Independent Forestry Panel

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REVIEW OF CIFOA MITIGATION CONDITIONS FOR TIMBER HARVESTING IN BURNT LANDSCAPES

A Report to the NSW Environment Protection Authority

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Executive Summary

1. In 2019/20 extreme wildfires burnt 37-42% of public forests in NSW and caused an unprecedented reduction in the distribution and abundance of key threatened species including the fire sensitive Koala.

2. The primary effect of fire and past logging was to restrict fauna populations to a series of small, fragmented and isolated patches of unburnt or lightly burnt forest, referred to as fire refuges, scattered throughout the severely burnt forest.

3. Fauna populations in fire refuges are likely to survive and recover by expanding outwards over the next 120 years in large unlogged public forest reserves. The time required for recovery of threatened and sensitive species after average fires ranges from around 10 - 120 years. Recovery times are likely to be around 10 years for the Hastings River Mouse, up to 45 years for the Koala and 20-120 years for the Greater Glider and Yellow-bellied Glider.

4. Fauna populations surviving in fire refuges in state forests are at risk of elimination by timber harvesting under the normal Coastal Integrated Forestry Operations Approvals (CIFOA) which could prevent recovery, and cause catastrophic population decline in species such as the Koala, Greater Glider and Yellow-bellied Glider.

5. Following the 2019/20 fires, the Environment Protection Authority (EPA), in consultation with Forestry Corporation of NSW (FCNSW), developed a suite of Site-Specific Operating Conditions (SSOCs) to manage environmental risks associated with timber harvesting in burnt landscapes to supplement standard CIFOA.

6. The purpose of this review was to evaluate whether the CIFOA, both with and without SSOCs provides adequate mitigation for ecological and environmental impacts from timber harvesting in areas impacted by the 2019/20 wildfires, and to provide recommendations for any changes/additions to proposed conditions consistent with the objectives and requirements of the Forestry Act 2012 and application of the precautionary principle.

7. While the literature on fire and logging impacts is comprehensive there remain significant areas of uncertainty. Scientific studies have relied heavily on surveys of past fire and logging events which were generally less intense than recent harvesting and fire. This has caused the risk from current harvesting practices to be significantly underestimated, especially at landscape scales.

8. This review found that timber harvesting disturbance is more severe than the effects of fire in several important respects including the following:
   - it preferentially removes rather than retains natural fire refuges in gullies, sheltered aspects and stands of older forest that contain developing or actual hollows;
   - retained forest patches are generally too small to sustain viable local populations for the number of years (10-60) required for surrounding forest to recover after logging and fire; and
   - selective logging is too intense and the basal area of retained trees is too low to maintain the natural post-fire forest structure required by mature and late stage dependent fauna like Greater Gliders and Yellow-bellied Gliders, especially in Dry Sclerophyll Forests.

9. It was concluded that the normal CIFOA in the context of the 2019/20 wildfires will not deliver ecologically sustainable management as required under the objectives of the Forestry Act 2012 and is likely to cause a significant impact under the NSW Biodiversity Conservation Act 2016 and the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999.

10. It was also concluded that special conditions in SSOCs for the burnt areas are inadequate to mitigate fire and logging impacts, primarily because their time frame (12 months) of application is too short.

11. The SSOCs include a recommendation to provide temporary protection from logging for all unburnt and lightly burnt forests within the net harvest area for a period of 12 months. This recommendation has been opposed by FCNSW which proposes to harvest unburnt and lightly burnt forest immediately in some areas. An examination of case studies indicates that protection of unburnt and lightly burnt areas could mitigate logging impacts in burnt landscapes if it was made permanent (or longer than 20-120 years) and extended to protect a minimum 50% of the least burnt area of forest in each compartment across the entire landscape.

12. In general, as a precautionary principle, it can be assumed that species of native fauna and flora are adapted to, and able to sustain viable populations, under scales and patterns of fire and logging that do not exceed the scale and pattern of natural disturbances occurring after severe wildfire. Current CIFOA fall well short of constraining timber harvesting to the scale and pattern of natural disturbance.

13. This report recommends implementation of a whole new suite of standards that take into account the impacts of both wildfire and timber harvesting at regional and landscape scales across all public tenures, to supplement existing CIFOA controls which are largely focused on regulation of biodiversity impacts at logging compartment scales.

14. New conditions are required that focus on permanent protection of large forest patches across regions and landscapes and which capture and include fire refuges (areas of forest that are least likely to be burnt and which provide wildlife oases after fire) and old growth and which link all retained forest in patches larger than 5 hectares in size in a network of permanent wildlife corridors.

15. This report also recommends that the intensity of so called selective harvesting in all Dry Sclerophyll Forest types be significantly reduced by increasing minimum tree basal area limits and minimum medium and large tree stocking limits, to ensure that populations of threatened and sensitive fauna such as Koala and Greater Glider are maintained at close to normal densities within the net harvest area consistent with principles and requirements for ecologically sustainable harvesting required under Regional Forest Agreements and the Forestry Act 2012.

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1 Introduction

1.1 2019/20 wildfire

In 2019/20 forests in NSW were subject to unusually extensive and severe wildfires which burnt 5.37 million hectares of land, including 37% of the national park estate, 42% of state forests and 4% of freehold land (DPIE 2020). Some state forests and national parks were more extensively burnt than others. A total of 57 national parks and 43 state forests had more than 99% of their area burnt and a total of 73 national parks and 72 state forests had 75-99% of their area burnt. The unusual extent and severity of these fires, shown in Figure 1 (DPIE 2020), has had an unprecedented adverse impact on biodiversity. Ecological condition, which measures the naturalness and condition of retained vegetation communities declined from 72% in 2013 to 44% after the fires and ecological carrying capacity, which measures the degree of connectedness or fragmentation of vegetation decreased by 39% within the burn area from 62% in 2013 to 38% in 2020. The fires also burnt 25% of the best Koala habitat in the state and more than 61 threatened species had >80% of their known location records within the burn area or fire ground (DPIE 2020).

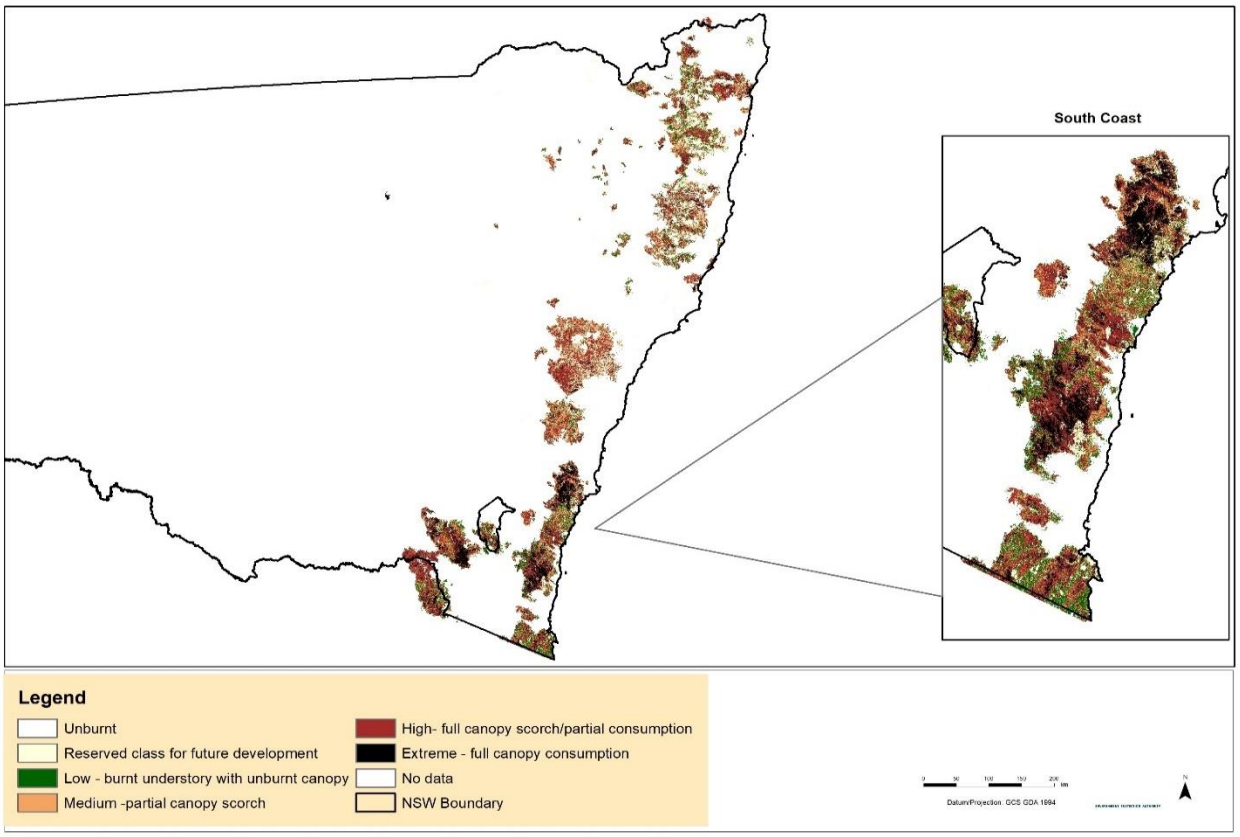

Figure 1 Extent and severity of 2019/20 wildfire in NSW showing the burn area (from DPIE 2020).

The effects of wildfire on biodiversity are compounded by the effects of past timber harvesting in state forests, especially where state forests adjoin national parks or provide a matrix of forest that surrounds and links with national parks. Timber harvesting has an additive or multiplicative impact in combination with wildfire but is generally more severe, longer lasting and more permanent because it is repeated in the same location at short intervals (harvest rotations) of insufficient duration for trees to reach maturity and develop hollows at 120+ years of age (Ambrose 1982).

The extreme severity and extent of the 2019/20 wildfires has exposed the need for better management and mitigation of the combined impacts of fire and timber harvesting across entire landscapes, regions and tenures. The recovery of biodiversity, ecological carrying capacity and threatened species after fire and logging (both historical and proposed logging) will depend on the modelling, mapping and protection of unburnt or lightly burnt fire refuges (areas with a lower risk of future wildfire) and their connection by corridors. The focus of Coastal Integrated Forestry Operations Approval (CIFOA) prior to the 2019/20 wildfires was primarily to mitigate logging impacts at the compartment scale. There were few or no standards for mitigating the combined impacts of fire and logging, or for mitigating fire and harvesting impacts at landscape scales by protecting wildlife refuges of sufficient size to provide source populations for re-colonization of burnt areas as they regenerate after severe fires such as those in 2019/20.

Following the 2019/20 fires, the Environment Protection Authority (EPA), in consultation with Forestry Corporation NSW (FCNSW), developed a suite of measures to manage the environmental risks associated with timber harvesting in burnt landscapes that supplemented conditions in the CIFOA. These are termed Site-specific Operating Conditions (SSOCs) under which FCNSW has been and continues to undertake logging operations in burnt landscapes. SSOCs are measures additional to the CIFOA intended to address impacts on soil and water, biodiversity and ecosystems that may result from logging in burnt sites. Now, six months after the 2019/20 wildfire season, there is pressure to remove these additional conditions and return to the standard CIFOA ruleset.

FCNSW has submitted a proposal which, in particular, looks to remove some conditions of the SSOCs to allow harvesting in partially unburnt forests as well as to reduce buffers on riparian zones – the principal rationale being to increase wood supply volume. In response, the EPA has developed separate options for supplementary conditions to the CIFOA which would apply across the full extent of burnt landscapes where logging is proposed. More recently, FCNSW has proposed to put aside the SSOC and continue harvesting under the CIFOA alone. This review provides independent advice on the adequacy of the various proposed approaches to risk mitigation within the context of current proposals, scientific uncertainty, limited availability of post wildfire and timber harvesting impact data, and the need to adopt a precautionary approach.

1.2 Timber harvesting approval context

The CIFOA are rules for conducting native forestry operations on public land to deliver ecologically sustainable forest management. They prescribe minimum standards to be met by FCNSW (and their contractors) to protect plants, animals, habitat, ecosystems, soil and water during and following forestry operations. Compliance with the CIFOA provides FCNSW (and their contractors) with a defence against threatened species (BC Act) and water pollution (POEO Act) offences (NSW Government Coastal IFOA Summary).

1.3 Purpose of the Report

This project and report was commissioned by NSW EPA Environmental Solutions Forestry to address the following objectives.

- To evaluate whether the CIFOA, both with and as a separate consideration, without SSOCs of the type that have been issued, provide adequate mitigation for ecological and environmental impacts from timber harvesting in areas impacted by the 2019/20 wildfires.

- To review the adequacy of positions the EPA and FCNSW have proposed to apply going forward in order to mitigate the impacts of timber harvesting in burnt landscapes on biodiversity.
- To provide recommendations for any changes/additions to proposed conditions in line with best practice that meet the objectives of Part 5B of the Forestry Act 2012, the objectives of the CIFOA and the precautionary principle where appropriate.

1.4 Scope

The intention of this report is to provide an independent critique of the appropriateness of the conditions for timber harvesting in burnt landscapes and suggest necessary changes or additions to the conditions in line with best practice. The review content includes the following:

- The statutory objectives of Part 5B of the Forestry Act 2012 and the objectives of the CIFOA;
- The CIFOA (standard conditions and protocols) which are available online;
- the CIFOA supplemented by Site Specific Operating Conditions (SSOCs);
- EPA proposed CIFOA amendment for fire affected landscapes (EPA option); and
- FCNSW proposal for fire affected landscapes (FCNSW option).

Output for this report is to include advice on the adequacy of the CIFOA (standard ruleset) in mitigating the biodiversity impacts of proposed timber harvesting in burnt landscapes and, if not, guidance on what timeframe and recovery indicators would be required before the CIFOA is adequate, including consideration of the relevance of the FESM (Fire Extent and Severity Mapping) (2020) modelling now and into the future as the forest recovers.

