MONITORING WILDLIFE RECOVERY

BUSHFIRE EXPERT BRIEF

JULY 2020

Australian Academy of Science

OVERVIEW

- The bushfires of summer 2019–20 had a devastating impact on Australian wildlife
- 37 ecological communities classified as 'threatened nationally' have been affected
- Policymakers should take this opportunity to reinvest substantially in terrestrial biodiversity monitoring
- Data from immediate and continued monitoring efforts will need to be transparent and shared to maximise effective management

Bushfires are often seen as destructive because of their impacts on lives, property and wildlife. However, in Australia they are often part of a cycle of disturbance and renewal. Some Australian bushland experiences fire on a periodic basis, with or without human intervention, and many native plants and animals have traits that allow them to survive and thrive after a fire has passed. Sometimes these cycles may be managed, such as in the burning regimes of Traditional Owners or government land managers, but too often they are unmanaged or inappropriately managed.

BACKGROUND

The 2019–20 bushfires far exceeded the normal extent of bushfires in Australia. Ecosystems burned that had never or rarely been subjected to fire before[1]. Other areas experienced repeated burns that destroyed new growth before it was able to fully replenish and recover. Some areas were burned more severely than usual, reducing the capacity for regrowth[2]. This has challenged the resilience of ecosystems, even those where fire is regular[3]. Actions taken during the fires managed to preserve some species, such as the Wollemi Pine and Stocky Galaxias (see box: Threatened species rescue missions), but the priority was necessarily on protecting human lives and property.

The fires represented an additional challenge to environments already suffering from an extended drought. Several species may be classified as having a higher threat level under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) because of the fires. It is therefore necessary to monitor these species to determine the impacts of the fires, to determine the change in these species' extinction risk, and to provide the necessary evidence base to direct rescue and recovery efforts.

This Australian Academy of Science evidence brief summarises the impacts of the 2019–20 bushfires on threatened species and communities and considers the impact of the fires on biodiversity monitoring.

WHAT IMPACTS DO BUSHFIRES HAVE ON WILDLIFE AND HABITATS?

Much of Australia's biodiversity is currently in decline; almost 2000 species and ecological communities are listed as threatened under the EPBC Act[4]. The actual number of biota at risk of extinction is likely much higher, as the list is biased towards vertebrate animals and certain types of plants.

The impact of the 2019–20 bushfires on these species and communities was, and is, incalculable. Credible assessments based on estimated species densities suggest that more than a billion vertebrate animals were killed in the fires[5]. The fires affected the ranges of species already identified as threatened and at risk of extinction, and of species that are not currently listed that will likely qualify for listing as a result of the fires. In some cases, the only known populations of threatened species were within fire-affected areas, and it is not yet known whether these species survived. A small captive group of an endangered species, the Australian smoky mouse, succumbed to smoke inhalation from fires more than fifty kilometres away, meaning the impact of the fires on wildlife might be more severe and widespread than first thought[6].

While it is often said that Australian bushland is adapted to bushfires, its component ecosystems are each adapted to particular patterns and types of fire rather than fire *per se*. Abrupt changes in fire regimes—specifically, more frequent and more intense fires—can make vegetation communities vulnerable to collapse[2,9]. Successive and frequent challenges to an ecosystem, including repeated fires but also other

challenges such as drought and habitat clearance, reduce its resilience and capacity to respond. In turn, an ecosystem suffering multiple challenges will lose the capacity to support populations of animals and plants, increasing the risks to these species.

THREATENED SPECIES RESCUE MISSIONS

Wollemi Pine[7]

The Wollemi Pine (*Wollemia nobilis*) is one of the world's oldest and rarest plants, and the only known natural stand of these trees is in an undisclosed location within Wollemi National Park in New South Wales. They were thought to be extinct until discovered in 1994.

During the bushfires, an environmental protection mission by the NSW National Parks and Wildlife Service and the NSW Rural Fire Service used fire retardant and water-dropping helicopters to reduce the impact of fires, while specialist fire-fighters set up an irrigation system. Although some trees were burned, the stand is expected to survive in the wild.

