

State agency responses to support biodiversity recovery following the 2019–20 wildfires

Daniel J. Rogers, Rachael Alderman, Sarah Barrett, Anne Buchan, Allan H. Burbidge, Tracey Churchill, Sarah Comer, Rosemary Gales, William Geary, Carl R. Gosper, Mark S. Harvey, Jason Higham, Steve Leonard, Hannah Lloyd, Lisien Loan, Manda Page, Tania Reid and Ian S. Walker

Summary

- The wildfires that occurred in 2019–20 affected Queensland, the Australian Capital Territory, New South Wales, Victoria, Tasmania, South Australia and Western Australia. During these fires, relevant land management agencies rapidly mobilised to support management and recovery of biodiversity.
- There were some shared themes that facilitated state agencies to respond appropriately at the landscape scale to wildlife and habitat recovery. These include having collated and accessible information to support decision-making on the distribution, abundance, temporal trends, ecology, and threats to species and ecosystems; the development and maintenance of internal agency technical capacity and capability to guide and support on-ground action; and having the ability to draw on external expertise and partnerships to rapidly develop inclusive and well-informed response plans.
- Key challenges that now form lessons for the future include developing and implementing emergency response plans and strategies that more effectively coordinate across stakeholder groups; continuously improving policies and frameworks that more effectively manage conservation priorities before, during and after wildfire events; and further developing the knowledge, capacity, planning and partnerships required to meet the challenge of conserving biodiversity with the ongoing influence of climate change on wildfire events.

Introduction

The wildfires that occurred over the summer of 2019–20 affected every state and territory, except the Northern Territory (Table 23.1). The scale of these fires was nationally and globally significant, both for their impact on the human communities affected and for their impacts on the wildlife, threatened species, ecosystems and natural values within the

Table 23.1. Fire extent area per jurisdiction during 2019–20 in southern and eastern Australia (as at 28 April 2020).

This is known as the 'Preliminary Analysis Area' (Chapter 1), which enabled national analysis and evaluation of the potential impacts of the fires on wildlife, plants and ecological communities, and appropriate response (DAWE 2020). Fire extent area calculations for this national dataset can differ from fire extent areas in state and territory agency datasets as a result of using different methodological approaches to mapping fire extent and classifications of fire types (e.g. wildfires v. prescribed burns).

Jurisdiction	Fire area ('000 ha)
Australian Capital Territory	90
New South Wales	5682
Northern Territory	0
Queensland	574
South Australia	313
Tasmania	45
Victoria	1583
Western Australia	2044
Total	10 331

fire extent. What was also significant about these fires, however, was the response of the Australian and global community in wildlife recovery efforts, including that of government agencies, non-government organisations (NGOs), researcher institutions and others.

State and territory environment and land management agencies played complex and multiple roles in the response to the wildfires, and in the efforts to support short- to medium-term recovery of threatened species, ecosystems, habitats and natural values impacted by the fires. These agencies have key responsibilities in ensuring the protection and conservation of native biodiversity, are often responsible for the management of the public protected area estate (national parks and other conservation reserves), and are frequently a key (though not always primary) agency responsible for fire management and fire emergency response. This often applies personally to regional agency staff and parks rangers, who may be part of agency or volunteer fire fighting teams, and members of the affected communities themselves. The application of such complex and comprehensive roles during and after the wildfires meant that agencies were required to rapidly reprioritise their capacity and capability, and rapidly enable existing partnerships, towards the response and recovery effort required to mitigate the risks to environmental and community values.

This chapter shares the experiences of state environment agencies with respect to the impact of the wildfires on wildlife, and how we responded. This is by no means an attempt to be comprehensive, or review what worked or did not (see Chapter 29). Rather, we hope that our individual and collective experiences of the 2019–20 wildfires provided us with an opportunity to learn from one another, and to adapt our responses in the future.

