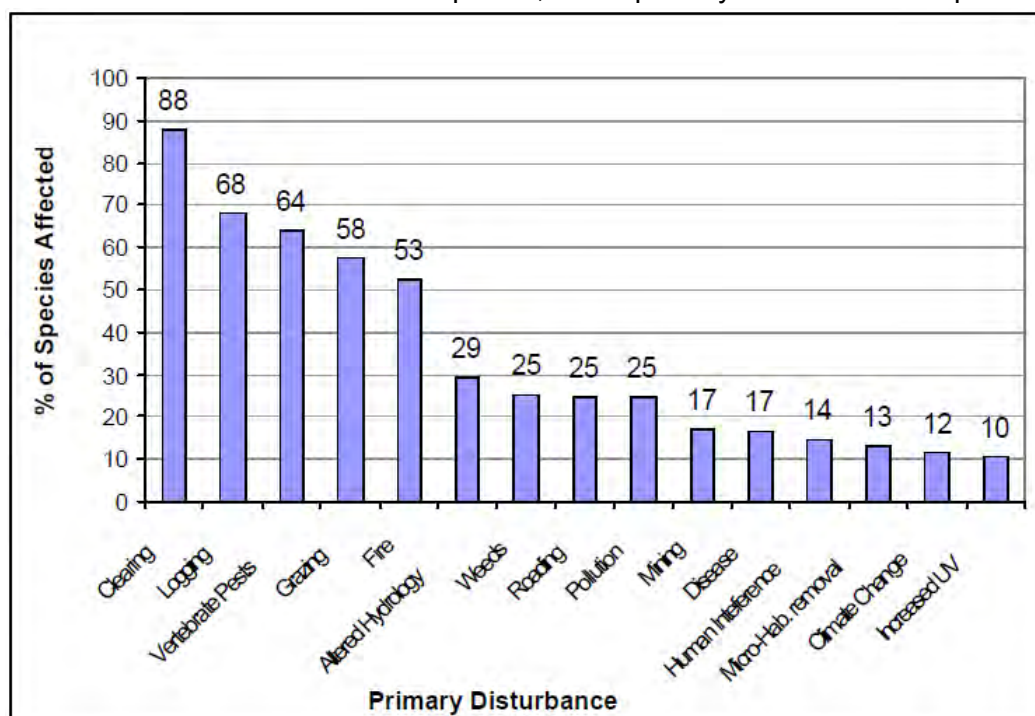
The existing prescriptions aimed at protecting minimum numbers of key food trees across the landscape, notably for nectivorous species (such as honeyeaters), Koalas, and Yellow-bellied Gliders, must be maintained. Maintaining mature trees for these key food resources must remain the focus of the prescriptions. The landscape feed tree prescription for the Koala should apply to the trees larger than 30cm diameter that they actually feed on to stop the Forestry Corporation continuing to meet this need by using trees too small for Koalas to eat.

2.3. Species Specific Conditions

During expert workshops conducted as part of the CRA process for North East NSW information describing the disturbances that affect the priority species was collected (Environment Australia 1999). This involved experts listing all the disturbances affecting a species and then ranking them in terms of their impact on the regional population. Those disturbances that had the most detrimental affect were ranked one and so on. Many species have multiple threats.

For 175 priority fauna species in north-east NSW the expert panels assessed threats are detailed in Appendix 1 (Environment Australia 1999). In summary the experts (including FCNSW and NPWS) identified:

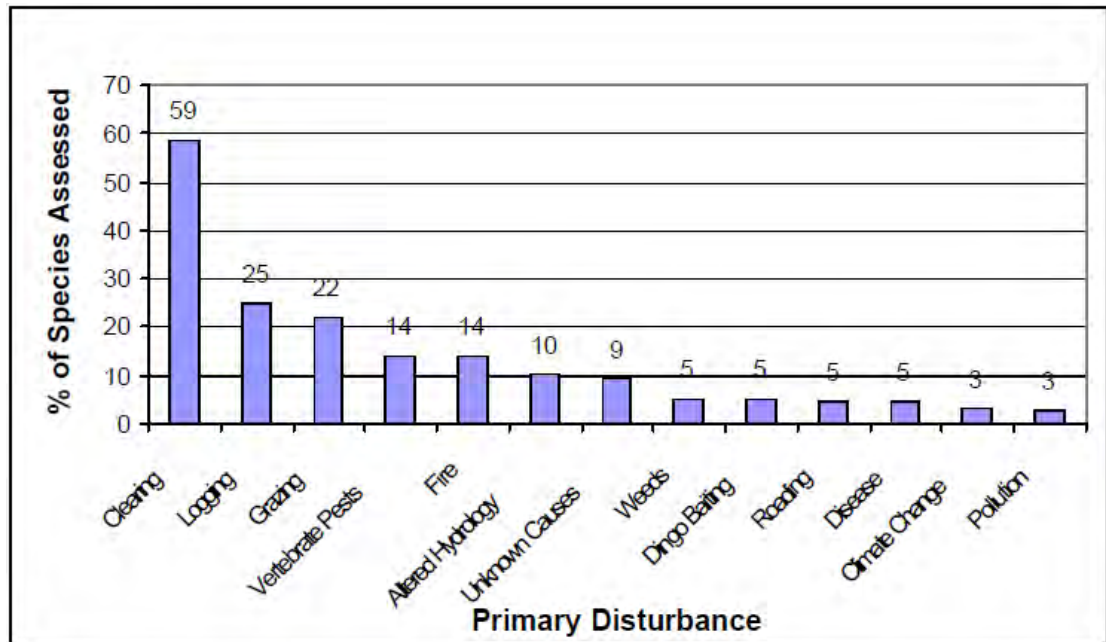
- clearing is a serious threat to 88% of species, and a primary threat to 59% of species;
- logging is a serious threat to 68% of species, and a primary threat to 25% of species;
- grazing is a serious threat to 58% of species, and a primary threat to 22% of species;
- vertebrate pests are a serious threat to 64% of species, and a primary threat to 14% of species;
- fire is a serious threat to 53% of species, and a primary threat to 14% of species;
- altered hydrology is as a serious threat to 29% of species and a primary threat to 10% of species; and,
- weeds are a serious threat to 25% of species, and a primary threat to 5% of species.



- The percentage of all fauna species assessed that have the listed disturbances nominated as having an adverse impact. From Environment Australia (1999).

To satisfy the JANIS requirement to incorporate viable populations of priority fauna into the national reserve system, for the Comprehensive Regional Assessment reserve targets for fauna were identified by application of a formula which used life history parameters known to influence a species probability of extinction to give an estimate of the relative amount of suitable habitat different species may need to persist. This was described as the minimum viable area needed to maintain a species in perpetuity and the output was termed a habitat protection target. Expert panels then identified subregions for populations separated by

dispersal barriers. Targets were applied using modelled mapped habitat reviewed by expert panels.



- The percentage of all fauna species assessed that have the listed disturbance ranked number one. From Environment Australia (1999).

Flint, Pugh and Beaver (2004) applied the CRA reserve targets to analyse the adequacy of the north-east NSW reserve system for fauna, taking into account all reserve additions up til 2004. They found that there is still grossly inadequate reservation for most species;

A binary target assessment of all 710 fauna populations under consideration (excluding targets for bat roosts) reveals that only 217 (31% of all populations) have met conservation targets. Seventy-two of the 139 species (or 52% of species) with targets set have failed to meet target for any of their populations. Only 17 species have met target for all their populations, while the remaining 50 species have met target for at least one but not all populations.

A proportional target analysis indicates that only 45% of fauna populations have sufficient habitat reserved to achieve 50% or more target fulfilment, and 20% of fauna populations are yet to achieve even 10% of the habitat required to meet targets. The mean target achievement for all populations across all tenures is 49%, and the target area index is 33%. The mean target achievement for public lands is 76% and the target area index is 70%.

...

Of the 38 fauna species ranked by the expert panel as having the highest vulnerability to threatening processes (vulnerability 1), 30 do not attain targets for any populations, and none attain targets for all populations. Only 8 species attain targets for one or more populations. Therefore, species with the highest vulnerability to threatening processes remain very poorly reserved.

Examples of the achievement of reservation targets for particular species (Flint, Pugh and Beaver 2004) in north-east NSW (UNE and LNE) were:

- **Hastings River Mouse**, a nationally Endangered species; target was 33,969 breeding females distributed across 8 populations (of up to 4,251 females each). The outcome was the reservation of a total of 2,863 breeding females, with 8% of the mean target achieved (1-29% for each population).
- **Spotted-tailed Quoll**, a nationally Vulnerable species; target was 4536 breeding females distributed across 4 populations (of up to 1,800 females each). The outcome was the reservation of a total of 1,201 breeding females, with 25% of the mean target achieved (10-55% for each population)
- **Barking Owl**, a State Vulnerable species; target was 1,610 breeding females distributed across 2 populations (of up to 805 females each). The outcome was the reservation of a total of 466 breeding females, with 61% of the mean target achieved (44-79% for each population)
- **Powerful Owl**, a State Vulnerable species; target was 756 breeding females distributed across 2 populations (of 378 females each). The outcome was the reservation of a total of 234 breeding females, with 14% of the mean target achieved (11-18% for each population)
- **Yellow-bellied Glider**, a State Vulnerable species; target was 9,240 breeding females distributed across 8 populations (of 1,155 females each). The outcome was the reservation of a total of 1,636 breeding females, with 18% of the mean target achieved (6-33% for each population)

These outcomes highlight the failure of the RFA process in north east NSW to satisfy national reserve criteria and deliver on the promise of an adequate reserve system sufficient to maintain the ecological viability and integrity of fauna populations. The extremely poor reservation status of many threatened fauna species in north-east NSW, and their identified vulnerability to forestry activities, emphasises the need for substantial additions to the reserve system to improve fauna conservation, as well as the strict application of strengthened logging protocols that take into account the poor reservation outcomes. Evidence from NEFA's audits is that off-reserve management prescriptions for fauna are frequently not being applied, are inadequately implemented or are negated by other forestry practices.

As part of the harvest plan preparation the Threatened Species Licence now requires *Pre-logging and Pre-roading Flora and Fauna Surveys* to be conducted by suitably experienced and trained persons, with minimum survey requirements explicitly identified. Targeted fauna surveys are required within compartments that contain known or potential habitat for those fauna species that require site-specific or species-specific conditions. They are not required if there has been a reliable survey in the vicinity in the previous decade. For the Upper North East NSW there are 38 fauna species identified as requiring targeted surveys. For 21 of these species, rather than surveying the Forestry Corporation can opt to assume they are present and apply the required prescriptions to the whole compartment. The Forestry Corporation would usually rather undertake the survey because in the unlikely event that they find the species they will only have to apply the prescription to a limited area.

As well as the species specific surveys, the Forestry Corporation is required to traverse 4km of every 200 hectares of the logging area, during which they are required to spend six person hours surveying for threatened plants and four person hours looking for scats, feed trees, dens and nests of specified threatened fauna. The Forestry Corporation primarily rely upon their own staff to undertake pre-logging flora and fauna surveys using prescribed methods over broad areas before harvesting plans are prepared.

Many survey requirements are not triggered until logging, where the Forest Corporation is required to undertake *Mark Up Surveys* ahead of logging. Under the TSL Harvesting Operations

are prohibited in areas which have not been subject to compartment mark up surveys. At this time ~~an~~ *adequately trained person must conduct a thorough search for, record and appropriately mark ... threatened and protected species features*". These features include nests, roosts and dens of a variety of hollow-dependent species, Koala high use areas, latrine and den sites of the Spotted-tailed Quoll, Glossy-black Cockatoo feed trees, Yellow-bellied Glider and Squirrel Glider sap feed trees, bat tree roosts, Swift Parrot and Regent Honeyeater feed or nest trees, wombat burrows, soaks and seepages in *Phyloria* spp. habitat, and threatened flora. This is a key step in providing the intended protection to a range of threatened species. It is only by undertaking the required on-ground assessment that the features can be found that that trigger a variety of prescriptions

It is apparent that the Forestry Corporation does not have the required expertise or intent to undertake their required *Pre-logging and Pre-roading Flora and Fauna Surveys*. They do generate many records of some of the easiest to find species, though have poor results for some of the more cryptic species. NEFA regularly locate threatened species in areas being logged where they were not identified by the Forestry Corporation. There are significant issues with the competence of their surveys.

For example in their 2007 pre-logging flora and fauna survey in compartment 502 of Styx River State Forest the Forestry Corporation recorded the vulnerable Rufous Scrub-bird (*Atrichornis rufescens*) at 7 sites. These records were made by playing tapes of their calls and hearing them respond. The Rufous Scrub-bird is a small secretive understorey bird of highland wet forests in north-east NSW. It is a living fossil with a lineage dating back 97 to 65 million years but is now listed as vulnerable to extinction, with burning and logging recognised as primary threats. It has long been considered to be in decline on the New England Tableland. The Threatened Species Licence requires that for the Rufous Scrub-bird, all microhabitat within modelled habitat and within 300m of a record, plus a 20m exclusion buffer, is to be excluded from logging.

When planning logging operations in Compartment 502 of Styx River SF Forestry Corporation decided to ignore their own records of the Rufous Scrub-bird, certifying in their March 2011 flora and fauna survey report that records of the Rufous Scrub-bird made by their own trained fauna surveyor, which were recorded in their own databases and NPWS's Wildlife Atlas, did not exist. It wasn't until over three months later that they questioned the surveyor and undertook site investigations to attempt to justify that the records they had ignored were invalid and that no suitable habitat existed in the area. They made no subsequent attempt to have the area resurveyed by a competent person with the required expertise.

In early 2012 the Forestry Corporation burnt much of the area and started logging. When a complaint was made by Joe Sparkes to the EPA in March 2012, the EPA undertook a preliminary assessment which failed to identify any problems. Conservation groups then had to engage qualified experts to undertake two separate habitat assessments, and complain to the responsible Ministers (Pugh 2012 a, b, c, d), before the EPA engaged a suitable expert in May who also verified the presence of qualifying Rufous Scrub Bird microhabitat – contrary to the Forestry Corporation's claims. Being the wrong time of year, surveys for any birds that had survived the burning and logging were not able to be undertaken.

The EPA's March inspection was obviously incompetent and it took two expert assessments by conservation groups to force them to engage their own expert two months after the first complaint was made. Logging continued over this time. Even though their own expert verified

the presence of Rufous Scrub Bird microhabitat (as defined in the TSL), the EPA protected three remaining areas of qualifying habitat, though allowed an area assessed as potential habitat, and other uninspected areas, to continue to be logged.

The EPA (2013) refused to take any regulatory action, though in response to the Forestry Corporation's claims that their surveyor was a field worker with no formal qualifications, who had done their Forestry Wildlife Training, and thus was not adequately trained and thus had misidentified the birds, wrote to the Forestry Corporation:

The EPA further acknowledges that the records were allegedly misidentified by a surveyor who at the time of the survey was not appropriately trained or with inadequate experience to undertake these surveys. ... the EPA is concerned about the extent and potential error associated with the previous surveys conducted by [the forester] in the region. The EPA notes that the original surveys for Styx River State Forest were undertaken in January 2007, with the surveyor continuing to undertake ecological surveys until July 2011, allowing for a period of five years in which diurnal bird surveys may not have been undertaken adequately.

It needs to be recognised that this inadequately trained surveyor (who supposedly mis-identified a response to a taped call he just played on numerous occasions) was responsible for surveying for all animal groups and plants across many forests for many years.

Despite four ecologists with expertise in identifying Rufous Scrub Bird habitat (including one engaged by the EPA) agreeing that qualifying microhabitat existed in the area, the EPA (2013) allowed the Forestry Corporation to get away with ignoring their own records on the basis that subsequent inspections by the Forestry Corporation ecologists had claimed that the habitat did not satisfy the explicit criteria for suitable microhabitat specified in the licence. The EPA did raise concerns that:

The EPA has noted that none of the July 2011 habitat assessments were conducted in the highest quality habitat, despite the presence of 8 hectares in the compartment. ...

The EPA notes that all but one of the July 2011 assessment were undertaken adjacent to Styx River Forest Way, a site characterised by a high level of clearing, disturbance, structural openness and which runs along the ridge line. The EPA notes that the on ground highest quality habitat tends to be within the wetter environments, in gullies, in close proximity to rainforest and way from sites which are characterised by disturbance....

...the EPA considers that Forests NSW failed to target areas of greatest suitability for microhabitat assessments. Accordingly the EPA considers that Forests NSW failed to meet the licence intent of the habitat surveys condition thus increased the risk of failing to protect the habitat of threatened species".

The EPA ignored the fact that even with this rorting of the intent of the licence, the Forestry Corporation had claimed qualifying microhabitat did not exist in areas where the experts did identify it. The EPA also refused to consider NEFA's complaint that at the time the Forestry Corporation signed a document that falsely certified that the records did not exist they were yet to do their shoddy habitat assessments and justify why they considered the records erroneous.

There are many rare and threatened features that can not be dealt with remotely and are not covered in the pre-logging fauna surveys. These require *Mark Up Surveys* to identify them ahead of logging. Experts with the required specific expertise are needed to identify an array of features requiring protection, including Koala High Use Areas, Yellow-bellied Glider den and feed trees, and threatened plants. Forestry Corporation have proven themselves incapable of performing these tasks.

The triggering of Koala protection is dependent upon Mark Up Surveys to find sufficient Koala scats to identify Koala “high use” and “intermediate use” areas. If there is no mark up surveys then there is no protection for Koalas. The TSL requires the Forestry Corporation to thoroughly search trees for Koala scats at 10m intervals in suitable habitat. Given the frequent failure to undertake mark-up surveys found in our audits it is apparent that no attempt is being made to minimise impacts on Koalas in many logging operations.

At Royal Camp State Forest NEFA (Pugh 2012e) found logging of Koala High Use Areas were occurring due to a failure of Forestry Corporation to search for Koala scats ahead of logging, with one Koala High Use Area actively being logged and three other proposed for logging. The forest had an open understorey, though there was leaf litter and bark under most trees and dense grass in places – it was easy to tell whether trees had been searched. In one area being logged NEFA identified 23 high use Koala feed trees (as defined by having >20 Koala scats beneath them) where Forestry Corporation had not identified any. Even after our initial complaint Forestry Corporation only identified 7 of these trees. While logging was stopped in one area while the EPA investigated some of our complaints, NEFA found that in the area where logging continued Forestry Corporation failed to search for Koala scats and continued to log Koala High Use Areas, with 2 more being found by NEFA after logging.

The EPA’s (2013) belated report states:

In summary, the EPA’s investigation determined that FCNSW had not adequately implemented koala protection prescriptions in parts of its operations, particularly around log dump 20 in compartment 15. The EPA identified that compartment mark up and searching was not conducted in adherence with the TSL in this area. The EPA also identified that timber harvesting had been conducted within areas considered to be koala high use.

The EPA considered that these breaches were significant and could have been prevented. As noted above the EPA issued FCNSW three penalty notices in relation to these matters.

Even after we had exposed the Forestry Corporation’s refusal to thoroughly search for Koala scats ahead of logging in order to identify and protect Koala high use areas, we continued to find they are not looking.

As part of their Mark Up Surveys the Forestry Corporation are required to retain and mark 15 Yellow-bellied Glider feed trees in the vicinity of records and to identify, retain and mark Yellow-bellied Glider sap-feed trees. Sap-feed trees are those chosen by Yellow-bellied Gliders to tap for sap by chewing, often V shaped, channels into the bark to concentrate sap for feeding. Only very specific trees are chosen. At Yabbra SF (Pugh 2009) the EPA issued Forestry Corporation a Penalty Infringement Notice and \$300 fine for failing to identify and mark over a dozen Yellow-bellied Glider sap-feed trees, and failing to retain and mark over a hundred other feed trees in their vicinity.

The EPA refused our repeated requests to investigate two Yellow-bellied glider sap-feed trees that went unidentified in logging at Doubleduke SF (ie Pugh 2010), despite being shown one of them and auditing the area. At Royal Camp State Forest NEFA (Pugh 2012e) also found a distinctive Yellow-bellied Glider sap-feed tree logged that should have been identified in the compartment mark-up. In company with a fauna expert, NEFA took the EPA to the tree head left on the ground and showed them the obvious V notches, where even the teeth marks could be seen, yet they again refused to verify the record or do anything about it.

At Wedding Bells (Pugh 2011) the EPA did at least issue a warning to Forestry Corporation for not properly marking a Yellow-bellied Glider sap-feed tree, damaging it by dropping trees on it and leaving debris around its base. This tree had not been identified and protected in the Mark Up Survey despite the Forestry Corporation's own fauna surveyors identifying it by a "YBG" and arrow pointing to it sprayed onto a tree alongside the track.

Forestry Corporation's Threatened Species Licence (5.2.1b) requires them to identify and appropriately protect locations around an array of threatened plant species. Except where there are pre-existing records, protection depends upon threatened species being searched for and located at the time of compartment mark-up.

In a single inspection of Doubleduke SF a botanist employed by the North Coast Environment Council (see Benwell 2010, Pugh 2010b) found *–The endangered species Lindsaea incisa (a small ground fern) was identified at a site that appeared to be within the harvestable area of cpt 145*" and in compartment 144 he found the threatened grass *Paspalidium grandispiculatum* *–amongst earth on an upturned stump at the edge of the recently constructed or upgraded access track, so would appear to have been directly damaged during track construction*".

NEFA subsequently found large numbers of *Lindsaea incisa* (within a wetland and its buffer that had been illegally logged) in Doubleduke SF from within which trees had been logged and machinery driven through it, despite the requirement being for a 50m exclusion zone to be established.

For Doubleduke, Benwell (2010) considered *"No pre-logging flora surveys or flora assessments that could have detected this species appear to have been carried out by FNSW"*. After roading and logging resumed in compartment 144 NEFA was informed that a foreman had been trained (by showing him a picture) to identify the cryptic *Paspalidium grandispiculatum*. It is evident that most foresters do not have the required skills to identify most threatened plants.

The most recent example of the Forestry Corporation's unwillingness to protect threatened plants and Koalas was on private property at Whian Whian. The operation was undertaken by the same Forestry Corporation staff who manage public land logging in the region. NEFA's (Pugh 2014) audit located 8 Koala high use trees, 10 endangered Slender Marsdenia, 30 vulnerable Arrow-head Vines, and 36 vulnerable Red Bopple Nuts on the property that were affected by forestry operations occurring within 20 metres of them. The Private Native Forestry Code of Practice for Northern NSW (PNF Code) requires the implementation and marking of 20m buffers around each of these species, though has no requirement to look for them.

NEFA wrote to the EPA on the 22 September 2013 to request the immediate and urgent imposition of a Stop Work Order in accordance with Section 37 of the Native Vegetation Act 2003 to stop the Forestry Corporation's ongoing unlawful logging operations on private property

at Whian Whian (adjacent to Nightcap National Park), after a survey found a road marked for construction through what should have been exclusion zones for 8 Koala high use trees, over 60 Red Bopple Nut *Hicksbeachia pinnatifolia*, and 3 Slender Marsdenia *Marsdenia longiloba*.

The EPA sent a team in to help the Forestry Corporation, though refused to stop work. Three days after our request the track was constructed within what should have been 20m exclusion zones for 3 Koala high use trees, 7 endangered Slender Marsdenia, 12 vulnerable Arrow-head Vines, and 8 vulnerable Red Bopple Nuts, most of which had been identified and tagged with pink tape (by either NEFA or the Forestry Corporation) prior to track construction. Two Slender Marsdenia were killed, one injured and 3 are missing. One Arrow-head Vine has since died. The fact that these breaches of the threatened species provisions of the PNF Code were knowingly committed by the Forestry Corporation, and under the supervision of the EPA after they had refused NEFA's request for a Stop Work Order, is reprehensible.

NEFA also found 4 other threatened fauna species, and the community another endangered and another vulnerable plant species, requiring prescriptions within the area proposed for logging. None of these were found by the Forestry Corporation. This example proves that the Forestry Corporation have total contempt for threatened species and will not willingly protect them.

The above examples are only a few of those we have found in our inspections of a very small sample of logging operations. NEFA have reported numerous other instances where the Forestry Corporation has not complied with the species-specific requirements of the TSL.

More generally, NEFA has often found the Forestry Corporation logging in areas without doing the required mark-up surveys. If there is no mark up surveys then there is no protection for Koalas, key fauna features or threatened plants. In response to our complaints about the failure to do the required surveys and protect the required features in Yabbra SF (Pugh 2009) and Girard SF (Pugh 2010) the EPA claimed that the surveys were not necessary because of the "*thick impenetrable vegetation*" which meant *Forests NSW is not required to mark up the harvest area (including in advance of the operation in preferred koala habitat) due to occupational health and safety considerations*". While NEFA accepts that some parts had impenetrable understories (mostly of lantana resulting from past logging), most of the areas not marked up did not have impenetrable understories. At Doubleduke SF the EPA issued the Forestry Corporation a caution for failing to adequately mark up an area prior to logging, this was after we had written to the ministers and issued a media release calling for the logging to be stopped.

Eventually the EPA decided to check for themselves, noting on their website:

In June 2012, the EPA instigated a campaign to check Forestry Corporation of NSW compliance with mark-up requirements. The campaign clustered a number of audits over a week on north coast NSW forests from Sydney to the Queensland border.

The EPA identified that in some areas, mark-up complied with licence requirements, and in other areas the EPA identified the need for improvements. In some areas, marking had not been performed ahead of operations, or was incomplete.

The EPA now seem intent on using what occurred at Whian Whian as their model for public land, though not only will they abolish survey requirements for most threatened species they will

also remove the need for the Forestry Corporation to have to do anything when threatened species are found. The EPA undertake a biased and selective review of the Forestry Corporations survey data to justify stopping surveys for most species:

The landscape-based approach reduces the need to locate threatened species through costly surveys, which are often inefficient and ineffective.

...

Surveys are costly to implement and there is frequently a poor link between the survey effort and environmental outcome. The new IFOA will be more outcome-focused by moving towards greater landscape protections, rather than targeted surveys.

...

FCNSW has undertaken more than 5260 traverse surveys over more than 6971 kilometres of traverse in the Lower North East Region since 1998. Wildlife Atlas records reveal that since the IFOA commenced, only 11 nests, dens or roosts of five species have been found during these surveys, and that for the majority of species no nests, dens or roosts have been located.

The lack of den, roost and nest records is not necessarily indicative of low abundance or decline, as many of the species have been regularly recorded during pre-harvesting surveys. There have been over 4000 yellow-bellied glider detections, 2000 large forest owl detections and 1700 tiger quoll detections across the North Coast since surveys were introduced in 1997. The frequency of detections but lack of required actions under the TSL is indicative of an inefficient licence approach, suggesting that a general condition would be more effective for these species.

...

The NSW Government believes that the targeted survey approach used in the current IFOAs can be highly inefficient and that improvements in environmental outcomes over the past 15 years as a result of the surveys has been negligible, particularly when compared to the significant cost and effort required to undertake them.

The TSL for the Lower North East IFOA region requires targeted surveys for nine riparian frog species and a separate survey for the two bat species. The total cost of implementing these surveys since 1998 is over \$1.7 million. When a record of one of these species is found during a survey, a site-specific protection zone is applied. For example if a golden-tipped bat is found, an exclusion zone 30 metres wide must be applied to all first and second order streams within a 200m radius of the record.

Although these surveys across the North Coast have generated over 1200 barred-river frog and over 500 golden-tipped bat records, they have not resulted in significant additional habitat protection.

...

Where appropriate, species-specific conditions will apply in specific areas of mapped habitat for the species concerned. Targeted surveys will still be required to locate and protect some threatened fauna and flora species.

Under the current coastal IFOAs, large amounts of data and information is recorded as part of threatened species surveys. FCNSW devotes substantial resources (approximately \$1.7 million per year) to these pre-harvest surveys.

The EPA do not appear to have conducted a rigorous review of the results of the Forestry Corporations survey results, but rather resorted to a distorted and selective review in an attempt to justify getting rid of species specific prescriptions. It is evident that the Forestry Corporation's failure to locate many species and features, such as threatened plants, Koala High Use Areas,

and Yellow-bellied Glider sap-feed trees, is due to their lack of expertise, refusal to do the required surveys and reluctance to allow threatened species to interfere with timber yields. Some features, such as den and nest trees, are hard to find though this doesn't mean that they shouldn't be looked for while conducting other searches.

Those cases where the record of a species doesn't result in significantly increased protection are more indicative of the inadequacies of prescriptions rather than a reduced need to protect the species. Despite their inadequacies there are numerous species-specific exclusion zones of various forms that have been identified across the landscape as a result of the species-specific prescriptions of the TSL. These exclusion areas have targeted parts of the habitats of an array of threatened species for protection and thus provide a worthwhile, though inadequate, contribution to their conservation. The EPA needs to collate the records of all these exclusions in order to attain an indication of the effectiveness of current prescriptions in attaining outcomes.

It is evident that the Forestry Corporation are often not undertaking the required surveys for threatened species and that when they are undertaken it is often by inadequately trained people. Much of the \$1.7 million per year of public money being reportedly spent on these inadequate surveys is being wasted on inferior work. Rather than abandoning pre-logging surveys and needed protections for an array of threatened species, it would be more cost-effective for an independent third party (such as OEH) to employ consultants to undertake the required surveys and identify areas to be excluded from logging. Forests could be assessed on a catchment basis, rather than in an ad-hoc manner.

The EPA have established their own internal "expert" panel of Forestry, EPA and OEH staff to review prescriptions in light of the EPA's landscape approach, reducing survey needs and reducing administrative costs. They refuse to say who is on their panel and what their expertise is. It is evident that the EPA do not have the required expertise in species and ecosystems to represent environmental needs in such a process.

Any review of prescriptions needs to be undertaken in a transparent manner using independent and balanced expert panels for each fauna group (mammals, birds, reptiles, amphibians) and plants, overseen by the EPA, to review prescriptions to improve their performance. Any reductions in prescriptions due to timber demands must be openly justified.

There needs to be explicit performance measures identified for flora and fauna prescriptions, with regular auditing of the outcomes of those prescriptions by independent experts to assess their effectiveness in achieving the intended protection, and improvements implemented. Monitoring should be a means of reviewing and improving specific prescriptions, not an alternative to them.

3. Maintaining Water Values

With severe declines in populations of most native fish, massive increases in sedimentation and turbidity, loss of riparian vegetation, alienation of floodplain wetlands, increasing salinity, alteration in flow and flooding patterns, and increasing instances of toxic blue-green algae blooms, there is little doubt that many, perhaps the majority, of Australia's rivers and streams are seriously degraded (Hart 1992, Mackay and Landsberg 1992). The community have identified the protection of streams and water quality as one of their highest concerns.

In forested catchments management practices have a major affect on water yields and water quality in streams. The changes initiated by poor management practices can have a significant impact on downstream aquatic flora and fauna, and users of that water. The costs of declines in yields and quality increase with the rarity of downstream biota and the numbers of users. Catchments upstream from the habitat of threatened species and major water storages are of such importance that the water they yield can be of far higher value than any other use of that catchment.

Logging and burning practices that significantly reduce the age classes of trees in a catchment cause a significant reduction in water yields. Logging, burning and grazing can all significantly affect water quality. The Environment Protection Licence is focussed of reducing the impacts of logging and burning on water quality, with the Fisheries Licence specifically focussed on maintaining water quality for threatened fish (though effectively just repeating the EPL prescriptions). The Threatened Species Licence also places high reliance on protection of riparian vegetation to mitigate logging impacts on numerous threatened plants and animals. No regulation is focused on maintaining water yields from forested catchments, particularly as the Forestry Corporation has been successful in confusing the issues.

The impacts of logging on water quality, and some mitigation measures, are briefly discussed in Section 3.1. The importance of retaining riparian vegetation is discussed in Section 3.2. The impact of logging on water yields is discussed in 3.3. The intentional ineffectiveness of regulation by Fisheries NSW is highlighted in 3.4.

Application of prescriptions in the real world is where the process can often fail (Grayson *et. al.* 1993). In practice poor implementation is a common occurrence (Croke and Hairsine 1995, Croke *et. al.* 1999, Pugh 2000). Croke and Hairsine (1995) note *the economic pressure on contractors to supply resources often compromises code compliance and in some instances forces deliberate violations*". Croke *et. al.* (1999) note *Through the course of the project, we have observed many instances of poor road and track drainage, resulting from operator confusion and poor communication*". The excuse of ignorance is not tenable for repeated offences, particularly when these occur year after year.

Prescriptions intended to reduce soil erosion and stream pollution have long applied to forestry operations, and for just as long have been routinely ignored and contravened. Guidelines for the mitigation of soil erosion during and after logging operations were first formulated in 1975 by a working party comprising representatives of the Soil Conservation Service, Forestry Commission and Catchment Areas Protection Board. Called the „Standard Erosion Mitigation Conditions for Logging in New South Wales“, they were meant to be applied to all forestry operations on Crown lands and „protected lands“.

In May 1981 Commissioner Wal Gentle told a “Senior Officers Conference” that their field

performance was *too sloppy; there is no doubt in anyone's mind that the Conditions were being breached, and seriously, almost all the time*". Stating:

Our barrister told us that we certainly could never put in evidence the fact that what was happening in the bush was in fact what we said was happening when we wrote these erosion conditions into our management plans. In other words, the field performance was too sloppy. So a very, very big improvement has to be made by everyone because these are the grounds we can be pulled into the Land and Environment Court for breaching the law, which we are doing.

In the late 1980s NEFA found that the Standard Erosion Mitigation Conditions were still being routinely breached. In April 1992 NEFA blockaded a logging operation at Mount Killekrankie (Oakes SF) in the New England Wilderness to halt horrendous logging and roadworks that were causing massive erosion and pollution of the Bellinger River. CaLM (1992) investigated our complaints and found numerous violations of the SEMCs, including 26 incursions into streamside protection areas, pushing of soils into watercourses, unmapped drainage lines "did not obtain special protection", logging occurred on mapped "steep slideslopes", 86 required cross banks were not constructed, 179 cross banks were inadequate or failed, snig track grades were exceeded on 82 readings, snig tracks were constructed on side slopes in excess of 30° on 220 occasions, and a log dump was constructed in a drainage line (to name just a few). CaLM (1992) estimated soil loses were 3,300 tons from snig tracks, at least 17,140 tons from snig track batters, and 67,700 tons from road batters, noting:

In total this represents an estimated 88,140 tons of soil lost from the batters and tracks of these compartments. If it was necessary to carry that tonnage out of the forest in trucks it would take 8,814 loads or at one truck per hour over a 40 hour week it would take over 7 months to remove that volume of fill.

CaLM (1992) identified that one of the problems was:

The language used in the SEMC's and the discretionary nature of the clauses indicates their intent as an extension or advisory document based on soil conservation principles, not a set of enforceable conditions in a legal document.

...

It is not possible to determine whether some clauses within the SEMC's have been correctly complied with because they allow for discretionary approval and it is not known whether this approval was given or not. Similarly some clauses refer to the intent of the operator, and this cannot be judged ...In other cases the clauses are worded loosely, reflecting their intent as guidelines not prescriptive regulations against which performance can be measured. ...

They also note that:

It was apparent that the operator had no understanding of the standards with which he was obliged to comply.

The supervisor, likewise

- *had no understanding; or*
- *did not check or see the operation; or*
- *if he did understand, was not prepared to enforce the conditions.*

NEFA collected the required expert evidence, though did not proceed with a proposed court case on the basis that the Environmental Protection Authority would take action. The Forestry

Corporation was charged with an offence of polluting waters contrary to s 16 of the *Clean Waters Act 1970*, and while the offence was proven no conviction was entered against the Forestry Corporation.

This case did prove the need for legally enforceable prescriptions for forestry and did result in the application of Pollution Control Licences to Forestry Corporation's operations. Standard Erosion Mitigation Guidelines for Logging (SEMGL) were consequently drafted by CaLM in 1994 to strengthen the conditions under which logging operations can be carried out in order to control erosion. . The Forestry Corporation vigorously resisted their adoption, with the SEMGL's having to be imposed upon them by the Minister for Planning as part of the Environmental Impact Statement (EIS) determination process.

In 1997 the EPA prosecuted the Forestry Corporation for three breaches of its Pollution Control Licence .in Nullum State Forest following a blockade by local residents The Forestry Corporation pleaded guilty and were fined \$25,000 plus costs. Sheahan J (1997) commented:

The Forestry Commission, although gaining a profit from its activities, carries out a function in the public interest, and the public looks to the public body involved in the industry to set some standard for the private sector of it, to be the leading edge" operator in the industry.

The forestry industry must be persuaded to adopt preventative measures because the potential for harm to the environment is great, and is a public concern reflected in the relevant legislation. Such harm as is an inevitable consequence of industry operations must be minimised as to extent and duration.

A pollution control licence imposes... a degree of public trust", per Stein J in EPA v Caltex Refining (Unreported, 21 July 1994), in that the licence permits a licence holder to pollute within the constraints of that licence.

The EIS process was a total failure, only a few were ever determined and the Forestry Corporation managed to avoid the improved regulations for most of their operations until the introduction of Environmental Pollution Licences as part of the Regional Forest Agreement Process in 1998. Though the EPA's intended prescriptions were greatly reduced in the process.

This comprehensive regulation was short-lived. In 2003 the EPA prosecuted the Forestry Corporation after 600 cubic metres of fill from a road they had constructed in Chichester State Forest collapsed into a creek in contravention of the Environmental Protection Licence. The ground slope of the road exceeded 30 degrees, the engineer's plans had been changed and the track was poorly constructed. The parties agreed that "*Quality assurance procedures were not implemented to ensure that the road was constructed in accordance with accepted procedures and guidelines. Accordingly the failure resulted from inadequate site planning, poor construction techniques and methodologies and unsuitable equipment*". Estimated costs for rectification were \$206,000. The court concluded there was harm caused to streams, that were both avoidable and foreseeable, though because of their guilty plea fined the Forestry Commission \$30,000 and awarded costs. .

This offence occurred in May 2003 and the judgement was delivered in December 2004, though in May 2004 the Forestry Corporation was successful in getting the Environmental Pollution Licence amended to have the effect of excluding "non-scheduled" forestry operations from

requiring licences. Since then the Forestry Corporation have been refusing to obtain licences for increasing numbers of their operations. Now over 90% (often over 97%) of their logging operations are no longer subject to EPLs. For example in 2006/7 there were 221 forestry operations in the UNE region, the EPL applied to 23 of these, leaving 198 operations where logging occurred without EPL coverage. This enables the Forestry Corporation to avoid regulation, while also having the benefit of avoiding some requirements of the EPL.

