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# Making choices: prioritising the protection of biodiversity in wildfires

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## ABSTRACT

Biodiversity is in chronic decline, and extreme events – such as wildfires – can add further episodes of acute losses. Fires of increasing magnitude will often overwhelm response capacity, and decision-makers need to make choices about what to protect. Conventionally, such choices prioritise human life then infrastructure then biodiversity. Based on shortcomings revealed in the 2019–20 Australian wildfires, we propose a series of linked steps that can be used to identify and prioritise biodiversity assets (including their priority relative to other types of assets), enhance and implement their protection through planning and practice, and strengthen legislation to safeguard them.

**Keywords:** biodiversity, climate change, conservation, emergency response, fire management plans, prioritisation, sacred values, wildfires.

## Introduction

> '*The real problem is not just that of achieving a whole new attitude of responsibility, but of seeing this as possible, or even desirable*' (Wright 1968).

Global climate change is leading to marked changes in fire regimes and escalating the frequency of severe environmental disturbances, including catastrophic wildfires (Abatzoglou *et al.* 2019). In many cases, the magnitude of such fires exceeds the response capability of management agencies. In such situations, decision-makers must make urgent and fateful choices about what they prioritise for protection – and hence what they abandon.

Using the Australian Black Summer wildfires of 2019–20 as a case study, we review how biodiversity assets are considered by decision makers during fire, relative to other values, and then suggest how decision-making processes and legal frameworks might be improved. Although we focus on this single case, the issues are global in nature: increasingly, across the world, key biodiversity assets are being lost in extreme events (Kelly *et al.* 2020), at least in part due to low prioritisation accorded to those assets and insufficient obligations to protect them. The issues described in this paper are germane to other forms of crisis management, and we consider that biodiversity protection should be explicitly recognised and included within the basic functions of crisis response networks generally (Quarantelli 1988).

The Black Summer fires led directly to the death of 33 people (Filkov *et al.* 2020) and destroyed at least 3000 houses (Filkov *et al.* 2020), with estimated economic losses of approximately AUD 10 billion (Royal Commission into National Natural Disaster Arrangements 2020). These tolls are notwithstanding heroic efforts to save human lives and property as part of the operational response. Some efforts were also made to protect biodiversity; for example, emergency actions were taken to prevent looming fire from destroying the few remaining Wollemi pines (*Wollemia nobilis*) that occur in the wild. However, most biodiversity assets in the path of the fires were not actively

protected and the fires burnt approximately 10 million ha of native vegetation, damaged World Heritage areas, killed millions of wild animals, and caused the likely extinction of at least one species (Moir 2021) and the imperilment of hundreds of species (Gallagher *et al.* 2021; Legge *et al.* 2022*b*; Marsh *et al.* 2022). In some cases, actions taken to protect human life or property were not only undertaken in preference to actions for the protection of biodiversity, but those actions themselves (such as widespread use of back-burning, and bulldozing mineral earth containment lines) are likely to have caused at least some detriment to biodiversity.

A springboard for this paper is the formal review processes undertaken in the aftermath of these fires, a focus of which was to make recommendations on how to reduce the likelihood of future losses. The Royal Commission into National Natural Disaster Arrangements (2020) recognised that in an emergency setting with finite resources, there needed to be a consistent hierarchical approach to asset protection. It explicitly stated that in wildfire control operations, biodiversity protection was subordinate to other considerations:

> 'In responding to disasters, … emergency services agencies have primary responsibility for protection of people, property and the environment – they provide protection in that order.'

The Royal Commission did not challenge this deeply rooted hierarchy or reflect on whether there may be circumstances in which the risks of significant and irreparable biodiversity loss may justify prioritising that biodiversity ahead of other assets, such as human infrastructure. This hierarchy appears to be widely presumed and applied in many other emergency settings, globally (Kanowski *et al.* 2005; Boin and 't Hart 2010).

In contrast, a contemporaneous inquiry in New South Wales was more nuanced (Government of NSW 2020). It recognised that there was no system in place for determining or ranking priorities 'when multiple assets of value are threatened by fire and there are insufficient resources to protect them all', and concluded that:

> 'to avoid uninformed decisions during a fire event on what to protect, a formal mechanism is needed for working out in advance the relative value of different assets' (p. 149).

