



FLORA & FAUNA
GUARANTEE

FLORA AND FAUNA GUARANTEE - SCIENTIFIC ADVISORY COMMITTEE

PRELIMINARY RECOMMENDATION ON A NOMINATION FOR LISTING

Salvage Logging of Burnt Forests

(Potentially Threatening Process)

DOCID107-417469679-742

Dates of Consideration: 1 April, 29 April, 8 June, 5 Aug, 5 Oct, 18 Nov 2021, 21 Jan, 16 May, 30 June, 19 Aug, 21 Oct, 6 Dec 2022, 3 Feb, 20 March, 5 May, 19 June 2023.

Validity: The nomination is for a valid item.

Prescribed Information: The prescribed information was provided

Name of the Nominator is adequately provided

Name of the Item is adequately provided

In the opinion of the Scientific Advisory Committee (SAC) the Potentially Threatening Process (PTP) is adequately defined and described. The nominated process is defined as 'Salvage Logging of Burnt Forests'.

Eligibility for listing as a PTP under the Flora and Fauna Guarantee Act 1988

The SAC has assessed the eligibility of this nomination in accordance with Section 16C of the *Flora and Fauna Guarantee Act 1988* (the FFG Act) and the criteria for determining eligibility for listing prescribed in the Flora and Fauna Guarantee Regulations 2020 (FFG Regulations).

Process Information

Process description

Logging to 'salvage' economic returns from areas affected by natural disturbances has become increasingly prevalent globally. This is particularly true in forest landscapes where salvage harvesting of burnt stands is widely practiced to offset some of the economic losses that occur when high-quality merchantable timber is damaged by fire. Salvage logging is often justified on the assumptions that naturally disturbed areas have limited value for biota and that the impacts of logging are similar to the impacts of natural disturbance (Lindenmayer & Noss 2006, Lindenmayer & Ough 2006, Lindenmayer et al. 2012, Lindenmayer et al. 2021).

Post-fire salvage logging resembles clear-felling, but the disturbance order is reversed. Stands are initially burned by wildfire, then fire-damaged stands are clear-felled with all merchantable timber removed. The intensity of harvest and size and pattern of logged areas vary according to accessibility and fire intensity. On some occasions, regeneration burns, or mechanical site-preparation methods are used to re-establish eucalypt stands (Lindenmayer & Ough 2006). Post-fire salvage logging involves the removal of particular trees or components of burnt forest stands that are often more uncommon in the landscape, such as the largest trees, because of their economic value (Lindenmayer et al. 2012).

Ecological impacts

Post-fire salvage logging results in the immediate loss of vital habitat resources, disrupts natural processes of forest regeneration and reduces forest resilience. The mechanical disturbance of salvage logging damages surviving plants, soil and seed banks. It is a new type of disturbance that compounds the impacts of bushfire (Lindenmayer et al. 2021). Conditions that precede logging, conditions under which logging occurs, the type and characteristics of trees logged, and the logging practices applied may all differ between salvage logging and conventional logging. These differences can have important influences on the maintenance of ecosystem processes and biodiversity (Lindenmayer & Noss 2006).

Ecological impacts of salvage logging can be classified into two broad categories: impacts on habitats and species (including impacts on the physical structure of forest stands and aquatic systems) and impacts on key ecosystem processes (e.g. succession, hydrological cycles, nutrient cycling, and soil formation). They are often interrelated and can be additive or cumulative (Lindenmayer et. al 2012).

Habitats and Species

Patterns of ecosystem recovery are influenced by the types, numbers, and spatial arrangements of biological legacies remaining following wildfire. In burnt forests, biological legacies include intact patches of understory vegetation, large living and dead overstory trees, logs, and patches of unburnt or partially burnt forest. Biological legacies can be critical for biodiversity and influence the rate and pathway of post-fire recovery. Among the factors that make recently disturbed forests biologically diverse are a combination of surviving and pioneering species; diverse plant life forms and structures, which provide habitat for many organisms; high availability of light and moisture; and a variety of microclimates (Lindenmayer & Noss 2006). In the montane ash forests of Victoria, wildfires can promote the development of cavities in large trees which provide sheltering, nesting, and foraging sites for more than 40 species of vertebrates (Gibbons & Lindenmayer 2002). Similarly, wildfires may generate pulses of large fallen logs, and these have an array of ecological roles. The ecological benefits derived from large-scale disturbances can be lost or severely diminished by salvage operations for decades and even centuries (Lindenmayer & Ough 2006).