This also had the effect of once again excluding most of their operations from external regulation of erosion mitigation conditions. While Forestry Corporation claim that they will still abide by the intent of the EPL our recent audits have found that they routinely breach prescriptions intended to protect water quality and fish habitat, most notably by refusing to implement prescriptions for unmapped drainage lines, wetlands and drainage depressions, dropping trees into stream buffers, poorly constructing and failing to rehabilitate stream crossings, failing to establish adequate drainage on tracks and roads, and otherwise being careless.

Sparkes (2010) identified 27 breaches of NSW environmental regulations by FNSW in the UNE, noting:

Ten of these involved failures to implement adequate erosion controls after logging, in the worse case 27 cross-banks had been so poorly constructed that they failed and caused significant pollution of Washpool Creek. In one case a bridge had collapsed into a 4th order stream and in another Forests NSW had failed to properly assess, and thus under-estimated, soil erodibility. DECCW directed that remediation should be undertaken for 8 of these breaches and sent warning letters in respect to 3 others. No action was taken in respect to the failure to properly assess soil erodibility. Five of the breaches involved logging of stream exclusions imposed to protect habitat for an array of threatened species (TSL 5.7a) and water quality, with up to 2,150m² being logged in the worst case. DECCW issued a Penalty Infringement Notice for one of these incursions and issued warning letters for three others.

In our audits of the last few years NEFA have again found the EPL prescriptions to be poorly applied and regularly breached. For example in our audit of Yabbra SF (Pugh 2009) NEFA identified 5 unmapped drainage lines which had not been marked in the field and documented 22 trees that had been illegally removed from their stream banks. From NEFAs small sample it was evident that many other unmapped streams had also been subject to logging and burning, with estimates that over 100 trees were likely to have been illegally logged. Forestry Corporation had not switched on the EPL, though their harvest plan (which is a legal document) claimed *all EPL conditions will apply to harvesting and roading operations*, as well as identifying that the Fisheries Licence applied. Forestry Corporation's own audit failed to identify any problems. Fisheries NSW upheld our complaint and issued a Penalty Infringement Notice and \$500 fine for failing to mark exclusion boundaries on unmapped drainage lines, and a Penalty Infringement Notice and \$500 fine for logging, bulldozing and burning within 10m of these unmapped streams. A fine of less than \$10 per tree illegally obtained. Forestry Corporation would have sold the trees for many times this cost to sawmillers and profited from this illegal logging. We also found roads draining directly into streams, inadequate cross banks and wetlands logged.

In Royal Camp State Forest (Pugh 2012e) an illegal crossing was bulldozed across a first order stream while forestry operations were meant to be suspended and while both EPA and Forestry Corporation were supposedly auditing two identified Koala High Use Areas, one 200m away

and another 1km away. Also at Royal Camp SF harvesting machinery had been used in a special operational zone (10m around stream buffer zones) where the soil was saturated contrary to the EPL and Fisheries Licences. Despite both these breaches being reported to the EPA and NSW Fisheries, the EPA refused to investigate them (even though the crossing was constructed in a riparian buffer required to be protected by the TSL) and NSW Fisheries failed to inform us if they took any action.

Even where Forestry Corporation do find breaches of unmapped drainage lines they often fail to take appropriate action or remediate damage. Forestry Corporation identified breaches in Girard SF in April 2010, stating "*Bulldozer driver opening old road for snig track, pushed through 2 unmapped drainage lines*". Despite appropriate stream crossings not being constructed, large amounts of fill being pushed into the drainage lines and both crossings being situated upstream (50-80m) from a Stuttering Frog exclusion zone, Forestry Corporation concluded that there was no environmental harm and simply explained the licence to the operator without undertaking any remedial or disciplinary action. When NEFA (Pugh 2010d) audited the operations in August they independently identified these breaches, observed that erosion had commenced, and that erosion was expected to rapidly worsen. While logging had finished no attempt had been made to remove the spoil from the streams or undertake rehabilitation.

After finding two wetlands totally trashed in Yabbra State Forest (Pugh 2009), in Doubleduke SF NEFA found a wetland had two roads constructed through it, trees dropped into it and its buffer logged, despite complaining of this to the Minister for the Environment and its being a breach of both the TSL and FL as well as the EPL, and involving mechanical disturbance to a nationally endangered plant that required 50m buffers, the EPA refused to investigate it despite investigating the same area for other breaches.

The EPL is the only licence requiring protection of drainage depressions. Drainage depressions are the heads of streams above where defined beds and banks begin to form. The EPL requires that 5 meter buffer strips are retained along drainage depressions within which soil disturbance during forestry activities must be prevented to the greatest extent practicable. Since regulation of these has been removed it is open slather on drainage depressions, even though the Forestry Corporation continue to claim they voluntarily apply the EPL.

Despite most compartments not being subject to the EPL after 2004, there were still 146 "non-compliance Incidents" with the EPL identified by regulators in the Upper North East from 5 audits in 2006/07 and 122 from 3 audits in 2007/08 (Pugh 2011). This is an average of over 33 breaches per audit, and not one fine was issued. Again in 2010-11 the EPA identified 414 non-compliances with the EPL and in 2011-2012 they recorded 245 non-compliances. In 2010-11 the EPA issued 11 penalty notices to Forestry Corporation of NSW for pollution of waters offences, and 5 in 2011-12.

It is apparent that the Forestry Corporation are regularly and frequently breaching requirements of the Environmental Protection Licence. Commissioner Gentle's admonishment that erosion mitigation conditions are *being breached, and seriously, almost all the time* is as relevant now as it ever was. For almost four decades they have proven themselves incapable of self regulation. What is most worrying is that over 30 years of frequent breaches has created a toxic legacy for our streams.

For soil conservation purposes logging has long been banned on excessively steep and erodible slopes. Since 1974 erosion mitigation conditions have sought to have logging excluded from the most erodible slopes. This is reflected in the current licence. The proposal by the EPA to now allow logging of excessively steep slopes (in excess of 30°) and highly erodible soils heralds a return to the worst excesses of the distant past. It is only a matter of time until we get another Killekrankie (particularly as their “trial” of logging excessively steep land is in the same area).

Regulating forestry operations to try to force compliance with erosion mitigation conditions was found to be necessary in 1992 after over 17 years of abuse by the Forestry Corporation. The exemption of over 90% of logging operations from the ambit of the EPL in 2004 during an EPA prosecution has resulted in a return to the bad old days. The EPA’s intent to now make most EPL conditions variable and voluntary, and their allowance of logging on excessively steep and erodible slopes, is grossly irresponsible given that the Forestry Corporation has proven it can not be trusted to implement the prescriptions voluntarily.

3.1. Mitigating Soil Erosion

Raindrop impact and overland flow are the principal means of detaching and transporting sediments and nutrients in forests.

In a logging operation the removal of vegetation allows an increase in rainfall volumes and the force of raindrops reaching the ground, and thus a greater mobilisation of soil particles can occur. Movement of machinery and dragging of logs causes an increase in compacted areas of soil surface and removal of topsoil, thereby reducing the permeability of the soil and increasing runoff, as well as causing channelling and creating loose soil for easy movement. In the short term the removal of the canopy also decreases transpiration, allowing water tables to rise and the soil to become saturated sooner and begin generating overland flow, particularly nearer streams.

The increased runoff also acts to increase the erosive force as doubling the depth of overland flow increases the velocity four times, resulting in the movement of particles 4096 times larger than before and an increase of 1024 times in the total mass able to be carried.

Loss of understorey vegetation and leaf litter, which slows overland flows and traps sediment, will also facilitate transport of soil for longer distances. The impacts of logging are greatly amplified by burning which removes the understorey and ground litter and/or weakens soil structure or increases soil hydrophobic properties.

Where runoff becomes concentrated (i.e. outlets of road drains, cross-banks on snig tracks) it can create channels. Once water enters a channel there is very little deposition of sediment within the channel. Most channels created by roads and logging are likely to feed straight into streams. On disturbed sites and in wet weather, overland flows can overwhelm the soil’s diminished infiltration capacity and also flow directly into streams. The closer that disturbances occur to streams the more likely it is that mobilised soil will reach the stream.

As the soil becomes more disturbed or wetter it becomes more resistant to infiltration and thus overland flow is increased and mobilised soil can pass directly into streams and thus increase

stream turbidity. The potential effects of logging on streams are therefore more pronounced in wetter weather and as operations get closer to streams.

The suspended sediment added to the streams is like a dust storm on dry land – fish can be suffocated, vegetation smothered, and sediment can permeate into all the homes and nurseries of invertebrates hidden away in nooks and crannies between rocks and in gravel beds. As the velocity of the water begins to slow the larger soil particles begin to be deposited, causing sedimentation of stream beds and ultimately dams. At their worst, sediments can completely cover the natural substrate, filling pools and turning the stream beds into the equivalent of biological deserts.

As noted by Cornish (1980) *“the quality of water emanating from virgin forested catchments is generally of the highest order. A reduction of quality may occur as a consequence of operations associated with logging, and this is frequently due to an increase in stream sediment concentrations and associated turbidity levels.”*

Logging has been found to result in a variety of impacts on stream quality:

- (i) significant increases in peak sediment loads (Campbell and Doeg 1989, Lake and Marchant 1991, Bonell, Gilmour and Cassells 1991, Sadek *et. al.* 1998) leading to increased sediment deposition in streams with consequent short-term and long-term impacts on invertebrates and fish (Campbell and Doeg 1989, Lake and Marchant 1991, Davies and Nelson 1994);
- (ii) increased nutrient levels which can stimulate algal production in summer (Campbell and Doeg 1989, Lake and Marchant 1991, Davies and Nelson 1994), affecting both the instream community in the vicinity of logging and downstream water users and reservoirs; and,
- (iii) reductions in levels of dissolved oxygen in streams as a result of oxygen demands of decomposing logging debris in streams, which becomes most apparent in periods of low flows (Campbell and Doeg 1989).

The rate of soil formation in forests may be somewhere between 0.5 and 1 tonne per hectare per annum. In its submission to the Kempsey/Wauchope EIS CaLM (1993b, p.13) note that *“soil erosion is a detrimental impact under any land use circumstance, and any soil erosion in a forest situation greater than the equivalent of 1 tonne/ha/yr is unsustainable, and certainly not reversible in the short term.”*

The Standard Erosion Mitigation Guidelines for Logging (SEMGL) were drawn up by CaLM to strengthen the conditions under which logging operations could be carried out in order to control erosion. SEMGL were based on using the Universal Soil Loss Equation (USLE) and site based data to estimate *“the long-term average sheet and rill erosion from specific areas of uniform topography under specified cover and management conditions”* (CaLM 1993b). USLE was thus used to identify the erosion hazard. The USLE *“does not attempt to predict concentrated flow erosion, gully erosion, stream bank erosion or deposition”* (CaLM 1993b). The SEMGL were only ever intended to reduce the erosion due to logging operations rather than instigate sustainable logging.

SEMGL's divided soils into erosion hazard classes:

- Low - is when less than 40 tonnes of soil is predicted to be lost per hectare in year one.
- Moderate - is when 40-400 tonnes of soil is predicted to be lost per hectare in year one.
- High - is when 400-800 tonnes of soil is predicted to be lost per hectare in one year.
- Extreme - is when over 800 tonnes of soil is predicted to be lost per hectare in year one.

SEMGL were based on 40 year logging cycles and the assumption that erosion is most likely to occur from 1-3 years. CaLM originally intended the cutoff point to be 400 tonnes of soil loss per hectare per logging operation (ie restricting logging to the low and moderate erosion hazard class) (or at least to severely restrict logging above this level) on the premise that soil loss of 10 tonnes/ha/annum is acceptable for agriculture and thus if the soil loss from one operation is averaged over a logging cycle of 40 years then the loss of 400 tonnes/ha/annum per logging operation is acceptable.

Pressure from Forestry Corporation prevailed to allow logging in the low, moderate and high erosion hazard classes. Allowing the loss of up to 800 tonnes of soil per hectare following logging is clearly not sustainable. Forestry Corporation still vigorously resisted their adoption, with the SEMGLs having to be imposed upon Forestry Corporation by the Minister for Planning as part of the EIS determination process.

As an outcome of the RFA in 1999 the SEMGLs were reconstituted into significantly weakened Environment Protection Licences (EPLs) and applied to all logging operations on public land in north-east NSW. The EPL states:

The objects of this licence are to require practical measures to be taken to protect the aquatic environment from water pollution caused by forestry activities and to ensure monitoring of the effectiveness of the licence conditions in achieving the relevant environmental goals.

The Environment Protection Licence (EPL) attempts to regulate activities so as to protect water quality. As well as constraining sources of erosion it attempts to limit sediments entering streams by limiting machinery disturbance near streams and establishing undisturbed buffer strips to capture sediments in overland flows.

Many of the basic premises underpinning EPLs are no longer relevant, most notably:

- an area may be subject to a number of logging operations over a 40 year period, rather than one;
- on going sources of erosion, such as roads and heavily degraded snig-tracks, are not accounted for;
- protection for filter strips along streams and drainage depressions has been reduced/removed;
- the increasing mechanisation of logging operations has resulted in far more intensive and extensive soil disturbances than accounted for; and
- the frequency of extreme rainfall events, and thus erosion events, is increasing due to climate change.

Even with the implementation of „best practice“ measures logging has been found to still result in increased erosion and thus stream turbidities (Davies and Nelson 1993, Davies and Nelson 1994, Grayson *et. al.* 1993, Lacey 1998).

As noted by Croke *et. al.* (1997) –*Erosion undoubtedly occurs in forestry environments and, in particular, on disturbed areas such as snig tracks. The transportation and delivery of this material to the drainage lines depends upon a number of factors. These include the prevailing slope, topography, soil texture, and trapping efficiency of drainage structures and protection features, such as buffer strips, within the catchment.*”

Davies and Nelson (1994) found that –*Logging significantly increased riffle sediment, length of open stream, periphytic algal cover, water temperature and snag volume. Logging also significantly decreased riffle macroinvertebrate abundance, particularly of stoneflies and leptophlebiid mayflies, and brown trout abundance. All effects of logging were dependent on buffer strip width and were not significantly affected by coupe slope, soil erodibility or time (over one to five years) since logging. All impacts of logging were significant only at buffer widths of <30 m.*”

The major sources of runoff and sediments in a logged catchment are unsealed roads, snig tracks, log landings and the most heavily disturbed parts of the general harvesting area. When water flows spread and move slowly downslope they give time for infiltration to occur and sediments to be deposited. When water flows are concentrated sufficiently to initiate erosion channels, sediments can be rapidly and efficiently transported into streams.

Management of logging operations therefore needs to focus on minimising soil disturbances, the removal and restoration of vegetation cover, the initiation of erosion channels, and the frequency of overland flows reaching streams. Permanent roads and clearings need to be adequately sited, drained and maintained to minimise ongoing sediment generation. Temporary clearings involving intense soil disturbance (i.e. snig tracks and log dumps) need to be rehabilitated and drained as soon as possible and before major erosion can occur. Intact vegetation needs to be retained around vulnerable areas to help protect streams and wetlands.

Direction of runoff onto undisturbed vegetation and the maintenance of undisturbed filter strips along streams are the principal means of reducing the impacts of logging on water quality. The theory being that the undisturbed soil allows increased infiltration of water and thus sediment deposition and the roughness of the ground litter and vegetation act as sediment traps. Though if the forest is disturbed by machinery which causes compaction or channelling, or subject to burning removing ground litter and vegetation then the effectiveness of such zones is greatly reduced. Filter strips along streams encompass the most saturated soils of a catchment, so their effectiveness as sediment traps is also greatly diminished when higher groundwater levels reduce infiltration of runoff.

Implementation of best practices to reduce increases in sediment mobilisation, stream turbidity and sedimentation due to logging in a catchment requires:

- Restricting roading and logging activities in relation to rainfall intensity, ground slope, soil type and vulnerability to erosion (Croke and Hairsine 1995, Croke *et. al.* 1999, EPA 1999).
- Limiting the area of a catchment subject to disturbance at one time (Croke and Hairsine 1995, Croke *et. al.* 1999) and avoiding the compounding affects of multiple disturbances.
- Reducing the effects of compaction by avoiding machinery movement over soils, particularly when soil moisture is higher than an acceptable level (Grayson *et. al.* 1993, Croke and Hairsine 1995, EPA 1999).

- Minimising soil disturbance by using walk over techniques where possible and avoiding the exposure of subsoils (Croke and Hairsine 1995).
- Deep ripping heavily compacted areas after use (Cornish 1980, Grayson *et. al.* 1993).
- Ensuring rapid revegetation of disturbed areas (Lamb 1986, Grayson *et. al.* 1993).
- Siting roads and tracks on ridges, minimising construction across sideslopes and steep road grades (Lamb 1986, Croke and Hairsine 1995, Croke *et. al.* 1999), and avoiding streams (Grayson *et. al.* 1993, Croke *et. al.* 1999).
- Ensuring drainage of roads and tracks are of adequate design and spacing to minimise runoff volumes and avoid initiation of erosion channels (Lamb 1986, Croke *et. al.* 1999, EPA 1999). Directing runoff into areas with a good vegetation and leaf litter cover, in an area unlikely to become saturated in prolonged wet weather, and areas not subject to machinery disturbance or burning (Grayson *et. al.* 1993, Croke *et. al.* 1999, EPA 1999).
- Regularly maintaining roads left open for regular traffic (Grayson *et. al.* 1993, Croke and Hairsine 1995, Croke *et. al.* 1999, EPA 1999), with special precautions taken after grading (Grayson *et. al.* 1993).
- Keeping temporary tracks (i.e. snig tracks) open for as short a time as possible, adequately draining them immediately operations are complete (Croke *et. al.* 1999, EPA 1999), and constructing temporary drains when there is a threat of rain.
- Applying adequate buffers to all streams, stream channels and areas most likely to become saturated in wet periods (Grayson *et. al.* 1993, Croke and Hairsine 1995, Croke *et. al.* 1999, EPA 1999). Varying buffer widths according to site characteristics and to provide a reasonable probability of sediment deposition in extreme weather conditions (Croke and Hairsine 1995, Croke *et. al.* 1999, EPA 1999). Maximising the infiltration capacity of buffers by minimising disturbances (Croke and Hairsine 1995, EPA 1999).
- Avoiding stream crossings where possible (Lamb 1986, Grayson *et. al.* 1993). Where a stream crossing is unavoidable the road or track should be properly drained well away from the stream, drain spacings should increase in proximity to the stream (Croke *et. al.* 1999, EPA 1999), the road surface should be adequately armoured (rocks, concrete, bitumen) in the vicinity of the stream to resist erosion; and disturbance to the stream bed and obstruction of natural flows should be minimised.

It is apparent that enhanced measures could be adopted to reduce increases in sediment mobilisation, stream turbidity and sedimentation due to logging in a catchment, though this would require significant enhancements of current practices, such as:

- Applying adequate buffers to all streams, drainage lines and areas most likely to become saturated in wet periods;
- Stopping logging when soil moisture is higher than an acceptable level;
- Deep ripping and revegetating (to an acceptable cover within 6 months) heavily compacted sites (ie log dumps, snig tracks);
- Constructing adequate cross drains on roads and tracks at the end of operations and when rain is threatening;
- Directing runoff into areas with a good vegetation and leaf litter cover, in an area unlikely to become saturated in prolonged wet weather, and not subject to machinery disturbance or burning;
- Avoiding roads crossing streams where possible, where a stream crossing is unavoidable the road should be properly drained well away from the stream and the road surface adequately armoured (rocks, concrete, bitumen) in the vicinity of streams to resist erosion with crossings rehabilitated at the completion of operations;

- Frequently maintaining roads left open for regular traffic, with special precautions taken after grading; and,
- Constantly and rigorously supervising logging operations.

It is important not to abandon the science that was intended to underpin erosion mitigation conditions. It was wrong for most forestry operations to have been excluded from the ambit of the Environment Protection Licence in 2004. Rather than further weakening of conditions, the erosion mitigation prescriptions need to have their integrity restored by being subject to independent expert review, using explicit performance measures, to identify appropriate constraints to reduce erosion and stream pollution in light of contemporary logging practices, recent science and climate change.

3.2. Implementing effective stream buffers

Direction of runoff onto undisturbed vegetation and the maintenance of undisturbed filter strips along streams are the principal means of slowing runoff and trapping mobilised sediments before they reach a stream. They are thus the principal means of mitigating the unavoidable impacts of logging and roads on water quality. Outside of the saturated zone the undisturbed soil allows increased infiltration of water and thus sediment deposition and the roughness of the ground litter and vegetation slows surface-flows and act as sediment traps.

If an infiltration area is logged, disturbed by machinery, subject to burning or grazed by livestock then the effectiveness of such zones is greatly reduced and sediment can more easily pass directly into streams and thus increase stream turbidity and sedimentation.

Stream buffers serve several functions:

- shading of streams and minimising fluctuations in water temperatures
- reducing the volumes of overland flows entering streams
- trapping sediments and associated pollutants moving from upslope towards streams
- maintenance of stable stream channels
- maintenance of habitat requirements for many aquatic and terrestrial species

Wasson and Wasson (2000) found that *“channel size is related to riparian vegetation. From this it follows that riparian vegetation should be protected wherever it still exists, and that channel widening may be arrested (and perhaps reversed) in some circumstances by revegetation”*.

Croke and Hairsine (1995) considered that *“Streamside Reserves must be ... retained along all rivers, streams (permanent and temporary), drainage lines, swamps, springs, wetlands and bodies of standing water”*.

Davies and Nelson (1993) note that *“the role of first-order streams in sediment transport from hillslopes experiencing accelerated erosion has long been recognised”*. In their assessment of logging impacts on streams in steep country in northern Tasmania, Davies and Nelson (1993) found that *“fine sediment infiltration in ephemeral, first-order streams ... is significantly enhanced by logging on steep slopes, by factors of two to three times the median values for unlogged streams. Infiltration by very fine organic sediment ... is greatest during the 2 years immediately after logging, decreasing with time to a level similar to that for unlogged streams*

after 6 years.”, concluding that ~~enhanced fine sediment movement in streams as a result of logging is most likely to occur owing to disturbance of headwater stream channels,~~”.

Croke and Hairsine (1995) note ~~in general it is agreed that buffer strips should extend to the springhead or runoff confluence point of any sub-catchment and should be well upstream of any existing channel or streambed, since flow will occur at a higher point in the catchment once the forest has been cleared.~~” Cornish (1975) states that rather than ~~permanence of flow~~ ~~the high peak flow situation (with the coincident likelihood of higher surface runoff) is more in need of strip protection~~”.

In current practice buffer strips along streams increase in size with stream size rather than catchment area. Bren (1999) notes that the problem with this is that ~~compared to more rigorous methods this under-protects the stream head, but overprotects divergent areas downstream. A method based on a constant ratio of upslope contributing area to buffer area gave the widest buffers at the stream head and buffers of diminishing width as one moved downstream.~~” One estimate is that 70-80% of inflow comes from first order streams. Bren notes that having relatively wider buffers for the smaller headwater streams ~~makes sense hydrologically but is probably politically unacceptable.~~”

At a macro-scale, buffer widths need to be increased along with increasing catchment area, increasing rainfall intensities and increasing slopes to maintain relative effectiveness. At a micro-scale, the widths of buffer zones need to be increased along with decreasing soil storage capacity, increasing soil moisture content, reduced evapotranspiration of vegetation, and reduced ground cover within the buffer. The condition of the slopes draining into buffers also has significant effects, increasing buffer widths are required with increasing levels of disturbance.

As noted by Cornish (1975) ~~the effective width of a filter strip is of direct relevance to the absorption of sediment from upslope~~”. Bren and Leitch (1985) found that spreading outflow from a road evenly over a 5m wide and 5m long area of undisturbed ground ~~did not have any effect. Scrutiny of the individual storm records indicated that a possible effect was discernible only for very small storms~~”, an outcome which they in part attributed to the area quickly becoming ~~covered with a layer of fine sediment which blocked points of infiltration entry into the soil~~” and the tendency of the water ~~to flow along preferential paths, thereby reducing the opportunity for infiltration~~”. Bren and Leitch (1985) concluded that *“if infiltration of the outflow of road culverts is to be obtained then special measures to distribute water adequately over the slope and to maintain infiltration pathways may be necessary.”*

Lacey (1998) assessed sediment accumulation at traps located 5 m below cross bank outlets on snig tracks and found it ~~to be of a similar magnitude to that of the on-track traps~~” at all of his Orara West sites and one of his four Doyles River sites. In other words, in the majority of cases re-direction of silt laden water over short infiltration slopes had no effect. Lacey attributed this to a fire 2 months before logging at Orara West removing ground litter and vegetation and ~~some ground disturbance by logging machinery~~” at the Doyles River site. Croke *et. al.* (1999) found that ~~severe disturbance of the filter strip by successive passes of a bulldozer reduced sediment trapping to 40%~~”.

Croke *et. al.* (1999) found in the Eden area that, for every 5 m of hillslope below a cross bank overland flow was reduced by 336±189 litres. Based on this they constructed a lookup table to

identify ~~the probability of road/track runoff reaching the stream network~~". For example, for a 1 in 10 year storm event generating 27 mm of runoff with cross banks spaced at 20 m intervals, at least some 75 m of available hillslope length would be required below the outlet to ensure that runoff does not enter the stream.

Heron and Hairsine (1998) note that ~~infiltration rates are likely to be highly variable in riparian zones due to the combined effects of vegetative growth and soil properties, as influenced by land management.~~"

Davies and Nelson (1994) found that ~~All effects of logging were dependent on buffer strip width and were not significantly affected by coupe slope, soil erodibility or time (over one to five years) since logging. All impacts of logging were significant only at buffer widths of <30 m.~~"

At buffer widths of 10-30 m Davies and Nelson (1994) found that the most significant impacts were increases in superficial silt and decreases in populations of macroinvertebrates and Brown Trout, with declines in abundance of 80% and 54% respectively at buffer widths <30 m.

Davies and Nelson caution that their assessment was undertaken during low flow conditions and that ~~it is possible that larger buffer widths may be needed in some or many situations to protect streams from enhanced sediment and/or nutrient loads associated with substantial storm events.~~" They cite research by Gowns and Davis which found that even with 100m buffers the macroinvertebrate composition in buffered streams was intermediate between unlogged and clearfelled streams, suggesting ~~that even logging with 100-m buffers may still cause community responses at the species level.~~"

If impacts on streams are to be minimised it is essential that the buffers applied be of an adequate width. Munks (1996) reviewed the available literature to identify buffer widths for various functions (Table 3.4.) and recommend minimum buffer widths for streams (Table 3.5.).

Table 3.4: Recommended buffer widths for various functions of riparian vegetation (Munks 1996)

Function of the Riparian Vegetation	Recommended Buffer Width (from edge of bank)
Water Quality, Sediment, Pollutants etc.	20-50m (streams) 40-100m (rivers)
Bank Stabilisation	10 m + (rivers and streams)
Provision of habitat for terrestrial animals	50-60 m (rivers)
Provision of food, habitat and protection of stream fauna	30-100 m (streams)

Table 3.5. Munks (1996) recommended minimum buffer widths for streams:

Type of River or Stream	Minimum width from stream bank*
Main Rivers	40 m
Creeks and streams from the point where their catchment exceeds 100 ha	30 m
Small streams with a catchment of 50 to 100 ha	30-50 m
Small streams, tributaries, gully and drainage lines which only carry surface	30 m

water during periods of heavy rainfall

* If the slope of adjacent land running down to the stream is greater than 10%, the recommended width is increased to 50m.

Munks (1996) also considers that *adequate widths of riparian vegetation for fauna protection needs to be species-specific.*

Croke and Hairsine (1995) categorised streamside buffers as Streamside Reserves (no logging or machinery disturbance) and Filter Strips (logging, but no machinery disturbance), and made recommendations for their minimum widths along streams and around wetlands (Table 3.6). All their buffers are classed as Streamside Reserves except for those on drainage lines.

Table 3.6. Croke and Hairsine’s (1995) recommended “Minimum Streamside Reserve and Filter Strip Widths according to stream type”

Type of River or Stream	Minimum widths
Rivers, Lakes and Streams used for water supply	100 m
Creeks and streams from the point where their catchment exceeds 100 ha	40 m
Small streams with a catchment less than 100 ha	30 m
Temporary streams flowing more than 1 in 5 years and carries water for some time (weeks) after rainfall.	20 m
Drainage lines carrying water only during or immediately (hours, days) after rainfall	10 m
Permanent springs, swampy ground, wetlands and bodies of standing water	30 m

Croke and Hairsine (1995) note that Streamside Reserves must be:

extended beyond the minimum widths wherever necessary according to a field assessment of the size and flow of the stream or spring, the size and nature of the soak, swampy ground or body of standing water; the nature of the surrounding topography and soil type, the intensity and magnitude of the harvesting operation; the riparian habitat value; and the proximity and physical design of any water supply take-off and distribution system.

Croke and Hairsine consider that extensions of Streamside Reserve widths must *be determined according to soil type, hazard class slope, and other climatic and geomorphic variables relevant to the region*.

Croke and Hairsine (1995) also emphasise that *it is crucial when defining buffer strips in the field that all sources of runoff generation are included within the buffer strip zone. It is essential to incorporate the ‘saturated zone’, which is the area along the stream or drainage line that is permanently saturated (eg swampy ground) or becomes saturated (eg seepage area) with the onset of rain*. They consider that *this is recognisable through the existence of saturated soil or presence of a vegetation associated with frequently saturated soil*.

The Standard Erosion Mitigation Conditions specified:

A filter strip shall be retained where the catchment area of a stream or drainage line exceeds 100 hectares or such lesser area as otherwise specified. The minimum width of any filter strip shall be 20 metres along each side of a drainage line or banks of a stream. Both the width of the filter strip and catchment area may be varied if, in the

opinion of the Forestry Commission or the Commissioner, shape erosion hazard or stream conditions so warrant.

Following the Forestry Commissions horrendous logging in Oakes SF (CaLM 1992), in 1994 the EPA tried to get regulation of Forestry Corporation logging with Pollution Control Licences that specified that, except with authorisation in low and moderate hazard areas, trees were not allowed to be felled within or into protection strips and filter strips, and machinery was not allowed to enter them:

EPA's 1994 intended minimum filter strip width for streams and drainage lines/

	Low Hazard		Moderate Hazard		High Hazard	
	Slopes <18o	Slopes >18o	Slopes <18o	Slopes >18o	Slopes <18o	Slopes >18o
Watercourses	20m	30m	30m	40m	40m	50m
Drainage features (catchment >30ha), wetlands, swamps, drainage plains	10m	20m	15m	20m	20m	30m
Drainage features (catchment <30ha)	5m	5m	10m	10m	15m	15m

The Forestry Corporation vigorously fought the EPA's attempts to get stronger licence requirements, being successful in getting them dramatically reduced before they were adopted. Outside the excluded inherent hazard class 4, the EPA (1999) use the inherent hazard classes to vary requirements for filter strips. Filter strips are also required to be retained around wetlands and swamps and 100 metre filter strips must be retained around all major water storages. A five metre "buffer strip", that can be logged, is also applied to drainage depressions.

EPA's 1999 minimum filter strip width for mapped and unmapped drainage lines, prescribed streams and watercourses in public native forests (metres - measured along the ground surface).

Stream Order	Inherent Hazard Level 1	Inherent Hazard Level 2	Inherent Hazard Level 3
Unmapped	10	10	15
1st order	10	15	20
2nd order	15	20	25
3rd order or greater	20	25	30

EPA's 1999 minimum filter strip width for mapped and unmapped wetlands and swamps in native forests (metres - measures along the ground surface).

	Total Area of Wetlands or Swamps (ha)	
	0.01 - 0.5 ha	Greater than 0.5 ha
Wetlands or Swamps	10	40

Mapped drainage lines are those identified on 1:25,000 topographical maps. While the identification of streams on these maps is relatively good, many smaller streams are often missed, and some larger ones, particularly in some landscapes. These missed streams are the

“unmapped drainage lines” protected by the EPL. The Fisheries Licence also protects these in the vicinity of records of threatened fish (when Fisheries bother to report their presence to Forestry Corporation). The Threatened Species Licence only requires protection of mapped drainage lines.

The EPL requires the exclusion of logging from within 10 metres, and the exclusion of machinery from within 5 metres, of unmapped drainage lines. An additional 10 m wide protection zone is applied in which machinery disturbance is meant to be minimised. A principal reason Forestry Corporation sought to be exempt from the EPL was to allow unmapped drainage lines to be logged.

A first order stream is where overland flow becomes concentrated during storm runoff or by baseflow to form a small stream, these can have permanent flows, though their flow is usually intermittent. Below where two first order streams meet the stream is classed as second order. Below where two second order streams meet the stream is classed as third order, and so on. This classification method of streams is somewhat arbitrary as it depends upon the accuracy of mapping of smaller streams and the chance of when mapped streams of the same order meet. It does result in streams being identified as the same order which have vastly different sized catchments. It also fails to account for the actual catchment size of an actual length of stream.

It is evident that the EPA has already made considerable compromises to the preferred width of buffer zones to meet Forestry Corporation’s demands. They have therefore not ensured that best management practices are applied to forestry operations on public lands. The failure of the EPA to ensure that minimum requirements are implemented becomes even starker when the high rainfall intensities experienced in north east are accounted for, along with the increases in intensities being experienced as a result of climate change.

The EPA are now intending to change the approach to stream protection to one based on LiDAR and GeoNet mapping (rather than 1:25,000 mapping) which is likely to result in a better identification of streams, particularly currently unmapped streams in the headwaters. Stream buffers will be based on the size of the catchment area (ie 50ha, 50-100ha, 100-200ha, etc). They say that some equivalence will be maintained with existing buffers (ie there will be no net change to protected areas or timber availability), though this may mean that because of the high number of unmapped streams identified that they will significantly reduce protection for already mapped lower order (ie 1st order) streams in return for some protection for currently unmapped streams.

Though it needs to be recognised that estimates of timber yields is based upon the assumption that unmapped streams will be protected. As an outcome of the RFA it was intended that unmapped streams would be protected in accordance with the Environmental Protection Licence (condition D6) and Fisheries Licence (condition 7). To account for this in determining the available timber yields modeling was undertaken to identify likely unmapped streams and likely highly erodible areas, which were excluded from the net harvest area for yield assessments. These areas “*of modelled GIS data where field verification is required to accurately map the features*” were subsequently classified as Forest Management Zone 8 on the basis that field investigations would be undertaken to determine the locations of the unmapped streams and rezone them to FMZ3A as harvesting progressed. This rezoning never happened and when the Forestry Corporation was granted exemption from the EPL for most of their operations in 2004 they obtained a major resource windfall by logging the banks of the unmapped streams and increasing disturbance to drainage depressions.

It needs to be recognised that the new LiDAR and GeoNet mapping will simply be refining the modelling used in the RFA to identify unmapped streams that were not counted as contributing to timber commitments. While the Forestry Corporation gained a windfall when they were allowed to log some of these after 2004, it also needs to be recognised that they are still not allowed to log many of them, particularly in the Upper North East, because of the presence of threatened fish downstream. There is no excuse for not fully protecting all streams that are identified in the remapping.

The EPA are proposing that there will be less (no?) marking of riparian and other exclusion areas in the field and more reliance upon GPSs. This is all part of the new approach to mechanical logging, with no requirement for anyone to get out of their logging machines and set foot in the forests. GPSs have limited accuracy, particularly in valleys under dense canopies, and are unable to locate the tops of stream banks to measure from. Currently stream exclusion areas are required to be manually marked in the field, with buffers measured from the top of the stream bank. Even with this marking there are frequent reckless breaches. Without marking, and the vagaries of GPSs, there is likely to be a far worse, and unenforceable, outcomes.

Existing buffer requirements for mapped and unmapped streams, wetlands and swamps are grossly inadequate, most particularly on steeper slopes and highly erodible soils, and need to be significantly increased in accordance with scientific recommendations. For buffers to be effective disturbances to them must be avoided where possible.

3.3. Enhancing Water Yields

Forests are responsible for capturing water from the atmosphere by increasing rainfall and condensing fog. This effect is enhanced by the taller trees and rougher canopy of an oldgrowth forest. Forests are also responsible for returning significant amounts of water to the atmosphere through transpiration, thereby contributing to rainfalls elsewhere.

Of the rain that falls upon a forested catchment some is evaporated directly from leaf and ground surfaces and part may be redirected by surface flows directly into streams. Except in intense rainfall events, the majority can be expected to infiltrate the soil where it is used for transpiration by plants, with the excess contributing to groundwater seepage into streams or possibly seeping deep down to aquifers. In a natural forest situation most of the streamflow response to rainfall is provided by the groundwater system.

Mackey *et. al.* (2010) identify that native vegetation has a multitude of effects in catchments:

Various studies have also found that the presence of native vegetation can influence local rainfall in complex and unexpected ways and that land clearing can lead to a reduction in rainfall (Lyons et al 1993; Lyons 2002; Durieux et al 2003; Silberstein et al 2004; Gero and Pitman 2006; Preston and Jones 2006; Ray et al 2006). Native vegetation protection and rehabilitation are also important to other aspects of the hydrological cycle, including groundwater recharge, managing dryland salinity and maintaining riparian vegetation (Hairsine 1997).

The identification of a relationship between forests, rainfall and water yields has long been recognised. Andreassian (2004) cites Pliny the Elder as probably the first to allude to the hydrological role of forests in his Natural History (written in the first century AD);

Often, after woods have been cut down, springs on which trees used to feed emerge: for example, on mount Himus, when Cassander besieged the Gauls, who cut down a forest to build themselves an entrenchment. Often, disastrous torrents are formed after the felling of mountain woods, which used to hold back clouds and feed on them”

Andreassian (2004) cites Bernardin [de Saint Pierre](#) Studies of Nature „Etudes de la Nature” published between 1784 and 1788, describing the impact of forests on rain and streamflow in Mauritius:

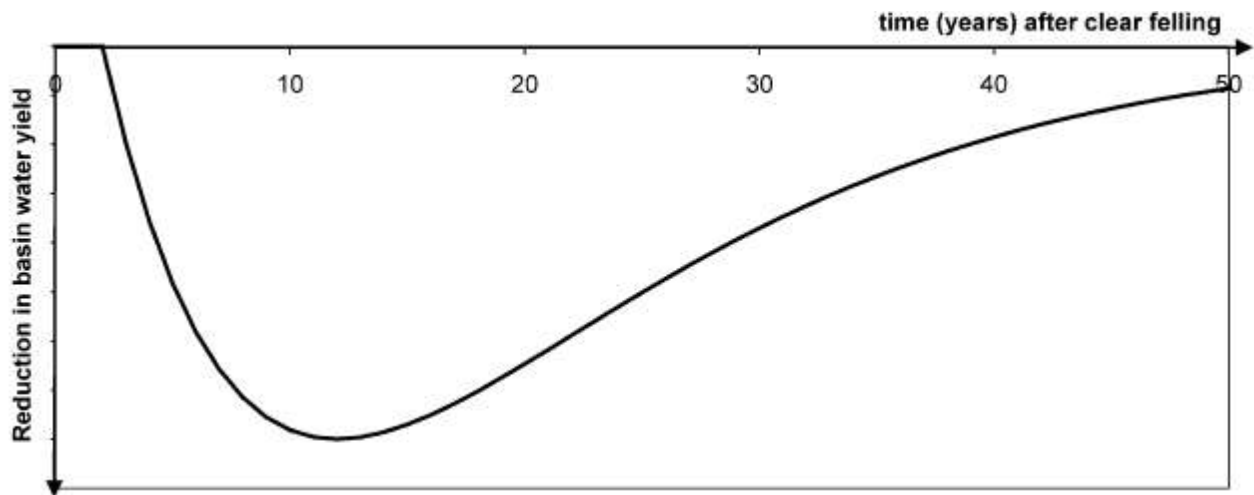
This attractive force of the forests on this island is such that a field in an uncovered situation close to them often suffers a lack of rain whereas it rains almost all year long in woods that are situated within gunshot. It is by destroying part of the trees crowning the heights of this island that one has caused most of the streams that watered it to dry up. I attribute to the same lack of foresight the notable diminishing of the streams and rivers in a large part of Europe.”