The New South Wales inquiry recognised some successful examples of the protection of biodiversity, such as the Wollemi pine, but posited some fundamental questions:

> 'But should the Wollemi Pine be saved at the expense of human life? And at the expense of houses, farms, towns and infrastructure? And why were the Wollemi Pines saved and not, for example, some other rare botanical species?' (p. 150).

The inquiry concluded that a more comprehensive approach was required to attribute value to assets of varying types and thence to prioritise them for protection, and that such a valuation and prioritisation system was challenging and required community support.

In this paper, we take up the challenge sketched by the New South Wales inquiry and consider how biodiversity assets can be more explicitly prioritised and thus protected in extreme events. In the sections below, we describe a framework that would improve protection for prioritised biodiversity assets in emergencies (Fig. 1). A fundamental premise of our response is that such a framework should be developed *prior to* wildfires (Boin and 't Hart 2010).

## Prioritising among biodiversity assets

The New South Wales inquiry lamented that there was no existing system for evaluating relative importance among different biodiversity assets. As a consequence, significant biodiversity assets were unprotected, in part because their 'relative value' was not defined or not known to decision makers leading the emergency response. Assigning relative value amongst biodiversity assets is challenging, given that there are many dimensions of value for biodiversity. However, for other purposes (such as the allocation of management resources and systematic reserve design), workable approaches for prioritisation have been developed based on such considerations as degree of imperilment, phylogenetic distinctiveness, contributions to ecosystem services, and cultural value (Pressey *et al.* 1993; Joseph *et al.* 2009).

A further critical consideration should be irreplaceability (Pressey *et al.* 1994): the extent to which an asset is either localised or has multiple occurrences, with prioritisation given to the former. Although the Black Summer wildfires were so extensive that they caused major population losses for many widespread species, impacts were most pronounced for some highly localised species, where fire impacts affected the entire population (Dorey *et al.* 2021; Gallagher *et al.* 2021; Moir 2021).

In the context of wildfires, prioritisation should also consider the susceptibility of biodiversity assets to individual fires and fire regimes (Gallagher *et al.* 2021; Legge *et al.* 2022*a*; Marsh *et al.* 2022), and the extent of their ability to recover without intervention (Legge *et al.* 2022*b*). Many species are fire-adapted but many are not. It is more important to protect a biodiversity asset that will not recover from fire (such as the sole location of a fire-susceptible threatened species) in preference to protecting one for which the likely impact of fire is transient.

We note it may be difficult to assign value and prioritise sites for the protection of poorly known species. For