Post-fire salvage logging may have impacts on key elements of stand structure that are additive to those of traditional logging. For example, large trees killed in a wildfire can remain standing for over 50 years in an un-salvaged stand. Conversely, fire killed trees are more likely to collapse when the surrounding stand is logged, and the remaining slash is burned. In this case, two fires (a wildfire and a postharvest regeneration burn), in combination with harvesting impacts, create greater susceptibility to collapse than a single wildfire. Accelerated rates of tree loss create nesting-site shortages for an array of cavity-dependent vertebrates (Lindenmayer & Ough 2006). Loss of hollow-bearing trees from Victorian native forests is listed as a Potentially Threatening Process under the FFG Act (SAC 1991).

Prolonged droughts and high temperatures are typical before wildfires in some forest types, and these can exert strong influences on many species. Consequently, plants and animals are often under stress at the time of the disturbance and may not have recovered (or have the potential to recover) from the dual impacts of environmental stress and the disturbance before the salvage logging operations begin (Lindenmayer et al. 2012). Post-disturbance plant recovery can be changed by salvage logging, leading to altered composition of plant species and abundance of plant life forms. For example, seedlings that germinate following a wildfire may be damaged or killed by mechanical disturbance associated with salvage logging (Lindenmayer & Noss 2006). In addition, seed banks for many flora species may be activated following a wildfire but then exhausted if mechanical harvesting and/or a regeneration burn occurs soon after (Lindenmayer & Noss 2006).

Ecosystem Processes

Post-fire salvage logging occurs at a time when forest landscapes are most vulnerable to increased run-off, erosion and impacts on downstream water quality. For example, compared to long-undisturbed sites, mountain ash sites subject to compound disturbances consistently had the lowest values of a wide range of soil measures which affect ecosystem function and forest productivity (Lindenmayer et al. 2021). Salvage logging often impairs key ecosystem processes such as hydrological regimes, soil profile development, soil compaction and nutrient cycling. The time taken for catchment water yield to recover increases when post-fire salvage logging occurs and can cause long term reductions in water yield. The combined effects of wildfire and salvage logging can also cause large increases in run-off, erosion and nutrient loss compared to burnt unlogged forest (Lindenmayer 2021). In contrast to the natural recovery of a disturbed ecosystem, salvage logging has the potential to convert a relatively intact system to a strongly modified site in which ecosystem resilience is reduced (Lindenmayer & Noss 2006).

Decision by the Scientific Advisory Committee

The eligibility of the nominated PTP to be specified in the Processes List must be determined in accordance with the eligibility criteria prescribed for the purposes of Division 2 of Part 3 of the FFG Act. The relevant eligibility criteria are prescribed in Schedule 3 of the FFG Regulations, which provides that if a criterion is met, the PTP is eligible to be specified in the Processes List.

Criterion 1.1 *the potentially threatening process poses or has the potential to pose a significant threat to the survival of two or more taxa.*

Evidence:Fauna species

Thorn et al. (2018) conducted a meta-analysis across 24 species groups and found that salvage logging significantly decreases numbers of species of eight taxonomic groups. Richness of dead wood dependent taxa (saproxylic organisms) decreased more strongly than richness of non-saproxylic taxa. Lindenmayer et al. (2018) found evidence of a gradient in bird species richness from highest richness in unlogged and unburned sites (least disturbed sites), and lowest richness in the most disturbed sites (sites subject to salvage logging without island retention). All forms of logging on burned sites impaired recovery in bird species richness relative to sites subject to high-severity fire. Alterations in stand structure and plant species composition (and hence modification in bird habitat suitability) due to logging are the most likely reasons for reduced bird species richness and delayed patterns of recovery. These effects can be very long term with some species occurring only in the remaining patches of forest that are older than 200 years (Lindenmayer et al. 2021).

Post-fire salvage logging reduces the future availability of hollow trees. The impacts of the loss of tree hollows on fauna populations are therefore long term. The impacts of salvage logging are not confined to the immediate area logged, as there are impacts on populations of hollow-using animals at landscape scales. The declining abundance of large, hollow-bearing trees is leading to population declines in hollow-dependent species including the vulnerable Greater Glider (*Petauroides volans*) and the critically endangered Leadbeater's Possum (*Gymnobelideus leadbeateri*). Without intervention, the ongoing loss of hollow-bearing trees will also increase the extinction risk of other hollow-dependent animals (Lindenmayer et al. 2021).