1.5 Limitations

The review was undertaken by Dr. Andrew Smith, Director of Setscan Pty Ltd and Principal of Austeco Environmental Consultants, who has 45 years of experience in ecologically sustainable forest management in eastern Australia. The review was limited to a desktop assessment of documents and maps supplied by EPA and other material considered relevant as referenced in the report. The review was time constrained, which necessitated a scale back in task expectations to those achievable in the time frame. The author liaised with and acknowledges the advice, review comments and support of Officers of the EPA during preparation of the report.

2 Overview of the impacts of the 2019/20 Wildfire

2.1 Overview of impacts of the wildfire on biodiversity

Wildfire is a natural part of forest ecosystems and our native fauna are adapted to cope with natural patterns of fire disturbance. Intense wildfires either kill resident native fauna in areas of severely burnt forest or displace them to other areas where they are at high risk of dying from competition or lack of food (Lunney 1987, Lunney et al 2004, Wallis 2013). Recovery of native fauna populations after fire occurs by dispersal from unburnt or lightly burnt refuges which are patches of forest large enough to support small populations or breeding pairs able to breed and disperse after the environment recovers. Recovery times are highly variable depending fire frequency, intensity and extent and the body size, mobility and diet of affected fauna species. Generally, small litter foraging omnivores and insectivores recover relatively rapidly and the large arboreal mammals relatively slowly. It takes about 5-6 years for leaf litter and ground cover to recover after fire (Fox et al 1979) and about 10 years for shrub cover/diversity to recover and provide seeds and habitat for small mammals such as the Hasting's River Mouse (Smith et al 1994, 95, Smith and Quin 1996). It takes about 15-45+ years for arboreal mammal communities including

Koalas and some gliders that depend on foliage, flowers, understorey shrubs, saps and gums to recover fully after normal fire regimes in Dry Sclerophyll Forests (DSF) (Smith and Murray 2003, Law et al 2017). It takes from 40 to > 120 years for species that depend on large trees with hollows and large fallen logs to recover after intense fire and or logging in Wet Sclerophyll Forests (Eyre 2006, Eyre and Smith 1997, Incoll et al 2001, Smith 2019). Surveys of Greater Gliders in northern NSW have shown that they are sensitive to fire and less abundant in forest burnt within the previous 10-20 years (Smith et al 1994, Andrews et al 1994, McLean et al 2018). These studies were undertaken in forests subject to normal fire regimes, recovery is likely to be much longer after severe fires such as those in 2019/20. Greater Gliders disappeared from Royal National Park after a severe fire in 1994, were not seen again for 18 years (Andrews et al 2014), and will likely require 20+ more years for population recovery.

Fires vary in their intensity, frequency, patch size, pattern and regional occurrence. Fire intensity is especially variable at local (compartment) scales with some areas unburnt, some burnt only in the understorey, some lightly crown burnt, and others severely crown burnt. Low intensity fires such as control burns have less impact on fauna than severe hot fires. Low intensity burns create mozaics of burnt and unburnt patches at the scale of tens to hundreds of metres. After low intensity control burns from 20 - 90% of the forest remains unburnt at the compartment scale and an extensive network of connected unburnt refuges typically remains in gullies and lower slopes. The frequency of re-occurrence of these low intensity fires is about 5 years on ridge tops and 20 years in gullies (Penman et al 2007). High intensity fires such as the 2019/20 fires create similar mozaics of burnt and unburnt forest and retain similar networks of unburnt or lightly burnt forest in gullies and protected aspects, but the size of burnt patches is larger and the network of unburnt or lightly burnt forest patches may be less well connected (Leonard et al 2014). Unburnt fire refuges become increasingly important to maintain biodiversity as the extent and severity of fire increases (Chia et al 2015).

As well as providing refuge habitat for fire sensitive mammals, long unburnt forest patches also provide the best habitat for birds in severely burnt landscapes. Robinson et al. (2014) found that long unburnt forests in the Victorian Highlands harboured 20-40% more bird species and up to 56% more individuals, leading them to recommend that all long unburnt vegetation in the landscape, in particular, vegetation within positions naturally sheltered from fire such as gullies and rocky screes, be recognized and protected. Small ground mammal communities are also sensitive to time since fire. In the Grampians of Victoria all native mammal species were negatively associated with areas burnt within the last five years, and most species especially the Southern Brown bandicoot (*Isoodon obesulus*) did not recover or reach peak abundance for periods of 20-50 years after fire (Hale et al. 2016). In south eastern NSW the vulnerable Long-nosed Potoroo (*Potorous tridactylus*) is sensitive to time since fire and increased linearly over a 20 year period after severe fire.

Examples of the mosaic pattern created by the 2019/20 fires at South Brooman State Forest and Yambulla State Forest are shown in Figures 2 and 3 at landscape scales. Examination of the landscape scale pattern at South Brooman (Figure 2) shows that unburnt areas (pale yellow) are limited to scattered and isolated patches. Lightly burnt areas (dark green) are much more extensive and largely remain connected in an extensive network of gullies and sheltered aspects. The unburnt forest provides refuges that will be of critical importance for sustaining remnant populations of the most fire sensitive species that are easily killed by fire such as Koalas, and by acting as source populations as the forest recovers. The lightly burnt refuges are likely to support scattered individuals of fire impacted populations of forest canopy species such as Greater Glider that survived by sheltering in particularly large trees with hollows that were only

partially or lightly burnt. The fire was much more severe in Yambulla where the unburnt and lightly burnt refuges are small and generally isolated. Biodiversity recovery in Yambulla can be expected to take much longer and will rely heavily on moderately burnt forest in addition to unburnt and lightly burnt forest. Ultimately all native fauna populations in this burnt landscape can be expected to recover naturally over time by dispersal away from these unburnt and lightly burnt refuges, but the time to recovery will be slow about 10-45 years in DSF (dry sclerophyll forest) and up to 120 years or more in the most severely burnt WSF (wet sclerophyll forest) patches.

2.2 Overview of the impacts of timber harvesting on biodiversity

The effects of timber harvesting on biodiversity can be broadly likened to the effects of fire but there are some important differences listed below that make timber harvesting effects more severe:

1) *Timber harvesting is not naturally constrained like fire to leave undisturbed fire refuges over large parts of each compartment or landscape but is more likely to remove natural fire refuges because they generally support larger trees.*
2) *Selective timber harvesting is much more intense than the effects of fire especially in its permanent removal of medium sized trees and large trees with hollows.*
3) *Intensive harvesting is much more extensive and frequent than fire disturbance in natural forests and maintains a much higher proportion of the forest in early regrowth stages rather than late mature and old growth stages.*
4) *Timber harvesting does not retain the degree of connectedness (natural corridors and links) found in burnt forests.*

As a generally precautionary principle it can be assumed that native fauna and flora are adapted to, and able to sustain viable populations, under scales and patterns of fire and logging that do not exceed the scale and pattern of natural disturbances occurring after severe wildfire. Section 4 of this report identifies and recommends some minimum standards for the scale and pattern of timber harvesting at the landscape scale based on observed fire patterns, which can be used to identify precautionary limits necessary to maintain viable population of our most vulnerable fauna under both timber harvesting and natural fire regimes.

3 Adequacy of Timber Harvesting Conditions

3.1 Background and history of logging approvals

Conditions for timber harvesting operations in NSW were initially developed in the 1990's based on the results of independent, scientifically rigorous, multi-year field surveys and investigations of the impacts of previous timber harvesting on biodiversity and reviews of available scientific literature on timber harvesting impacts in Australia (Smith et al 1992, 1994, 95, Andrews et al 1994 and others). These studies identified the key components of the forest environment that are most sensitive to logging and fire (Table 1) and recommended a range of key mitigation measures to protect and maintain these components at compartment and landscape scales. Not all of these mitigation measures were included in early Regional Forest Agreements (RFAs) or in the CIFOA adopted in 2018. Notable omissions included lack of protection for fire refuges, inadequate provision for wildlife corridors, inadequate provision for recruitment of late stage mature and old-growth forest, lack of effective conditions to limit selective harvesting intensity, and no assessment of the adequacy of reserves for maintenance of viable populations of the most sensitive species at landscape scales.

In the 20 years since standards were first applied in NSW there has been little monitoring, scientific analysis and validation of their effectiveness. This lack of adequate monitoring has precluded the use of adaptive forest management and necessitated a continuation of precautionary approaches to take into account the following limitations to current knowledge:

a) some rare and threatened species have not been studied and their habitat requirements and sensitivity to fire and logging remain poorly known;
b) timber harvesting was generally less intense in the past than it is today so harvesting impacts determined from studies of past logging will generally underestimate future impacts;
c) fire intensity was less severe in the recent past than experienced in 2019/20 so that fire impacts determined from surveys of past burning will generally underestimate future impacts; and
d) there have been few or no adequate studies of logging and fire impacts at landscape scales.

The purpose of the standard CIFOA is to ensure that timber harvesting in NSW is ecologically sustainable. Essentially this means that timber harvesting should not cause serious or irreversible declines in biodiversity or distribution and abundance of threatened species. In general, under the precautionary principle, timber harvesting can be considered ecologically sustainable if it mimics and does not exceed, or compound, the impacts of natural disturbances such as wildfire. Our native fauna are well adapted to survive and recover from extreme wildfires such as those in 2019/20, but this recovery takes time (up to 120 years or more) and will require long term or permanent protection of unburnt fire refuges in large patches linked by corridors and the use of low intensity selective logging to maintain natural forest structure in a majority of the surrounding matrix.

The following sections assess the adequacy of the various conditions and agency proposals to mitigate the impacts of logging in areas affected by the 2019/20 wildfires. The conditions assessed below include the standard CIFOA, the CIFOA plus SSOC, EPA proposal and FCNSW proposal/s. Two compartments that have different burn severity patterns have been used as examples to demonstrate the spatial implications of the conditions, South Brooman 58A (patchy burn) and Yambulla 290 (widespread severe burn), as presented in Figure 2 and Figure 3. For insight and context when reviewing Figure 2 and 3, the primary approach of the SSOC (s2.3) is to direct logging operations into parts of the net harvest area that have been more severely burnt (moderate to extreme severity).

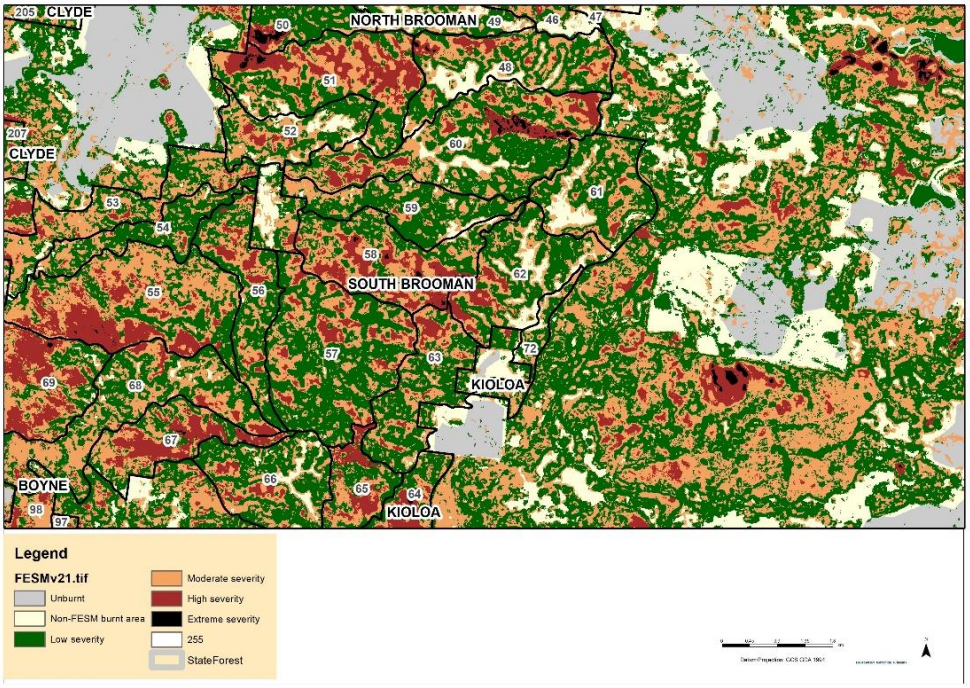

Figure 2: South Brooman State Forest was subject to a patchy burn, with low severity (dark green) and unburnt patches (yellow) providing important refuge habitat during and after the wildfire. These refuges play a critical role (source populations) in the recovery of fauna populations occupying the broader landscape over the coming decades.