Stocky Galaxias[8]

Stocky Galaxias (*Galaxias tantangara*) is a fish species listed as critically endangered by the International Union for Conservation of Nature (IUCN), but which has not been formally assessed under Australian EPBC Act legislation. It is only known to exist in Tantangara Creek in Kosciuszko National Park. While it was not clear that the fish would be impacted directly by the fires, heavy rains could wash ash and debris into the creek, imposing a serious threat.

Ahead of a forecasted downpour, University of Canberra scientist Mark Lintermans led a rescue team to stun the fish using an electric current, catch the fish, and transfer them to a temperature-controlled hatchery. The fish will be returned to Tantangara Creek when conditions are suitable, or used in a breeding program.

Mammals, birds, reptiles and other vertebrates respond to bushfires in different ways. Despite the large estimates of mortality, individuals of many species may survive to replenish their populations. Some mammals, birds and reptiles survive by taking shelter in rivers, holes and burrows, avoiding the worst and most intense fires as the fire front passes. Survivors must then contend with the lack of shelter and resources in the burnt environment, particularly if remaining shelters such as fallen trees are removed. Survivors of some species are at increased risk of predation, particularly by introduced invasive species such as foxes and cats.

River-associated species such as aquatic invertebrates, some frogs, and fish are affected by environmental stresses. Burnt riverside forests can no longer provide shade, leading to warm water stressors[10]. Rains wash ash into rivers, choking fish gills, smothering food supplies, and providing the nutrients that fuel harmful algal blooms. Increased erosion from areas with fewer trees and other plants leads to additional sediment in river systems, filling gaps and water holes where species shelter and breed.

Patterns of recovery after fires usually show regrowth of burnt plants and recolonisation of bushland species. Plants regrow from seeds in the soil or dropped from plants' crowns, or from the resprouting of surviving plants. Recolonisation comes from unaffected populations outside the burnt area, or from surviving populations in refuges within the burnt area[11].

The 2019–20 Australian bushfires were particularly damaging due to their very large extent (meaning the borders with unburnt land were further away from affected populations) and intensity (meaning fewer survivals and fewer refuges). In addition, the bushfires affected many ecosystems that do not regularly experience fire, and such ecosystems are unlikely to have characteristics that allow them to recover rapidly. This means that while recovery will still happen, the overall pattern of recovery across all affected areas will be different from previous fires and will likely be slower and less complete. Recovering ecosystems will continue to be vulnerable to additional challenges, including future fires and other threats, well into the future.

On 19 February 2020, the Department of Agriculture, Water and the Environment (DAWE) released an initial list of threatened ecological communities which had more than 10% of their estimated distribution in areas affected by bushfires in southern and eastern Australia between 1 July 2019 and 11 February 2020[12]. Preliminary results indicate that of the 84 nationally listed threatened ecological communities, 37 have some of their estimated distribution within the fire extent, and 7 have a large proportion of their range affected (more than 30%). These estimates are preliminary assessments based on pre-fire assessments of community distribution and need to be supplemented by on-the-ground surveys, which are being undertaken as a priority.

WHAT BIODIVERSITY MONITORING PROGRAMS ARE THERE, AND HOW WERE THEY AFFECTED?

Monitoring is essential for halting biodiversity loss, maintaining threatened species populations, determining responses to threatening processes, and evaluating management effectiveness[13]. A 2019 survey found "marked inadequacies" in Australia's extent and quality of monitoring for threatened species; one in four threatened vertebrate taxa

were not monitored at all, and monitoring quality across nine metrics was generally low[14]. Listing of a species under the EPBC Act does not trigger a formal requirement to monitor that species. Where monitoring of a threatened species occurs, it is usually part of a species-specific program carried out by government (commonwealth, state or territory), or academic or non-government organisations. Monitoring programs are often not well coordinated, even across species in the same area when it would be appropriate to do so.