State and territory accounts

Queensland

In south-east Queensland, over 7 million ha in total burnt during the 2019–20 wildfires (https://www.qra.qld.gov.au/sites/default/files/2020-08/2019_qld_bushfires_recplan_2019-20_lr.pdf; 574 000 ha classified as emergency bushfire areas in southern and eastern

Australia; Table 23.1), including important habitats for over 640 threatened species (Fig. 23.1). The Department of Environment and Science (DES), through the Queensland Parks and Wildlife Service (QPWS) had to immediately close many parks to the public until access could be made safe. Aside from visitor safety, immediate post-fire work included enabling access for post-fire ecological assessments and action to support the impacted fauna and flora.

To prioritise recovery efforts, DES led a process to analyse the spatial overlap of fire extent with the predicted distribution of biota classified as threatened under the Queensland *Nature Conservation Act 1992*. While impacts were identified state-wide, the focus was on southern Queensland, due to the preceding severe drought, and to align with the scope of emergency support from the Australian Government's bushfire recovery package for wildlife and their habitat. The information was evaluated to prioritise the threatened species and identify key threats to recovery, by a quickly assembled panel of experts from across DES (QPWS and Science and Technology), the Queensland Museum, Queensland universities, non-government conservation organisations, and other partners. The outputs were cross-checked with a broader assessment undertaken by the Australian Government for species listed as threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. This process reinforced existing scientific networks and fostered new partnerships, which will serve to streamline ongoing efforts to protect threatened species in Queensland.

DES established a process to map fire severity in detail, helping to identify optimal locations for species' surveys and the targeted control of weed and pest animal threats. An innovative method was developed to integrate fire severity mapping with expert



Fig. 23.1. Main Range National Park in the Gondwana Rainforests of Australia World Heritage Area was extensively burnt in the 2019 fires, and included temperate rainforests at altitudes over 1350 m. (Photo: Robert Ashdown/Queensland Government)

knowledge of vegetation community fire tolerance and threats to post-fire recovery, termed the 'Potential Ecological Impact' (PEI). PEI mapping helps identify areas, within ecosystems, likely to be most severely impacted that may require increased resources (e.g. pest management), or altered management approaches (e.g. modification to planned burn program) to enhance recovery (see <https://parks.des.qld.gov.au/management/programs/fire-management/post-bushfire-evaluation>). This new technique will enable faster post-fire assessments in the future and deliver richer ecological insights into fire impacts to guide park management decisions.

The subsequent threatened species recovery program (The State of Queensland (Queensland Reconstruction Authority) 2020) supported the recovery of 53 threatened plant and vertebrate species, alongside priority invertebrate species, across the Queensland sections of the Gondwana Rainforests of Australia World Heritage Area, and Great Sandy, Oakview and Bulburin national parks (<https://www.qld.gov.au/environment/plants-animals/conservation/bushfires-threatened-species-recovery>). These species include short-range endemics representing ancient lineages that are now of increased conservation concern, particularly in the face of climate change projections including increasing fire frequency and intensity. The recovery program has enhanced the ecological data available for the priority species, and highlighted the critical need for baseline data on threatened species to meaningfully assess post-fire impacts and to track recovery. It helped establish a survey protocol for multiple species in response to an unprecedented fire event. The ready availability and collaboration of ecological experts was essential to rapidly prioritise species, undertake urgent field surveys, produce habitat models, interpret results, and guide management actions. This work has also enhanced engagement with First Nations people and built capacity to manage the ongoing threats to key biodiversity values, including culturally significant species.

New South Wales

Following the 2019–20 wildfires, ~5.4 million ha (7% of the entire state) were impacted, including damage across 37% of our national parks. The scale of the emergency response was unprecedented (Fig. 23.2). Within the NSW Government, a taskforce was established to coordinate efforts. The Saving our Species program (<https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/saving-our-species-program>) led the threatened species response. The staff from the National Parks and Wildlife Service fought fires on the front line and implemented large-scale pest and weed control actions to protect species. This involved comprehensive prioritisation across bushfire affected regions and on-ground assessments, research and monitoring into the effects of the fires on threatened species, populations and communities. NSW Government scientists undertook critical work mapping and analysing impacts on threatened species. Community groups, volunteers and NGOs, including the wildlife rehabilitation sector, provided essential support. Corporate and community sponsors also had an important role. For example, Woolworths, Foodbank and WWF-Australia donated food resources for emergency wildlife food supplementation (see Chapter 24). The Australian Government provided funding support for immediate and medium-term recovery actions.