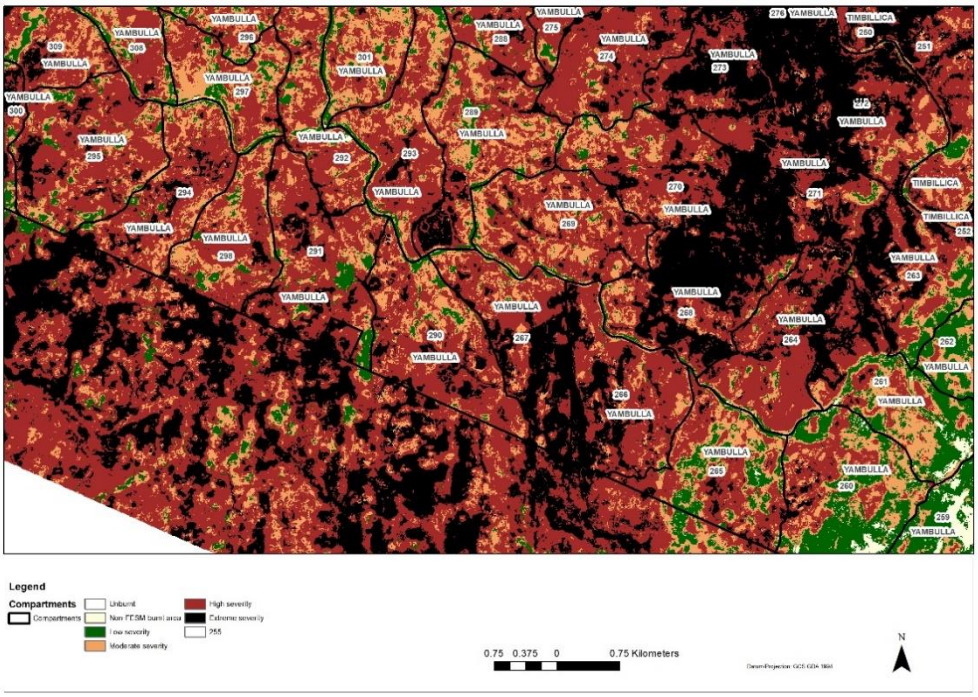

Figure 3: Yambulla State Forest was subject to widespread and severe wildfire, with few refuges (yellow and dark green) available. This burn pattern has catastrophic implications for local fauna populations, with fauna species population recovery likely to take several decades to probably over a century.

3.2 Adequacy of the standard CIFOA in mitigating logging impacts in fire affected areas

The effectiveness of standard CIFOA measures for mitigating impacts of fire and logging on biodiversity are summarised in Table 1. This review concluded that, particularly in the context of the 2019/20 wildfires, the standard conditions (CIFOA 2018) fail to guarantee ecologically sustainable forest management and are likely to cause an ongoing decline and significant impact on biodiversity, inconsistent with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Forestry Act 2012*.

The key reasons for concluding that standard CIFOA conditions are inadequate and that timber harvesting and fire will have a significant impact on biodiversity are as follows:

1) There is no mandatory provision to identify, map and protect fire refuges in net harvest areas (areas of unburnt and lightly burnt forests or with a low probability of future fire) for sufficient length of time (20 - >120 years) necessary for biodiversity recovery after fire and logging.
2) The harvesting intensity limits (including the basal area retention requirements for selective harvesting which are largely met by habitat tree protections alone) effectively allow intensive harvesting or clear felling on short rotations in the net harvest area which will permanently eliminate late stage forest dependent fauna from the net harvest area over time.
3) There are no effective requirements for protection and recruitment of a minimum area and percentage of late stage (uneven-aged and old growth) forest and its dependent fauna within compartments or across landscapes to mitigate the losses from timber harvesting (such areas could be substantially coincident with fire refuges).
4) The current size, area and pattern of retained unlogged Environmentally Sensitive Areas (ESAs) within compartments and across landscapes is not adequate to provide the suitable habitat, corridor links, or unlogged and/or unburnt forest patches of sufficient size (20 - >100 ha.) to sustain viable populations of vulnerable and threatened late stage dependent fauna like Greater Glider and Yellow-bellied Glider.

ESAs and other reserves provide substantial areas of retained habitat at both compartment scales (about 5%-45%) and landscape scales (about 45%) within NSW state forests, but the pattern and distribution of these retained areas does not guarantee protection of important unburnt refuges and biodiversity conservation. Critical landscape features including unburnt refuges and late stage forests are not targeted for protection, and retained areas are often too small, too isolated, contain unsuitable habitat, are not specifically located in fire refuges, and are not connected across the landscape by a network of permanent protected corridors in low fire risk areas across all public tenures.

An example of the application of standard CIFOA to a burnt logging compartment (58a) in South Brooman is shown in Figure 4. This figure shows the location of all ESAs within the compartment. Individual retained habitat trees are not represented and these may be scattered across the net harvest area (yellow), where they are available (note, it is possible that many habitat trees have been burnt out and lost as a result of the wildfire). Examination of Figure 4 shows that ESAs are largely confined to riparian strips and some small, isolated patches. Once all the yellow area in this compartment is harvested the mature forest dependent fauna like Greater Glider (*Petauroides volans*) and Yellow-bellied Glider (*Petaurus australis*) will be eliminated and remain permanently absent if the forest is re-harvested within about 60 years. The riparian strips are too small and narrow (<200 m width) and the ESAs are too small (< 20 ha) and isolated

to sustain viable populations of species such as Greater Glider in the short or long term (Smith 2002, Smith et a 2002). The corridor system along the riparian zones is too long and narrow to be certain of sustaining resident populations of Greater Gliders or Yellow-bellied Gliders (Goldingay and Kavanagh 1991, Smith 2002, Smith et al 2002, McLean et al. 2018). If the pattern of proposed harvesting in South Brooman compartment 58a is typical and is extended to adjoining compartments over time (within the next 10-20 years) it is likely that mature and old growth dependent Greater Gliders and Yellow-bellied Gliders will be eliminated from the entire compartment and all the surrounding landscape with similar retention and harvesting patterns.

It can be concluded that the standard CIFOA will not deliver ecologically sustainable management as required under the objectives of the *Forestry Act 2012* and is likely to cause a significant impact under the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Table 1: Forest habitat components sensitive to fire and logging, standard mitigation measures in the CIFOA (2018), notes on their effectiveness and recommended changes for details refer to Appendix A.

	CIFOA Conditions	Effectiveness	Action Needed
Landscape Scale Components			
Reserves (> 5-20 ha)	Limited to existing CAR reserves	Unknown	Review adequacy for sustaining viable populations
Fire Refuges	none	None	Model, map and protect
Old growth (large patches)	Exclusion of existing mapped CRAFTI old growth, re-evaluate on unassessed land	limited, no adequate recruitment, patches small and isolated, not linked	Need to ground truth, review OG definition, expand to include uneven-aged forest & Greater Glider habitat. Recruit in areas where scarce
Mature and Uneven Aged Forest (large patches)	none	none	Reduce intensity of selective harvesting, increase minimum retained basal area across all large tree size classes
Mature Forest (large patches)	none		Longer rotation
Links and Corridors	Ridge and headwater habitat	Too narrow, limited occurrence and puts all mature forest components at the head of ridges where bushfire risk is high	Permanent wildlife corridors Permanent roadside corridors
Riparian & Aquatic Zones	Riparian Strips	moderate	Widen
Compartment Scale Components			
Old growth (small patches 1-5 ha)		Limited to existing mapped	Retain 50% minimum area unlogged at compartment scale
Mature & Uneven Aged Forest (small patches)	Harvesting Intensity Limits	Not effective selective harvesting too intense	Reduce intensity of selective harvesting, increase minimum retained basal area across all large tree size classes
Hollow Trees	Habitat tree retention	Mostly satisfactory	
Recruitment Hollow Trees	Tree Retention Clumps (5-8%)	Satisfactory (non-regrowth zone)	Recruit into intensive harvest areas
Food Trees	Food Tree retention	Limited, not permanent	Permanent protection needed
Roost Trees	Pre-log survey exclusion zone	Limited	Permanent protection needed
Understory Shrubs	Habitat Clumps (10-13%)		Pre-harvest surveys ineffective after severe fire, need to wait 5 years
Heath	Habitat Clumps (10-13%)	unknown	
Ground Cover	Habitat Clumps (10-13%)	Unknown, limited	
Rock Outcrop & cliff	Buffer	unknown	
Large Logs (CWD)	Habitat Clumps (10-13%)	None- limited	Declines over time without old growth recruitment
Aquatic Riparian zones	Riparian exclusion strips	moderate	widen
Rare & Poorly Known Species	Pre-log survey & exclusion zone	limited	More comprehensive pre-log survey, less reliance of mapping, include indicators species
Monitoring and Adaptive Management			
	Post-logging Surveys	limited	All compartments at least once
	Long term Monitoring	limited	Scientifically adequate sample
	Data Analysis & Validation	none	Critically important

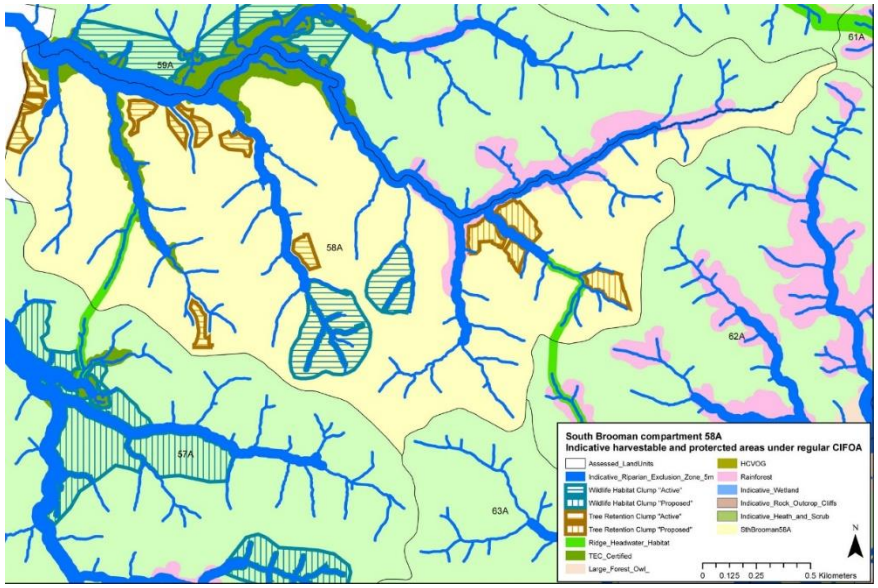

Figure 4: harvesting and retention areas on South Brooman Compartment under standard CIFOA

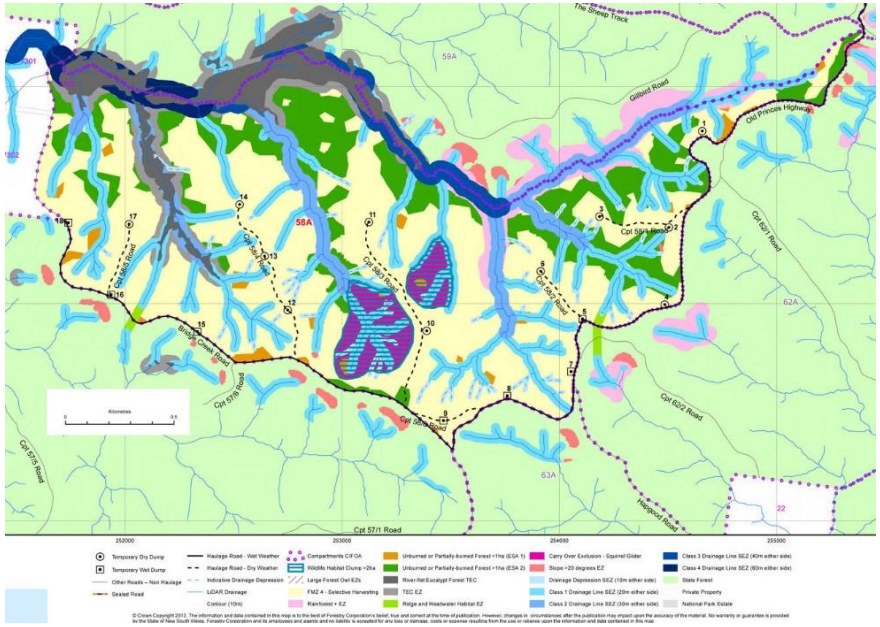

Figure 5: South Brooman under standard CIFOA + SSOC. Note: the additional areas to be retained (e.g. unburned and partially burned areas shown in dark green), additional riparian buffers and temporary clumps) are only required to be retained for the period of the SSOC (i.e. 12 months) after which timber harvesting could proceed in these temporary ESAs.

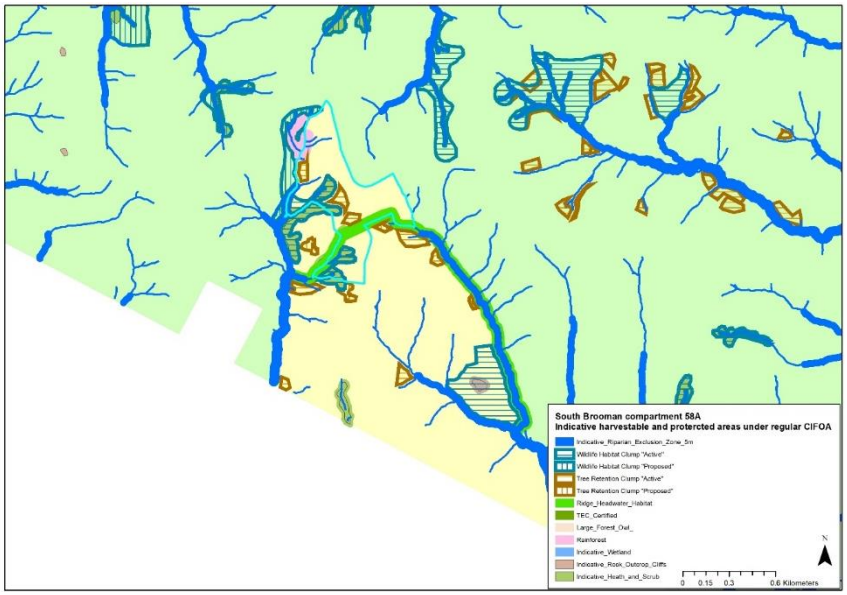

Figure 6: Yambulla 290 standard CIFOA. Note, Yambulla 290 is in an area subject to alternate coupe harvesting, where, the catastrophic population consequences of the 2019/20 wildfire are likely to be far more pronounced due to population impacts from historic intensive harvesting and the population recovery period likely to be lengthy (>100 years) (s3.4.2). The yellow highlighted area represents a 'coupe' that would be subject to intensive harvesting under the 'alternate coupe' harvesting approach in the CIFOA.