Dargavel *et. al* (1995) note:

Streamflow is the residue of rainfall after allowing for evaporation from vegetation, changes in soil storage from year to year and deep drainage to aquifers. Forest management operations can interfere with these processes by:

- *changing the type of vegetative cover on a catchment. Experimental results show that these changes can affect evapotranspiration and therefore streamflow;*
- *changing the soil properties. The ability of the soil to both absorb and store moisture infiltration can affect the proportion of rainfall delivered. Forest operations which compact the soil can reduce both infiltration and storage capacities.*

The most significant relationship between water yields and vegetation is that related to forest age. The basic relationship between water yields and eucalypt forest age was established by studies of regrowth Mountain Ash forests following wildfires in Victoria. Kuczera (1985, cited in Vertessy *et. al.* 1998) developed an idealised curve describing the relationship between mean annual streamflow and forest age for mountain ash forest. This shows that after burning and regeneration the mean annual runoff reduces rapidly by more than 50% after which runoff slowly increases along with forest age, taking some 150 years to fully recover.



Kuczera (1985) Curve.

Vertessy *et. al.* (1998) has attempted to quantify the different components of rainfall lost by evapo-transpiration, identifying them as: interception by the forest canopy and then evaporated back into the atmosphere; evaporation from leaf litter and soil surfaces; transpiration by overstorey vegetation; and transpiration by understorey vegetation. All of these have been measured as declining with increasing forest maturity, with the exception of understorey transpiration which becomes more important as transpiration from the emergent eucalypts declines.

While not apparent at the large catchment scale used to generate the Kuczera curve, smaller catchments have been found to often generate increased flows of water following clearfelling where a significant area of the catchment is cleared. This “initial yield increase” is largely due to removal of vegetation and soil disturbance causing increased overland flows during rainfall events.

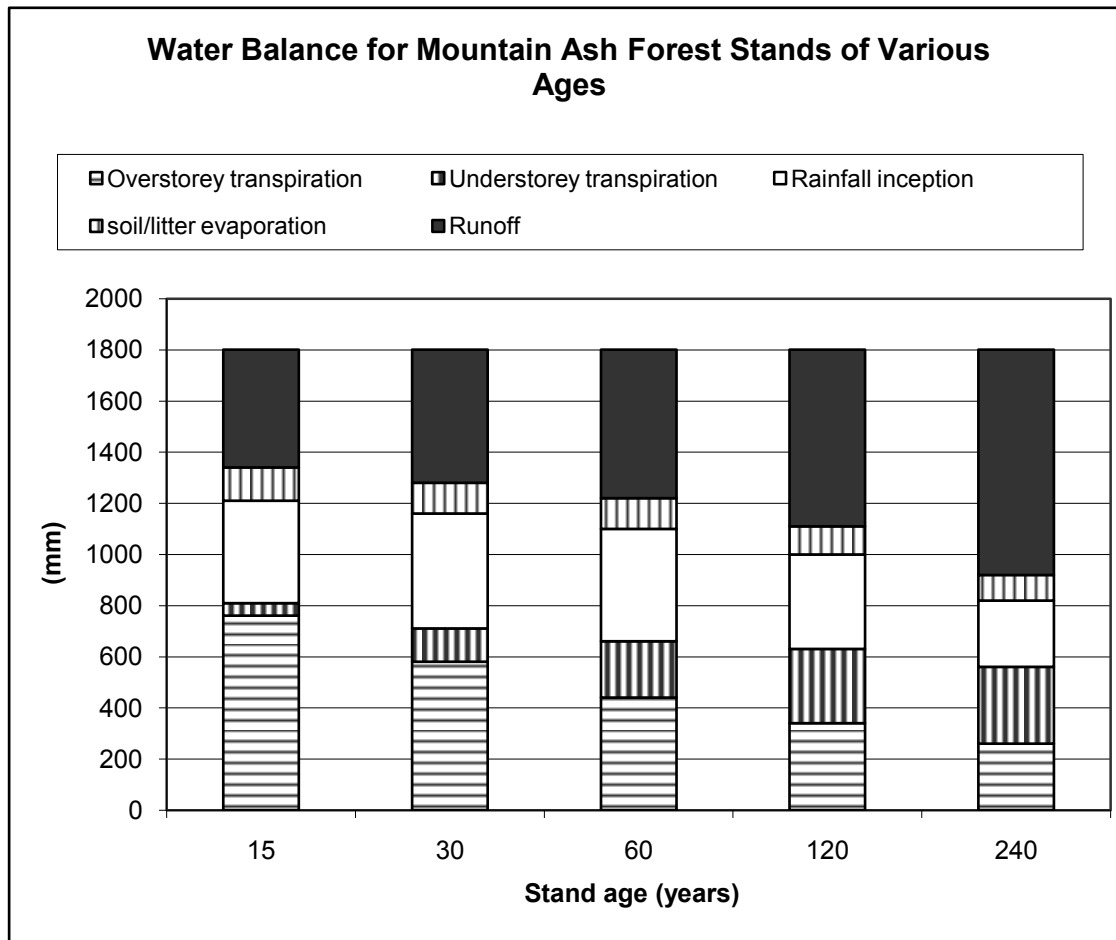
The generalised pattern following heavy and extensive logging of an oldgrowth forest is for there to be an initial increase in runoff peaking after 1 or 2 years and persisting for a few years. Water yields then begin to decline below that of the oldgrowth as the regrowth uses more water. Water yields are likely to reach a minimum after 2 or 3 decades before slowly increasing towards pre-logging levels in line with forest maturity.

relatively limited period. Thereafter water yields usually decline relatively rapidly in relation to growth indices of the regrowth, after some decades maximum transpiration of the regrowth is reached and water yields begin to recover with increasing forest maturity.

For Mountain Ash forest in Victoria, a mean annual rainfall of 1,800 mm/yr has been found to generate a mean annual runoff from oldgrowth Mountain Ash forest of about 1,200 mm/yr (Kuczera 1987, Vertessy *et. al.* 1998). After burning and regeneration the mean annual runoff reduces rapidly by more than 50% to 580 mm/yr by age 27 years, after which runoff slowly increases along with forest age, taking some 150 years to fully recover (Kuczera 1987). Following clearfelling of a forest there may or may not be an initial increase in water yields for a

In the Barrington Tops area Cornish (1993) found that *–water yield decline exceeded 250 mm in the sixth year after logging in the catchment with the highest stocking of regeneration and the*

highest regrowth basal area". This represents a major reduction given that the mean runoff pre-



logging was only 362 mm (38-678 mm) and that only 61% of its catchment was logged.

Water balance for Mountain Ash forest stands of various ages, assuming annual rainfall of 1800 mm (after Vertessy et. al. 1998)

Cornish and Vertessy (2001) report that the yields kept declining:

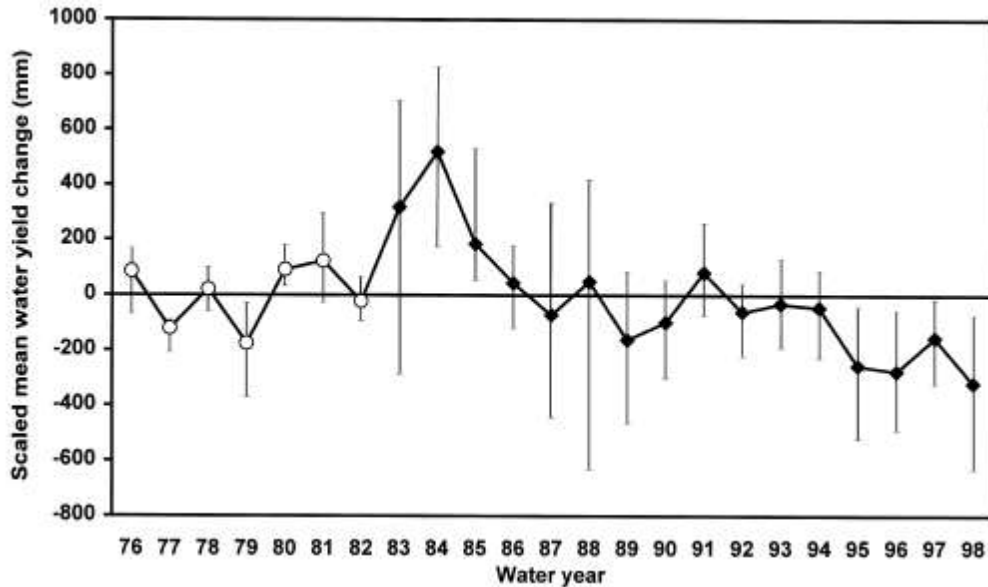
Water yields in a regrowth eucalypt forest were found to increase initially and then to decline below pre-treatment levels during the 16-year period which followed the logging of a moist old-growth eucalypt forest in Eastern Australia. ... Yield reductions of up to a maximum 600 mm per year in logged and regenerated areas were in accord with water yield reductions observed in Mountain Ash (Eucalyptus regnans F.J. Muell.) regeneration in Victoria. This study therefore represents the first confirmation of these Maroondah Mountain Ash results in another forest type that has also undergone eucalypt-to-eucalypt succession. Baseflow analysis indicated that baseflow and stormflow both increased after logging, with stormflow increases dominant in catchments with shallower soils. The lower runoff observed when the regenerating forest was aged 13–16 years was principally a consequence of lower baseflow.

Cornish and Vertessy (2001) elaborate:

This analysis indicates that (in common with the results of many previous studies, e.g. Bosch and Hewlett, 1982) canopy removal increased water yield substantially. Mean increases here were frequently significant while the regrowth trees were less than 3 years old. As the trees increased in age water use increased, but mean water use was

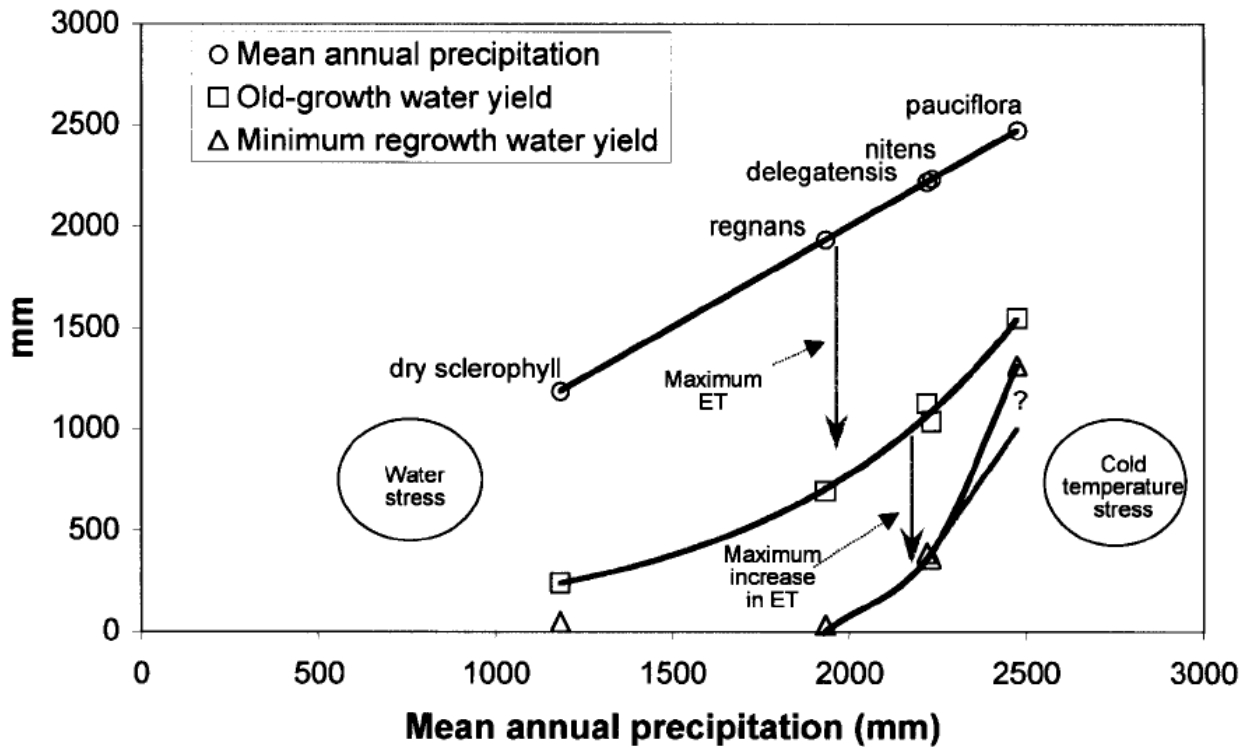
not significantly different from the pre-treatment forest between ages 3 and 12. Water yields then declined further between ages 13 and 16 years, resulting in mean reductions being statistically significant in all but one catchment.

Vertessy (1999) notes that *the maximum decrease in annual streamflow is over 60 mm per 10% of forest area treated, which is similar to the maximum reductions noted for Victorian mountain ash forests*.



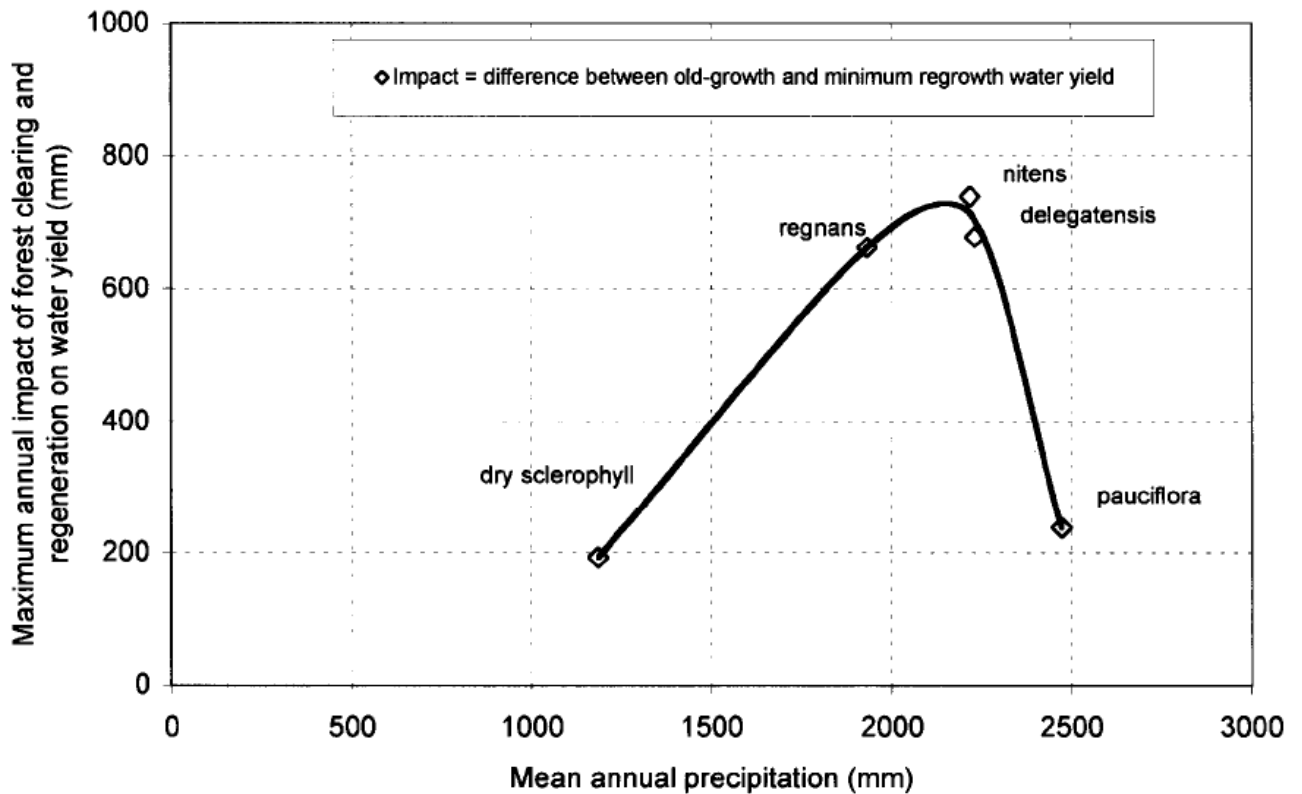
Means and ranges of estimated annual changes in water yield in the six Karuah research catchments logged (Cornish and Vertessy 2001).

Peel *et. al.* (2000) undertook modelling in the Maroondah and Thomson catchments to identify the variations in water yield depressions according to forest types and rainfall.



To make it more confusing, this relatively simple pattern is complicated by varying vegetation types and conditions within a catchment, the depth of soils, rainfall and a multitude of environmental variables, and the compounding effects of events over time. Even then we are still dealing with averages and it is in the drought events when water stored in dams and soils is of highest value, that impacts are greatly accentuated and have the most effect.

Summary of simulated impacts of forest clearing and regeneration on water yield, showing the relationship between species, precipitation, and water yields. From Peel *et. al.* (2000)



Relationship between species, precipitation and maximum impact of regeneration on water yields. From Peel *et. al.* (2000)

The effects of yield reductions are most pronounced in dry periods as the vegetation utilises proportionately more of the rainfall. Vertessy (1999) notes that South African studies demonstrated *that absolute reductions in streamflow were greatest during the wet months, but that the reductions were proportionally greatest during the low flow periods*.

Forest areas that have been recently logged or where regrowth is the dominant vegetation have a very rapid response time in relation to delivery of water into the storage system. Conversely, older less disturbed forests allow more water to permeate into the soil. Soil moisture then percolates more slowly through the catchment increasing the persistence of higher flows.

Water yield has been found not to return to pre-logging levels for some 150-200 years (Kuzcera 1987, O'Shanghnessy and Jayasuriya 1987).

SKM (2007) undertook modelling of the effects of the 2003 wildfires over the whole burnt area of Victoria and selected parts of NSW that drain into the River Murray or Victoria, and their initiation of regrowth, on water yields, identifying that in the absence of fire *there would have*

been a net increase in streamflow over the next 150 years due to the natural aging of the forest”, and concluding:

The results indicate that the typical streamflow response following a fire consists of an initial increase followed by a long-term reduction, rejoining the streamflow response for a no-fire scenario after approximately 100 years. The initial increase in streamflow, compared to mean annual flow pre 2003, for the River Murray was predicted to be 1,116 GL and 250 GL for the Gippsland Lakes. The maximum reduction in streamflow for the Best Estimate was 692 GL for the River Murray by 2022 and 155 GL for the Gippsland Lakes by 2024, compared to mean annual flow pre 2003. However, compared to anticipated streamflow assuming no fire had occurred, streamflow under the Best Estimate fire scenario was 859 GL less for the River Murray and 195 GL less for Gippsland Lakes, both occurring by 2027.

The EPA needs to recognise that logging has significant impacts on water yields from native forests, such that:

- d. Reduction of mature and oldgrowth forest to younger growth stages will cause a significant reduction in water yields;**
- e. Water yields will increase with increasing forest maturity; and,**
- f. Logging should be excluded from significant water catchments.**

In their review of „Logging and Water“ Dargavel et. al. (1995) concluded *–The hydrological evidence reviewed in this report indicates that current logging regimes in the native forests of eastern Australia result in a decline in water yields. ... In catchments used to supply urban centres, this means that there is less water flowing into dams that provide water to cities and towns for drinking, washing, cleaning, watering gardens and industrial uses.*”

All forests are important for water supply, though this importance increases in relation to the numbers of people and the value of industries a catchment supplies. For the more significant catchments water supply should be a “*primary consideration in decision-making affecting the catchment*” and not an incidental consideration as it often is now. The Sydney Water Inquiry was established following the 1998 Sydney water contamination crisis, in part it concluded (McClellan 1998):

–The health of the catchment is a fundamental responsibility of our community, both for this, and subsequent generations. I have concluded that immediate action must be taken to establish appropriate management and regulatory structures to ensure the catchment is not further compromised and, if possible, existing problems minimised or removed. ... We must not allow vested interests to inhibit the creation of effective planning, regulatory and management structures for the catchment.

–The problems of the catchment demand a strong and effective response. A modern treatment plant is not a substitute for proper catchment management. Protecting the catchment provides the best long-term protection for Sydney’s drinking water. ...

–Under the current arrangements, the catchment is managed to allow a range of activities. Water quality considerations may be diminished in favour of agricultural, urban and rural residential, forestry, mining and other developments. ...

–In my view, this situation cannot be allowed to continue. ... From now, water quality should be the primary consideration in decision-making affecting the catchment. This has significant implications for proposed future developments in the catchment. ...

–There is a need to develop directions, catchment wide strategies and water quality objectives to guide management activities and development decisions in the catchment.

...

–I also believe it is appropriate to give one agency specific responsibility for managing Government-owned land in the Inner Catchment. In my view, the National Parks and Wildlife Service is best placed to manage these areas for both water quality and broader ecological considerations, provided it is resourced adequately.”

Dargavel et. al. (1995) note *–There are very large costs associated with providing water storage for urban water supply, so that decrease in stream flow may mean that greater or earlier investments in dams become necessary. Similarly, increased siltation of streams due to upstream economic activities may require dredging of dams or construction of new ones before they are due. These both impose costs on urban water consumers. Sediment from logging activities can increase the cost of municipal water treatment.”*

Water has an economic value that depends on its end use, being greatest in catchments supplying dams used for domestic water.

The major economic study of forests and water was carried out by Read Sturgess for Melbourne Water. Read, Sturges and Associates (1992) determined that the economic worth of water and timber from the forests of the Thomson Dam catchment, in Victoria, was maximised by either no logging at all or by strip thinning combined with a rotation length of 200 years. These two options had a 'Net Present Value' of \$147 and \$169 million, respectively, above continued logging under the current system.

Pugh (2000) undertook an assessment of the costs and benefits of protecting the then Whian Whian State Forest which encompasses part of the catchment of the Rocky Creek Dam, which is a regional water supply. He identified:

State Forests (Cornish 1997) have conservatively estimated that logging has to date resulted in an overall reduction of 15-23% (5,600 to 8,400 megalitres - ML) in water yields to Rocky Creek Dam from the catchment. Though the actual reduction may in fact be as high as 16,800 ML If logging was now stopped in the whole catchment then its water yield will increase over time in line with forest maturity, with something like a third (1,900 ML to 5,600 ML) of the lost yields recoverable within the next 30 years and two thirds (3,700 ML to 11,100 ML) within 60 years.

...

The economic valuation of the water foregone due to continued logging of 30% of the catchment is likely to have a value of at least \$124,000 to \$366,000 per annum. Though if the benefits of delaying new infrastructure requirements are accounted for the Net Present Value (NPV) of ceasing logging in the remaining 30% of the catchment may be somewhere between \$2.5 and \$9.3 million.

The North East Forest Alliance (2002) undertook water yield modelling to estimate how much additional water would be available if logging is excluded from the entire Central Coast

catchment which is then regenerated back to an oldgrowth condition. 17,922 ha of State Forest (60%) was available for logging in the catchment, and 12,036 ha (40%) was „unloggable“. NEFA concluded that there is a very high likelihood that the yields produced as a result of ending logging in the catchment will be in the order of 15 GI/annum.

Water yield from forests has a real value to regional communities which increases with time since logging. Managing logged forests to increase the stocking of older and larger trees over time provides for increasing water yields and benefits for downstream users, aquatic ecosystems and aquatic species. The monetary value of water depends on the downstream uses of the water, with those waters used for urban water supply being the most valuable. Because the highest value of forests within water catchments used for urban water supplies is the provision of clean and reliable drinking water the EPA should exclude such forests from logging.

**WHIAN WHIAN STATE CONSERVATION AREA,
A STUDY IN FOREST BENEFITS**

Pugh (2000) undertook an assessment of the values of the then Whian Whian State Forest and found that timber was worth only a fraction of the other values identified:

VALUE	ANNUAL VALUATION (\$1,000)
Timber	2.5 - 11
Water	4,500
Recreation	2,500 - 5,000
Conservation	2,250 - 15,000

Whian Whian State Forest encompassed a major part of the catchment for the Rocky Creek Dam (a regional water supply for 4 local government areas) and had a visitation of 125,000 visitors per annum. Given that both water yields and visitation would increase in the absence of logging, there could be no doubt that both these use values far outweighed the value of the forest for timber production.

Pugh (2000) found that, based upon optimistic yields, timber production from Whian Whian State Forest had a current value of \$2,484 - \$10,953 per annum. This was the threshold that the forest protection benefits had to exceed for cessation of logging to be in the best economic interests of the community. He found this would require an increase in the annual visitation rate of somewhere between 62 to 540 people (0.05% to 0.43%) for reservation to be of net economic benefit to the community.

State Forests (Cornish 1997) conservatively estimated that logging had to date resulted in an overall reduction in water yields to the dam of 15-23% (5,600 to 8,400 megalitres – ML per annum), though the reduction could have been double this. Pugh (2000) found that cessation of logging in the catchment would result in water yield increases of 62 to 185 ML per annum for the next 60 years. He estimated that the Net Present Value of water yield increases from ceasing logging in the remaining 30% of the catchment would be somewhere between \$2.5 and \$9.3 million.

Given that the forest also supported eleven species of plants and animals listed as in danger of extinction, 61 species listed as vulnerable to extinction, and a further 22 species of plants considered nationally rare, along with significant rainforest stands, and extremely high national estate values, there could be no doubt that its protection as National Park was also in the community’s best interests.

It was primarily the neighbours who lobbied and negotiated for better management of this forest, and their years of effort resulted in its addition to the reserve system as the Whian Whian State Conservation Area in the 2003 Icon Decision. Its visitation has now doubled to 250,000 people per annum, its forests are maturing and increasing water yields into the Rocky Creek Dam, its forests are sequestering and storing increasing volumes of carbon every year, threats to its numerous threatened species have been reduced, and the neighbours welcome the change. There can be no doubt that the community has socially and economically benefited from its protection.

3.4. Protecting Threatened Fish

Forestry Corporation undertake logging operations under a Fisheries Licence (FL), introduced as an outcome of the RFA, which is intended to regulate activities so as to protect State and national threatened species of fish. NEFA have found that the FL has rarely been applied or enforced. As Fisheries NSW and Forestry Corporation are both in the NSW Department of Primary Industry there is a strong reluctance by Fisheries to regulate or penalise their colleagues, as evidenced by just one FL audit/complaint being dealt with in the UNE over the 10 years 1999/2009, and no enforcement action being taken. NEFA's recent audits prove that the FL is being regularly breached, the problem is that despite the lack of compliance by Forestry Corporation there is no effective oversight and minimal enforcement by Fisheries NSW.

The Fisheries Licence is itself a weak regulatory instrument designed to have minimal additional impact on forestry operations, thus the real lesson from Forestry Corporation's intentional refusal to implement the intent of the FL is that they will not implement any requirement for sustainable logging unless legally forced to.

The Fisheries Licence requires in Section 9 that "*forestry activities must not be undertaken in any compartment unless a pre-logging and pre-roading aquatic habitat assessment has been conducted*". Aquatic Habitat Assessments (AHA) are required to identify Class 1 habitat where potential habitat of threatened fish occurs within 2km upstream and 5km downstream, and Class 2 habitat where potential habitat of threatened fish occurs within 100km downstream. Class 1 and 2 habitat then triggers application of prescriptions. AHAs are to be undertaken by "*suitably experienced and trained*" surveyors.

While this appears to establish a clear requirement for AHAs to be prepared for all logging operations, it is interpreted to mean that an AHA is only required if instream works are proposed. While "in stream works" refer to any activity between the banks/edges of a watercourse, Forestry Corporation limit its application to the construction of stream crossings and ignore their crossing of watercourses with logging machinery. Forestry Corporation's planning "Checklist to Ensure Fisheries Licence Requirements Met" only triggers the need for an AHA and the identification of Class 1 and 2 habitat where "*in stream works' consisting of new/replacement or significant upgrade proposed*". If such works are not proposed the checklist states *no further assessment required*.

The other key problem is that Forestry Corporation consider that according to the FL, irrespective of publicly available data, they do not have to take any specified actions to protect threatened fish species unless the data is first provided to them by Fisheries NSW. On this

basis, apparently the FL did not even come into effect until records of the endangered Eastern Freshwater Cod were provided to Forestry Corporation in 2002.

Since Forestry Corporation abandoned the EPL (see Section 4.2.1.) for most logging operations in 2004 the FL has taken on greater significance, particularly in Upper North East NSW where a variety of threatened fish occur within 100km downstream of operations, because it still requires the protection of unmapped drainage lines. After Forestry Corporation was exempted from the EPL for most operations they seem to have gone on a spree of logging unmapped drainage lines, even where they were still legally required to protect them by the FL.

In our audit of Yabbra SF (Pugh 2009) NEFA identified 5 unmapped drainage lines which had not been marked in the field and documented 22 trees that had been illegally removed from their stream banks. From NEFA's small sample it was evident that many other unmapped streams had also been subject to logging and burning, with estimates that over 100 trees were likely to have been illegally logged. Forestry Corporation had not switched on the EPL and ignored the requirements of the FL despite being informed that the endangered Eastern Freshwater Cod occurred downstream.

The harvest plan (which is a legal document) for Compartments 162 and 163 of Yabbra SF identified that all conditions of the IFOA, including the EPL and FL, would be applied. Though the plan made no mention of the presence of the Eastern Freshwater Cod downstream and it appears an Aquatic Habitat Assessment was not undertaken. Contrary to the harvesting plan there was no attempt made to exclude logging from the banks of unmapped streams. Because of our complaint Fisheries NSW undertook a cursory assessment of some of the areas we had identified and for the first time issued 2 Penalty Infringement Notices and \$500 fines for failing to mark exclusion boundaries on unmapped drainage lines and logging, bulldozing and burning within 10m of these unmapped streams.

NEFA's audit of Doubleduke SF (Pugh 2010c) found that Forestry Corporation had not prepared an AHA for one compartment (despite later roading through a wetland), though had prepared what they claimed was an AHA for another where they proposed the construction of new creek crossings. The AHA was prepared by the supervising forester instead of by a "*suitably experienced and trained*" surveyor. He recognised the presence of the endangered Eastern Freshwater Cod downstream but not the publicly available evidence of the presence and potential habitat of the endangered Oxleyan Pygmy Perch.

The Oxleyan Pygmy Perch is identified as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Fisheries Management Act 1994*. Threats to this species include runoff and sediment from stream crossings, logging operations and post-logging burns. The FL was specifically intended to protect this species when it was issued in 1999.

When NEFA complained that the Oxleyan Pygmy Perch had been ignored despite information presented in the 2005 Oxleyan Pygmy Perch Recovery Plan showing it occurred downstream we were told (J. Murray pers. com., November 2010) that they didn't need to consider the species because Fisheries NSW had not provided them with the required information. It is revealing that Fisheries NSW were going to give them the data years before, but apparently hadn't got around to it, as stated in the 2004/5 RFA report:

Preparation of distribution data for the Oxleyan pygmy perch (Nannoperca oxleyana), a species occurring in coastal areas of northern New South Wales, and Macquarie perch (Macquaria australasica) occurring in streams of the southern highlands and slopes, is complete. Both species could be affected by forestry operations and the distribution data is expected to be provided to Forests NSW shortly.

It is also revealing that Fisheries NSW approved the Doubleduke assessment without themselves identifying the missing endangered species.

Despite discussing our concerns with both agencies and submitting a written complaint, Fisheries NSW refused to take any legal action against Forestry Corporation – not even a warning letter. NEFA was verbally assured by a Fisheries NSW officer that the problem had been fixed by provision of the required data to Forestry Corporation and would not occur again.

NEFA's audit of Wedding Bells SF (Pugh 2011b) found that Forestry Corporation had again failed to prepare Pre-Logging and Pre-Roading Aquatic Habitat Assessments within the catchment of known and potential habitat for the endangered Oxleyan Pygmy Perch in the catchment of the Corindi River, and failed to exclude unmapped drainage lines from logging and roading to protect downstream habitat of the Oxleyan Pygmy Perch as required by the FL. It is extremely concerning that within days of our complaints over Doubleduke SF Forestry Corporation had done a shoddy checklist for Wedding Bells which again ignored the presence of Oxleyan Pygmy Perch downstream.

Despite Fisheries NSW finding that instream works had indeed occurred on a number of locations in unmapped drainage lines they again refused to take any action on the grounds that they had not provided adequate records to Forestry Corporation. Because of a technicality the Forestry Corporation have managed to exempt themselves from many requirements of the Fisheries Licence for 15 years.

It is revealing that since at least 2004 the Roads and Traffic Authority has been acknowledging the potential habitat of the Oxleyan Pygmy Perch in Wedding Bells State Forest in its planning processes. The RTA (2006) "Pacific Highway Upgrade – Woolgoolga to Wells Crossing Preferred Route Report" identified the presence of known habitat downstream from Wedding Bells SF and potential habitat within Wedding Bells SF from information provided by Fisheries NSW.

NEFA's audit of Royal Camp (NEFA 2012e) found that the AHA still did not consider the presence of the Oxleyan Pygmy Perch within 100km downstream, and for a crossing proposed in mapped potential habitat of the Eastern Freshwater Cod, the site of the Aquatic Habitat Assessment used to determine whether suitable habitat existed for the Cod at a proposed creek crossing was 9km away, upstream, in farming land.

NEFA's few samples of logging operations reveal that there has been a widespread and deliberate failure to implement the minimalist requirements of the Fisheries Licence to reduce impacts of forestry operations on threatened fish in New South Wales. It is important to recognise that the prescriptions are aimed at reducing pollution and sedimentation of streams and thus are of benefit to all fish species.

Fisheries NSW have still failed to provide records of Oxleyan Pygmy Perch to Forestry Corporation. When last checked in mid 2011 Fisheries NSW had also failed to provide records of the endangered Purple Spotted Gudgeon to Forestry Corporation despite its being listed in January 2008, so it has been similarly ignored. It is also apparent that the last records of the Endangered Eastern Freshwater Cod were provided in 2002 and are in need of updating. This is a significant failure on behalf of Fisheries NSW, though Forestry Corporation should be capable of collating this information for themselves.

Forestry Corporation and NSW Fisheries have colluded for over a decade to avoid preparing Aquatic Habitat Assessments and to not take any action to implement legal requirements to protect a number of Endangered fish on the pretext that the Fisheries NSW have not provided the required data to Forestry Corporation. Fisheries NSW have also allowed unqualified people to prepare the few AHAs that have been done and failed to critically review Forestry Corporation's deficient assessments.

This raises two key questions "Why have Fisheries NSW failed to provide the required data on threatened fish to Forestry Corporation for over 15 years?", and "Why does Forestry Corporation not act responsibly and take action to protect a nationally endangered species unless forced to by the letter of the law?"

The refusal by Forestry Corporation to employ anybody with expertise in freshwater fish to advise them or undertake Aquatic Habitat Assessments is an obvious problem that must be addressed.

Audits have revealed that, if at all, Forestry Corporation are undertaking deficient Aquatic Habitat Assessments that routinely omit endangered fish, fail to collect adequate water data, and use inappropriate sites. Forestry Corporation's continuing refusal to consider the endangered Oxleyan Pygmy Perch on the grounds that Fisheries NSW have still not provided the required distribution maps is untenable for both organisations.

To ensure that threatened fish are responsibly dealt with and treated in a more sustainable manner, an independent body (such as OEH) needs to employ suitably qualified people to prepare Aquatic Habitat Assessments and to apply the intent of the Fisheries Licence. The Fisheries Licence needs to be amended to make its intent, to minimise eroded soil entering streams and affecting populations of threatened fish, clear and legally enforceable.

4. Maintaining and Enhancing Carbon Storage

Solving the climate change problem facing Australia and the world requires that emissions of greenhouse gases be reduced and that the storage of carbon in vegetation be increased, so as to enable atmospheric concentrations of greenhouse gases to be stabilized at a level that avoids the most dangerous climate changes.

The need for reducing emissions from deforestation and forest degradation is now recognized by the international community as an essential part of solution to addressing carbon emissions. Since the 2007 United Nations Climate Change Conference in Bali international negotiations have focused on the role of natural forests in storing carbon.

Native forests play a significant role in the storage of carbon and the sequestration of carbon dioxide from the atmosphere. Old growth forests are the most significant carbon storehouses, with most carbon stored in the oldest and biggest trees (Roxburgh *et al.* 2006, Mackey *et al.* 2008, Stephenson *et al.* 2014). Old-growth forests also remove carbon dioxide from the atmosphere and sequester it in live woody tissues and slowly decomposing organic matter in litter and soil. (Zhou *et al.* 2006, Luysaert *et al.* 2008)

Mackey *et al.* (2008) found;

Our analyses showed that the stock of carbon for intact natural forests in south-eastern Australia was about 640 t C ha⁻¹ of total carbon (biomass plus soil, with a standard deviation of 383), with 360 t C ha⁻¹ of biomass carbon (living plus dead biomass, with a standard deviation of 277). The average net primary productivity (NPP) of these natural forests was 12 t C ha⁻¹ yr⁻¹ (with a standard deviation of 1.8).

Average Carbon Carrying Capacity of the Eucalypt Forests of South-eastern Australia. (from Mackey *et al.* 2008)

Carbon component	Soil	Living biomass	Total biomass	Total carbon
Carbon stock ha ⁻¹ (t C ha ⁻¹)	280 (161)	289 (226)	360 (277)	640 (383)

Carbon stock per hectare is represented as a mean and standard deviation (in parentheses), which represents the variation in modelled estimates across the region

Logging significantly reduces the volume of carbon stored in forests. In regards to logging Mackey *et al.* (2008) note:

The carbon stock of forests subject to commercial logging, and of monoculture plantations in particular, will always be significantly less on average (~40 to 60 per cent depending on the intensity of land use and forest type) than the carbon stock of natural, undisturbed forests.