In January 2020, the former Department of Planning, Industry and Environment (DPIE) released its Wildlife and Conservation Bushfire Recovery Immediate Response (DPIE 2020). The document included several immediate response actions including: supplementary food, water and shelter; seed banking and insurance populations; feral animal and weed control; survival, recovery and regeneration; and supporting wildlife carers.



Fig. 23.2. NSW National Parks and Wildlife Service staff work to support the recovery of species in difficult post-fire conditions. (Photo: Alex Pike/Saving our Species/DPE)

Many affected species and communities in NSW will take years to recover. To support this recovery, the ongoing work of Saving our Species aims to maximise the number of threatened species secure in the wild in NSW. The NSW Government's medium-term response plan (DPIE 2021a) outlines a suite of focus areas such as undertaking evidence-based planning, improving knowledge, undertaking intensive interventions, conducting long-term monitoring, and enhancing community collaboration, including with Aboriginal communities.

Immediately after the fires, NSW Government staff undertook a desktop assessment of all impacted threatened species through mapping and some on-ground assessments (DPIE 2020). On-ground efforts focused on providing supplementary food, water and shelter to threatened animals, undertaking feral animal control, securing insurance populations for plants and animals, and supporting wildlife carers with \$1 million in emergency funding. Survey and monitoring work also commenced to help understand the impacts and species responses to fire. In 2019–20, Saving our Species developed more than 170 fire response plans for threatened species and ecological communities, and supported over 200 species and ecological communities at over 330 sites with over 470 post-fire conservation actions adopted and implemented (DPIE 2021b).

While critically important, the emergency response was just the first step in an ongoing recovery effort that requires critical actions to be implemented over longer time scales. In 2020–21, Saving our Species undertook around 200 post-fire actions for more than 90 species. Significant recovery projects are now underway, supported by the Australian Government. This includes targeted threatened species projects across priority fire-affected regions. Key actions in this phase include seed banking and captive breeding, feral animal

and weed control, and habitat restoration. Insurance populations have been established for a range of impacted species including the Manning River helmeted turtle (*Myuchelys purvisi*), southern corroboree frog (*Pseudophryne corroboree*), regent honeyeater (*Anthochaera phrygia*) and Bellinger River snapping turtle (*Myuchelys georgesi*).

Now 2 years after the fires we can reflect on the factors that have been important to an effective response. Prior to the wildfires, Saving our Species had established projects to secure over 400 species and ecological communities. These existing projects put New South Wales in a good position to understand, and respond to, the needs of threatened species during and after the wildfires. The adaptive management framework and resourcing allocation process for emergencies and large environmental events has also been reviewed, with a focus on continuous improvement. Saving our Species is the centrepiece of the NSW Government's strategy to secure threatened species in the wild. Alongside the NSW Koala Strategy, it is the largest commitment to threatened species conservation in our state's history. These dedicated resources for threatened species are essential to building species resilience and enabling a rapid response to future fires.

Australian Capital Territory

The 2020 Orroral Valley wildfire burnt more than 80% of the ~100 000 ha Namadgi National Park and over 20% of Tidbinbilla Nature Reserve – both listed on Australia's National Heritage List. Namadgi National Park is also the primary water supply catchment for Canberra.

The fire affected nationally threatened bogs and fen communities in the Australian Capital Territory, resulting in losses of the threatened broad-toothed rat (*Mastacomys fuscus*), the two-spined blackfish (*Gadopsis bispnosus*) and the montane spiny crayfish (*Euastacus rieki*). The loss of vegetation and ground cover as a result of fire greatly exacerbated the impacts of two unprecedented rain events in the following year. The increased volume and intensity of run-off destroyed infrastructure and habitat, and mobilised large amounts of sediment through the Australian Capital Territory's primary water catchment.