DAWE is responsible for administration of the EPBC Act, including maintenance of the List of Threatened Species. DAWE also maintains recovery plans for threatened species and other instruments of the Act.

The National Environmental Science Program (NESP) is a long-term program of environmental and climate research supported by DAWE. One of its six research hubs is the Threatened Species Recovery Hub, which supports management of threats and improving recovery of threatened species. The Threatened Species Recovery Hub encompasses a wide range of research activities that identify and address risks to threatened species. The fires impacted NESP by disrupting research and recovery efforts for threatened species, and rapidly and radically altering threat profiles for many species. Although the Threatened Species Recovery Hub will not continue under the successor program, NESP 2, its functions are to be distributed among the four NESP 2 hubs.[15]

In addition to these major programs, additional monitoring and research takes place through universities and research centres, land management organisations, environmental groups, state and territory government programs and other organisations. This monitoring is rarely long term because of resource constraints.

WHAT SHOULD WE DO NOW?

Despite the devastation, the disruption of the bushfires offers an imperative to greatly improve monitoring of threatened species and ecosystems. Efficiencies can be gained by ensuring that monitoring programs are integrated with statutory instruments such as Recovery Plans and Threat Abatement Plans under the EPBC Act, and that these plans are effectively implemented.

Immediate monitoring—already begun by DAWE in conjunction with other organisations and researchers but restricted by safety concerns and interrupted by the COVID-19 outbreak—is necessary for prioritising actions to recover affected species and ecosystems. Initial assessments of high-level remote sensing data, coupled with extant information about threatened species and their response to fires, will provide direction for immediate recovery efforts. The priority should be on species at immediate risk of extinction; on 20 March 2020, DAWE released a provisional list of animals requiring urgent management intervention, including 17 bird, 20 mammal, 23 reptile, 16 frog, 5 invertebrate, 22 spiny crayfish, and 16 freshwater fish species[16].

Intermediate-term monitoring should follow these recovery efforts, examining the impacts of the fires and the effectiveness of crisis interventions. Ideally, monitoring should span multiple fires over prolonged periods, including before-and-after studies and contrasts with unburned areas. Studying species and ecosystem recovery pathways will inform disaster response plans, ensuring that the response to the next major fires can be well coordinated and well directed. Given that further bushfires of the same scale as the 2019–20 events are likely, it will be greatly beneficial to have strategic, well-communicated response plans to allow direct, purposeful action in crisis situations. It must be noted that some future fires will affect different areas to those burnt in 2019–20; baseline monitoring and strategic planning must be nationwide, rather than focusing solely on at-risk or already affected areas.

There should also be a rapid assessment and reassessment of the conservation status of affected species and ecological communities, to ensure that monitoring programs reflect the needs of vulnerable species. The Threatened Species Scientific Committee has prioritised such assessments in a fire response action plan that has been approved by the Minister for the Environment. Nonetheless, the committee's capacity to undertake this work will be compromised by the travel constraints resulting from the COVID-19 pandemic, which is seriously limiting immediately necessary on-ground monitoring.

Long-term monitoring should then move towards maintaining a knowledge base to inform the protection of species under the EPBC Act, and other species and ecosystems considered at risk. Monitoring will be most valuable if it is coordinated at the ecosystem or regional level and includes habitats as well as species of conservation concern.

As the purpose of monitoring is to inform protective and maintenance actions and to gauge the effectiveness of these actions, it is important for data collected under these monitoring programs to be transparent, consistent and accessible to facilitate access by researchers and program directors and to allow reuse across research and conservation programs[17,18].

Ensuring that post-fire biodiversity monitoring is well designed across sites which have been subjected to various levels of fire (including unburnt sites) and other disturbance and has appropriate statistical power to detect trends should improve understanding of the impacts of bushfires and allow better conservation planning to protect threatened species and ecosystems.

This approach will require considerable ongoing investment. The 2019–20 fires should be a catalyst to improve the monitoring of Australia's globally significant terrestrial and freshwater biota.

REVIEWERS

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