...

The majority of biomass carbon in natural forests resides in the woody biomass of large old trees. Commercial logging changes the age structure of forests so that the average age of trees is much younger. The result is a significant (more than 40 per cent) reduction in the long-term average standing stock of biomass carbon compared with an unlogged forest. ..

It is important to recognise the outstanding contribution of big old trees to storage of carbon in forests. For example Roxburgh *et.al.* (2006) found:

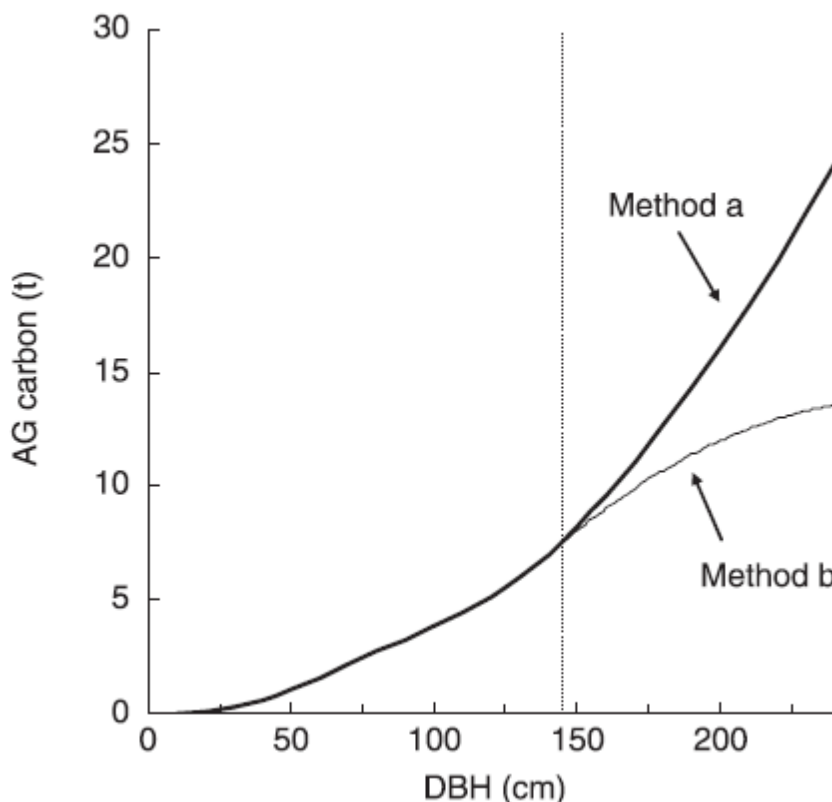
In mature forests, large diameter trees greater than 100 cm d.b.h. comprised 18% of all trees greater than 20 cm d.b.h. and contained 54% of the total above-ground carbon in living vegetation. ... The influence of large trees on carbon stock therefore increases with their increasing size and abundance.

In Australian forests Roxburgh *et.al.* (2006) found that following logging:

Model simulations predicted the recovery of an average site to take 53 years to reach 75% carrying capacity, and 152 years to reach 90% carrying capacity.

This is compatible with the findings of Harmon *et. al.* (1990) in America, who found that during simulated harvesting carbon storage is reduced by 49-62% and does not approach old growth storage capacity for at least 200 years (even when storage in wooden buildings is accounted for).

Above-ground biomass/carbon relationship to tree diameter at breast height. From Roxburgh *et.al.* (2006). Method A assumes minimal internal tree decomposition. Method B allows for internal decay.



Stephenson *et. al.* (2014) concluded:

Forests are major components of the global carbon cycle, providing substantial feedback to atmospheric greenhouse gas concentrations. Our ability to understand and predict changes in the forest carbon cycle—particularly net primary productivity and carbon storage—increasingly relies on models that represent biological processes across several scales of biological organization, from tree leaves to forest stands. Yet, despite advances in our understanding of productivity at the scales of leaves and stands, no

consensus exists about the nature of productivity at the scale of the individual tree, in part because we lack a broad empirical assessment of whether rates of absolute treemass growth (and thus carbon accumulation) decrease, remain constant, or increase as trees increase in size and age. Here we present a global analysis of 403 tropical and temperate tree species, showing that for most species mass growth rate increases continuously with tree size. Thus, large, old trees do not act simply as senescent carbon reservoirs but actively fix large amounts of carbon compared to smaller trees; at the extreme, a single big tree can add the same amount of carbon to the forest within a year as is contained in an entire mid-sized tree.

Mackey et. al. (2008) state:

Conventional approaches to estimating biomass carbon stocks are based on stand-level commercial forestry inventory techniques. These data are not, however, suitable for calculating the carbon carrying capacity of natural forests.

Roxburgh et. al. (2006) and Mackey et. al. (2008) advocate an approach to assessing the carbon stocks of native forests based on the Carbon Carrying Capacity of oldgrowth forest. Mackey et. al. (2008) consider that for reliable carbon accounts two kinds of baseline are needed;

1) the current stock of carbon stored in forests; and 2) the natural carbon carrying capacity of a forest (the amount of carbon that can be stored in a forest in the absence of human land-use activity). The difference between the two is called the carbon sequestration potential—

the maximum amount of carbon that can be stored if a forest is allowed to grow given prevailing climatic conditions and natural disturbance regimes

With the urgent need to sequester carbon from the atmosphere we should be managing our forests as carbon sinks. As Mackey et. al. (2008) conclude;

The remaining intact natural forests constitute a significant standing stock of carbon that should be protected from carbon-emitting land-use activities. There is substantial potential for carbon sequestration in forest areas that have been logged commercially, if allowed to regrow undisturbed by further intensive human landuse activities

Forests recovering from logging will sequester carbon and increase the volume stored in both living biomass and soils. Most importantly the retention of older trees is of utmost importance in maintaining and enhancing a forest's carbon storage and sequestration.

The EPA needs to recognise that logging has significant impacts on carbon storage in native forests, such that:

- e. Loss of mature and oldgrowth trees will cause a significant reduction in carbon storage and sequestration in forests;**
- f. Carbon storage and sequestration will increase with increasing forest maturity;**
- g. Large trees are particularly important for carbon sequestration and storage; and,**
- h. Forests should be managed so that they are carbon sinks.**

For the Great Eastern Ranges corridor Mackey et. al. (2010) note:

One necessary action to help solve the climate change problem is to prevent emissions from deforestation and forest degradation (reduced emissions from deforestation and degradation: REDD) (IPCC 2007a). Emissions from deforestation represent about 18% of annual global emissions – a share greater than that of the global transport sector (Nakicenovic 2000; IPCC 2006). Emissions from degradation of forests and other ecosystems have yet to be fully accounted for, but they are likely to be in the order of 10–15%. This would mean that emissions from land clearing and ecosystem degradation may account for more than 20% of the root cause of the climate change problem. Various mechanisms are now being considered for directing investments for funding activities that will result in REDD. Different rules and policies may be promulgated for REDD in developing versus developed countries. In any case, we should plan for ‘wall-to-wall’ carbon accounting in anticipation that the green carbon in natural forests and woodlands will very soon have a market value.

More specifically, appropriate conservation management could lead to the GER corridor making a significant contribution to Australia’s national carbon accounts by (Keith et al 2009, 2010):

- *protecting the stocks of carbon in forests and avoiding depletion of these stocks through emissions associated with forest logging, soil disturbance and regeneration burning*
- *allowing forests to reach towards their carbon-carrying capacity by cessation of the logging and other land use activities that remove, in particular, large, old trees that store most of the aboveground carbon and cause emissions of soil carbon stocks, thus restoring the forest’s current carbon stocks*
- *further increasing the stock of carbon stored in the GER corridor ecosystems by promoting permanent native revegetation and restoration.*

Perkins and Mackintosh (2013) undertook an economic analysis to compare the net financial benefits from harvesting NSW’s Southern Forest Region’s native forests with those produced by conserving the forests and generating carbon credits, finding that *“using the forests to generate carbon credits will generate greater aggregate net benefits than harvesting”*. They note:

The analysis in this paper suggests that, in the absence of a rebound in relevant wood product prices (especially the export woodchip price), continued harvesting in the SFR is likely to generate substantial aggregate net losses over the next 20 years. In the core harvest scenario (H1), the combined net financial benefits generated by the Forestry Corporation of NSW and the SFR’s private hardwood processors over the period 2014-2033 were estimated at between -\$40 million and -\$77 million. These losses would be borne by the Forestry Corporation of NSW and SEFE; the sawmills are projected to produce a small positive net financial benefit over the projection period. This is mainly because the Forestry Corporation of NSW and SEFE’s operations subsidise SFR hardwood sawmilling.

Stopping harvesting and using the native forests of the SFR to generate carbon credits offers a viable alternative to commercial forestry. In the core no-harvest scenario (CC1, method 1), it was estimated that the New South Wales government could earn 33.8 million ACCUs over the period 2014-2033 (an average of 1.7 million per year). The net financial benefits that could be generated through the sale of these credits (accounting for transaction and management costs) were estimated at \$222 million. The Australian government would also receive the benefit of 12.8 million residual FM credits from the

cessation of harvesting in the SFR over the period 2014-2033. However, if the New South Wales government receives ACCUs, the financial benefits to the Australian government are likely to be relatively small as lost company tax revenues associated with ceasing harvesting would largely cancel out the financial benefits received from the residual FM credits.

Overall, the analysis supports two general conclusions:

- under current and likely future market conditions, the harvesting and processing of native logs in the SFR is likely to generate substantial losses; and*
- the aggregate net financial benefits are likely to be significantly higher if commercial harvesting is stopped and the native forests of the SFR are used to generate carbon credits.*

The EPA needs to recognise that using the forests to generate carbon credits will generate greater aggregate net benefits to the community than harvesting. Prescriptions that require increased retention of core habitat across the landscape, large old hollow-bearing trees, the enhanced food resources provided by mature trees, and the restoration of multi-age forests, enhance the carbon storage within native forests. The avoidance of emissions from retaining these trees, and their ongoing carbon sequestration, provides a higher benefit to the people of NSW than logging them.

5. Dealing with Dieback

There are many forms of dieback affecting native forests and remnant trees in partially cleared land in NSW. The most obvious example of forest ecosystem collapse in NSW is the dieback associated with logged forests, psyllid infestations and colonies of the Bell Miner. “Bell Miner Associated Dieback” (BMAD) has affected tens of thousands of hectares of forests in north-east NSW, in severe cases leading to death of trees and replacement by lantana.

Bell Miner Associated Dieback (BMAD) is recognised as a significant problem and growing threat to thousands of hectares of forests in north east NSW, it has been listed as a “Key Threatening Process” (KTP) and identified as affecting timber and water yields, as well as many plants and animals. It is associated with the invasion of forest understoreys by the weed Lantana (another KTP) following logging. Both the Forestry Corporation and EPA appear disinterested in the problems caused by BMAD and Lantana invasion, the need to avoid logging operations in affected stands and the need for active rehabilitation of degraded areas.

The Bell Miner Associated Dieback Working Group (BMADWG 2004) summarise the problem:

Bell miners are a natural part of eucalypt ecosystems and normally have minor and positive impacts on forests. However, increases in Bell miner populations and their distribution, in addition to other factors such as tree stress, psyllid infestation, dense forest understoreys as well as weed invasion, drought, logging, road construction, pasture improvement, bio-diversity loss both floral and faunal, soil nutrient changes, and changing fire and grazing regimes have all been implicated in the spread of dieback. The outward expression of BMAD is generally characterised by:

- *trees stressed and dying;*
- *high populations of psyllids and other sap-sucking insects contributing to tree stress;*
- *high Bell miner numbers, with their aggressive territorial behaviour, driving away insectivorous birds that would otherwise help to control insect numbers;*
- *alteration of the forest structure: canopy and midstories depleted with grassy and wet and dry sclerophyll understoreys replaced by dense shrubby vegetation, often associated with lantana invasion*

The Bell Miner Associated Dieback Working Group (BMADWG 2004) summarise the consequences:

The potential impacts of BMAD on forest productivity and biodiversity cannot be overstated.

Potential impacts for conservation include:

- *Extreme degradation of forest ecosystems in World Heritage listed National Parks such as Border Ranges NP, Murray Scrub and Dome Mountain in Toonumbar NP, Bungdoozle and Cambridge Plateau in Richmond Range NP, Mt Nothofagus NP, Kooreelah NP, and Mt Clunie NP.*
- *Major disruption in ecosystem function, and reduction in diversity and abundance of threatened flora and fauna species including Dunn's White Gum (*Eucalyptus dunnii*) and Rufous Bettong (*Aepyprymnus rufescens*) across all land tenures,*
- *Increased weed invasion and associated displacement of native forest species.*

Impacts on forest productivity can be severe. Dieback defoliates the crown, ultimately leading to the death of standing trees. Not only do the standing trees die, but the lack of

foliage and flowering and subsequent fruiting, reduce and eventually eliminate the seed production necessary for forest regeneration. Dense understorey development (primarily Lantana weed invasion in northern NSW and Cissus in the south) continues with little overstorey and reduced alternative species competition. Reduced eucalypt flowering directly impacts on honey production and on bird species and populations that compete with Bell miners.

Impacts of BMAD on private lands are significant, as these areas are critical to the livelihoods and well being of local communities. Forest woodlots and timber supplies, honey production, shelter belts and forest-related lifestyles are under threat from BMAD.

Local economies may also be impacted through declining forest tourism as dieback reduces the value, significance and aesthetic appeal of the forests.

In 2004 Forestry Corporation identified almost 20,000 hectares of the approximately 100,000 hectares of apparently susceptible forest types in an area of north-eastern NSW bounded by the Border Ranges, Richmond Ranges and Captains Creek as being affected by dieback attributed to BMAD (Wardell-Johnson et. al. 2006). The NSW Scientific Committee's (2008) final determination for listing „Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners“ as a Key Threatening Process notes that:

Of the affected area, approximately one third (6511 ha) has been assessed as severe, with many dead trees, severe thinning of crowns, low stocking rate of susceptible species and greatly increased mesophyllitic ground story vegetation including weeds such as lantana' (State Forests of NSW, 2004).

Wardell-Johnson et. al. (2006) state

Bell Miner Associated Dieback (BMAD) is a significant threat to the sustainability of the moist eucalypt forests of north-eastern NSW and south-eastern Qld, and to biodiversity conservation at a national scale.

...

BMAD is a nationally significant conservation problem that has the potential to reduce the chances of achieving sustainable forest management in north-eastern NSW. There is a strong likelihood for significant biodiversity loss in the medium future in the general region, including south-eastern Qld, as well as reduced available timber volumes. Blaming Bell miners for the problem will not lead to its resolution.

...

The severity of the BMAD problem is such that tens of thousands of hectares in north-eastern NSW is currently affected with over 2.5 million hectares considered potentially vulnerable (Ron Billyard pers comm., Nov. 2004). A substantial (although uncertain) area of south-eastern Queensland is similarly affected, although less attention has been directed there. BMAD occurs on both public and private land and the area affected is expanding rapidly. The severe impact of this form of forest canopy dieback has profound implications for the conservation of the internationally significant biodiversity of the region.

There are numerous requirements for Forestry Corporation to redress dieback and restore degraded areas to a healthy and productive condition. The IFOA (2.7.1) requires that in carrying out forestry operations "SFNSW must give effect to the principles of ecologically sustainable

forest management as set out in Chapter 3 of the document entitled, “ESFM Group Technical Framework”.

The IFOA (4.26) also requires:

SFNSW must ensure that the scale and intensity at which it carries out, or authorises the carrying out of, forest products operations in any part of the Upper North East Region, does not hinder the sustained ecological viability of the relevant species of tree, shrub or other vegetation within the part.

Forestry Corporation’s (2005) ESFM Plan identifies as policy:

Forests NSW will maintain or enhance the health and productivity of forests to support nature conservation, timber production and other ecologically sustainable uses in Upper North East (UNE) Region.

In relation to BMAD Forestry Corporation (2005) go on to state:

Chronic decline occurs when long term environmental changes, as a result of human management, impair tree health. It is increasing throughout dry and moist eucalypt forests, particularly in coastal areas. Approximately 20,000 ha of forest within UNE Region, including about 6,000 ha on State forest is showing signs of decline while a larger area of forest throughout the region is thought to be susceptible.

In UNE Region; Forests NSW is collaborating with other agencies, universities, landholders and conservation groups through the Bell Miner Associated Dieback Working Group in the coordination of efforts to better manage chronic decline. The group has identified key actions that need to be undertaken to develop effective management measures including surveying and assessing the extent of decline, supporting independent literature review, lantana removal trials, guidelines for restoration of affected areas and promotion of the issue.

...

Declining forests are susceptible to invasion by exotic weeds such as lantana because unhealthy trees are weak competitors, and the weeds are better adapted to changed soil conditions that make the trees unhealthy.

The RFA reviews recognize the significance of BMAD, The seriousness of BMAD is stated in the NSW & CoA (2009) 5 year review of the RFA:

*The resultant cycle of tree stress commonly causes the eventual death of forest stands, and serious ecosystem decline. In NSW the potential impact of BMAD-induced native vegetation dieback represents a serious threat to sclerophyll forest communities, particularly wet sclerophyll forests, from Queensland to the Victorian border. The forests most susceptible to dieback are those dominated by Dunn’s white gum (*Eucalyptus dunnii*), Sydney blue gum (*E. saligna*), flooded gum (*E. grandis*) and grey ironbark (*E. siderophloia*). There is also evidence that some normally non-susceptible dry sclerophyll types may be affected when dieback is extreme. Current estimates place the potential at-risk areas at a minimum of approximately two and a half million hectares across both public and private land tenures in NSW.*

BMAD is emerging as a pressing forest management issue in both the UNE and LNE regions. The potential impacts include:

- *degradation of sclerophyll forest ecosystems across the UNE and LNE*

- *reduction in diversity and abundance of threatened flora and fauna species including Dunn's white gum and rufous bettong*
- *increased weed invasion and associated displacement of native forest species.*

Dieback-affected areas are located in the catchments of the major rivers of the North Coast of NSW including the Tweed, Richmond, Clarence, Macleay and Hastings. Maintenance of water quality in these river systems is critically dependent on maintenance of healthy forest cover over the catchment uplands. Bell miner associated dieback has the potential to degrade these forests, and consequently impact negatively on rivers and catchment communities through increased sediment and nutrient loads, and increased frequency and intensity of flooding.

The 2003/4 FA implementation report (NSW Government 2007) and DECCW (2010) echo these concerns and identify BMAD as *“a serious threat to sclerophyll forest communities, particularly wet sclerophyll forests”*. The NSW&CoA (2009) 5 year RFA review identifies that BMAD *“is of prime concern in the northern forest regions of the state”*.

Despite the clear recognition of Bell Miner Associated Dieback as a serious threat to the survival of numerous forests and ecosystems across NSW, the Forestry Corporation continue to refuse to identify affected areas in their harvest plans and deliberately target such areas for increased logging intensity to remove the surviving trees. The EPA have repeatedly refused to force the unwilling Forestry Corporation to recognise and manage these areas in accordance with the ESFM requirement to maintain healthy ecosystems. Now they are proposing removing the unmet need for weed management plans, along with silvicultural restrictions on logging intensity in affected areas.

Bell Miner Associated Dieback is a major threat to the sustainability of many forest ecosystems over large areas of north-east NSW, and appears to be rapidly worsening. Tens of thousands of hectares of forest in north-east NSW are affected and millions of hectares are vulnerable. It is a serious threat that has been procrastinated over for far too long.

5.1. The causes of Bell Miner Associated Dieback

NEFA considers that Bell Miner Associated Dieback is typically associated with heavily logged forests where much of the overstorey has been removed and the understorey invaded by lantana. While we recognise that there are a variety of confounding factors we consider heavy logging to be the primary factor responsible for its current extent. Our concern is that the range of secondary factors are being used to confuse the issue and frustrate required responses.

The NSW Scientific Committee's (2008) final determination for listing „Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners“ as a Key Threatening Process notes that:

Broad-scale canopy dieback associated with psyllids and Bell Miners usually occurs in disturbed landscapes, and involves interactions between habitat fragmentation, logging, nutrient enrichment, altered fire regimes and weed-invasion (Wardell-Johnson et al. 2006). At

*present, no single cause explains this form of dieback, and it appears that Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners' cannot be arrested by controlling a single factor. Over-abundant psyllid populations and Bell Miner colonies tend to be initiated in sites with high soil moisture and suitable tree species where tree canopy cover has been reduced by 35 – 65 % and which contain a dense understorey, often of *Lantana camara* (C Stone in litt.).*

*...Increased light intensity associated with canopy reduction promotes the growth of the expanding foliage preferred by psyllids as well as understorey growth which is also influenced by altered fire regimes. Increased understorey growth, particularly of the invasive weed *Lantana camara*, suppresses eucalypt regeneration and provides enhanced shelter and safer nest sites for Bell Miners.*

Stone *et. al.* (1995) found that the affected areas range in size from 1 ha to nearly 100 hectares, with the Sydney Blue Gum league of forest types (FT no's 46, 49, 53 and 54) most affected and the grey ironbark/grey gum league (FT 60) second most affected. They note that *–The vast majority of plots (97%) had been exposed to some degree of logging and were on their second or third rotations*", postulating *–that bell miners prefer a dense understorey and a discontinuous sclerophyll overstorey.*" Stone *et. al.* (1995) concluded that:

–A possible long-term explanation of why the dieback problem may be increasing, is that the proportion of moist sclerophyll forest being exposed to selective logging is increasing throughout the State. In support of this argument is the observation that the non-logged old growth Sydney blue gum stands in Pt. Giro State Forest (Walcha District) are in good health(based on aerial observations) and bell miner colonies appear to be absent in this forest (R. Kirwood, Forester, Walcha District, pers. Comm.)."

Wardell-Johnson *et. al.* (2006) state

A range of multi-tropic attributes (e.g. local climate/host tree condition and structure/natural enemies) have been identified as contributing to elevated psyllid populations. Fragmentation, changed disturbance regimes (particularly fire and logging), and pathogens are implicated. Changes in nutrients and other soil constituents, climatic regimes and hydrological factors have also been implicated.

*... Logging and associated disturbances can have direct and indirect effects on overstorey, midstorey and understorey structure and floristics. However, studies directly associating logging, forest structure, floristics and BMAD have not been carried out. While the proliferation of dominant understorey weeds, such as *Lantana* (*Lantana camara*), in the north-eastern region of NSW has largely been attributed to the disturbance caused by logging and associated activities, no direct link between BMAD and *Lantana* has been established.*

*... Bower (1998) argued that it is probable that broad-scale habitat modification through intensive logging operations and subsequent *Lantana* domination has promoted conditions that favour the establishment of psyllids and Bell miner colonies.*

... Kavanagh and Stanton (2003) argued that their findings supported the hypothesis that the disturbance associated with logging can be a contributing factor in creating the habitat conditions required by Bell miners.

...

...Stone (1999) suggested that selective logging without effective overstorey regeneration encouraged dense understorey development. She suggested that this provided conditions favouring the colonisation of Bell miners. Stone (1999) argued that Bell miners then trigger forest decline because they interfere with predators that would otherwise regulate folivorous insects.

...

Hence, logging operations may be both implicated in the development of BMAD, and affected by changes in yield induced by BMAD. Nevertheless, the literature remains very limited concerning the impacts of logging and associated disturbance on the initiation or development of BMAD.

...we have not been able to locate information concerning the impacts of logging on BMAD. We find it surprising that more information is not available concerning the direct and indirect impacts of logging, in the preferred Bell miner habitat of north-eastern NSW. The increase in the area of BMAD has potential not only for significant biodiversity loss, but also for significant reduction in timber yields from these eucalypt stands.

In north east NSW BMAD is most commonly associated with the invasive weed lantana. Even where not associated with dieback, lantana is the most significant understorey weed in north east NSW. In deciding to list the Invasion, establishment and spread of Lantana (*Lantana camara* L. sens. lat) as a key threatening process, the NSW Scientific Committee note:

9. *L. camara* readily invades disturbed sites and communities. Various types of sclerophyll woodlands, sclerophyll forests, rainforests and dry rainforests are all susceptible to Lantana establishment ... There is a strong correlation between Lantana establishment and disturbance (Stock and Wild 2002; Stock 2004), with critical factors being disturbance-mediated increases in light and available soil nutrients (Gentle and Duggin 1998) and, in rainforest, the competitive advantage of seedlings relative to many native species (Stock 2004). ...

...

16. The generally suppressive effect of Lantana on a wide range of native species is attested by several studies (Gentle and Duggin 1998, Day et al. 2003) and a multitude of field observations. Swarbrick et al. (1995), citing observations by Driscoll and Quinlan (1985) that "eucalypt seedlings generally fail to establish under lantana", infer inhibition of germination through lack of light.

...

22. *L. camara* is "regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts" (CRC Weed Management 2003). It is one of the initial 20 Weeds of National Significance declared under the National Weeds Strategy, and a national Lantana Strategic Plan has been adopted (ARMCANZ ANZECC&FM 2001). ...

In relation to lantana, the Bell Miner Associated Dieback Working Group (BMADWG 2004) state:

Lantana is a highly invasive weed affecting a range of land-use types within a wide range of climates and topographies of Australia. The complexity of this weed is amplified by its 29 different varieties, difficulty in integrating control measures and finding suitable biocontrol agents. The extensive infestation across more than 4 million hectares poses a

threat to economically effective control. Lantana is a social problem for landholders and community. The National Lantana Strategy highlights the need for increased responsible action and incentive to landholders, local government, regions and State government to take action. The Strategy establishes the National Lantana Management Group; provides for extension and education; encourages best practice in lantana control and management; and includes a community biocontrol element encouraging adoption of biological control measures.

Wardell-Johnson et. al. (2006) state

While Lantana may not be a primary causal factor initiating BMAD, the literature suggests that its presence reflects increased canopy opening, which in itself may be a primary cause for increases in psyllids. These outbreaks in turn may attract the presence of Bell miners, which have the benefit of increased food resources and suitable structure for nesting. There has been some advocacy for management strategies which reduce weed encroachment and plant community degradation to identify and maintain ecological barriers to Lantana invasion. Because large areas in the region affected by BMAD are dominated by Lantana, there has also been advocacy towards the use of fire as a means of Lantana control.

...

For the environments in which BMAD occurs, arguments have been presented suggesting a need both for more frequent fire, and for less frequent fire in particular ecosystems. ...

...

... Lantana in particular has become a dominant understorey plant in open areas of eucalypt forest in the region (Bower 1998; Wardell-Johnson et al., 2005). There have been many recent changes in agriculture and forest management in north-eastern NSW that have been associated with the spread and intensification of Lantana in particular, but also a wide range of other weedy species (see Kanowski et al., 2003; Wardell-Johnson et al., 2005).

...

Bower (1998) argued that the proliferation of Lantana in his study areas was largely associated with the disturbance associated with logging activities which improves the conditions for Lantana germination and recruitment. Bower (1998) further argued that while high intensity burns can be effective at controlling Lantana, many post-logging burns are of low to medium intensity and have often been found to be ineffective at controlling Lantana, which resprouts from basal stems. Bower (1998) argued that the inability of Lantana dominated areas to regenerate significantly impacts on the succession of a structurally complex forest ecosystem.

...

Gentle and Duggin (1997)...found that shading played a greater role as a limiting factor than any other and concluded that successful invasions of Lantana are likely to occur whenever canopy disturbances create patches of increased light availability. ...

...

... While it is no surprise that Lantana proliferates as the eucalypt canopy opens or dies or that Lantana is associated with events which disturb the soil and open the ground to sunlight, this does not mean that Lantana is a cause of BMAD.

The EPA need to recognise that Bell Miner Associated Dieback is associated with logging opening up the canopy and understorey disturbance promoting lantana (or other low vegetation), which in turn favour Bell Miners who aggressively exclude other birds and thereby facilitate outbreaks of sap-sucking insects which kill the trees. BMAD is degrading, and increasingly destroying, both forest ecosystems and forest productivity.

5.2. What is being done about Bell Miner Associated Dieback?

The North East Forest Alliance has been pursuing the issue of Bell Miner Associated Dieback for over twenty years. We tried to get it addressed in the Environmental Impact Statements prepared in the early 1990s. This was a major issue we pursued when we were on the North East Harvesting Advisory Board in 1996/8. We unsuccessfully attempted to have this issue dealt with in the CRA process. We have been involved with the BMAD Working Group since early 2002.

While we recognise that we have made some progress over that time the condition of the forests has continued to decline, and Forestry Corporation are continuing to ignore and compound the problem in their logging operations.

State Forests recognised dieback associated with psyllids as a significant problem in the Gosford-Wyong area of north-east NSW in 1950 (Moore 1959). Stands of Sydney Blue Gum were reported as dying during the period 1949 to 1958, *the increasing numbers of deaths reaching economic significance toward the end of that period*" (Moore 1959). The two areas assessed by Moore showed 55% and 59% of trees as dead or expected to die. Moore (1959) hypothesised that *the abnormal rainfall adversely affected the physiology of Eucalyptus and other species generally, making them susceptible to heavy attack by psyllids.*" Bird et. al. (1975) report Moore (1962) as finding that *there were more than 150 separate occurrences of variable extent up to 1,500 ha.*"

Wyong District Forester, Charlie Mackowski (pers. comm.), noted that field work in the early 1990"s had delineated 5,000 hectares of "Bellbird Dieback" on State Forests in the then Wyong District.

Forestry Corporation (Stone et. al. 1995) have identified significant areas of dieback in the Morisset, Bulahdelah, Gloucester, Taree, Wauchope, Kempsey, Walcha and Urbenville districts. Stone et. al. (1995) notes *More recently, District staff have reported that affected areas are increasing in size and that previously unaffected areas are developing symptoms.*"

In 2003 the NSW Nature Conservation Council Annual Conference unanimously passed the resolution:

that there should be no further logging in BMAD affected forests or those at high risk of developing BMAD until the causes of the problem are better understood and an acceptable, sustainable management plan is developed to restore the health of these forests'.

The Bell Miner Associated Dieback Working Group (BMADWG 2004) has identified key actions that they consider need to be undertaken in order to develop effective management measures for BMAD. They do not address logging directly, though include *“Developing guidelines for restoration of dieback affected sites which may be implemented by landholders and government agencies”*.

The NSW Scientific Committee’s (2008) final determination for listing „Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners“ notes that

8. Due to the complex interaction between factors that have been altered as a consequence of landscape-level disturbance, there is at present no obvious means of arresting the threat presented by Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners’. Moreover, expert opinion varies considerably as to which factors are causes of dieback and which factors are effects. Broad-scale research and adaptive management are required to understand how to best manage this threatening process, to prevent its expansion throughout forests of eastern New South Wales.

NEFA understand (J. Morrison pers. com.) that DECCW are presently preparing a „Statement of Intent“ to address the BMAD Key Threatening Process determination. NEFA note that this is a considerably weaker response than the preparation of a „Threat Abatement Plan“ and is only required on the NPWS estate. NEFA consider that attempts to address the BMAD issue warrants strong legislative requirements across all tenures in relation to disturbance to at risk forests and mandatory requirements to undertake post disturbance rehabilitation where disturbance cannot be avoided.

The Bell Miner Associated Dieback Working Group (BMADWG 2004) identifies Forestry Corporation’s claimed approach:

Consistent with the EFSM requirements FNSW are preparing Regional Forest Health Management Plans as part of the Native Forest Health Management Strategy. The current management intent is to integrate native forest harvesting with trials to reduce the spread of dieback into open forests by use of frequent low intensity fire and to trial rehabilitation methods for dieback affected areas.

While some trials have been instigated, the heavy logging of BMAD affected areas continues unabated.

Wardell-Johnson et. al. (2006) conclude:

...It may be appropriate for management to prevent the creation of habitat that is preferred by the Bell miner, as such habitat will also facilitate the primary cause of eucalypt dieback. However, to attempt such management intervention in isolation from an understanding of both the processes and the behaviour of Bell miners under different levels of disturbance may compound the problem.

Forests with existing colonies of bell miners and susceptible tree species are at very high risk of developing BMAD following disturbance and subsequent weed invasion. NEFA considers that considerable resources need to be directed towards rehabilitation of extensive weed infested tracts of susceptible forest types, and the minimizing of disturbance to less than thirty percent canopy removal relative to a fully stocked healthy forest stand.

When NEFA were on the North East Harvesting Advisory Board in the late 90s we attempted to get Forestry Corporation to map dieback areas in compartments on harvest plans. According to Jim Morrison (pers. comm. 2010) the BMAD Working Group's attempts to get Forestry Corporation to take appropriate action has been similarly frustrated:

The BMADWG has for a number of years requested that FNSW record simple data about the presence of Bell Miners and or associated dieback on its harvest plans as they are prepared. Systematic, simple BMAD identification procedures urgently need to be made a mandatory part of the harvest planning process. This could be done when ecological surveys are undertaken, and also by the harvesting forester and be required to be reported just like any other threat identified in logging compartments. In fact the continued refusal of Forest NSW to undertake this simple task requested by the BMADWG only heighten suspicion that Forest NSW don't want to reveal the full extent of the problem across its estate.

While the Forestry Corporation have established a number of logging trials, they routinely fail to monitor and report on them. The landscape is littered with failed "trial" areas that the Forestry Corporation simply abandoned.

The principal problem is that Forestry Corporation continue to log in and adjacent to BMAD areas without considering the impacts of their operations on the proliferation of the Key Threatening Processes of BMAD and Lantana invasion. In affected areas logging is focussing on the removal of most of the healthiest trees surviving, is promoting lantana due to extensive understorey removal, and this degradation then favours BMAD. Often many of the retained trees are subsequently killed. And the Forestry Corporation can not be bothered monitoring the effects or undertaking post-logging rehabilitation. These impacts will be compounded by increasing severity of droughts due to climate change (which is likely to already be a factor in the spread of this problem).

For over 60 years the growing problem of Bell Miner Associated Dieback has been procrastinated over despite the clear evidence that it is being facilitated by the opening of the canopy by logging and the consequent spread of lantana facilitated by machinery disturbance and burning. BMAD affected forests are being targeted for increased logging intensity without monitoring or rehabilitation works.

The EPA is requested to support a sustainable approach to the key threatening process Bell Miner Associated Dieback by recommending an urgent moratorium on logging in and adjacent to BMAD areas until such time as rehabilitation strategies for restoration of ecosystem health are implemented.

Forestry Corporation are targeting Bell Miner Associated Dieback Areas for removal of all healthy remaining trees and then abandoning them to their fate as destroyed ecosystems. A sustainable response to Bell Miner Associated Dieback involves:

- e. Identifying and mapping all affected and susceptible areas;**

- f. Placing all affected and susceptible areas under a logging moratorium until such time as appropriate management responses that restore ecosystem health and functioning are identified;**
- g. Undertaking rehabilitation works (i.e. lantana control) in affected stands; and,**
- h. Monitoring effects of any treatment and refining methods before repeating it.**

6. Implementing Sustainable Yields

Managing forests to maintain a sustainable yield of sawlogs over time has long been an objective of forest management in NSW, and is a key requirement for the implementation of Ecologically Sustainable Forest Management (ESFM). Implementation of a sustainable harvesting regime to supply the required trees over time has also been debated for a long time, with many foresters preferring to manage forests by clearfelling natural stands and managing them as plantations rather than native ecosystems. The IFOA attempted to put constraints on clearfelling, though committed timber volumes at an unsustainable, and thus destructive, level,

Despite an often claimed intent, public forests in north-east NSW have never been managed on a sustainable yield basis. In 1998 the Government adopted a “*Sustainable Wood Supply Strategy*” that involved intentionally overcutting for a further 20 years until 2018 before reducing logging volumes down to a sustainable level. Following a desktop yield review in 2003 the Government reduced annual commitments but increased the total volumes committed by extending unsustainable logging for another five years until 2023.

Timber allocations have historically been on the basis of “quota sawlogs” which are generally taken to be large high quality sawlogs with minimal defect and a centre diameter of >40 cm. Some Management Areas (Kendall, Coopernook and Taree) have included small logs down to 25 cm small end diameter as quota for decades. Quota is the annual commitment of quota sawlogs to industry. In the Forest Reform process quota was taken to apply to Large High Quality sawlogs, with commitments separately being entered into for Small High Quality sawlogs and Low Quality sawlogs.

Sustainable yield is generally taken to be a specified annual volume of quota sawlogs which is expected to be able to be maintained at that level in perpetuity, generally 100 years.

Historically Forestry Corporation’s resource assessments are at best estimates of sustained yield, i.e. the volume of “quota” sawlogs that can be maintained over some specified period, rather than in perpetuity, and without consideration of environmental constraints.

One of the prime motivations for the creation of the Forestry Commission expressed in the 1907 Royal Commission of Inquiry on Forestry was the dwindling timber resources and the need to sustain them into the future (PAC 1990). In 1980 the former Commissioner for Forests, Dr. S.W. Gentle noted that there were many management areas not being logged on a sustained yield basis and emphasised the need to bring operations onto sustained yield (PAC 1990).

At the start of the Forestry Reform process, even without consideration of environmental constraints, it was evident that timber was grossly over-allocated. State Forests (1993) note that:

On some management areas with a long management history, medium-term sustained yields are expected to increase towards long-term sustainable yields in the near future, but it could be well in excess of 100 years before some management areas achieve a stand structure able to supply yields at long-term sustainable levels. Yields for the State as a whole should be approaching long-term sustainable levels when the youngest regrowth stands (regenerating about 2030) are maturing in about 2110-2130.

For the incoming ALP Government in 1995 State Forests identified that an overall reduction of 23% was required in the 1995 allocations of quota sawlogs to reduce yields from north-east NSW to a sustainable level. Pugh (1996) reviewed State Forests' documents and actual yields to estimate that a reduction of well over 50% in 1995 allocations was likely to be required to compensate for past overcutting and achieve a sustained yield of quota sawlogs, without any conservation outcome. Sawlog quotas from state forests were reduced to 70% of the 1995 quota allocations in July 1996.

Since the Unsworth Government first introduced Wood Supply Agreements in 1988 these annual commitments of quota sawlogs have slowly been converted to term agreements for periods of from 10 to 20 years. Under the Greiner Government most of BORAL's annual commitments were converted into 20 year agreements, with allowances for reviews of yields if shortfalls in resources were identified.

It was the Carr Government which dispensed with the ability to change commitments in response to identified resource shortfalls when it issued 5 by 5 Wood Supply Agreements in 1996. These agreements were issued across the board as an outcome of the Interim Assessment Process to every quota sawmiller who wanted one at 50% of their 1995 allocations. They only allowed for a review after 5 years on the basis of token "value adding" criteria, no matter what the identified sustained yield at that time was.