The ACT Government, through its Bushfire and Flood Recovery Plan 2020 (Environment, Planning and Sustainable Development Directorate 2020), committed to restoring the park's natural and built environment. The ACT Government also committed increasing resilience through the 'build back better' principle, working with Canberra's communities and Traditional Custodians to restore the park's health and wellbeing. This plan involved the development of a report from the Rapid Risk Assessment Team (ACT/NSW Rapid Risk Assessment Team 2020), which identified immediate post-fire recovery priorities, focusing on mitigating immediate risk to park and rural land, removing dangerous trees, restoring access, controlling invasive species, and protecting the Australian Capital Territory's water supply.

Longer-term responses involved monitoring broader trends and drivers like climate change, as well as actions to support the recovery of the natural landscape, built infrastructure and local community. The plan supports actions to control invasive plants and animals; protect threatened species; support catchment rehabilitation efforts and protect water quality; manage and monitor erosion; manage impacts and threats to cultural heritage; consider climate change adaptation and mitigation measures; restore infrastructure including roads, walking tracks, signage, bridges; and assist local landholders. The website https://www.environment.act.gov.au/ACT-parks-conservation/bushfire_management/recovering-from-the-2020-bushfires contains further information on the recovery efforts including story maps 'Namadgi Phoenix', monitoring results that

document the recovery of Namadgi National Park and ecosystem recovery programs 1 year on from the Orroral Valley fire.

Recovery efforts were informed by the following guiding principles:

- Traditional Custodians, the Ngunnawal people, and the government will heal Country and walk the journey to recovery together.
- Environmental integrity and ecosystem functions will be restored through assisting natural processes.
- Heritage values will be restored through collaboration using contemporary and traditional practices.
- Canberra's communities, recreational, interest, conservation and user groups will be genuinely and meaningfully engaged throughout the recovery phase and reconnected to country.
- Recovery actions will consider ecosystem drivers and be underpinned by sound science, credible research, monitoring, and best practice techniques.
- Climate adaptation will be considered in every aspect of recovery.
- We will support our people through the recovery journey.

Several important lessons were learnt from the experience of the 2019–20 wildfires. First, protection of natural and cultural values during the fire was helped by having values officers with appropriate conservation expertise embedded in the incident management team. For example, such access to expertise ensured that retardants were not used in bog and fen communities. Second, preparation of a rapid risk assessment report while the fire was still burning set up the recovery program to respond with appropriate urgency, and set expectations with government. Third, recovery needs to plan for a different future and integrate climate resilience, rather than the status quo.

Victoria

The 2019–20 wildfires were exceptional in size and impact within Victoria. They have affected all Victorians and have meant significant change to the work many are doing. The collective biodiversity and wildlife welfare response and recovery effort was incredible. The Victorian Government worked with Traditional Owners, experts and key stakeholders to produce a report, 'Victoria's bushfire emergency: biodiversity response and recovery' (DELWP 2020), on biodiversity impacts and response actions informed by state-wide datasets and models. This report set out the approach to recover critical biodiversity values in the months following the fire season, as well as a longer-term agenda to restore natural environments and build resilience to future fire events.

In Victoria, the 2019–20 fire season affected more than half of the habitat for over 240 species, including at least 110 species that had more than half of their habitat burnt by high-severity fire. This rapid analysis of fire overlaps with species distributions helped to identify species of key concern, and the immediate and short-term actions they needed, such as emergency extraction, supplementary feeding and seed banking. The Victorian Government paired this species-specific approach with a landscape-scale spatial conservation action planning tool to identify the priority areas for invasive species control inside and outside the fire extent, to help ameliorate the intensified effect of these threats post-fire.

The ability to respond quickly and effectively is testament to the expertise and knowledge held within the Department of Environment, Land, Water and Planning and portfolio partners, and was facilitated through critical relationships and collaborative

approaches with key stakeholders nurtured under Protecting Victoria's Environment – Biodiversity 2037 (DELWP 2017). This early response enabled the Victorian Government to build response and collaboration across the sector. It demonstrates the value of pre-existing capability, and foundational datasets and analyses suitable for rapid, integrated, spatial assessment of values, impacts and intervention options. At the same time, the 2019–20 wildfires highlighted the need to improve preparedness and suppression planning before the next major fire event so that biodiversity information can be targeted and fit-for-purpose.