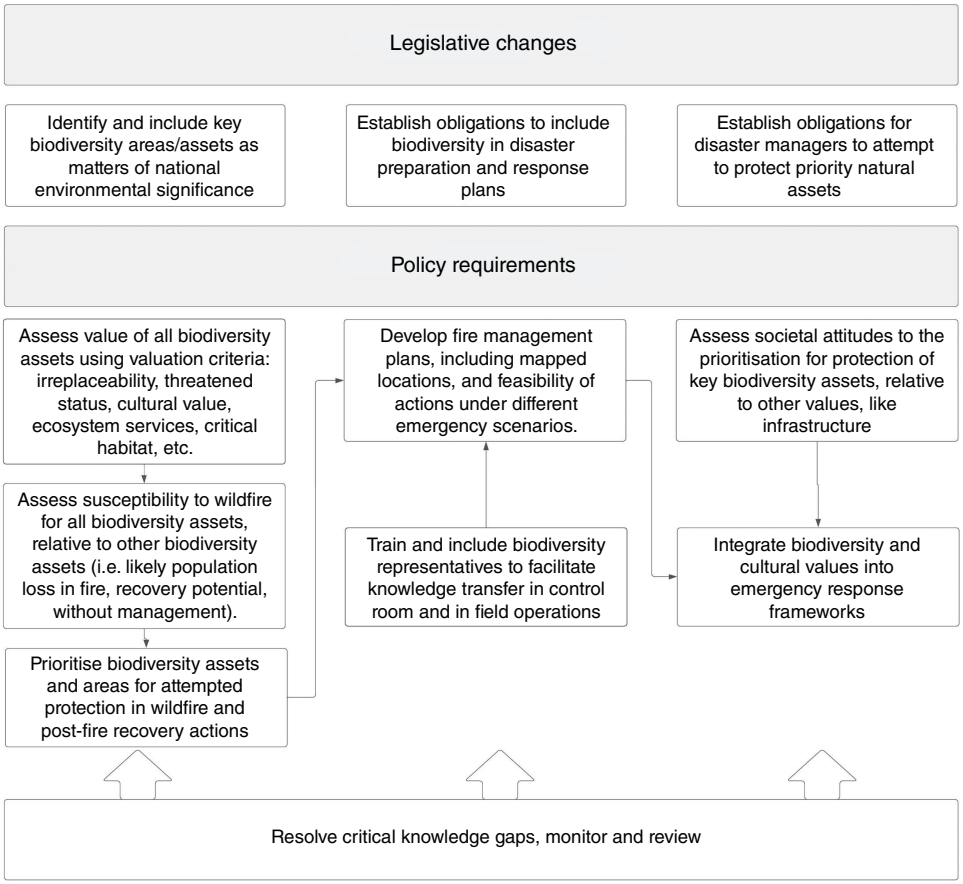


**Fig. 1.** Schematic diagram outlining the components and linkages required for enhancing the protection of biodiversity during a wildfire (or comparable major disturbance events).

example, susceptibility may not be well known for some species, especially in the context of wildfires that are more extreme than in the past. However, in the absence of evidence from studies of previous responses to fire, information on life history and other traits can be used to infer susceptibility (Gallagher *et al.* 2021; Marsh *et al.* 2022). Furthermore, many poorly known and imperilled species, including many that are likely to be fire-susceptible, co-occur at centres of endemism (Harvey *et al.* 2011). If we protect these critical sites from fire, many species may be saved; conversely, if such sites are burnt, many species may be lost (Marsh *et al.* 2022).

Knowledge shortcomings constrain many aspects of crisis management, not just fire (Boin and 't Hart 2010). With respect to the valuation and protection of biodiversity, these knowledge gaps include uncertainty about the way that many species respond to fire (Jolly *et al.* 2022) and hence the priority that should be accorded to their protection, as well as uncertainty about the efficacy of management responses. For example, during the Black Summer wildfires, managers undertook a rescue operation for a population of threatened eastern bristlebirds (*Dasyornis brachypterus*) that occurred in the fire's projected path. However, of the 15 birds that were captured, many soon died in captivity (in part due to lack of previous husbandry experience or recognition of risks) and only eight birds were re-released after the fire (Selwood *et al.* 2022). This example serves to illustrate that biodiversity protection during wildfires, or other comparable crises, may not be straightforward or without risks. It also shows that a more robust evidence base and appropriate recognition of uncertainty will lead to better decision making (Rumpff *et al.* 2023), as will training as part of contingency planning.

Freely available spatial decision support tools can be used to prioritise sites during emergencies, based on the distribution of 'high value' biodiversity assets (Moilanen *et al.* 2005). Such tools were used after the Black Summer wildfires to prioritise biodiversity recovery efforts (Geary *et al.* 2021).

Once key biodiversity assets have been identified, management plans should be developed that articulate feasible and cost-effective actions for them under varying fire emergency scenarios. This will help highlight which biodiversity assets or sites may be easy to protect and require few resources to do so, and where protection of others in an emergency may be an insuperable challenge. These plans are pre-prepared, such that when risks to key assets are identified, a ready plan for action exists if a decision is made to act.

The valuation system sketched here would have provided an explicit justification for prioritising the protection of Wollemi pine, at least relative to other biodiversity assets.

It is a Critically Endangered species of extraordinary phylogenetic significance, likely to be extremely susceptible to high-severity fire, and occurring at only a single site (therefore irreplaceable); protecting the population from fire was feasible. Furthermore, appropriate information outlining the need to protect the Wollemi pine during wildfire, and how this could be achieved, was available prior to the Black Summer wildfire in the species' recovery plan and in the fire management plan for the conservation reserve in which it occurs (NSW Department of Environment and Conservation 2006). The Wollemi pine example clearly illustrates the application of the criteria we describe for prioritising species for protection; however, its protection was a near-exceptional case. We are seeking here to provide a more formal and explicit approach that would apply to, and help protect, other biodiversity assets of value.