It was on the basis of State Forests' inadequate 1996 Wood Resources Study (WRS) that forestry Minister Kim Yeadon convinced Government to give such large volumes of resources to industry in what are effectively 10 year Wood Supply Agreements. During the Interim Assessment Process major problems with State Forests' estimates of quota sawlog resources were identified by the foresters, NPWS and conservationists (Pugh and Flint 1998). The NPWS (Wall and Flint 1996) review found

–The WRS ...obscures the extent of overcutting and the current state of the forest resource because it continues SFNSW historical pattern of overestimation in relation to timber resources."

–Timber harvesting on a sustained yield basis should theoretically harvest a similar net loggable area in successive years. However, investigation of the area logged by year in northern New South Wales reveals large increases in cutting area with each year and provides testimony to the practice of continued overcutting. A corollary is that the volume of timber extracted per hectare has decreased markedly over time as old growth and mature trees have been exhausted and smaller regrowth trees harvested prematurely."

–Therefore, it is most probable that actual sustained yield is less than 50% of the WRS yield estimates."

–Wood supply agreements would promote levels of harvesting in excess of sustained yield, and would increase the pressure on forest ecosystems. Furthermore, such agreements would jeopardise the development of a Comprehensive, Adequate and Representative reserve system, encourage further depletion of the timber resource, and compromise the long term viability of the timber industry in northern New South Wales."

As at 1998 there was a total of 129,215 m³ of large high quality sawlogs committed under the 5x5 Wood Supply Agreements to the timber industry in Upper North East NSW (55% of 1995

quotas) and 139,860 m³ (49% of 1995 quotas) in Lower North East NSW from public forests (State Forests 1998f). An additional 1,877 m³ of small high quality sawlogs were committed in the Upper North East and 8,346 m³ in the Lower North East from public forests. These Wood Supply Agreements were issued to industry at no cost, aside from the royalties they pay when the timber is obtained.

For the CRA Forestry Corporation introduced a whole new resource estimation methodology called the Forest Resource and Management System (FRAMES). After the creation of the new (1998) national parks, and with the protection of the Government's HCV oldgrowth forest, rainforest, streams and allowance for threatened species protocols, FRAMES identified the 100 year sustainable yields of *High Quality Large Sawlogs* as 80,319 m³ gross of high quality large sawlogs per annum for the Upper North East CRA region (UNE) and 136,902 m³ per annum in the Lower North East (LNE). Thus 217,221 m³ per annum was identified as the sustainable yield of large quota sawlogs at that time.

As an outcome of the CRA, and based upon the FRAMES estimates, the NSW Cabinet determined in November 1998 that supplies to industry from public forests would be 109,000 m³ of High Quality Large sawlogs (quota sawlogs) and 2,000 m³ High Quality Small sawlogs per annum from the Upper North East, and 160,000 m³ of high quality large sawlogs (quota sawlogs) and 8,500 m³ High Quality Small sawlogs per annum from the Lower North East. The intent was thus to log at the unsustainable rate of 269,000 m³ per annum until 2018, before reducing down to a sustainable yield of 183,5000 m³ per annum thereafter. The NSW Government thereby intended to deliberately commit NSW to unsustainable logging.

Conservationists and foresters had for some time been highlighting the problems with gross over-estimations of quota sawlogs, particularly in State Forests' Northern Rivers area. The pending issuing of new wood allocations led to State Forests' Northern Rivers Sales Manager (Sigley 1998) to state:

–Don't we have a much greater responsibility than the one to this government don't we have a responsibility to the people of this State and those that work within this organisation."

–keep saying it but you can't forget it. Just because a volume is said to be standing somewhere don't assume that a percentage of it is loggable. It is not even right to assume that any of it is loggable. A percentage of hardly anything spread thinly over a large area doesn't make for a viable operation and simply won't happen."

–We have just one last chance to come clean and be honest about the way things are before this UNE RFA is signed. State Forests will be held accountable for whatever happens as a result of the RFA decision and if the industry has been lead to believe that the volume is there in this part of the State then we should be held responsible."

In an effort to avoid the proposed gross over-allocation of resources conservationists undertook a detailed review of yield estimates from state forests throughout north-east NSW (Pugh and Flint 1999), concluding:

Calibration of FRAMES to compensate for identified over-estimations (see Section 2.6.) indicates that there may be as little as 8 years supply at proposed term agreement levels available outside the new reserve system in the UNE region and 9 years in the LNE region, after which it will be decades before the forests can again be used for sawlog

production. Therefore, FRAMES represents a very unsound basis on which to provide timber supply commitments and there will be large compensation risks associated with any such commitments.

Over-commitment of resources has significant environmental and social impacts when, to maintain committed timber volumes, State Forests; log in environmentally significant areas, refuse to adopt enhanced environmental prescriptions on the grounds of loss of resources, seek reductions in prescriptions to obtain more timber, withdraw resources from smaller mills and fail to reduce quotas to sustainable levels in line with new estimates.

The concerns of foresters and conservationists were largely in vain. The Carr Government's decision on the north-east forests included a reduction in timber volumes from the 1997/98 level of 297,781 cubic metres of quota sawlogs down to the Wood Supply Agreement levels of 269,000 cubic metres of quota sawlogs in two stages from the 1st January 2000. This proposed reduction was anticipated to cost some 80 jobs, though the industry changed their mind and instead claimed the industry would increase jobs under this scenario.

Carr's package included the promise of up to 160 new jobs in the timber industry, a further industry assistance package worth more than \$53 million on top of the existing \$120 million Forest Industry Structural Assistance Package, and 105 new jobs in National Park management. This meant that there was anticipated to be no negative employment outcome from Carr's decision. To the contrary, according to the Government and industry more jobs would be created. It was therefore hard for Carr to use socio-economic impacts as a justification for delivering such a poor reserve outcome.

In clear recognition of the failure to apply sustainable yield in north-east NSW, the Regional Forest Agreements (Anon 2000) now claim to be implementing a strategy:

***"Sustainable Wood Supply Strategy"** means the intent to manage yields of High Quality Large Sawlogs and Large Veneer Logs from the forest at a specific and constant level for twenty years under a given management strategy and suite of sustainable use objectives. It recognises that a transition to long term Sustainable Yield will be phased in to accommodate social and economic considerations;*

The strategy was to go on logging at unsustainable rates, and to supplement this by purchasing private properties with existing resources and for establishment of new plantations to attempt to increase future timber availability. However the strategy has not fulfilled its aims and the resource assessments it is based on have been found to be inflated and fundamentally flawed. The transition to a long term Sustainable Yield has not occurred.

The Regional Forest Agreement for North East New South Wales (Upper North East and Lower North East Regions) (Anon2000) states:

Under the Sustainable Wood Supply Strategy, NSW agrees to supply 129,000m³ per annum for 20 years in the Upper North East Region and 140,000 m³ per annum in the Lower North East Region of High Quality Large Sawlogs and Large Veneer Logs. Annually, approximately 20,000 m³ of High Quality Large Sawlogs and Large Veneer Logs allocated in the Upper North East Region will be sourced from the Lower North East Region over the period of the Agreement.

...

... It is estimated that the 100 year supply levels after 2018 will average approximately 70,000 m³ per annum in the Upper North East Region and 113,500 m³ per annum in the Lower North East Region of High Quality Large Sawlogs and Large Veneer Logs from existing native forests and Plantations on State forests and other land owned by SFNSW, assuming harvesting under existing terms and conditions.

... Both Governments aim to provide additional sawlog and other wood products that will become available through purchase by SFNSW of private native forest property and through Plantations established on purchased land or as joint ventures. These measures are currently predicted to bring the average annual available High Quality Large Sawlog and Large Veneer Log yield from State forests beyond the 20 years of this Agreement to within approximately 15 per cent of the 20 year contracted levels for Upper North East Region and Lower North East Region.

In 2009 the NSW Auditor-General, Peter Achterstraat, prepared the report "Sustaining Native Forest Operations: Forests NSW". He reached the obvious conclusion that *current yield from native forests in the north coast is not sustainable in the long term*" stating:

To meet wood supply commitments, the native forest managed by Forests NSW on the north coast is being cut faster than it is growing back. This is especially the case for the blackbutt species. This does not mean that the forest will not regrow but there will be a reduction in yield in the future.

6.1. Sustainable Timber Assessments

In 1998 Forestry Corporation identified the 100 year sustainable yields of *High Quality Large Sawlogs* as 217,200 m³ per year for the North East CRA region. With the signing of the Regional Forest Agreement (Anon 2000) the State and Federal Governments agreed to set quotas at 269,000 m³/year until 2018, with the intent to thereafter reduce cutting down to an estimated sustainable yield of 183,500 m³/year until 2100. The over-commitments for large high quality sawlogs were entrenched in 20 year Wood Supply Agreements.

In 2002 Forestry Corporation found that *actual yield was 87 per cent of predicted*". A 2002 review identified that *"the harvest able to be sustained during the next 20 years is 220,000 m³/year at most"*, though at this level the long-term sustainable yield was estimated to be reduced to 110,000 m³/year.

New Wood Supply Agreements were signed in 2003/4 for 215,422 m³/year for 20 years until 2023. In issuing these new WSAs the NSW Government entrenched intentionally unsustainable logging for a further 5 years. In a grossly irresponsible act the NSW Government removed the clause from the WSAs that allowed yields to be adjusted in line with revised resource assessments.

Thereafter things went from bad to worse. A 2004 yield review identified that 187,000 m³/year could be sustained for 5 years, with the 6-20 year cut needing to be reduced to 170,000 m³/year, and a reduction to a sustainable yield of less than 60,000 m³/year thereafter.

The UNE Forest Agreement (Anon 2000, 3.5) requires that monitoring be used to improve FRAMES, noting:

Monitoring of FRAMES performance will also comprise comparison of actual and predicted volume each 12 month period at the RFA Region level, and assessment of the progressive 20 year supply at the RFA Region level.

The results of resource inventory and annual monitoring must be used to review the performance in achieving the implementation of sustainable yield of timber products.

Initially Forestry Corporation complied with this requirement. This was until Forestry Corporation's 2002 North Coast Timber Supply Monitoring Estimate showed that actual yield was 87 per cent of predicted. The Auditor General (2009) identified that:

Forests NSW completed two studies comparing harvest results with yield estimates for the north coast between 1999 and 2001. The longest study, covering a two and a half year period, showed that actual yield was 87 per cent of predicted.

In contravention of the Regional Forest Agreement, Forestry Corporation's response was to stop collecting data comparing actual to predicted yields.

In 2002 Jerry Vanclay (Southern Cross University) undertook a desktop review "Review of Projected Timber Yields for the NSW North Coast" of FRAMES "based on an examination of documentation and on interviews with State Forests staff and other stakeholders involved in preparing the estimates ... no field visits were made and no new field data were obtained". Vanclay (2002) presented results from Forestry NSW's 2002 North Coast Timber Supply Monitoring Estimate which he endorsed, stating that for both the UNE and LNE "With these assumptions, it is evident that the harvest able to be sustained during the next 20 years is 220,000 m³/year at most ... In the longer term (21-100 years), production from native forests is expected to range between 175 and 110,000 m³/year, and will need to be supplemented from hardwood plantations.". He recommended monitoring of a large range of key variables to improve the best current estimate.

2002 North Coast Timber Supply Monitoring Estimates of large high quality sawlogs compared to FRAMES 1998 (From Vanclay 2002)

Item & Source	RFA-FRAMES	NCTS Monitoring
Short-term yield (20 yrs)	269,000 m ³ /yr	220,000 m ³ /yr
Medium-term yield (21-40 yrs)	183,500 m ³ /yr	175,000 m ³ /yr
Average Long-term yield (41-100 yrs)	183,500 m ³ /yr	110,000 m ³ /yr

This reduction in predicted short-term unsustainable log volumes by 18% and long-term sustainable volumes by 5–40% is significant. The North Coast Timber Supply study was not made publicly available and is one of a number of Appendices removed from Vanclay's report.

By the 30 June 2001 Ford Timbers owed Forestry Corporation \$1 million, so Forestry Corporation retired the debt in return for 15,000 cubic metres of large quota sawlogs, which was to take effect from 1 January 2003. The Public Accounts Committee (2002) conducted an investigation which found:

The Committee understands that State Forests has never sold a resumed log allocation before and that [Ford Timbers], as with all customers, was never required to pay an up front fee for the original allocation.

... as [Ford Timbers] never paid for the original allocation, treating the subsequent reduction as a -repurchase" of that allocation is not consistent with commercial practice.

...
The Committee was concerned that this action by State Forests was in fact a forgiveness of debt. This is not State Forests' view as they expect to reassign the log allocation and obtain an up front payment from the purchaser of the allocation as well as continuing royalties

It appears that the 15,000 m³/annum was never resold, but rather later gifted to millers in their new WSAs.

In 2003 the NSW Government created 42,522ha of new national park and reserves (the Icon decision) from Forestry Corporation's estate on the north coast, as well as gazetting some 19,000ha of oldgrowth forest as Special Management Zones (SMZ).

Despite the reduction in the area of state forest the "net harvest area", which is the basis of yield estimates, was actually increased by some 700ha according to Forestry Corporation's (2004) FRAMES modelling, primarily because of the decision to remove "buffers on buffers". This was achieved by amending the IFOA to allow the accidental felling of trees into most exclusion areas and the entry of machinery into some exclusion areas to fell trees. This significantly increased the proportion of the gross area that could be harvested, theoretically compensating for the new reserves.

Timber availability at that time had also been increased by new plantations and additions to State Forests' estate from private property purchases, while commitments had been reduced by the buy-back of quota from Ford Timbers. So if resource estimates were accurate there should have been no resource problems caused by the new reserves.

Based on Vanclay's assessment, in 2003/4 the NSW Government issued new Wood Supply Agreements to north coast sawmillers for quota, small and low quality sawlogs and extended them for 5 years (until 2003) past the expiry of the NSW Forest Agreements. Most significantly the NSW Government removed the clause that allowed for a non-compensable reduction in commitment following a review of available timber resources.

Forestry Corporation's (2005) ESFM Plan provides the details of Wood Supply Agreements for north east NSW.

Table 9. 2004 Wood Supply Agreement Strategy. From Forests NSW ESFM Plan (2005)

Product	WSA Volume	WSA Type
High-quality large Products	215,422	A
	7,655	B
High-quality small Products	57,759	A
	31,100	B
Low Quality Sawlogs	14,897	A&B
	190,000	C
Total Volume	516,833	

Forestry Corporation (2005) explain:

The Type A agreements are for a fixed volume for a twenty-year period.

The Type B agreements provide 75% of the volume fixed for the first 10 years, with future volumes subject to resource assessment review in years 10 and 15 of the

agreement. The remaining 25% is a share of production capped at 25% of the total agreement, also subject to review in years 10 and 15.

The Type C agreements are based on a share of production and if there is insufficient production in any year, the available volume will be distributed equitably amongst customers as a share of the total production in that year. The figure under WSA for Type C is a target volume rather than a fixed commitment.

For quota sawlogs this set a volume of 215,422m³ per annum for 20 years, five years past the end of the LNE and UNE Forest Agreements, and resulted in firm commitments for a total supply of 4,365,852m³, and tentative commitments for a further 95,687m³. At the time the new WSA were made there were remaining commitments of 254,000m³ of large quota sawlogs for 15 years, which is a total of 3,810,000m³. These new WSAs thus resulted in an increase in committed volumes of large quota sawlogs of 555,852 to 651,539m³ - not a bad windfall for millers, particularly as Ford Timbers' quota had been bought back for some \$1million and yield reviews were showing that commitments needed to be substantially reduced.

The Government was even more generous, giving millers commitments of up to 1,777,180m³ of high quality small sawlogs and 4,097,940 m³ of low quality sawlogs, increasing the total volume of sawlogs committed in WSAs by up to 271%. While such commitments of tradeable timber rights are worth a fortune to the millers, they were again given freely with no tender process.

The Auditor General (2009) comments:

In this new agreement, the Government waived its rights to reduce commitments without compensating industry for any loss. This removed Forests NSW's ability to better manage supply risks by adjusting commitments. In addition, timber volumes were more or less maintained despite the loss of forest estate to national park and reserves.

As if Forestry Corporation and the timber industry had not already been given enough, the area available for logging was again significantly increased in 2004 by amendments to the Environment Protection Licence that effectively allowed logging within the buffers of most unmapped streams. This was simply achieved by excluding non-scheduled forestry activities from the requirements of the Environment Protection Licence on 17 May 2004. As a result of this change over 90% of logging operations no longer required Environmental Protection Licences. By removing the requirements for 10m buffers on unmapped streams this significantly increased the areas and volumes available for logging. It has also resulted in significantly increased environmental harm and stream pollution.

Forest Management Zone 8 areas are primarily comprised of modelled unmapped streams, with some modelled high erosion areas, that are intended to be further assessed at the Harvesting Plan stage. These represent tens of thousands of hectares that were not counted as contributing to timber supply on the basis that they would be refined by field assessments and allocated to exclusion zones (ie FMZ 3A). In practice, since unmapped streams are no-longer required to be protected (except where threatened fish are present downstream), they are not further assessed and now simply counted as being part of the general logging area.

Thus, despite actual yields being found to significantly below predicted yields and the reduction in State Forests resultant from the 2003 Icon decision, the total volumes of timber committed to industry and the actual areas available for logging were significantly increased.

Since they began their new resource assessments as part of the Forest Reform process, Forestry Corporation had repeatedly denied that there were any problems with their resource assessments (ie Pugh and Flint 1999), and when their comparisons of actual to predicted yields proved unfavourable they simply stopped making any comparisons. So it is surprising that over the next year Forestry Corporation undertook 3 reviews of wood resources that discredited their own yield assessments and the basis of the new wood supply agreements:

1. Forests NSW, July 2004 , "State of the Resource, A Review of Wood Resources on the North Coast of NSW".
2. Forests NSW's, September 2004 "A Review of Wood Resources on the North Coast of New South Wales
3. Forests NSW (Partington and Stevenson), - „Forests NSW: Review of North Coast Standing Volumes for the 2004 Valuation," undated, late 2004, Report for the NSW Auditor General.

Two of these are available on line, though there is no documentation to put them in context, the only reference found to the July 2004 report was in Partington and Stevenson (2004), and the Partington and Stevenson report itself does not have a date or identify where it was published. It is revealing that even the Auditor General (2009) ignores the damning Partington and Stevenson report despite its apparently being prepared for him.

In July 2004 Forestry Corporation prepared a report "State of the Resource, A Review of Wood Resources on the North Coast of NSW". This document is not available on the web and has not apparently been referenced in the various RFA reports or yield reviews, though a subsequent report by Partington and Stevenson (Forests NSW 2004b) consider that it *clearly described* the deficiencies with the *process of estimating merchantable volume*"; stating that:

... for some time there has been concern about actual volumes being less than those predicted by the FRAMES process. And recently a report by State Forests highlighted deficiencies in just about every aspect of the process of estimating merchantable volume

...

...

The deficiencies described include the following: merchantable classification of species that are never harvested; inaccurate estimates from some of the tree volume, taper, and height equations; problems of consistency, reliability and ease of use in relation to tree proportionment, issues in relation to defect modifiers and the division of losses due to inherent defect and those due to sub-optimal log making practices; the limitations of the GIS system in adequately handling the complexity of net harvest area analysis and the difficulty of verifying the results of such analysis; technical problems with the net harvest area modifiers, their lack of currency and the small sample sizes on which the defect modifiers are based; a single strike rate is used but studies suggest different strike rates apply in different areas; growth models and the records on which they are based need to be overhauled; and most importantly the inventory data was no longer considered a reliable description of the resource due to the effect of harvesting and a lack of replacements for the harvested inventory plots.

In September 2004 Forestry Corporation released the simplistic report “A Review of Wood Resources on the North Coast of New South Wales”. Unfortunately only bits of data are poorly presented in a confusing and contradictory manner that appears designed to make it hard to interpret.

The outcome of the revised modelling for large quota sawlogs applying a set *high level of cut in the next 20 years* was “220,000m³ per annum of HQL for the first five years, decreasing to 200,000m³ per annum for years six to twenty”. The graph indicates that this drops to a “sustainable” yield of something like 63,500m³ per annum after year twenty, though no details of this dramatic reduction in long-term sustainable yield are provided or discussed.

Though the new assessment cautions that:

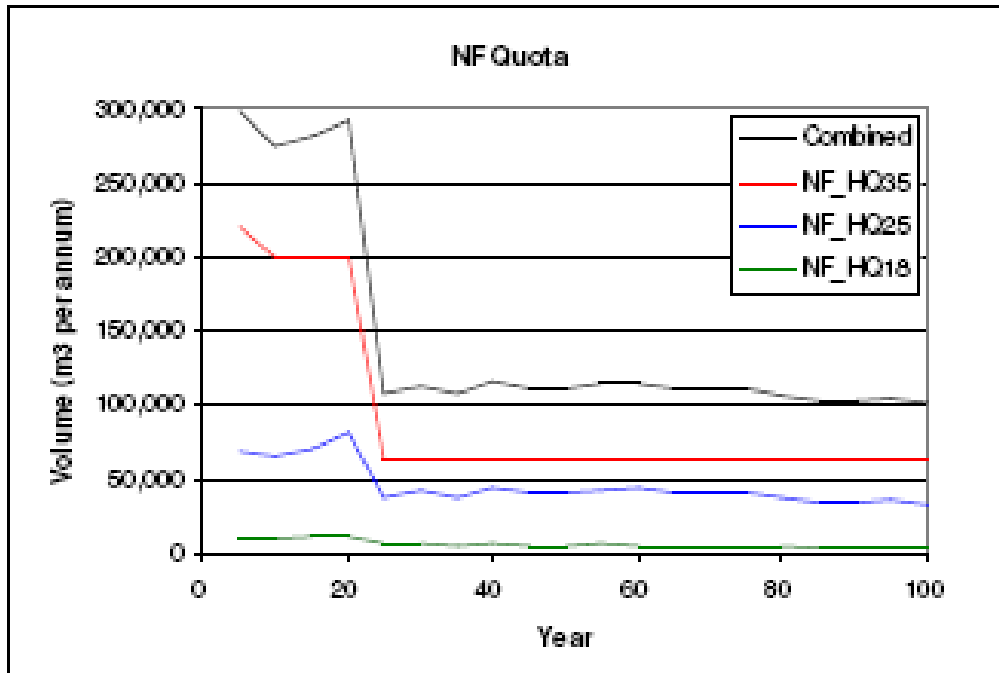
Interpretation of these results and their translation into management actions requires some care. In particular, the modelled outcome is generally 10-15% above the likely outcome due to factors that cannot be incorporated for practical reasons or cannot be adequately represented mathematically.

This caveat was subsequently ignored by both the NSW and Commonwealth Governments. If allowance is made for a 15% over-estimation, as a precautionary approach demands, then the 5 year cut is reduced to 187,000m³ per annum and the 6-20 year cut is reduced to 170,000 m³ per annum. There is an identified major reduction in large high quality (LHQ) sawlogs from Native Forests after year 20 (to around 65,000m³), though the corresponding information from plantations is not provided, which prevents any identification of the 100 year sustainable yield of LHQ sawlogs.

Given that these revised estimates are based on a similar nett harvest area to the NCTS, they represent yet another significant reduction in estimates of yields per hectare. Basically, when compared to Vanclay’s (2002) assessment that 220,000 m³/yr could be sustained for 20 years and 175,000-110,000 m³/yr for the next 80 years, the new modelling shows significantly reduced timber volumes, and brings a higher proportion of that available forward for logging within 20 years at the cost of increased reductions in yields thereafter. This effectively increases the rate of unsustainable logging.

Partington and Stevenson (Forests NSW 2004b) undertook a review for the NSW Auditor General - „Forests NSW: Review of North Coast Standing Volumes for the 2004 Valuation” which reached significantly different conclusions than Vanclay, stating *it has been clear for some considerable time that the timber volumes predicted by the FRAMES process are proving difficult to achieve. This naturally creates a question-mark over valuations derived from the FRAMES data.*”

Modelled Native Forest Quota Sawlog availability (From Forests NSW 2004). Note that HQ35 (red) corresponds to high quality large sawlogs. Also that *“the modelled outcome is generally 10-15% above the likely outcome”*.



Partington and Stevenson (Forests NSW 2004b) found that the FRAMES data was in disarray for many reasons, including that 500 of the 2000 inventory plots had been logged, noting:

Unfortunately, following the FRAMES process the intensity of effort that went into inventory management diminished. The responsibility for inventory management was allocated to the regions until this was changed in 2003. During this time, about 500 of the original 2000 or so north coast inventory plots were lost to harvesting. Many of these plots were not replaced. We are not critical of this; it may have been an entirely appropriate choice by regional management to invest their resources in other areas that they saw as more important. However, the consequences in Forests NSW own words, was that, –The inventory data can no longer be considered a reliable description of the resource due to the level of harvesting over the last five years and the lack of a replacement programme for harvested plots.”¹

There were also a number of other issues requiring attention including the need for a new system of management for the area records, the limited data on which estimates of the net harvest area modifier were based, variation in strike rates across the region, a need for new growth and product proportionment models, and various other issues that needed to be addressed. In short a complete overhaul of the native forest and hardwood plantation inventory was required.

... There will be a need for assessment and review and recalibration of some of the modelling. It is also apparent that the rebuilding of the inventory system is a work-in-progress. We think directions that are being taken are generally appropriate and the effort is admirable, but there is still some way to go.

It is also apparent that a number of interim measures have been employed in bridging the gap between the old system and the full implementation of the new system. This has been necessary in order to derive a set of numbers for the current valuation. For, example a single height diameter model was applied, irrespective of species, in order to estimate the height of trees from their diameter. Neither, with the functionality of the

current system, was it possible to grow the forest forward from the date of original measurement of inventory plots. ...

There are also some technical sampling issues. ...

It is interesting that the North East RFA “Attachment 12, Long-term Timber Supply Strategy and Sustainable Yield Systems and Processes, Part E FRAMES, Sustainable Yield Systems and Processes”, requires that Forestry Corporation:

Undertake additional inventory plot measurement consistent with FRAMES principles to improve the accuracy of volume estimates at the Regional Level, funded at \$500,000 per year for the first five years of this Agreement.

The draft NSW CoA (2009) 5 year RFA review identifies that from 1997 to 2003 there were 127 new plots established. It is hard to fathom how this marries with Forestry Corporation’s logging of over 25% of their existing plots over this period. And it is surprising that this is not mentioned in the RFA reviews.

Partington and Stevenson (Forests NSW 2004) state:

In the case of the native forest we would consider that an estimate within twenty percent of the true value would be a good job. In this context we note Forests NSW intends to provide sawlog volumes with a precision of about plus or minus fifty percent at the level of the tactical planning unit.

Partington and Stevenson (Forests NSW 2004) identified that Forests NSW were in the process of rebuilding the inventory system *–but there is still some way to go*”, noting:

There was limited time to conduct a detailed statistical analysis of the inventory data and in our judgement little need to do so since it was clear that the prior basis of valuation had to be changed and that the new basis was still a work-in-progress the reliability of which could not be cost effectively determined. Consequently, we concluded that the 2004 valuation could differ substantially from the true value, and, in our judgement, none of the possible statistical analyses were going to change that conclusion.

Partington and Stevenson (Forests NSW 2004) did identify a variety of problems with the work to date, such as errors in the data, inadequate data on some species, inadequate height models, poor estimates of loggable areas, flawed growth models, poorly specified models for estimating Total Standing Volume, etc., noting:

For example, in the inventory plot data that we received there are 304 trees which are reported as each having a total standing volume (TSV) in excess of 100 cubic metres, and there is one remarkable tree with a TSV of 597 cubic metres! [1.6 cubic metres is considered the average per tree]

...

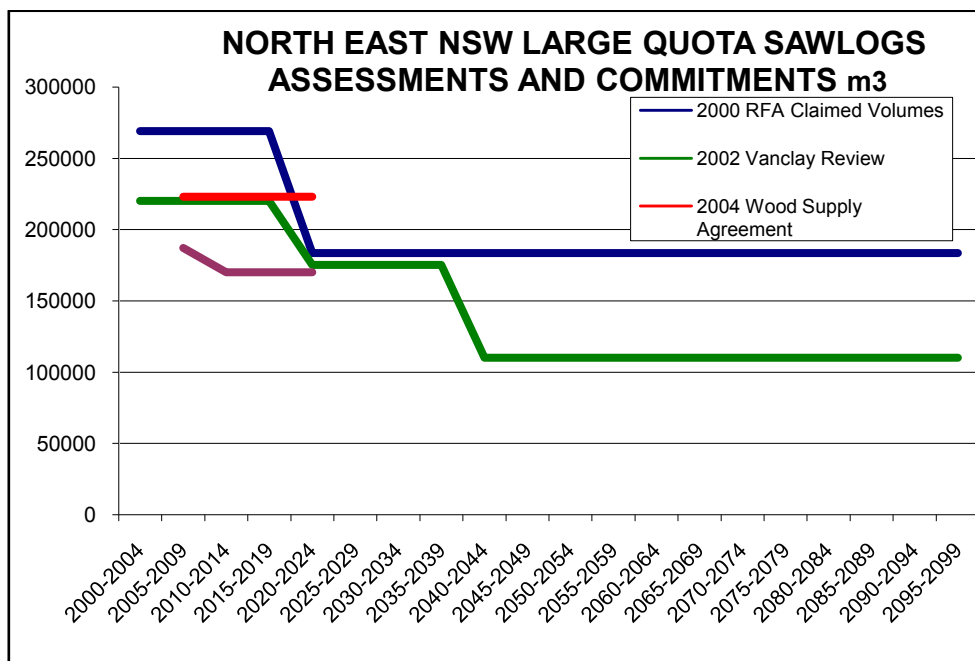
In past valuations height was modelled according to species group as a function of site and Dbhob. In the current valuation the height is estimated by a single model for all species as a function of Dbhob. ... This use of a single model across all species is a weakness in the valuation modelling and is only acceptable as an interim measure. We anticipate that when a wider range of models are implemented next year that volumes may change significantly as a result.

...

Another complicating issue is that areas previously considered unmerchantable are now being reclassified as merchantable as the constraints on available timber become more severe.

Partington and Stevenson (Forests NSW 2004) conclude:

In our opinion the comprehensive improvement of the hardwood inventory is highly desirable, and we believe that good work is being done. However, it is clear that the process is incomplete with many of the new models untested, and some models are still under development. Consequently, while it is feasible to conclude that this year's estimate of value represents the best estimate currently available, it must also be concluded that there is the potential for the value estimated to differ substantially from the true value.



So with a disgraceful history in yield estimations for native forests, a failed FRAMES modelling system and an untested new system, the Auditor General (2009) surprisingly “*found that Forests NSW has adequate estimates of how much timber is available from native forests, now and into the future*”. He also concluded that “*Forests NSW should have sufficient timber to meet its wood supply commitments which are fixed for periods up to 2023 using both native and plantation hardwood*”.

The Auditor General (2009, p23) relies upon the 2004 Forests NSW’s “A Review of Wood Resources on the North Coast of New South Wales”, though fails to consider the need identified in that assessment to reduce modelled estimates by 10-15%, and fails to acknowledge or consider the damning Partington and Stevenson (2004) report specifically prepared for the NSW Auditor General and the July 2004 report.

In their 2003/04, 2004/5, 2005,06, and 2006/07 Forest Agreement Implementation reports, the New South Wales Government (2007) fails to identify the revised Wood Supply Agreements or acknowledge any of the 2004 yield reviews assessments, instead (i.e. New South Wales

Government 2009c) extolling the virtues of Vanclay's (2002) outdated *–extensive independent review of FRAMES*".

Similarly the combined 5 and 10 year reviews of Forest Agreements DECCW (2010) and the draft NSW & CoA (2009) 5 year review of the Regional Forest Agreement extol Vanclay's *–independent review*", pay cursory attention to the 2004 review (with no mention of the reduced yields it identified and the need for a 15% discount), and fail to acknowledge the existence of the Partington and Stevenson review or the July 2004 review. This is particularly strange as the link (www.dpi.nsw.gov.au/forests/management/reporting/rfa-review-report) to Vanclay's report includes the Partington and Stevenson review.

It is particularly concerning that the NSW & CoA (2009) 5 year RFA review relies upon the 20 year estimates from the 2004 Review of Wood Resources as a surrogate for the long-term sustainable yield as required to be identified in the RFA (48g). Sustainable yield has to be maintained in perpetuity, not just for 20 years.

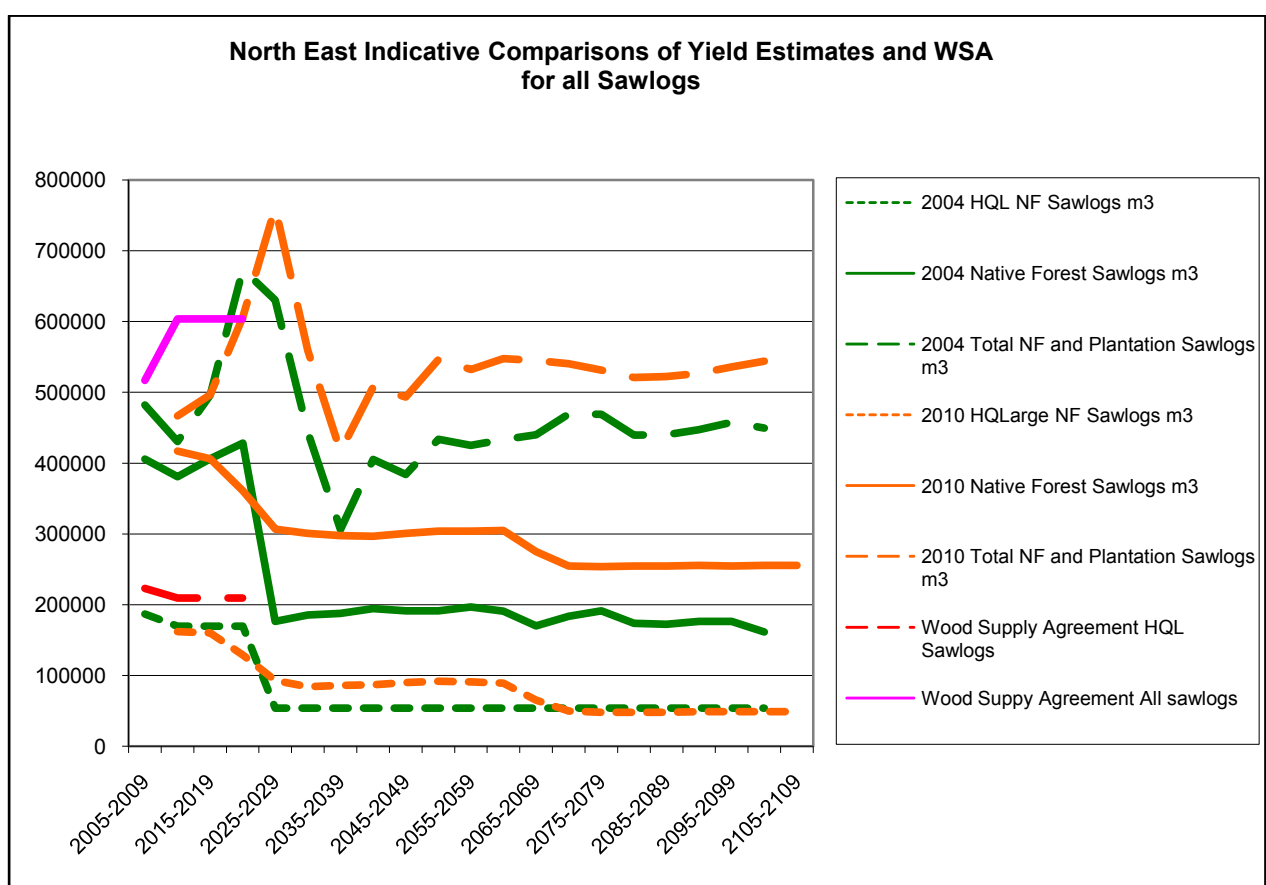
Similarly for his 5-year review of the RFA Spencer (2009) seems ignorant of the 2004 reviews and fails to consider the reduced yields and numerous problems they identify, instead only referring to Vanclay's review:

However there has been independent review of the system and to this extent there would appear to be compliance with RFA requirements. Nevertheless the last independent consideration of the system was at least 7 years ago. There have been a number of enhancements since that date and new data are presumably available.

While Spencer appeared unaware, the 2004 data were available. For his review Spencer (2009) sought additional information from Forestry Corporation who once again only referred to Vanclay's (2002) redundant study.

The Auditor General (2009) recommended that Forests NSW *–by June 2010, publicly report the results of yield estimates for high quality large sawlogs, high quality small sawlogs, low quality logs and pulpwood for each region*".

The graph below represents Forestry Corporation's (2010b) latest yield offering made on their website in response to the Auditor General's recommendation, it is dated November 2010, though was not released until 24 December 2010. There is no explanatory report other than the statement that *–The charts included in this report show estimated annual yields by broad product category in cubic metres (m3) over the next 100 years*". Forestry Corporation's latest yield estimates are presented without any methodology, explanation or review (independent or otherwise) and thus are of unknown veracity. As yet no data on plantation resources has been provided. Comparison with other yield estimates are made harder by the fact that the Central Region has now been separated from the North East Region and the data underlying the graphs has not been presented.



Notes on figure: This figure is presented for illustrative purposes. The 2004 data have been reduced by 15% in accordance with the caveat in the 2004 yield review. There are no revised plantation yields yet for 2010 so the 2004 plantation figures have been used. It is not known when the WSA commitments were increased for low quality purposes, though for plotting purposes 2009 was taken as the date (also for the reduction in HQL sawlog commitments). For comparison purposes the 2004 figures are aligned with 2005.

The only conclusion that can be reached from the data provided is that Forestry Corporation's new FRAMES is once again predicting significantly increased resources. The overall large quota sawlog yields from native forests are on a par with the 2004 estimates before the identified 15% reduction is accounted for, and there has been a significant increase in estimates of total sawlogs from native forests. It seems unlikely that the bonus FMZ8 areas are factored in, suggesting that any estimates should be conservative. The fantasy seems to be alive and doing well. The 2004 yield estimates identifying that commitments of quota sawlogs should be limited to 187,000m³ per annum for 5 years and then reduced to 170,000 m³ per annum for years 6-20, and Forestry Corporation's own reports damning of the methodology, seem to have been forgotten.

The Auditor General (2009) identifies that since the unfavourable early outcomes, Forestry Corporation is not comparing actual yields to predicted yields:

Harvesting results are not used to update FRAMES. This makes it difficult for Forests NSW to develop a clear picture of the impact of harvesting on the inventory and future yield. ...

