LOGGING AND WILDFIRE IMPACTS ON THE GREATER GLIDER (*Petauroides volans*) Third Report.

A Report to the Supreme Court of Victoria

Proceeding S ECI 2020 00373

By Dr. Andrew P. Smith.

31 January 2022

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Qualification and Experience

Qualifications

a) Ph. D Monash University 1981, for studies on the ecology of Leadbeater's Possum and the Sugar Glider.
b) B.Sc. (Hons1) Sydney University 1975, majoring in entomology, zoology and botany.

Experience General

1. Over 44 years experience in ecology of possums and gliders and forest planning and management in the states of Victoria, New South Wales and Queensland.

a) Completion of a Ph.D on the diet and ecology of Leadbeater's Possum and other species of possums and gliders in the Central Highlands of Victoria (1977-80);
b) sixteen years as a lecturer, then Associate Professor and Sub-Dean in the Faculty of Natural Resources at the University of New England conducting and supervising postgraduate research of various aspects of forest fauna ecology and management in timber production forests (1980-96);
c) twenty seven years as a Director and Principal of Austeco Environmental Consultants, preparing policy documents, management plans, ecological surveys and environmental impact statements for a wide range of forestry operations.

Experience Greater Glider

2. Devised and evaluated the stag-watching method for survey of arboreal marsupials including the Greater Glider in the Victorian Central Highlands (Smith 1980, Smith et al. 1989). Carried out the first regional scale arboreal mammal survey in the Victorian Highlands (Smith et al 1985). Pioneered methods for wildlife survey, habitat modelling and mapping using Geographic Information Systems (GIS) (Smith et al 1989, 2002, Ferrier and Smith 1990, Smith 1997) for biodiversity conservation and management in Australia and Madagascar. Author or co-author of many studies and reports on the effects of timber harvesting on arboreal mammals including Greater Gliders (Dunning and Smith 1986, Smith and Lindenmayer 1988, 92, Smith et al. 1993, 94, 95, 2002, Andrews et al 1994, Eyre and Smith 1997). First person to identify the threat to possums and gliders from tree hollow loss in timber production forests and to model relationships between arboreal mammal abundance and the number of tree hollows in forests (Smith 1982, Smith et al 1985, Smith and Lindenmayer 1988). Expert advisor to Government Departments on standards for protecting tree hollows in wood production forests in NSW, Queensland and Victoria (Smith et al 1985, Smith 1991, 93, Lamb et al. 1998).

Experience in Forest Policy and Ecologically Sustainable Forest Planning and Management.

3. Commissioned by NSW Government to develop guidelines for regulation and implementation of ecologically sustainable forestry operations on private lands throughout the state of New South Wales (Smith 2001). First to devise a wide range of ecologically sustainable forest management "standards", commonly referred to as "conservation protocols", that have since been widely adopted and expanded to provide a foundation for sustainable forestry and implementation of Regional Forest Agreements. These include standards for protection of hollow dependent wildlife (habitat trees), maintaining forest

structure, pre-logging surveys and protecting sensitive and poorly known threatened species and ecological communities (Smith et al. 1992, 1993, 1994, 1995, Andrews et al 1994). Adviser to the NSW Department of Environment and Planning and the Department of Natural Resources of Queensland on prescriptions for tree hollow (old growth) protection in state forests of NSW (Smith 1993) and Qld. (Lamb et al. 1998). Proposed the original forest zoning and old growth forest protection system subsequently modified and used to maintain Leadbeater's Possum in timber production forests in the Victorian Highlands (Smith et. al. 1985). Appointed to the panel of inquiry into wood chipping (value added utilization) in East Gippsland (Gruen et al. 1989) by the Victorian Minister for Planning and Environment. Appointed to a panel of inquiry into gap and cluster clear felling silviculture in NSW (Attiwill et al. 1996) by the NSW Minister for Land and Water Conservation. Co-convenor of a national Sustainable Forestry Conference (UNE February 1993). Reviewed forestry practices and conservation protocols in the Eden Management area for the CRA/RFA process (CSIRO et al 1997). Prepared sustainable forest management guidelines for private native forestry and timber harvesting on protected lands for the NSW Government Department of Land and Water Conservation (Smith 2001). Appointed to an expert panel to provide "*expert advice regarding approaches to identification and mapping of koala occurrence and habitat in areas of NSW subject to Crown and or Private Native Forestry*." for the NSW Environment Protection Authority in 2015. Commissioned by the NSW Environment Protection Authority to provide an analysis of what constitutes (ecological) best practice forestry operations in burnt forest after the 2019/20 wildfires and independent, expert advice and recommendations informing the ongoing development of best practice forest management in NSW forests (Smith 2020). Details of qualifications and experience are provided in a summary CV attached to this report (Attachment 1).

Expert Witness Code of Conduct

4. I, Andrew Peter Smith of 35 Albany Lane Currumbin, Queensland have read, complied with and agree to be bound by the Expert Witness Code of Conduct Rule 44.01. The opinions expressed in this report are based wholly or substantially on my specialized knowledge arising from my study, research, investigation and experience in Greater Glider ecology and forest conservation and management. I declare that I have made all the inquiries which I believe are desirable and appropriate (save for any matters identified explicitly in the report), and that no matters of significance which I regard as relevant have, to my knowledge, been withheld from the Court.

Brief.

5. This report was prepared in response to a brief supplied by Danya Jacobs of Environmental Justice Australia dated 21 December 2021. The brief requested my opinion and written reply to specific questions relating to the impact of wildfire and timber harvesting on populations of the Greater Glider (*Petauroides volans*).

Facts and Assumptions

6. I based my assessment of the impacts of timber harvesting and fire on Greater Gliders in the specified coupes on the following:

a) My prior experience and observations of timber harvesting operations at numerous coupes in the Central Highlands, Alpine Area and East Gippsland regions of Victoria. These included regional surveys of logged Ash forests during the periods 1977-1980 and 1983-84 for the purpose of formulating forest management policies and recommendations for protection and management of Leadbeater's Possum (Smith 1980, 1982 and Smith et al 1985), inspection of logging operations and proposed experimental silvicultural trials in Victorian Ash and Mixed Species forests for the Minister for Planning and Environment in 1989 (Gruen et al 1989), inspection of harvesting impacts on Greater Gliders and/or Yellow-bellied Gliders at seven coupes in East Gippsland in 2010 and 2016 (Smith 2010, 2016), and inspection and measurement of timber harvesting impacts on Greater Glider habitat at 58 coupes in the Victorian Central Highlands in 2018 (Smith 2019).

b) My published scientific research papers, reports and unpublished data on the effects of timber harvesting on Greater Gliders and other possums and gliders at a wide range of locations, including the Victorian Central Highlands, East Gippsland, a range of Northeast NSW State Forests and the New England Tablelands (Smith et al 1985, Smith et al 1987, 1992, 1994, 1995, Smith 1982, 2010, 2019, Andrews et al 1994, Dunning and Smith 1986, Lindenmayer et al 1990).

c) My critical review of the scientific literature and published scientific studies of others (as referenced in this report) on the ecology and effects of timber harvesting and fire on arboreal mammals. I have relied on the published scientific studies and reports of others only when I consider the methods of study and statistical analysis to be rigorous and reliable and the interpretation and conclusions to be consistent with factual data presented. It is not uncommon, in my experience for the interpretation of scientific data to be ambiguous or inconclusive and for some conclusions and statements made by study authors in report abstracts and discussions to be speculative and inconsistent with the factual data presented.

d) My experience in application of the scientifically rigorous findings of my own and others to formulate ecologically sustainable forest management policies and recommendations at the request of various state Government timber management Agencies including VicForests (Smith 1985), Minister for Planning and Environment Vic. (Gruen et al 1989), Forestry Commission of NSW (Smith et al. 1992,94,95), NSW Department of Planning (Smith 1993), Queensland Department of Natural Resources-Forest Resources (Lamb et al 1998), NSW Department of Conservation and Land Management (Smith 2001/10), and RACAC NSW (CSIRO et al 1997,98) and EPA NSW (2020). My most recent experience involved a review of timber harvesting impacts in NSW state forests affected by extreme wildfires in 2019/20 at the request of the Environment Protection Authority of NSW (Smith 2020), in which I recommended changes to current silvicultural practices and adoption of new minimum standards for corridors, old growth protection, diameter limited harvesting and protection of fire refuges, amongst others, to sustain sensitive species including the Greater Glider.

e) Examination of site and aerial photos of logging disturbance in "**the Coupes"** and examination of coupe plans and maps of forest type, fire and logging history and other environmental variables on and in the vicinity of these coupes provided as evidence in these proceedings.

f) I have detected a **Typing Error on Page 60 para 7** second last line of my second report which should read "*and recover from moderate to low intensity fires (category 3-4) that do not kill overstory trees*"

Part 1. Response to Questions Part A. Species description, conservation status, threats and bushfire impacts.

7. **Question 1. Are one or more of the threats, impacts and trends that you described at [8] and [17]-[26] of your report dated 30 June 2021 (your first report), and [21]-[49] of your report dated 23 August 2021 (your second report), "real threat(s) of serious or irreversible damage" to Greater Glider? Question 3 Is the impact of VicForests' timber harvesting described at [17]-[26] of your first report, [38]-[46], [48] and Appendix 1 of your second report, having regard to all contextual matters you consider relevant to assessment of damage, a "real threat of serious or irreversible damage" to Greater Glider?**

Yes to all threats, impacts and trends. I have re-read my previous response to questions in the paragraphs specified above (from my first and second reports) in light of changes to the Code of Practice and information in the affidavit of Dr. Nitschke. I have found no reason to vary my previous assessment of threats, impacts and trends and it remains my opinion that:

a) current forestry practices in Victoria are causing a significant (real and serious) on going decline in the distribution and abundance of Greater Gliders in Victorian timber production forests (those areas shown in Green in Figure 1 below),

b) if current practice is allowed to continue Glider populations could be eliminated from production forests altogether;

c) loss or extensive reduction of Greater Gliders from the matrix of production forests that surrounds conservation areas (shown in yellow on Figure 1) could threaten surviving Glider populations in conservation parks over the long term (100's – 1000s of years) due to their small size, limited inclusion of preferred habitat, lack of connectivity, and lack of broad ecological gradients (from sea level to mountain peaks) necessary to respond to future fire, drought and climate change.

d) current threats are ongoing, resulting in cumulative and continuing population decline,

e) current threats are of high magnitude (proportional to or greater than the rate of forest logging) and certainly not negligible,

f) current threats are likely to be permanent in areas of timber production forests where Glider habitat is retained only in small patches isolated from large conservation reserves and refugia by inadequate or non-existent corridors,

g) these threats are not mitigated by existing or proposed adaptive management measures.

It also remains my opinion that management and mitigation measures proposed in my previous reports (eg increasing the proportion of forest retained in corridors and conservation areas and reducing the intensity of timber harvesting to retain a permanent uneven-aged old growth structure in all Mixed Species and the majority of Ash forests) are considered and proportionate because they allow selective harvesting of high value sawlogs to continue at ecologically sustainable rates and while substantially reducing the ecologically unsustainable yield of low value woodchips.

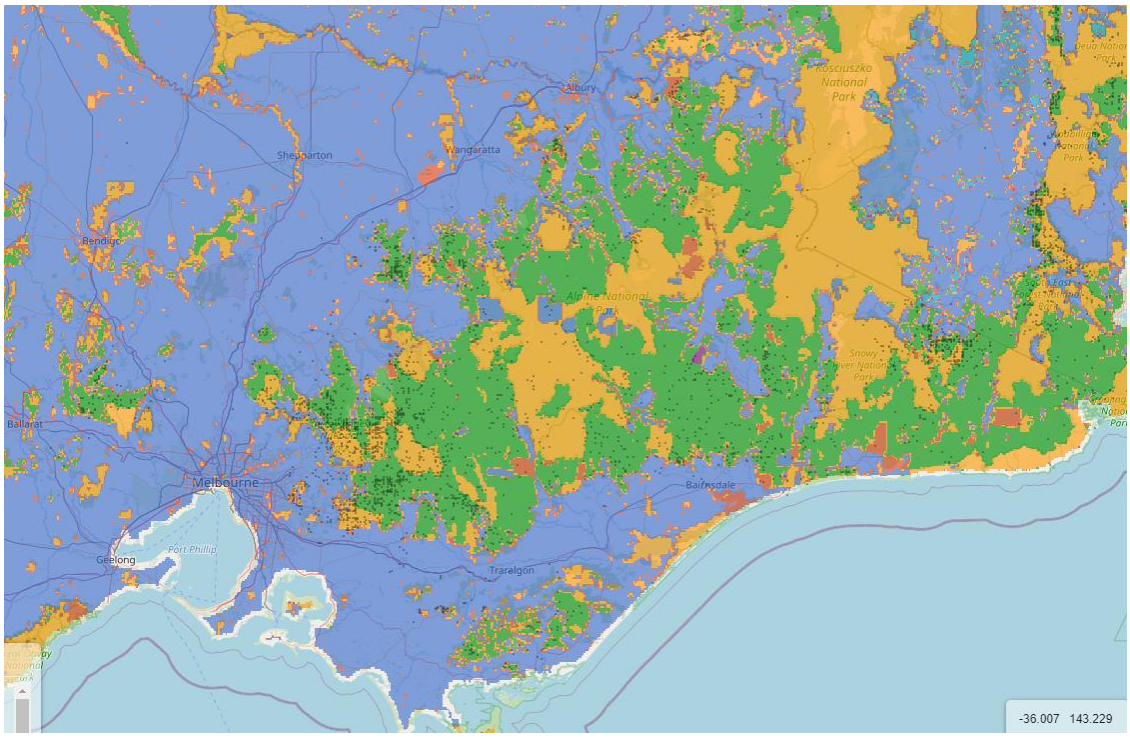


Figure 1 Greater Glider location records (dots) overlayed on the tenure of Australian Forests (conservation areas in yellow, multiple use forests in green) (after the Atlas of Living Australia 18 Jan 2022) showing the isolation or conservation areas and general scarcity of Glider records in conservation areas.

8. **Question 5 Are the adaptive measures you have proposed in your reports (for example, see your first report at [30], [41] and [49], and your second report at [67], [68], [70], [76], [79] final row, and Appendix 1): (a) proportionate to the threat; and (b) consistent with relevant monitoring and research?** Yes at (67 and 70), where mitigation measures are to be applied only if a certain minimum density of Gliders are present it is an essential and unavoidable necessity to undertake adequate pre-logging surveys.

9. Yes at (68), I note the Dr. Nitschke has agreed with me that clear-felling of mixed species forests (including ecotone forests) is not ecologically sustainable unless these forests are harvested selectively in a way that maintains uneven-aged structure. This can only be done reliably with some form of mandated minimum stocking and basal area retention (by tree size class). My recommended minimum standard of 60% large tree basal area retention can be considered proportionate because it allows continuation of high value sawlog production while at the same time causing around a 55% (range 15-75%) reduction in average Glider density in logged forest (see my second report para 56 figure 10 reproduced s Figure 2 below).

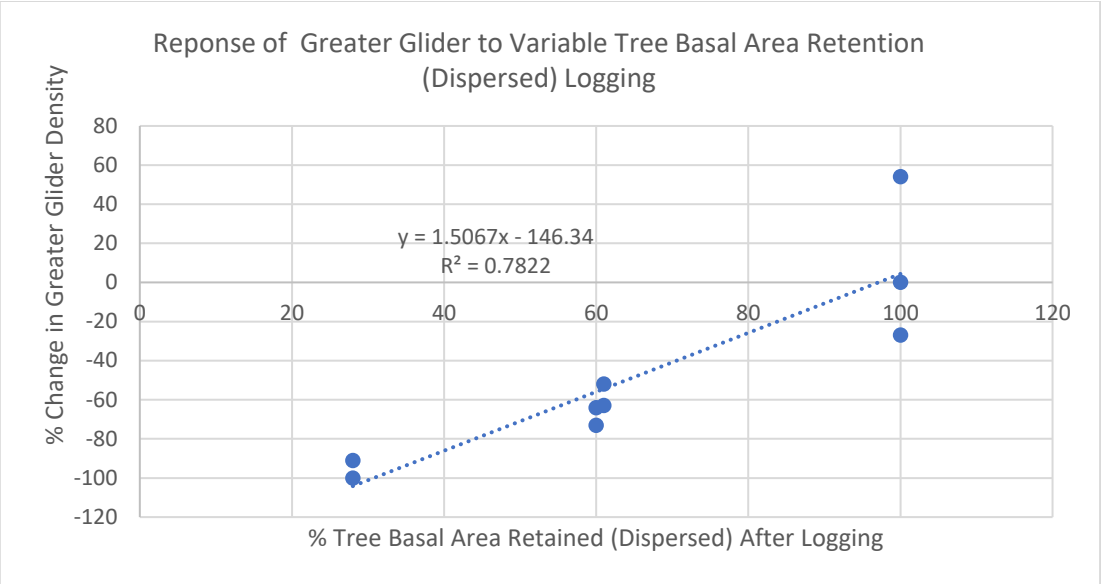


Figure 2. From my second report para 56.

10. Yes at (76A, C, D), Mixed Species forests are adapted to recover relatively rapidly (within 15 years) after intense fire which is the primary reason why salvage logging should be excluded from Mixed Species forests and limited only to severely burnt Ash Forests which have been killed by fire.

11. Yes at 76E. Subsequent to making this recommendation I have statistically analyzed associations between Greater Glider abundance and habitat variables at 30 sites that I surveyed for Greater Gliders and other marsupials in the Victorian Central Highlands in 1983/84 (Smith et al 1985 and Smith unpublished) and in 59 logging coupes surveyed for Greater Gliders by Friends of Leadbeater's Possum (Mckenzie 2018, Smith 2019).The best predictors of Greater Glider abundance in wet (Ash) forests in both 1984 and 2019 were the number of large old senescent trees, and the percentage occurrence of multi-cohort, uneven-aged old growth forest in gullies and protected slopes within survey coupes or within a 1 km area surrounding survey plots (Figure 3). Uneven-aged old growth forest was defined to include all forest visible on aerial photographs with a tall, irregular, uneven canopy structure with emergent large diameter tree crowns. Areas with small diameter uniform crowns were identified as regrowth (1939 and younger). Site inspections confirmed that aerial photo interpretation underestimated the actual occurrence of uneven-aged old growth forest on coupes because some large senescent trees with dead or broken crowns are not visible in regrowth canopies, particularly on ridge tops. This problem was evident on Myrrh coupe (see my second report para 29 in coupe descriptions) where Gliders were abundant in areas with uniform tight crowns on aerial photographs because habitat trees were short with damaged or broken crowns that did not project above the canopy. Uneven-aged old growth forest areas identified by this method have the double benefit of incorporating potential "fire refugia" because it typically occur in moist sheltered gullies where fire impacts and risk are lower (Collins et al 2012) and the presence of large old senescent trees with hollows indicates that at least some trees in these forests have survived past fires for at least 150+ years.

12. ***In my opinion the simplest and most effective approach to protection and maintenance of Greater Gliders in Victorian timber production forest would be to identify, map, protect and link (by protected corridors) all remaining areas of uneven-aged old growth forest with regrowth cohorts older than 40 years and a scattered or dense mature to senescent old tree cohort at a density > 0.75/trees/ ha***. This approach is likely to protect more than 50% of the Glider population in about 40% or less of the forest including key fire refuges, drought refuges and most remaining areas with living emergent senescent trees that provide hollows. It is also my opinion that this approach is essential for Glider conservation in all remaining Ash forests because so little suitable Glider habitat remains in this forest type. In Mixed Species forest there is an alternative option to sustain Glider populations within logged coupes by low intensity selective harvesting of high value sawlog only.

13. Uneven-aged old growth forests identified in this report include any multi-cohort forest with a regrowth cohort older than 40 years or more and an older living tree cohort that includes a minimum of 0.75 large old senescent trees with hollows per hectare (2 per 3/ha). Greater Gliders were found to occur (at low densities) in uneven-aged old growth Ash forests with as few as 2 large senescent old trees with hollows per 3 hectares of forest (0.75 senescent trees/ha.). The average number of emergent senescent living trees with hollows in uneven-aged old growth Ash forests in mapped coupes was found to be very low (2.1/ha), due to a combination of high mortality after the 1939 fires and subsequent salvage logging. In contrast the number of large senescent trees with hollows in ecotone and mixed species forests was very high (6-8/ha) because dominant trees in these forest types were better able to survive the 1939 fires and were less favoured by salvage logging. Because large old senescent trees with hollow are now so scarce in Ash forests I have recommended protection of all uneven-aged (multi-cohort) forests with as few as 0.5 senescent trees per hectare.

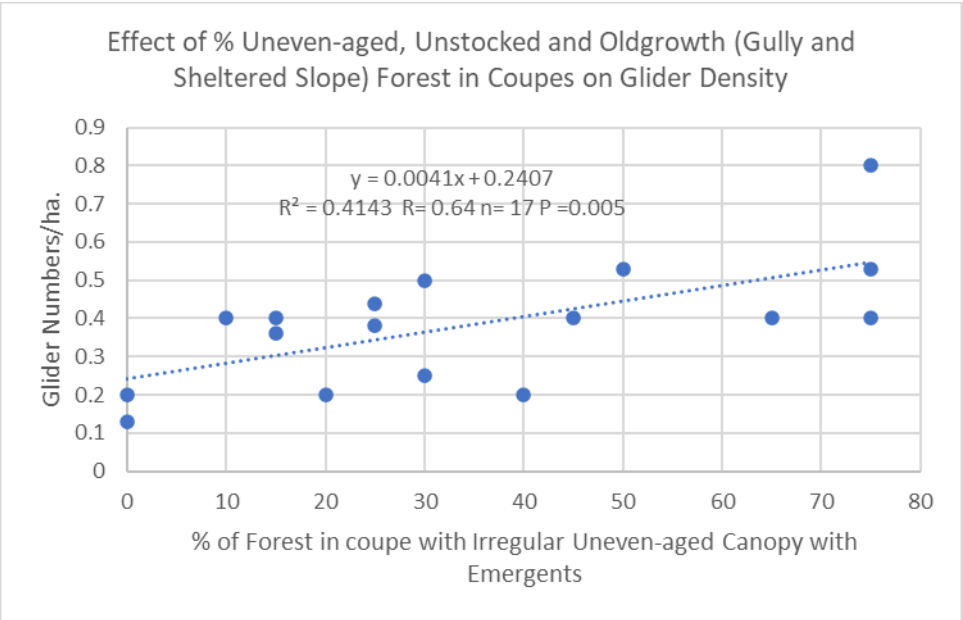


Figure 3 Correlation between Greater Glider density and the occurrence of uneven-aged old growth forest in Ash Forest coupes in the Central Highlands. A similar relationship was found in Mixed Species forest.

14. My response at 77 A requires clarification. I support the DELWP method which takes in to account the total area available for harvesting. In my opinion risk is “deflated”, not inflated, by arguments that consider only arbitrary restricted limits such as annual harvest limits or harvesting limits to 2030. Deflation of risk occurs when proponents fail to consider or take into account cumulative impacts of future and ongoing development. This is a key area of difference between myself and Dr. Nitschke. It is my opinion that on a precautionary basis it is reasonable and necessary to assume (for the purpose of impact assessment) that current practice will be ongoing until such time as measures to the contrary have been legislated and proven effective. It has been my experience, over the past 47 years of forestry impact assessment in Victoria, that timber harvesting has steadily intensified despite Government promises to the contrary. In the 1980’s, for example, the Victorian Government promised rotations in Ash forests of 80-150 years (Smith 1997) but subsequently began harvesting Ash forests on cycles of less than 50 years.
15. Yes at 77B, since preparing my initial reports I have undertaken further comprehensive analysis of my own data and that of others to assess the effects of fragmentation and isolation on Greater Gliders (see paragraphs 18-34 following). These analyses have confirmed the high extinction risk associated with reduction of naturally occurring continuous forest habitat to a system of small man made isolated or partially isolated remnants.
16. Appendix 1. Yes, to paragraphs 1-13. But note there is a Typing Error P 60 para 7 on the second last line which should read “***and recover from moderate to low intensity fires (category 3-4) that do not kill overstory trees***”

17. **Question 2. If yes to (1), is the threat (or threats) attended by a lack of full scientific certainty (in the sense of material uncertainty)? Question 4. If yes to (3), is that threat attended by a lack of full scientific certainty (in the sense of material uncertainty)?**

In my report I have attempted to minimize uncertainty by:

a. checking that statements, findings and conclusions in abstracts and discussions of various reports and publications are consistent with the reported underlying facts and results;
b. reading and satisfying myself that study designs and statistical analyses are adequate and appropriate to prevent a type 1 (false positive) or type 2 (false negative) error;
c. not relying on the findings of theoretical models, particularly Population Viability Analyses (PVA), which are unvalidated, unsupported by underlying empirical data, overly simplistic, have limited input data (eg landscape scale data such as climate and topography only), rely on modelled input data (most climate data) or are overly influenced by unvalidated underlying assumptions built into the model;
d. relying on average values for key Glider life history parameters (eg dispersal range, longevity, density, time to extinction in small fragments, density response to logging) rather than selecting extreme values at either end of the range that may suit a particular argument.

Despite these precautions there remains an element of uncertainty and lack of full certainty in nearly all “predictions” of future population trends and responses to timber harvesting and other disturbance (fire, climate). This uncertainty arises because every logging coupe and disturbance event is unique; past responses to disturbance are not always repeated, and some predictions, especially those relating to

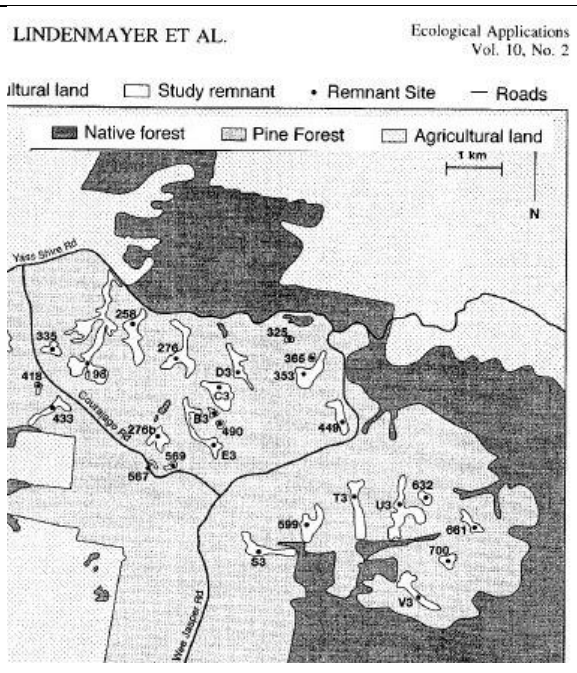
the cumulative impact of future logging at landscape scales, have never occurred before. Uncertainty is higher when extrapolating to broader scales or longer time frames, but so is risk. The potential consequences of assuming that current logging practice will have negligible impact on Glider populations at state wide or landscape scales (as advocated by Dr. Nitschke) are potentially catastrophic, relative to making the same decision at the coupe scale, if later found to be wrong. The current definition of the Precautionary Principle requires consideration of the "risk-weighted consequences of various options". I understand this to mean that where risk is greater, which it clearly is at state wide or landscape scales, that management must be much more precautionary. In my opinion the various management measures that I have proposed in my earlier reports (or as modified in subsequent sections of this report) are the minimum necessary to provide certainty that there will not be a catastrophic landscape scale decline in Glider distribution and abundance attributable to timber harvesting over the long term.