## Valuing biodiversity relative to other assets

Much more complex than relative valuation within the set of biodiversity assets is the valuation of biodiversity assets relative to human life and property. This task is complex and fraught. The issue of what to save in an emergency includes taboo trade-offs – forced choices that pit values that may be considered sacred, absolute and inviolable (such as a threatened species) against secular values, such as a house (Tetlock 2003). Even more formidable are tragic trade-offs, which pit one set of sacred values (such as human life) against another set, such as a species extinction (Tetlock 2003). Tragic trade-offs necessarily violate a moral principle no matter what choice is made, and their resolution will often result in greater moral conflict and less confidence in choice (Mandel and Vartanian 2008).

These are complex challenges but a range of established valuation techniques can provide guidance. Whereas the insurance industry can attribute explicit financial value (and hence a prioritisation) to human life and property, the value of biodiversity attributes is not quite so fungible. Nonetheless, monetary value can be ascribed to environmental services (Liu *et al.* 2010). Furthermore, social surveys have provided estimates for what the community is willing to pay to conserve biodiversity (Zander *et al.* 2022), and those values could be weighed against the cost of repairing or reconstructing infrastructure. Similarly, biodiversity 'crediting' processes associated with offsets suggest that biodiversity can be assigned a value that is legally defined and tradable (e.g. Division 2, *Biodiversity Conservation Act 2016* (NSW), empowering the relevant Minister to enter biodiversity stewardship agreements that support the creation and trade of biodiversity 'credits' or payments for management that benefits biodiversity).

However, notwithstanding such approaches that may allow for comparison of the financial value of biodiversity vis-à-vis infrastructure, such valuation is a solipsistic human construct. It can be argued instead that all species have a right to exist, and much more so than does, say, a shed (Heise 2016). Built assets may be readily replaceable and are insurable, whereas at least some forms of biodiversity loss cannot be recompensed or replaced. A large majority of people believe that extinctions should be prevented regardless of cost (Zander *et al.* 2021). Therefore, options that may result in the potential extinction of a species should not be countenanced as an acceptable trade-off: in an emergency setting, protecting a species that would otherwise become extinct should take precedence over any infrastructure.

Furthermore, the protection of biodiversity is exclusively within the remit of decision makers and cannot realistically be delegated. During the Black Summer wildfires, fire services issued explicit warnings to people in at-risk areas, to evacuate before fires reached them, and warned that fire fighters might be unable to assist them if they stayed. No such transfer of responsibility to potential victims of fire can be given to biodiversity.

These trade-off issues should not be left to decision makers operating under multiple pressures in an emergency setting. The issue of tragic and taboo trade-offs requires considered community input and should be explored and established in deliberative settings well before any emergency need. There are established mechanisms to do so: for example, best–worst scaling approaches can be used to gauge society's rankings of disparate assets (Zander *et al.* 2021). There are also precedents for societal consideration of comparable complex trade-offs. For example, studies have shown that communities are prepared to accept fire management practices that provide explicitly for protection of biodiversity, even if such practices lead to reduced effort allocated to protecting human life or property (Moskwa *et al.* 2016). More such studies are needed to provide a socially acceptable basis for the prioritisation of biodiversity vis-à-vis other assets, and thus to break the convention of always ranking biodiversity last.

## A more supportive regulatory and legislative basis

Choices about which priority biodiversity assets to protect in emergency settings should be clearly articulated (including their precise location and value) well before an emergency. The more location- and context-specific the instrument in which these priorities are articulated, the better the chances of implementation. For example, this could be in fire management plans, particularly where such plans are widely accessible, developed with an opportunity for public input, and are referred to during an emergency response. Although these plans may not be statutory (and therefore not strictly enforceable), they are specifically designed to articulate priorities, objectives, actions and zones for fire management, and provide a mechanism for guiding decisions made by incident controllers in emergency settings.

Other planning instruments may help to support the protection of biodiversity in emergency settings. For example, threatened species recovery plans (developed and implemented under environmental laws) typically provide information about the locations of key populations, susceptibility and management needs during and following any major disturbance. In the Black Summer wildfires, established plans that described actions to protect Wollemi pines were used to implement and justify rapid conservation interventions. However, in practice, many threatened species do not have recovery plans, and for those that do, few are fully implemented.