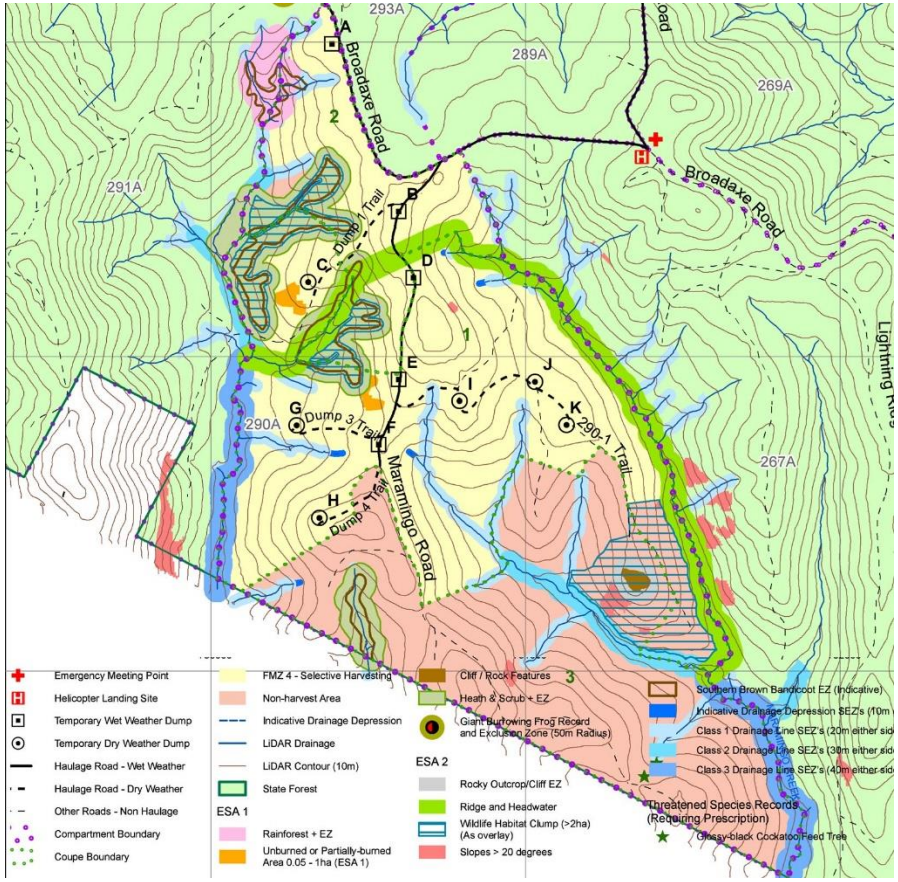

Figure 7: Yambulla 290 CIFOA + SSOC. Note the cream/yellow area is the Net Harvest Area (only part of the compartment is being harvested) and only small areas of partially unburned available and to be retained for 12 months. The additional areas to be retained (e.g. unburned and partially burned, additional riparian buffers and temporary clumps) are only required to be retained for the period of the SSOC (i.e. 12 months).

3.3 Adequacy of the CIFOA and Site Specific Operating Conditions in mitigating logging impacts in fire affected forests

The EPA SSOCs are potentially adequate to mitigate impacts of fire and logging if they are further modified and made permanent, or applied for a minimum period of 20-40+ years and reviewed only after long term monitoring has proven them to be no longer necessary. EPA SSOCs have been developed in consultation with FCNSW and Department of Primary Industry (DPI) and add mitigation measures to the standard CIFOA. The SSOC are in place for a 12 month period of time after the SSOC are issued in an attempt to facilitate biodiversity recovery in the post fire environment. This short period of validity of the SSOC is the principal reason why the CIFOA plus SSOC is also not adequate in mitigating the impacts of logging on biodiversity (i.e. the remainder of the compartment can be harvested 12 months later at a crucial period when biodiversity is recovering). Evaluation of the SSOC has been done using two different examples of landscape wildfire burnt patterns (Figure 2-3) that have impacted compartments, South Brooman 58A and Yambulla 290 (Figures 4-7).

A summary of additional conditions for South Brooman 58A and Yambulla 290 and a summary assessment of their effectiveness is given in Table 2. The principal effects of the additional SSOCs is to:

1) Increase the total and percentage area of forest in ESAs (unlogged) at the compartment scale to around 40% or more in South Brooman, though less in areas such as Yambulla where severe widespread wildfire limits the amount of unburnt forest available.
2) Temporary protection of lightly burnt and unburnt fire refuges that are greater than 0.05ha until the adjacent more severely burnt forest recovers.
3) Increase the width of riparian zones improving their function as wildlife corridors (also to manage erosion and water quality), increasing the overall area and percentage of forest retained, and increasing proximity of regrowth forest to future old growth in unlogged riparian corridors and strips.
4) Retain all hollow bearing trees and some specific habitat values in the net harvest area.

None of these additional conditions for the burnt areas are likely to mitigate fire and logging impacts or have substantive biodiversity benefits because the time frame (12 months) of application for all but the latter (retention of all tree hollows) is too short. The time required for recovery of many threatened and sensitive species after average fires ranges from around 10 to more than 120 years. The following general fire/logging recovery intervals can be expected for some key fire sensitive indicator species and groups based on surveys of forests subject to past wildfires:

- The Koala is most abundant in north east forests unburnt for 45 years (Law et al 2017);
- the Greater Glider in Dry Sclerophyll Forests (DSF) unburnt for 10-20 years (Smith et al 1994, MacLean et al 2018) and in Wet Sclerophyll Forests (WSF) unburnt for 60-> 120 years (Incoll et al. 2001, Smith 2019);
- the Hastings River Mouse in north east forests unburnt areas for 10 years (Smith and Quin 1996);
- The Long -nosed Potoroo in south east forests unburnt for more than 20 years (Catling et al 2001) and;
- arboreal mammals in general in forests unburnt for 10 years (Smith and Murray 2003).

These time spans can be expected to be longer after the 2019/20 fires in the most severely burnt landscapes, such as Yambulla State Forest. **This means that SSOC for fire affected landscapes would need**

to remain in place permanently or for minimum periods of around 20-60 years in DSF and much longer (40->120 years) in WSF in order for biodiversity to recover from the 2019/20 fires. If these conditions were applied permanently to provide protection against future fire and logging, and similar or equivalent patterns of unburnt and lightly burnt forest distribution occurred on adjacent compartments across the landscape, **it is likely that timber harvesting would not have a significant impact on biodiversity in the less severely burnt areas like South Brooman**. In the more severely burnt areas like Yambulla additional standards will be required to protect a minimum percentage of the least burnt forest.

The most important condition in the SSOCs and recommendations are those requiring the protection of unburnt and lightly burnt forests and their inclusion in ESAs. The average percentage of the net harvest area unburnt or only lightly burnt (>90% green canopy) in State Forest regions ranges from about 25 – 45% (FCNSW 2020). Within individual compartments the percentage unburnt or lightly burnt is more variable from near zero to more than 50%. An example the effect of CIFOA and SSOCs on a timber harvesting compartment at Yambulla where widespread severe wildfire occurred as shown in Figure 7. In this compartment the area of unburnt and lightly burnt forest is so small that the net increase in total area of ESAs under the SSOC is likely to be insufficient to prevent a significant impact on biodiversity even if it were permanently protected. In order to protect biodiversity in compartments with low percentages of unburnt and lightly burnt forest like those in the Yambulla region, the EPA's approach of 23 May 2020 has also proposed protecting the least burnt 50% of each Local Landscape Area (LLA). If this condition was adopted, made permanent and applied to adjacent compartments across the landscape it would allow a significant proportion of the forest (50% +) to recover from the effects of fire and allow biodiversity to recover slowly over the long term. In the Yambulla region shown in Figure 3 this would require protection of most of the moderately burnt as well as unburnt and lightly burnt forest.

There is an option to trade off high (50%) ESA retention limits if selective harvesting intensity is reduced to remove no more than 40% of the natural medium and large tree standing basal area in unlogged forest such that late stage forest dependent fauna like Greater Glider and Yellow-bellied Glider are maintained within the net harvest area and are not wholly dependent on unlogged ESAs for survival. This would require effective pre-and post-logging survey of tree size distribution and glider abundance and subsequent monitoring over several years and decades to demonstrate that late stage uneven aged forest structure is maintained and that these old growth fauna species are not eliminated. At present no such data is available, and none is likely to become available until effective monitoring has been undertaken.

Table 2: Summary of key additional SSOC for the South Brooman and Yambulla compartments with a summary of impacts and comparisons with the standard CIFOA.

SSOC (Conditions)	South Brooman 58A Comment/comparison to CIFOA alone	Yambulla 290 Comment/comparison to CIFOA alone
13 unburned and partially burned areas are protected for 12 months	Effectiveness depends on area unburned or lightly burned, and the duration of protection. In South Brooman the area unburned was moderately high which will be highly effective in biodiversity impact mitigation if protected for a minimum 20 years, and much more so if permanently protected.	Very limited areas of unburned and partially unburned – i.e. condition will be ineffectual.
13. Wildlife Clumps. Prioritize unburned and partially burned areas include in wildlife habitat clumps and tree retention clumps	All unburnt and lightly burnt forest should be protected for a minimum period of 20 years	Very limited areas of unburned and partially unburned – i.e. condition will be ineffectual.
15 to 21 Pre-logging Surveys. Where safe to do so.	Pre-logging surveys will be ineffective for most species in severely burnt areas for 5->20 years after fire.	
22 All hollow bearing trees are to be retained in the harvestable area.	CIFOA has requirement for 8 trees per ha for selective harvesting and all HBT in intensive harvesting. Effectiveness depends on compliance. Highlights a need for monitoring and validation analysis.	Few hollow bearing trees likely to be present in Yambulla SF due to intensive harvesting history. Need to recruit hollows and old growth into coupes.
24 at least 10 dead trees per ha to be retained, balance can be harvested	CIFOA states that all dead standing trees to be retained condition 64.2, impact of change depends on number of trees killed by fire.	
27 retain all living giant trees. Prioritize dead giant trees for inclusion in clumps	Same as CIFOA. Upgrade to mandate inclusion of all dead giant trees in clumps to provide for future CWD (coarse woody debris), change definition of giant tree to all tree > 120 cm dbh (WSF) all trees > 100 cm dbh DSF.	Few if any giant trees likely to be present in Yambulla SF due to intensive harvesting history.
29 a) Permanently retain all live red gums and swamp mahogany over 20cm DBH	Reality is, many of these would be protected in riparian and TEC mapping – there'd be a few red gums outside this mapping potentially.	
b) retain at least 10 live *Allocasurina* spp over 10cm DBH per ha in net harvest area	Any live ones are likely to be in the unburned/partially burned areas anyway.	
c) retain all unburned banksia, Acacia spp., Xanthorhoea spp.	Critical for more rapid recovery of biodiversity.	
31 to 34 Requires protection of temporary feed tree clumps in 5% of the area available for harvesting.	Ineffective. Nothing to stop FCNSW from removing this after the 12 months has lapsed. Most dependent fauna will not have recovered within 12 months.	
37-41,42 Widening of existing buffers around some retained habitat, effects shown in the attached map.	Will slightly increase retained area of forest on compartments.	
42 wider riparian strips	Will increase width and potential effectiveness of corridors if made permanent, little or no biodiversity benefit if only temporary.	

3.4 Adequacy of EPA NSW proposed CIFOA amendment for fire affected landscapes

This section critiques the adequacy of the EPA proposal to move away from the SSOCs 6 months after the wildfire and shift towards either an CIFOA amendment or a new protocol to address the longer term impacts of the wildfire and compounding impacts of logging on the environment.

3.4.1 23 May 2020 EPA proposals and correspondence

The EPA proposal attempts to find a balance between managing impacts on the environment and allowing some harvesting. In particular, it acknowledges that some areas of partially burnt forest may become open to harvesting, provided that the critical landscape elements for biodiversity remain (e.g. additional riparian buffers, fire refuges) and provides a Local Landscape Area (LLA) approach to manage cumulative impacts.

Table 3: EPA proposal to move forward with timber harvesting outside of SSOCs based on a combination of SSOC conditions and the EPA position/approach.

Key EPA proposal components	South Brooman 58A Comment/comparison to CIFOA alone	Yambulla 290 Comment/comparison to CIFOA alone
Maximum 20% of the LLA can be harvested	Need to specify time period over which 20% limit applies, ineffective unless applied for at least 40 years. Recommend a different approach with a maximum 50% harvest at compartment and landscape scales and minimum 50% permanently protected at LLA scale.	
The least burnt 50% of an LLA must not be harvested.	Good initial approach to mapping and preserving fire refuges in burnt areas but may be better to also consider remaining forest structure and fire risk models (eg. Leonard et al 2014) over longer term.	Essential in severely burnt areas to allow time for recovery before future fires and logging.
Additional 10 m buffers on all riparian EZs	Need to make permanent to improve function of riparian strips as wildlife corridors for terrestrial (non-riparian or aquatic) fauna.	
Modified survey expectations: • CIFOA targeted survey requirements do not apply • CIFOA BAHS requirements do not apply • SSC post-fire survey consisting of: o Survey targeting Wildlife and Conservation Bushfire Recovery Immediate Response Red List species o Habitat features o Fire responsive threatened flora species	May not be of much use in short term, as will get low return and target more common and adaptable species until forest recovers in 20 years, but essential over long term to validate effectiveness of mitigation standards and apply adaptive management	
No other harvesting in LLA for five years	Insufficient time to allow full recovery of the ecosystem from wildfire and logging disturbance.	
No regular CIFOA forestry operations within 5km of a 2019/20 fireground within two years of the date of fire	Need unlogged buffer around small unburnt, lightly burnt areas (<20 ha. patches) to allow opportunity for local fauna populations to survive long enough to disperse outwards over time	The need for buffers will depend on the pattern of retained, least burnt forest. The main aim of buffers should be to infill and link unburnt and lightly burnt refuge patches. It would be more appropriate to remove the buffer standard and replace with a corridor standard.