18. Statements at page 12 (Para 2) and elsewhere in Dr. Nitschke's response to my reports indicate that his conclusion that logging impacts on Gliders are not irreversible and negligible at landscapes scales relies primarily on some factually incorrect information that seriously overstates Greater Glider dispersal capability and capacity to survive in small isolates to reach. He states "GG *can persist in these aggregated retention areas provided there are sufficient HBTs and forage habitat (Lindenmayer et al., 1993, Kavanagh, 2000). Lindenmayer et al. (2021) found that the amount of logging around monitoring sites did not have a significant effect on GG occurrence which is support by Kavanagh and Bamkin (1995) who found that GG were impacted at the coupe level but not at broad scales (~700 ha) by logging. This is also supported by Taylor et al. (2007), who found that GG were able to persist and maintain gene flow between isolated patches (1.6 ha to 30 ha located 1 to 7 km apart) of native forest in a landscape dominated by exotic pines highlighting that GGs can move between habitat patches through a landscape matrix with no forage or nesting habitat. This research indicates that GG conserved in aggregated retention of sufficient area within coupes (2.6 – 6 ha) and connect to habitat patches adjacent to coupes is appropriate and therefore harvesting is not likely to have severe or irreversible impacts on the GG. The GGs in the remaining 32.2% of area impacted by harvesting however may be severely impacted by harvesting within known GG habitat (see Kavanagh and Bamkin, 1995).* I have reviewed the studies referred to above (se details in following paragraphs) and found that all of the key information relied on by Dr. Nitschke is incorrect. Close examination of these studies shows that there is no evidence that Gliders can disperse 7km through pine forests, and no data supporting the notion that Gliders can survive for more than a few years in small (2.6 - 6ha) isolated habitat patches. Consequently, there is no certainty that aggregated retention harvesting will not be severe or irreversible as assumed by Dr. Nitschke, and no certainty that such harvesting will not scale up over time to have severe impacts at landscape scales.

19. **Lindenmayer et al 2000, 2001**. A great many of the Glider habitat patches identified and mapped by Lindenmayer et al (2000, 2001) as small remnants within a pine forest are not isolated as claimed, but are connected by to one another or to uncleared adjacent natural forest by corridors of Eucalyptus forest along streams and road verges. Based on my inspection of recent and historical aerial photographs it is apparent that out of the 39 isolated patches identified by Lindenmayer et al (2000, 2001) at least 13 are connected to a nearby large expanse (about 2000 ha) of uncleared forest along corridors and roadside

strips, 3 sites are linked by corridors to a large patch of forest (140 ha) adjacent to the northern edge of the pine plantation and a further 2 sites are liked to a large remnant (95 ha) on agricultural land to the south of the plantation. Some of the corridors linking habitat patches to external forest are bisected by forestry roads but these roads are too narrow to present a barrier to Glider movement. Many of the small patches with Gliders that are mapped and statistically treated as “isolated” by Lindenmayer et al (2001) are in fact continuous with other remnants. For example, patches 276b, E3 and C3 are directly connected by corridors (clearly evident on aerial photographs, see Figure 4 below) which means that they actually comprise a single medium sized patch of 54 ha. rather than several isolated smaller patches. Also, these patches are linked across a potentially crossable 65 m wide power line easement to areas of continuous forest to the north via another patch (276a). Similarly, patches S3, V3, U3 and T3 (which are analysed and treated as separate patches by Lindenmayer et al 2000, 2001 and others) are directly connected to continuous forest to the south and consequently to one another (see Figure 4b below). Lindemayer et al (2000, 2001) identified the mean size of their 39 remnants to be only 10.7 ha., but when corridor linkages and connections with adjacent natural forest are taken into account, I find that the mean size of patches increases to more than 140 hectares. These errors can be easily checked and verified by anyone by examination of current and historical aerial photographs on Google Earth. Once remnant Glider habitat patch size from the Lindemayer et al (2000, 2001, Taylor et al 2007) studies are corrected to their true size it becomes apparent that Gliders have not survived (have all died out) in patches less than 70 ha. in size over periods of about 30 years after (true) isolation in pine plantations. This conclusively demonstrates that Gliders are not able to disperse large distances through pine forests or survive in networks of small, isolated patches of forest within pine forests and agricultural land. I note that my corrected findings showing that Gliders are highly sensitive to isolation and die out rapidly in small to medium sized remnants are entirely consistent with the findings of Sucking 1980,82) who carried out a similar study into the effects of fragmentation on Gliders in South Gippsland. Suckling (1980,82) found that no Gliders survived in isolates less than 144 ha. in size after isolation for about 60 years. I also note that a later study by the same authors (Lindenmayer Pope and Cunningham 2004) shows the patches 276b, E3 and C3 are connected and linked to continuous forest in the same manner that I have illustrated in Figure 4a below. A copy of the habitat patch mapping shown in Lindemayer et al 2004 is reproduced in Figure 4 c to show similarity with my mapping (Figure 4a). Despite apparently latently recognizing that so called isolated patches used in their earlier studies were connected and not isolated (Figure 4c) I am not aware of any retraction or correction of these earlier false results.

4a Aerial photograph (Google Earth 2010) showing continuity between patches 276b, E3 and C3, and connections across a power line easement to continuous forest.



4 b Map of remnants in Lindenmayer 2001, showing 276b, E3 and c3 to be isolated for the purposes of statistical analysis in this study and others.

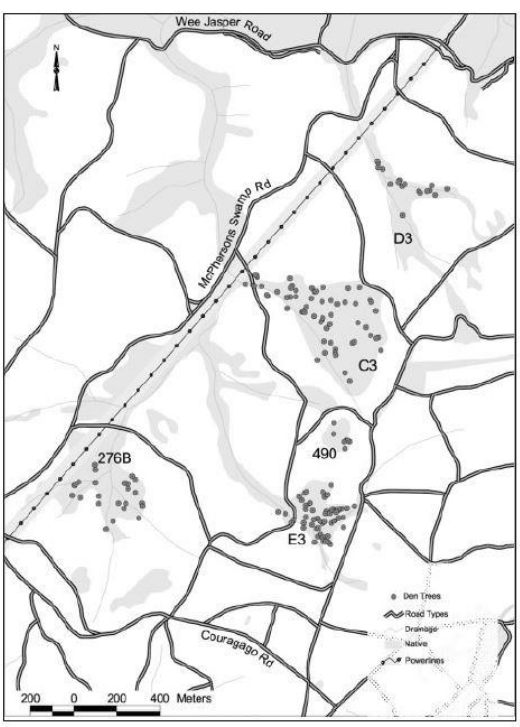


Fig. 1. Locations of *P. volans* den trees.

4 c Map of remnants in the study area in Lindenmayer et al 2004 showing continuous connections (shaded) between patches similar to those shown in my Figure 4 a

Figure 5 showing how patches S3, 593, T3, V3, and U3 of Lindenmayer et al 2000, 20001 are not isolated but connected to one another via riparian and retained corridors with continuous forest to the south. (Image from Google Earth 2003).

20. **Effects of Fragmentation and Isolation** I have undertaken research on the effects of fragmentation on arboreal mammals and developed empirical models (Smith 2002) to predict the effects of patch size, shape and degree of isolation on survival on a related threatened gliding marsupial species, the Squirrel Glider (*Petaurus norfolcensis*). My findings and models have been applied by Wyong Shire (Smith 2001) and Lake Macquarie City Council (Falding and Smith 2008) to plan the practical on ground protection and conservation of this species in a network of fragmented conservation reserves in Wyong Shire and in the Morisset region of coastal central New South Wales. In my previous reports I used these models to guide my assessment of the potential impacts of contextual matters (spatial arrangement of logged and unlogged forest) on the Greater Glider in Victorian timber production forests. Because the Greater Glider is larger, less mobile and less willing to come to the ground than the Squirrel Glider my initial reliance on the Squirrel Glider models is likely to have been conservative and to have underestimated the effects of fragmentation and isolation. To address this uncertainty, I have subsequently tested and validated the use my models for predicting the impact of habitat fragmentation and isolation on Greater Gliders using data from two previously published regional studies of Greater Glider occurrence in remnant patches of eucalyptus forest. One in the La Trobe Valley of Victoria where 59 remnants were isolated for about 40-60 years by land clearing for agriculture and pine plantation between 1920 and 1950 (Suckling 1980, 82), and one in retained riparian corridors and roadside strips of eucalyptus forest in a matrix of cleared agricultural land and pine forest established between 1930's and 1980 near Tumut in southern NSW (Lindenmayer et al 2001). The raw data of Lindemayer et al (2000) was corrected prior

to testing the to allow for unmapped habitat and corridor linkages using the methodology of Smith (2002). The frequency of occurrence of Greater Gliders in remnants was significantly (P <0.0001) correlated with the predictions of the Squirrel Glider model but over-estimated the survival of Gliders in small and intermediate sized remnants (8-200 hectares in size). The difference between predicted Glider frequency of occurrence in remnants of different size and actual Glider frequency of occurrence in remnants in Tumut and South Gippsland are shown in Figure 6. This discrepancy is consistent with the lower dispersal ability of the Greater Glider and its apparent reluctance to come to the ground to cross cleared gaps. The data from both surveys shows that there is a very steep decline in Glider survival in remnants once they fall below about 250 hectares in size and there is only a 10% chance of survival in remnants less than 64 ha. that have been isolated for about 30- 70 years, which is within the approximate duration of a harvesting cycle. All of the habitat patches proposed to be retained in the harvesting coupes that are the subject of these proceedings are smaller than 64-250 hectares in size. This indicates that there is a risk that Glider populations retained after harvesting will decline to zero if they are isolated by future clearing. The only way to eliminate this risk is to ensure that retained patches are directly connected to similar retained patches in other adjacent coupes such that the combined area of retained habitat is > 250 ha. This requires simultaneous forward planning across multiple coupes at local landscape scales (areas of about 5km by 5km). In my opinion, VicForests and Dr. Nitschke's approach to impact assessment, which considers impacts on one coupe at a time, and at only one point in time, is not capable of accurately predicting or evaluating the severity and reversibility of Glider population trends in response to harvesting over time.

21. The findings above indicate that my earlier assessments of the cumulative impacts of fragmentation and isolation were conservative, and that the risk of Greater Glider population extinction in small patches of habitat (less than 250 ha in size) retained after logging and surrounded by roads and non-habitat (dense low regrowth without hollows) is much higher than I had previously anticipated. My recent findings predict that about 50% of all Greater Glider populations isolated in patches of about 128 hectares in size (the area of about two adjacent logging coupes) could be expected to go extinct within the duration of a single harvesting rotation (40-60 years), and that retained patches of Greater Glider habitat will need to be around 500 hectares in size to have a 95% chance of survival over 60 years. Habitat patches smaller than 60 hectares in size have less than a 10% chance of retaining glider populations after isolation. The only way to eliminate this risk, and to ensure that Gliders persist in small, patches of retained unlogged habitat in logging coupes, is to link these patches together with effective movement corridors linked to large (>500 ha) nearby conservation areas or to reduce logging intensity so that Gliders are retained within logged forest.

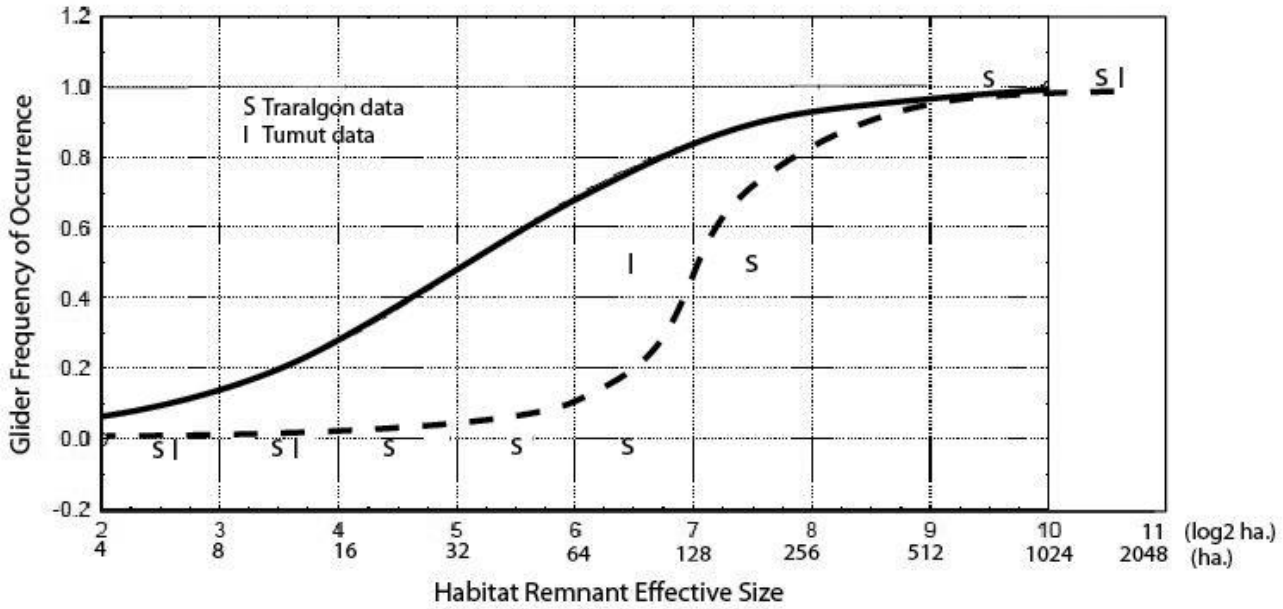


Figure 6 Showing the actual relationship between Greater Glider frequency of occurrence and effective remnant patch size in system of forest patches isolated by cleared agricultural land, roads and exotic pine forest (dotted line) compared with the predicted frequency of occurrence based on the model for Squirrel Gliders in a system of remnants in Wyong Shire NSW (solid line). S indicates data from remnants in La Trobe valley (Suckling 1980) and l indicates data from remnants in Tumut (Lindenmayer et al 2001). Effective patch size is the size of a patch plus the size of any adjoining patches linked to it by any crossable gaps (eg narrow roads) of class 2 or 3 (modified from Smith 2002).

22. **Glider Dispersal** At present there is only limited data on the minimum width and length of corridors required to facilitate Glider dispersal into and out of small remnants. Further analysis of Greater Glider occurrence in remnants at Tumut indicates that Greater Gliders are less capable of crossing gaps than Squirrel Gliders and will require wider corridors (> 100 m) with narrower gaps (<70m) to ensure dispersal. A statistically significant correlation was found between the density of Greater Gliders in retained corridor patches at Tumut and the width of the largest gap that Gliders would have to cross to disperse into the patch from any nearby expanse of habitat (> 25 hectares in size) (Figure 7). This relationship shows that Greater Gliders are unlikely to disperse across cleared gaps wider than 70m on a regular basis sufficient to sustain viable populations, unlike Squirrel Gliders which more readily come to the ground and can cross road gaps up to 100m (Smith 2002). Glider populations isolated by cleared gaps wider than 70 m are likely to become rapidly extinct, within 65 years or the duration of a single forest harvesting rotation. Most forestry roads are less than 70 m wide and should be crossable by Gliders if flanked by tall mature forest on both sides. For this reason, I have recommended that unlogged corridors of forest be retained on both sides of all forestry roads. A road with short dense regrowth on one side and unlogged forest on the other is likely to be a significant barrier to Glider movement.

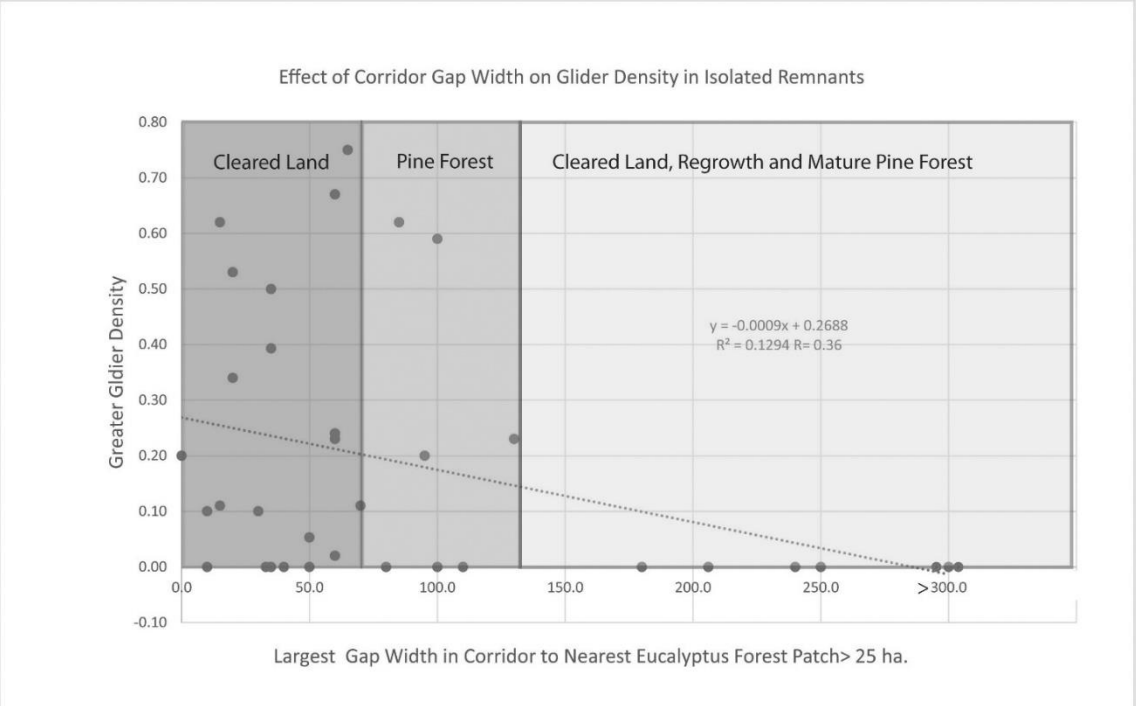


Figure 7 Showing the relationship between Glider density in small (<25 ha) isolated patches of Eucalyptus forest habitat at Tumut and the width (m) of the widest gap separating their patch from an adjoining patch of suitable Eucalyptus forest habitat >25 ha in size.

23. At Tumut, Gliders were found in some small remnants surrounded by pine forests up to 140 metres distant from the nearest expanse of Eucalyptus forest. This indicates that Gliders can disperse small distances (up to 140 m) through pine forests that may be tall enough to allow movement but are otherwise unsuitable for permanent habitation. It is important to note that Gliders have been reported to feed on Pinus radiata (Cunningham et al 2004) especially on buds and male cones, and that Pinus pollen may be an important supplement to their diet during the breeding season. Despite this, no Gliders occurred in any Eucalyptus patches that were separated from large expanses (>25 ha) of Eucalyptus forest by more than 140 m across any combination of cleared land, pasture or pine forest. (Figure 7). This indicates that to the best of current knowledge retained patches of Greater Glider habitat should not be isolated from other patches of suitable habitat by areas of non-habitat, including young regrowth forest, wider than 140 m.

24. **Taylor et al (2007)** Dr. Nitschke has relied heavily (in the sense that he frequently quotes or relies solely on (eg p13 last para)) and has accepted on face value (without qualifying) a speculative statement in the study of Taylor et al (2007) that Greater Gliders are good dispersers capable of crossing 7 km of pine forest. I have critically reviewed this study and found that it provides no evidence that Gliders can cross large areas of pine plantation. Taylor et al (2007) hypothesized that Gliders can move 7km through pine forest simply because the level of genetic similarity between two glider populations located 7 km apart (as the crow flies across a plantation) suggested that they were closely related. The published map used in their study showed the patches in question to be widely separated by pine forest (7km) when in fact aerial photographs show the two patches are almost continuously linked via a system of large remnants and corridors of retained natural forest to the south (see Fig 8). The widest gap in the corridor and reserve system linking these two patches

is only 110m of pine forest and several gaps of about 60 m of partially cleared agricultural land (see Figure 8). Thus, even if the genetic data is correct and not the result of chance similarity, this relatedness can be explained by natural glider dispersal through continuous natural habitat along the blue route shown in figure 8 rather than by assumptions of dispersal through 7km of roads and pine plantation as the crow flies.

25. The results of the Taylor et al 2007genetic study have shown conclusively that isolation of Gliders in small populations causes a reduction in genetic diversity. In the discussion section of this paper the authors stated that genetic data were inconsistent with their conclusion that Gliders could disperse 7 km through pine. In discussing this anomaly that authors made the following statement " ***Although one long distance dispersal event to a remote patch was inferred in this study (f2 to 1908), the generally low degree of admixture in such isolated patches suggested that long distance dispersal events through pine are rare***." In his evidence Dr. Nitschke appears to have assumes that this single inferred dispersal event is typical or normal without considering the qualifying remarks by the study authors which clearly identify this purported event to be rare and abnormal. I have now shown that it is not necessary to infer this rare and extreme dispersal event to explain the genetic data of Taylor et al 2007. Genetic relatedness of Gliders in patches f2 and 1908 can be explained by the near continuous connection of these remnants via large (>100 ha) unmapped habitat patches and corridors to the south. It there was any dispersal between f2 and 1908 it is more likely to have occurred through native forest and could have been bi-directional from a common patch to the south. A dispersal event of about 3.5 km from a common habitat to the south is consistent with the maximum dispersal distance of 3.2 km through continuous forest reported by Tyndale Biscoe and Smith (1969). The latter dispersal event was atypical and at the extreme end of the bell curve relative to the average dispersal distance by all Gliders of only 1.2 km over several years. The genetic data of Taylor et al 2007 supports my position and conclusion that small isolated patches of Glider habitat *with less than 6-37 individuals* (remnants of about 15- 100 ha) are a unsuitable for sustaining Glider populations in the long term due to loss of genetic diversity from inbreeding. The data of Taylor et al also supports my conclusion (Para 18,19) that patches C3 and 276b, claimed and assumed to be isolated by Lindemayer et al (2001) and Pope et al (2004), are in fact continuous with one another and with adjacent continuous forest. They found that "***animals in patch c3, which was separated from continuous native eucalypt forest by just over 1 km, exhibited genetic diversity and allele sharing levels comparable with those measured for continuous forest sites.***" My data show that C3 is linked to continuous forest by a corridor of retained forest across a powerline easement about 65 m wide.

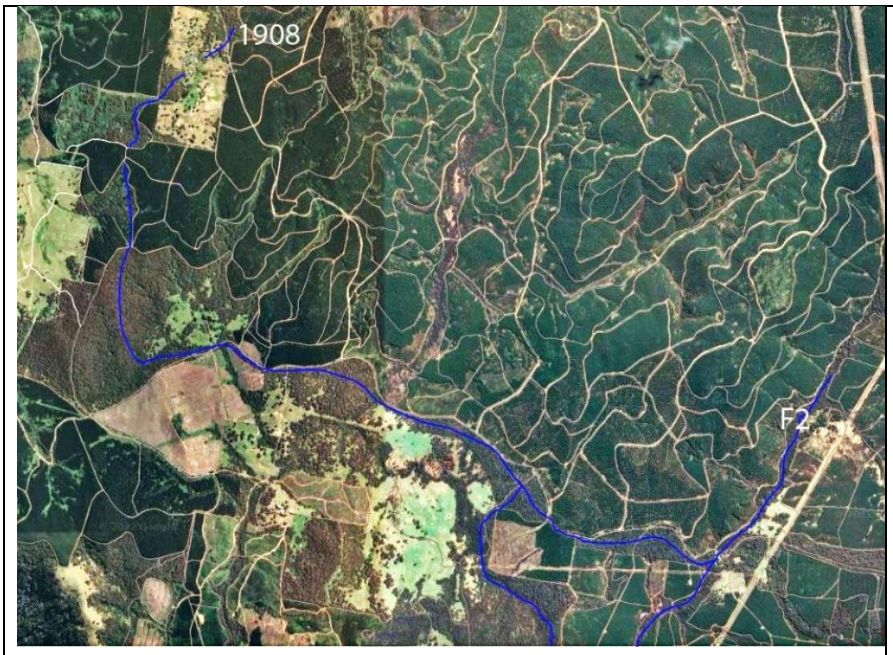
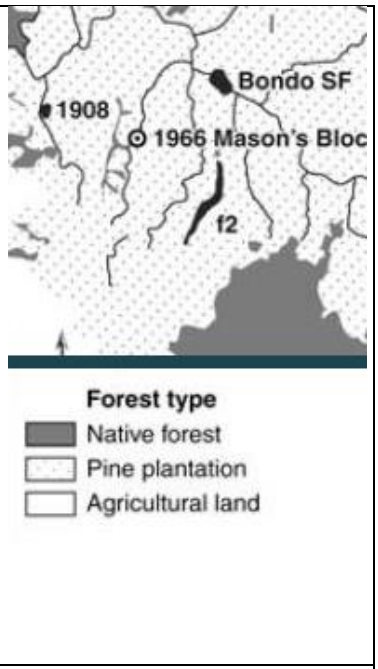


Figure 8 showing native forest corridors and fragments that link remnants F2 and 1908 (blue routes). These remnants are not included on the adjacent figure.



Map from Taylor et al 2007 incorrectly showing native forest fragments f2 and 1908 to be isolated by 7 km of pine forest

26. **Dispersal Range** At present there is no conclusive data on exactly how far Gliders will travel through a matrix of regrowth Eucalyptus forest that is structurally suitable for movement (eg 30+ year old regrowth) but which is unsuitable for habitation due to lack of hollows, unsuitable structure, or lack of suitable tree species. The risk of glider extinction in small patches left isolated by intensive logging is cumulative and will increase over time as a higher proportion of surrounding forest is harvested. The chance of Gliders dispersing in random directions through an uninhabitable matrix of young regrowth forest and finding small patches of suitable uneven-aged old growth habitat to occupy before they succumb to water or heat stress (in the absence of suitable hollows to occupy) and areas to feed, is likely to become prohibitively small once regions become progressively logged out. This is especially true of forests at low elevations in East Gippsland where summer temperatures are higher and dependence of large well insulated habitat trees with moist humid cavities is likely to be especially important. Until such more conclusive information becomes available it would be reasonable in my opinion to assume on a precautionary basis that expanses of dense regrowth forest and other uninhabitable vegetation act as barriers that seriously reduce or prevent regular Glider movement (sufficient to cause local extinction) where they are wider than about 140 m.

27. All studies of Greater Gliders movement throughout Australia that I am aware of, show this species to be extra-ordinarily sedentary with the most limited dispersal capability of all the southern possums and gliders. Pope et al (2004) tracked 40 Gliders over a 12 month period and recorded only one large dispersal event, a distance of 1 km between two areas linked by a corridor. The largest study of Glider movement to date was undertaken by Tyndale Biscoe and Smith (1969) who marked and released over a 1000 Gliders at the edge of a forests being progressively cleared for Pine plantations at Tumut, and monitored their movement into unlogged areas over a period of up to 5 years. Only one animal was found to make any substantive movement (3.2 km) through habitable native forest during this period. The great majority of Gliders only

made small movements (less than several hundred metres) and died without being able to establish themselves. The small percentage of Gliders that dispersed and survived longer than a year (7%) moved only 1.14 km on average (range 200-3200 m) during the 5 year study. The authors concluded from this that Gliders are so sedentary that "*the displaced gliders die in situ rather than emigrate to occupied forest*". At present there is no evidence that gliders will routinely disperse more than 1.2 km through occupied suitable habitat, and no evidence that they will routinely disperse more than 140 m through non-habitat. On this basis, it is appropriate in my opinion to adopt a precautionary approach and assume until such time as contrary data is available that wide patches (> 140m) of intensively logged regrowth forest without tree hollows or wide patches of unsuitable forest types will act as barriers to glider movement and increase the risk and rate of extinction any small (< 100 individuals) local populations isolated by such barriers. I am not alone in arriving at this precautionary conclusion, I note the following statement by Possingham et al (1994) " ***The clearfelling method is used to harvest and regenerate the forest (Squire et aL, 1991) and such operations will eliminate P. volans from logged areas (Lindenmayer, 1992). Although oldgrowth forests are excluded from timber harvesting (Macfarlane & Seebeck, 1991), extensive timber harvesting operations elsewhere in the forest estate may serve to isolate these areas further. This may be important for P. volans as the species may have difficulty in dispersing through stands of young regrowth forest (Suckling, 1982). Therefore, logging operations could lead to increased mortality during dispersal and have a negative impact on the metapopulation dynamics of P. volans."***

28. There is some additional evidence from post fire surveys that extensive tracts of previously logged or intensively burnt forest act as a potential barrier to Glider dispersal and population recovery at landscape scales. A recent study by the Victorian Government (Department of Environment Land, Water and Planning (DELWP, Cripps et al 2021) failed to detect any Greater Gliders in unburnt potential fire refuges in East Gippsland within the 2019/20 fire envelope. The authors noted that Gliders were absent from fragmented patches of suitable habitat within a landscape disturbed by past bushfires and timber harvesting and concluded that " ***Due to the large areas of currently unsuitable young regrowth forest (including stands dominated by E. sieberi) it is unlikely that many areas of the East Gippsland IPAs will be occupied now or into the future; these large areas of unsuitable habitat may also act as a barrier to recolonisation***". They further concluded, based on slow or negligible spread of Greater Glider populations from refuges in the Kilmore East-Murrindindi region more than a decade after fire in 2009, that recovery of populations in East Gippsland ***may only be achieved by "assisted colonization***".