For the first time in Victoria's history, a very senior position (called the State Controller Wildlife) was created under formal emergency response arrangements to guide delivery of wildlife welfare and emergency actions for biodiversity through the State Control Centre. This role facilitated the delivery of priority actions under a 7-day plan via the local incident management teams. The creation of the State Controller Wildlife reflected a new level of public scrutiny and expectation about the government's response to protecting not just lives and built assets from fire impacts, but also the natural environment.

The Victorian Government took a holistic, state- and species-wide approach in its response to the wildfires, one which considered long-term resilience. The response also prioritised Traditional Owner wellbeing by supporting programs to enhance connection to, and health of, Country. This included Traditional Owner-led assessments, and actions to heal Country.

Future conservation programs need to proactively account for the risk of megafires in planning, especially given climate change and associated changing fire regimes. This should include, where possible, spreading the risk to species by establishing new populations or strengthening existing populations of species vulnerable to fire. Governments will increasingly need to consider how megafire risk can be built into long-term conservation planning.

Tasmania

During the 2019–20 fire season, Tasmanian fire management agencies relied on systems for assessing and responding to wildfire threats to biodiversity, which were developed following the experience of past wildfires in Tasmania, especially the 2018–19 wildfires season. These earlier fires had threatened key occurrences of fire-sensitive natural values within the Tasmanian Wilderness World Heritage Area. Key elements of these systems include:

- the Bushfire Risk Assessment Model, which identifies natural, cultural and economic assets that are prone to wildfire impact, thereby providing strategic guidance to wildfire preparedness and response planning;
- fine-scale spatial data on the distribution of species, communities and other natural values most at risk of (local) extinction or permanent degradation if exposed to wildfire – these data guide 'tactical' wildfire response planning;
- clear lines of communication between fire managers and biodiversity specialists, with the latter 'on call' for the duration of the fire season to advise on priorities for wildfire protection and carry out rapid desktop and field impact assessments; and
- staff within the Parks and Wildlife Service Fire Management Section with fire ecology expertise tasked to liaise with specialists to feed biodiversity advice into operational planning.

These systems are brought together via the Reserve Values Protection Planning (RVPP) process, in which the natural and cultural values within key areas at risk from wildfire are

identified and prioritised and response plans are formulated. While in 2019–20 these plans were formulated ‘on the fly’ as the fire situation evolved, the intention is to develop plans in readiness for future wildfires. The RVPP approach has been recognised for its quality and innovation (AFAC 2019) and is likely to be a useful model for other jurisdictions. These systems are subject to ongoing refinement, drawing on research and operational experience in Tasmania and beyond.

Tasmania has also progressed policies and processes to manage *in situ* supplementary feeding of wildlife and the care of injured and orphaned fauna following wildfires. Work is also in progress to develop techniques for restoration of fire-affected alpine ecosystems.

Compared to the rest of south-east Australia, Tasmania experienced a subdued wildfire season in 2019–20. Five wildfires of greater than 2500 ha occurred, with ~0.6% of the state affected by bushfire (Table 23.1). Having the systems described above in place meant that fire managers were able to readily assess threats to biodiversity as the fires progressed and direct resources accordingly. As it transpired, these wildfires mostly affected fire-adapted ecosystems, such that long-term impacts are expected to be minor.

Although the existing systems are valuable, further work is required to ensure biodiversity protection is appropriately prioritised in wildfires response. In addition, there is a need to increase the priority of planned burning programs that aim to reduce wildfire risk to biodiversity – currently most of the focus is on planned burning to protect community infrastructure. Ongoing improvement of these processes will help minimise impacts of future wildfires on Tasmania’s unique natural values.

South Australia

The significance and scale of the fires of 2019–20 brought an increased scrutiny on the plight of native animals and habitats. The fires affected several areas across the state with the largest impacts in the Mount Lofty Ranges and Kangaroo Island. Widely shared images and stories highlighted those impacts and drew the attention of the state, national and global community. In South Australia there was a particular focus on Kangaroo Island, a place internationally renowned for its natural beauty and abundant iconic Australian wildlife, such as koalas (*Phascolarctos cinereus*), kangaroos and many other species. The fires on Kangaroo Island impacted ~210 000 ha (close to half of the area of the Island), including 95% of western Kangaroo Island’s national park estate. The fires affected iconic species, many threatened species, and species endemic to the Island.