One way to check the reliability of yield estimates is to compare them to the actual timber volumes harvested from the forest. The Regional Forest Agreements require monitoring of actual versus predicted volumes on an annual basis.

We found that Forests NSW does not routinely check its harvest results against yield estimates. ... we consider these reviews necessary to test its estimates.

For the 5-year RFA review Spencer (2009) could not understand why Forestry Corporation insisted that there could be no comparison between actual and predicted yields at any scale, stating:

However it is a specific RFA requirement to monitor modelled and actual performance on a continuous basis. The reasons for such a requirement seem quite obvious and to not do so suggests that models should be accepted without reference to whether they reflect reality.

In response to Spencer's concerns, Forests NSW (Spencer 2009) maintain that:

FRAMES performance has been monitored through comparison of actual versus predicted volumes. Each year, actual volumes harvested have been reported against allowable cut, which is calculated according to the whole-of-region predicted volumes from FRAMES.

It is astounding that Forestry Corporation can get away with pretending that comparisons between what was logged and annual commitments in anyway reflects a comparison between actual and predicted yields. If it does, then FRAMES is grossly over-predicting resources.

The Auditor General (2009) recommended that *by June 2010 Forests NSW –compare harvest results against its yield estimates over five year periods as a means of testing the accuracy of estimates*". In response to questions on notice from the General Purpose Standing Committee No.1 Budget Estimates 2009-10, Steve Whan claimed that the annual and five year (till June 2010) *–results will be published on Forests NSW website by December 2010*". They were not.

In 2012 Forests NSW (2012) finally presented a convoluted comparison of FRAMES-predicted volumes by log class with actual harvested volumes by log class for areas harvested during the period July 2005 to June 2010, that showed actual yields of large high quality sawlogs were 101% of that predicted for the North East region and 103% of that predicted for Central region. They note:

... the study demonstrated that FRAMES predicted HQL volumes are very similar to the volumes of HQL actually harvested between July 2005 and June 2010, at both Analysis Group and Regional level, with the only exception being the highly variable Tableland forests in North East Region. There was no statistical difference between actual and predicted HQL volumes per hectare at Analysis Group level.

If this is correct, then it would seem that Forestry Corporation have rectified all the problems identified in 2004. Forestry Corporation therefore should be able to deliver the commitments to industry without any problems. The question is therefore, why has Forestry Corporation been unable to supply commitments any year since 2004?

The available supplies of both large and small sawlogs from north-east NSW's public forests are grossly overcommitted, and the current policy of liquidating the

large sawlog resource and over-logging small sawlogs is severely compromising the future productivity of public forests and their ability to provide high-value products. This gross over-commitment is also driving the frequent breaches of existing prescriptions and the wind back of prescriptions now underway.

6.2. Sustainable Timber Yields

Ever since the 2003/4 WSAs were signed, Forestry Corporation have not been able to meet commitments. Across north east NSW, over the 8 years 2004-12 there was a shortfall between commitments given in WSA and actual yields of large high quality sawlogs of at least 323,064m³ (19%). To supplement supply Forestry Corporation has increased logging of small high quality sawlogs (the large sawlogs of the future) and is getting into the plantations too early. This is further reducing long-term sustainability.

Forestry Corporation have already had to buy back timber committed in WSAs, compensate mills that they couldn't meet supply commitments to, and are logging private property. Forestry Corporation have already had to pay half a million dollars compensation to Boral and were subsequently prosecuted for a further 3 years of failure to supply commitments. This is also part of the reason why Forestry Corporation are increasingly logging trees and areas meant to be protected. With yields declining and native forest operations now operating at losses of over \$14 million per annum the situation is worsening rapidly.

The NSW Auditor General (2009) states that in 2006 and 2007 Forestry Corporation bought back wood supply allocations for large sawlogs from north east NSW from two customers totalling 13,403m³.

The NSW Auditor General (2009, Exhibit 20) indicates that the new Wood Supply Agreements are for 209,500 m³ per annum of large high quality sawlogs. It is astounding that none of the NSW Forest Agreement implementation reports or reviews bother to identify the WSA commitments and the changes made to them. The draft NSW&CoA (2009) 5 year RFA review is the only document located that identifies the new Wood Supply Agreements, though it fails to identify their type.

While the Auditor General highlights one change there have obviously been significant changes to high quality small sawlogs (-25,087) and low-quality sawlogs (+125,657) when compared to Forests NSW's (2005) ESFM Plan. Such changes to allocations of public resources should be made public and not kept secret.

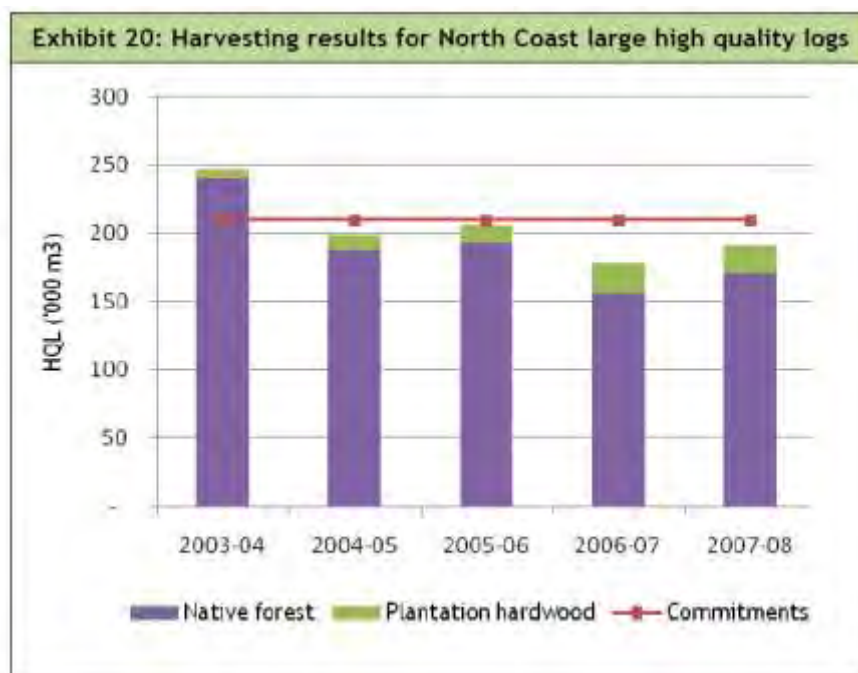
WOOD SUPPLY AGREEMENTS FOR NORTH EAST PUBLIC FORESTS UNTIL 2023. From NSW & CoA 2009 4.21 Volume Review, Table 4.7.

Log type	UNE (cubic metres)	LNE (cubic metres)	TOTALS
High-quality large sawlogs including veneer logs and girders	83,686	125,814	209,500
High-quality small sawlogs	27,184	36,588	63,772
Low-quality sawlogs	153,677	176,867	330,554
Pulp grade and chipwood (domestic and export grade)	45,000	120,000	165,000

In answers to questions in parliament the Minister for Forests identified that in 2006 2,000m³ was purchased for \$500,000 (\$250 per m³) and in 2007 10,194m³ was purchased for \$2,277,000 (\$223.36 per m³). This 12,194m³ is less than the 13,403m³ reduction identified by the Auditor General.

These purchases indicate that the Wood Supply Agreements are worth around \$14 per m³ per annum. This gives a value of over \$61 million for the total 4,365,852m³ of large high quality sawlogs committed in WSAs in 2003/4, with the remaining 11 years of commitments worth some \$32 million.

The Auditor General (2009) identifies that at 2008 there were wood supply agreements for some 209,500 m³ per annum of large high quality sawlogs from north coast forests and that commitments are not being met (see below), and neither are commitments for low quality sawlogs. Immediately after giving the new Wood Supply Agreements to the millers, the Auditor General identifies that Forestry Corporation had to compensate mills for not supplying commitments and start buying back wood supply allocations, for example paying one mill (Boral) \$550,000 for 34,000m³ of high quality large sawlog they were unable to supply during 2004-2006.



Note that the Auditor General fails to account for increased WSA commitments pre 2006-7.

As well as possibly getting into the plantations and small sawlogs too early, the Auditor General notes that Forestry Corporation have not been meeting their target of 30,000m³ per annum from private property for the north coast, instead averaging only 7,000m³ per annum over 5 years. This increases the strain on public forests and plantations and further jeopardises future yields.

NORTH EAST COMPARISON OF ACTUAL YIELDS TO COMMITMENTS From NSW&CoA (2009). (based on WSA commitments therein rather than Forests NSW (2005) ESFM Plan, note that WSA figures for UNE and LNE have been significantly changed over these three years though as the timing of the changes and their distribution across the regions is not publicly available, the current figures have had to be used)

		Wood Supply Agreement m ³ per annum	2004/5 yields m ³ (% WSA)	2005/6 yields m ³ (% WSA)	2006/7 yields m ³ (% WSA)	3 year deficit m ³ (% WSA)
High-quality large sawlogs (incl. veneer and girders)	UNE	83,686	70,389 (84%)	70,333 (84%)	68,814 (82%)	-41,522 (-17%)
	LNE	125,814	127,539 (101%)	135,744 (108%)	111,537 (89%)	-2,622 (-0.7%)
Small high quality sawlogs	UNE	27,184	29,500 (109%)	32,763 (121%)	29,959 (110%)	+10,670 (+113%)
	LNE	36,588	24,780 (68%)	29,316 (80%)	31,127 (85%)	-24,541 (-22%)
Low-quality sawlogs	UNE	153,677	86,258 (56%)	88,219 (57%)	69,148 (45%)	-217,406 (-47%)
	LNE	176,867	147,401 (83%)	138,769 (78%)	148,788 (84%)	-95,643 (-18%)
Pulp-grade and chipwood (domestic and export grades) (tonnes)	UNE	45,000	11,648 (26%)	19,220 (43%)	12,269 (27%)	-91,863 (-68%)
	LNE	120,000	108,647 (91%)	97,170 (81%)	121,162 (101%)	-33,021 (-9%)

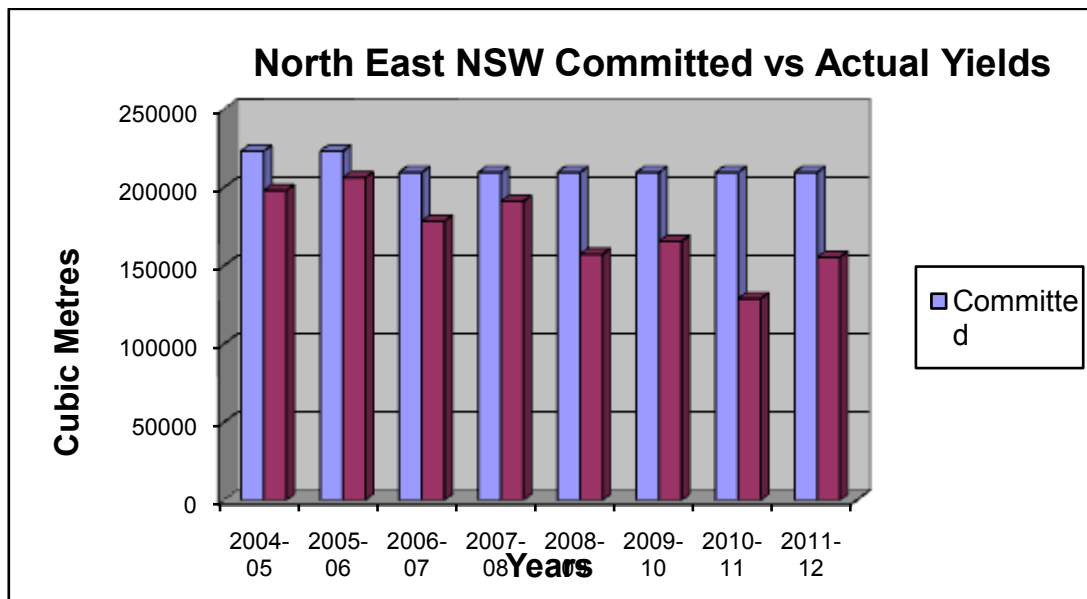
Annual shortfalls of at least 17% in large quota sawlogs and 47% in low-quality sawlogs in the UNE are significant. The failure to meet large sawlog commitments indicates an inability to meet supply commitments given in the Wood Supply Agreements. Given that this is one of the performance indicators the causes should have been documented by now.

Across north east NSW over the 8 years 2004-12 there was a shortfall between commitments given in WSA and actual yields of large high quality sawlogs of at least 323,064m³ (19%).

NORTH EAST COMPARISON OF ACTUAL YIELDS TO COMMITMENTS. Source DECCW 2010, Auditor General 2009, parliamentary responses, N. Roberts pers. comm.

	Wood Supply Agreements m3	HQ Large Yields m3	% Actual of WSA
2004-05	223077	197928	89
2005-06	223077	206077	92
2006-07	209500	178351	85
2007-08	209500	191086	91
2008-09	209500	157234	75
2009-10	209500	165422	79
2010-11	209500	128797	61
2011-12	209500	155195	74
TOTAL	1703154	1380090	81

In the UNE the cut of small sawlogs is significantly higher than commitments, presumably to help compensate for the significant undercut in large sawlogs. This just helps entrench unsustainable logging further as the future large sawlogs are cut early.

NORTH EAST COMPARISON OF ACTUAL YIELDS TO COMMITMENTS.


The problem is also with the species mix being provided. The Auditor General (2009) notes:
... Resource reviews were a key risk management tool for Forests NSW which is no longer available under wood supply agreements for large logs.

...the North Coast region has been unable to meet its species commitment since 2004 for blackbutt, although this is based on best endeavours'. This commitment accounts for about 36 per cent of all high quality sawlog allocations on the north coast.

Regional staff report that the Blackbutt commitment forces them to harvest coastal timber when they would prefer to balance commitments between the less accessible tableland timber and other species. This is in order to sustain the resource on the coast and buffer the impact of cost increases as it accesses more tablelands timber. This issue could have been addressed if the review clause remained in the north coast wood supply agreements.

The Auditor General also identified that Forestry Corporation were taking 56% more sawlogs from plantations than proposed, noting that if it is taking more than planned to meet commitments *-this could affect future production*" as plantations *"will form an increasing proportion of future supply"*, *-because current yield from native forests in the north coast is not sustainable in the long term; that is, beyond the term of the current contracts*".

Forestry Corporation have already had to buy back timber committed in WSAs and compensate mills that they couldn't meet supply commitments to. Forestry Corporation are already overcutting small sawlogs in the UNE and sawlogs in plantations to help compensate for their shortfalls.

As well as possibly getting into the plantations and small sawlogs too early, the Auditor General notes that Forestry Corporation have not been meeting their target of 30,000m³ per annum from private property for the north coast, instead averaging only 7,000m³ per annum over 5 years. This increases the strain on public forests and plantations and further jeopardises future yields.

The Regional Forest Agreement 2000, Attachment 12, Part C, Hardwood Sawlog Supply Supplementation Strategy, states:

19 The Parties agree that the following long-term hardwood sawlog supply supplementation strategy will be implemented to allow the supply of more timber and raise the long term Sustainable Yield of hardwood sawlogs from public forests in northern New South Wales;

- Subject to availability of suitable land, New South Wales will spend the allocated \$18 million between 1999 and 2004 to purchase Private Land and/or timber rights to provide approximately 180,000 m³ of High Quality Large Sawlogs and Large Veneer Logs for the Upper North East and Lower North East regions within the term of this Agreement.*
- Subject to the availability of suitable land, New South Wales will spend the allocated \$30 million by 2004 to establish at least 10,000 ha of hardwood Plantations across both the Upper and Lower North East Regions to supplement supplies of High Quality Large Sawlogs and Large Veneer Logs from public forests. This initiative is expected to produce approximately 125,000m³ per annum for 10 years commencing*

DECCW (2010) note:

Forests NSW has purchased 11 properties across the UNE and LNE regions (three in the UNE region and eight in the LNE region) under the Private Property Timber Supplementation Program. These cover an area of more than 13,000 ha of native forest with an estimated standing volume of 141,439 m³ of high quality large quota sawlogs.

As of June 2005, three timber sale agreements for purchase of private property timber rights have been implemented across the LNE region with a further 10,962 m³ of high quality large sawlogs estimated to be produced.

In sourcing 152,401 m³ of supplementary high quality large sawlog, Forests NSW has made substantial progress in achieving the targeted outcome of 180,000 m³.

....

Forests NSW successfully established 7,543 ha of hardwood plantation in the UNE and LNE regions between 1999 and 2004.

Subsequent strong real estate prices and competition for land have made it difficult for Forests NSW to secure appropriate land to establish additional hardwood plantations.

These are significant shortfalls in the volumes (15%), areas (25%) and 2004 timelines established by the RFAs, it is thus surprising that they are not remarked on in FA Implementation Reports.

One of the Auditor General's (2009) recommendations was for Forestry Corporation to investigate the reasons for not meeting its private property targets for hardwood timber. In their 24 December 2010 response Forestry Corporation make the extraordinary claim:

Important background note to this recommendation is that the 'private property targets' were set in the ESFM Plans framed in 2005, not in the Regional Forest Agreements signed around 2000.

There are significant shortfalls in the targeted volumes of timber required to be obtained from private property and the areas of new plantations required to be established to enhance yields

from 2018 until 2100. When combined with declining yields and early logging of sawlogs from native forests and plantations the prospects of reasonable long-term yields are declining.

The Legislative Council Inquiry into the Management of public land in New South Wales (2012) reported:

Serious concerns over the sustainability of current logging practices have been raised by inquiry participants from the timber industry with particular concerns over future resources. Greensill Bros Pty Ltd expressed that the view that under the current regulations restricting access, the small area of forests is being overcut. Newells Creek Sawmilling Company similarly said that we are overcutting the bush because we are limited to a small area for sustainable forestry while vast areas have been locked up for timber production and placed under the management of National Parks. Mr Notaras highlighted the long term implications for the industry, contending that they will not have high quality large logs in the future.

The Committee acknowledges the evidence received from Inquiry participants from the timber industry which expressed the view that the conversion of land had significantly restricted timber supply, with Inquiry participants suggesting the Forestry Corporation of NSW is experiencing difficulty in meeting the wood supply volumes required by the forestry agreements. The Committee notes the corroborating statements from both the timber industry and conservationists suggesting that this has led to smaller areas being subject to increased logging effort in order to meet commitments regarding the volume of supply.

Inquiry participants said that the commitments given under the wood supply agreements were a decisive factor for mill owners in choosing whether to exit the timber industry. The Committee is concerned at the suggestion that the Forestry Corporation of NSW has failed to deliver on its commitment to supply the specified volume and quality of saw logs. In addition, the Committee questions whether the wood supply agreements were based on unsustainable yields from the outset, making it impossible to deliver the supply of wood needed to sustain the industry. ...

NEFA recommends that the NSW Government make two fundamental changes in timber resource allocation from State Forests to improve its sustainability;

- **The urgent reduction in allocations of sawlogs down to the estimated long-term sustainable yield and the refocus of silviculture from liquidating the large sawlog resource to sustaining it in multi-aged forests.**
- **A reduction in yields commensurate with the additions necessary to establish a truly Comprehensive Adequate and Representative reserve system and the establishment of truly ecologically sustainable management practices.**

6.3. Sustainable Silvicultural Prescriptions

Forests are naturally multi-aged, in general they are composed of individuals or cohorts from a range of age classes resulting from past disturbances. These regeneration cohorts can result from past disturbances, such as wildfires, and go through a self-thinning process as they age. Forests are thus naturally multi-aged.

Mackowski (1987) and Smith (1999) provide evidence that in natural forests there is a natural mortality rate in the order of 50% of trees between each age class, with mortality rates increasing with age and increasing due to declining site quality. This means that in a natural forest, in order to retain one tree in an age class, there is a need to retain at least twice as many trees in the next youngest age class. Mackowski's (1987) assessment was that Blackbutt forests had a 50% mortality between 80 year age classes.

Smith (1999) identified the averaged structure of natural native forests according to tree size class and site productivity in eastern NSW (Table 1).

Table 1. Smith (1999) Number of stems (all species) per hectare and stand basal area (square metres per hectare) in increasing diameter classes in unlogged or "old-logged" forests.

Productivity Class	20-39 cm dbh	40-59 cm dbh	60-79cm dbh	80-99 cm dbh	>100 cm dbh	Stand Basal Area
1 low	69	24	10.8	2.5	-	18
2 low-mod	80	50	16.7	6	1.3	26
3 mod-high	87	57.4	31.6	11.5	5	43
4 high	64	44.7	14.3	7.6	11.9	47

1. Shading depicts where significant numbers of hollows with an entrance >10 cm diameter and estimated depth >25 cm were recorded.
2. Size classes are based upon diameter at breast height (dbh).

These generalised stand descriptions are indicative and do vary, particularly in the tall wet forests with rainforest understories where major disturbances are rare events. For example data for high productivity oldgrowth on the Richmond Range (Table 2) show a similar distribution of stockings by age classes, though with more individuals in the 60-99 cm size classes and correspondingly less in the 40-59 cm size class.

Table 2. Stocking of diameter classes in predominately oldgrowth forest in the Duck Creek area on the Richmond Range (from State Forests' Urbenville EIS)

Productivity Class	40-59	60-79	80-99	>100
4 high	26.8	18	19.2	12

The problem is that the structure of NSWs public forests has been severely degraded by logging targeting the older age classes for removal, failure to retain trees with good growth potential through the range of tree sizes, and an obsession with clearfelling so as to create pseudo-plantations (a consequence of "pinus-envy"). This gross mismanagement has severely

degraded the forests environmental services and productive potential. As noted by Smith (2000):

–Over-cutting without silviculture has run down both wood and non-wood values leaving forests dominated by small diameter low value wood products most suitable for woodchip and low quality sawlog. Growth rates are disappointing and there is little or no silvicultural experience to draw from the last 25 years of public forest management (J. Brandis pers. comm., R.L. Newman and Partners 1996).

–The history of NSW public forest logging has been one of increasing harvesting intensity, decreasing harvesting intervals, declining stand volumes and declining yields. Many remaining forests are considered less than optimal for wood production...”

In general, the coastal forests have been most severely impacted by the intention to convert them into even aged regrowth, removal of large hollow-bearing trees in Timber Stand Improvement programs, and “thinning from above” removing the most vigorous trees and leaving suppressed trees with poor form and growth potential behind. This has been exasperated in recent years by limiting the retention of hollow-bearing trees, and recruits, to however many are left (when less than 10 per 2ha) rather than the requirement in the escarpment forests to restore a stocking of 10 hollow-bearing trees per 2 hectares by retaining the largest remaining trees where there are insufficient hollow-bearing trees. The coastal forests are also now often subject to 70-80% basal area removal under a perverted application of Single Tree Selection silviculture where basal area removal is meant to limited to less than 40%.

The industry has itself been a major driver for the degradation of public forests due to their preference to maximise profits in the short-term. The NSW Public Accounts Committee (PAC 1990) recognised this, stating:

–In the long-term, sustainable harvesting is in the industry’s best interest, but in the short-term many mills would prefer to process tomorrow’s timber today, gaining tomorrow’s profit today, then relocate once the resource is too degraded to be useful. Under these circumstances, it would be naive not to recognize that short-term economics is in direct conflict with regulation and the principle of sustained yield.”

For example, Forestry Corporation made the deliberate decision to log the Walcha and Styx Management Areas unsustainably in the 1960s on the basis “*that management of the hardwood forests on a sustained yield basis would not be economically practicable*”. With repeated decisions thereafter to cut far in excess of sustainable yield estimates. In 1991, in response to the Resource Assessment Commission inquiry emphasis on sustainable yield, the quota sawmiller wrote to Forestry Corporation reminding them that in 1984 they had agreed “*the full quota in that area would be available until pine saw logs were made available, or when the forest was completely cut*”. He stressed that there was never a plan to adopt sustained yield and asked for an assurance that quotas would not be reduced. (Pugh and Flint 1999).

The Government and industry reached agreement in 1998 to extend the intentional unsustainable sawlog allocations across the whole public forest estate in north-east NSW. The consequences are massive over-logging of public forests and massive degradation of their future ability to provide large sawlogs. This intent is reflected in Forestry Corporation’s ‘*Native Forest Silviculture Manual*’ and its aim of liquidating the large sawlog resource to meet contractual agreements entered into as an outcome of the Regional Forest Agreements: “*... the agreements aim to optimise timber production from existing trees in native forests over a twenty*

year period ...Commercial maturity of trees and stands will be assessed in terms of their capacity to produce realisable quota sawlog volume within the planning period."

Despite the aims of silvicultural prescriptions being the maintenance of multi-aged forests, Forestry Corporation are rorting the intent by practicing virtual clearfelling of large tracts of forests to convert them into single-aged regrowth monocultures. This is contrary to the intent of the legal requirements and the basic precepts of ecologically sustainable forestry.

There is nothing sustainable about the intentional over-logging of public forests in north-east NSW. Allocations of sawlogs need to be urgently reduced down to a level that is sustainable as a priority.

The sustainable use of those public forests outside the reserve system that are identified as appropriate for timber production requires a whole new management model. The management model has to be predicated on the maintenance and restoration of an uneven-aged structure throughout native forests used for timber production.

Attiwill *et. al.* (1996) recommended:

–Promotion of the north-east forests as a region for production of high value-added specialty hardwood products (poles, beams, floorboards, kiln dried furniture timber, and timbers of large size and strength) and biodiversity conservation, by management under low cost, low intensity (less than 35% canopy removal) selection logging techniques and discouragement of management for low-value products including scantling (housing frame), woodchips, and wood fibre."

Smith (2000) goes to great lengths to outline the requirements for a sustainable silvicultural system. He considers that maintenance of uneven-aged forest structure with regrowth, mature and senescent elements is the best way to optimize both wood production and non-wood production objectives simultaneously. He notes:

–By maintaining an uneven-aged structure it is possible to sustain wood production and biodiversity values concurrently in the one stand. Biodiversity values are optimized with a higher proportion of senescent stems while wood production is optimized with a higher proportion of mature stems. A balance between biodiversity and wood production objectives is achieved by retaining a small percentage of senescent stems and selecting a minimum stocking of mature stems of high quality to grow into large stems (>70cm) in the late mature stage. Maintenance of uneven-aged structure in combination with low intensity (partial) logging enables most forest fauna species to persist within logged forests (Dunning and Smith 1986, Kavanagh and Webb 1998).

Florence (1996) notes:

–Certainly, the uneven-aged forest offers the best scope for taking into account within the one stand, a range of management objectives. ...A greater emphasis on the environmental factor would characterise a more intensive approach to selection practice. Such an approach would require a good ecological appreciation of species patterns and biological process in the forest, seek to achieve near-full production on all sites, and maintain diversity in the composition and structure of the forest.

–There will be those who will argue that the concept of intensive selection silviculture in this way is too divorced from the present reality, the priorities of the State, financial

constraints, and the availability of experienced field foresters. Nevertheless, thinking on the future of the forests should not be constrained by immediate demands on the forest and current management philosophies. State policies, management objectives and priorities may change as the forests become an increasingly valuable environmental resource, generating a professional responsibility to keep them in near peak silvicultural condition. Moreover, the forests are rich in species providing fine timbers offering combinations of strength, durability and attractiveness. If there are, as expected, higher value markets for them in the future, both domestic and export, the case for more intensive forms of uneven-aged forest management will become stronger.”

Butcher (1994) also recognised the need for maintenance of forest structure as a measure of sustainability:

–ESD (1991) supports these needs in stating that „...to ensure that there is a constant supply of the largest-sized trees required ... it is necessary to develop a desired age or size class structure.” (p.38) and „Monitoring of the forest, and particularly comparison of actual forest structure with predicted structure, is an essential part of sustainable yield management.” (p.39).

–Sustainable yield is therefore more critically related to sustaining a forest structure capable of supplying logs and other values than to the actual continuity of production flows. For example it is critical to continue to grow trees into the mature size classes if large diameter logs or trees with hollows are required, hence there need to be age classes continually contributing to provide the necessary perpetuation. This is most critical for those age/size classes which are hardest to replace, the large mature/senescent forest, or the climax community in a successional forest. Therefore to provide future communities with options forests at the regional level must still contain an appropriate proportion of these components.”

Smith (2000) establishes a baseline using data from unlogged or lightly logged stands (see Table 1), and then identifies retention rates that “*closely mimic patterns of natural disturbance*”, according to percentages of regrowth, mature and hollow bearing size classes. Smith (1999) recommended minimum stocking levels for each size class at the following levels:

- *40% of the unlogged average stocking for mature (merchantable) size classes;*
- *50% of the average unlogged basal area for senescent tree size classes most likely to contain tree hollows or a minimum of five trees in the two median habitat tree size classes;*
- *70% (dry forest) to 100% (wet forest) of the unlogged stocking of small diameter stems.*

His retention rates are based upon size classes of trees and basal areas, varied according to four broad productivity classes. This methodology is aimed at managing forests primarily for the highest value large sawlogs.

Smith’s retention rates are similar but lower than Curtin’s idealised stocking for Blackbutt forest (Florence 1996), and as noted by Florence (2001, pers. comm.) “*is more or less consistent with the optimum stocking for a mixed species blackbutt forest as described by M.R. Jacobs in Growth Habits of the Eucalypts*”). It is worth noting that Blackbutt is generally considered an “intolerant” species and thus requires less overstorey for successful regeneration than “tolerant” species.

Table 3. Smith's (2000) proposed minimum retention rates (stems per hectare) are:

Productivity Class	Min Stocking 20-39 cm	Min Stocking 40-59 cm	Min Stocking 60-79cm	Min Stocking 80-99 cm	Min Stocking >100 cm	Minimum Basal Area
1	50	12.5	4	2		11
2	60	25	5	2.5	1	16
3	80	30	8	3	2.5	23
4	60	35	10	4	4	28

Smith (2000) also requires that canopy gaps do not exceed 25m diameter.

Table 4. Curtin's idealised stocking for Blackbutt forest (from Florence 1996).

Productivity Class	Min Stocking 20-39 cm	Min Stocking 40-59 cm	Min Stocking 60-79 cm	Min stocking 80-99 cm	Min Stocking >100 cm	Minimum Basal Area
3?	67	31	14	7	-	22

It needs to be recognised that unlike the situation where Curtin and Jacobs were developing their retention rates, there are now requirements to incorporate other values into forest management. It is apparent that from a purely timber production standpoint that Smith's retention rates are close to optimum. There is a concern that from a wildlife standpoint they are already sub-optimal, though they have the advantage of providing a retained framework for forests which is essential to support those trees needed to be retained for fauna in perpetuity.

Establishing minimum retention standards for each size class encourages the return of multi-aged stands over time. For example, in a stand dominated by 20-39 cm trees the land manager can remove a large number of these for timber, while still retaining some to grow into the next size class. Once they have grown sufficiently, they can again remove most of these while still being required to retain some to grow into the next size class, and so on. The end result is enhanced biodiversity values while still allowing for timber production.

In his advice to the Richmond Regional Vegetation Management Committee, Florence (2001) states:

Any regulatory process for uneven-aged forest must express silvicultural objectives, for example

- 1) *to maintain a structurally diverse forest with trees through a range of size classes, including those trees needed to meet standards set for wildlife habitat, food and recruitment trees; and*
- 2) *to progressively improve the productive condition of the forest (consistent with ESFM principles) by*
 - i) *retaining trees with good growth potential through the range of tree sizes and*
 - ii) *ensuring regeneration is able to develop through the growth stages to maturity by creating canopy openings of an appropriate size.*

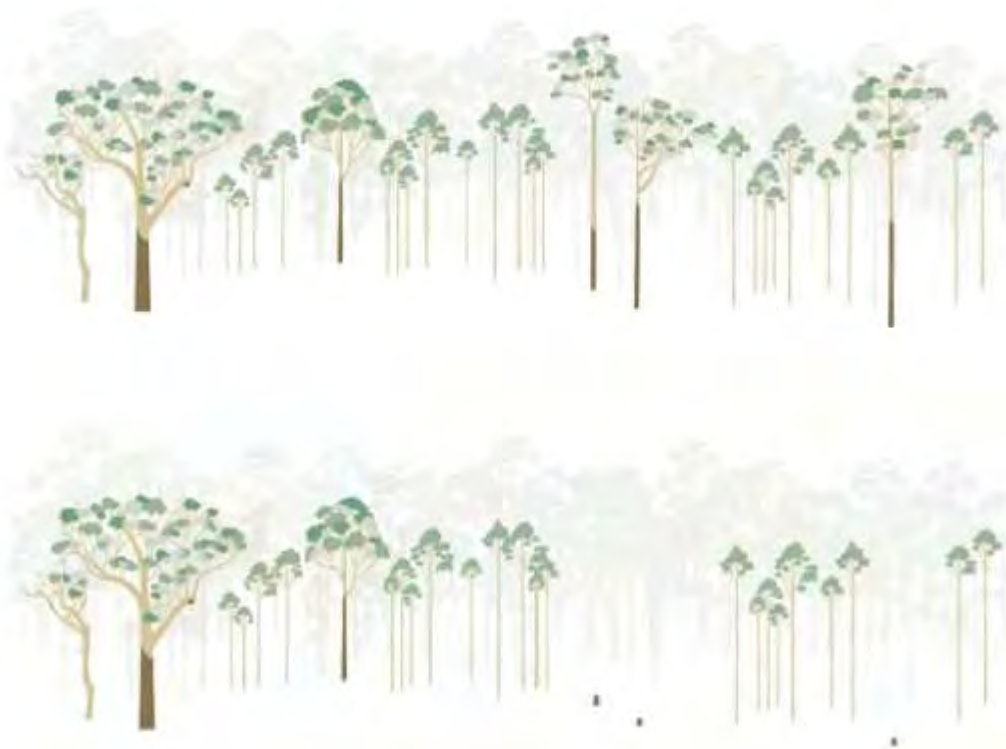
Currently public forestry is regulated by the Integrated Forestry Operations Approval. It authorises two silvicultural methods that can be applied in north-east NSW's forests:

- Single Tree Selection is meant to be the light impact method where no more than 40% of the basal area is harvested in any one operation.

- Australian Group Selection is the intensive method that allows for up to 22.5% of a logging area to be patch clearfelled on 4 occasions at 7 year intervals. Patches are not allowed to be bigger than 50x50m.

Single Tree Selection is the most widely used silvicultural prescription, though it is now often used to undertake the heaviest logging where 80% of the basal area is removed over large swathes of forest. Forestry Corporation use a loophole that allows for the 40% to be averaged across the harvest area to compensate for the heavier logging by excluding logging from a part of the area and claiming the average removal is only 40%. They then return to log the excluded area. While STS was based upon 15 years between logging events they often return a few months or years later. Despite this being a blatant rorting of the intent of Single Tree Selection the EPA refuse to do anything about it because the letter of the law does not preclude it.

New South Wales Single Tree Selection (STS)



EXTRACT FROM FORESTS NSW NATIVE SILVICULTURE MANUAL

Despite the aims of silvicultural prescriptions being the maintenance of multi-aged forests, Forestry Corporation are rorting the intent by practicing virtual clearfelling of large tracts of forests to convert them into single-aged regrowth monocultures. This is contrary to the intent of the legal requirements and the basic precepts of ecologically sustainable forestry.

The EPA is now proposing that existing limits on clearfelling and intensive logging be removed, along with prohibitions on the logging of slopes over 30 degrees. These are major losses for sustainability and long sought wins for the loggers after short-term windfalls.

In order to improve the sustainability of logging it is necessary to prohibit clearfelling and have a prime silvicultural objective for state forests of maintaining or restoring structurally diverse forests, with trees through a natural range of size classes and species, including those trees needed to meet standards set for wildlife habitat, food and recruitment trees.

7. Non-logging Activities

The National Forest Policy Statement has as one of its three requirements for ecologically sustainable development –*optimising the benefits to the community from all uses within ecological constraints.*” The RFAs and IFOAs were always intended to appropriately regulate all activities being undertaken on public lands. It is reprehensible that the EPA has never bothered to enforce explicit requirements and legally enforceable prescriptions for management of forest activities other than logging over the past 15 years. It is contemptible that the EPA are justifying the removal of regulations for all forest activities, other than logging, on the grounds that the EPA has not bothered to enforce compliance with these requirements over the past 5 years.

If the EPA get their way, the new regulations will only apply to logging operations and will not attempt to provide any regulation for other forest uses. Current restrictions on the removal of products of economic value other than timber (ie plants and plant material such as seeds, bark, and tea tree oil) will be removed except during logging operations. Similarly attempts to regulate grazing and weed control by requiring the preparation of long overdue management plans which address requirements of threatened species have been abandoned. Loss of these regulations will also result in the lost of restrictions on a variety of non-logging activities in Forest Management Zones comprising the informal reserve system, as well as prohibitions on issuing grazing permits over new areas and excluding grazing from wetlands.

The IFOAs were always intended to appropriately regulate all activities being undertaken on public lands as this is a basic premise of ESFM and a requirement of the RFA, it is reprehensible that the EPA are intending to remove regulation from all activities conducted on State Forests other than logging.

The IFOA’s were always intended to be the mechanism by which indigenous and non-indigenous cultural and heritage values of forests are protected to fulfil State and Commonwealth obligations. In relation to “Heritage -Aboriginal and non-Aboriginal” the EPA state “*The new IFOA would not cover heritage matters*”. In relation to heritage the North East NSW RFA (2000) makes it clear that the parties rely upon the IFOA:

The Integrated Forestry Operations Approval covering the Upper North East region is the principal vehicle by which Environment and Heritage Values that are impracticable to include in reserves can be conserved. The JANIS Reserve Criteria provide for the management of such values through prescriptions. The Integrated Forestry Operations Approval takes account of the extent of reserved habitat, whether the prescriptions are operationally feasible, and the relative conservation status of each species

Manage cultural values, both Aboriginal and non-Aboriginal, in the Upper North East region, consistent with the guidelines in the Protective Mechanisms for Cultural Heritage – Generic Version and the Lower North East region consistent with the guidelines in the Protective Mechanisms for Cultural Heritage – Lower North East as outlined in clause Error! Reference source not found., Attachment 4 and the principles in Attachment 10. The Commonwealth acknowledges that the Cultural Heritage Guidelines attached to both the Upper North East Integrated Forestry Operations Approval (December 1999) and the Lower North East Integrated Operations Approval (December 1999) are consistent with the above documents;

Parties agree that forest uses other than timber production will be determined in accordance with New South Wales legislation with due regard for protection of Environment and Heritage Values. ...

Parties agree that the management of cultural values, both Aboriginal and non-Aboriginal, in the Upper North East region, be undertaken consistent with the guidelines in the Protective Mechanisms for Cultural Heritage – Generic Version and in the Lower North East region consistent with the guidelines in the Protective Mechanisms for Cultural Heritage – Lower North East. The above guidelines are based on the principles of The Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance) which provides the framework for the protection of cultural heritage sites and places. The Commonwealth acknowledges that the Cultural Heritage Guidelines attached to the IFOA 1999 are consistent with the above guidelines

It is not acceptable for the EPA to now remove cultural heritage from the ambit of the IFOA as it is a requirement of the Regional Forest Agreement. The onground activities of the Forestry Corporation have been found to have significant impacts on sites of cultural and heritage significance, and it is these on-ground operations that need to be appropriately regulated through the IFOA.