29. During my re-analysis of the Lindenmayer et al (2000) survey data I found that the number of Gliders in retained patches of forest in strips along drainage line corridor patches in Tumut to be significantly positively correlated with corridor width (R=0.5 p <0.001). Gliders were absent from corridor patches with an average width or less than 39 m and reached peak abundance in corridor patches with a mean width of greater than 190 m. I also found that density of Gliders in corridor patches was significantly negatively correlated with corridor patch length (R= - 0.33 P<0.05) and that Gliders were scarce or absent from corridor patches more than 1500 m in length. These results suggest that my earlier recommendation (Second report, Appendix 1 para 48 and elsewhere) that retained patches of Glider habitat in logged forests be linked by corridors not more than 4 km in length (to nearby large conservation reserves and fire refuge areas) may not be sufficiently

precautionary. ***Consequently, it is now my view based on these more recent analyses that mapped and retained Glider corridors should be not less than 100 m wide and not less than 1.2 km long before connecting to another refuge patch > 250 hectares in size.***

30. VicForests does not currently have adequate mandatory prescriptions for the minimum width and length of wildlife corridors and minimum size and connectedness of retained patches of unlogged Glider habitat. Current prescriptions retain a network of SPZs and narrow streamside corridors, bisected by roads that are frequently logged on both sides. SPZs and streamside or other retained unlogged corridors cannot automatically be presumed to provide corridors suitable for Glider movement because these areas may be dominated wholly or in part by non-forest vegetation, including riparian vegetation and shrubs, unstocked and unmerchantable forest with few or no large trees suitable for Gliders. Any system of wildlife corridors for Gliders needs to be based on mapping and retention of actual Glider habitat and fire refuges, and not on existing SPZs or other areas left unlogged for different purposes, without ground truthing and mapping of forest type, structure and habitat suitability for Gilders. AS far as I am aware this has not been done, an until such time as it has been done, a precautionary approach to impact assessment and mitigation would need to assume that the existing SPZs do not function as effective wildlife corridors and local landscape reserves for Greater Gliders.

31. There is currently no certainty that VicForest's prescriptions that call for retention of 20-40% coupe area retention for mitigation of impacts on high density populations of Gliders will prevent ongoing Glider population decline over the short or long term because there is no mandatory requirement to ensure that retained habitat is: a) suitable for Gliders, b) protected from post logging burns, c) permanently protected and not harvested in subsequent rotations, d) not retained in small scattered and isolated patches, e) connected by wide corridors with narrow gaps to other large patches greater than 200 ha in size not more than 1500 m distant. Current Vic Forests provisions for reserve and wildlife corridor protection are so remote from these standards that in my opinion there is very high certainty that Glider populations will gradually be eliminated from timber production forest over the course of several harvesting rotations under current practice. In my opinion recent landscape scale declines in Glider abundance in East Gippsland and Southern NSW are consistent with and can be explained by excessive broadscale timber harvesting that has eliminated tree hollows and moist climate and fire refuge habitat over such extensive areas that the Glider population has been unable to recover from past fires (see my second report para 27 Figure 6) and recent droughts and periods of above average temperature over the past 20 years (see para 24 in my second report).

Part 2 Reply to report of Dr. Nitschke

General Response

1. **Do you agree that Greater Glider has been found to be impacted by timber harvesting at local scales but not at broader scales (Nitschke, summary, p3 and p14 first paragraph)? Please provide any comments concerning the statements regarding scale in the second half of the first paragraph on p14 of Dr Nitschke's report. Q2. Please address whether timber harvesting is a cause of population decline of the southern Greater Glider at each of the local and broader scales.**

In note that Dr. NItschke has agreed that logging may be cumulative and may cause severe impacts on Glider populations at local (coupe scales) but claims that this impact is negligible at broad scales. Dr. Nitschke has not provided a methodology for arriving at this conclusion but quotes a series of studies and reports inferred to support this position. I have reviewed these reports and summarized my findings in the following paragraphs. As with Taylor et al (2007) and Lindenmayer et al (2001) I found no factual data in these studies and reports that supports Dr. Nitschke's claims or that refutes my findings, conclusions and recommendation. In most cases, a closer examination of these studies found them to be consistent with my own findings and recommendations and to contradict Dr. Nitschke's assumptons.

2. **Kavanagh and Bamkin 1995.** Dr. Nitschke has made the claim that "*The GG is a species that has a relatively small home range (Kavanagh and Bamkin, 1995) and that has been found to be impacted at local-scales by forest harvesting but not at broader scales (Kavanagh and Bamkin, 1995; Lindenmayer et al. 2021).*" This statement is misleading because the study is not relevant to timber harvesting in Victoria. A closer examination of this study shows that logging was incomplete at the time of Glider survey, that logging appears to have eliminated Gliders from the extensive more intensively logged parts of the landscape and that future logging could yet eliminate Gliders from the remainder of the landscape. The study was carried out in southern NSW in the 1990's where logging patterns are much less intensive than those in Victoria. Harvesting in NSW retains wildlife gully and riparian corridors linked by 40 m wide streamside reserves in recent logging areas (similar to those which I have recommended in Victoria) but not in earlier logging areas. The study compared Glider abundance in 100 logged 100 unlogged compartments. Higher elevation compartments on Devonian substrates each included about 4 coupes of which only half were logged at time of study, under an alternative coupe harvesting system. On average only 40.7% of the forest around these "logged" survey sites was actually logged and 59% was unlogged. Greater Glider number were found to have declined by 47% in these compartments, half way through an alternate coupe logging process that has yet to be completed and which removed only 41% of the forest on average. At this rate of decline (47% glider population loss after logging 40% of the forest) completion of alternate coupe harvesting could lead to a 100% loss of Greater Gliders numbers in compartments within this landscape, despite the retention of corridors. At survey sites on Ordovician soils Greater Glider numbers declined to zero (100% decline) on all logged relative to unlogged compartments. (see Figure 1 below). Ordovician sites are located predominantly at low elevations where timber harvesting was generally more intensive and pre-dated alternative coupe harvesting. There is no evidence or data to suggest that a similar decline to zero does not await Greater Glider populations on Devonian substrates once alternate coup logging is completed and all coupes in each compartment are logged. The study

concluded that the Greater Glider was the "***species most adversely affected by logging***". Results of these surveys for Greater Gliders are reproduced in Figure 1 below. Dr Nitschke states on page Part 2 page 6 of his report that he defined impact "*as being severe and therefore not negligible when GG risk was > 30%*" he further defined risk as "*the proportion of GG that are at risk to management when GG within and adjacent to the coup are considered*". By Dr. Nitschkes own measure the level of decline after logging reported in this study must be considered "severe" only part way through the logging cycle athe coupe scale and severe (100% decline) at the landscape scale once logging is completed. Completion and extension of this logging to other unlogged areas of State Forests will lead to extensive (broadscale) reduction or loss of Greater Glider numbers. In my opinion these findings are cause for considerable alarm, as Gliders have disappeared to zero in all compartments sampled over a vast areas on fertile Ordovician substrates. I fail to see how this result in any way supports Dr. Nitschke;s position.

46 *Rodney P. Kavanagh, Khia L. Bamkin*

Table 2. Total counts of nocturnal forest birds and mammals, and their frequency of occurrence, in south-eastern Australia (n = 200 sites; 50 sites in each cell)

Species	Logging history[a]	Geology				Total counts	Total no. sites recorded
		Ordovician		Devonian			
		Counts	Sites	Counts	Sites		
Powerful owl	L	10	8	12	10	22	18
	U	13	11	7	6	20	17
Sooty owl	L	10	9	3	3	13	12
	U	4	4	0	0	4	4
Masked owl	L	2	2	1	1	3	3
	U	3	3	4	4	7	7
Southern boobook	L	35	27	20	17	55	44
	U	25	20	12	10	37	30
Australian owlet-nightjar	L	42	29	28	24	70	53
	U	33	27	33	24	66	51
White-throated nightjar	L	2	2	0	0	2	2
	U	10	6	1	1	11	7
Tawny frogmouth	L	3	3	4	4	7	7
	U	2	2	3	3	5	5
Greater glider	L	0	0	28	13	28	13
	U	11	8	59	18	70	26

Figure 1 reproduced from Kavanagh and Bamkin showing Glider numbers found in L= logged sites, and U = unlogged sites

3. **Lindenmayer et al 2001.** Dr. NItschkes claim that the study of Lindenamyer et al (2021) shows that Gliders are *impacted at local-scales by forest harvesting but not at broader scales (Kavanagh and Bamkin, 1995; Lindenmayer et al. 2021)"* is also misleading and incorrect. The study of Lindenmayer et 2001 is confined to Ash Forest and does not and cannot (by design) assess logging impacts on Gliders because the monitoring survey sites used in this study were explicitly protected from logging. Logging occurred in some areas adjacent to some of these monitoring sites, and this logging may have had a neighbourhood effect of providing refuge for displaced animals and artificially boosting fauna abundance in the monitoring sites, but any conclusion that logging does not impact on Gliders based on this study is false. The study found an increase in the number of Sugar Gliders and Bobucks in proportion with surrounding logging which may have been a refuge effect. This study was carried out by stagwatching which counts the number of Gliders emerging from trees with hollows at dusk (Smith 1980) so the number of Gliders on monitoring sites is primarily related to the number of trees with hollows. It is also well known that the number of dead trees with hollows in Ash forests has been

declining rapidly since 1939 due to decay of fire killed trees, leading to a decline in abundance of Gliders and other hollow-dependent possums (Smith 1982, Smith and Lindenmayer 1992, Lindenmayer et al 1990) and this decline is likely to have been much Greater if the monitoring sties were logged (because logging harvests some habitat trees and burns others (Smith 2010). Because of its design and exclusion of logging impacts Lindenmayer et al 2021 underestimates landscape scale Glider declines in Ash forests and is not a true monitoring study.

4. **Ryan et al 2001**. Dr. Nitschke quotes the work of Ryan et al (2001) to support his claim that "local scale impacts do not extrapolate to the regional scale". I have reviewed this study and found it to be an interesting academic modelling exercise that is entirely theoretical and simplistic, lacks validation and is too uncertain for any practical application. While this model may be improved and adapted at some point in the future, its current output can only be considered highly speculative. There is no new underlying factual data in this study. The input data for this model is very limited (broadscale climate, fire, modelled forest structure and mapped forest age class data (which I have found to be totally unreliable in Mixed Species forests and frequently unreliable in Ash Forests), and does not consider the most important variables for predicting Glider abundance at local scales (habitat tree distribution, large tree basal area, fire refuge distribution, corridor retention, old growth and uneven-aged forest patch size and isolation). The model also relies of "pseudo absences", artificially created locations where Gliders are assumed (by informed guesswork) to be absent. The key predictions of the model, that any impacts of fire and timber harvesting over the next 50 years will be overshadowed by climate change, are entirely speculative and driven by limitations and assumptions of the model and future climate change. It is not surprising that climate variables emerge as a predictors of Glider occurrence when using a model in which the underlying input data is broadly limited to landscape scale topography and climate variables. This does not mean these climate variables have any direct effect on Gliders, or any importance in determining the abundance of Gliders within their core range, which includes most State Forest in Victoria. There is no certainty that any of the predictions arising from this model are real and not artefacts of the model structure and limited input data.

5. Glider distribution modelling by Wagner et al (2020) predicts that drier conditions over recent decades may have varied or restricted the range of forests suitable for Gliders in parts of Victoria but this modeling is not accurate (see next paragraph) and must be considered highly speculative. It remains unclear to what extent the unusually hot and dry conditions of recent decades are cyclical and to what extent they may reflect a long term trend. There is no evidence that recent drought conditions have caused any landscape scale changes in Glider geographic range in the Central Highlands. Recent surveys in over 100 coupes in these and previous proceedings (Smith 2019) have found Gliders to be present at about 95% of all unlogged coupes surveyed over a wide range of forest types, elevation and climate conditions. No correlation has been found with elevation and Glider abundance on these coupes, which I consider to be a strong indication that climate is not a limiting factor for Gliders in the Central Highlands of Victoria or in the Strathbogie Ranges (see para24 and 25 of my second report). Less information is available for East Gippsland but this region is dominated by drier Mixed Species forests which have been extensively logged using ecologically inappropriate high intensity clear-felling

and hot regeneration burns which destroy natural uneneven-aged old growth forest stands and convert them to young uniform aged regrowth crops unsuitable for Gliders (Smith 2010). In the absence of any data to the contrary it remains my opinion that extensive clear-fell logging combined with local factors (forest type and fire history) alone is sufficient to explain apparent reported declines in Glider abundance at landscape scales in East Gippsland (DEWLP unpublished, in Department of Agriculture, Water and the Environment Consultation on species listing eligibility and conservation actions Petauroides volans (Greater Glider southern) June 2021).

6. I have examined the Greater Glider distribution model generated by Ryan et a. (2001), overlayed it with known Glider records from the Atlas of Living Australia (Figure 2) and satisfied myself that it is inaccurate, no more reliable than previous Glider models (see para 16 and 17 of my second report) and unsuitable for predicting Glider distribution at either local or landscape scales. I note that Mr. Blake Nisbet (affidavit in these proceedings) has also tested the Glider distribution model of Dr, Nitschke against survey records and found it to be inconsistent and unreliable. Dr. Nitscke has agreed (para 60 a) with my assessment of that earlier landscape scale Glider models are inadequate and unreliable, but has assumed for the purpose of his impact assessment that output from the Ryan et al (2001) model is real and factual when in fact it is hypothetical and speculative.

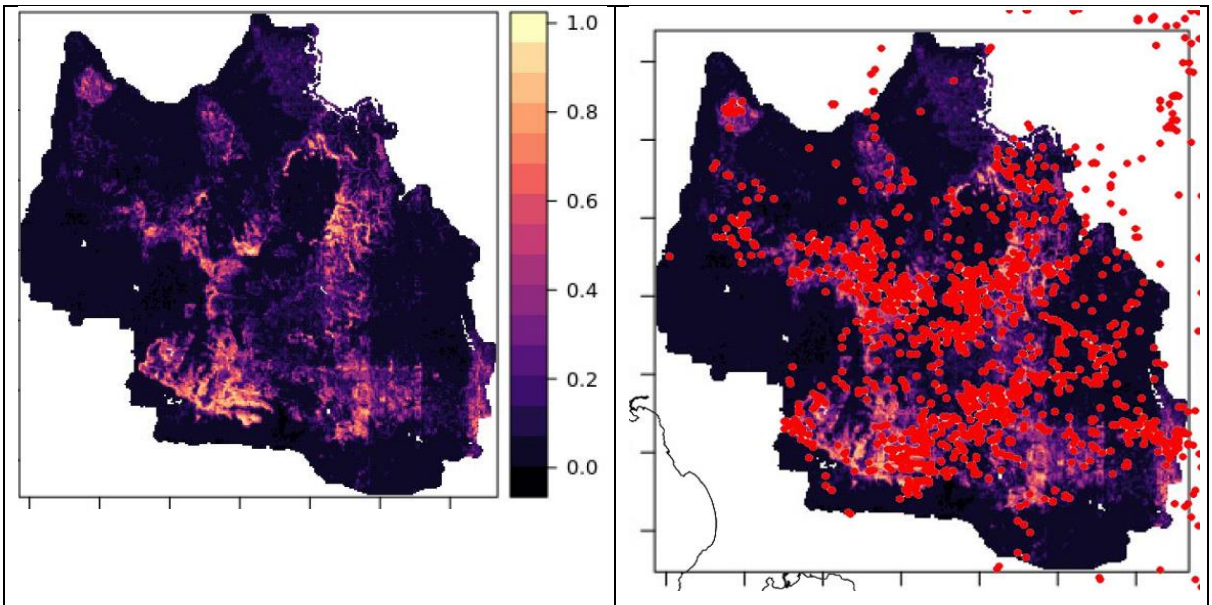


Figure 2 Ryan et al 2021 Glider model.	Model overlayed with Glider Distribution records from Atlas of Living Australia showing extensive inconsistencies

7. On p12 (last sentence) Dr. Nitschkes claims that the model of Ryan et al (2012) shows that ongoing timber harvesting in the Central Highlands forest management area "*is unlikely to reduce the minimum expected population size of GGs compared to if no harvesting took place*". This finding is unvalidated and speculative, and in my opinion is a speculative extrapolation well outside the capability, reliability and utility or the model. It is also a finding inconsistent with the data showing the extensive reduction

(90%) in total area of mature and older Ash forests in Victoria after 80 years of timber harvesting since the 1939 fires (VEAC 201a7, see para 43 of my second report) and the extensive conversion of old growth Mixed Species forest to uniform aged regrowth with few or no tree hollows in East Gippsland evident from tree age mapping by VEAC (2017b). As noted in para 45 of my second report if the same form of intensive even-aged timber harvesting that has eliminated Glider habitat from most Ash forests is extended to Mixed Species forests in the Central Highlands (as proposed in most of the coupes the subject of these proceedings) it is inevitable that current steep declines in Glider abundance will continue at the landscape scale throughout the remainder of the Central Highlands. I note that Dr. Nitschke has agreed (P18 Table 3-3) that even aged clear felling of the type extensively applied to Ash forests is not ecologically appropriate in Mixed Species and ecotone forests and that they must be harvested by low intensity 60% retention selective harvesting for Glider persistence. Given this agreement, and VicForests proposal to continue harvesting Mixed Species using intensive Ash style clear fell harvesting (and not to use 60% retention), the conclusion is inescapable that Gliders will decline at the landscape scale in equal or greater proportion to the area of such forests logged.

8. **Question 3 Please comment on Dr Nitschke's statements that: (a) "The species has been found to persist in patches of mature forest with suitable nesting and forage resources within harvested areas of native forest (Lindenmayer et al., 1993; Kavanagh 2000) and in remanent patches of habitat in landscapes dominated by exotic pines (Taylor et al. 2007)." (p3), (b) his related comments in the second paragraph on p12, and (c) his answer to question (c) on p22, in particular the first half.**

   See previous paragraphs for comments on the Taylor et al 2007.

   Lindenmayer et al 1993. The statement above by Dr. Nitschke is not correct or at best misleading. Claims that Gliders persist in patches of retained mature forest within harvested areas of native forest is not supported by the reported study. Lindenmayer et al (1993) measured Glider abundance in 1939 regrowth forest in retained linear strips. There is no evidence that these survey areas were isolated patches and this is unlikely because they were mostly retained along small creeks which link into larger creeks flanked by retained riparian strips. The average width of strips was 110 m which is abnormally large, but similar to minimum widths that I have recommended for Glider corridors (100m). It is not clear how distant these corridors were from unlogged forest. Gliders were surveyed only once within four years after logging of adjacent forest so the study measures only the immediate short term occurrence of gliders in retained corridors not long their term persistence. Gliders are expected to persist in unburnt retained patches at least until they reach old age at about 5-10 years. The study found Gliders in only 32 % of retained strips, so it is possible that Gliders had already declined by 68% since logging if they were present in all coupes prior to harvesting. The authors of the study concluded that ***"The results of this study and those of Suckling (1984) and Recher et al. (1987) have indicated that some species of arboreal marsupials can survive in linear refuges in the short term. However, there are, at present, no data to demonstrate the long-term effectiveness of such areas***." This conclusion does not support the claims of Dr. Nitschke.

9. **Kavanagh 2000.** The findings of this study do not support the assertion of Dr. Nitschke that Gliders persist in retained patches. The study of Kavanagah 2000 was carried out in NSW using low intensity selective

harvesting which has no equivalent in Victoria and provides no data or insights into the ability of Gliders to persist in small remnants isolated by uniform clear felled forest. Kavanagh states (P28) that " ***Logging intensity in this study could best be described simply as selective" "The level of tree retention of the logged blocks ranged from 35 -83% of the original stand area***". The results of this study were used to support earlier hypothesis by the author that a minimum 21-39% of tree basal area must be retained to retain Gliders in logged forest. The results of this study support my position that current intensive clear felling in Victoria will eliminate Gliders from logged areas. It provides no support for claims that Gliders will survive in retained small patches of forest.

10. **Question 4 Do only those impacts which threaten: (a) the species' viability and conservation status, considering its entire range and population (Nitschke, p3), (b) the Greater Glider population in a whole Forest Management Area, constitute threats of serious or irreversible damage to Greater Glider?**

    No. Forest Management Areas are only relevant to viability of Gilder populations in so far as they limit or define threats such a logging. The population of Gliders in Victoria comprises a network of sub-populations isolated from one another to varying degrees by clearing, past intensive forestry, past intensive fire and unsuitable habitat. Threats of serious or irreversible decline may apply to any or all of these sub-populations, and the risk to the species as a whole is the sum of threats to all individual sub-populations plus any collective neighourhood effects caused by increased fragmentation and isolation as individual sub-populations become locally extinct or decline to the point where they fail to maintain genetic exchange across the full range of currently occupied environments. Dr. Nitschke has stated that "*in my opinion, there are two perspectives centred around the impact of harvesting on GG and these are based on scale. Smith argues that the cumulative impacts of fine-scale actions in harvesting are synergistic with predation and droughts leading to increasing impacts over time and space. VicForests sees the that with a broadening of spatial and temporal scales the cumulative impacts of harvesting are antagonistic, this means that the combined effects at broad scales are viewed as less than the individual effects at the coupe scale. I see merits and logic in both arguments. The work by Ryan et al. (2021) suggests that for the Central Highlands the impacts are not synergistic and that timber harvesting does not increase the risk to GG meta-populations at the regional scale*". Dr. Nitschke miss quotes my position. I argue that the cumulative impacts of fine scale actions are primarily additive or multiplicative, and over time give rise to impacts at broad scales that trend toward the same magnitude of impact that occurs at local scales. I have argued that some impacts are synergistic (mainly fire, drought and logging) and that impacts in State Forests can have adverse neighbourhood impacts on embedded conservation reserves, but my impact assessment is largely based on the sum of these additive effects because synergisms are too complex to quantitatively estimate with current data. Dr. Nitschke claims that he sees merit in claims that the cumulative effects of logging at coupe scales are antagonistic but provides no data or facts to support this. The model of Ryan et al (2012) as previously discussed is entirely theoretical and open to manipulation by the user and its predictions of current Glider distribution and abundance are inaccurate and unreliable. For the purpose of clarification, I have provided in following paragraphs a summary of the methods that I have used for risk assessment.

11. Methods of Impact Assessment

A) Impact assessment is a science and should therefore be based on facts and certainty where possible and adopt precautionary mitigation measures where risks are possible and real but quantitatively and directionally uncertain. There are a great many steps and questions involved in impact assessment. A key first step is to ask is: what is the area and proportion of habitat lost at the coupe scale?. When a coupe is logged under current intensive (clear felling) practices Gliders are eliminated from the logged area of the coupe which may range from 95% (as proposed in Arena coupe) to about 60% (in coupes with abundant gliders and 40% retention). This represents an initial Glider population decline of about 60-95% at the coupe scale. While the actual decline may vary about this range depending on the quality of habitat lost and retained on individual coupes, the overall initial impact of logging at the coupe scale is clearly severe (>50%).

B) A key second step is to ask is: does the logging of habitat on a coupe have any adverse impact on Glider populations beyond the coupes and within the surrounding "neighbourhood"? For example, does it remove refuge habitat that is important to long term recolonization after wildfire?, does it remove habitat that is important as part of a corridor (see the potential for this in Stimpy, P87 of my second report)?, does it leave retained habitat on the coupe or in adjoining coupes in an isolated patch (see Zinger see p 85 para 4 of my second report)?, does it remove habitat that is important to retain as part of a local corridor and small reserve (125+ ha) system essential to maintain the viability of small glider populations left in patches after logging? VicForests has a system of SPZs which may provide a default corridor system in some areas but the suitability and effectiveness of the SPZ system to sustain viable Glider populations over the long term (at least on harvesting rotation) is uncertain and has not been tested or demonstrated by Vic Forests. For this reason, the SPZ system must be supplemented by minimum corridor and reserve standards known to be effective before an assumption of "no neighbourhood impact. So, for each coupe we must ask is the average width of SPZs wide enough to function as a Glider corridor (>100 m)? do SPZs contain Glider habitat? do SPZs contain large patches (>250 ha) of Glider habitat at regular intervals (ever 1.2 km)? are SPZs continuous with one another and linked to major conservation reserves? As far as I have been able to ascertain VicForests makes no attempt to consider, assess or answer any of these questions or to mitigate these "neighbourhood" risks through a formal corridor and refuge/reserve plan. The science of island biogeography and studies of Glider persistence in fragmented ecosystems (Suckling 1980,82) tell us that Glider populations in patches have a high risk of declining to zero within about 60 years once patch areas falls below about 250 hectares in area. I am not aware of any VicForests policy or plan or mitigation measure that will ensure that all or any Glider populations left in patches after timber harvesting on coupes will be effectively linked to or apart of patches that exceed 250 ha in area. Consequently, I conclude that there is a high and real risk that retention of glider populations in small, retained patches on coupes is a risky and potentially ineffective strategy that could result in all or most Glider populations left in patches after timber harvesting becoming extinct within the near future.

C) A key third step is to ask how long Glider habitat patches, habitat trees (HBT) and corridors will be retained and whether they are secure and protected in the long term. At present VicForests makes no

guarantees to protect retained habitat patches or individual retained trees (HBT). HBT can be removed at a whim for safety reasons or by burning and neglect in future cutting cycles. There is no guarantee that retained habitat patches will not be logged within another year or another cycle. Given VicForests failure to map such areas for permanent protection and lack of commitment to certainty, it is reasonable and necessary for impact assume that current patterns of HBT harvesting and loss will continue over time and that retained habitat patches could be harvested.