The fires and the interest in the wildlife led to an overwhelming desire from the community to help. This raised several challenges for the Government agency responsible. These challenges included limited data and knowledge on which species were affected and how severely; slow provision of information to the community on wildlife impacts; and coordination of activity on ground. The desire of the public to help occasionally led to perverse outcomes, such as feeding wildlife and rescuing animals before the firegrounds were safe.

In order to address some of these challenges, the SA Government set up an independent Wildlife and Habitat Bushfire Recovery Taskforce. This taskforce deliberated with experts and community and developed the Wildlife and Habitat Recovery Framework, so that next time we are in the same situation we have a template to work from to assist in the transition from emergency response to recovery. The taskforce has also released a report with eight key recommendations to address challenges and improve future preparedness.

On Kangaroo Island, a partnership with the National Environment Science Program enabled us to hold a workshop on Kangaroo Island immediately following the fires



Fig. 23.3. Workshop participants develop an action plan to guide recovery efforts for Kangaroo Island. (Photo: Nicolas Rakotopare/Threatened Species Recovery Hub)

(Fig. 23.3), and to work with experts from across government, organisations and the community to develop an action plan (Rogers *et al.* 2021) for recovery efforts. This action plan, funded by both state and Commonwealth, guided priority activities to understand the impacts, address threats and undertake recovery actions. This approach meant that effort across a range of partners was prioritised, and complementary, and has led to effective on-ground outcomes. Ongoing collaboration and coordination between partners has allowed the recovery efforts to accommodate new and emerging threats, including blue gum ‘wildlings’, while continuing to undertake recovery actions. There are still concerns, however, as recovery will be long and slow for many species, but the initial recovery funding has come to an end. Nevertheless, the funding and efforts to recover species after the 2019–20 wildfires are a substantial step up compared with that of past fires.

Western Australia

Wildfires over the summer of 2019–20 burnt ~1.5 million ha in relatively remote parts of the Great Western Woodlands and South Coast areas of Western Australia, but only 23 692 ha in the heavily populated south-west corner of the state. The post-fire biodiversity conservation response of the Western Australian Government, through the Department of Biodiversity, Conservation and Attractions and the Western Australian Museum, initially focused on identifying where the fires putatively had greatest impact on species and communities already recognised as being at high risk of extinction. This prioritisation was informed by pre-fire population and survey data attained through long-term monitoring of threatened flora, fauna and ecological communities, and was underpinned by an

understanding that the impact of the 2019–20 fires was best understood in the context of the past fire regime and other interacting threats.

In Cape Arid National Park and Nuytsland Nature Reserve two wildfires (47 195 and 80 146 ha) impacted an estimated 18 500 ha of core habitat of the Critically Endangered western ground parrot (*Pezoporus flaviventris*) and, combined with extensive fire in 2015, over 80% of suitable habitat was burnt over a 4-year period. Slow post-fire recovery of the kwongan heath habitat resulted in significant areas of poor vegetation cover, reducing the quality of shelter and leaving the habitat accessible to foxes and feral cats, rendering such areas unsuitable for roosting or breeding by the parrots. Consequently, post-fire management has focused on maximising the effectiveness of introduced predator control through additional baiting and trapping, and implementing strategies for reducing further risk of fire in ground parrot habitat (Burbidge *et al.* 2016; Comer *et al.* 2021; <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals/western-ground-parrot>). Extensive acoustic monitoring of ground parrots has highlighted the importance of long-unburnt habitat in the breeding season and identified priority areas for predator management. With support from BirdLife Australia and the Friends of the Western Ground Parrot, a translocation was also initiated, with selection of the release site and threat mitigation in this area preceding the trial release of birds to the east of Albany in April 2021 (Comer *et al.* 2021).