3.4.2 Yambulla YBG Population Viability report

EPA provided an internal report that looks to undertake a Population Viability Assessment (PVA) using VORTEX of the Yellow-bellied Glider population in Yambulla State Forest (EPA 2020). This section provides a critique of the PVA and recommendations. The species information, life history, home range size and dispersal model inputs in the EPA PVA are similar to model inputs in previous PVA modelling studies, but more conservative, so they may underestimate actual population declines. The EPA model predicts that a population of below 25 pairs in a 1500 ha LLA has a moderate to high (15 % to 25 %) probability of extinction in the next 100 years. In contrast a PVA study by Goldingay and Possingham (1995) predicted that populations of 390 individuals or habitat areas of over 18000 -35000 ha are required to be certain of Yellow-bellied Glider persistence for 100 years.

The findings of EPA (2020) indicate that the population of Yellow-bellied Gliders within a Yambulla State Forest LLA has a high probability of extinction, even in the absence of proposed harvesting, and the period of time for the population to recover from the 2019/20 wildfire may take over 100 years. Modelling the additional impacts of harvesting in the LLA sends the population of 34 individuals on a continued and more rapid downward trajectory towards extinction (Figure 8). There are some empirical data for Squirrel Gliders (*Petaurus norfolcensis*) which supports the predictions of the EPA PVA models for the related Yellow-bellied Glider. Studies of the Squirrel Glider (Smith 2002) found that populations in small isolated patches of habitat needed to be in excess of about 100 individuals to have a high (>90%) probability of survival over 40-100 years, which is about the duration of a single logging coupe rotation or the interval between major wildfires. The size of habitat patches required to sustain this many Squirrel Gliders is 250 ha, or 170 ha for Greater Gliders and 1250 ha for yellow-bellied Gliders. Much larger areas will be required to sustain glider populations over the long term. Studies of wildlife persistence on offshore islands isolated by rising sea levels about 8 thousand years ago have shown that habitat patches about 10 times this size are necessary to maintain viable populations for thousands of years.

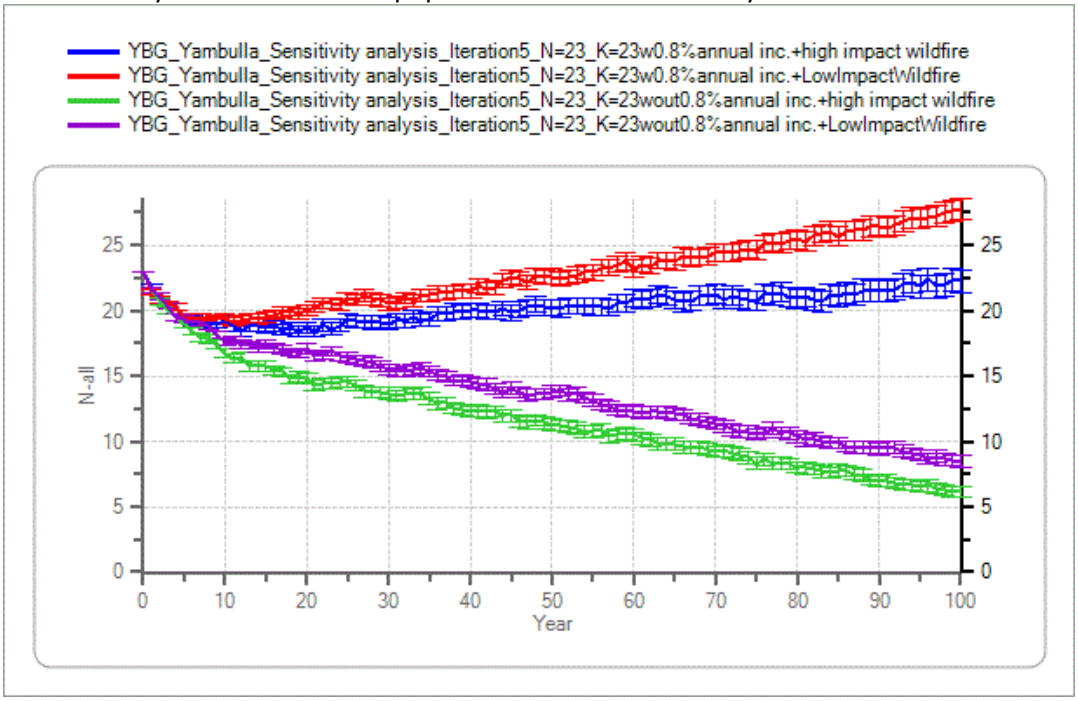

Figure 8: Excerpt figure 3 from EPA (2020). Y axis is number of yellow-bellied glider pairs in an LLA, x axis is the years projecting forward after the wildfires. The red and blue graph shows low and high modelled impacts from the wildfire and purple and green show the low and high modelled wildfire impacts with low and high modelled impacts of harvesting.

Based on the findings of the Yambulla study it was recommended (EPA 2020) that:

1. Any timber harvesting mitigations should adopt the precautionary approach and worst-case population impacts should be assumed until post wildfire population data has been acquired.
2. Post wildfire timber harvesting mitigations should include but not be limited to:
   a. No more than 20 % of the LLA is to be harvested in the next five (5) years;
   b. Timber harvesting is to be selective and retain all hollow bearing trees and other important habitat features.

If the first of these points is accepted then the second should be rejected, there should be no further logging in this LLA unless further monitoring surveys and studies show that the local population extends into adjacent LLAs and national parks and exceeds 100 individuals, and then only if this population is shown to be linked to others in the surrounding area with a combined size of 1000 individuals or 12,500 ha.

Recommendation 2 b) relies on an assumption that selective timber harvesting with retained habitat trees will sustain Yellow-belied Gliders within the net harvest area. This assumption is not supported by studies of Yellow-bellied Gliders which have shown that they are found predominantly or only in old growth forests, and uneven aged forests dominated by large older stems (> 60 cm dbh) (Milledge et al 1991, Eyre and Smith 1997). Current definitions of selective logging, and limits to selective harvesting intensity in CIFOA guidelines for NSW forests are not consistent with maintenance of the mature uneven age forest structure required by Yellow-bellied Gliders (Smith 2001/10). Current limits to selective logging allow forests to be intensively logged and effectively clear felled with retention of scattered habitat trees because basal area retention limits are too low (10-12 m2/ha.) and there is no requirement to focus retention on large and medium sized trees to maintain forest structure. The adequacy of ESA for protection of Yellow-bellied Gliders and maintenance of other threatened species and biodiversity will require and depend on assessment and mapping of the following information within logging compartments and the LLA in its entirety:

- Forest type;
- Time since wildfire, intensity of wildfire, frequency of wildfire;
- Forest age and growth state (regrowth, pole, mature, old growth or uneven aged with mature and old growth, uneven aged without mature and old growth); and
- Forest Structure and Stand Basal Area by tree size class for each forest type and growth stage present.

In summary, EPA (2020) provides model inputs consistent with the literature, but falls short when it comes to appropriate recommendations to avert extinction of Yellow-bellied Gliders and gliders in general. Section 4 of this report provides additional recommendations for gliders to address this shortfall.

3.5 Adequacy of Forest Corp NSW proposal for logging in fire affected landscapes

3.5.1 7 May, 3 June and 17 June 2020 FCNSW proposals and correspondence

FCNSW has made submissions seeking modification or removal of the SSOCs and initially a return to CIFOA standard conditions for a number of logging areas and compartments in Eden and the South Coast. More recently, FCNSW now seeks to return to the standard CIFOA across its jurisdiction in coastal NSW. Generally, they seek a removal of the additional riparian buffers, seek to harvest partially burnt areas where it is widespread (e.g. South Brooman State Forest) and removal of temporary habitat clumps to increase the net area available for harvest. The justification has mostly been focused on the need to maximise wood volume and assumes that post-fire vegetation regrowth has now stabilised soil in most cases and that management of biodiversity/fauna populations is no longer a risk some 6 months after the

wildfire. Justification for these changes is minimal and based on erroneous claims that the use of selective harvesting will be sufficient to maintain biodiversity in the net harvest area. Their observation that "*most FCNSW operations are selective harvesting and will be planned to cover 25-75% of an LLA. In the intensive zones the normal CIFOA limits are 33% (North East) and 50% (Eden) for any LLA*" is not sufficient to sustain biodiversity under the current low minimum basal area limits that define selective harvesting.

The focus of FCNSW proposal is that continuation of SSOCs will cause a substantive increase in ESAs and reduction in harvestable wood volumes. The extent of increase in ESAs and reduction in wood volumes for 5 sample compartments in South Brooman is shown in Table 4 below. FCNSW has argued that these conditions "*are significantly beyond FCNSW expectations and would have an immediate and substantial impact on FCNSW ability to meet wood supply agreements (WSA) in the short term and for the next 5 years by making large tracts of otherwise harvestable forest unavailable. EPAs 5 year condition would extend the impact well beyond the scope of the SSOCs negotiated and agreed by the EPA and FCNSW between November 2019 and May 2020*." FCNSW claims that "*to lose more than half of the planned compartments for next year from across all of the Coastal IFOA areas would simply mean that FCNSW could not guarantee timber supply to any WSA customer next year and likely for the next 5 years*."

Reduction of timber yield is not relevant to a biodiversity impact assessment. It is not a matter that is taken into consideration in tests that assess the significance of impacts on threatened species under the *Biodiversity Conservation Act 2016* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. It is the responsibility of FCNSW to set timber yield at levels that achieve ecologically sustainable forest management and do not cause an ongoing or irreversible decline in biodiversity by over committing an unsustainable supply. The 2019/20 fires have highlighted the necessity for yield levels to be conservative and for any forward commitments to include escape clauses in the event of severe or above average wildfire.

FCNSW has also objected to an increase in the width of riparian buffers under SSOCs. They state that "*FCNSW note that the scientific basis for stream buffers on Class 1 & 2 drainage lines relates to soil and water protection, while Class 3+ buffers are in place to provide extensive network of riparian corridors across the landscape. FCNSW has proposed additional buffers on class 1 & 2 drainage lines where there is a lack of ground cover and where soils are therefore unstable and not fully recovered from the fires. This maintains the established scientific principle of soil and water protection in forestry operations. Importantly, FCNSW only support that these additional buffers where an assessment of ground cover and general stability has determined it is necessary. From field inspections across the CIFOA areas FCNSW believe that these buffers would not be required in many harvest areas and as such the impact of applying such buffers would be marginal. FCNSW do not support additional buffers on all riparian exclusions. These buffers are not in place for soil and water protection (class 3+ buffers are already 40m+ wide) but as a landscape biodiversity provision. The EPAs proposed extension of riparian corridors across all areas cannot be reasonably justified against the WSA requirements. The net impact is not possible to accurately forecast in the time allowed, but FCNSW estimate that it would likely be in the order of a 20% reduction of available timber."*

FCNSW acknowledges that a key role of riparian strips is to function as wildlife corridors. Available scientific data on wildlife corridors indicates that current riparian zones are generally too narrow to be effective in maintaining resident populations of old growth dependent fauna and should be increased to minimum 150+ m forest width to have a possible effect (Goldingay and Kavanagh 1991). Examination of

the pattern of stream retention on Figures 2 and 3 indicate that there would be some merit in removing the SSOC requirement for widening class 1 streams, but maintaining it on class 2 streams and widening it considerably to 150m on class 3 and larger streams.

FCNSW has also noted that they want to prioritize timber harvesting in burnt areas where there is a high likelihood that trees will die or significantly degrade due to the effects of the fires. This area where SSOCs and FCNSW objectives appear to have common ground only applies to the Alpine Ash (*Eucalyptus delegatensis*) forests around Tumut.

Table 4: FCNSW statistics for areas excluded from harvesting and wood volume declines associated with CIFAO and SSOCs.

% Protected under different scenarios	Burnt Area 1,003 ha (52%)	Partial Burn/Unburnt Area 936 ha (48%)
Normal CIFOA Exclusions	24%	22%
CIFOA with additional S&W Protections only	39%	35%
Normal CIFOA + 20% temporary clumps in partial burn (FCNSW position).	24%	38%
CIFOA + S&W protections + 20% Temporary Clumps in partial burn areas (EPA Position)	39%	48%

Harvestable Ha	High Volume Area (Grey ha) (@30m3/ha)	Low Volume Area (Yellow ha) (@10m3/ha)	Total Area (ha)	Total Volume (m3)	Volume Recovery
Normal CIFOA	654	831	1485	27,935	100%
CIFOA with S&W buffers	447	761	1209	21,036	75%
CIFOA with 20% Partial Burn only (FC Proposal)	602	738	1340	25,438	91%
CIFOA+S&W+20% (EPA proposal)	412	676	1088	19,131	68%
*Likely EPA Outcome w Operational Constraints	300	500	800	14,000	50%

*Realistically the double hit of wider stream buffers and 20% clumps all within partial burn areas makes compartments such as 55A, 56A, 66A and 49A unsuitable to harvest under SSC as the higher volume areas on lower slopes underpin the viability.

Position	EPA	FCNSW
Partial Burn Area Protection	48%	38%
Volume Maintenance	50%	91%

3.5.2 Review of Forestry Corporation (2020) - 2019-2020 Wildfires Environmental Impacts and implications for timber harvesting in NSW State forests. September 2020.