D) A key fourth step is to ask is when, and under what circumstances does regenerating logged forest become suitable for Gliders retained in permanently protected areas of Glider habitat? The answer to this question depends on the type of forest and whether forests have been logged intensively (clearfelled), or lightly (selectively logged). Generally, across a wide range of forest types and regions, Glider abundance is most strongly correlated with mature forest structure, particularly the proportion or basal area of large trees (> 40 cm dbh) and the number of trees with large hollows (Smith et al 1994,95, 2019, Smith et al 2007, Eyre 2006, Nelson et al 2018). Many studies have found that Gilders can withstand and are moderately abundant in selectively logged forests (Smith et al 1994, 1995, Dunning and Smith 1986, McLean et al 2018) that maintain and uneven aged structure including large trees and trees with hollows suitable for Gliders (Smith et al 1994, 1995, Dunning and Smith 1986, McLean et al 2018). However, logging of this type does not occur in the Mixed Species and Ash forests of the Central Highlands and East Gippsland. These forests are intensively logged by clear-felling, a practice that has no natural equivalent in nature. In nature these forests are periodically subject to wildfires that may kill a portion of the overstorey trees, particularly in wet sclerophyll or Ash forests. Mixed species forests are dominated by tree species more resistant to fire and recover their natural uneven-aged structure and Glider populations relatively quickly after fire (within 10-20 years, Smith et al 1994, 1995, Dunning and Smith 1986, McLean et al 2018). Trees in Ash forests are more easily killed by fire and a small proportion of these forests (about 24%, Smith et al 1985, Smith and Lindemayer 1992) may regenerate naturally in uniform aged stands with an overstorey of dead fire-killed trees. Many such stands developed after wildfires in 1939. Dead trees in these forests decay rapidly (Smith 1982, Lindenmayer et al 1991) and are now either largely absent from, or too decayed to be used by Greater Gliders (Smith unpublished data.). All uniform aged 1939 regrowth forests without dead or living trees with large hollows can be considered unsuitable for Gliders. I have analyzed Glider survey data from 30 sites in regenerating Ash forests in the Central Highlands surveyed by the author in 1983/4 and 58 sites in logging coupes surveyed by Friends of Leadbeater's Possum in 2017-19. The 1984 surveys found Greater Gliders to be absent from young regrowth forests (<15years), absent from 1939 regrowth Ash forests (45 years of age) with only dead trees with hollows, at moderate density (0.23 /ha) in multi-cohort 45 year old (1939) regrowth with at least one large living hollow bearing tree per hectare in the overstory, moderately abundant (0.23/ha) in advanced regrowth (45-80yr), and most abundant (0.32/ha) in uneven aged or multi-cohort forests with advanced regrowth (45-100 year) and at least one living large old senescent trees with hollows in the overstory. This study also found Glider density in regrowth Ash forest to be significantly correlated ($R=-0.44$ $P<0.05$) with distance (km) to the nearest patch of mapped old growth or pre-1900 forest (> 25 ha in size), and with the percentage of forest within a 1 km squire surrounding the site that includes mapped old growth ($R=0.45$ $P<0.05$). The best predictor

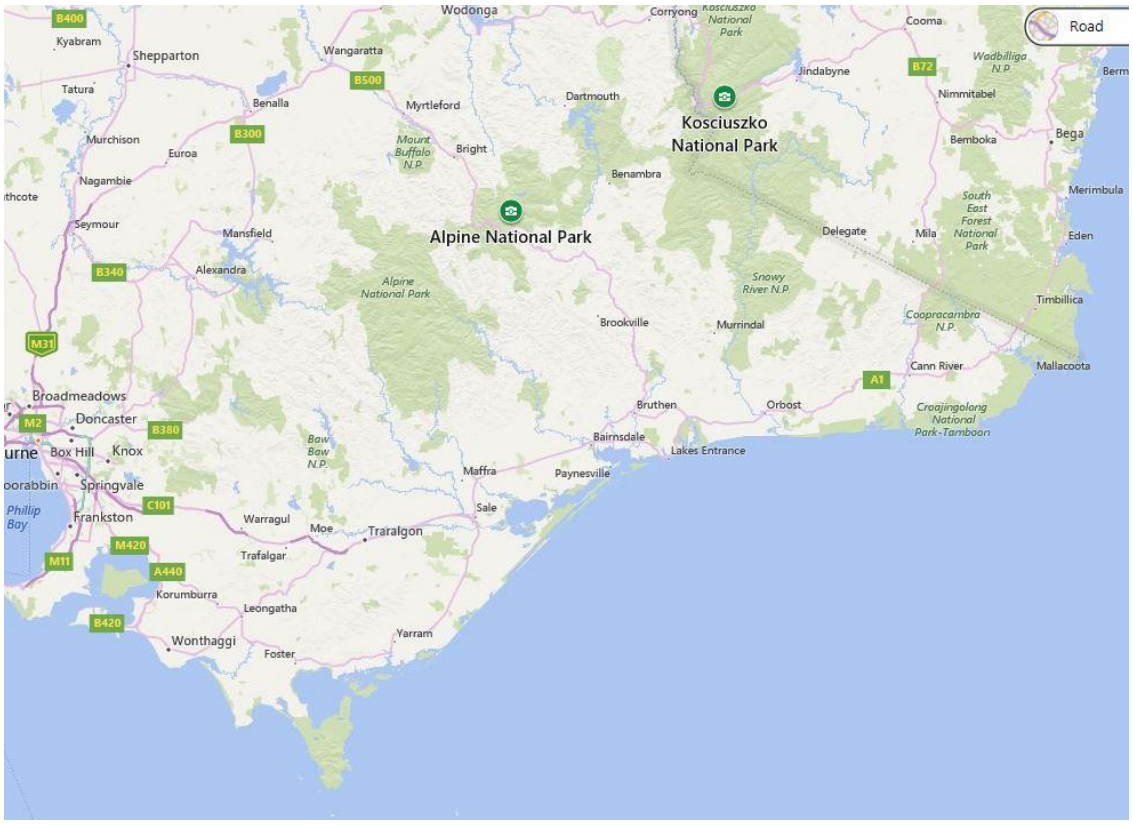
of Glider abundance (R=0.57 P<0.01) was the percentage of forest within a 1 km^2 area surrounding the site found on aerial photographs to have an irregular or uneven-aged canopy dominated by large diameter trees crowns. Glider density was predicted to be zero in forests more than 2500 m from mapped patches of old growth and zero in forests with less than 10% uneven-aged forest in the surrounding 100 ha. These results are consistent with the independent findings of others including Incoll e al. (2001) who found Glider abundance in Ash forests to be best predicted by overstorey tree basal area and old growth (pre 1900) forest patch size, and Nelson et al (1996) who found Gliders to be most abundant in old growth (pre 1830 forest), scarce to low density in 55 year old (1939) regrowth and absent from 5-20 year regrowth (except at an anomalous site adjacent to a retained gully corridor of uneven aged forest). It needs to be noted here that Ash forests are very fast growing relative to Mixed Species so that the time required for trees to reach a suitable size for recolonization by Gliders (> 40 cm dbh) will be much longer in Mixed Species forests, potentially up to 80 years instead of 40 years.

E) I concluded from the preceding studies that on average Greater Gliders are potentially capable of re-colonizing uniform-aged post Ash logging regrowth about 40-60 years after logging and Mixed Species regrowth at about 60- 100 years after intensive logging), provided that: a) a minimum of 1 and preferably 4 large living senescent trees with hollows suitable for Gliders/ha are present throughout the forest; b) the regrowth is linked to a large patch (>125 ha) of unlogged uneven aged mature or old growth refuge habitat large enough to sustain a viable population of Gliders within about 1.2 km.; c) that forests will be harvested on long rotations (> 60 Years Ash forests and > 90 years Mixed Species forests). VicForests current policies and practices do not provide any of these guarantees and there is no evidence that current SPZs perform any of these functions adequately, so I must therefore conclude that there is a very high risk that Glider populations in Ash forests, and any Mixed Species forests clear felled in a similar manner to Ash forests, within state forests will continue declining in the foreseeable future and could decline to zero if current harvesting practices are continued.

F) **Use of Average Values.** I also wish to note here that when assessing and planning to mitigate impacts it is in my opinion, necessary and appropriate to use “average” values, rather than ”extreme” or outlying values for Glider life history and performance parameters such as longevity, dispersal capability, density in different forest types. For example, I would not rely on occasional or outlying records of Gliders reported in 5-20 year old regrowth (Nelson et al 1996) to set or define that age at which Ash regrowth becomes suitable for Gliders. It is apparent from my own research and that of others (above) that while Gliders can occur in 45 year old regrowth they are present at low density and low frequency (<25% of sites), and do not reach a higher frequency of occurrence or an average density until regrowth is older. In my opinion the assumed time for Gliders to recolonize uniform aged regrowth for planning purposes should be based on the age at which at least half of the survey sites are likely to be occupied or the age at which Glider density is at least half the mean natural Glider densities for the forest type and location. For Ash forests in the Central Highlands this would be about 55+ years. Similar arguments apply to other parameters including the dispersal capability of Gliders. I would not assume Glider

dispersal ability to be 7km on the basis of one outlying study (even if it was reliable) but would use the average dispersal distance of about 1.2 km reported in the study of Tyndale Biscoe and Smith (1969b).

G) A key final step is to ask: will the elimination of Gliders from State Forests have a significant impact on Glider populations outside state forests in unlogged conservation areas in Victoria and elsewhere in the species range? National Parks and SPZs in Victoria are fragmented and isolated from one another by a matrix of State Forest (see Figures 3 below). If this matrix becomes unsuitable for Gliders, populations in these embedded conservation area will become isolated from one another and will be cut off from the elevation and topographic gradients necessary for genetic adaptation to environmental change over the long term (100s -1000s of years). We know from genetic studies and loss of large mammal populations on offshore islands after isolation by sea level rises at the end of the Pleistocene (about 12,000 years ago) that small isolated mammal populations under about 2000-5000 individuals are highly likely to become extinct over the longer term (Burbidge et al 1997). At present the exact size, distribution and location of Glider populations within Victorian conservation reserves is imprecisely known, but most of the larger reserves are dominated by non-forest or low quality forest vegetation unlikely to support substantial Glider populations. An examination of Figure 2 in part 1 of this report shows that there are comparatively few Glider records in State conservation areas and that the main concentration of Glider records occurs in high elevation Ash and Mixed Species in State Forests in the Central Highlands, including those on coupes that are the subject of these proceedings. Consequently, there is a real risk that each Victorian conservation area may be too small, and contain insufficient Glider habitat, to sustain viable glider populations in isolation if the matrix of habitat in the surrounding State Forest becomes fully logged. Given this risk, I conclude that continuation of Vicforests current ecologically unsustainable intensive harvesting practices poses a real and significant risk to survival of the Greater Glider in Victoria and southeastern Australia as a whole at both local and state wide landscape scales.



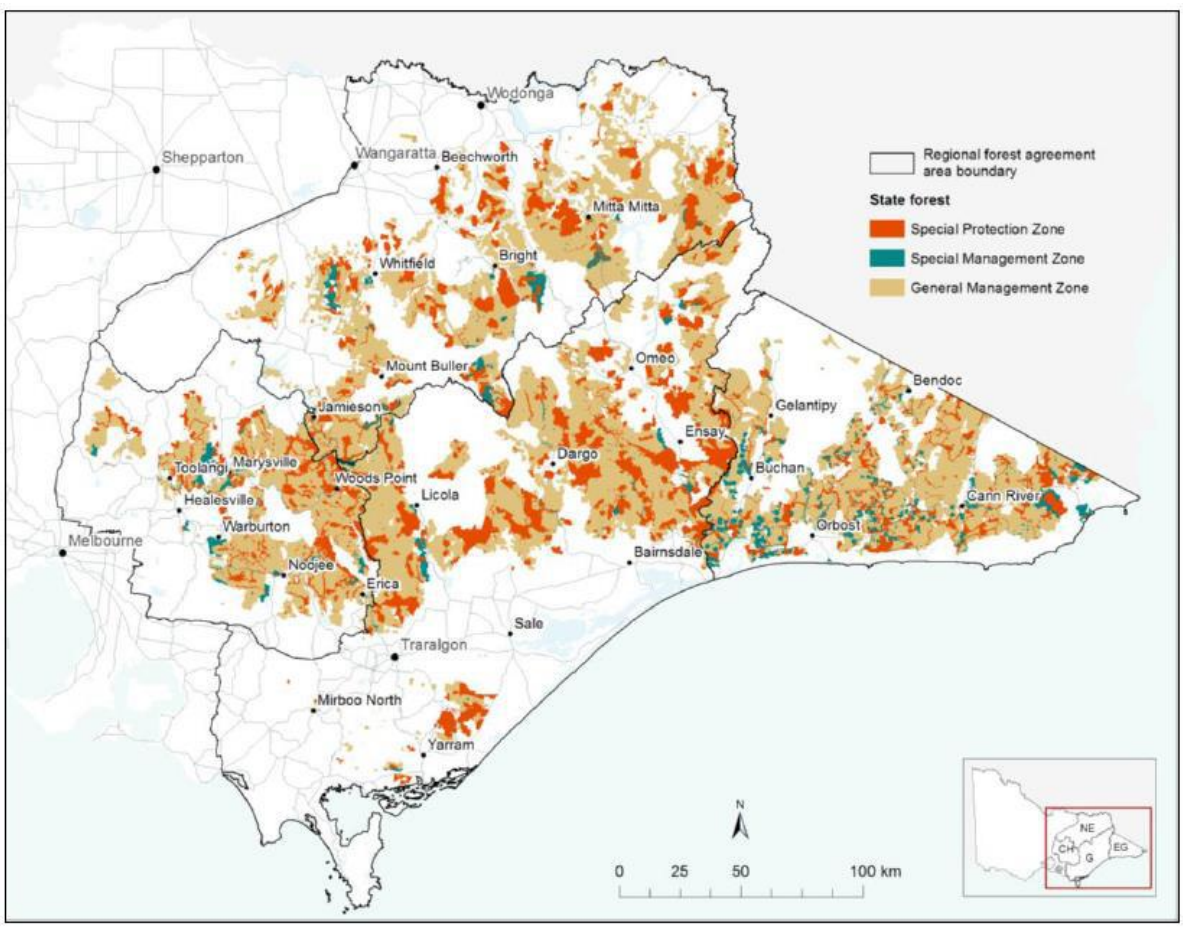


Fig 3 a, b. Showing the fragmented and isolated nature of Conservation reserves and SPZs in Victoria (after Victorian Environmental Assessment Council 2017)

12. **Question 5 Do you agree with Dr Nitschke (summary p3, final paragraph p17 of Dr Nitschke's critique of your report and [78] on p20 of that critique) that VicForests has applied the precautionary principle properly at broad scales such that the threat of serious or irreversible damage to Greater Glider is negligible? If not, please address whether VicForests' reliance on SPZs, Parks and Reserves and Code of Forest Practice Exclusions (referred to at [78], p20 of Dr Nitschke's critique of your report) constitute measures that are effective to address the threat to the Greater Glider, at the local and broad scales**.

No. See my answer at para 10F and Part 1 para 29.

While it is true that small areas of habitat are retained on some coupes in association with stream buffers and any SPZs, such areas are generally small and remnant populations in such areas will in my opinion be at high risk of extinction over successive rotations due to the narrow, isolated and fragmented nature of these remnants and the SPZ in general, and also due to the burning, natural loss and gradual elimination of habitat trees (including for OHS purposes) without recruitment from the surrounding timber production matrix (Smith 2010). The long term protection of Gliders in Victoria is likely to require the preservation of as much of its genetic diversity as possible. At present we have little detailed information about the spread of genetic variation in Greater Glider populations and how this relates to climate tolerance at the extremes of the species range. Available genetic data shows that Glider populations rapidly (within 35 years) lose diversity in small remnants (<95 ha)(Taylor et al 2007) risking extinction from inbreeding and maladaptation to changing habitat . In the absence of this more genetic information we need to preserve populations throughout their natural geographic range and especially at the extremes of ecological gradients such as elevation, rainfall and temperature, and connect these populations to one another along continuous corridors or gradients located in the least fire prone areas (eg moist gullies an lower slopes). In the Central highlands this would require protection of Greater Glider habitat throughout the landscape and not just in a small number of scattered isolated national parks (Map 5 below) and special protection zones.

13. **Question 6 Do you agree with Dr Nitschke's response to Q1 on p4?** Yes, I generally agree, but note that (Wagner et al accepted) is not a source for the statement about home range size and productivity. Wagner et al is a theoretical modelling exercise and not a source of primary data.

14. **Question 7. Do you have any comments concerning Dr Nitschke's analysis of the likelihood of coupes containing Greater Glider, and in particular his statement that "I found to be a significant predictor of GG abundance in a coupe was the proportion of the coupe in mixed eucalypt species … and proportion of ash species.." (p4, final paragraph), informed by his model there referred to**?

It is not clear to me how Dr. Nitschke derived the relationships shown on page 5 of his report. These graphs show a relationship between forest type and Glider probability of occurrence on coupes. I found that Gliders were present on all but one of the 64 coupes (frequency of occurrence 98%) which should preclude this type of statistical analysis. Dr. NItschke states that "irrespective of reported stand composition there is 25 to 75 percent chance of Gliders occurring, how can this be if gliders are actually present on all coupes. Also, I do not find this type of statistical model useful or practical to interpret because

it presents the results of the predictive model (which is constrained by a pre-determined algorithm) and does not show the visual spread of actual data points.

15. I have some disagreement with interpretation of the presented data and the implication for Glider habitat requirements. Like Dr. Nitschke I have also found negative correlations between glider density and the percentage of mapped wet (Ash) forest on coupes in the Central Highlands (Smith 2019), which is the opposite of what climate models predict, but on close examination I found that this result was an artefact of confounding with tree hollows. When I re-analysed the data after splitting it into Mixed Species, Ecotone and Ash subsets I found that the negative correlation with Ash was an artefact of very low average habitat trees densities in Ash forests caused by past logging, fire and natural decay of fire killed hollows. The loss of hollows from Ash forests has been well documented (Smith 1980, 82, Lindenmayer et al 1991, Smith and Lindenmayer 1992). This negative association with Ash does not mean that Ash forests are less important to Gliders than Mixed Species forests, in my opinion it is an indication that Glider numbers have declined more significantly on average in Ash forests since the 1939 fire and subsequent salvage logging, than in the more fire-resistant Mixed Species. Mountain Ash is very important to Gliders because it is one of the only mono-cultures (forest dominated by a single species) known to sustain high Glider densities and it occurs in a favourable climatic zone for the species.

16. **Wagner et al. (2020)** have found correlations between Glider abundance and climate which suggest that recent climate change may be responsible for recent Glider declines at the landscape scale. But I have considerable reservations with the Wagner et al model. The authors of the model claim that ***the models are robust and can be used as a predictive tool for greater glider occupancy across the studied landscapes***. This claim is not supported by independent data and in my opinion is most unlikely to be true. The model is validated using a subset of the original data set, not by independent ground survey, so it is a pseudo-validation that is only as good as the original data. The model relied on input data from Lumsden et al (2013) that are highly variable and inaccurate and likely to contain many false zeros because of small survey plot size (100m transect). Output from the Lumsden model shows no close correlation with actual Glider records (see my second report para 16, 17 and Dr. Nitschke and I are both agreed that these models are not reliable). Findings of the model (that climatic variables, particularly those related to aridity and extreme weather conditions, such as number of nights warmer than 20°C, are significant predictors of greater glider occurrence) are expected when analysed across the full range of this species distribution at very broad scales (south eastern Australia) but there is no certainty that they have any predictive reliability at local scales within the core of the species range, which includes most of Victoria above 200-300m elevation. This model takes no account of the many other non-climate variables known to be good predictors or Glider abundance including logging history, tree hollows, and proximity to old growth, so cannot be expected to produce reliable predictions at local scales.

17. I agree that the Greater Glider is vulnerable to high temperatures and water shortage, and that high temperatures may limit the distribution of this species on the margins of its range. This is a normal pattern amongst a wide range of mammal species which are physiologically adapted to different climate regimes. However, I am not aware of any conclusive evidence that climate change is responsible for population

decline and local extinction within the core of the species range or anywhere in Victoria. The Wagner et al and similar research is still in early stages, mostly theoretical, and based on inaccurate models and less than reliable modelled input data (models of models). Gliders in inland south-east Queensland are likely to experience much hotter and drier conditions than those currently predicted by Wagner et al models to eliminate Gliders in Victoria. Unusually hot and dry climate conditions experienced during recent decades are similar to those experienced 120 years in Victoria. Gliders survived earlier hot periods before the subsequent era of intensive timber harvesting and removal of large old trees with hollows. Much of the apparent decline in Glider abundance on the hotter drier margins of the species range in south eastern Australia may simply be due to loss of old growth by logging. Gliders are nocturnal and active in the cooler periods of night. Very large old trees that are thick-walled, with deep humid central hollows and sometimes pools of water, can potentially provide Gliders with insulation from climate extremes. Good hollows should enable them to live in moister (gully) topographies in otherwise apparently hostile climates. Much of the decline in Glider abundance in Victoria's warmer climatic zones of East Gippsland could potentially be due to extensive clear-felling and loss of old growth hollows rather directly due to droughts and climate warming. In my experience, very large old trees with hollows (> 1.5 m dbh) are now rare in these forests. Almost everywhere that Gliders have been studied in moderately to severely logged forests density has been found to be correlated with the number of trees with hollows (Eyre 2006, Smith et a l 2007, Smith and Lindenmayer 1988, Smith et al 1994,1995), indicating that above all else the quality of hollows is likely to have primacy in determining the abundance of this species. The importance of hollows may lie, in a large part, in their role in mitigating and offsetting the effects of unusually hot and dry weather, particularly at the extremes of the species range. Consequently, it remains my opinion that any local effects of recent and forecast extreme climate are either minimal or non-existent within most of the species core range in Victoria, and any such effects are likely to be heavily confounded with, and largely a consequence of, intensive logging and removal of large old trees. Gliders have been found at all but one of the unlogged coupes that are the subject of these proceedings. This near 100% occupancy of unlogged forest is powerful evidence that Gliders can persist throughout the Victorian landscape during unusually dry climatic conditions, except in areas that have been intensively logged or intensively burnt.

18. **Old growth Mapping** I have found that most Mixed Species forests that I have inspected in the Victorian Central Highlands are incorrectly mapped by VicForests as 1939 regrowth when in fact they are uneven or multi-aged old growth with abundant large old living trees with hollows in the canopy. This problem has also been recognized and well described by the Victorian Environment Assessment Council (VEAC 2017b, section 2.3 Modelled Tree Age). It is widely known that unlogged (virgin) stands of high and low elevation Mixed Species forests in Victoria are typically uneven-aged with large mature and overmature trees dominant (Lutze et al 1999). I have previously argued (Smith 2019) that this uneven aged structure which prevails in naturally occurring Mixed Species forests is a climax state and is therefore "old growth" as defined in the JANIS report and employed in formulation of Regional Forest Agreements. This argument was accepted by Mortimer 2020 (2020 Federal Court of Australia Friends of Leadbeater's Possum Inc v VicForests (No 4) [2020] FCA 704 VID 1228 of 2017) who had the following to say on this matter: *"**I am satisfied that in his evidence Dr Smith adhered, as he said he did, to the definition of old growth sourced from the JANIS Report and employed in the CH RFA. That is entirely***

appropriate in the present context, and, contrary to VicForests' submissions, there is nothing "unorthodox" about it. It is the departure from this which might be described as unorthodox. It would be inappropriate to use a narrower "forestry definition", even if such a "definition" has been promulgated so that some forest can be exposed to logging without, at least in forestry terms, being seen to involve harvesting "old growth" forest.". Most of the timber harvesting that has occurred in Victoria in Mixed Species forests of East Gippsland, and much that has occurred in Ash Forests of the Central Highlands, has been "old growth" logging. This logging has significantly reduced the number and density of potential habitat trees in logged forests over extensive regions of Victoria, by direct harvesting of mature trees with hollows, and felling and burning of non-merchantable older senescent or so called "defective" trees. In my opinion all of the data on Glider distribution and abundance in Victoria is consistent with severe population declines that followed this extensive clear fell logging of uneven aged Mixed Species old growth in East Gippsland and extensive clear-fell logging of uneven-aged and old growth (pre-1900) Ash forest in the Central Highlands. Without substantial and major changes to forestry practice, as advocated in my previous reports, it remains my opinion that current VicForests timber harvesting proposals are on track to cause the same (or greater) extent and magnitude of Glider population decline in Mixed Species forests (including all those mapped as 1939 regrowth) as those that have previously occurred in Ash forests of the Central Highlands. It is also my opinion that this threat is greater, more imminent and more likely than any changes that may or may not arise as a result of climate variation or wildfire.

19. **Wagner et al accepted.** I have reviewed this publication cited by Dr. Nitschke and I find it to be an entirely theoretical study of various hypothetical scenarios with no new facts, and some speculative output that is highly constrained by the model assumptions and structure (which appears to be over weighted to respond to small variations in climate). As noted by the authors ***" In our simulations unfavorable climatic conditions overwhelmed the impacts of feeding resource availability".*** I do not place any reliance of the output of theoretical models. The models are unvalidated by independent survey data and like previous models may bear no relationship to a more complex reality. The authors claim that their findings "*further reinforce recent conclusions that coarse determinants of habitat suitability have a strong effect on greater glider population persistence at a landscape scale (Kearney et al., 2010; Wagner et al., 2020*)". This statement is so general as to be relatively meaningless. It is well known that animal distributions are limited by physiological intolerance of extreme climates on the margins of their ranges, but this does not mean that climate determines density within their ranges. This knowledge has little practical merit beyond defining the broad limits of a species distribution such as those seen in field guides (eg Menkhorst et al 1995). It tells us a little about possible climate limitations on the margins of a species range but little or nothing about what is going on at local scales within the species range where factors such as tree hollows and structure are the primary determinants of Glider abundance. Consequently such broadscale studies have no bearing on the effects of timber harvesting and fire on Glider distribution and abundance in most of Victoria.

20. **Habitat Trees.** I have analysed associations between the number of habitat trees mapped by VicForests and the total number of Gliders recorded on logging coupes. Glider counts included results of recent

surveys by Wotch, FSP and VBA summed after eliminating duplicate records within approximately 50 m of one another. I found that the number of Gliders on coupes was significantly ($P<0.05$) positively correlated with the total number of Habitat Trees of types 1-3 (types 1, 2a,2b, and 3) mapped on coupes by VicForests and this relationship was strongest for Ash Forest coupes. Importantly, I found no significant correlation between the number of Gliders and the number of Type 1 habitat trees on coupes. Type 1 habitat trees comprise very old trees of little or no commercial value, they are the only type of habitat tree that VicForests is obliged to retain and protect under existing regulatory controls (see figure 4 below). They are the type of tree most likely to be short lived, considered a safety hazard or to catch fire and fall over in regeneration burns. The lack of correlation between Glider abundance and Type 1 habitat trees (as identified and mapped by VicForests), suggests that this class of senescent trees are not suitable for Gliders, possibly because they are too decayed and do not provide adequate microclimates or protection from predators. The strongest correlation between Glider numbers on coupes and habitat tree numbers was with those identified by VicForest personnel as Type 2 b trees, large mature trees with hollows that are likely to be merchantable and of high commercial value as well as providing hollows for wildlife. There is apparently no regulatory requirement to retain or protect these habitat trees so it is possible that all or more will be harvested for timber production. These results in conjunction with previous similar findings (A. Smith 2019 and unpublished) show that there is currently a relative shortage of Glider habitat trees in most forests on the scheduled and logged coupes and that any reduction in number of habitat trees, by logging, felling of safety reasons, or burning will cause a decline in the capacity of these forest to support Gliders for more than 120+years into the future.

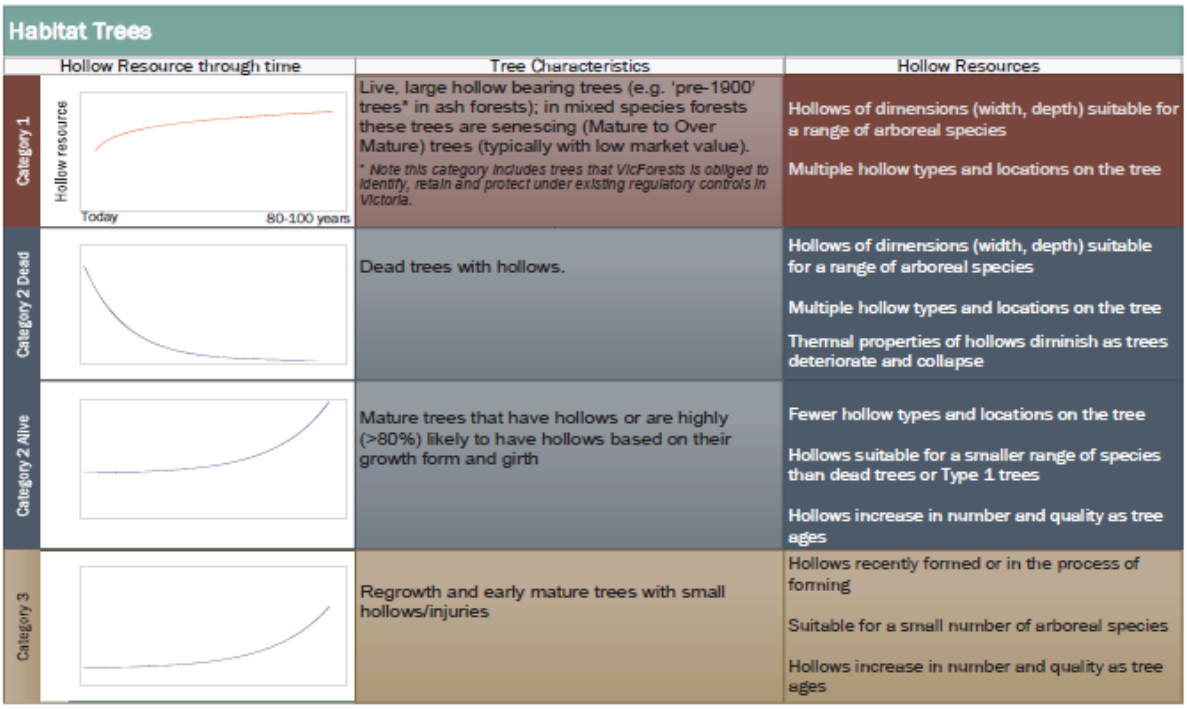


Figure 4 VicForests Habitat tree resource and inventory survey guideline V 1 Oct 2019.