7.1. Constraining Grazing to Limit Impacts

It is true that people often can't see the forest for the trees. If you look hard enough beneath the trees you may still be lucky enough to see an understorey with its natural abundance of shrubs, herbs, grasses and large logs, upon which numerous species of invertebrates, mammals, birds, reptiles and frogs depend. Grazing focuses on this understorey. The impacts of grazing are concentrated in the vicinity of streams and wetlands.

Wilson (1990) notes –The grazing lands are home to approximately 50 million sheep and 15 million cattle. They are also grazed by approximately 20 million kangaroos, 0.5 million feral goats and perhaps 100 million wild rabbits. This is a major increase in the intensity of defoliation compared with that 200 years ago. Herbivore numbers were then comparatively low (although more diverse), and controlled more by scarcity of water and predators than by forage supply.”

Cattle directly affect forests by permanently changing the structure and composition of forest ground cover and understorey vegetation (*Hobbs and Hopkins 1990, Wilson 1990, Bennet 1990b, RAC 1992a*); removing nutrients from, and redistributing nutrients within, forests (*Landsberg, Morse and Khanna 1990, RAC 1992a*); assisting the invasion of introduced plants (*Smith and Waterhouse 1988, A.N.P.W.S. 1991*); compacting and degrading soils (*Hobbs and Hopkins 1990, Wilson 1990, A.N.P.W.S. 1991*); degrading stream banks and wetlands (*Debus and Czechura 1988, Hobbs and Hopkins 1990, CWCMA2008*); eliminating regeneration of overstorey trees (*Saunders 1979, Bennet 1990a*); and causing reductions in populations of a variety of mammals, birds and invertebrates by competition for food and shelter while also destroying shelter for other species (e.g. *Jarman 1986, Annon 1988, Wilson 1990, Bennet 1990b, Hobbs and Hopkins 1990, RAC 1992a*).

The Central West Catchment Management Authority's (2008) Best Management Practices for riparian areas highlight some of the impacts of grazing in these particularly vulnerable areas:

The grazing and trampling activities of domestic livestock have had a particularly pervasive influence on riparian habitats. Livestock spend a considerable amount of their time at landwater interfaces as they congregate to drink, access palatable forage and gain refuge from heat. Introduced livestock and inappropriate grazing management are among the most significant causes of chronic modification to land-water interfaces in Australia

...

Grazing impacts on streamside vegetation

The prolonged trampling, rubbing and browsing of riparian lands by stock can physically damage plants and compact the soil. Compaction may reduce soil infiltration rates, increase runoff and decrease water availability to plants as well as reduce germination rates of seeds. The potential of the riparian zone to act as a buffer strip and improve water quality is also decreased⁵, while loss of groundcover allows soil temperature to rise and increases evaporation from the soil surface.

Grazing impacts on soil and streambeds

Loss or modification in composition and biomass of soil-binding vegetation communities, together with the impact from hard-hoofed animals reduces the structural stability of stream banks⁶. This impact results in increased susceptibility to erosive forces and results in higher loads of sediment into waterways. ...

...

Grazing impacts on water quality

Uncontrolled livestock grazing affects water quality in several ways, including:

- *an increase in water temperature due to the loss of streambank vegetation and reduced shade cover,*
- *an increase in turbidity resulting from increased levels of suspended sediments from exacerbated bank erosion and/or elevated inputs from overland flow, and*
- *an increase in nutrient and pathogen levels from soil, overland flows and faeces. Faeces and urine of stock in the riparian zone and waterway directly contributes to phosphorous and nitrogen levels in streams. Cattle have been found to defecate 50 times more per metre of stream crossing than on adjacent raceways.,,,*

...

Grazing impacts on habitat

Livestock in riparian zones can also have significant detrimental effects on instream and bank-side ecology. Elevated nutrient and sediment loads can lead to prolific algal growth, reduced light penetration in the water column and suppression of in-stream processes. Vital habitats can be smothered by deposited fine sediments and disturbed by animals walking in-stream.

Fish and aquatic invertebrate population diversity and assemblages can be indirectly affected by all the impacts to the water quality and loss of habitat as described above. Other organisms affected by uncontrolled grazing in riparian lands include terrestrial birds and freshwater crayfish.

Habitat structure is a major determinant of bird species diversity. Extensive grazing practices can significantly alter the structure and composition of riparian habitat through a combination of trampling, grazing, changes in nutrient fluxes and loss or altered recruitment. Collectively these impacts result in a decline in abundance of riparian birds. Likewise, freshwater crayfish which burrow into riverbanks, are also affected by riparian land uses that impact on soil condition and vegetation cover. In-stream habitat stability

which is conferred by intact riparian vegetation is important in crayfish survivorship. In conjunction with bank instability, soil compaction and larger nutrient loads, significantly fewer crayfish burrows are found in areas of grazed riparian lands than in native forest.

Grazing impacts on flora and fauna become particularly severe in drought periods when native fauna become concentrated into wetter areas along with stock (Hobbs and Hopkins 1990, Recher and Lim 1990). This effect is accentuated by the practice of maintaining excessively high stocking rates at the onset of droughts (Hobbs and Hopkins 1990).

The principle management tool used by graziers in forests is fire. Most like to burn the forest frequently (often every 1-3 years) to promote fresh green pick for their cattle.

The consequences of the combination of grazing and frequent fires on our biodiversity are profound. Together they have been responsible for the elimination of numerous species from vast tracts of our native forests, some being wiped from the face of the planet. Many of our most threatened plant and animal species survive only in or near refuges from frequent fires and cattle.

State Forests have long complained that, aside from them, *“Fire has been the most destructive agency”* in the forest, and that *“Most fires result from uncontrolled or unauthorised (often illegal) burning off by pastoralists during the spring”* (ie Dorriga Management Plan, 1985). Their commercial concern is this burning is causing *“the death of regeneration and large trees, loss of increment due to total or partial crown removal and butt and bole damage to crop trees causing increased defect”* (ie Urbenville Management Plan 1986).

It is not just the commercial potential that is being degraded. As noted in the Fauna Impact Statement prepared by Austeco (1992) for State Forests’ Glen Innes EIS;

“Frequent burning suppresses the shrub component of the forest and greatly reduces floristic diversity in the ground cover and midstorey layers (Binns 1991). The decrease in floristic diversity and the simplification of forest structure caused by fire, in turn causes changes in the faunal species composition of the forest. In all the major faunal groups studied, Birds, Reptiles and Mammals, some species were found to be advantaged and others disadvantaged by grazing and burning. However, more species were disadvantaged than advantaged by grazing and burning, and those benefiting were predominantly common species of low conservation significance. In order to secure the future of species that are disadvantaged by frequent burning and grazing, it will be necessary to maintain some areas of hardwood forest free of grazing, and subject to infrequent fire regimes.”

Frequent low intensity fires (prescribed burns) have been noted to eliminate the shrub layer and allow grasses and ferns to dominate the understorey (Gill 1975, McIlroy 1978, Catling 1991); cause a loss of obligate seed-regenerating plants if they don’t have enough time between fires to set seed (Gill 1975, Floyd 1976, Ashton 1981, Noble and Slatyer 1981, Lamb 1986); increase the risk of fire by enhancing more inflammable species (Floyd 1964, Gill 1975, Noble and Slatyer 1981, Hopkins 1981); promote weeds (Floyd 1964) and destroy eucalypt regeneration (Floyd 1964).

Floyd (1964) notes that in northern NSW the succulent kangaroo grass has been replaced due to fire (mostly instigated by graziers) by the tough and largely unpalatable bladey grass and

whisky grass, concluding that *–Perhaps the grazier is merely an unwitting slave to the fire over which he claims mastery.*”

Species of small ground mammals exhibit a replacement sequence in reaching maximum abundance following fire, variously species may reach maximum abundance after one to eight years, with populations of some species found to be still increasing after six to eight years and even after 30 years (*Fox and McKay 1981, Wilson et al. 1990*). Populations of some species may be eliminated by fire (*Wilson et al. 1990, Townley 1996*) and others may not establish populations in burnt areas for many years (*Fox and McKay 1981, Lunney, Cullis and Eby 1987, Wilson et al. 1990*).

Fire results in the loss of shrubs, and the invertebrates, nectar, nest sites and shelter from predators they provide for birds (*Cowley 1971, Recher, Allen and Gowing 1985, Recher 1991*), and the loss of woody material and litter, and the invertebrates and nest materials they supply (*Recher 1991*). Recher, Allen and Gowing (1985) found that following a wildfire the density of birds in unlogged forest was reduced to averages of 38-54% of unburnt stands and numbers of species to 71-86%. Reptiles are affected by loss of logs and litter by burning (*Dunning and Smith 1986*).

While populations of some species may recover in parallel with the rate of post-fire revegetation (*Recher, Allen and Gowing 1985, Recher 1991*) it is considered that frequent burning can result in degraded habitat and the loss of habitat components upon which species rely (*Cowley 1971, McIlroy 1978, Leigh and Holgate 1979, Saunders 1979, Rohan-Jones 1981, Mackowski 1987, Debus and Czechura 1988, Moon 1990, Wilson et al. 1990, Winter 1991, Catling 1991*).

As noted by Catling (1991): *“For the long-term survival of our forest fauna, managers must begin to question the frequent use of low-intensity prescribed fires, particularly the aerial ignition of large tracts of forest as a prescribed burning technique, because it creates large tracts of simplified forest habitat detrimental for most native fauna.”*

Burning has been shown to affect forest soils by releasing large quantities of nutrients in smoke to be deposited elsewhere on land or in the sea (*Harwood and Jackson 1975, Raison 1980, Stewart and Flinn 1985, Stewart et. al. 1989, Sims 1991*), significantly changing soil chemistry, structure and functioning (*Floyd 1964, Langford and O’Shaughnessy 1977, Raison 1980, Leitch, Flinn and van de Graaff 1983, Stewart and Flinn 1985, Sims 1991*), and exposing the soil to loss of large quantities of nutrients by wind and water transport of ashes and organic matter (*Floyd 1964, Good 1973, Raison 1980, Langford and O’Shaughnessy, 1977, Leitch, Flinn and van de Graaff 1983, Atkinson 1984*).

As Ashton (1981) points out, *–the fertility of soils is likely to be depleted in areas of high rainfall subjected to repeated burning. In terms of ecosystem potential it is a downward spiral.*”

The Resource Assessment Commission (1992a) concluded *–Given the evidence for serious impacts on the forest environment from grazing of domestic stock and the inherent difficulties of enforcing codes, forest management agencies should review whether the marginal benefits are worth the environmental risks.*”

The impacts of grazing on the natural environment and the economics of grazing on public lands were considered in the Comprehensive Regional Assessment.

According to the 1998 CRA "Report on the Profile and Economic Evaluation of Grazing in State Forests" there were then 385,300ha of State forests in the UNE and 140,670ha of State forests in the LNE licenced for grazing in various forms, with licences lasting for periods from 10 weeks to perpetuity. The State Forests" based cattle industry across both regions was estimated to generate a total net profit of \$826,000 to producers and result in the equivalent of nine and a half full time jobs.

The environmental impacts of grazing were considered in the expert workshops. For priority fauna species in north-east NSW the expert panels assessed threats to priority fauna species (Environment Australia 1999), finding grazing is a serious threat to 58% of species, and a primary threat to 22% of species.

The flora expert panel unanimously agreed the main threats to plant biodiversity in northeastern New South Wales were land clearing, inappropriate fire regime, weeds (and forest hygiene in general) and grazing (Environment Australia 1999). One of their recommendations was:

Exclude cattle (and feral grazing generally) from State Forest and National Parks areas or at least limit the area adversely affected by this threatening process.

The Integrated Forestry Operations Approval (33 (1)), along with the terms of the Threatened Species Licence (TSL) and Fisheries Licence, require Forestry Corporation to prepare grazing management plans with specified strategies to control any adverse impacts on the environment. A model plan was due to be submitted to DUAP by 30 June 2000, with grazing management plans covering the whole of the region within 6 months of the model plan being approved. It is unknown how many of these plans have been prepared, one hadn't for Yabbra State Forest in 2010 though the EPA didn't appear to care.

The TSL condition 5.15 requires that *–The areal extent of grazing authorities issued by SFNSW must not be extended*". Grazing is also required to be excluded from wetlands under TSL condition 5.9. The Fisheries Licence condition 6.1c requires that

The areal extent of grazing authorities issued by SFNSW must not be extended in any compartment where there is no physical barrier to prevent cattle from entering exclusion zones and buffer zones implemented under the conditions of this licence,

The EPA needs to recognise that grazing has significant impacts on streams, vegetation, threatened plants and the habitat of many native animals. Instead of removing grazing from the ambit of the IFOA the EPA should ensure that existing requirements to prepare grazing management plans are honoured (better late than never), ensure that existing requirements for no expansion of grazing on public lands are maintained, and that grazing is excluded from riparian areas and wetlands.

8. Forest Regulation.

The EPA's stated intent for their new outcomes-based regulation *involves moving away from a reliance on detailed and prescriptive rules towards more high-level, broadly-stated principles* with the primary intent to *reduce the prescriptive nature of licence conditions*. They have said there will be a tiered approach with many current prescriptions made into best practice guidelines, (ie many EPL prescriptions, designs for stream crossings, surveys for species) which the Forestry Corporation will write, be able to vary and which will not be enforceable (and which the EPA will thus ignore). Above these there will be protocols and licence conditions which are claimed to be legally enforceable, though their intent is to have few of these. Protocols relate to prescribed methods of doing things (ie assessing soil erodibility) and licence conditions to enforceable actions. These enforceable conditions will no longer be part of the IFOA and RFA in order to make them easier to later weaken.

The EPA's description of problems with the current licence is misleading and dishonest. Since the current IFOA licences were issued in 1998 the EPA (including in their previous incarnations as part of NPWS/DECCW) have overseen major slashing of the prescriptions, thus creating most of the problems the EPA is now complaining about. The EPA has had years to rectify the wording problems with prescriptions they now complain about, though with the exception of a failed attempt to clarify the wording and intent of the habitat tree retention prescription, the only thing they have done is weaken prescriptions and remove protections for threatened species.

For example the EPA complain that *Some of the duplicated conditions are also inconsistent and can result in confusion during implementation and regulation. For example, the EPL, TSL and FL currently have different requirements for the protection of the same drainage features and wetlands*. Yet the major discrepancy between these is the removal of the requirement to mark exclusion boundaries on the ground from the Fisheries Licence (FL), a change recently made by the EPA. The other major discrepancy is that both the Fisheries Licence and the Environment Protection Licence (EPL) require the establishment of exclusion zones on unmapped streams.

The Environment Protection Licence was amended in 2004 to have the effect of excluding "non-scheduled" forestry operations from requiring licences, primarily to remove a need to place exclusion zones on unmapped streams. Now over 90% (often over 97%) of the Forestry Corporation's logging operations are no longer subject to EPLs and thus they are not legally bound to apply exclusion zones on unmapped streams. The problem for them is that NEFA have repeatedly caught them out routinely logging unmapped streams that the Fisheries Licence applied to and thus still required to be protected.

Their complaints about the enforceability of some prescriptions is the result of the EPA's acceptance of the Forestry Corporation's deliberate subversion of the intent of many prescriptions on the basis that they will only enforce clear and unambiguous prescriptions, and their refusal to fix wording problems or at least issue interpretation guidelines.

It is outrageous that the EPA are now claiming that part of the current problem is that many prescriptions are not prescriptive enough as they make *reference to actions that should be implemented to the greatest extent practicable*, when the EPA's intent is to make most current prescriptions even weaker as best practice guidelines that the Forestry Corporation can write themselves and ignore at their whim. Given that the EPA currently picks and chooses which

prescriptions it will implement and have repeatedly told us that they will only enforce prescriptions that are clearly legally enforceable, it is apparent that their intent is to do nothing about ensuring compliance with best practice guidelines and other unenforceable requirements.

The EPA's hypocrisy is also evident by their claims that there will be no change to current timber commitments to industry because the current commitments "*ensure that volume removal does not exceed sustainable levels*". This is widely acknowledged to be patently false as timber is grossly over-committed from north-east NSW and there is a timber supply crisis (ie Legislative Council Inquiry into the Management of public land in New South Wales).

Despite often unambiguous wording the EPA is partially justifying their removal of forest products operations, grazing activities, beekeeping activities, and weed and pest control activities from regulation on the grounds that the ~~EPA~~ *has had no regulatory focus on [these activities] over the past 5 years*". It is not that some of these have not been the subject of complaints, but rather that the EPA refused to deal with these activities, and now want to dump regulation of these activities because they still have no intent to deal with them..

The chief argument for slashing prescriptions, removing the need for (most) surveys and pre-logging mark-up is to save money. The EPA claim that some of the savings will go into monitoring, apparently by the Forestry Corporation, though the appalling track record of both agencies on this and the Forestry Corporations long history of tailoring their "research" to reduce prescriptions, does not give any hope, even if some funding is available, that any meaningful results will be obtained.

It is not believed that any of the set flora or fauna prescriptions have been subject to monitoring to assess their effectiveness, though this does not stop the Forestry Corporation claiming otherwise. In relation to biodiversity Forests NSW (2005) ESFM Plan notes:

Forests NSW will use adaptive management principles and actions within State forests to complement the management of the CAR reserve system.

...

During operations, site specific conditions are continually assessed, results recorded, the appropriateness of operational conditions reviewed and plans amended where necessary.

We have come across no evidence of this, quite to the contrary we are concerned that Forestry Corporation does not learn from their mistakes. We are most concerned that neither the EPA nor Forestry Corporation have bothered to assess the effectiveness of prescriptions over the past 15 years and improve them accordingly. Rather than applying adaptive management as a routine practice we find that Forestry Corporation use it as an occasional excuse to log somewhere they shouldn't.

There are a few prescriptions that actually already require monitoring and adaptive management. In Wedding Bells SF (Pugh 2011b) NEFA found that Forestry Corporation were still logging habitat of the threatened plants Rusty Plum *Amorphospermum whitei*, now called *Niemeyera whiteii*, and Milky Silkpod *Parsonsia dorrigoensis* under 2000 prescriptions for these species that were effectively meant to be 2 year monitoring programs. They clearly state that logging where these species occur is expected to kill a number of individuals and that therefore monitoring will be undertaken for 2 years to ascertain the numbers killed and their regeneration ability. It states that results are required to be reviewed after 2 years at which time a new prescription was meant to be applied. While Forestry Corporation were still logging under this

two-year monitoring program they did not submit their first monitoring report on Rusty Plum to the EPA until 2008 and on Milky Silkpod until 2009.

After we forced the EPA to justify why these species were being killed in the logging, the EPA (2012) decided they were not happy that the monitoring was of representative operations and for both species *–is currently reviewing the results ... with the objective to negotiate for either further monitoring or prescribed conditions during harvesting or other relevant action”.*

As far as we know these species have since been ignored and logging continues without either agency reviewing the prescriptions. It is shameful that logging is still occurring 13 years after the two year monitoring plan was meant to have been completed and a final prescription adopted. This is “scientific logging” – logging under a monitoring program that is still incomplete and a prescription that has never been reviewed. This is what the agencies term “adaptive management” and what we can expect from their future monitoring.

Allowing the Forestry Corporation to undertake their own environmental assessments has been a costly failure. There is a need to separate the environmental requirements from the commercial objectives of the Forestry Corporation. One way of achieving this is to task a separate body with undertaking the required flora and fauna surveys and mapping areas required for exclusion or modified harvesting before logging. Regulatory and audit functions could still be undertaken by the EPA, though there need to display more professionalism and independence.

Evidence is presented throughout this submission of routine and repeated breaches of the Forestry Corporation’s legal requirements. These stretch back decades and continue today. As part of her consideration of Forestry Corporations legal record, NSW Justice Pepper (2011) of the NSW Land and Environment Court commented:

However, in my view, the number of convictions suggests either a pattern of continuing disobedience in respect of environmental laws generally or, at the very least, a cavalier attitude to compliance with such laws.

... Given the number of offences the Forestry Commission has been convicted of and in light of the additional enforcement notices issued against it, I find that the Forestry Commission's conduct does manifest a reckless attitude towards compliance with its environmental obligations ...

There had been a regulatory failure on behalf of the EPA to redress the frequent and repeated flouting of NSW’s environmental laws by the Forestry Corporation. They are a failed regulator. Their current proposal to reduce regulation will compound existing problems and significantly worsen outcomes.

Stronger deterrents and more effective regulation are required to stop the Forestry Corporation from routinely causing environmental harm. The EPA needs to recognise that, for Forestry Corporation to implement them, and EPA to enforce them, logging prescriptions need to be made clearer, unambiguous, capable of auditing, and clearly enforceable. The penalties applied to breaches of

the Threatened Species Licence are not commensurate with the environmental harm caused and are grossly inadequate to act as a deterrent. To be effective penalties need to be increased to reflect the gravity of the offence. There is also a need to require active rehabilitation of illegally logged areas and protection of compensatory habitat.

URS (2008) consider:

Public sector reforms across Australia over the past two decades have recognised that separating policy and regulation from operations provides greater clarity in objectives for each function of government and improved performance. ...

Governments manage native forests for multiple objectives. They manage them to protect a range of environmental and biodiversity values as well as for commercial wood production. Separation of the environmental from the commercial objectives is fundamental to sustainable multiple-use management. So too is separation of regulatory and audit functions from the bodies being regulated and audited.

URS (2008) state:

A lack of separation between environmental, governance and commercial management can result in a lack of transparency and accountability. For example, it may be in the short to medium term interests of a commercial forest manager to increase harvest volumes above long-term sustainable yields to maximise profit. To offset this incentive, checks and balances should be in place to ensure that harvest volumes are indeed sustainable and do not compromise environmental objectives (outside the domain of the forest entity).

In Victoria, for example, DSE determines the sustainable yield while VicForests is responsible for the harvest and commercial sale of timber. The environmental aspects of commercial operations of these agencies are externally regulated through the EPA, which undertakes annual audits of compliance with relevant legislation. The situation is similar in Queensland where operational and governance/auditing activities are undertaken by separate government agencies. However in other states, there is less separation of commercial operations from the regulation and governance function. This is most notable in NSW, where Forests NSW sets sustainable harvest levels and also carries out commercial operations on public land, and is not subject to external audit against relevant legislation and regulation.

Despite our concerns with the reluctance of EPA to be strong and effective regulators we consider that there is a need for increased separation of policy and regulation from Forestry Corporation's operations. The performance of the EPA will be greatly enhanced by clarifying the clauses of the TSL and other regulatory instruments to ensure that the intent is clearly reflected in licence conditions. Though most importantly third party rights to enforce prescriptions need to be restored.

It is suggested that the IFOA review consider the issue of public forest management arrangements and recommend further separation of policy and regulation from forestry operations. It would be far more efficient and effective for the threatened species assessments to be undertaken by a

separate body. Any such system would be enhanced by allowing members of the public third party appeal rights.

The EPA propose that legislation be introduced to enable a framework for minimum competencies for forest contractors to be developed to make them more responsible for meeting relevant regulatory requirements. This appears to be an attempt by the Forestry Corporation to divest themselves of some (all?) legal responsibility.

In response to efforts by the Forestry Corporation to shift responsibility for a breach onto the contractor in Nullum SF, Sheahan J (1997) commented

The EPA also submitted in evidence a record of interview with Mr Graeme King, general manager of the Northern Region who admits that the person responsible for the offence did not sign off on a harvesting plan, when attending a training day on the new conditions, allegedly because the conditions were too difficult to understand.

I do not place a great deal of weight on this evidence. It is unacceptable for the Forestry Commission to have not informed its employees and contractors of the licence conditions in place, but there is evidence before the Court that an attempt was made to inform, and the confusion that may have existed cannot be said to flow from any flagrant disregard for the conditions in force.

The current IFOA ensures that the Forestry Corporation are held responsible for activities undertaken on land that they manage:

43. SFNSW to ensure compliance by certain persons

(1) SFNSW must expressly require as a condition of any licence, permit or other authority that it issues or grants under the Forestry Act 1916, authorising the carrying out of forestry operations, that the holder of the licence, permit or authority comply with the applicable terms of this approval.

Note: The purposes of the above condition are:

- to promote awareness among holders of authorities under the Forestry Act 1916 of their responsibilities under this approval; and*
- to ensure that, by including relevant express conditions in authorities, SFNSW is effectively able to enforce compliance with this approval under the Forestry Act 1916.*

Section 26(2) of the Forestry and National Park Estate Act 1998 requires that all persons carrying out forestry operations to which this approval applies comply with its terms. This means that even holders of authorities which are issued or granted under the Forestry Act 1916 prior to the granting of this approval must comply with the terms of this approval.

(2) SFNSW must include a condition in such an authority that, where there is an inconsistency between the authority and the approval, the approval prevails.

(3) SFNSW must take all reasonably practicable steps to ensure that in so far as they are authorised by SFNSW to carry out forestry operations, the following persons comply with the applicable terms of this approval:

- (a) officers, employees and other persons referred to in section 10 of the Forestry Act 1916;*
- (b) contractors, subcontractors and agents of SFNSW;*
- (c) licence holders under the Forestry Act 1916;*
- (d) permit holders under the Forestry Act 1916; and*
- (e) other persons authorised under the Forestry Act 1916.*

(4) For the purposes of subclause (3), SFNSW must:

- (a) ensure that the persons referred to in subclause (3) are provided with sufficient information about, and training in, their responsibilities under this approval;*
- (b) ensure that the persons referred to in subclause (3) are adequately supervised when carrying out forestry operations, or that the carrying out of forestry operations is monitored, and that particulars of these supervisory or monitoring arrangements are recorded;*
- (c) ensure that particulars of non-compliance with this approval that come to the attention of SFNSW (including persons engaged to supervise or monitor operations under paragraph (b)) are recorded;*
- (d) ensure that measures taken to address instances of non-compliance (referred to in paragraph (c)) are recorded; and*
- (e) take such other measures as may be necessary to ensure that its obligations under subclause (3) are fulfilled.*

The TSL also clearly establishes the Forestry Corporation as the responsible agency:

2.1 General

- f) SFNSW must ensure that a SFNSW employee is present at each compartment while harvesting operations are occurring under this licence for the purposes of ensuring compliance with this licence, for at least the equivalent of one full working day per week per harvesting operation.*

It is already open to the Forestry Corporation to take action against contractors for not complying with the conditions of the IFOA, licence requirements and Harvesting Plans through their contracts, though they rarely do. Contracting companies can simply go bust to avoid any penalties. It is essential that the Forestry Corporation remain responsible for breaches committed under their supervision if there is an intent to improve supervision of forestry operations.

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10. Appendix 1

Appendix 4 from Environment Australia (1999) Response to Disturbance of Forest Species in CRA Regions in NSW- Upper North East and Lower North East Regions.

10.1.1. Disturbances identified for Arboreal Mammals and their impacts ranked relative to each other.

Species	Disturbance	Rank	Comments
Koala	Habitat clearing	1	
	Introduced predator- foxes and dogs	2	
	Wildfire	4	
	Disease	6	
	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive)	3	Logging that fails to retain stems in the 30-80 DBH size class
	Roadkills	5	
Squirrel Glider	Habitat clearing	1	
	High frequency burning	2	
	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive)	3	Removal of large trees and hollows, includes firewood collection
	Apiary- competition for hollows	4	
	Introduced predator- foxes, dogs and cats	5	
Yellow-bellied Glider	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive)	1	Logging that fails to retain a high proportion of large trees and hollows
	High frequency burning	3	
	Habitat clearing	2	
Greater Glider	High frequency burning	2	
	Intensive logging that removes the critical tree size classes from the stand (may be frequent or single and intensive)	1	Logging that fails to retain a high proportion of large trees and hollows
Eastern Pygmy-possum	High frequency burning	1	
	Habitat clearing	2	

10.1.2. Disturbances identified for Bats and their impacts ranked relative to each other.

Species	Disturbance	Rank	Comments
Nyctimene robinsoni	Clearing	1	esp rainforest
	Logging of wet sclerophyll	2	of wet sclerophyll

Species	Disturbance	Rank	Comments
	Wildfire	5	
	Regeneration burn	5	regeneration
	Fragmentation	3	predation (owls)
	Weed invasion	3	lantana and others
	Dams	5	
	Roading	5	
	Barbed wire fences	4	
	Roadkills	5	
	Climate change	5	
	Altered hydrology/microclimate - oldgrowth-regrowth	3	
Pteropus alecto	Shooting	3	
	disease	5	lyssavirus
	Powerlines	3	
	Direct disturbance to camps	2	proximity to humans
	Clearing - habitat loss	1	
	Clearing resulting in fragmentation	4	
	Logging of sclerophyll	3	of sclerophyll - loss of older trees
	Wildfire	4	
	Apiary	5	competition for nectar
	Barbed wire fences	5	
	Climate change	6	
	Weed invasion	4	
	Drainage of swamps	2	
	management burns	3	
Syconycteris australis	Clearing resulting in fragmentation	2	increased predation, decreased food
	Clearing - habitat loss	1	
	Logging of sclerophyll	3	coastal sclerophyll with banksia understorey
	Wildfire	2	
	Apiary	2	
	Barbed wire fences	5	
	management burns, including illegal	1	
	Weed invasion	2	
	weed spraying	3	Aerial spraying of bitou bush
	Drainage of swamps	2	
	mining - sand	2	
	Recreational 4WD	4	Sand dune disturbance
	introduced predators	5	
Pteropus poliocephalus	Shooting	3	
	Powerlines	3	
	Direct disturbance to camps	2	
	Clearing - habitat loss	1	
	Clearing resulting in fragmentation	4	

Species	Disturbance	Rank	Comments
	Logging of sclerophyll	3	
	disease	5	lyssavirus
	Wildfire	4	
	Apiary	5	
	Barbed wire fences	5	
	Climate change	6	
	Weed invasion	5	less restricted to rainforest remnants than P. alecto
	Drainage of swamps	2	
	management burns	3	
Kerivoula papuensis	Clearing resulting in fragmentation	2	
	Clearing - habitat loss	1	esp rainforest
	Logging - loss of hollows	2	
	Logging - loss of understorey	2	
	Wildfire	3	
	Weed invasion	3	
	weed spraying	4	
	introduced predators	4	
	grazing	2	
	dams	4	
	Roadkills	4	
	Frequent burning	1	
	Altered hydrology/microclimate - oldgrowth-regrowth	3	
Chalinolobus nigrogriseus	Clearing - habitat loss	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows & oldgrowth	2	
	Logging - loss of understorey complexity	4	
	Frequent burning	4	
	Grazing	4	
	Wildfire	5	
	Pesticides	5	
	mining – sand	5	
Myotis adversus	Altered hydrol old-regrowth - altered flow	3	
	Altered hydrol old-regrowth – sedimentation	3	
	Clearing - habitat loss	1	riparian vegetation
	Use of chemicals	2	
	Clearing – fragmentation	1	
	Logging - loss of hollows	4	
	Bridge removal	3	
	Frequent burning	4	
	Recreational activities	5	fly fishing, boating

Species	Disturbance	Rank	Comments
	Eutrophication	3	from agriculture, grazing and sewage
	Weeds	5	
	grazing	2	
	dams	3	
	Use of chemicals	2	mosquito control, pesticides
	fish	6	trout
Mormopterus beccarii	Clearing - loss of habitat	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows	1	
	Logging - loss of understorey complexity	5	
	Wildfire	5	
	Frequent burning	3	impact on invertebrates
	Pesticides	3	
	grazing	3	
Vespadelus troungtoni	Clearing - habitat loss	3	
	Clearing - fragmentation	4	
	Frequent burning	3	
	grazing	3	
	Wildfire	4	
	Pesticides	4	
	Recreational activities	2	That disturb caves
	Disturbance to camps/ caves	4	
	introduced predators	5	
	logging - loss of foraging habitat	3	
Miniopterus australis	Clearing - habitat loss	1	
	Clearing - fragmentation	3	
	logging - loss of foraging habitat	3	
	logging - loss of hollows	5	
	Frequent burning	3	
	grazing	4	
	Wildfire	4	
	Pesticides	4	
	Disturbance to camps/ caves	2	By limestone mining (cave collapse, altered air flow, noise, dust etc) and recreational activities
	introduced predators	5	
	Altered hydrology/microclimate - oldgrowth-regrowth	3	
	mining - sand	5	
Chalinolobus dwyeri	Clearing - habitat loss	3	
	Clearing - fragmentation	3	
	Frequent burning	2	
	grazing	2	
	Wildfire	2	

Species	Disturbance	Rank	Comments
	Pesticides	3	
	Recreational activities	2	That disturb caves
	Disturbance to camps/ caves	1	Disturbance to caves - collapse due to mining
	introduced predators	3	
	logging - loss of foraging habitat	3	
Vespadelus pumilus	Clearing - habitat loss	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows & oldgrowth	2	
	Logging - loss of understorey	3	
	Frequent burning	3	
	Weed invasion	4	
	grazing	3	
	weed spraying	5	
	Wildfire	4	
	Altered hydrology/microclimate - oldgrowth-regrowth	3	
Rhinolophus megaphyllus	Clearing - habitat loss	1	
	Clearing - fragmentation	2	
	logging - loss of foraging habitat	3	
	logging - loss of hollows	5	
	Frequent burning	4	
	grazing	5	
	Wildfire	4	
	Pesticides	5	
	Disturbance to camps/ caves	3	
	introduced predators	4	
	Altered hydrology/microclimate - oldgrowth-regrowth	3	
Saccolaimus flaviventris	Clearing - habitat loss	2	
	Logging - loss of hollows & oldgrowth	1	
	Frequent burning	3	
	grazing	3	
	disease	5	lyssavirus
	Barbed wire	5	
	Pesticides	4	
Nyctophilus timoriensis	Clearing - loss of habitat	1	
	Clearing - fragmentation	2	
	Logging - loss of hollows	1	
	Logging - loss of understorey complexity	2	
	Wildfire	3	
	Frequent burning	3	

Species	Disturbance	Rank	Comments
	Pesticides	3	
	grazing	2	
	mining - coal	3	
	introduced predators	4	
Nyctophilus bifax	Clearing - habitat loss	1	
	Clearing - fragmentation	2	
	Logging - loss of hollows	4	
	Logging - loss of understorey	3	
	Frequent burning	3	
	Weed invasion	4	
	grazing	3	
	dams	5	
	mining - sand	3	
	weed spraying	4	
	Wildfire	5	
	Roadkills	5	
Scotorepens orion	Clearing - habitat loss	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows & oldgrowth	2	
	Logging - loss of understorey	4	
	Frequent burning	4	
	Pesticides	4	
	grazing	4	
	Wildfire	5	
	Altered hydrology/microclimate - oldgrowth-regrowth	5	
Falsistrellus tasmaniensis	Clearing - habitat loss	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows & oldgrowth	1	
	Logging - loss of understorey	3	
	Frequent burning	3	
	Weed invasion	4	
	grazing	3	
	Wildfire	4	
	Altered hydrology/microclimate - oldgrowth-regrowth	4	
	Climate change	2	
Scotoeanax rueppellii	Clearing - habitat loss	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows & oldgrowth	1	
	Logging - loss of understorey	3	
	Frequent burning	3	
	Weed invasion	4	
	grazing	3	

Species	Disturbance	Rank	Comments
	Wildfire	4	
	Altered hydrology/microclimate - oldgrowth-regrowth	4	
	Barbed wire	4	
Miniopterus schreibersii	Clearing - habitat loss	1	
	Clearing - fragmentation	4	
	logging - loss of foraging habitat	4	
	logging - loss of hollows	5	
	Frequent burning	4	
	grazing	5	
	Wildfire	5	
	Pesticides	3	
	Disturbance to camps/ caves	2	
	introduced predators	5	
	Altered hydrology/microclimate - oldgrowth-regrowth	3	
Scotorepens balstoni	Clearing - loss of habitat	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows	2	
	Logging - loss of understorey	4	
	Pesticides	3	
	grazing	4	
	mining - coal	2	
	Barbed wire	5	
Scotorepens greyii	Clearing - loss of habitat	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows	2	
	Logging - loss of understorey	4	
	Pesticides	4	
	grazing	4	
	Frequent burning	5	
	mining - sand	3	
	Altered hydrology/microclimate - oldgrowth-regrowth	5	
Mormopterus norfolkensis	Clearing - loss of habitat	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows	1	
	Wildfire	5	
	Pesticides	3	
	Logging - loss of understorey	4	
	grazing	3	
Mormopterus planiceps	Clearing - loss of habitat	1	

Species	Disturbance	Rank	Comments
	Clearing - fragmentation	5	
	Logging - loss of hollows	2	
	Logging - loss of understorey	4	
	Pesticides	3	
	grazing	4	
	mining - coal	2	
	Barbed wire	5	
Nyctinomus australis	Clearing - loss of habitat	2	
	Logging - loss of hollows	1	
	Wildfire	5	
	Frequent burning	3	
	Pesticides	3	
	grazing	4	
	Barbed wire	5	
Mormopterus sp 1	Clearing - loss of habitat	1	Coastal
	Logging - loss of hollows	2	
	Pesticides	3	
	Logging - loss of understorey	4	
	grazing	4	
	Wildfire	5	
Scotorepens sp 1	Clearing - loss of habitat	1	
	Clearing - fragmentation	3	
	Logging - loss of hollows	2	
	Logging - loss of understorey	4	
	Pesticides	4	
	grazing	4	
	Frequent burning	5	
	mining - sand	3	
	Altered hydrology/microclimate - oldgrowth-regrowth	5	

10.1.3. Disturbances identified for Diurnal Birds and their impacts ranked relative to each other

Species	Disturbance Description	Rank	Comments
Double-eyed Fig-parrot	Clearing for agriculture	1	
	Urban development	2	
	intensive horticulture	3	
	weed invasion	4	in lowland remnants (exotic vines)
	logging	5	eucalypt adjacent to lowlands - subtropical and dry rainforest
Black-throated Finch	Grazing and associated burning	1	.
	Pasture improvement and cropping	1	
	Predation by exotics	2	