The scale of FCNSW operations in State Forests and extent and severity of the 2019/20 wildfires have the potential to cause a combined adverse impact on biodiversity of considerable magnitude. A potential impact of this size merits an environmental impact assessment of the highest scope, rigour and calibre. The FCNSW 2020 Wildfires Environmental Impacts and implications for timber harvesting in NSW state

forests report of September 2020 falls well short of this requirement. It lacks a comprehensive and rigorous scientific review of fire and logging impacts, it fails to provide any monitoring data from the previous 20 years of harvesting to justify the effectiveness and continuation of past practices, it relies on unsubstantiated overly optimistic assumptions, it fails to consider cumulative impacts of past and future fires and logging on threatened species population trends, and comes to conclusions at odds with existing scientific knowledge. In short it risks causing a real and substantive decline in biodiversity and local threatened species extinction across coastal NSW and provides no justification for moving beyond the Precautionary Principle. Failure to monitor harvesting impacts over the past 20 years, in conjunction with the severity of the 2019/20 fires, has necessitated the adoption of new and expanded precautionary standards for mitigating logging impacts in fire affected landscapes.

The FCNSW fire and biodiversity impact report (FCNSW 2020) states that it aimed to assess whether there are any impacts on biodiversity arising from the 2019/20 fires that should be taken into account in planning and carrying out future management activities within native State forests, particularly in relation to timber harvesting. FCNSW (2020) describes fire extent and severity in NSW state forests by region and short-term ground cover recovery. It assessed the potential impacts of the 2019/20 wildfires on key habitat features and individual threatened fauna by overlaying fire severity mapping with a range of key mapped communities, species habitat models if available and species records where models were not available. The assessment claims to apply the precautionary principle *to ensure that serious or irreversible environmental damage is prevented*, but fails to make any rigorous scientific assessment of the effects or either fire, or logging, or both combined on threatened species population trends or biodiversity in general.

The FCNSW report measures the percentage of threatened species ranges that have been burnt at high medium and low intensities, and the proportion of each threatened species modelled range that has been burnt at moderate to high intensities in the harvestable and non-harvestable areas of state forests. It notes that ranges of many threatened species have been greatly reduced by fire but concludes that "*the potential for significant impact on any of species over the next five years from timber harvesting operations assessed is low as most preferred habitat is not available for harvest and only a small proportion of that available will be harvested in the coming 5 years*." This, approach is overly simplistic and inconsistent with state (Biodiversity Conservation Act 2016) and Commonwealth (EPBC Act 1996) guidelines for significant impact assessment. These guidelines outline many circumstances under which a low annual impact on threatened species or their habitats can be considered significant, none of which have been addressed in the FCNSW report. A low impact is potentially significant if it places a viable local population of a species (eg. the Yellow-bellied Glider) at risk of extinction, or if it removes, fragments, or isolates habitat that is important to the long term survival of a species, such as fire refuge areas and late stage mature and old growth forest. The FCNSW report disregards the following impacts:

a) The need to consider the effects of the size and pattern of remnant habitat patches remaining after fire and logging on the viability of threatened species local populations, especially those dependent on mature and old growth forest stages.
b) The importance of protecting unburnt/lightly burnt fire refuges from harvesting over the next 10-120 years to allow time for relict surviving populations of threatened and other fauna species to expand into the surrounding forest as it recovers after fire.
c) The cumulative impacts of fire and timber harvesting over time, especially in the absence of adequate wildlife corridor networks, lack of protected fire refuge areas, and failure to retain

habitat in large enough patches (20-100 ha.) to sustain viable local populations in isolation for periods of 10-60 years while they wait for surrounding forest to recover from fire and logging.

Ecologically sustainable forest management requires that species are retained throughout their natural range, and not just in public national parks and nature reserves, in order to maintain genetic diversity and the capacity for continued evolution. Current evidence indicates that fire and logging is causing progressive declines in the population size and abundance of sensitive and threatened species like the Greater Glider and Yellow-bellied Glider leaving local populations in state forest isolated and vulnerable to genetic drift and extinction (Lumsden et al 2013, Lindenmayer and Sato 2018).

The FCNSW (2020) impact assessment acknowledges that "*Large-scale high-intensity fires can cause widespread habitat destruction and direct mortality of flora and fauna species (Lindenmayer et al. 2013; Mclean et al. 2018*)", but fails to consider the additional impact of harvesting and offers no effective mitigation measures for either fire or harvesting. The report notes that "*patches and areas burnt at low severity serve as habitat refuges after fires, offering habitat that allows for persistence and recolonisation of populations from these unburnt areas*, and that "*that long unburnt habitat patches can be important for particular species*; but it offers no mechanism to identify and protect unburnt or lightly burnt fire refuges for sufficient length of time for recovery to occur. Instead FCNSW are now proposing to harvest in some unburnt refuges.

In its case study of the Greater Glider, the report states that the "*CIFOA manages these harvesting risks by requiring at least eight hollow-bearing trees to be protected per hectare where they occur and placing harvesting limits to retain basal area across most of the Greater Glider habitat*". As discussed in s2.2, minimum tree basal area retention limits for selective harvesting imposed under the CIFOA are inadequate (too low) to maintain Greater Gliders within logged areas, and wildlife habitat tree retention for this species is ineffectual as harvesting rotations are likely to be too short for logged forests to advance to a late stage forest structure suitable for Greater Gliders to return. Even if habitat does regenerate sufficiently for gliders to return there is nowhere for them to return from because retained wildlife habitat clumps are too small to support resident breeding populations of this species, there are no mandated corridors or links connected to reserved patches of Glider habitat and there is no requirement for any reserved or retained patches of Greater Glider habitat to be large enough to sustain viable populations over the short term of single logging rotations (40-100 years) or the long term (1000+ years). Studies in Victoria have shown that retained mature and old growth forest patches in timber production forests have to be larger than 60 hectares in size to have an 80% chance of sustaining Greater Gliders and more than 130 hectares in size in order to have a 30% chance of sustaining Yellow-bellied Gliders (Incoll et al 2001). Yet the FCNSW report fails to consider the effects of mature and old growth patch size and isolation on the ability of these and other threatened species to persist in burnt and logged forests.

The FCNSW report notes that 32% of Koala habitat in state forest was burnt at high intensity and that the "*Koalas' low reproductive rate means populations are likely to recover slowly where source populations were reduced to a small size*". But no attempt is made to identify such areas or make provision to protect small remnant Koala populations. Studies by Law et al (2017) have shown that Koalas are extremely vulnerable to fires. Fire frequency and intensity in the previous 45 years is the best predictor of Koala occurrence in northern NSW forests, Koalas are least abundant in areas with more than 3 fires every 45 years. Retaining food trees in clumps is not sufficient to protect Koalas, the key to their survival is permanent protection of long unburnt areas (> 45 years) and fire refuges such as moist gullies adjacent

to feeding areas. This cannot be achieved without targeted pre-logging Koala surveys, protection of existing Koala populations, and the modelling, mapping and permanent protection of Koala fire refuge areas adjacent to known populations.

In general, FCNSW (2020a) erroneously assumes that impacts of timber harvesting and wildfire on threatened species and biodiversity can be addressed by continuation of current practice and increased retention of a few small scattered habitat clumps within the net harvested area. An overly simplistic approach that appears to have been justified on the basis of unvalidated, unproven, theoretical retention harvesting concepts (Gustafsson et al 2012) of sustainable forestry derived primarily for northern hemisphere forests with little or no relevance or transferability to Australia. FCNSW has failed to demonstrate and is unable to conclude, that normal CIFOA timber harvesting practices will not have a significant impact on biodiversity in burnt areas. Under these circumstances it would be appropriate to apply new highly precautionary measures to limit harvesting extent and intensity in burnt areas to prevent environmental harm and limit the risk of serious or irreversible damage to threatened species and biodiversity.

4 Recommendations

As concluded above, based on the absence of key scientific knowledge/data on the impacts of the 2019/20 wildfire on biodiversity and the need to apply the precautionary principle, the 2018 CIFOA alone, or even with the addition of SSOCs, will not deliver Ecologically Sustainable Forest Management (ESFM) without additions and modification. Current CIFOA Conditions and Protocols for timber harvesting contain no specific measures to protect biodiversity from the cumulative, and additive or multiplicative effects of fire and logging.

This report recommends new minimum standards for timber harvesting scale, intensity and pattern that mimic and do not exceed those caused by wildfire, and which can be considered precautionary limits necessary to maintain viable populations of our most vulnerable fauna. These standards focus on permanent protection of large forest patches (>20 ha) across regions and landscapes based around fire refuges (areas of forest that are least likely to be burnt and which are likely to provide fauna source populations after fire), old growth and mature and uneven-aged forest remnants with existing populations of Greater Gliders and or Yellow-bellied Gliders, and the linkage of all these retained areas in a network of permanent wildlife corridors. This report also recommends the adoption of new standards to reduce and limit the intensity of so-called selective harvesting by increasing minimum tree basal area limits and minimum medium and large tree stocking limits. This is essential to ensure that populations of sensitive and threatened fauna, such as Greater Glider and Yellow-bellied Glider, that are dependent on mature and late stage forests are maintained within the harvest area consistent with principles of ecologically sustainable forest management. In the absence of all these additional controls there is a real risk that biodiversity in logged native forests in NSW would progressively diminish to levels marginally above those found in hardwood plantations.

4.1 Key recommendations

Until such time as additional and revised landscape scale conditions have been devised that take into account matters raised in this report it is recommended that the following key conditions be applied to all timber production forests. Unless these conditions are met, it is unlikely that proposed harvesting in burnt forests will meet the requirement of Ecologically Sustainable Forest Management, or adequately

address the precautionary principle as necessitated by the absence of post-wildfire and long term post-harvest monitoring data on biodiversity.

1) That timber harvesting be excluded from all mapped unburnt and lightly burnt forests within state forests for a minimum period of 20 years.
2) That all timber harvesting be limited to a maximum average 50% of compartment area (with a maximum of 75% within individual compartments) and maximum 50% of the total local landscape Area.
3) That the pattern of harvesting at the compartment and landscape scales be modified to ensure that all retained forest patches > 5 ha in size are connected by permanent corridors and that all gaps in corridors created by roads, rivers and other non-forest areas do not create barriers to glider movement and dispersal.
4) That fire refuge areas be modelled and mapped across all compartments and landscape areas to identify and protect those areas of each forest type within each compartment considered least likely to burn or with the lowest burn frequency, and where such areas will initially (for the next 20 years) include all areas unburnt or lightly burnt in the 2019/20 fires.
5) That intensive harvesting (all forms of logging that remove more than 40% of the natural (unlogged) tree stem basal area) be limited to Blackbutt and Alpine Ash forest types, and the size of harvesting patches be limited to "gaps" of 10 hectares or less where gaps are defined as areas wholly surrounded by either unlogged forest or low intensity logged forest (forest that retains 60% or more of the natural tree basal area across all tree size classes.
6) That harvesting intensity under selective harvesting in all DSF be limited to retention of 60% or more of the natural stand basal area across all medium and large tree size classes to ensure that biodiversity is maintained within the net harvest area.
7) That all compartments are subject to comprehensive pre-logging surveys at least once every logging rotation to gather all essential information for application of mitigation conditions and that post logging surveys are undertaken at repeat intervals of 1 to 10 years after harvesting at a minimum representative selection of sites sufficient for statistical analysis and feedback for adaptive management at compartment and landscape scales.

4.2 Monitoring, forest type and species specific recommendations

Appendix A provides all specific monitoring, forest type and species specific recommendations to mitigate the impacts of both the 2019/20 wildfires and proposed timber harvesting. These recommendations have been designed within the context of limited scientific knowledge on the impacts of the wildfires and intensive timber harvesting on fauna populations and the consequent need to apply a precautionary approach.

5 Conclusions

1. The 2019/20 extreme wildfires burnt 37-42% of public forests in NSW and caused an unprecedented reduction in the distribution and abundance of key threatened species including the fire sensitive Koala.

2. The primary effect of fire and logging was to restrict populations of threatened species to a series of small, fragmented and isolated patches of unburnt or lightly burnt forest, referred to as fire refuges, scattered throughout the severely burnt forest.

3. Fauna populations surviving in fire refuges are likely to survive and expand outwards over the next 10-120 years in large unlogged forest reserves. The time required for recovery of threatened and sensitive species after average fires ranges from around 10 - 120 years. Recovery times are likely to be around 10 years for the Hastings River Mouse, 20+ years for the Long-nosed Potoroo and Southern Brown Bandicoot, up to 45 years for the Koala, 20-120 years for the Greater Glider and Yellow-bellied Glider

16. Fauna populations surviving in fire refuges in state forests are at risk of elimination by timber harvesting under the normal Coastal Integrated Forestry Operations Approvals (CIFOA) which could prevent recovery, and cause catastrophic population decline in species such as the Koala, Greater Glider and Yellow-bellied Glider.

4. Available scientific studies of fire and logging impacts have relied heavily on surveys of past fire and logging events which were generally less intense than recent harvesting and fire. This has created a real risk that impacts of current harvesting practices are being significantly underestimated, especially at landscape scales.

5. This review found that timber harvesting disturbance is more severe than the effects of fire in several important respects including the following:
   - it preferentially removes rather than retains natural fire refuge areas commonly found in gullies, sheltered aspects and stands of older forest;
   - retained forest patches are generally too small to sustain viable local populations for the number of years (10-60) required for surrounding forest to recover after logging and fire; and
   - selective logging is too intense and the basal area of retained trees is too low to maintain the natural post-fire forest structure required by mature and late stage dependent fauna like Greater Gliders and Yellow-bellied Gliders, especially in Dry Sclerophyll Forests.

6. While substantial areas of forest are currently protected and retained in ESAs (Environmentally Significant Areas) at both compartment scales (about 5%-45%) and landscape scales (about 45%) within state forests the pattern and distribution of these retained areas does not guarantee biodiversity conservation because they are often too small, too isolated, contain unsuitable habitat, are not specifically located in fire refuges and are not connected across the landscape by a network of permanent protected corridors in low fire risk areas across all public tenures.