21. **Question 8 Please provide any comments concerning Dr Nitschke's statement as to post-fire responses in the second last paragraph on p7.** On page 7 Dr. Nitschke states "*Post-fire responses of*

GG are known from a few studies. GG have been observed in 11-year-old post-fire ash forests in Victoria (van der Ree and Loyn, 2002) and in 8-10-year post-fire forests in NSW (McLean et al., 2018). Fleay (1947) and Fox (1978) reported the recovery of GG within 3-4 years of the 1939 fire in the Central Highlands forests in Victoria and 7 months after the 1972 fire in the Nadgee Nature Reserve, respectively. In Fleay(1947), GGs moved from patches of unburnt forest into the burnt landscape and in Fox (1978) the GG survived in patches not severely burnt (e.g., gullies, sheltered slopes). Fox (1978) observed gliders foraging on epicormic growth in adjacent severely burnt forests within 7 months post-fire." In my opinion, in this paragraph and other similar paragraphs Dr. Nitschke has overstated the capacity of Gliders to recover from fire and to occupy young post fire/logging regrowth by selective quotation of extreme, abnormal, or incorrect information without adequate qualification.

van der Ree and Loyn 2002 this study was designed to examine the impact of time since two fires (in 1939 and 1983) on arboreal mammals. Post fire Ash regrowth is different from post logging regrowth in retaining a proportion of larger living trees resulting in uneven-aged stands, unlike logging regrowth which is uniform in age so the results of the study cannot be extrapolated to predict logging impacts. In any event, the study found Gliders to be scarce and mostly absent from young post fire regrowth. The study states that "***P. volans was fairly common in 1939 regrowth and was observed on only two occasions in the 1983 regrowth from the same site close to the fire boundary***" (ie adjacent to older forest). This study clearly shows that Gliders can recover from wildfires within 80 years, but that Gliders are absent or occur only on edges (adjacent to unburnt forest) in 18 year old regrowth. There is no certainty that these Gliders were residing or feeding in the 1983 fire regrowth, indeed this is unlikely. The study also states that "***an adult and a juvenile were found emerging from a hollow bearing tree within the 1983 regrowth and moving approximately 50 m into the adjacent 1939 forest to feed:"***

22. **McLean et al 2018**. The study of McLean et al 2018 This study was carried out in forests of northern NSW and has no relevance to assessment of logging impacts on Gliders in Victorian forests. Northern NSW forests are subject to relatively frequent (every 3-20 years) low intensity fires usually started by graziers (Smith et al 1994, 1995) and to selective or low intensity timber harvesting. There is no pulpwood market in northern NSW so only sound mature sawlogs are harvested and small diameter and large defective trees are left behind leaving an uneven-aged forest structure with abundant hollows. It has previously been established that this form of silviculture generally has no long term significant impact on Gilder populations (Smith et al 1992, 1994, 1995, Andrews et al 1995). This situation is totally unlike that in Victorian where forests are subject to less frequent but more intense fires and high intensity logging that removes small and large defective stems (trees with hollows) for pulpwood in addition to sawlogs. McLean et al. found that Glider density was determined primarily by fire frequency and logging intensity consistent with the findings of previous surveys in the region (Smith et al 1994, Andrews et al 1994) which found that Glider density to recover within 5-15 years after fires. This finding has no relevance to timber harvesting in Victoria where Gliders may take from a few years to more than 120 years to recover from fire depending on fire intensity and the number of habitat trees retained. The McLean et al study reported very high numbers of habitat trees (with hollows) on their survey sites, averaging averaging 29/ha (range 8-74) in wet forests and 17/ha in dry forests (range 12-23). This density of old growth indicates that past fire and

logging on these survey sites has been mild to negligible. Habitat tree density was so high that hollows were not found to be a limiting factor in Glider Density, this is the opposite of the situation in Victoria.

23. **Fleay 1947.** David Fleay is a naturalist author and his book (1947) is not quantitative scientific study but a collection of anecdotes. He was possibly the only person to report on the effects of the 1939 fire on Gliders stating that " ***in the holocaust of early 1939 tens of thousands of these volpaning creatures perished in the Victorian ranges and even many that survived in odd sheltered gullies died subsequently of starvation, because leaves of their food trees where not consumed were blasted and withered.. for weeks after the flames had died we found poor tortured Greater Gliders crawling weakly over the charred ground"***. Fleay goes on to say *"**that one of the remarkable features following that dreadful fire .. is the extraordinary rehabilitation of the species in the forest-clad slopes of the ranges so comparatively recently laid to waste. During the autumn and winter months of 1943 and 1944, during many nocturnal quests on the slopes of Mount Riddell Healesville, I was amazed to find the big gliders quite numerous again**.* But this conclusion is qualified by the statement that "***Certainly the deep valley of Badger Creek was not entirely devastated by fire, but from surviving stock in this valley, and perhaps other far away, it is logical to assume that the increase must have come***". I do not rely on this evidence for the purpose of impact assessment because it is not quantitative and lacks the rigor of scientific study, design and analysis, and also because David Fleay frequently miss-identified Greater Gliders and confused them with Yellow-bellied Gliders which are much more mobile and better able to undertake long distance dispersal after fire. None-the-less the observations of Fleay are consistent with my conclusions and assumption that Gliders survive intense fire in Gully refuges from which they gradually disperse to recolonize lightly to moderately burnt surrounding forest over time. I do not agree with and fail to see how this anecdote of David Fleay's supports Dr. Nitschkes statement that **"***Fleay (1947) and Fox (1978) reported* ***the recovery*** *of GG within 3-4 years of the 1939 fire in the Central Highlands forests in Victoria***"**. In my opinion the Glider population in the Central Highlands has still not recovered and is still declining as a result of the 1939 fire due to subsequent and on going collapse of dead fire killed habitat trees in intensively burnt 1939 regrowth and due to logging of living surviving habitat trees by VicForests in low to moderately burnt 1939 regrowth. I have not read Fox 1978 (a publication in a parks service magazine) but I note that the reported observation that Gliders survive in unburnt patches and move into severely burnt forest to feed on epicormic new growth within 7 months of fire are consistent with my assumptions and expectations.

24. **Nelson et al 1996**. Elsewhere in his report Dr. NItschke (page 11, P 17 para68) appears to have assumed for the purpose of impact assessment that Gliders can occupy post logging Ash regrowth as young as 5-20 years age based on studies by Nelson et al 1996. I find nothing in this study to support this assumption, in fact I find the reverse. The study of Nelson et al 1996 clearly indicates that Gliders prefer on old growth, occur in much lower than normal densities in post fire regrowth, and are absent from logging regrowth away from retained gully vegetation. The results section of this study states that "***Greater Gliders were significantly more abundant in the old forest than in the adjacent 55-year-old fire regrowth (p=0.00 l)".*** The study also states "***Greater Gliders were not recorded in the logging regrowth of the old/young contrast, but three individuals were recorded from one logging regrowth site of the***

55/young contrast (Figure I). This site is adjacent to a gully where a strip of mixed age forest including hollow-bearing trees, had been retained." This study clearly indicates on careful reading that Greater Gliders are absent from normal logging regrowth, scarce in 55 year old (1939) fire regrowth and reach normal abundance on old growth forest (>165 years). The study found that Glider abundance across all forest correlated most strongly with the abundance of habitat trees. These findings are consistent with my own research data. I have found that Gliders only occur in 1939 Ash regrowth where habitat trees are present at a density >2/3ha (0.75 habitat trees/ha) and that Glider density is directly proportional to the number of retained habitat trees.

Figures 1 and 7 from Nelson et al 1996 study showing results for the Greater Glider are reproduced below. The first graph shows that Greater Glider occurrence in logging regrowth is so low as to be effectively negligible. It also shows that Glider abundance declines linearly with distance away from an unburnt old growth 1939 fire refuge and is close to zero at distances of 700-900 m from a refuge. This result is consistent with my own research which found a statistically significant correlation ($R = 0.44$ $P < 0.01$) between Glider density in Ash Forests and distance to the nearest patch of mapped old growth or uneven-aged forest. The second graph shows that living habitat trees are virtually absent from logged young regrowth Ash forests. Since we know that dead habitat trees decay and fall over very rapidly in Ash Forests that they are completely gone before the forest is old enough to develop new hollows (120+ years) (Smith1982, Lindenmayer et al 1990), and since Vic Forests has a policy of not providing recruitment habitat trees in forest where they are gone, and harvesting Ash forests on short rotations not long enough for trees to develop new hollows, **the conclusion is inescapable that Gliders will become permanently absent from the logged forests in the Nelson et al study area**. This study is a good demonstration of Glider decline in Ash forest caused by a combination of fire and logging.

Figure 5 showing results of Nelson et al 1996	

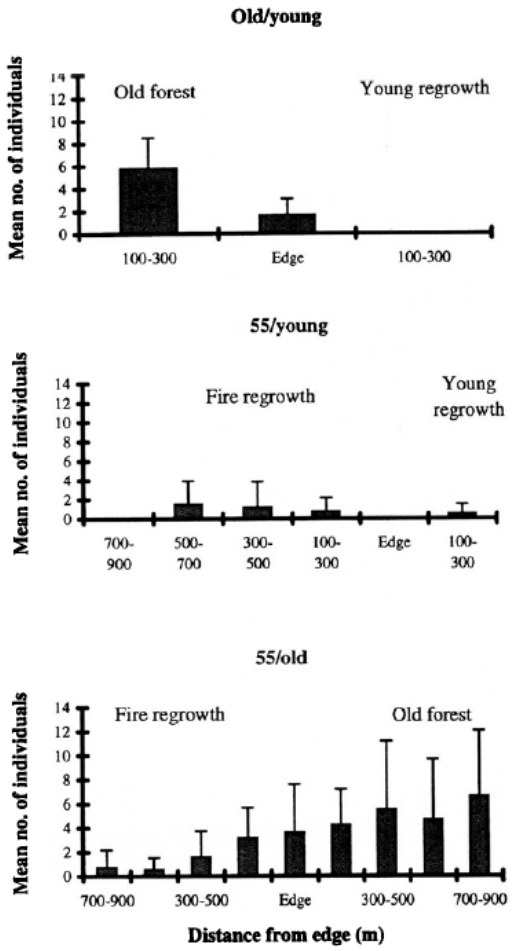


Figure 1. The mean number of Greater Gliders recorded per spotlight hour at different distances from forest edges. Error bar = mean + one standard deviation. Old forest- 165+ years, Young regrowth- Logging regrowth 5-20 years, Fire regrowth- Fire regrowth 55 years.

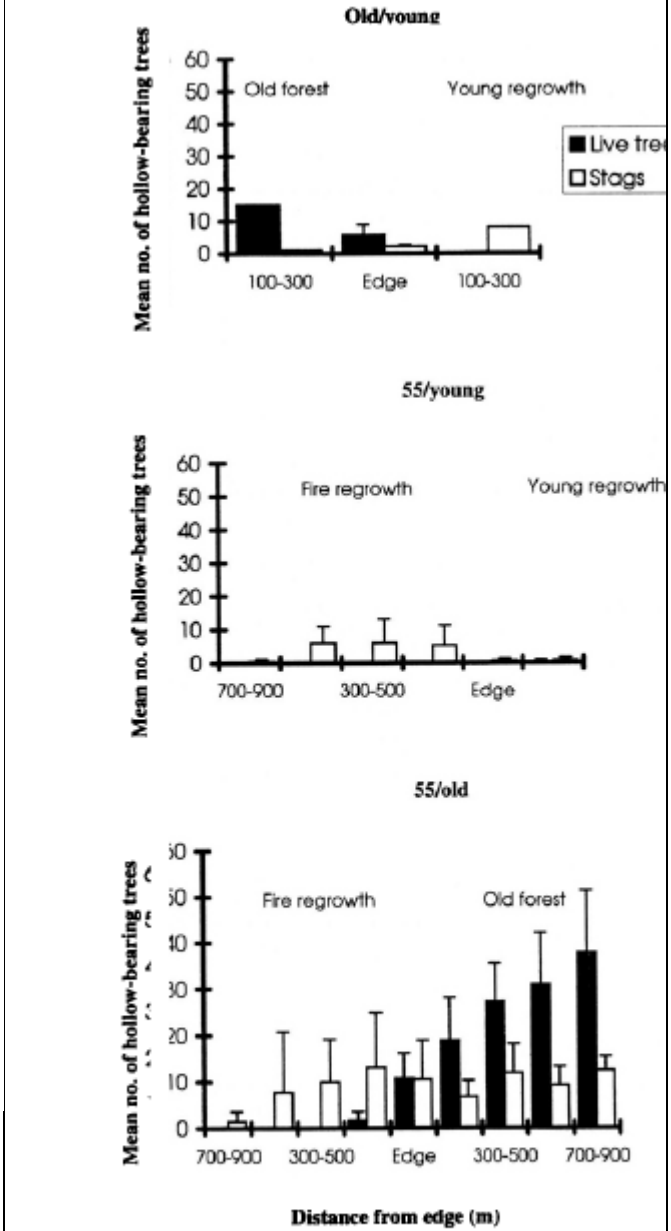


Figure 7. The mean number of hollow-bearing trees/ha a different distances from forest edges. Error bar = mean + one standard deviation. Old forest- 165+ years, Young regrowth- Logging regrowth 5-20 years, Fire regrowth- Fire regrowth 55 years.

25. **Question 9 Do you agree that the unburnt area in East Gippsland referred to by Dr Nitschke in the first paragraph on p8 (response to Q9) represents a climatic refugia for the Greater Glider and is the most important area in terms of habitat suitability and Greater Glider occurrence**? Yes, with qualification. I concur that this area is an important refuge from fire, based on the density and frequency of Glider records in the area, the predominance of wetter vegetation and the fact that it was not burnt in the recent fires. In my opinion it is neither necessary nor desirable to use unvalidated and unreliable Glider models to arrive at this conclusion.

26. **Question 10. Does the analysis of the proportion of recent recorded Greater Glider detection locations that burnt in the bushfires (final paragraph p8, response to Q9) give a fair assessment of the impact of the bushfires on the Greater Glider? What is the effect (if any) of geographic differences in survey effort and repeat or cumulative fire impacts**? No. I agree with Dr. Nitschkes comment that "***Modelled habitat does not necessarily reflect occurrence of GG on sites. Due to uncertainties in models, a more robust measure of impact on known GG populations is to look at known occurrences impacted by the wildfires***." But I do not agree with his second comment that " *Due to uncertainties in models, a more robust measure of impact on known GG populations is to look at known occurrences impacted by the wildfires.* " In my opinion it is highly likely that many of the Glider records in East Gippsland and the Central Highlands are heavily biased in areas where there has been or is public controversy over timber harvesting. The broad statistics provided in Table 2 may be indicative of the regional frequency of fire impact, but without proper survey design and random sampling we cannot be certain. This table does not provide comparable statistics for the effect of the 2009 fire in the Central Highlands, so it would not be appropriate for this information to be used to assess regional differences in fire impact.

27. **Question 11 .Do you agree with Dr Nitschke that:**
(a) "the critical area for GG in the region (see Figure 1) was predominantly spared"? (p9)
(b) "The importance of this refugia cannot be understated and given uncertainties around locations and rates of recovery of GGs in burnt areas within this landscape its conservation status and value for GG is exceptionally high"? (p9)
(c) "the cumulative impacts of further harvesting of forests in this fire refugia and climatic refugia (see Wagner et al., 2020) constitutes serious threat to GG based on how harvesting in GG habitat is being implemented (discussed below) and would not be consistent with the application of the precautionary principle"? (p9-10)

    a) I do not agree with a). The area saved may have supported a high density of GG but is not necessarily the most critical area for GG. In my opinion critical areas for GG also include patches of unlogged uneven-aged forest in gullies and sheltered slopes (fire refugia) scattered throughout East Gippsland and the entire geographic range of the Glider, especially in the more marginal Mixed Species habitats where Gliders are most vulnerable to fire and the compounding effects of logging and drought.

    b) I agree with b) with qualification that this refuge may be at risk from isolation if its protection is not accompanied by Glider habitat protection in the surrounding matrix of lesser quality habitat.

    c) I have previously noted that the Wagner et al model is theoretical, unvalidated and is unlikely to have of any predictive merit at local scales and in my opinion cannot be relied on for the purposes of impact assessment.

28. **Question 12 Please consider the final paragraph on p 10 of Dr Nitschke's report, and the first paragraph on p21 of Dr Nitschke's critique of your report. Does the total area:**

    (a) of the coupes named in the case, including as a proportion of State forest or the whole Central highlands; or

(b) of all coupes that contain or are likely to contain Greater Glider or its habitat in the Central Highlands; or
(c) that VicForests states it will harvest (36,846 ha2) in Victoria until 2030 when current Government policy states native forest logging will end, have the effect that continued timber harvesting in such coupes do not pose a threat of serious or irreversible damage to Greater Glider? Please explain the reasons for your answer by reference to individuals, local populations, and important populations.

I am struggling to understand Dr. Nitschke's logic on Pp 9-12. He concludes that 15-23.4% of Glider habitat within the 2019/20 fire area was burnt at high intensity (P8 table 2). This represents a minimum 15-23% decline in glider population numbers killed in high intensity fire areas. If we allow another 50% loss of gliders in an equivalent area of moderately burnt forest, glider population loss increases to 22-35%. This loss is additional to losses in earlier fires (my second report para 27) and from intensive logging (which are not calculated) which could push habitat loss to well over 50% in recent decades (see areas of logged forest shown in all colours other than dark blue on figure 6 below, after VEAC 2017b). Dr. Nitschke appears to consider that these extensive cumulative impacts from fire and logging pose a serious threat of irreversible harm in the East Gippsland FMA (*the cumulative impacts of further harvesting of forests in this fire refugia and climatic refugia (see Wagner et al., 2020) constitutes serious threat to GG based on how harvesting in GG habitat is being implemented (discussed below) and would not be consistent with the application of the precautionary principle*. But Dr. Nitschke does not appear to consider the risk or possibility of cumulative impacts in the adjoining FMA. He says "*It is clear from the list of coupes and their locations (see Figure 3) that there is a limited focus of timber harvesting in this FMA an adjacent FMAs with only 5 coupes occurring in the central and eastern areas of the state. At a landscape scale, these 5 coupes contain a net harvest area of 71.23 ha and in four of the coupes logged, GG were either absent (n=3) or included in retention (n =1). Given the limited area occupied by these coupes within the landscape context, I do not believe these coupes will have or pose a serious threat to GG populations in these FMAs*"). Dr. Nitschke appears to be arguing in the latter case that the precautionary principle is not applicable, or is to be interpreted and applied differently, because the loss of Glider population on the coupes from timber harvesting is small relative to total state forest area (0.3%) when considered in isolation from previous and subsequent harvesting impacts (or the added effects of fire and drought). Dr. Nitschke notes that past timber harvesting since 1960' amounts to 28% of the State Forest area in Victoria but makes no estimation of the percentage future loss if current intensive harvesting continues. He goes on to imply that there is no future adverse effect of timber harvesting or fire by arguing that regenerating regrowth forests are highly suitable for Gliders based on highly selective and incorrect references which I have previously shown do not support his assumptions (Fleay 1947, Van der ree and Loyn 2002, Nelson et al 1996, McLean et al 1998 see previous paragraphs).

29. Dr. Nitschke summarizes his argument for negligible impact in his last paragraph of p12 which states "*These local scale impacts do not however constitute a real and severe and/ or irreversible threat to GG at the FMA level, the exception being East Gippsland due to the 2019/2020 bushfires (see Ryan et al., 2021). In the CH RFA, where the majority of coupes in question are located, the overall impact on modelled GG habitat is ~0.2%. This is based on the assumption that GG occurred homogenously across the moderate and highly suitable modelled GG habitat (based on updated modelling presented in Wagner et*

al. 2020). This suggests that the impact at the FMA scale though present is negligible when considered at this scale. My assessment is based on the distribution of habitat in unlogged state forest and parks and reserves but also by the observation of GG in previously logged areas. These observations highlight that the impacts of harvesting on GG are not irreversible and that habitat recovery begins broadly within 30 years of harvesting. Combined with my assessment of GG in the East Gippsland FMA, I conclude that the areas proposed for harvesting do not pose a serious or irreversible threat to GG at the FMA or State level. This is supported by Ryan et al. (2021) who found that the ongoing harvesting in the this FMA is unlikely to reduce the minimum expected population size of GGs compared to if no harvesting took place". I have shown that the references and assumptions on which Dr. Nitschke has relied to reach his conclusion are either incorrect, unreliable, taken out of context, based on extreme rather than average data, based on unvalidated and unreliable modelled predictions, or simply incorrect. I further note in relation to key assumptions highlighted above that Dr. Nitschke has provided no reliable or accurate data_on the occurrence of actual (real rather than hypothesized or modelled) Glider habitat in unlogged state forest and parks and reserves, and no factual data showing that Gliders will persist in previously logged areas over the longer term. There is currently some uncertainty about the extent of Glider habitat in parks and reserves, but based on vegetation types the proportion of Glider habitat in parks and reserves is likely to be much lower than the proportion of Glider habitat in State Forests because the more silviculturally productive forests have tended to remain available for wood production (VEAC 2017b).

30. **Question 13 Please consider the final paragraph on p11 of Dr Nitschke's report and Table 4, and his response to your answer to Q1b-14C (p6 of Dr Nitschke's critique of your report). Please provide any comment on: (a) the statements and figures concerning observations of Greater Glider between 2010 and 2020 in areas previously logged between 1960 and 2009; and**
(b) the use of young regrowth forests by arboreal marsupials or Greater Glider.

Dr. Nitschke (p11) states "*Of the post 2010 GG records that intersected with logged coupes, 5.7% (n = 129) occurred in coupes harvested after the records were reported while 11.8% (n = 267) occurred in coupes harvested pre-2010. These latter records show that GG occur in areas previously harvested with the majority (65%) occurring in areas harvested between 1960-1989 (Table 4). This is consistent with observations of greater gliders in 5-20-year-old logging regrowth (Nelson et al., 1996), within 11-year-old post-fire ash regrowth (van der Ree and Loyn, 2002) and in 8-10-year post-fire forests in NSW (McClean et al., 2018)*." Unlike Dr. Nitschke I would not rely on a mapped overlay of logging history with Glider atlas records to assess logging impacts on Gliders because there is too much scope for error in data identification, recording, mapping and overlay alignment. I may use such information as a guide but would not rely on the results without first ground truthing the sites in question to confirm that Gliders really are present on logged regrowth and not areas of retained unlogged forest. In my opinion, based on my own assessments and the studies of others (reviewed above), the claim that 11.8% of glider records occurred in young, logged regrowth is likely to be completely erroneous if checked on the ground. While occasional Gliders may be observed moving through young uniform regrowth adjacent to unlogged forests there is no scientific data to support contentions that such forests are permanently inhabitable by Gliders (see previous paragraphs) unless they are lightly logged and uneven aged (eg as in the forests surveyed by Maclean et al 2018 in northern NSW) or regrowth older than about 40-80 years (depending of forest type and growth rate) with a cohort living habitat trees in the overstory. Dr. Nitschke again justifies his

assumption that Gliders will not be lost after future logging based on a suite of references (p12, Lindenmayer et al., 1993, Kavanagh, 2000, Lindenmayer et al. (2021), Kavanagh and Bamkin (1995), Taylor et a l2007) that I have previously shown do not support his assumptions.

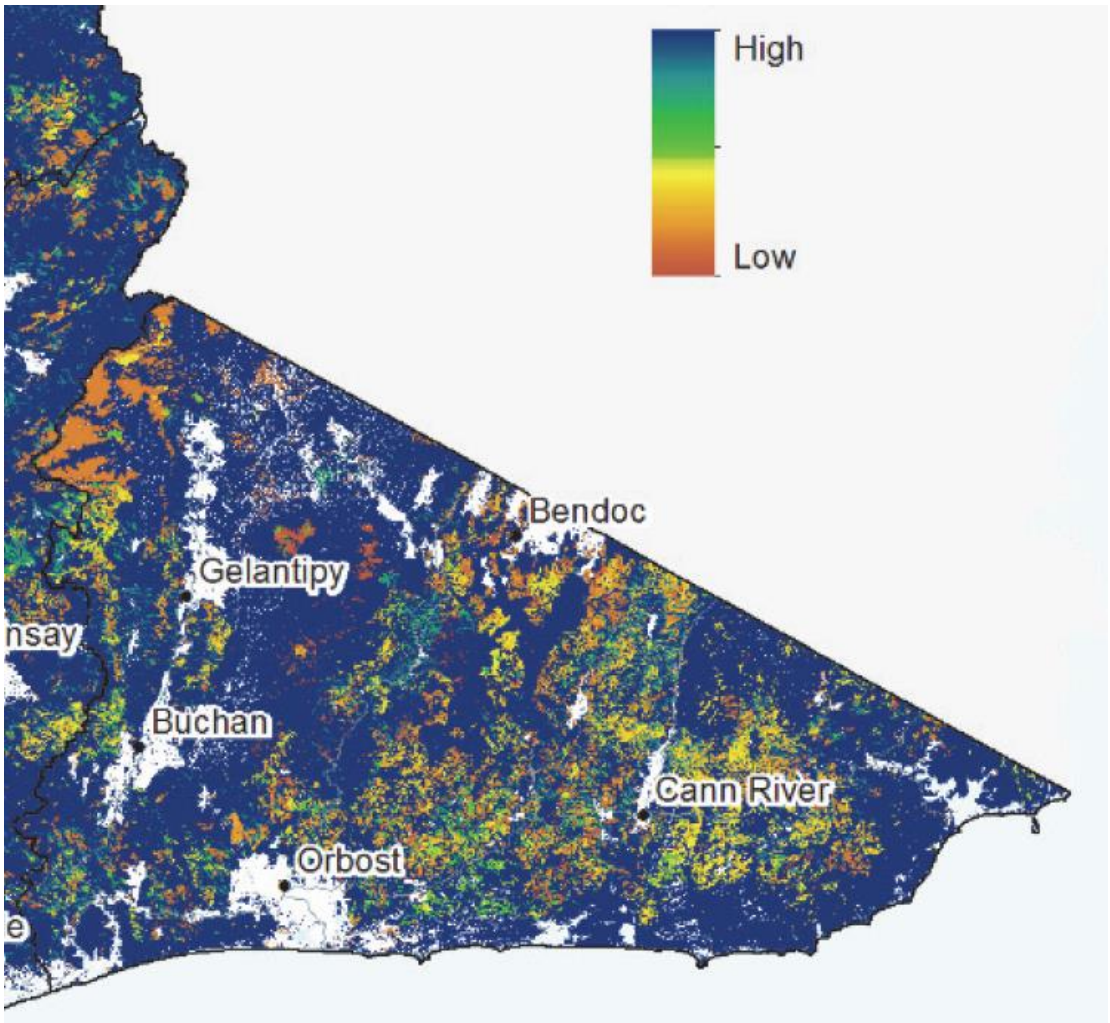


Figure 6 Forest Age in East Gippsland prior to 2019/20 fires (old growth dark blue, logged and fire regrowth other colours) Areas in dark blue are unlogged but may also include low quality open forest and woodland Explanatory Text from VEAC 2017:

- Large orange patches between Bright and Dargo, and around 50 km east of Omeo largely represent snow gums and alpine ash killed in the large fires of 2007 and 2003 respectively.
- Otherwise these large fires are predominantly shown as blue and green and without clear boundaries against adjoining unburnt forests as many trees in these burnt areas survived the fires and are of similar age to those in the adjoining areas not burnt in those fires.
- Away from these large fires, stippled patterns of small patches of a variety of colours closely enmeshed – e.g. between Orbost and the New South Wales border east of Cann River, and between Warburton and Erica – generally represent the timber harvesting mosaic and sometimes smaller, patchier and or variable intensity fires
- The effect of timber harvesting in some of these stippled areas is apparent adjoining Croajingolong, Coopracambra and Errinundra national parks and Bunyip State Park (in blue), with the contrast against the younger adjoining state forest (generally in green or orange) being due largely to the absence of recent timber harvesting in the parks.