The FFG Act listed (Vulnerable) Glossy Black-Cockatoo (*Calyptorhynchus lathami*) is found mostly in East Gippsland and the 2019-20 bushfires are considered to have impacted 64% of the bird's modelled habitat, with 26% impacted by high severity fires (State of Victoria 2021). Glossy Black-Cockatoos feed almost exclusively on certain *Allocasuarina* seeds and the impact of the bushfires on their food source is likely to be severe (State of Victoria 2020). Compounding this impact with post-fire salvage logging could have serious consequences for the survival of the species, not only through impeding the recovery of *Allocasuarina* stands, but through the loss of hollow bearing eucalypt trees, which the birds rely on for breeding.

The FFG Act listed (Critically Endangered) Southern Giant Burrowing Frog (*Heleioporus australiacus flavopunctatus*) is encountered rarely and inconsistently, and there is no certainty about population trends in Victoria. Although detection in Victoria is most common at or close to breeding sites, this subspecies has been found hundreds of metres from free water and riparian areas. Since so little is known of the use of non-breeding habitat by this secretive, burrowing frog (such as areas used for foraging, dispersal, and shelter), it is likely that these habitats are being inadvertently destroyed or degraded by human activities in forests, such as post-fire salvage logging (Clemann & Swan 2023). In early 2021, Clemann observed clear-fell salvage logging of Southern Giant Burrowing Frog non-breeding habitat (just upslope of pools containing tadpoles) at two sites in East Gippsland that had been severely burnt in the 2019-20 Black Summer fires (Clemann & Swan 2023). Forest-dependent threatened species such as Southern Giant Burrowing Frog, Watson's Tree Frog (*Litoria watsoni*) and Spotted Tree Frog (*Litoria spenceri*) are particularly susceptible to harm from both 'traditional' and post-fire salvage logging. Soil compaction and disturbance due to salvage logging likely detrimentally affects burrowing frogs such as the Southern Giant Burrowing Frog. When erosion control measures fail or are inadequate, increased loads of sediment entering water bodies can fill and destroy frog egg-laying sites. This salvage logging of recently burnt habitat is likely to accelerate and exacerbate losses of populations already compromised by disease and severe fires (Clemann & Swan 2023).

Clemann provided the following personal comments regarding the impacts of salvage logging on the Southern Giant Burrowing Frog:

During our reconnaissance work in East Gippsland during and immediately after the 2019-20 Black Summer bushfires, we surveyed streams and surrounding areas within fire affected forests and detected Southern Giant Burrowing Frog tadpoles within a small stream. Some months after our first visit to this area we returned to find much of the burnt area had been salvage logged. Trees and logs present after a fire are often the only shelter / refuges / habitat remaining for many vertebrate and invertebrate fauna and around this stream, these were what was making the difference between precarious persistence and outright loss of fire-affected populations. The salvage logging had removed large areas of standing burnt trees, and everything on the ground, including burnt logs, had been bulldozed into large piles. Most of the affected area was now just bare sand. When it rained, sand and ash washed into the tiny streams in the area, affecting water quality, infilling and burying rocks, cobbles and crevices and grossly affecting naturally occurring sand banks. These underwater and beside-the-water features are critical shelter and egg-laying sites for frogs, turtles and Water Dragons.

Since the salvage logging occurred, we have been unable to detect Southern Giant Burrowing Frog in this area. That does not necessarily mean the frog has been totally lost from the area, but I believe that the salvage logging certainly caused great harm to the subspecies, and local extinction is plausible. I believe that in the salvage logged

areas, the great majority of the fauna that were not directly killed by the fires would have been killed or displaced by the subsequent logging. The trees, stags and logs that are the essential building blocks of biological recovery after fire had been removed or bulldozed into large piles.