Species	Disturbance Description	Rank	Comments
	Illegal trapping	2	
	Introduced herbivores	2	
	Clearing for agriculture	1	
Red Goshawk	Clearing for agriculture	1	
	Drainage of swamps	3	lowers densities of waterbirds (prey)
	egg collecting	8	
	Urban development	2	
	logging	4	
	intensive horticulture	3	
	agricultural chemical use	6	
	weed invasion	7	
	changed fire regimes	5	
Regent Honeyeater	Clearing for agriculture	1	
	grazing	5	
	Urban development	2	
	firewood collection	3	
	logging that reduces age classes	3	reduced age class, decreased nectar
	changed fire regimes	4	
	apiary	5	
	native predators	4	nest predation by birds
Black-breasted Button-quail	Clearing for agriculture	1	
	grazing	3	by cattle and macropods
	weed invasion	4	in lowland remnants by exotic vines
	any logging	3	alters microclimate and removes shelter
	introduced predators	4	
	high frequency burning	2	
Swift Parrot	Clearing for agriculture	1	
	mining coastal sands	3	
	Urban development	2	
	grazing and associated burning	2	
	intensive horticulture	3	
	logging that reduces size class of trees	2	
	firewood collection	2	
Black-necked Stork	Drainage of wetlands	1	
	Dams	1	
	Pesticide contamination of wetlands	3	
	Powerlines	2	
	Intensive horticulture	2	Tea trees
	Urban development	3	
	Loss of nest trees	3	
	Shooting	4	
Wompoo Fruit-dove	Urban development	2	
	Clearing for agriculture	1	

Species	Disturbance Description	Rank	Comments
	weed invasion	2	In lowland remnants
	logging that reduces size class of trees	1 (2 JS)	Of fleshy fruit trees in wet sclerophyll forest
	loss of habitat trees in agric land	2	loss of fig trees
	intensive horticulture	3	
Rufous Scrub-bird	logging	2	that alters microclimate and litter dynamics - of wet sclerophyll
	climate change	1	
	Clearing for agriculture	3	
	exotic predators	3	cats
	management burns	2	
Albert's Lyrebird	exotic predators	4	
	management burns	3	
	logging	3	that alters microclimate and litter dynamics
	climate change	2	
	clearing resulting in fragmentation	1	
	roadkills	4	
	weed invasion	2	by lantana following logging of wet sclerophyll on higher nutrient sites
Eastern Bristlebird	Grazing and associated burning	1	
	Predation by exotics	2	
	Clearing for agriculture	1	
	Climate change	2	
	Altered fire regimes	1	
Varied Triller	Clearing for agriculture	1	
	Urban development	1	
Square-tailed Kite	Clearing for agriculture	1	
	grazing and associated burning	2	
	egg collecting	4	
	logging	2 (3 JS)	increases structural density through reducing age classes, decreased nectar prod.
	intensive horticulture	2	
	Urban development	3	
	nest site loss	2	
	firewood collection	3	
Black Bittern	Clearing for agriculture	1	
	Pollutants	2	Pollutants
	Urban development	1	
	Grazing	1	Cattle grazing and damage to riparian areas
	Diversion of irrigation water	1	Reduces stream flow
Red-tailed Black-Cockatoo	Grazing and associated burning	2	

Species	Disturbance Description	Rank	Comments
	Clearing for agriculture	1	
	Intensive horticulture	1	
	Urban development	1	
	Logging	2	loss of large, old, dead trees
Osprey	Drainage of wetlands	1	
	Chemical pollutants	1	
	Urban development	1	
	Loss of nest sites	1	
	Commercial fishing	1	Removal of mullet, loss of food
Barred Cuckoo-shrike	Clearing for agriculture	1	and plantations
	Urban development	1	
	weed invasion	1	
	loss of habitat trees in agric land	1	fig trees
	intensive horticulture	1	
Painted Honeyeater			
	Grazing and associated burning	2	
	Clearing for agriculture	1	
	Pasture improvement and cropping	2	
	Apiary	3	
	Firewood collecting	2	
	logging	2	Yellowbox forest only
Rose-crowned Fruit-dove	Clearing for agriculture	1	
	Urban development	1	
	weed invasion	1	
	logging that reduces age classes	2	of mesomorphic midstorey
	loss of habitat trees in agric land	1	
	intensive horticulture	1	
Glossy Black-Cockatoo	Clearing for agriculture	1	
	grazing and associated burning	1	
	Urban development	1	
	logging that reduces age classes	1 (DM,S G) 2 (HR,JS)	of eucalypts and allocasuarina
	Cats	3	climbing into nests
	firewood collection	3	
Paradise Riflebird	clearing resulting in fragmentation	2 (1 JS)	
	logging that reduces age classes	1	
	management burns	3 (1 JS)	
Collared Kingfisher	Chemical pollutants	2	
	Urban development	1	
	Increased sedimentation	2	
Superb Fruit-dove	Clearing for agriculture	1	

Species	Disturbance Description	Rank	Comments
	Urban development	1	
	weed invasion	1	
	logging that reduces age classes	2	of mesomorphic midstorey
	loss of habitat trees in agric land	1	
	intensive horticulture	1	
Regent Bowerbird	Logging	1	Logging that affects fruit lower strata
	Logging	2	Logging that affects fruit lower strata
	Clearing for agriculture	2	
	Urban development	1	
	Intensive horticulture	2	
	Weeds	1	In remnants and gallery strips
Brahminy Kite	Drainage of wetlands	1	
	Chemical pollutants	1	
	Urban development	1	
	Loss of nest sites	1	
Olive Whistler	climate change	1	
	Cats	2	
	management burns	2	
	clearing resulting in fragmentation	2	
	logging	3	immediate response only
White-eared Monarch	intensive horticulture	3	
	clearing resulting in fragmentation	1	
	Urban development	2	and rural residential
	weed invasion	2	of remnants
Turquoise Parrot	grazing and associated burning	2	
	Clearing for agriculture	1	
	firewood collection	2	
	exotic predators	3	
	pasture improvement and cropping	1	
	predation by native fauna	3	increased abundance of native predators
Pale-yellow Robin	Clearing for agriculture	1	Particularly fragmentation
	Logging	1	Logging that encourages dense low stratum
	Logging		
	Intensive horticulture	2	
	Urban development	2	
Pacific Baza	Clearing for agriculture	1	
	logging that reduces age classes	2	
	roadkills	3	
	weed invasion	2	of remnant gallery forest
Bush-hen	Predation by exotics	1	
	Chemical pollutants	2	
	Grazing	1	In riparian vegetation
	Urban development	1	

Species	Disturbance Description	Rank	Comments
Mangrove Honeyeater	Urban development	1	With associated mangrove loss
Grey Goshawk	Clearing for agriculture	1	
	Logging that reduces age classes	2	
	Urban development	2	
	Loss of nest sites	1	
Forest Raven	Clearing for agriculture	1	Causes disadvantages to this bird when competing with other corvids
	Urban development	1	Causes disadvantages to this bird when competing with other corvids
Gang-gang Cockatoo	Grazing and associated burning	2	
	Clearing for agriculture	1	
	Logging that reduces age classes	2	Loss of old trees
Noisy Pitta	Predation by exotics	2	
	Clearing for agriculture	1	
	Intensive horticulture	2	
	Weeds	1	
	Urban development	2	
	Logging	3	Removes the large rainforest trees changing microclimate and reducing food supply
Brush Bronzewing	Predation by exotics	2	
	Clearing for agriculture	2	
	Urban development	1	
	Altered fire regimes	2	
Black-eared Cuckoo	Clearing for agriculture	1	
	Grazing	1	Changes to understorey density- woody understorey
Oriental Cuckoo	Grazing and associated burning	1	
	Clearing for agriculture	1	
Forest Kingfisher	Clearing for agriculture	1	
	Intensive horticulture	2	
	Loss of nest trees	2	
	Grazing	2	prevents recruitment of woodland trees
	Predation by exotics	3	
Little Shrike-thrush	Clearing for agriculture	1	
	Intensive horticulture	2	
	Urban development	1	
	Logging	1	Loss of older age classes
	Grazing	2	Removes native vines and encourages weed vines
	Weeds	1	
Peregrine Falcon	Cheemical pollutants	1	pesticides
	Shooting	1	
Little Bronze-Cuckoo	Clearing for agriculture	1	

Species	Disturbance Description	Rank	Comments
	Intensive horticulture	1	Tea trees
	Urban development	2	
	Weeds	2	
Russet-tailed Thrush	Clearing for agriculture	1	
	Predation by exotics	2	
	Logging	2	Increases understorey density and changes moisture regimes
	Urban development	2	
	Intensive horticulture	2	
Hooded Robin	Clearing for agriculture	2	leading to fragmentation
	pasture improvement and cropping	3	
	grazing and associated burning	1	
	exotic predators	2	
	firewood collection	3	
	native predators	2	
Grey-crowned Babbler	Clearing for agriculture	1	
	grazing and associated burning	1	
	exotic predators	2	
	firewood collection	2	
	pasture improvement and cropping	1	
	intensive horticulture	2	
Musk Lorikeet	clearing for agriculture	1	
	grazing and associated burning	2	
	firewood collection	2	
	logging that reduces size class of trees	2	
	apiary	3	
Chestnut-rumped Heathwren	Grazing and associated burning	1	
	Predation by exotics	2	
	Clearing for agriculture	2	
	Mining	3	Open cut mining
	Altered fire regimes	1	
	Pasture improvement	2	
Prince Edward Lyrebird	grazing and associated burning	2	
	exotic predators	1	
	management burns	2	
	Clearing for agriculture	3	
Yellow-tufted Honeyeater	grazing and associated burning	1	
	native predators	2	
	management burns	1	
	high intensity logging	3	

Species	Disturbance Description	Rank	Comments
	weed invasion	3	lantana - suppressing understorey recovery
Red-backed Kingfisher	Grazing and associated burning	1	
	Predation by exotics	2	
	Clearing for agriculture	1	
	Logging	2	Change in forest structure with young regeneration
Lewin's Rail	Predation by exotics	2	
	Clearing for agriculture	2	
	Drainage of wetlands	1	
	Urban development	1	

10.1.4. Disturbances identified for Frogs and their impacts ranked relative to each other

Species	Disturbance Description	Rank	Comments
Litoria castanea	habitat clearing	4	
	wetland swamp drainage - other	2	
	increased UV radiation	1	
	disease	1	
	siltation from grazing	4	
	silt from urban devel	5	
	trampling	5	
	introduced weeds	5	
	fish	1	
	altered hydrology - earthworks	2	
	pollution from nutrients	2	
	pollution from chemicals	3	
	droughts	1	
	unknown decline	1	
Litoria brevipalmata	disease	?	
	habitat clearing	?	
	altered hydrol - earthworks	?	
	altered hydrol - oldgr - regrowth	?	
	oldgrowth logging	?	
	changes in soil moist - roading	?	
	changes in soil moist -logging	?	
	rare/ poorly known	1	
	increased UV radiation	?	
	fish	?	
	logging - removal large dead fallen trees	?	
	logging - reduced leaf litter input	?	
Litoria piperata	unknown decline	1	

Species	Disturbance Description	Rank	Comments
	rare/ poorly known	1	
	habitat clearing	?	
	increased UV radiation	?	
	disease	?	
	siltation from logging	?	
	siltation from roading	?	
	siltation from grazing	?	
	trampling	?	
	introduced weeds	?	
	fish	?	
	pollution from nutrients	?	
	any other site specific potential threats should be addressed	1	
Mixophyes fleayi	increased UV radiation	4	
	disease	1	
	unknown decline	1	
	change in soil moist - logging	2	
	change in soil moist - roadding	2	
	logging - reduced litter input	2	
	introduced weeds - lantana	3	lantana
	fish	4	
Litoria aurea	habitat clearing	4	
	wetland swamp drainage - other	2	
	increased UV radiation	1	
	disease	1	
	trampling	2	
	introduced weeds	5	
	fish	1	
	pollution from nutrients	3	
	pollution from chemicals	5	
	droughts	1	
	mining	2	sandmining
	unknown decline	1	
Assa darlingtoni	changes in soil/litter moisture	1	
	clearing for agriculture	2	
	droughts	3	
	climate change	4	
	increased UV radiation	4	
	disease	4	
Philoria sphagnicolus	changes in soil/litter moisture	1	
	clearing for agriculture	3	
	droughts	4	
	climate change	5	
	increased UV radiation	5	

Species	Disturbance Description	Rank	Comments
	disease	5	
	altered hydrology and stream flow	2	
	siltation from logging	6	
	siltation from roading	6	
Mixophyes iteratus	increased UV radiation	4	
	disease	1	
	unknown decline	1	
	change in soil moist - logging	1	
	change in soil moist - roadding	1	
	logging - reduced litter input	1	
	introduced weeds - lantana	3	
	trampling	2	
	siltation from logging	3	
	siltation from roading	3	
	siltation from grazing	3	
	pollution - nutrients	4	
	altered hydrology - oldgr-regr	3	
	habitat clearing	2	
	introduced predators - foxes, cats	5	
	fish	4	
	burning rainforest	5	
Phyloria loveridgei	increased UV	5	
	disease	5	
	altered hydrol - oldgr-regr	2	
	change in soil/ litter moist-log	1	
	change in soil/ litter moist - road	1	
	siltation from logging	5	
	siltation from roading	5	
	droughts	3	
Litoria subglandulosa & daviesi	habitat clearing	4	
	increased UV radiation	4	
	disease	2	
	siltation from logging	1	
	siltation from roading	1	
	siltation from grazing	1	
	trampling	4	
	fish	2	
	pollution from nutrients	3	
	pollution from chemicals	4	
	altered hydrology- old-regrowth	3	
	change in soil moist - logging	4	
	change in soil moist - roading	4	
	burning - frequent	2	

Species	Disturbance Description	Rank	Comments
	oldgrowth logging - removal hollows	3	
	logging - removal fallen trees	2	
	mining - gold	4	
Mixophyes balbus	increased UV radiation	3	
	disease	1	
	unknown decline	1	
	change in soil moist - logging	2	
	change in soil moist - roadding	2	
	logging - reduced litter input	2	
	introduced weeds - lantana	3	
	trampling	2	
	siltation from logging	3	
	siltation from roading	3	
	siltation from grazing	2	
	pollution - nutrients	4	
	altered hydrology - oldgr-regr	3	
	habitat clearing	2	
	introduced predators - foxes, cats	5	
	fish	4	
	burning rainforest	3	
	mining - gold	5	
Phyloria kundagungan	increased UV	5	
	disease	5	
	altered hydrol - oldgr-regr	2	
	change in soil/ litter moist-log	1	
	change in soil/ litter moist - road	1	
	siltation from logging	5	
	siltation from roading	5	
	droughts	3	
	habitat clearing	2	
	logging - removes fallen trees	3	
	logging - reduced litter	3	
Litoria olongburensis	habitat clearing	1	
	wetland swamp drainage-mossie control	1	Drainage for mosquito control
	altered hydrology etc earthworks	1	
	fish	3	
	pollution	3	
	mining/ quarrying	2	Sand mining
	tea tree harvesting	4	
Phyloria sp 2 (undescribed)	increased UV	5	
	disease	5	
	altered hydrol - oldgr-regrowth	2	
	change in soil/ litter moist - road	1	

Species	Disturbance Description	Rank	Comments
	change in soil/ litter moist -logging	1	
	siltation from roading	5	
	siltation from logging	5	
	droughts	3	
	logging - removes fallen trees	3	
	logging - reduced litter	3	
	mining - gold	3	
	wetland swamp drainage - other	5	
	habitat clearing	2	
	trampling	3	
	dams	5	
	pollution - nutrients	5	
	pollution - chemicals	4	
Philoria sp 3 (undescribed)	increased UV	5	
	disease	5	
	altered hydrol - earthworks	2	
	change in soil/ litter moist - road	1	
	siltation from roading	4	
	droughts	3	
Litoria littlejohni	rare/poorly known	1	
	habitat clearing	1	
	wetland swamp drainage-mossie control	1	
	altered hydrology etc earthworks	2	
	fish	3	
	pollution	5	
	mining/ quarrying	2	Sand mining
	trampling	4	
	droughts	6	
Paracrinia haswelli	habitat clearing	1	
	wetland swamp drainage-mossie control	1	
	altered hydrology etc earthworks	1	
	pollution	3	
	fish	3	
	mining/quarrying	2	
	tea tree harvesting	4	
Crinia tinnula	habitat clearing	1	
	wetland swamp drainage - mosquitos	1	
	altered hydrol - earthworks	1	
	fish	3	
	pollution	3	
	mining/quarrying	2	
	tea tree harvesting	4	
Litoria revelata	disease	?	

Species	Disturbance Description	Rank	Comments
	habitat clearing	?	
	altered hydrol - oldgr - regrowth	?	
	oldgrowth logging	?	removal of hollows/n cavities
	changes in soil moist - roading	?	
	rare/ poorly known	1	
	fish	?	
Litoria jervisiensis	habitat clearing	1	
	wetland swamp drainage-mossie control	1	
	altered hydrology etc earthworks	1	
	pollution	3	
	fish	3	
	mining/quarrying	2	
	tea tree harvesting	4	
Litoria booroolongensis	habitat clearing	?	
	increased UV	?	
	Disease	?	
	fish	?	
	dams	?	
	pollution - chemical	?	
	pollution - nutrients	?	
	droughts	?	
	unknown decline	?	
	rare/poorly known	1	
Pseudophryne bibronii	increased UV radiation	?	
	disease	?	
	grazing	?	
	trampling	?	
	fish	?	
	pollution - nutrients	?	
	pollution - chemical	?	
	altered hydrology - earthworks	?	
	change in soil moist - logging	?	
	change in soil moist - roading	?	
	mining - sand	?	
	unknown decline	1	
Litoria pearsoniana	habitat clearing	5	
	disease	1	
	siltation from logging	4	
	siltation from roading	4	
	fish	3	
	altered hydr - oldgrowth-regrowth	2	
	change in soil moist - logging	4	
	change in soil moist - roading	4	
	old growth logging - removal cavities	4	

Species	Disturbance Description	Rank	Comments
	logging - removes large fallen trees	4	
	logging - reduced litter input	4	
	unknown decline	1	
Limnodynastes terraereginae	habitat clearing	?	
	poorly known	1	not rare, just poorly known
	competition - cane toads	?	mistaken ID
Heleioporus australiacus	habitat clearing	1	
	increased UV radiation	5	
	disease	5	
	siltation from logging	3	
	siltation from roading	3	
	siltation from urban devel	2	
	weeds	3	
	pollution - nutrients	3	
	pollution - chemical	1	
	altered hydrology - earthworks	3	
	burning - frequent	2	
	change in soil moisture - roading	3	
	change in soil moisture - logging	3	
Pseudophryne australis	habitat clearing	1	
	increased UV radiation	5	
	disease	5	
	siltation from logging	3	
	siltation from roading	3	
	siltation from urban devel	2	
	weeds	3	
	pollution - nutrients	3	
	pollution - chemical	1	
	altered hydrology - earthworks	3	
	burning - frequent	2	
	logging - reduced litter	5	
	bush rock collecting	2	
Litoria barringtonensis	habitat clearing	5	
	disease	1	
	siltation from logging	4	
	siltation from roading	4	
	fish	3	
	altered hydr - oldgrowth-regrowth	2	
	change in soil moist - logging	4	
	change in soil moist - roading	4	
	old growth logging - removal cavities	4	
	logging - removes large fallen trees	4	

Species	Disturbance Description	Rank	Comments
	logging - reduced litter input	4	
	unknown decline	1	

10.1.5. Disturbances identified for Nocturnal Birds and their impacts ranked relative to each other

Species	Disturbance Description	Rank	Comments
Marbled Frogmouth	selective logging wet scler	1	
	Aust group selection	1	
	reducing forest age	1	
	weed invasion	1	
Marbled Frogmouth	thinning	1	
Bush Stone-curlew	habitat clearing	2	
	grazing	1	
	grazing burn	1	
	illegal grazing burn	1	
	predation by foxes	1	
	rabbits	1	
Powerful Owl	logging which reduces prey mammals	1	Where arboreal mammals are reduced - dependent on regime and location
	fire which reduces prey	2	Where it reduces prey
	nest and roost site dist	3	by logging and recreational birdwatching
	habitat clearing	4	
	habitat fragmentation	5	
	introduced predators	6	dog and fox on juveniles
	roadkills	7	on adults
	cultivation for agriculture	8	in juveniles
Sooty Owl	logging which reduces prey mammals	1	Where arboreal and terrestrial prey are affected
	nest and roost site dist	2	
	wildfire	3	.
	fire which reduces prey	4	frequent burning where reduces ground mammal abundance
	birdwatching	5	including survey playback
Masked Owl	clearing for agriculture	1	
	clearing for urban development	4	
	logging which increases structural density of forest	2	Where affects mid to ground layer - affects manoeuvrability
	fire - high frequency	3	
		4	
	roadkills	5	
	nest and roost site dist	6	

Species	Disturbance Description	Rank	Comments
Barking Owl	clearing for agriculture	1	
	fire - high frequency	2	
		4	
	firewood collecting	3	through loss of nests
	grazing	2	where compromises some sapling regrowth
	drainage of swamps	5	

10.1.6. Disturbances identified for Reptiles and their impacts ranked relative to each other

Species	Disturbance Description	Rank	Comments
Turtles			
Elseya georgesi	Grazing - trampling banks, riparian damage	1	
	Grazing - eutrophication	1	
	Predation - fox	1	
	Illegal netting	2?	
	Grazing - increased sedimentation	1	
	Roading - construction and maintenance assoc with logging	1	
	Logging - siltation - local	2	
	Logging - siltation - upstream	2	
	Human interference with communal nesting sites	2?	
	Fishing - recreational for bass	2?	
	Fire - resulting in increased sediment	3	
	Dam construction - impoundment	1?	immediate potential threat
	Elseya purvisi	Grazing - trampling banks, riparian damage	1
Grazing - eutrophication		1	
Predation - fox		1	
Illegal netting		2?	
Grazing - increased sedimentation		1	
Roading - construction and maintenance assoc with logging		1	
Logging - siltation - local		2	
Logging - siltation - upstream		2	
Human interference with communal nesting sites		2?	
Fishing - recreational for bass		2?	
Fire - resulting in increased sediment		3	
Dam construction - impoundment		1?	

Elseya sp2 (Gwydir & Namoi Rivers)	Grazing - trampling banks, riparian damage	1	
	Grazing - eutrophication	1	
	Predation - fox	1	
	Illegal netting	2?	
	Grazing - increased sedimentation	1	
	Roading - construction and maintenance assoc with logging	3	
	Logging - siltation - local	3	
	Logging - siltation - upstream	3	
	Human interference with communal nesting sites	2?	
	Fishing - recreational for bass	2?	
	Fire - resulting in increased sediment	3	
	Disease	1	
Emydura sp (Bellingen River)	Grazing - trampling banks, riparian damage	1	
	Grazing - eutrophication	1	
	Predation - fox	1	
	Illegal netting	2?	
	Grazing - increased sedimentation	1	
	Roading - construction and maintenance assoc with logging	3	
	Logging - siltation - local	3	
	Logging - siltation - upstream	3	
	Human interference with communal nesting sites	2?	
	Fishing - recreational for bass	2?	
	Fire - resulting in increased sediment	3	
	Dam construction - impoundment	1?	immediate potential threat
	Urban runoff	1	
	Intensive horticulture - tea tree plantations	1	
Emydura sp1	Grazing - trampling banks, riparian damage	1	
	Grazing - eutrophication	1	
	Predation - fox	1	
	Illegal netting	2?	
	Grazing - increased sedimentation	1	
	Roading - construction and maintenance assoc with logging	3	
	Logging - siltation - local	3	
	Logging - siltation - upstream	3	
	Human interference with communal nesting sites	2?	
	Fishing - recreational for bass	2?	

	Fire - resulting in increased sediment	3	
	Dam construction - impoundment	1?	
	Agriculture - use of pesticides	1	
	Agriculture - fertilisers	1	
	Agriculture - siltation	1	
	Urban runoff	1	
	Intensive horticulture - tea tree plantations	1	
Lizards			
Ophioscincus truncatus	Any fire	1	
	Predation by introduced species	3	
	Clearing for agriculture	1	
	Clearing - partial for grazing	1	
	Weed invasion - lantana	3?	
	Grazing and associated burning	1	
	Firewood collecting	2	
	Logging - changing canopy structure	1	
	Logging - dessication - altered microhab	1	
Cautula zia	Any fire	2	
	Predation by introduced species	3	
	Grazing and associated burning	3	
	Logging - changing canopy structure	1	
	Logging - loss of large ground logs	1	
	Logging - dessication - altered microhab	1	
	Logging that reduces age/size structure	1	
	Climate change	1	for potential to be affected
Coeranoscincus reticulatus	Clearing for urban development	3	
	Roadkills	3	
	Any fire	2	
	Predation by introduced species	2	
	Clearing for agriculture	3	
	Clearing - partial for grazing	3	
	Grazing and associated burning	3	
	Logging - changing canopy structure	1	
	Logging - loss of large ground logs	1	
	Logging - dessication - altered microhab	1	
	Weed invasion	3	
	Logging that reduces age/size structure	1	
	Feral pigs	3	
Ctenotus eurydice	Fire - any except wildfire	2	
	Predation by introduced species	3	
	Clearing for agriculture	1	

	Grazing and associated burning	1	
	Mining	3	
	Bush rock collecting	3	
Saproscincus challengerii	Clearing for urban development	3	
	Any fire	2	
	Predation by introduced species	3	
	Clearing for agriculture	3	
	Clearing - partial for grazing	3	
	Logging - changing canopy structure	1	
	Logging - loss of large ground logs	1	
	Logging - dessication - altered microhab	1	
	Logging that reduces age/size structure	1	
Saproscincus galli	Clearing for urban development	3	
	Any fire	1	
	Predation by introduced species	3	
	Clearing for agriculture	3	
	Clearing - partial for grazing	3	
	Logging - changing canopy structure	1	
	Logging - dessication - altered microhab	1	
	Logging that reduces age/size structure	1	
	Grazing and associated burning	3	
Saproscincus rosei	Clearing for urban development	3	
	Any fire	1	
	Predation by introduced species	3	
	Clearing for agriculture	3	
	Clearing - partial for grazing	3	
	Logging - changing canopy structure	1	
	Logging - dessication - altered microhab	1	
	Logging that reduces age/size structure	1	
	Grazing and associated burning	2	
Underwoodisaurus sphyrurus	Any fire	1	
	Predation by introduced species	3	
	Clearing for agriculture	1	including loss of habitat, partial clearing for grazing, resulting in fragmentation; clearing dead wood and debris from paddocks
	Grazing and associated burning	1	
	Mining	3	
	Bush rock collecting	3	
	Firewood collecting	2	
	Dam construction - large ones	3	
Varanus rosenbergi	Any fire	3	
	Predation by introduced species	1	

	Grazing and associated burning - loss of litter	3	
	Grazing and associated burning - changes structure of understorey	3	
	Clearing for urban development	1	
	Roadkills	2	
	Mining - sand extraction	2	
Eulamprus kosciuskoi	Any fire	3	
	Predation by introduced species	2	
	Clearing for agriculture	1	
	Grazing and associated burning	1	
	Pasture improvement and cropping	1	
	Weed invasion	3	
	Firewood collecting	2	
	Dam construction	2	
	logging - altered microhab - altered flow	1	
	Drainage of swamps	1	
	Altered flow regimes-diversion of water	1	
	Clearing of riparian vegetation	1	
	Climate change	2	potential to influence reserve selection
Hypsilurus spinipes	Any fire	1	
	Predation by introduced species	2	foxes, cats and dogs
	Clearing for agriculture	3	
	Clearing - partial for grazing	3	
	Logging - changing canopy structure	1	
	Logging - dessication - altered microhab	1	
	Grazing and associated burning	2	
	Weed invasion	2	
	Road maintenance	1	
	Roadkills	2	
Lampropholis caligula	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	1	
	Grazing and associated burning	1	
	Pasture improvement and cropping	1	
	Weed invasion	1	scotch broome
	Firewood collecting	2	
	Climate change	1	
	Logging - altered microhab - old-regrowth	1	
Lampropholis elongata	Any fire	2	
	Predation by introduced species	3	
	Clearing for agriculture	1	
	Grazing and associated burning	1	
	Pasture improvement and cropping	1	

	Firewood collecting	2	
	Climate change	1	
Saltuarius swaini	Any fire	3	
	Predation by introduced species	3	
	Clearing for agriculture	3	
	clearing - partial for grazing	3	
	Grazing and associated burning	3	loss of logs; litter reduction; changes in structure of understorey and ground cover; changes in invert avail
	Clearing for urban development	3	
	Weed invasion	3	
	Logging - changing canopy structure	1	
	Logging - dessication - altered microhab	1	
	Logging - loss of large trees and hollows	1	
Saltuarius wyberba	Any fire	2	
	Predation by introduced species	2	
	Clearing for agriculture	1	loss of hab; partial for grazing; resulting in frag
	Grazing and associated burning	2	changes structure of understorey and ground cover; changes invert avail and litter cover
	Pasture improvement and cropping	1	
	Firewood collecting	3	
	Climate change	2	
	Logging - altered microhab - old-regrowth	2	
	Roadkills	3	
	Logging that reduces size and age class	2	
	Logging - loss of hollows	2	
	Mining - gold	3	
Calyptotis ruficauda	Any fire	2	
	Predation by introduced species	3	
	Clearing for agriculture	1	
	Clearing - partial for grazing	1	
	Grazing and associated burning	1	
	Firewood collecting	2	
	Logging - changing canopy structure	2	
	Logging - dessication - altered microhab	2	
Eulamprus murrayi	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	1	
	Clearing - partial for grazing	1	
	Grazing and associated burning	3	
	Logging - changing canopy structure	1	
	Logging - dessication - altered microhab	1	
	Weed invasion	2	

	Logging that reduces age/size structure	1	
Eulamprus tenuis (N pop only)	Any fire	1	
	Predation by introduced species	3	
	Clearing for agriculture	3	
	Clearing - partial for grazing	3	
	Grazing and associated burning	3	
	Logging - changing canopy structure	1	
	Logging - dessication - altered microhab	1	
	Weed invasion	3	
	Logging that reduces age/size structure	1	
	Logging - loss of hollows	1	
Eulamprus tryoni	Climate change	1	
	Predation by introduced species	3	
Tympanocryptis diemensis (northern)	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	3?	
	clearing - partial for grazing	3?	
	Grazing and associated burning - loss of litter	1?	
	Grazing and associated burning - changes structure of understorey	1?	
	Logging - altered microhabitat - reduced ground cover and litter	1?	
Tympanocryptis diemensis southern pop not considered at risk			
Tympanocryptis lineata pinguicollis	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	1	loss of habitat; partial for grazing; resulting in fragmentation
	Grazing and associated burning	1	
	Pasture improvement and cropping	1	
	Weed invasion	1	
Saproscincus oriarus "North Coast sp"	Any fire	1	
	Clearing for agriculture	1	
	clearing - partial for grazing	1	
	Grazing and associated burning - changes structure of understorey	2	
	Clearing for urban development	1	
	Drainage of swamp forests, wet heath, wetlands and shrublands	1	
Cacophis harriettae	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	1	

	clearing - partial for grazing	1	
	Grazing and associated burning - loss of logs and litter	1	
	Grazing and associated burning - changes structure of understorey	1	
	Clearing for urban development	2	
	Logging - loss of fallen logs	1	
	Roadkills	3	
	Firewood collecting	2	
Hoplocephalus bitorquatus	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	1	
	clearing - partial for grazing	1	
	Grazing and associated burning - loss of logs and litter	2	
	Grazing and associated burning - changes structure of understorey	1	
	Clearing for urban development	3	
	Logging - loss of large trees, stags and hollows	1	
	Logging - loss of fallen logs	1	
	Roadkills	2	
	Mining - coal	2	
	Drainage of swamps	1	
	Firewood collecting	2	
	Pigs - predation and hab dist	2	
Hoplocephalus stephensii	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	3	
	clearing - partial for grazing	3	
	Grazing and associated burning	1	changes structure of understorey and ground cover
	Clearing for urban development	2	
	Weed invasion	3	
	Logging - changing canopy structure	2	
	Logging - loss of large trees, stags and hollows	1	
	Logging - loss of fallen logs	1	
	Roadkills	2	
Tropidechis carinatus	Any fire	2	
	Predation by introduced species	2	
	Clearing for agriculture	1	
	clearing - partial for grazing	1	

	Grazing and associated burning - loss of logs and litter	2	
	Grazing and associated burning - changes structure of understorey	2	
	Clearing for urban development	1	
	Logging - loss of large trees, stags and hollows	2	
	Logging - loss of fallen logs	2	
	Roadkills	2	
	Drainage of swamps	2	
Austrelaps ramsayi	Any fire	3	
	Predation by introduced species	3	
	Clearing for agriculture	1	
	Grazing and associated burning	2	changes structure of understorey and ground cover
	Pasture improvement and cropping	1	
	logging - altered microhab - altered flow	3	
	Drainage of swamps	1	
	Altered flow regimes-diversion of water	1	
	Clearing of riparian vegetation	1	
	Climate change	2	
	roadkills	3	
Drysdalia coronoides	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	1	
	Grazing and associated burning	1	
	Climate change	2	
	firewood collecting	2	
Cacophis krefftii	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	2	
	Clearing - partial for grazing	2	
	Grazing and associated burning	1	loss of logs and leaf litter
	Roadkills	2	
	Logging - loss of large logs	2	
	Clearing for urban development	2	
Acanthophis antarcticus	Any fire	1	
	Predation by introduced species	2	
	Clearing for agriculture	1	
	clearing - partial for grazing	1	
	Grazing and associated burning - loss of litter	1	
	Grazing and associated burning - changes structure of understorey	1	
	Clearing for urban development	1	

	Roadkills	2	
	Logging - altered microhabitat - reduced ground cover and litter	2	
	Deliberate killing	2	
	Cane toad consumption	2?	
Hoplocephalus bungaroides	Any fire	1	
	Clearing for urban development	1	
	Bush rock collecting	1	
	Feral goats - degrading of ridgelines	3	
	logging - loss of large trees, hollows and stags	1	

10.1.7. Disturbances identified for Terrestrial Mammals and their impacts ranked relative to each other

Species	Disturbance	Rank	Comments
Eastern Quoll	grazing and associated frequent burning	2	loss of logs
	exotic predators	1	competition and predation by foxes, cats and dogs
	baiting for dingoes	2	against dingoes, favouring foxes
	disease	3	toxoplasmosis - spread by feral cats
	clearing - loss of habitat	2	
	roadkills	6	
	lack of source population	1	
Rufous Bettong	predation - fox	1	
	clearing - loss of habitat	3	
	intensive horticulture	4	for tea tree cultivation
	altered fire regimes	2	frequent encourages bladey grass - poor forage
	clearing - fragmentation	3	
Red-legged Pademelon	predation - fox	1	.
	logging - reduction of midstorey	3	in rf and wet sclerophyll - reduced leaf litter etc
	clearing - loss of habitat	4	
	clearing - fragmentation	4	
	predation - domestic dogs	1	
Brush-tailed Rock-wallaby	predation - fox	1	
	baiting for dingoes	1	
	exotic competitors	2	goats
	hunting	5	
Black-striped Wallaby	predation - fox	1	
	shooting	3	
	clearing - loss of habitat	2	

Species	Disturbance	Rank	Comments
	predation - domestic dogs	1	
Long-nosed Potoroo	predation - fox	1	
	clearing - loss of habitat	1	
	clearing - fragmentation	2	
	grazing and associated frequent burning	1	
	clearing for urban development	1	
	baiting for dingoes	3	
Parma Wallaby	predation - fox	1	
	baiting for dingoes	1	
Whiptail Wallaby	partial clearing for grazing	1	
	Altered fire regimes	2	
	exotic competitors	2	cattle
Tiger Quoll	grazing and associated frequent burning	3	
	exotic predators	1	competition and predation by foxes, cats and dogs
	baiting for dingoes	1	
	disease	4	toxoplasmosis - spread by feral cats
	clearing - loss of habitat	2	
	clearing - fragmentation	3	
	roadkills	5	correlated with fragmented habitat
Common Wombat	predation - dingo	?	
	clearing - loss of habitat	?	
	climate change	?	
	shooting	?	
	exotic competitors	?	cattle grazing
	disease	?	mange from foxes
Platypus	roading	3	sedimentation from gravel roads
	pollution by chemicals	4	
	grazing - destruction of creek banks by trampling	2	
	altered water flow regimes	2	
	clearing of riparian vegetation	1	
	fishing	2	that uses nets - both commercial and illegal
	mining - sand and river gravel	5	
	fish	4	carp affecting water quality
Hastings River Mouse	grazing and associated burning	2	frequent burning
	wildfire	2	in absence of refuges
	predation - cat	1	
	predation - fox	1	
	logging - loss of hollows	3	need hollows in butt cavities of old growth
	baiting for dingoes	1	increased foxes when remove dingoes
	roading	2	exotic predator ingress

Species	Disturbance	Rank	Comments
Brush-tailed Phascogale	predation - cat	1	
	predation - fox	1	
	baiting for dingoes	1	
	intensive horticulture	2	clearing for tea tree horticulture
	clearing - loss of habitat	1	
Eastern Chestnut Mouse	mining - sand	3	
	predation - cat	1	
	predation - fox	1	
	clearing - loss of habitat	2	
	altered fire regimes	2	
	baiting for dingoes	1	increased foxes when remove dingoes
	grazing and associated burning	1	inducing changes in floristics and ground cover structure
Broad-toothed Rat	predation - fox	1	
	climate change	3	
	baiting for dingoes	1	increased foxes when remove dingoes
	grazing and associated burning	2	
Common Planigale	predation - cat	1	potential interaction between predators and other processes
	altered fire regimes	2	
	baiting for dingoes	2	increased cats when remove dingoes
	clearing - loss of habitat	1	coastal - usually urban or tea tree clearing
	predation - cane toad	4	
	exotic competitors	3	cane toad
Pale Field-rat	altered flood regimes	3	
	intensive horticulture	2	tea tree clearing
	clearing - loss of habitat	1	
	altered fire regimes	3	
Grassland Melomys	mining - sand	2	
	predation - cat	2	
	predation - fox	2	
	clearing - loss of habitat	1	
	urban development and infrastructure	2	
	baiting for dingoes	1	increased foxes when remove dingoes
	drainage	1	
New Holland Mouse	mining - sand	2	
	predation - cat	2	
	exotic competitors	4	house mouse
	baiting for dingoes	2	increased cats when remove dingoes
	clearing - hab fragmentation	2	
	clearing - loss of habitat	1	
	altered fire regimes	3	
	urban development and infrastructure	4	

Species	Disturbance	Rank	Comments
Dusky Antechinus	predation - cat	3	
	predation - fox	3	
	logging - altered hydrology oldgr-regr	2	affects litter moisture - reduces food (see Alberts Lyrebird)
Dingo	baiting for dingoes	1	
	Clearing- loss of habitat	3	
	Clearing- fragmentation	2	
	Hybridisation	2	
	Roading	3	