31. **Question 14**, **Please read the first paragraph on p12, the final two sentences on p16, the first sentence on p17, and Figure 6. (a) Please provide any comments on Dr Nitschke's statements concerning: i. the mitigation of risk by Greater Gliders in aggregated retention; and ii. the proportions of Greater Glider records in coupes in aggregated retention, and reduction by half of Greater Glider records being impacted.**

Dr Nitschke states*" In my analysis of GG records within the coupes, I found that 48% (± 7.4%, 95% CI) of GG occur or are planned to occur in aggregated retention and 8.1% (± 1.2%, 95% CI) in areas to be selectively logged (> 60% BA retention); however, 43% (± 6.6%, 95% CI) of GG occur or are likely to occur within the net harvest area where varying degrees of dispersed retention has or is planned to be applied. This reduces the proportion of records in coupes being impacted by about half*. *Considering GGs adjacent to the gross coupe areas as a metric of local impact of harvesting on the GG then 67.7% (± 7.1%, 95% CI) of GG observations are retained while 32.3% (± 7.1%, 95% CI) fall within the net harvest area*." I do not agree with this assessment. Dr. Nitschke appears to be assuming that aggregated retention harvesting and dispersed retention harvesting will retain Gliders in logged areas over the long term (50+ years) based on studies (Lindenmayer et al., 1993, Kavanagh, 2000, Kavanagh and Bamkin (1995), Taylor et al. (2007). I have previously shown that none of the cited studies provide any factual evidence that Gliders can persist in small, retained patches in logged forests for the long term. These is no proof, and in my opinion little or no likelihood, that current timber harvesting practices in Victoria, including dispersed and aggregated retention, will retain any Gliders in logged coupes for reasons that I have previously explained at length (small patch sizes, isolation, post regeneration burning, short rotation cycles, progressive loss of habitat trees, no permanent protecton). Dr.Nitschke states that 8.1% of coupes are to be selectively logged with 60% BA retention. I have not checked this statistic, but if correct I would consider that Gliders in these selectively logged coupes are likely to decline by about 60% in the logged area (see para 56 of my second report) which would protect about 4% of the Glider population in these areas over the long term not 67.7%. I note that Dr. Nitschke has agreed with me that current intensive harvesting (including aggregated and retention harvesting) of Mixed Species and forests with a mix of Ash and Mixed species is not appropriate or ecologically sustainable. (He states (P15 o) *the continued application of even-aged management in mixed species forests and dominant use in ash forests violates the principle of emulating natural disturbance regimes which is a required of ecosystem-based management and therefore ecologically sustainable forest management*. P15 g) *that the 40% threshold is too low in less it captures all GG habitat in the coupe. 60% retention is likely required to maintain home range abundances.* I further note that the great majority (about 80%) of coupes identified in these proceedings are dominated by Mixed Species forest types which Dr. Nitschke agrees should be harvested by low intensity selection harvesting (last para P 15 of his reort). If these 80% of Mixed Species coupes were to be managed by selection harvesting (60% basal area retention), that we are both agreed is appropriate, then I would estimate the Glider population to decline by about 50% in the logged area in the short term but to recover relatively rapidly over the longer term. With appropriate safeguards (mitigation measures previously recommended in my earlier reports) I would not consider such harvesting to have a significant impact on Gliders in Mixed Species, but this is not what VicForests is proposing. I am puzzled by the contradiction in Dr. Nitschke's acknowledgment of the need to apply selection harvesting in all Mixed Species forests but failure to acknowledge and recognize the impacts of on Glider populations in Mixed Species if our recommendation to limit harvesting to selective logging is ignored.

32. Question 14(b) **Is there a likelihood that Greater Gliders are, or were prior to logging, present in parts of the coupes in which they have not been recorded?** Yes, the pattern of cluster in records and evidence in affidavits of McKenzie and Nisbet indicates that surveys have been undertaken on lines of walk that sample only part of each coupe.

33. **Question 14 c) Are current surveying practices sufficient to reliably identify Greater Gliders throughout the coupes?** No. I am not aware of any mandatory requirement to survey Gliders throughout the entire forest area of each coupe.

34. **Question 14 d) If, and to the extent that, Dr Nitschke's opinions at these passages involved his reliance upon VicForests' and/or FPSP records of Greater Glider only (i.e. if he excluded WOTCH records), would that affect his analysis at these passages, and if so, how?** I have found that a significant proportion (about 35%) of coupes lack FPSP Glider records, that about 16% of coupes lack Wotch records and that when all survey records are considered, including atlas records, that all but one coupe contain glider records. I have found no significant correlation between glider numbers on coupes recorded by Wotch and numbers recorded by FPSP suggesting that these surveys are to some degree complementary rather than redundant. (see para 67 of my second report). For the purpose of analysis of associations between coupe environmental parameters and Glider abundance I have combined the results of all surveys after eliminating duplicate records within 50 m of one another. In my opinion any analyses of Glider occurrence or habitat associations based just on FPSP records alone would be misleading and should be considered void.

35. **Question 14 e) Please read the third paragraph on p12. We enclose the unpublished report referred to in that paragraph, Ryan et al 2021. Please comment on this paragraph and to the extent you agree or disagree with any part of it, please explain your answer**. See my answer to this Question at Paragraph 28 above.

36. **Question 15 Please read the first paragraph in answer to Q9(b) on p13, and the Part 2 Coupe-level assessment Table 1 answers to Q21b and Q24b. Do you agree that, having regard to all relevant contextual matters including fire and logging history, Greater Glider occupancy, abundance, habitat distribution and population trajectory, there is "sufficient" certainty regarding the damage to the Greater Glider, including duration, at the coupe scale and surrounding forest, with respect to: (a) each of the Coupes (being those listed in Dr Nitschke's Table 1); and (b) all other coupes that contain or are likely to contain Greater Glider and their habitat**. No, I do not agree with Dr. Nitschke's assessments in columns Q21b and Q4b. Firstly I am certain that current studies and research findings show that there is a high risk/likelihood that all Glider populations in logged coupes (other than those few that are selectively logged at low intensity and any identified) will decline to zero over the medium to long term (30+ years) under current and ongoing forest management and timber harvesting practice. Dr. Nitschke appears to be certain of the opposite. This in itself is proof of uncertainty.

37. Question 16. Please read Dr Nitschke's answer to Q 10(a) on p14, and the coupe-by-coupe answers in Table 1 to Q22a and 25a. (a) Are the threats of serious or irreversible damage facing the Greater Glider, from all sources, including but not limited to timber harvesting, negligible in FMAs other than East Gippsland? (b) Having regard to all contextual matters which you consider relevant to an assessment of the severity of impact, is the threat to the Greater Glider of serious or irreversible damage (if any) from timber harvesting in: 1. the Coupes; and 2. all other coupes that contain or are likely to contain Greater Glider and their habitat, negligible in FMAs other than East Gippsland? (c) Please provide any comment on the paragraph under the subheading "*Rationale*".

I note that Dr. Nitschke's response to Q22a and Q 25a puts "negligible" against a large proportion of recently logged coupes based on rationale outlined on P14. I do not agree with this assessment, I would conclude that there is no certainty that either past and future impacts on these coupes will be negligible. This rationale for Dr. Nitschke's response seems to be based on a claim that the magnitude of habitat/population loss in State Forests is small compared to the amount of habitat in unlogged reserves. I do not agree with this conclusion or methodology, firstly we do not have sufficient reliable data on the amount of habitat in unlogged reserves to make this assumption, and secondly this argument completely ignores or significantly under-estimates the risk and impact of fragmentation and isolation to both remnant glider populations in state forests and in unlogged reserves from extensive areas of uniform aged young regrowth (post logging) forest. The impact of fragmentation and isolation by uninhabitable forest is potentially severe and will not become apparent for 20-60 years, by which time it will be too late to implement mitigation measures. I have reproduced below a map of the habitat fragments surveyed by Suckling (1980,1982) in South Gippsland. This survey found Gliders to be absent from all remnants (shown in crosshatching in Figure 7) isolated by forest clearing for agriculture and establishment of pine plantations (over the past 30-60 years) unless they were greater than 144 ha. in area. Note that some of the remnants from which Gilders are now absent are linked to a very large source patch with Gliders by relatively short distances (1-3 km) through pine plantations. This refutes the assumptions of Dr. Nitschke (based on the now discredited claims of Taylor et al 2007) that Gliders can move 7 km through pine plantation.

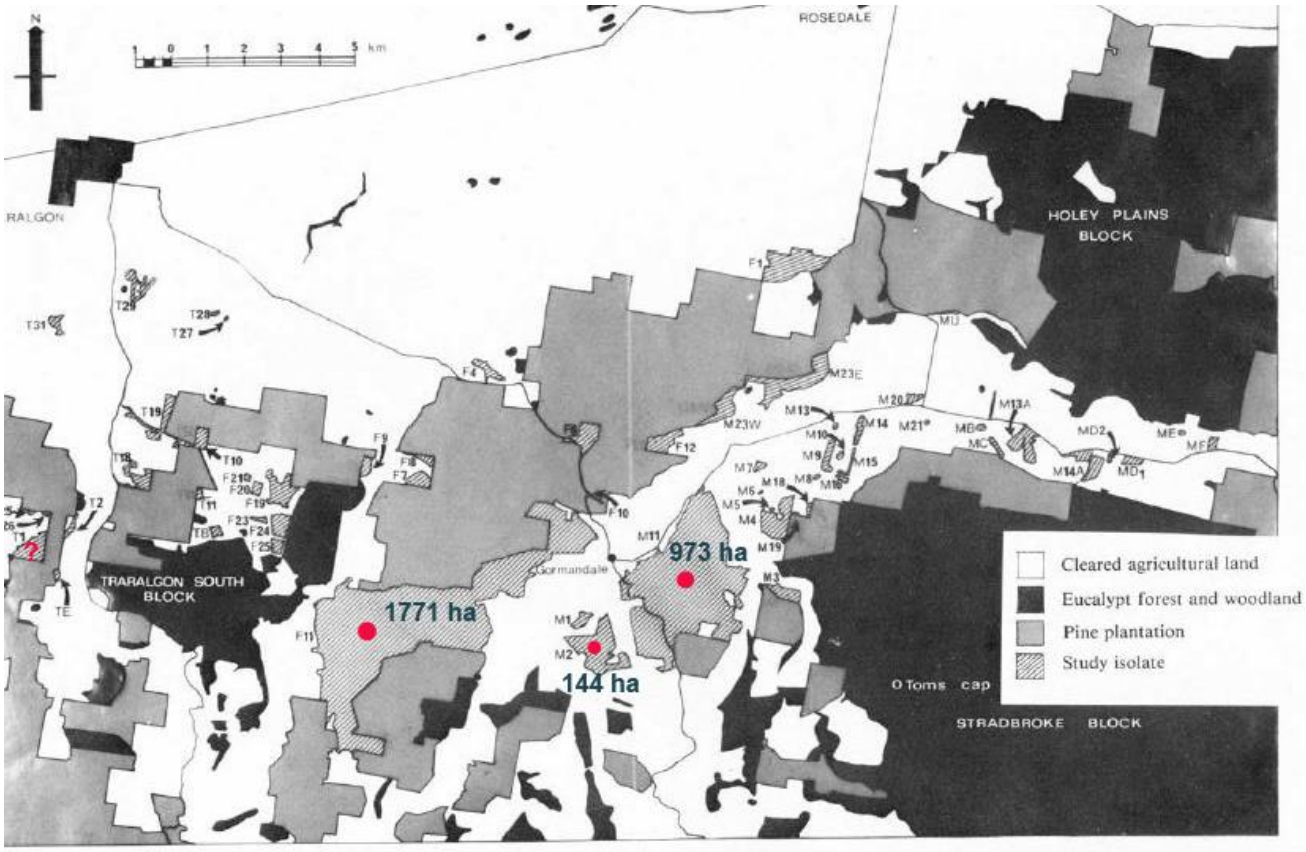


Figure 1. The location of all study isolates and distribution of pasture, native forest and pine plantation in the study region, 140 km ESE of Melbourne.

38. **Figure 7** from Suckling 1982 showing the size and isolation of remnants with Gliders (red dots) and without Gliders (all other cross hatched and numbered remnants).

39. **Question 16. ((d) Do you agree with Dr Nitschke's classification of the threat of timber harvesting in the coupes listed in Table 1 as "negligible" for coupes: Empire State, Mount Rushmore, Camp David, Lemon Lime, Rumba, Pumba, Barcelona, Porto, Arena, Benefactor, Glanworth, Dowse, Jolimont, Even Steven, Myrrh, Turkey Feet, Maxibon, Facet, Tenderloin, Monster, Fergana, Bauble, Groves Manna, Pony, Brumby, Triple Don, Walkindapark, Windy Road, Stimpy, Nine Miles High, Jokes, Wales, Princess Di, Ruprecht and Rock a Rhyme?**

    I have provided summary impact assessments for all of these coupes in my second report. I have outlined for each coupe the mitigation measures that I consider to be essential to prevent a severe or irreversible impact. My opinion is, that unless these recommended measures are adopted Glider populations will decline irreversibly on each of these coupes causing a severe and irreversible local decline, and that the collective impact of these declines in association with previous similar declines (after past timber harvesting) and potential future declines (after future similar timber harvesting) in the region will have a serious and irreversible ongoing impact at regional or landscape scales.

40. **Question 16 (e) If, and to the extent that, Dr Nitschke's opinions in this answer involved his reliance upon VicForests' and/or FPSP records of Greater Glider only (i.e. if he excluded WOTCH records), would that affect his analysis of whether the threat is negligible, and if so, how**? In my opinion any assessment of timber harvesting impacts that does not consider WOTCH records is likely to be

methodologically and factually in error because it will be based on false absences. I note however that the method and rationale provided on P14 by Dr. Nitschke to justify conclusions of negligible impact does not require any information about Gliders at the coupe level, in fact it does not seem to require much information at all beyond the area of forest logged, because it simply assumes that any effect of logging is negligible when the area of forest logged is small relative to the area of forest unlogged.

41. **Question 17 Please read the answer to Q11 on p18-19. (a) Do you agree that the fires did not impact the Greater Glider in a manner that increases or changes the risk posed by timber harvesting to State Greater Glider populations in other FMAs?**

No. the area identified by Dr. Nitschke as the most important area for GG in east Gippsland is the area with the greatest frequency of records and highest average density of Gliders. In my opinion equally if not more important habitat for the Glider includes all the remaining patches of unlogged, taller, moister forest found in gullies and along sheltered aspects that are scattered throughout the medium and low density Glider habitat throughout East Gippsland and the Central Highlands and all state forest in Victoria. I have found habitat in gullies and sheltered slopes with tall, larger trees and complex uneven-aged structure to be the best predictor of Gliders occurrence and abundance in the Central Highlands and I see no reason why this predictor would not apply equally to East Gippsland. Gullies have been shown to be especially important as fire refuges and for maintaining complex habitat structure with hollows, especially in undulating and topographically complex landscapes (Collins et al 2012) such as those found throughout Victorian State Forests.

42. **Question 17(b) Does Dr Nitschke's answer affect your answer at [29] of your first report dated 31 July 2020?**

No.

43. **Question 17 (c) Do you agree that harvesting of Greater Glider habitat should not occur in East Gippsland FMA as this would constitute a breach of the precautionary principle on the new definition, set out above? Is your answer at [41] of your first report affected by any matters**?

Yes, I agree, and as noted in para 41-44 of my first report I consider that similar (longer) restrictions should be applied to the Central Highlands to mitigate risks to Glider populations arising from the 2009 wildfires. It appears to me that Dr. Nitschke's rationale for recommending that harvesting of Glider habitat would comprise a serious and irreversible landscape scale impact and should therefore not occur in East Gippsland (P 9 last para) applies equally to the Central Highlands. The coupes which are the subject of these proceedings in the Central Highland together with 58 coupes that were the subject of similar proceedings in 2019 (Smith 2019) provide much of our current distribution data for Gliders in the Central Highlands, but these coupes have a distribution bias which is likely to result in over-estimation of Glider population size and underestimation of logging impacts at landscape scales. These coupes are located primarily in areas where the 2009 fire either did not occur or was of low to moderate intensity. High Glider frequency of occurrence (95+% of coupes) in these unburnt coupes indicates their importance as refuge areas for facilitating long term recovery of Glider populations in adjacent more severely burnt areas comparable with the role unburnt high Glider density refuge areas in East Gippsland. We currently known

relatively little about the size and density of Glider populations within the extensive areas that were severely burnt in 2009, but it is likely that Glider density in these areas is very low or zero in the most intensely burnt areas. The time to recovery for Glider populations in these extensive intensively burnt areas (Figure 8) remains largely unknown and is likely to depend on proximity to unlogged refuge habitat in surrounding areas, including habitat on coupes the subject of these proceedings.

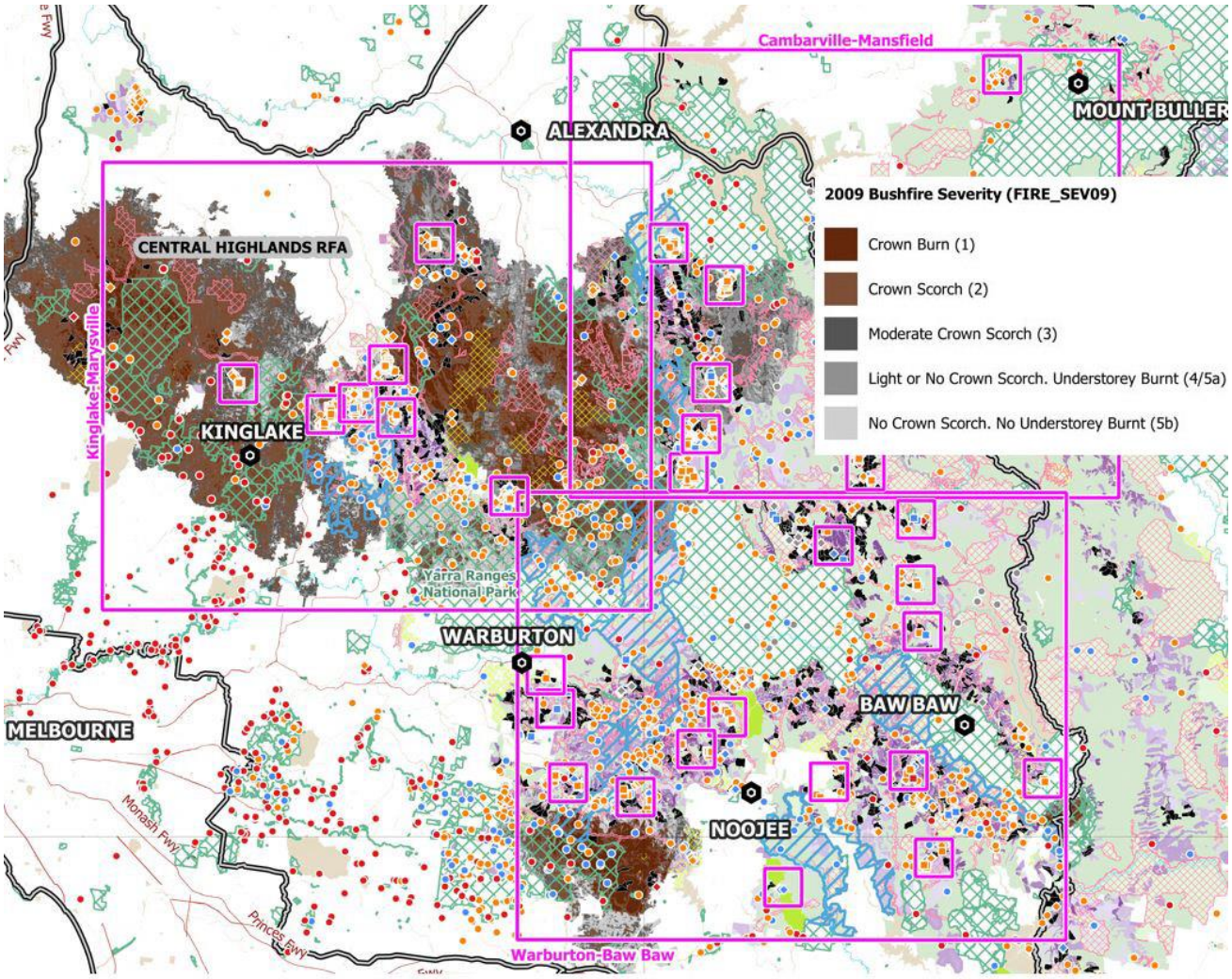


Figure 8 Distribution and intensity of 2009 fire in the Central Highlands showing the location of coupes the subject of these proceedings primarily within areas that were unburnt or only lightly burnt in 2009.

44. **Question 18 Please read the final paragraph on p21. Do you agree that it is likely that Greater Gliders in the Teeter Totter habitat patch can disperse through regrowth forest to other habitat patches?** I have provided a broad answer to this question in preceding paragraphs. Dr. NItschke's makes an assumption that Gliders can disperse through regrowth based on the work of Taylor 2007. I have previously shown that the work of Taylor tells us nothing about Gilder capacity to disperse through uniform regrowth eucalyptus forest. I consider it likely that Gliders can disperse from Teeter Totter through currently existing areas of unlogged uneven -aged forest to the south west, but I have no

certainty, and consider it unlikely that they can survive dispersal through previously logged forest in other directions.

45. **Question 19 Please read Dr Nitschke's answer to q(b) on p22. Please review item 22 in volume 2 of our enclosures (VicForests Risk Assessment Greater Glider extract) and the following affidavit sections Affidavit of James Gunn affirmed 21 May 2020 at [3-9], Second Affidavit of Maria Cardoso affirmed 14 May 2021 at [3]-[18] and Affidavit of William Edward Paul affirmed 7 May 2021 at [3]-[13] (Enclosure Vol 2 to our 30 June letter). Do you agree that VicForests undertook a proper assessment of the risk-weighted consequences of various management options? If not, what would such an assessment require?**

Dr. Nitschkes response to Qb) (in planning for timber harvesting operations in the relevant FMAs, did VicForests undertake a proper assessment of the risk-weighted consequences of the management options?) is as follows:

Yes – the higher-level planning address risks and consequences.

Rationale:

VicForests documents demonstrate that they have undertaken a risk-based approach based on impacts of fire in FMAs and amount of GG habitat in FMAs. They used a tenure-blind – landscape approach with the assumption that GG all areas of GG habitat irrespective of tenure contribute to the species conservation. This assessment was done at a broad-scale that diminishes the impact of fine-scale habitat changes on GGs. At these finer scales – adaptive management was applied to account for the occurrence of GGs and HBTs. The lowering of the GG trigger from 5 to 3 individuals exemplifies a risk-based decision. Target species surveys by VicForests across 100% of coupes and over 80% of coupes by the Forest Protection Survey Program also constitute significant risk-based planning.

I find no support in the above rationale to justify the conclusion that VicForests undertook a proper assessment. The assumption that all areas of GG habitat irrespective of tenure contribute to the species conservation is not proven and is demonstrably unlikely because many conservation areas are dominated by snow gum and alpine vegetation which is not suitable for Gliders. There are also large variations across the landscape in habitat suitability due to fire in 2009 (see figure 8) which are not taken into account. I am not aware of any data or logical argument to justify an assumption that doing an impact *assessment at a broad-scale diminishes the impact of fine-scale habitat*. It only diminishes impacts at a broad scale if you choose to ignore past and future cumulative logging impacts. In my opinion there is nothing "proper" about the decision to lower the GG trigger from 5 to 3 individuals, this is an arbitrary cut-off that is set too high to capture normal or average Glider habitat and populations. Average Glider density various with region, terrain and forest type and is often in the vicinity of 0.25-0.50/ha. in drier Mixed Species forests. In my experience a count of 5 Gliders per spotlight kilometre (allowing for detectability decline) is indicative of a Glider density of about 1.3/ha, and 3 Gliders per kilometre is indicative of about 0.78 Gliders/ha which is above a typical average for all but localized high quality wet habitat. This target selection process may exemplify *a "risk-based decision*" but it in my opinion the target levels are neither proportionate nor precautionary and will not prevent the risk of widespread ongoing Glider population decline in logged forests. I find no evidence that *" adaptive management was applied to account for the occurrence of GGs*

and HBTs". VicForests have counted some habitat trees but do not guarantee to protect or retain them, especially the most important type 2b habitat trees, or to recruit them in previous over-harvested areas. Where is the adaptive value in counting then felling or burning? VicForests adaptive management does not guarantee to protect retained Glider habitat patches from regeneration burns from future harvesting after 20 years, and does not provide permanent protected corridors linked to local reserves of sufficient size and proximity to guarantee that any retained Glider populations will survive in the medium (> 20 years) to long term. Another problem with this so-called adaptive management approach is that it re-enforces and rewards past bad management because areas that have previously been intensively logged and burnt will carry insufficient habitat trees to sustain high target Glider densities. As far as I have been able to ascertain VicForests has not undertaken Glider surveys on any coupes, let alone 100%, and FPSP have only surveyed 64% of coupes, and Dr. Nitschke has agreed elsewhere (P14a) that "*pre-logging surveys for gliders should be mandatory"* on all coupes.

Item 22 shows that Risk Assessment was based virtually entirely using HDM models which I have shown to be unreliable and inaccurate (first report para 16).

46. **Method of Impact Assessment** In my opinion a proper risk assessment would need to better and more reliably estimate changes in Glider populations size and density in space and time at both the coupe and local landscape scales (ie within a radius of about 5 km from each coupe) under different management options. It is not possible to reliably assess the effects of timber harvesting on Glider populations at either local or landscape scales when single coupes are considered in isolation, which is the current practice by VicForests. Changes in Glider populations on coupes after logging will depend on what has happened to Glider populations and habitat on adjacent coupes in the past and what is likely to happen to adjacent coupes in the future if current practices are continued. To properly undertake such an assessment, it is essential to:

    1) correctly map the age and structure of the forest, clearly distinguishing between young uniform regrowth without living habitat trees, uneven-aged mature and older forest with living habitat trees and intermediate areas (with a predominance of regrowth and only scattered living older trees) using aerial photography and ground truthing for a radius of at least 5km around the coupe (note that current VicForests mapping incorrectly maps most Mixed Species as regrowth rather than uneven-aged forest).

    2) Use this information to identify and map potential refuge areas and prime Glider habitat in gullies and sheltered areas and prepare maps showing how these areas are currently connected to one another via natural corridors, and how the size and shape (corridor length and width, patch size) of these habitat areas varies across the landscape and compares with minimum targets (eg 250-500 ha.) for sustaining viable populations over the duration of a harvesting cycle (60 years) or longer in the local landscape area (2500 ha).

    3) Conduct ground surveys of Gliders at a series of stratified locations to validate and adjust habitat mapping and estimate average Glider densities in each mapped forest type and structural class.

    4) Overlay habitat mapping with alternative management plans, distinguishing between permanently retained and protected areas and temporarily retained areas (that may be logged in future years).