Failures in the protection of biodiversity during extreme events are consistent with broader shortcomings in Australia's conservation laws, and such laws have proven inadequate to arrest biodiversity decline (Samuel 2020). Improving conservation laws more generally could support the implementation of clear, explicit priorities for protecting biodiversity in fire management plans and enhance the protection of biodiversity during extreme events in four important ways. First, Australia's primary national legislation – the *Environment Protection and Biodiversity Conservation Act 1999* ('EPBC Act') – provides a foundation for recognising and conserving matters of national environmental significance. However, much of its operational focus is reactive, aimed at minimising the impacts of development proposals. It provides no explicit requirement for any person to attempt to proactively protect biodiversity values from catastrophic events, nor any guidance about how trade-offs between biodiversity and other competing values ought to be balanced, including in emergency response scenarios (McDonald and McCormack 2022).

The EPBC Act does provide a mechanism for protecting Critical Habitat, which *could* allow for a clear demarcation of locations essential for conservation, including as priority places for protection during wildfire. However, the Act gives the Minister a discretion (not an obligation) to declare Critical Habitat, and may only do so on Commonwealth land. Accordingly, very few designations have been made, and none were listed in the area affected by the 2019–20 wildfires. In contrast, under legislation in some states, notably that of New South Wales, critical habitat has been more widely designated. National legislative change is needed to increase the designation of Critical Habitat or comparable setting as a mechanism to create legal and spatially specific bases for prioritising biodiversity in an emergency response (Fitzsimons 2020). One such setting – established as a response to the post-wildfire inquiry (Government of NSW 2020) that identified as a failing the lack of formal identification and obligation to protect high biodiversity values – has been the recent amendment of the *National Parks and Wildlife Act 1974* to declare Assets of Intergenerational Significance for areas of exceptional natural or cultural significance that warrant and are given special protection, with required protective measures specified in fire management and other plans.

Second, there is a need to address the poor implementation, resourcing and enforceability of Australian environmental laws generally. Implementation and resourcing failures likely played a role in the low priority accorded to biodiversity in the Black Summer wildfires (Royal Commission into National Natural Disaster Arrangements 2020), for example through the failure to develop and implement threatened species recovery plans. Another example of resource allocation de-prioritising biodiversity relates to federal cost-sharing arrangements for fire-fighting. Unlike fire-fighting to protect human assets, fire-fighting costs incurred by state government agencies for environmental protection are not automatically eligible to be partially reimbursed under the Australian government's National Disaster Support, instead requiring specific approval by the Australian Prime Minister – and exceptional circumstances.

Third, there is a need to introduce accountability for actions or inaction that cause a species' extinction, such as deciding not to protect a site of high biodiversity value (Woinarski *et al.* 2017). There is no legislative requirement in Australian law for planners and emergency decision makers to seek out and consider biodiversity information, or to respond to an emergency in a way that protects biodiversity. In fact, emergency firefighting activities are typically exempt from conservation and many other laws (e.g. ss 124B and 124D of the *Rural Fire Service Act 1997* (NSW)). Legislative obligations to act in a way that prevents a species from becoming extinct, and that creates incentives to avoid extinctions, with mandatory public extinction inquiries and/or reports to Parliament following events, could support changes to fire management plans and policies that more readily provide and oblige protection of biodiversity. A further factor that influences the low prioritisation for protection of biodiversity in wildfires is its limited legal rights. For animals and plants, this shortcoming allows them to be relegated to a status of 'legal inferiority' (Best 2021).

The inquiries that follow major wildfires in Australia have so far not proven to be an effective way to achieve the accountability we describe here. These inquiries have created a risk-averse culture focused particularly on human life and infrastructure in emergency agencies (Eburn and Dovers 2017). These 'accountability' measures lead to decisions focused on risk aversion, blame avoidance and conservativism in emergency response decisions, and this necessarily favours human assets not biodiversity. Some form of legal mandate to consider biodiversity assets may be needed to shift entrenched practice and attitudes. For example, strong legislative language requiring decision makers to act on the advice of conservation managers could help address the low priority currently accorded to biodiversity in firefighting operations. Developing the detail of appropriate interventions will be an essential next step, once emergency managers accept the need to mainstream biodiversity conservation in firefighting decision making.

## Other enabling mechanisms

Our focus in this paper is on prioritising the protection of biodiversity in emergency settings, through more explicit valuation of biodiversity and enhanced legal support. Many others factors can be woven into this objective, particularly to help reduce the risks to biodiversity assets before and during emergencies and to support their subsequent recovery. These include pre-fire management to bolster resilience of key biodiversity assets (e.g. through translocations to establish additional populations, control of other threats, protective burning around the perimeter), and the establishment of funding and capability to allow for rapid post-fire remedial responses (Wintle *et al.* 2020; de Bie *et al.* 2021).