7. The standard CIFOA does not guarantee delivery of ecologically sustainable management as required under the objectives of the *Forestry Act 2012* and is likely to cause a significant impact on threatened species under the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

8. Site-specific Operating Conditions (SSOCs) developed by the EPA to manage environmental risks associated with timber harvesting in burnt landscapes to supplement standard Coastal Integrated Forestry Operations Approvals (CIFOA) will have little or no benefit as their time frame of application is too short.

9. There is scope for one of the SSOCs, the requirement to exclude harvesting from unburnt and lightly burnt forests, to mitigate fire and logging impacts if it is extended for a period of 20+ years or made permanent, and if it is applied to the least burnt 50% of each compartment across the LLA.

10. In general, as a precautionary principle, it can be assumed that species of native fauna and flora are adapted to, and able to sustain viable populations, under scales and patterns of fire and logging that do not exceed the scale and pattern of natural disturbances occurring after severe wildfire. Current CIFOA fall well short of constraining timber harvesting to the scale and pattern on natural disturbance.

11. The severity of recent 2019/20 wildfires in conjunction with timber harvesting in state forests has exposed the need for planning and implementation of ecologically sustainable forest management across entire landscapes and tenures. It can no longer be considered sufficient to regulate timber harvesting activities in isolation primarily at the compartment scale over the short term. There is a clear need to develop additional landscape scale conservation measures to regulate the size, location and connectivity of retained environmentally significant areas (ESAs) within state forests over the long term to mitigate the combined impacts of wildfire and timber harvesting on biodiversity in both state forests and adjacent National Parks.

12. New conditions are required that focus on permanent protection of large forest patches across regions and landscapes and which capture and include fire refuges (areas of forest that are least likely to be burnt and which provide wildlife oases after fire) and old growth and which link all retained forest in patches larger than 5 hectares in size in a network of permanent wildlife corridors.

13. This report also recommends that the intensity of so called selective harvesting in all Dry Sclerophyll Forest types be reduced significantly by increasing minimum tree basal area limits and minimum medium and large tree stocking limits, to ensure that populations of threatened and sensitive fauna such as Koalas and Greater Gliders are maintained at close to normal densities within the net harvest area consistent with principles and requirements for ecologically sustainable harvesting required under Regional Forest Agreements and the Forestry Act 2012

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Victoria: introduction, translocation and the effects of a bushfire. The Victorian Naturalist 130 (1) 2013, 37-40).Appendix A - Additional recommendations for unburnt refuges, species, broad vegetation formations, habitat and food trees, and old growth forest

Appendix A Additional recommendations

6.1 Recommended Pre-logging surveys, Post Logging Surveys and Monitoring

While the short-term effects of timber harvesting and fire on biodiversity are relatively well known there is considerable scientific uncertainty about long term effects because there is a paucity of before-after surveys and long term monitoring studies of timber harvesting and wildfire impacts. There have been many one-off surveys which correlate biodiversity with time since past logging and fire in the landscape as a surrogate for long term monitoring but most fail to provide scientific certainty because:

1. The effects of logging are highly confounded with other environmental and site variables such as elevation, fire history, forest type, soil type, survey method and others, making it difficult or impossible to single out logging impacts.
2. Modern timber harvesting operations are different and generally more intensive than those carried out in the past.
3. The 2019/20 fires are more extreme than those in the recent past.
4. The negative effects of timber harvesting are cumulative and compounding over time, particularly with respect to loss of mature and old growth forest stages and the fragmentation and diminution of the unlogged matrix that provides refuge after harvesting and wildfire as well as corridors for dispersal and movement.

The only way to deal with the above problems is to undertake long term monitoring surveys and take precautionary corrective action (adaptive management) when monitoring reveals that threatened species and biodiversity are undergoing a decline. **Recent surveys of Greater Gliders in eastern Australia have concluded that this vulnerable, old growth indicator species is declining in the forests of eastern Australia as result of fire and logging (Lumsden et al 2013). The time to act to halt and reverse this decline is now.**

Long term monitoring studies are beyond the capability of most research institutions and individual research studies which are generally limited to three year time spans. Responsibility for undertaking long term studies lies with FCNSW as a mandatory component of its adaptive management responsibilities. This responsibility has been neglected in recent decades leaving no option but to apply precautionary measures to prevent the risk of catastrophic biodiversity loss following recent excessively intensive and extensive timber harvesting and severe wildfire.

There appears to have been no systematic collection or analysis of pre and post-logging survey and monitoring data by FCNSW to determine the effectiveness of the standard CIFOA for protection of threatened species and the requirement to collect such data is a glaring omission from recently revised and updated (2018) CIFOA. Pre-logging surveys are essential and unavoidable for detection of rare and poorly known species and those that require special protection where they occur. Failure to undertake comprehensive fauna surveys before harvesting creates a risk that some rare and poorly known species will be missed and their habitat destroyed. Under the Precautionary Principle it could be considered essential to undertake comprehensive fauna surveys in all logged compartments at least once prior to harvesting.

It is recommended that in addition to currently specified targeted flora and fauna surveys**:**

1) Over the next 10 years that all unburnt forests within the extent of the 2019/2020 wildfire be subject to a full fauna survey before any timber harvesting, and a full fauna survey after harvesting, and that the data be incorporated into a long term monitoring data base for adaptive management feedback.
2) All forests that are unlogged or have been logged in the past and which have a tree basal area greater than the 40% reduction threshold in Table 5 be subject to a to a full fauna survey at least once (within 10 years) before any timber harvesting and a full fauna survey after harvesting and that the data be incorporated into a long term monitoring data base for adaptive management feedback.

Table 5: Recommended minimum basal area and minimum tree numbers by size class immediately after selective or single tree selection harvesting. (for definition of productivity class and derivation of these limits see Smith 2001)

Productivity Class	40-59 cm dbh	60-79 cm dbh	80-99 cm dbh	>100 cm dbh	Minimum Basal Area (m2 /ha)	Minimum Stocking Stems > 60 cm dbh
2	25	5	2.5	1	16	9
3	30	8	3	2.5	23	13
4	35	10	4	4	28	18

3) All logging compartments be subject to pre-logging surveys for the Greater Glider (by spotlighting to a specified minimum standard under appropriate seasonal and weather

conditions) before timber harvesting and within 10 years post harvesting and that the data be incorporated into a long term monitoring data base for adaptive management feedback.

4) All logging compartments be subject to pre-logging habitat surveys for habitat trees, food trees, sap feed trees, giant trees, special habitat features including large logs, rock outcrops, cliffs, caves, Hastings River Mouse habitat (within its modelled range), and any other features required to be protected in habitat clumps.
5) That forest age structure be mapped on all logging compartments prior to harvesting and that each age class present be subject to pre-logging surveys of stand basal area and tree size distribution including stumps and dead trees within four representative 50 by 50 m plots in each logging compartment.
6) That pre-logging surveys be undertaken for Yellow-bellied Gliders concurrent with Greater Gliders and if any are detected that logging be excluded from within a 1 km radius until the minimum extent of ESAs exceed 1250 ha at the LLA scale and 12500 ha at the management zone scale.
7) That a minimum of 50 sites across the state forest estate be subject to full fauna and flora survey before and after (within 5 years) timber harvesting each year for a decade to provide data (from 500 sites) for long term monitoring and adaptive feedback.

6.2 Wet Sclerophyll Forest recommendations

In order to manage forest in a way that mimics and does not exceed the effects of wildfire in WSF, it is recommended that the following targets be met:

1. A minimum 50% of each major forest type within the state forest be permanently retained as mature, uneven-aged or old growth forest at the landscape scale.
2. A minimum 25% of the forest area in each compartment is permanently protected in designated and protected fire refuge areas being those with a low frequency or risk of fire, or an existing old-growth overstorey consistent with long absence of fire, and that priority be given in mapping such areas to any forests with a density of more than 0.6 greater gliders per hectare. These areas may be coincident with those identified in recommendation 1 above.
3. A maximum 25% of the forest is present as uniform aged regrowth less than 60 years of age at a landscape scale at any one time (or alternatively that more than 75% of the forest be permanently present as mixed age stands including old growth).
4. The maximum coupe size for uniform regrowth regenerating after intensive logging is 10 ha.
5. Intensive harvesting (including intensive harvesting, mixed intensity harvesting, shelterwood harvesting, alternate coupe logging and any selection harvesting that retains less than 60% of the stand basal area) in NSW is limited to Blackbutt and Alpine Ash WSF types (After Baur 1965).
6. Intensive harvesting coupes are dispersed through the compartment such that adjacent intensively logged coupes within compartments are not less than 30 years of age.
7. Single tree selection harvesting (defined as harvesting that retains more than 60% of the stand basal area (including proportional number of trees in the largest size classes >60 cm dbh) is limited to a maximum 35% of the forest area at a Local Landscape Area scale.
8. Habitat trees and key food trees are retained, recruited and dispersed in small patches (not less than 10m by 10m) within and throughout the harvested area at a minimum density of 6/ha.
9. The minimum area of environmentally significant areas (ESAs) including wildlife corridors, fire refuges, riparian strips, EECs, old growth and wildlife habitat retention patches is an average of 50% or more at the compartment scale (individual range 25-75%) and 50% or more at the Local Landscape Area scale.

10. No timber harvesting is undertaken in WSF dominated by giant or older trees, (> 120 cm dbh) at a density of 4 or more/hectare, or with a rainforest understory > 60 years of age.

6.3 Dry Sclerophyll Forest recommendations

It is recommended that that the criteria for inclusion in Wildlife Habitat Clumps be reviewed and expanded over the next 20 years (post the 2019/2020 wildfire) to capture more areas of fire sensitive understory and ground cover types and that minimum size and number of Wildlife Habitat Clumps be doubled to 2 ha. and 10% of the harvest area at the LLA scale and that these areas be incorporated into the permanently excluded area ESA network.

In order to manage DSF in a way that mimics and does not exceed the effects of wildfire in DSF, it is recommended that the following targets be met in addition to those for WSF:

1) All unburnt and partially burnt DSF and WSF forests within the mapped extent of the 2019/20 wildfires be protected from logging for a minimum period of 20 years.
2) That all timber harvesting in DSF is limited to low intensity selection logging that retains a minimum basal area and minimum number of trees stems per size class as shown in Table 5.
3) Less than 50% of the forest is subject to low intensity single tree selection harvesting at the Landscape scale on a permanent basis.
4) That harvesting rotations be not less than 20 years or until stand basal area and tree stocking exceeds minimums in table 5.
5) Habitat trees and key food trees are retained recruited and as evenly dispersed as possible across the net logged area landscape.
6) No timber harvesting is undertaken in DSF dominated by giant or older trees, (> 100 cm dbh) at a density of 4 or more/hectare, or with forest that supports more than 0.6 Greater Gliders/ha. or 2 or more greater Gliders per kilometre of spotlight transect.

6.4 Old Growth Forest recommendations

It is recommended that:

1. New (landscape scale) Standards and Protocols for forest management in NSW be introduced to recruit and maintain a permanent minimum of 50% of all DSF and 50% of all WSF within a network of connected existing and future old growth reserves in the Local Landscape Area (including any public nature reserves), and that such reserves include all currently mapped old growth, any mapped wildlife fire refuge areas (or all unburnt and lightly burnt forest in the interim), and any areas with Greater Gliders and or Yellow-bellied Gliders.
2. No logging be permitted in NSW forest without pre-logging spotlight surveys to search for the presence of the Greater Glider and Yellow-bellied Glider, and that any forest supporting resident populations of these species (indicated by Glider habitat trees or densities of > 0.6/ha, or by presence of Yellow bellied Glider food trees) be protected from logging and included within the permanent old growth reserve (above) until such time as the 50% minimum protection target has been reached

6.5 Unburnt wildfire refuges

It is recommended that:

1. Priority be given to modelling and mapping fire refuges in NSW forests, using existing fire intensity mapping information, and in the interim that:

2. All of the following areas be mapped and identified as fire refuges:

   a. all areas mapped and confirmed by ground survey as unburnt or lightly burnt in patches > 2 ha within the gross extent of forests severely burnt in the recent 20019/20 wildfires;
   b. all areas or patches of forest > 2 ha, in size with at least two large trees with hollows per hectare a minimum stocking of 5 living tree stems > 80cm dbh per hectare (DSF) or 4 tree stems > 100 cm dbh (WSF) in the least burnt 50% of DSF forests on each compartment;
   c. all areas or patches of forest with Greater Gliders in areas of burnt forest.
3. All mapped fire refuges (as above) within the gross extent of the fire area be protected from timber harvesting for initial minimum periods of 20 years (DSF) or 60 years (WSF) or until the following recommendation is implemented
4. A network of permanent protected modelled and mapped fire refuges be prepared at the Local Landscape Area scale including a minimum 25% of the WSF and 25% of DSF within all compartments and Local Landscape Areas in the timber harvesting estate and that these areas be linked by mapped and protected wildlife corridors suitable for movement by all fauna species including gliders.

6.6 Habitat and food tree recommendations

1. That a minimum of 8 large living trees with hollows be retained evenly dispersed in all logged forests and that where such numbers are not currently available that the largest trees in the forest without hollows be retained as recruitment trees.
2. That the standing dead trees be retained up to a maximum density of 10 per hectare, including the largest trees present.
3. That all fallen dead trees > 60 cm dbh be retained, buffered and protected as coarse woody debris.
4. That all retained standing living and dead trees be protected from damage during harvesting and from fire during pre-or post-logging burns.
5. That retained habitat trees may include those retained in habitat patches and clumps.
6. That all individual trees with a dbh > 100 cm in WSF forests and all trees > 80 cm dbh in DSF forests be retained and protected as habitat trees and recruitment trees, and that such trees may be included within the habitat tree count.
7. That all living and dead retained habitat trees are buffered by a 3 m radius exclusion, no logging and no felling zone.
8. That the current minimum basal area requirements for selection logging be increased and supplemented with requirements for a minimum density of large (> 60 cm) trees as shown in Table 5.