Flora species

Plant communities in post-fire salvage logged areas are likely to be dominated by a smaller suite of species (favouring taxa that are wind dispersed, have viable soil-stored seed remaining after salvage logging and regeneration burns, or have deep rhizomes) (Lindenmayer & Ough 2006). Fire triggers the germination of fire ephemerals from the soil seedbank. Many of these taxa are short-lived and persistence relies on post-fire seed set with the taxa then dropping out of the system until the next fire (e.g. *Irenepharus magicus*). Salvage logging threatens this process as the germinants may not reach reproductive maturity before the salvage logging disturbance event and so are unable to replenish the soil seedbank. Other long-lived taxa (e.g. *Persoonia arborea*, *P. subvelutina*) germinate post soil disturbance events such as fire or logging, but do not reach reproductive maturity for several years. The second disturbance event of salvage logging threatens the recruitment of these fire-killed taxa and the lack of replenished soil seedbank provides a threat to their persistence (Table 1). Bowd et al. (2018) found wet sclerophyll mountain ash sites that had been salvage logged supported no common persistent, resprout species (*Dicksonia antarctica*, *Polystichum proliferum*, and *Olearia argophylla*). The extent of the impact on plant communities will depend on the extent and intensity of mechanical disturbance to the site and if the salvage logging is followed by a regeneration burn (Lindenmayer & Ough 2006).

Table 1: FFG Act listed fire ephemeral flora species for which salvage logging has the potential to pose a significant threat to their survival.

| Common Name | Scientific Name | FFG Act Category of Threat |
|----------------------|-------------------------------|----------------------------|
| Toothed Lobelia | <i>Lobelia dentata</i> | Endangered |
| Alpine Stork's-bill | <i>Pelargonium helmsii</i> | Endangered |
| Violet Nightshade | <i>Solanum silvestre</i> | Critically Endangered |
| Kerrawang | <i>Commersonia dasyphylla</i> | Critically Endangered |
| Hairy Kerrawang | <i>Commersonia breviseta</i> | Critically Endangered |
| Papery Goosefoot | <i>Chenopodium erosum</i> | Endangered |
| Elusive Cress | <i>Irenepharus magicus</i> | Endangered |
| Ridge Flannel-flower | <i>Actinotus forsythii</i> | Critically Endangered |
| Lizard Orchid | <i>Burnettia cuneata</i> | Endangered |

Criterion 1.3 any other circumstance that demonstrates to the satisfaction of the Committee that section 16 applies to the potentially threatening process.

Evidence:

In addition to the direct impact of salvage logging on taxa of concern, the potential for salvage logging to mitigate or increase the risk of subsequent disturbances is also relevant. Leverkus et al. (2021) reviewed examples of where salvage logging altered the risk of further wildfire, insect outbreaks, flooding, major erosional events, mass movement events such as avalanches and landslides, windthrow, browsing and microclimate stress. They concluded that the degree to which salvage logging mitigated or increased the probability of further disturbances such as these likely varies in space, time and magnitude. Their key point is that the risk of subsequent disturbances due to the impacts of salvage logging will be highly contingent on local conditions (L Leverkus et al. 2021). These contingencies are consistent with the conclusion that salvage logging is a potentially threatening process under the FFG Act.

The potential to introduce *Phytophthora cinnamomi* (the causative agent of Phytophthora dieback: a state and nationally listed Threatening Process) through the process of salvage logging is possible; and the consequences on ecosystem recovery can be severe. *P. cinnamomi* can be introduced via spores on logging machinery and the subsequent soil disturbance that causes the development of pools of water where the spores can survive. Although there are mitigations (e.g. not introducing machinery from known *Phytophthora* localities) the introduction of spores from localities that are not known is possible.

Documentation

The published information provided to and sourced by the SAC has been assessed. To the best of their knowledge, the SAC believes that the data presented are not the subject of scientific dispute and the inferences drawn are reasonable and well supported.

Preliminary Recommendation of the Scientific Advisory Committee

As outlined above, the nominated PTP satisfies at least one criterion of the set of criteria prepared and maintained under Division 2 of Part 3 of the FFG Act and stated in Schedule 3 of the FFG Regulations.

The SAC concludes that on the evidence available, the nominated PTP is eligible for listing because Criteria 1.1 and 1.3 of the FFG Regulations have been satisfied.

The Scientific Advisory Committee therefore makes a preliminary recommendation that the nominated PTP be supported for listing under the *Flora and Fauna Guarantee Act 1988*.

Endorsement by the Convenor of the Scientific Advisory Committee**Date**


Dr. Michelle T. Casanova
Convenor

5 July 2023**References**

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