Inclusion of biodiversity expertise in decision making and incident teams can increase the likelihood that biodiversity values are recognised, and that they will be considered by decision makers (Inspector-General for Emergency Management 2020). As an example of this kind of institutional setting, Tasmania's emergency management arrangements establish a coordinated response to major fires (Tasmanian Interagency Fire Management Protocol), recognising that the conservation objectives of the state's Parks & Wildlife Service should be prioritised and adequately funded in bushfire planning and response, alongside the objectives of other relevant agencies (State Emergency Service 2018). This arrangement has been endorsed in post-fire reviews as an important way of ensuring that a full range of values – including World Heritage values – are considered and balanced in wildfire responses.

This paper was catalysed by the limited consideration of biodiversity in most post-fire inquiries that followed the Black Summer wildfires. The final important enabling mechanism is the requirement that such inquiries provide transparent assessments of successes and failures in protecting biodiversity, and compelling recommendations for improvements in legislation and management. It is rare for governments commissioning such inquiries to include Terms of Reference that are specific to biodiversity conservation, or to include biodiversity expertise amongst those appointed to lead these inquiries. This misses important opportunities to learn from failings and to build systems that can better protect biodiversity in future comparable events. It is also a deficiency that can be readily rectified.

## Conclusion

The agony of choice about what to protect during emergencies is becoming more pressing and consequential, as biodiversity further declines, human populations expand and climate change drives an increasing incidence of catastrophic wildfires and other disturbances. The Royal Commission into the Black Summer wildfires reinforced a long-held perspective that biodiversity protection is a dispensable discretionary priority in emergency settings, to be undertaken only after other values have been protected. We argue that this should not be so, given the significant value that society accords to biodiversity and the broadly agreed goal to protect species from extinction. Biodiversity loss affects us all – increasingly so because ongoing loss of biodiversity has pervasive consequences on our lives, health and prosperity.

As in crisis management generally (Boin and 't Hart 2010), we recognise that the approach we describe here may be overwhelmed by the unmanageable nature of some crises, especially as climate change ratchets up the magnitude of such events. Nonetheless, plans and processes that incorporate protection of priority biodiversity, and that are supported by society and underpinned by policy and legislation, are more likely to achieve conservation benefits than the current, largely *ad hoc*, approaches.

We were motivated to write this paper by the extraordinary losses of biodiversity that occurred in the Australian Black Summer wildfires, and the realisation that many of these losses may have been prevented. However, some biodiversity was saved, and substantial investments were made to support recovery of biodiversity after these fires. These are important precedents well worth celebrating. In the face of escalating catastrophes, we will increasingly need to consolidate, repeat and extend such efforts to secure and recover nature across the world.

To progress the framework we outline here, and enhance the likelihood of protection of biodiversity during wildfire or other crisis, we make the following recommendations.

1. The relative value of biodiversity assets and sites, and their need for protection, should be explicitly determined based on the criteria described above. This valuation should be informed by evaluation of society's relative prioritisation of biodiversity vis-à-vis other types of assets;
2. Priority research should address key knowledge gaps, including (i) information about species' vulnerability to and recovery from fire events and changing wildfire regimes, and (ii) distributional information and location of key sites for poorly known biodiversity;
3. Fire management plans and other fire-specific planning instruments should include explicit mapping of biodiversity values and clear and explicit priorities for biodiversity protection during emergencies (with this planning underpinned by legislation; Step 6 below);
4. Fire-fighting to protect biodiversity should be automatically eligible for cost-sharing arrangements among different levels of government, in the same way as fire-fighting to protect other assets;
5. Incident control teams established to coordinate responses to a wildfire should routinely include a biodiversity expert to ensure that wildlife and other

ecological values are understood and considered in fire-fighting strategy;

6. Systemic shortcomings in biodiversity conservation laws must be addressed, including to ensure that: compliance with these laws is fully resourced and implemented; that they (i) accurately identify and provide explicit protection to the highest priority biodiversity sites; and (ii) that conservation obligations apply equally in emergency settings (as a catalyst for implementing recommendations 3–5); and
7. The extent to which significant biodiversity assets were protected during wildfire events, and factors influencing such outcomes, should be monitored and reviewed following fire (e.g. as an explicit component of formal government inquiries), and processes subsequently refined to improve performance and outcomes.

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