Selective harvesting that reduces stand basal area below the 60% retention (40% reduction) threshold and number of mature and large stems (> 60 cm dbh) below the limits in Table 5 can be considered likely to eliminate Greater Gliders and other fauna that depend on mature and old growth forest from the net harvest area. These limits are not excessive and have been found to be broadly consistent with forest structure after past selective harvesting practices in NSW northern region forests (Smith 2001/10) which retain Greater Gliders.

6.7 Species specific recommendations

6.7.1.1 Greater Gliders, Yellow-bellied Gliders and Squirrel Gliders

1. At the Management Zone scale the minimum size of interconnected ESAs in Management Zones be 12,500 ha in regions with Yellow-bellied Gliders, 2500 ha in regions with Squirrel Gliders and 1700 in regions with Greater Gliders and that these ESAs include forests not less than 60 years of

age in patches > 20 ha (Greater Glider, Squirrel Glider) or 60 ha (Yellow bellied Glider) connected by continuous (no uncrossable gaps or barriers) wildlife corridors.

2. At the LLA scale the minimum size of connected ESAs in Local Landscape Areas be 1250 ha in areas with Yellow-bellied Gliders, 250 ha in areas with Squirrel Gliders and 170 in areas with Greater Gliders and that these ESAs include forests not less than 60 years of age in patches > 20 ha (Greater Glider, Squirrel Glider) or 60 ha (Yellow bellied Glider) connected by continuous (no uncrossable gaps or barriers) wildlife corridors.
3. No further logging be undertaken within any LLA with records of Yellow-bellied Gliders, Squirrel Gliders and Greater Gliders until the above targets are met.
4. A minimum 50% of all forest be left unlogged and protected in ESAs at the LLA scale in all state forests and that this retained are:
    - Include representative examples of all mapped forest types,
    - give priority to fire refuges**,** and actual and potential late stage mature, uneven-aged and old growth forests.
    - Include known records of Yellow-bellied Gliders and Greater Gliders.
    - Include all patches > 5 ha in size linked permanent wildlife corridors that are not dissected or isolated by barriers that Gliders are unable to cross (including roads, rivers, clearings, young dense stands even aged regrowth forests less than about 30 years of age and areas of non-forest habitat wider than about 35m) and that are not too long (> 1 km) or too narrow for (<50-200 m) to sustain regular Glider movement, dispersal and genetic interchange;
    - include unlogged strips and corridors of forest vegetation along the edge or all roads

6.7.1.2 Koala

1. All areas of modelled Koala habitat in northern NSW (Law 2017) within habitat suitability classes 0.3 or higher that were not burnt by the 2019/2020 wildfires but are within the general fire extent, be protected for harvesting for a minimum period of 45 years.
2. All areas of modelled Koala habitat (Law 2017) within habitat suitability classes 0.4 or higher that were not burnt by the 2019/2020 wildfires and are outside the general fire extent, be protected for harvesting for a minimum period of 15 years, or alternatively that a minimum 40% of all such areas be permanently protected from logging in designated fire refuge habitat**.**
3. A permanent network of fire refuge habitat be mapped and designated across the entire range of the Koala in NSW forests and that this area be not less than 25% of the state forest estate within the modelled distribution area of the Koala.
4. That pre-logging surveys be undertaken for Koalas using scat searches, direct observation and call recording during the mating season (as described by Law et al 2017) and that: either all areas with koalas or signs of Koalas (scratches and scats) be protected from logging by 100 m buffers and that logging in surrounding habitat (within 1 km) be limited to low intensity selective harvesting.

Personal submission to the Forest Industry Action Plan
From Virginia Young, 13 October 2024

Dear Panel members,

I live and work on Yuin Country in southern NSW.

My submission is informed by personal experience during the black summer bushfires including participation in a post bushfire recovery project lead by Griffith University and ANU (see http://www.busfirefacts.org/.); my work in the international climate and biodiversity policy arenas (CBD and UNFCCC Rio Conventions) on the nexus between climate change and biodiversity loss (see, *Critical Reforms for effective and timely action to prevent irreparable harm to Earth's climate and biodiversity* (DOI:https://doi.org/10.25904/1912/4822); my role with the IUCN Climate Crisis Commission as Nature Thematic Lead and as an active member of the IUCN World Commission on Protected Areas Climate Specialist Group; and my experience with on ground programmes working to protect and restore ecological integrity and connectivity at a landscape scale in eastern Australia (https:ger.org.au) and in south western Australia (https://gondwanalink.org).

I worked to support forest conservation outcomes during the Regional Forest Assessment (RFA) period contributing to NGO work in Tasmania, Western Australia, Queensland, NSW and Victoria.

I have a substantial depth and breadth of knowledge of the challenges facing Australia's forests and those likely to increase with climate change.

Introduction

While the past may well inform the future, our forests and a vast number of Australians who depend on their services, face an unprecedented and entwined

set of escalating risks as global heating and biodiversity loss escalate. This existential threat to communities can only be prevented if we tackle the climate and biodiversity challenges together. As the first ever joint workshop of the scientific advisory bodies to the Climate Convention and Biodiversity Convention noted in 2021, the climate and biodiversity crises amplify each other and urgent synergistic action to protect and restore carbon dense and species rich ecosystems is needed. Bringing climate and biodiversity policy and practice together is now an accepted imperative as this decision taken at UNFCCC COP 28 illustrates:

"*Further emphasizes* the importance of conserving, protecting and restoring nature and ecosystems towards achieving the Paris Agreement temperature goal, including through enhanced efforts towards halting and reversing deforestation and forest degradation by 2030, and other terrestrial and marine ecosystems acting as sinks and reservoirs of greenhouse gases and by conserving biodiversity, while ensuring social and environmental safeguards, in line with the Kunming-Montreal Global Biodiversity Framework; " (Para 33 from COP 28 CMA 5)

In the context of rapid global change Australia's forest policies, regulatory frameworks and on ground practices are not just out of date they are eroding the very foundations of recovery and forest ecosystem resilience.

Media coverage of the recent 'Nature Positive Summit' has been scathing because Australians understand that you can't be serious about reversing the extinction crisis while continuing to destroy core habitat, fire and drought refugia, ecological connectivity and ecosystem integrity. Nor can we achieve our climate targets if we increase the risk of losing the billions of tonnes of carbon stored in our forests to the atmosphere.

The scale of the problem

The 1992 National Forest Policy Statement (NFPS) promoted a vision of achieving ecologically sustainable forest management of public and private native forests and plantations. It required maintaining ecological processes and biodiversity within all forests and optimising the benefits to the community from forest uses

within ecological constraints. This policy and the instruments designed to deliver it, RFA's, have demonstrably failed on all fronts. It did not place the native forest logging sector on an ecologically sustainable footing – failing even to deliver long-term sustainable wood supply, let alone prevent ongoing damage to biodiversity and the integrity of forest ecosystems.

A 'set and forget' attitude to the conservation elements of the RFA's has meant logging agencies have had a largely unfettered hand in maintaining and in some cases increasing, ecologically damaging logging practices. This inflexibility extends to government and agency inability to respond appropriately to catastrophic events like the 2019/20 fires (see attached report to the EPA by environmental consultants austeco). The Forestry Corporation of NSW, the EPA and other government agencies have proven incapable of adjusting logging plans to help protect and recover even critically endangered species. The NFPS aspiration of reforming forest management to achieve ecological sustainability turned out to be a pipe dream.

Every day essential habitat resources (food, nesting sites and hollows, safe havens from predators) for state and federally listed endangered species are lost. The fate of threatened and endangered species is now completely dependent on securing urgent policy and legal change. If Australia is serious about halting and reversing the trajectory towards extinction of forest-dependent wildlife, change cannot wait.

Change, particularly in the face of global heating, which interacts with logging to increase the impacts of drought and fire, is imperative. The fate of our forests and the wildlife that contributes to their ecological integrity are not all that is at stake. If we are to reduce the risks to communities from severe and catastrophic fire we must act to restore the ecological integrity of our native forests and make much deeper cuts to Greenhouse gas emissions.

Exemption from Federal Environment Law, combined with weak or non-existent state government oversight of the effectiveness of legislative and regulatory arrangements for conservation, has resulted in a frankly terrifying set of circumstances for our native forests and the species dependent on them.

Thirty two years after the introduction of the NFPS, the challenges facing our native forests have increased beyond our imagining at that time. The impacts of,

and interactions between, the climate and biodiversity crises are rapidly playing out – impacts that are exacerbated by the limitations and failings of state and federal regulatory frameworks.

The native forest logging sector of the timber industry is in inexorable and terminal decline. As its' struggle for survival escalates, it is wreaking havoc on our unique plants and animals with umbrella species like the Greater Glider and Australia's iconic Koala already moved onto state and federal endangered species lists in the blink of 'evolutionary time', being pushed ever closer to extinction. It continues to seek new subsidies in the form of carbon credits to keep a flailing industry afloat; and has launched a major national re-branding effort of largely unchanged industrial logging practices under the guise of keeping 'forests healthy' or worse falsely claiming to mimic past management by aboriginal people.

What does ecological integrity mean and why does it matter?

The integrity of forest ecosystems determines their stability, i.e. their resistance and resilience to threats that are increasing with climate change. Every ecosystem service which forests provide including services critical for liveability in Australia — such as climate regulation and the provision of clean water—depend on the integrity and stability of forest ecosystems.

Every time we push a road into an area of old growth or long unlogged forest or log it (even 'lightly') we reduce its integrity and resilience, generate GHG emissions and increase the risk that the forest will release more of its remaining carbon in the future. Loss of big old trees (which make up 1-5% of trees globally but store 25-50% of the above ground carbon in forests) and other critical elements of biodiversity, combined with edge effects from roads and other impacts from logging disturbance, increase the vulnerability of forests to severe drought, heatwaves and fire and other human-induced threats such as insect predation and disease. All these threats are increasing with climate change and interact with logging to increase the risk of forest ecosystems reaching tipping points. Damaged forests are at much greater risk of loss than undamaged forests.

Ecosystems are dynamic and dependent on their full complement of native species for healthy functioning. For example: soil biota, invertebrates and fungi

break down coarse woody debris on the forest floor, thereby increasing water and carbon accumulation and retention in forest soils; pollinators and seed dispersers help maintain the natural vegetation composition (species mix) of the forests which helps determine resistance to insects, disease, drought and fire; many species support the composition and structure of a forest. In old growth and long unlogged forests the natural species composition, patterns and structure of biodiversity, including the presence of BIG old trees help the forest resist drought and fire thanks to moisture retention under a closed canopy. The bigger the trees in a forest, the harder it is to set alight. Minimising disturbance in forests is critically important for sequestering, storing and retaining carbon over the long term.

Forests and Climate Change

If there is a single misstep that led to the failure of government policy to realise the full climate mitigation benefits of native forests and enhance their resilience and adaptive capacity, it is blindness to the importance of retaining and recovering forest ecosystem integrity. Simply assessing the extent of forest cover and focussing on net annual fluxes of GHG reveals very little about the climate value of our native forests or their ability to resist and recover from severe drought and fire.

Failure to recognise that the integrity of forest ecosystems determines their stability, i.e. their resistance and resilience to threats that are increasing with climate change means we have strayed far from protecting forest ecosystem carbon reservoirs - reservoirs that hold billions of tonnes of carbon and could if allowed to recover sequester and more securely store, billions of tonnes more (Mackey et al ‘Green Carbon: the role of natural forests in carbon storage, part 1’ ANU e press, ISBN 9781921313882). The stability and risk of losing that carbon to the atmosphere and indeed of reaching forest ecosystem tipping points, as is happening in parts of the Central Highlands of Victoria, is dependent on both reducing gross emissions from all sources (fossil fuel and logging) and allowing forest carbon stocks to recover.

Unlogged forests, on average, store 50% more carbon than logged forests but this loss of carbon is not revealed in state or federal GHG accounts. This is because gross emissions from logging in the relatively small areas logged each year are netted out against sequestration occurring elsewhere in the larger forest estate Yet the maths are simple, if you log any area of forest older than 30 years it cannot recover its lost carbon stock by 2050. Also hidden is the carbon recovery potential of allowing previously logged forests to keep growing. And no policy maker ever considers the risks to long term forest carbon storage posed by ever reducing the ecological integrity of our native forests.

All these problems are discussed in the Mackey et al paper ***'Net carbon accounting and reporting are a barrier to understanding the mitigation value of forest protection in developed countries', Mackey et al, Environmental Research Letters, 2022'.*** Among this papers' findings was that " Analysis of reports at a sub national level revealed that the state of Tasmania delivered negative emissions due to a large change in forest management – a large and rapid drop in native forest logging 22mt.CO_2–yr^{-1} over the reporting period 2011/12 – 2018/19."

It's urgent that we refocus climate policy on forests to maximise their resilience and resistance to threats that are increasing with climate change

The Solution

There is only one moderate risk pathway to reversing the extinction trajectory of species like Koala and Greater Glider, recovering lost forest ecosystem stocks and improving forest ecosystem integrity and resilience – cease native forest logging .

As a matter of urgency we must:

- Immediately cease logging in all core habitat, fire refugia and areas essential for ecological connectivity and add these areas to the National Parks estate;

- Remove control of all public native forests from the conflicted and heavily compromised agency, the Forestry Corporation of NSW;

- Cease all native forest logging on public land in this term of parliament;

- Develop a forest ecosystem recovery plan utilising the best available science and ecological knowledge and traditional and local knowledge; and

- Explore funding and community involvement and regional job opportunities to support forest recovery that do not result in a zero sum outcome for either Greenhouse Gas emissions or biodiversity loss, i.e. avoid biodiversity and carbon offsets

Thank you for considering this submission. More detailed references are available on request and I am happy discuss any of the issues I have raised.

Virginia Young ,

[redacted], **Ph:** [redacted]