5) Estimate Glider populations sizes in current habitat and compare with estimates of Glider population size in permanent and temporarily retained habitat after logging as an estimate of potential long and short term impacts (populations declines) respectively.
6a) Adjust estimates of long term population size downwards according to the degree of fragmentation, including the size of the permanently retained area and its level of isolation (km) from large reserves (250-500 ha in size).
6b) adjust estimates of long term population trend upwards to allow for population increases after 40-80 years (depending on site quality) in areas of uniform aged regrowth where a high density of living habitat trees will be protected, recruited and retained.

This baseline information can also be used to design mitigation strategies such as low intensity selective harvesting and/or designation of permanent corridors and local reserve networks linked to all retained unlogged habitat. It is important to note that predictions and assessments of impacts arising from alternative practices at this stage must take into account whether retained areas of habitat (including habitat trees, patches and corridors) are guaranteed permanent protection from logging into the foreseeable future (eg by mapping of retained areas on landscape scale maps as permanent SPZs) or whether they are only temporarily protected and could be harvested in the future. In my opinion impacts of timber harvesting should only be considered "reversible" where they are located within a matrix of permanent corridor and reserve habitat of sufficient size, shape and location (in gullies) to sustain viable populations at the landscape scale (2500+ ha)

47. **Question 20. Please read the method and answers to Local Landscape Analysis in Part 2 Coupe level, approach on p6 and the associated Land Risk answers for each coupe in Table 1. (a) Please provide any comments on the approach, including whether it considers all relevant factors. (b) Do you agree with the Table 1 answers for Land Risk**? **Question 21 21 Please read the method and answers to Greater Glider Impact risk in Part 2 Coupe level, approach on p6, and the associated GG Risk answers for each coupe in Table 1. (a) Please provide any comments on the approach, including whether it addresses all relevant factors. (b) Do you agree with the Table 1 answers for GG Risk? (c) If, and to the extent that, Dr Nitschke's opinions at these passages involved his reliance upon VicForests' and/or FPSP records of Greater Glider only (i.e. if he excluded WOTCH records), would that affect his analysis at the risk, and if so, how**?

I have reviewed Dr. Nitschke's impact assessment methodology, and while I have some common ground with assessments at a local or coupe scale (eg column Q21a) I find the assessment at landscape scale (Land Risk) to greatly under estimate risk because it relies on incorrect or unproven assumptions that retained areas (including unlogged habitat on adjacent unlogged coupes) will be protected from future timber harvesting or loss, and that uniform logging regrowth will become suitable for gliders in the relatively near future 10+ years). Consequently, I have no agreement with the conclusions listed under Land Risk.

I do not agree with the allocation of an "unlikely" local impact ranking if a coupe is connected to adjacent unharvested forest because there is a risk that adjacent forest will be harvested next year, or in a subsequent year which could leave the retained population of the coupe isolated.

I consider the assessment in para 2 and 3 (planned retention, current retention) to be irrelevant. In my opinion impact is determined by the area of habitat loss added to neighbourhood effects and the extent to which this loss is permanent (irreversible), especially as retention areas are not guaranteed to be protected from further logging, and not by whether or not an arbitrary short term coupe level retention target is reached. There is nothing to stop VicForests returning to these coupes and logging all or some of the retained forest when adjacent coupes are harvested in subsequent years. In my opinion the logging retention area only counts if it is permanently set aside.

I have no confidence in Dr. Nitschke's reliance on records of GG presence in coupes (or presence in aggregated retention areas) because not all forest in each coupe has been surveyed for Gliders, habitat quality variation across each coupe has not been mapped or assessed, and Dr. Nitschke appears to have relied on only a subset of the available Glider distribution data for coupes.

I disagree with Dr. Nitschke's assumption that impacts of harvesting are reversible over time. I see no factual or logical justification for this assumption. Glider populations have declined and are declining in response to cumulative logging. Under current harvesting prescriptions (or more correctly under current harvesting prescription omissions) there is no certainty that Glider populations will recover (after all forms of logging other than low intensity selective logging) at either coupe or landscape scales. There is a risk that Gliders left behind in retained patches within logged landscapes will die out in within the next 60 years, because there is no certainty that adjacent areas will remain unlogged and that retained patches will not be logged in future, will not be burnt in regeneration burns and will not die out from isolation due to lack of adequate connecting corridors and linkage to local reserves.

On P6 Dr. Nitschke states "*As indicated, it is my opinion that the application of silvicultural systems that do not retained >60% of basal area/ area within a coupe do not emulate natural disturbances in Foothill mixed species forests; however, I have considered the application of the adaptive silvicultural practices (except STS) in areas not containing GGs but promoted the retention of biological legacies in these harvested areas as having a negligible impact and may provide some functional GG habitat over the next 10 to 50 years*." If Dr. Nitschke considers that single tree selection (STS) with >60% tree basal area retention should apply in all Mixed Species forests in order to emulate natural disturbances, then surely his methodology should find that timber harvesting by any other method (eg aggregated and retention harvesting) in all coupes dominated by Mixed Species will have a severe and potentially irreversible impact at local and landscape scales. Dr. Nitschke seems to imply that current silviculture proposed by VicForests in Mixed Species forests, other than STS should be limited to areas of forest not containing Gliders. I note that at present there are no data on what part of each coupe contains Gliders and which part does not, because complete surveys and habitat mapping have not been carried out at the coupe level. There are data which show that Gliders are present on all but one coupe. Consequently it is necessary in my opinion to apply a precautionary approach and assume that Gliders are present throughout all forest on all coupes, and therefore that STS should apply to all Mixed species forests on all coupes, and that a finding of

potentially severe and irreversible impact should apply to all Mixed Species coupes subject to harvesting by methods other than STS.

I do not agree with Dr. Nitschke's claim that *" It has been shown in the literature and existing data that the impacts of timber harvesting are not irreversible and as such I have assumed in my analysis that this is the case. I have therefore assessed the impact based on the severity of harvesting on GGs within and adjacent to coupes*." I have reviewed the literature quoted by Dr. Nitschke to justify an assumption that timber harvesting is not irreversible and found that none of it evaluates or supports this contention.

48. **Question 22. Please read Dr Nitschke's "Part 2 Coupe-level" analysis, at Table 1. Dr Nitschke answers "No" to Q21a and Q24a for certain coupes, being Apu, Ezard, Arena, Dowse, Jolimont, Turkey Feet, Maxibon, Facet, Tenderloin, The Falls, Stimpy, Nine Miles High, Wales, RockARhyme. (a) Do you agree with the answer "No" for those coupes? (b) If, and to the extent that, Dr Nitschke's opinions in these instances involved his reliance upon VicForests' and/or FPSP records of Greater Glider only (i.e. if he excluded WOTCH records), would that affect his analysis at the risk, and if so, how?** I note that many of these coupes (Apu Ezard, Turkey Feet, Stimpy, Nine mile high, Rock a Rhyme) are listed in Table 1 as either maybe or unlikely to support Gliders. This is not consistent with my data which shows that Wotch has recorded Gliders at a significant proportion of coupes where FPSP either did not survey or recorded no Gliders. I understand that using Dr. Nitschke's methodology this error is likely to cause underestimation of the importance of harvesting impacts on those coupes where Gliders are mistakenly considered absent or unlikely. In my opinion, the Glider survey data used and relied on by Dr. Nitschkse and VicForests is so incomplete and deficient that it cannot be used to demonstrate any lack of serious or irreversible impact (see previous section on methods of impact assessment this report). Limitations with existing data are illustrated by APU coupe. There is little planning data for this coupe with habitat trees mapped only in the part of the coupe scheduled for logging. The plan calls for retention of two additional recruitment trees "where practicable" around each type 1 habitat tree. Mapping shows type 1 habitat trees to be highly clustered and calls for retention of four habitat patches about 200 m apart. Type 4 habitat trees are widely scattered across the coupe but are not protected. Use of the wording "if practicable" provides no certainty and demonstrates a real risk that no recruitment trees will be retained. A wide streamside corridor is retained, but without continuation onto adjacent coupes and permanent protection it is just a temporary corridor to nowhere. There is no planning information on forward harvesting intentions in adjacent coupes and unlogged forest. Aerial photography shows that this coupe is dominated (75%) by complex uneven-aged structured forest, now very rare in wet forest types, that is potentially ideal for Gliders and for fire protection. FPSP either did not survey the coupe or recorded no Gliders and Wotch surveyed only a small part of the coupe. Mckenzie. J. (third affidavit) stated that he surveyed APU "*only along the southern boundary of this coupe*" where he found one Glider. A complete survey of this coupe could potentially return 10 or more Gliders. The information available for this coupe and adjacent forest is simply not adequate to conclude that impacts on Gliders will be negligible at either local or landscape scales. However, Information is adequate to conclude that any Glider population on this coupe will decline after logging, and that there is a real risk that this decline could be permanent and irreversible. Similar comments apply to virtually all coupes in these proceedings.

49. Question 23 Please read the first paragraph on p7 of Dr Nitschke's response to your report, numbered 18. Please provide any comment.

On p7 Dr. Nitschke states that "*The key point is that GG can persist in a landscape with a matrix permanently comprised of non-habitat*." This assumption, which underpins Dr. Nitschke's impact assessment, is not supported by any of the literature cited and as I have shown in previous sections of this report (para 18-30), there is nothing in these studies or any other studies that I am aware of that supports this assumption. The factual data that I have been able to assemble on this matter supports the opposite, that GG do not persist in small isolates (<250-500 ha) within a matrix comprised of non-habitat. The statement by Dr. Nitschke that "*This is support by the research of Lindenmayer et al. (1993) who found GG persisted in riparian buffers as long as suitable amount of HBTs were present and Lindenmayer et al.* (2021)" is simply not true. I have reviewed these studies (pat 2 para 7) and shown that they do not measure Glider persistence. This statement by Dr. NItschke indicates to me that he has failed to give any or adequate consideration to the real risk of population decline in small isolated retained habitat patches over time. I note that the authors of *Lindenmayer et al. (1993)* were much more circumspect, that concluded that "*The results of this study and those of Suckling (1984) and Recher et al. (1987) have indicated that some species of arboreal marsupials can survive in linear refuges in the short term. However, there are, at present, no data to demonstrate the long-term effectiveness of such areas.*"

50. Question 24 Please read the second paragraph on p8 of Dr Nitschke's response to your report. Please provide any comment.

My comment on excluding all harvesting in 1939 forests is founded on strong data compiled by (VEAC 2017, see para 43 of my second report) which shows that the age structure of Ash forests has become unbalanced by past fire and logging such that only a very tiny percentage of forests are dominated by stands aged pre 1900 critical to future survival of Greater Gliders. In 2017 there were still 35, 000 ha of 1939 regrowth Ash but most of this forest is at risk of being completely harvested out (in state forests) over the next 10-15 years to satisfy forward supply agreements VEAC 2017 (see paragraph 44 of my second report). At present most remaining 1939 Ash is unsuitable for Gliders because dead habitat trees have decayed and largely disappeared and living habitat trees that were not removed by salvage logging are scarce, occurring in less than 50% of sites surveyed (Smith et al 1985) and then only at relatively low densities (averaging only 1/ha). The only upside is that these forests are now 83 years old and will start developing natural hollows and providing new Glider habitat in about 40 years' time, <u>but only if they are not logged as scheduled</u>. In conclusion, it is a matter of fact that intensive timber harvesting in Ash Forests has caused an extensive decline in Glider habitat and Glider numbers at the landscape scale, comparable with the decline in Leadbeater's Possum habitat (Smith and Lindenmayer 1992), and that this decline will continue as more 1939 regrowth is logged.

I have previously pointed out that Dr. Nitschke' finding that Ash Forests are not the most important forest type for Gliders is likely to be an artefact (statistical confounding) of low Glider density in 1939 regrowth due to scarcity of tree hollows, and that in my opinion Mountain Ash is a key habitat for Gliders because

it occurs in high elevation moist habitats most resistant to drought and fire and because it is one of few habitats in which Gliders can survive by feeding on just a single tree species.

51. **Question 25 Please read the response under [35] on p10 of Dr Nitschke's response to your report. Please provide any comment.**

The study or McCarthy et al 1999 uses a largely theoretical model that is not empirically validated to estimate fire interval. There is nothing in this study that alters my opinion that the predominant structure in Ash forests in the absence of logging is uneven-age old growth.

My estimate of 5% mortality of Ash every 20 years is based on modelling by the Victorian Government (VEAC 2017) which concluded that 20% or less of the Ash Forest is likely to burn over 20 years. Given that fires only occur at high enough intensity to kill Ash in about 25% of the fire envelope this equates to 5% loss every 20 years. The balance of the forests burnt are not killed but regenerate in multi-cohort or uneven-aged stands which means that the majority of the Ash Forest at any one time (in the absence of logging) is likely to have had an uneven-aged structure with varying percentages of large old senescent trees depending on past fire intensity and frequency at particular locations. My definition of old growth is not limited to uniform aged stands but includes multi-cohort forests with at least some senescent living trees in the overstorey. My own studies in Mountain Ash show that about 50% of1939 regrowth Ash has living trees with hollows but the density of these living trees is very low (average 1.0 /ha) especially in salvage logged forests (0.8/ha). In the absence of post fire salvage logging timber harvesting I estimate that around 75% of forests would have been multi-cohort with a sparse to dense senescent overstorey prior to 1939.

52. **Question 26. Please read the response under [37], [45] and [48] on p11-12 of Dr Nitschke's response to your report. Please provide any comment.**

Response to 37. My statement that Dr. Nitschke is having difficulty with perhaps requires clarification. Timber harvesting limits the capacity of Ash Forests to recover from natural fire disturbance regimes by several unnatural means a) by salvage logging of large living old trees that survived wildfires and reducing the area of regrowth forest with living habitat trees suitable for Gliders, b) by clearfelling over unnaturally extensive areas causing the majority of the forest to be of very young age(< 40 years) unsuitable for Gliders (see figure 9 below from VEAC 2017), c) by not retaining all large living potential habitat trees after logging, and by burning and killing a high proportion of those that are retained, d) by not recruiting future habitat trees into areas where they have previously been lost due to salvage or other logging, e) by harvesting or extensively reducing and fragmenting fire refuge habitat in gullies that provide population source area for natural recolonization over long time spans (0-120+ years) after fire, f) by retaining Glider habitat to tiny scattered retained patches that may not be viable in isolation over time.

Response to 45 . Figure 9 below (from VEAC 2017) shows the age distribution of Ash Forest in Victoria prior to 2017. This report notes that much of the area shown as 1939 regrowth is scheduled for future harvesting and is expected to be logged out by before 2030 under forward commitments. This leaves

about only 10% of forest aged pre 1900. Since preparing my initial reports I have become aware that VicForests age class mapping in Ash Forest is not particularly accurate and fails to adequately identify and map uneven-aged forests. My own studies of aerial photographs on and within the vicinity of coupes in Ash forests suggest that there remain in Ash Forest (mapped as 1939 regrowth) substantial areas of complex uneven-aged forest (average 40% (range 0-75) of coupes) with at least a low density of living mature or senescent trees (>2/3ha) in the overstorey. These areas are located primarily within gullies or sheltered lower slopes or on ecotones where they adjoin Mixed Species forests, and are not shown on Vic Forests mapping. I have further found that the number of Gliders on coupes in Ash forests (and Mixed Species Forests) correlates highly significantly with the area of this unmapped uneven-aged old growth forest (see Figure 5). Based on this association I revise my estimate of Glider habitat in Ash forests from around 75% at the time of European settlement to about 25% in 2017. An effect of this upward revision is that the area of Ash forest Glider habitat likely to be reduced if current harvesting practices area continued is much higher than I previously assumed, which increases the severity of future decline and magnitude of impact at local and landscape scales.

Figure 1.7 Ash age class distribution

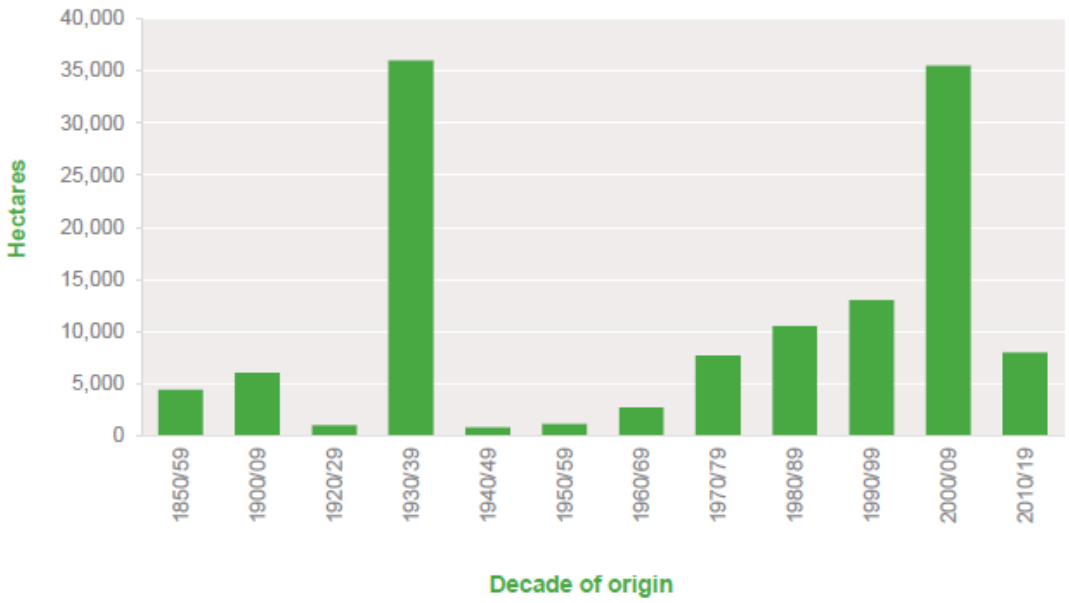


Figure 9 Showing the proportion of Ash forests by decade of origin in Victorian highlands (from VEAC 2017). Only classes older than 1939 are likely to be suitable for Gliders

Response to 48. I don't agree with the criticism of the use of the word "supporting" instead of probability of occurrence, perhaps to clarify I should say *needed to be greater than 60 hectares in size in order to have an 80% probability of Glider occurrence (Incoll et al 2001)."* Dr. Nitschke's statement that there is a 50% chance of survival when log area is 1 is also correct. Incoll et al also found, as I have done (Smith 2019), that Glider density also increases with increasing overstory large tree basal area. These two variables are likely to be confounded, bigger patches of old growth are likely to be older and have a higher basal area. The claim of Dr. Nitschke that "*the ability of GG to occur in a range of patch sizes is shown much more clearly in Taylor et al. (2007) who found GG persisting in patches 1.6 to 30 ha in size within a matrix of a pine plantation*" is not consistent with data in the quoted study (which is about population

genetics) and which I have previously shown to be based on substantial under-estimates of patch size and isolation.

53. **Question27** Please read the response under Q1h on p13 of Dr Nitschke's response to your report. Please provide any comment. Dr. NItschke states "*There is no proof of this. GG are disappearing in areas with no timber harvesting and in stands with sufficient HBTs and forage species (see Smith and Smith, 2018; Wagner et al. 2020; Lindenmayer et al., 2021). The data suggests the GG are declining due to climate change and fires with timber harvesting having an impact but only in the portions of its habitat that have been harvested. Timber harvesting has not occurred across 75% the species range. GG have also been observed in older clearfells suggesting that the impact is not irreversible with time*." There are no proven substantive Glider population declines that I am aware of in Victoria that have occurred in areas with no timber harvesting or wildfire. There have been no changes in Glider density in the Strathbogie Ranges over the past 34 years (Nelson et al 2018). The role of climate change in glider population declines is primarily theoretical and speculative, and in my opinion is only likely to be of importance on the margins of the species range where contractions and expansions are likely to be part of a normal climate cycles and variations. The reference to Smith and Smith relates to marginal low elevation glider populations in dry forests in the Sydney region of NSW where climate is substantially hotter than Victoria. One only needs to look at figures 1 and 3 b to see that state forests and timber harvesting has occurred across almost the full geographic range of the Greater Glider in Victoria. Figure 1 shows that Glider distribution (dots) coincides strongly with green areas of state forest. Similar patterns occur in south east Queensland and in NSW showing that timber harvesting is highly co-incident with Glider distribution. This is hardly surprising because Gliders like large old trees that are preferred for wood production.

54. **Question 28. Please read the response under Questions 12 and 16 on p17-18 of Dr Nitschke's response to your report. Please provide any comments**. Q12. I have responded to most of these comments in previous sections. I note that Dr. Nitschke qualifies his comments with the following statement "*If GGs use forests that are 40-60 years old, providing there are HBTs within or adjacent, then how do they continue to decline > 40 years*?" This shows that Dr. Nitschke assumes that current VicForests practices will retain sufficient HBT in perpetuity to provide habitat for Gliders. I find no evidence to support this assumptoin. My reason for concluding that gliders are likely to be eliminated from logging coupes are as follows:

a) only type 1 habitat trees must be retained and then only if they are not "unsafe" which means that there is no certainty that they will be retained.

b) the average number of type one habitat trees per hectare on coupe plans is 0.4/ha which is so low that it is not likely to support any Gliders,

c) about half of all retained habitat trees are likely to be killed during harvesting and regeneration burns which reduces the number of type 1 habitat trees to 0.2/ha.

d) about another half of the surviving half are likely to be killed during regeneration burns in the second harvesting rotation in about 40-60 years time,

e) and another half are likely to die of exposure, windthrow and natural death over 120 years, the overall effect being that HBT will rapidly trend to zero over time and will not be replaced under current policy,

f) there is no mandatory requirement to recruit future habitat trees in areas where they are below minimum levels for sustaining average or higher glider densities.

g) if there are some coupes where more habitat trees are selected and retained, there is high likelihood the Glider populations will have died out (due to isolation and fragmentation) out during the 40-60 year waiting period in Ash Forests (or 60-80 year waiting period in Mixed species forests) before habitat reaches a suitable age and structure for re-colonization.

h) there is no certainty that ash regrowth will not be re-logged within 40 years, there is no guaranteed minimum rotation time, and there is a real risk that under pressure to supply pulpwood that rotation times will be reduced (this risk is proven by the Victorian Governments failure to adhere to its policy in the 1980's to harvest on 80-150 year cycles, Smith 1991).

55. Question 28, Q16.

Table 2-1. In my opinion the effects of intensive harvesting must be considered irreversible if there is a real risk that harvesting will cause the loss of local populations within the next 40-60 years, if there is no certainty that habitat will be suitable for Gliders 40-60 years after logging, and if there is no certainty that Gliders from unlogged reserves will be able to recolonize after 40-60 years and if there is no certainty that forests will not be re-logged within 40-60 years.

Table 2.3 Dr. NItschke states " *a major tenet of VicForests biodiversity and risk strategy is the network of conservation reserves, modelled old-growth areas, and riparian corridors (with many being fire refuges). This was clear to me in the planning documents. VicForests takes a landscape-scale approach and relies on these SPZs, Parks and Reserves and Code of Forest Practice Exclusions to ameliorate the impacts of their management at the coupe-scale*". The opposite is clear to me. One only needs to look at the network of mapped SPZs in figure 3 b to see that they are fragmented and isolated from one another or at best linked by very long and narrow riparian strips with limited or unknown functionality, and that no serious attempt has been made to ensure that SPZs operate as a functional and effective wildlife corridor network linked to National Parks and Reserves. I have found no planning documents that assess the adequacy of SPZs to function as local reserves, corridors and fire refuges. I have seen no modification of SPZs on coupe plans specifically to assist with long term protection and maintenance of retained Glider populations, and I see little effort to comply with the Code of Forest Practice (see my second report para 86). I have seen no documentation of the reason for location of SPZs where they occur and no assessment of forest vegetation type and structure within SPZs. There is a real possibility that SPZs are primarily located in areas of low or little merchantable value (with few or no large trees) of little or no habitat value for Gliders.

56. **Question 29 Please read the response under Question 19 on p19 of Dr Nitschke's response to your report. Please provide any comments**.

I assign lower impact to fire because recovery after fire is certain with the passage of time while recovery after VicForests harvesting is not. I am not particularly concerned with thresholds such as greater or lesser

than 30% decline at the coupe or landscape scale in the short term. I am more concerned by population trends over the longer term (120+ years) and what is or is not being done to halt or reverse downward trends at the local landscape scale (about 2500+ ha. or approximately the area of habitat required to sustain viable populations in isolation for the foreseeable future).

57. **Question 30 Please read the paragraph under the heading "Variable Retention Harvesting" on p21, and [48] and [50] on p29. Please provide any comments, including what you consider to be the proper definition for old-growth trees**.
See my response at part 2 para 17.

58. **Question Do you agree that the matters Dr Nitschke lists under Q34 are adaptive management measures that address the threat of serious or irreversible damage to the Greater Glider and are proportionate to that threat? In answering this question, please do not assume that VicForests agreed not to harvest the top 20% modelled Greater Glider habitat or that harvesting has ceased in East Gippsland**. Dr. Nitschke says *Smith stated there was, "No evidence of Precautionary approaches." I disagree with this. The consideration of GG modelled habitat, VBA observations and the undertaking of surveys or use of FPSP surveys are precautionary approaches. The inclusion of observations of GG when they are recorded by third-parties is a precautionary approach. The application of the 40% BA retention target when 5 GG/km were detected is itself a precautionary approach (in policy). The reduction of the 5 GG/km to 3 GG/km constitutes and adaptive approach this is consistent with precautionary principle. The agreement to not harvest the top 20% of modelled GG habitat, despite how poor this decision-making tool is, was a precautionary approach. The decision to stop harvesting in East Gippsland FMA was a precautionary approach. The conductance of the risks posed to GG when considered in terms of FMA and State-level habitat and populations is a precautionary approach. The decision to retain increased amounts of HBT including Type 3 HBTs in relation to increased amounts of occurring HBTs is a precautionary approach.*

I say there are no precautionary measures because I consider an action to be a precautionary measure only if it is proven to work (to halt or reverse Glider population decline). There is no evidence that the so called "precautionary measures" quoted by Dr. Nitschke will halt or reverse long term Glider population declines.

a) The inclusion of observations of GG when they are recorded by third-parties is not a precautionary approach, it is simply a citizen compliance check on whether or not VicForests are doing their job properly.
b) The application of the 40% BA retention target when 5 GG/km were detected is itself is not a precautionary approach (in policy) because it only captures a small part of the Glider population and leads to greater fragmentation and isolation of existing poulaitons.
c) The reduction of the 5 GG/km to 3 GG/km does not constitute and adaptive approach consistent with precautionary principle because the target is set so high that it does not capture average or the full range of normal glider density.

d) The agreement to not harvest the top 20% of modelled GG habitat knowing how poor this decision-making tool is, is not a precautionary approach because the model is useless.
e) The decision to stop harvesting in East Gippsland FMA is not a precautionary approach unless harvesting ceases for long enough for Glider populations to recover from fire.

59. **Question 32, 33. Please otherwise provide any response you consider necessary to Dr Nitschke's comments on your report. To the extent there are any other comments you wish to make in relation to Dr Nitschke's report that have not been addressed in your answers to the questions set out above, please provide such comments**.

60. **Areas of Agreement. I** note the Dr. Nitschke has indicated his agreement with many important risks and inappropriate practices identified in my reports. Some of these key areas of agreement are listed below.

Part 2 P18 *From the perspective of GG conservation, areas within the potential home ranges of GG observations should not be subjected to even-aged management.*

P14 a**)** *pre-logging surveys for gliders should be mandatory because models are unreliable*

P14 b) *forests with average and higher densities of gliders are routinely felled*

P14 f) *habitat trees should not be felled on the grounds that they are unsafe*

P14 g) *all habitat trees should be protected*

P15 l) *corridor planning is not evident in planning documents*

P15 n) *There are no plans to cease ecologically unsustainable post logging burning and clear-felling practices (including variable retention 1 and 2 harvesting) in dry or mixed species forests and ecotone forests.*

P15 o) *the continued application of even-aged management in mixed species forests and dominant use in ash forests violates the principle of emulating natural disturbance regimes which is a required of ecosystem-based management and therefore ecologically sustainable forest management*.

P15 g) *that the 40% threshold is too low in less it captures all GG habitat in the coupe. 60% retention is likely required to maintain home range abundances*

P16 para 60 a) *the mapping and modelling of Glider habitat on which the process relies is inaccurate and unreliable*

P16 (para61) *the silviculture systems applied through dispersed retention are not sufficient unless it coincides with aggregated retention of all observed GG home ranges in the gross coupe area. Wagner et al. (accepted) identified that > 60% dispersed retention is needed.*

The persistence of GG will be contingent upon the size and connectivity of retention patches.

P18 Table 2-4 *The protection of HBTs and retention patches from regeneration burns is a major issue that needs to resolved to avoid eroding the harvesting practices implemented for biodiversity conservation.*

P18 Table 3-3 *that even-aged silviculture is not compatible with conserving GG and that gap or single tree selection is required to maintain GG home ranges and persistence on sites. This would resolve issues with HBTs if they, and they should be, included in the >60% retention.*

P 18 *para 70 if GG surveys are not conducted in coupes then the precautionary principle has not been followed based on current models and diagnostics used. It is quite clear from observed data that these current models are not appropriate for the task.*

P18 para 71 *the reliance solely on HBTs is not sufficient for GG. The connection to patches > 120 ha that are GG reserves is an excellent idea that should be considered.*

P19 72) *The harvesting of forests in East Gippsland post-fire, particularly in the Bendoc region that was unburnt should not have been considered no less planned.*

P 20 77b) *application of retained habitat for GG is ad hoc.*

P20 77c) *low levels of dispersed retention are not suitable for GG conservation*.

P 20 77d) *appropriate surveys need to be conducted. It is important to recognised that due to detection uncertainties it is possible for surveys conducted at different times to detect GG that may have been missed in another survey.*

P21 80) *if retained HBTs and recruitment trees are burnt and killed following harvesting than this defeats the purpose of conserving them during harvesting and reduces/ removes any conservation benefits that these biological legacies would have had over time*.

P21 80) *the prevalence of selective logging and VR2 is low in the dataset.*

P21 84) *harvesting in GG habitat requires different prescriptions then currently applied and proposed. I am in full agreement with Smith here.*

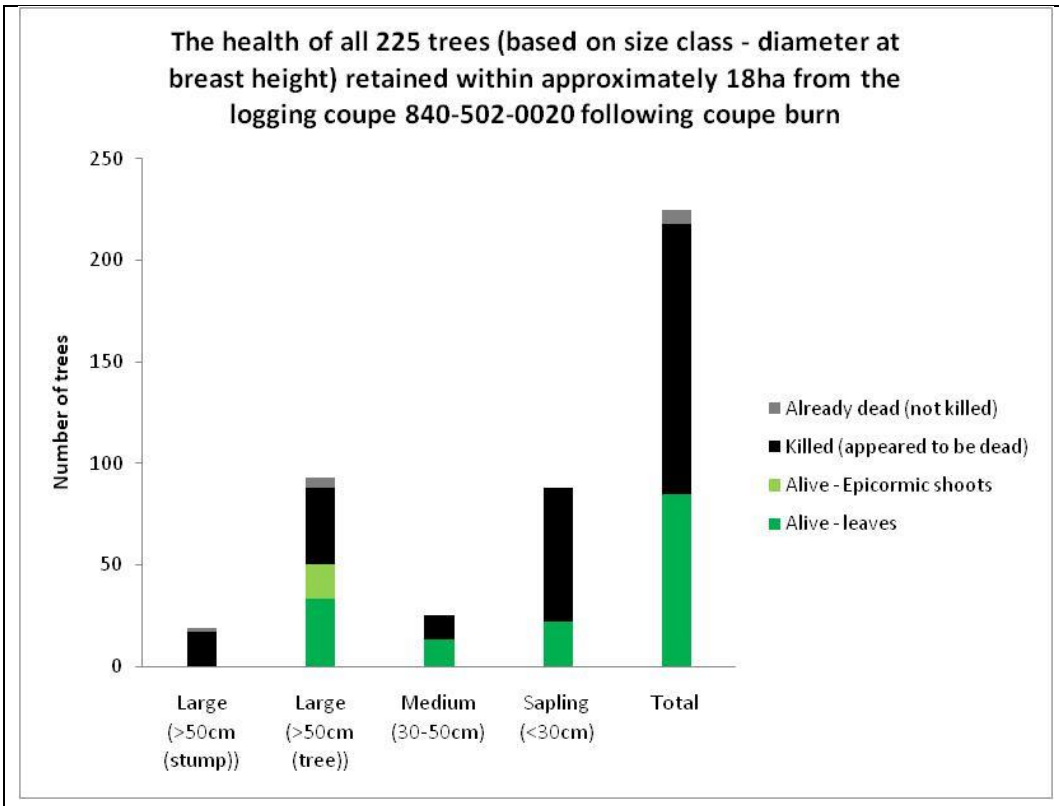
61. **Cumulative and Broadscale Impacts.** On the matter of cumulative impacts I note that Dr. Nitschke that (P3 second para) recognizes that cumulative impacts can occur. He states "*the cumulative impacts of management and natural disturbance can have antagonistic impacts on arboreal marsupial habitat over time (Nitschke et al., 2020*)" but does no appear to take this impact into account in his assessment of risk. Dr. Nitschke appears to simply assume that broad scale impacts are negligible without any comprehensive assessment or factual proof. He states that (P3 para 2) "*Through my assessment of data and documents I have concluded that the PP has been applied properly at broad-scales and the risks of severe and irreversible environmental degradation for the GG negligible*." Dr. Nitschke has agreed that severe declines are likely to occur at coupe scales after logging but has not provided any factual evidence which shows that this decline will be reversed by proposed management practices. My assessment of the literature (especially that relating to effects of fragmentation and isolation), my own research data, and my observations of harvesting practice all lead me to conclude that Glider populations retained on coupes

after logging under current and proposed harvesting practice (in all by selectively logged forests) are at high risk of declining further after logging and continuing to decline over time until they become locally extinct. As the number of coupes logged progressively increases and time passes any remnant glider populations left on coupes become "increasingly isolated" and more likely to die out from regeneration burning, predation, in breeding, demographic collapse, drought and wildfire. This means that long term cumulative impact is much more severe at both coupe and landscape scales that the short term impact which Dr. Nitschke accepts to be severe on most coupes with Gliders. My own research and that of others (Nelson et al 1996, Loyn et al 2002) show that the density of Greater Gliders in Ash forests declines significantly with increasing distance away from large refuge patches of uneven-aged and old forest (forest mapped as old growth or uneven aged forest in the 1980's or as pre 1900 in more recent VicForests mapping) and approaches an average of zero at a distance of more than 700- 3000 km from such refuges. At present VicForests has no current or planned future policy to protect older and uneven-aged forest refuges and no policy to provide linking corridors between such refuges or between such refuges and retained patches of Glider habitat on coupes.

62. **Disjunct Between Policy and Practice. Short and Long Term survival of Habitat Trees**

In my opinion, Dr. Nitschke's conclusion that timber harvesting will have negligible landscape scale impact is based on an assumption that VicForests proposed mitigation measures will a) be carried out as stated and b) will be effective, but he provides no proof of either. This problem is well illustrated by Dr. Nitschke's assumption that a matrix of young uniform aged, logged regrowth forest will provide a potentially suitable corridor for Glider dispersal because it will include retained or recruited habitat trees. In practice, Vic forests continuously depletes habitat trees in production forest by felling them for timber or safety reasons, by burning and killing them in regeneration burns and by failing to recruit adequate new habitat trees in areas where they have been lost or depleted. Retained habitat trees also die naturally and from wind throw at quite a high rate, and this is especially likely amongst older type 1 habitat trees. Continuation of habitat tree loss trends over current and subsequent logging cycles will, in combination with natural disturbances such as fire, eventually eliminate habitat trees from logged regrowth forests altogether. I am not aware of any Vicforests monitoring data which shows that habitat tree retention in logged forests is doing anything other than declining but I am aware of data showing the opposite (lindenmayer et a l 2021). My own data show substantial (> 50%) post harvesting declines in retained living habitat tree numbers after logging in East Gippsland (see Figure 10 below). My observations of logging practice in many coupes throughout the Central Highlands and East Gippsland lead me to believe that the statistics for this coupe are representative and typical of the impact of current logging and regeneration burning in Victoria. It is important to note that at the time of this study (2008/9) that management procedures for timber harvesting in Victoria's State Forests required the retention of at least 5 living old trees with a range of hollows for each hectare of logged forest. Management procedures also required that habitat trees be retained in clusters which include young regrowth and understorey, and that habitat trees be protected from regeneration burning by removal of harvesting debris within 20 metres. It is clear from my studies and observations that actual logging practice is not consistent with any of these proposed amelioration measures. In this case, no habitat trees were retained in small clusters with regrowth and understorey

within the body of the compartment; post logging burning was so severe that most retained trees have been killed; and the density of retained habitat trees ("*old living trees with a range of hollow sizes*") was only about half the requirement of at least 5 such trees per hectare.



	Large (>50cm DBH) Potential hollow bearing size		Medium	Sapling	
	Stump	Tree	(30-50cm DBH)	(<30cm DBH)	Total
Alive – leaves	-	33	13	22	85
Alive – with epicormic shoots	-	17	0	0	-
Killed (appeared to be dead)	17	38	12	66	133
Already dead (not killed in fire)	2	5	0	0	7

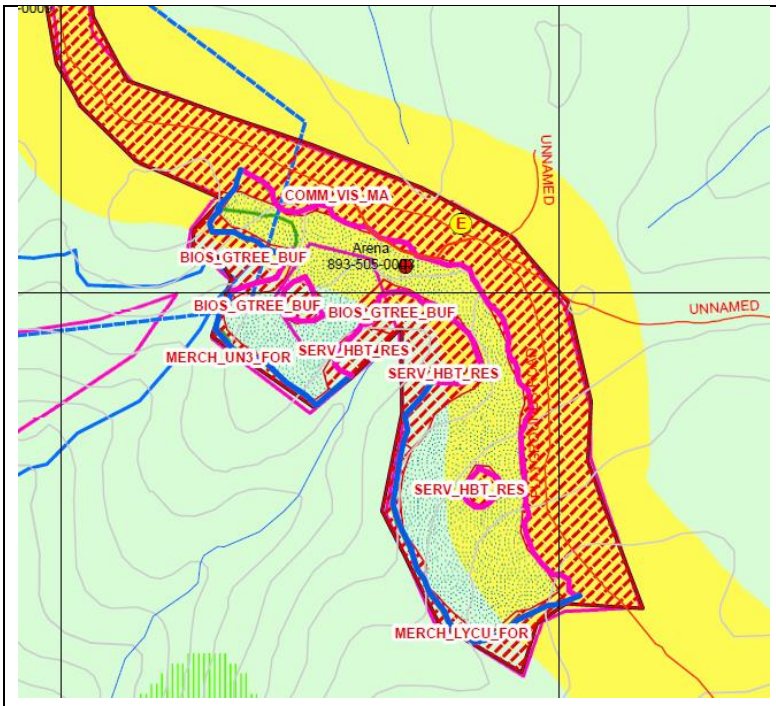
Figure 10. Showing the number of trees > 50 cm retained in Coupe 20 after logging and the proportion which appear to have died as a result of post logging fire (from Smith 2010)

63. Dr. Nitschke clearly recognizes the problem of habitat tree loss, but he incorrectly (in my opinion) assumes that this problem will be rectified by VicForests. on P14 he agrees that e) "*habitat trees are frequently killed and burnt in regeneration operations*" but proposes that this problem can be alleviated by "*cool burning or not burning at all*". It appears to me that Dr. Nitschke's conclusion of negligible impact is based more on faith that VicForests "will do the right thing" than on fact or actual practice. I have based my Impact assessment on actual practice and not what could or might be done in theory. VicForest have been aware of the regeneration burning problem since the 1980's (Wailes 1982) but they have failed to introduce no-burning policies in Mixed Species forests consistent with their natural ecology, and have failed to

enforce cool-burn or no burn policies in Ash Forests or to recruit new hollows, or to adequately protect trees with hollows (especially those with commercial value).

64. Disjuncts between Actual and Proposed Harvesting Practice in relation to Habitat Trees

A good example of the disjunct between habitat tree retention policy and coupe planning practiceis illustrated in my second report for Arena Coupe (Para 21) which says " *The coupe plan for **Arena** notes that modelled Glider habitat is present and calls for "Ten retained trees/ha. Mineral earth fire break will be constructed around retained patches. 7.9ha have been excluded from TRP area of 13.7ha". The operations map shows only an average of 1.7 habitat trees per hectare for retention which is 80% short of requirement and no trees are mapped for recruitment. The operations map shows five mapped Type 1 habitat trees within the planned logging area in total of which three are mapped as Hazardous Trees. One of these is protected in a retained clump of vegetation in the operations plan (which is the sustainable approach to protection of hazardous tree that I have recommended in this report) but the other two are presumably at risk of being harvested by logging contractors for "safety reasons*". This shows that VicForests plans can be inconsistent with policy and that reliance on policy rather than practice can seriously underestimate impacts. Since my second report this site has been logged and the post harvest plan (Figure from Exhibit JMG 38) shows no evidence of the required retention of 10 HBT/ha and the 9th affidavit of Mr. Gunn is silent on the matter of compliance with this requirement.



Post harvest plan for arena from JMG 38

65. **Wildlife Corridors** P 14 j) Dr. Nitschke agrees that "*retained patches are too small and isolated*" but adds that as a precautionary approach "*it would be better to have patches >2.5 ha in size and connected to unlogged forest by filter strips with 60% or more dispersed retention or located within the glide distance*

from the patch to adjacent mature forest which will be dependant of tree height." I support the qualification with the provision that the filter strip is understood to mean wildlife corridors and the that the corridor and adjacent mature forest are permanently protected and cannot be harvested on subsequent rotations. I would further require that wildlife corridors are at least 100 m wide, not more than 1.2 km long, contain mature forest, and are connected to patches of permanently protected high quality Glider refuge habitat (in gullies and on protected aspects) (> 50-200 hectares in size) at regular intervals. In my opinion Dr. Nitschke's agreement that retained Glider habitat patches in coupes are too small is not consistent with his conclusion of negligible long-term impact and should lead to an opposite conclusion.

66. **Dr Nitschke agrees P15 i**) that "*Retained forest patches are not linked by protected and mandatory wildlife corridors such unlogged buffer adjoining roads, retained unlogged buffers between coupes, streamside strips and wide corridors and fire refuges along all drainage lines*" but adds the same qualifier as above.

    In my opinion it is not sufficient to assume that existing filter strips and SPZs fulfill the role of wildlife corridors, this needs to be demonstrated by a dedicated statewide exercise in air photo interpretation, corridor mapping, refuge mapping and ground truthing. This has not been done.

67. **On P15 l)** In response to my statement that Corridor planning in logged forests is minimal and ad hoc and cannot be considered "precautionary" Dr. NItschke agrees "*that that explicit corridor planning is not evident in planning documents*; but claims that the work by Lindenmayer et al. (1993) *found that linear riparian strips were sufficient for maintaining GG provided HBTs were present. This suggests that riparian reserves (of appropriate width and containing HBTs and forage resources) likely provide connectivity. The dendritic patterns of streams and riparian areas provide connectivity from gullies to ridges and lowlands to uplands*. The study of Lindenmayer et al 1993 does not in any way provide support for the notion that existing riparian reserves are adequate as wildlife corridors as I have previously shown and discussed. In my opinion an assumption that riparian reserves "*likely*" provide connectivity is not scientifically rigorous and neither is it precautionary. If this is an area of uncertainty then it is a prime example of where application of the Precautionary principle, erring on the side of caution, is essential. A precautionary approach on this matter would assume that riparian strips are <u>not effective as corridors</u> until monitoring and scientific studies have shown that they are. A precautionary approach would consequently refuse timber harvesting or allow it to occur only after mandatory long term permanent corridors to a precautionary design (based on best available factual knowledge) have been put into place.

Part 3 Response to Mr Gunn Part 4 Response to Mr. Fagg

1. **Please review Mr Gunn's affidavit at [37]-[41]. Do you agree with Mr Gunn that "The majority of the time, the slash left in the coupe following harvesting combined with retained bark fuel and other retained fuels within the harvested area (e.g. understorey) would have a fuel hazard rating of more than high."? Please answer this question for selectively harvested coupes (applying the method of selective harvesting you recommend in your report), and separately for coupes logged by clearfell, seed tree, VR1 or VR2. a) If you have answered yes, for either selectively harvested coupes or those logged by VicForests' ordinary methods, is a regeneration burn the only way to reduce the fuel load to high or lower?**

   This is not my area of expertise but I note the following:

   - Slash levels will be much lower under selective harvesting because timber volume removed is 60% less and mostly sawlogs will be taken not pulp logs.

   - Tree heads could be removed from coupes, chipped and used for biomass or mulch to reduce ground fuel levels.

   - Under all other forms of silviculture slash can be windrowed or heaped and burnt to reduce fuel loads and remove any risk of damaging retained trees.

2. **Please review:**
   (a) Mr Gunn's statements concerning harvesting at certain coupes at [68]-[336];
   (b) the new HCV maps for Arena and Hole coupes (not previously provided to you) at JMG-37 and JMG-41;
   (c) the post-harvest maps and photos for Frankincense, Blue Streak, Barcelona, Lemon Lime, Arena, Glanworth, Hole, Groves Manna, the Falls, Shetland Carriage, and Walkindapark at JMG-25, JMG-32, JMG-34, JMG-36, JMG-38, JMG-40, JMG-42, JMG-43, JMG-45, JMG-47, JMG-49, JMG-50, JMG-52, JMG-53;
   (d) Mr Gunn's response to WOTCH evidence of damage to hollow-bearing trees, at [350]-[454], Mr Gunn's photographs of the Acheron coupes, Myrrh, Frankincense and Tense at JMG-25A, JMG-27, and JMG-65, and Mr Dodemide's site inspection report for the Acheron coupes at JMG-62;
   (e) the WOTCH photographs referred to by Mr Gunn in the above paragraphs at Enclosure Volumes 1.2, 1.3 and Supplementary 1.2 and 1.3 to our 30 June letter of instruction;
   (f) Mr Gunn's response to WOTCH evidence of intensive harvesting, at [474]-[480]; and
   (g) the WOTCH photographs referred to by Mr Gunn in these paragraphs at Enclosure Volume 1.3 to our 30 June letter,(8)

   Do any one or more of the above matters, whether considered individually or cumulatively, affect your opinion concerning the impact of, and approach to, harvesting at one or more of the Coupes, or the impact of VicForests' approach to harvesting at future coupes? I have reviewed documents in a) to c) above and find no new information that affect my stated opinions.

3. **Response to JMG 62**. This report states (para 1) "*In this field inspection no trees beyond the advanced regrowth growth stage were found that did not have noticeable butt scars, butt hollows, trunkor branch hollows which would have cause significant decay of the trunk of the tree, which would be evident in their stump if they were harvested.* The information provided in para 2 (large cut stump) is consistent with the tree being 1939 regrowth and may not have had hollows. However, if this tree is one of the larger in the stand then in my opinion it should have been retained as a recruitment tree for future hollows. I do not accept as reliable an assumption that trees with hollows can be identified from stumps.

4. Fallen dead tree. I am not convinced by arguments that this tree fell naturally given the large visible roots. Statements under fallen dead tree confirm my understanding and assumption that large trees considered "unsafe" are frequently removed by logging contractors, rather than being avoided and left, which is a more appropriated approach where trees with hollows are limiting or scarce. An argument is put that habitat tree retention was high in this patch but this may not be so when averaged across the entire coupe.

5. Response to JMG 38 Post Harvest Plan Arena. See my earlier reply at para 63.

6. Response to JMG 50. The coupe plan for Shetland Carriage has comprehensive requirements for marking and retention of a high density of HBT and recruitment trees (12/ha, see ninth affidavit of Mr. Gunn paras 277, 278). AT para 281 Mr. Gunn says " *I can see a number of retained trees have blown over, but the planned retention is above the target set in the HCV plan*" Mr. Gunn has provided no map or count of retained habitat trees to support this claim. My inspection of the post logging photo and plan suggests that the number of retained trees may be below specifications in the Coupe Plan.

7. **Mr Gunn's response to WOTCH evidence of damage to hollow-bearing trees, at [350]-[454], Mr Gunn's photographs of the Acheron coupes, Myrrh, Frankincense and Tense at JMG-25A, JMG-27, and JMG-65, and Mr Dodemide's site inspection report for the Acheron coupes at JMG-62;**
   I do not consider that I can comment usefully on this evidence because I have not inspected the stumps in question.

8. **Mr Gunn's response to WOTCH evidence of intensive harvesting.**

   Tense
   I find no evidence at 474 or in exhibit JMG-65 that would contradict a description of harvesting on this coupe as intensive logging with ffe retained habitat trees. The retained trees photographed appear to be very sparse and located on coupe edges.

   Blue streak. Mr Gunn states that 88 trees or 5.8 per hectare were retained. When I divide 88 trees by the stated logged area of this coupe (22h) I get a retention rate of 4/ha not 5.8. Mr. Gunn also states that 24 retained trees had blown over after harvesting. No estimate is made of how many trees were killed or weakened by fire, which based on photos (my second report para 52) could be most of them. Neither did he estimate how many of these retained trees are likely to fall over in subsequent years. If 22% blew over immediately after logging it could be that similar rates of fall will occur in following years.

9. **Question 3. Considering the material referred to above as a whole, does it affect your opinion concerning VicForests' approach to habitat tree retention or the impact of its harvesting practices on Greater Glider in your report? Q4. Please provide any other comment you wish in relation to Mr Gunn's and WOTCH evidence referred to above**.

   There is nothing new in this material which leads me to alter my initial conclusion the VicForest harvesting practices cause a severe short term and on-going long term decline in the density of HBT in State Forests, and that this will cause a severe short term and ongoing long term decline in the density and distribution of Greater Gliders. This is especially true because of VicForests HBT classification system which singles

out only, or predominantly, type 1 habitat trees for protection. These are very old trees that may not be preferred by Gliders, and which are least likely to survive over the long term or even a single harvesting rotation due to natural old age and susceptibility to windthrow, fire, and removal for safety reasons.

10. Mr. **Fagg Q1. Please consider the dot points titled "Slash burning – advantages" on p4 of Mr Fagg's report. Do you agree?** Most of this is outside my expertise. **Please provide any comments**.

    Mr. Fagg states "*Depending on the species, retained trees (for habitat or seed) may be killed, although this may not be a serious problem provided the trees remain standing. (The crowns of retained Mixed Species trees may also be scorched, but not killed, i.e. the trees will recover***.)"** I do not agree with this**,** killed trees decay rapidly and do not provide hollows for wildlife for as long as living trees and may also lack the thermal properties needed by Gliders for water and heat balance.

11. **Q2. Please consider the dot points titled "Mechanical disturbance – disadvantages'" on p5-6 of Mr Fagg's report. Do you agree?** Most of this is outside my expertise**. Please provide any comments**. I would have thought that obstructions to browsing by wallabies would be no greater in burnt landscapes.

    I have two major concerns with Mr.Faggs report in general. Firstly, it does not consider or allow for "natural regeneration" which is the normal form of regeneration in Mixed Species forests. Normal regeneration does not require either mechanical or slash burning. It occurs in small natural soil patches and gaps created by tree fall, or digging or litter scraping by wildlife, or after natural and control burns. This natural form of regeneration is perfectly satisfactory as evidence by the widespread recruitment of younger trees into Mixed Species forests. Secondly, Mr. Fagg has provided no statistics, data or discussion on the many failures in regeneration that are apparent and visible in some coupes when driving through logged state forests in Victoria. Regeneration failure is a risk not just to wood production but to wildlife that depend on forest regeneration. It is essential to have a better understanding of failure rates for different forest types and regeneration methods to properly assess impacts of timber harvesting on threatened species. Regeneration failure not only eliminates future habitat but may also create barriers to movement and dispersal. This is a further reason for mandating a precautionary wildlife refuge and corridor network system throughout all state forests, including those subject to low intensity single tree selection. Vic Forests needs to provide mapping data on regeneration failure.

12. **Q3. Please consider the response on p7 of Mr Fagg's report to the question on p6 regarding the risk that site preparation may pose to threatened species (or their habitat) in, or surrounding the coupes. Do you agree? Please provide any comments**. I have not examined or considered fire damage to surrounding unlogged forest. For the purpose of impact assessment I have assumed that there is none of great significance and that generally this is not an issue of great concern in Glider impact assessment. I have only considered fire impacts of on retained habitat patches and Habitat Trees within logged coupes, which can be severe.

13. **Q4a Please review the table in Mr Fagg's report titled "Report on VicForests' coupes numbered 1-66".**

(a) For each coupe where "BB" (Broadcast Burning) is one of the site preparation methods used or proposed in the third column, do you agree with Mr Fagg's answer in the seventh column to the question "is [such burning] appropriate given the risk to threatened species or their habitat in or surrounding the coupe", and his answers:

i. **for most coupes: "Yes. With retained habitat/seed trees, habitat islands, and the surrounding bush, the SP would pose minimal risk to such species"?**

ii. for Glanworth and Blue Streak coupes: "Probably. Some of the retained HBT and a habitat island, were burned, despite being trailed.", and for Myrrh coupe: "Probably – Despite some of the retained HBT being burned, despite being trailed."

iii. for Benefactor, Latrobe, the Shard, Nine Miles High coupes, "Probably yes. Little info provided to make a call."

In my opinion Mr Fagg has provided a simplistic subjective answer in column seven to the matter of risk to threatened species which is not supported by any facts or any referenced factual material or any accepted fauna impact assessment methodology. It does not take into account the age, type, refuge quality, habitat quality or corridor suitability of the "*surrounding bush*", temporal changes in habitat suitability, cumulative impacts of past or future logging in adjacent coupes, and generally appears to reflect a very narrow, limited and incorrect understanding of risks to threatened fauna from timber harvesting operations. Consequently, I have no confidence in, and place no value on any assessments relating to threatened fauna by Mr. Fagg.

14. **Q4b In relation to Triple Don coupe (proposed for selection harvesting):**

i. Do you consider the site preparation method "burn slash in gaps, only if needed" is appropriate for selection harvesting coupes? Yes, with the qualifications that "if needed" is an exception rather than a rule and that it occurs only occasionally where small patches (less than 10m by 10m) of deep slash are created and then only by cool hand (control) burning.

ii. Do you agree with Mr Fagg's response to the question "is it the only method available?" "Yes, as [rough heaping] is not appropriate for coupes where high stocking of trees remain?", for selection harvesting coupes? Yes.

15. **Q4c For each coupe in the table that you identified in your report as Mixed Species, which has "BB" (Broadcast Burning) as the site preparation method used or proposed, do you agree with Mr Fagg's response to the question "is it the only method available?" "Yes. RH would be unsuitable on this coupe (av. Slope 15 degree)" or 'Yes – as average slope (15 or 20 degrees) would prevent extensive RH"? i. Is burning the only regeneration method available on steep slopes at or above 15 degrees in Mixed Species forest?**
16. No. Both Dr. Nitschke and I are agreed that all Mixed Species should be harvested by low intensity selection logging (in order to comply with requirements for ecological sustainability) which is incompatible

with both BB and RH. This means that all regeneration in Mixed Species coupes will need to be by soil disturbance generated by equipment and activities associated with harvesting (which can be severe), or by unassisted natural regeneration which is the natural pattern in Mixed Species forest. In special circumstances (ie where there are localized small patches of high density slash that suppress regeneration of pose afire risk) by cool hand (control) burning of small patches (< 10m by 10 m).

17. **Q5. If selection harvesting is applied to Mixed Species coupes on slopes at or above 15 degrees, is burning required to achieve regeneration? Is mechanical disturbance an available method**? See above,,neither method is appropriate, limit regeneration to natural regeneration or regeneration on soils bared by felling and snigging activity.

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