Essentially all high-elevation areas in the eastern and central Stirling Range were impacted by wildfire over the period 2018–20, affecting a suite of threatened flora, the threatened Eastern Stirling Range Montane Heath and Thicket ecological community and many of the threatened and short-range endemic invertebrates found only in the Stirling Range National Park. The high-elevation portions of the Stirling Range support an exceptionally rich flora with high levels of endemism, which is threatened by susceptibility to *Phytophthora* dieback acting independently and in concert with short fire intervals (Barrett and Yates 2015). Management actions to support post-fire recovery consisted of (1) ongoing monitoring of post-fire recruitment and survival (see Chapters 8 and 9); (2) threat management, including phosphite application to reduce *Phytophthora* impact, and fencing and feral herbivore control to reduce browsing of post-fire recruits by mammals (see Chapters 17, 18); (3) establishment of two seed production areas with 14 species in *Phytophthora*-free locations outside of the Stirling Range to secure living collections of these species as an insurance against losses in the wild and to facilitate future seed collection; and (4) seed collections from natural populations of 11 species subsequently banked at the Western Australian Seed Centre, to support future recovery actions. Availability of pre-fire data for threatened and short-range endemic invertebrates of the Stirling Range was variable. However, for 39 of the 40 target species, 100% of known habitat was impacted by wildfires over 2018–20 (Bain *et al.* 2021); post-fire surveys documented the level of impact on these areas and provided a benchmark of population demographics and occupancy, which can be used to track recovery and future trends in these species.

Important lessons from the 2019–20 wildfires from a state agency perspective were that (1) robust pre-fire data on species, community status and susceptibility to threats supported understanding of fire impacts and development of management responses both during and after the fire; (2) pre-fire germplasm collections for those species suited to long-term storage was important for post-fire recovery actions, given fires can cover all or large portions of a species' range; and (3) having the capability and capacity for rapid post-fire monitoring and threat mitigation activities, on the scale of days to years, depending on the timeframe of post-fire recovery and elevated susceptibility to threats for different species, maximises the likelihood of population persistence.

Discussion

Australian states and territories were impacted differently by the severity and scale of the 2019–20 wildfires. The absolute and relative scale of the fires varied among the states (Table 23.1). Importantly, the ecological context of fire in these different landscapes varied enormously; the mallee–heath communities of south-west Western Australia and Kangaroo Island will experience very different recovery pathways to the rainforests of southern Queensland and northern New South Wales.

Our abilities to assess the ecological impacts, and respond appropriately, were as diverse as the range of ecological impacts experienced. While much of the response was built on existing programs and experience (e.g. invasive plant and animal control operations), the exceptional nature of the fires and the extent of their impacts required innovative responses, such as *in situ* supplementary feeding and other novel emergency-based approaches. What was important was that management agencies were required – and in most cases able – to design such responses, and have the confidence to apply them, in the rapid timeframes required.

Several key themes emerge from the narratives described in this chapter. Central to success was the development, application and maintenance of the tools and capacity to respond quickly across a broad scale. This foundation comprised:

- *knowledge and data on the distribution, abundance, temporal trends and ecology of species and ecosystems, and their drivers (including, but not only, fire regimes)*: having collated and usable information available in a timely manner at the fingertips of decision-makers was instrumental;
- *internal agency technical capacity and capability*: this includes the ability to mobilise an adequate on-ground emergency response, in the context of a broader disaster situation, as well as the required technical ecological expertise from within agencies and their partners for the ongoing response and recovery; and
- *the ability to rapidly develop inclusive and well-informed response plans*: the strength of existing relationships between state, territory and Commonwealth agencies, and with external partners, and the ability to draw on expertise and support from community groups, researchers, traditional owners and NGOs, was a strong determinant of the ability to coordinate our investment and on-ground activities across diverse areas of responsibility and interest.

The development and maintenance of the required information and the human and organisational relationships over the long-term can often be a challenge for agencies as they manage the tension between long-term strategic objectives and short-term responsive demands. However, the 2019–20 wildfires acutely brought to light the critical value of maintaining this capacity: its importance is most strongly demonstrated during times of crisis, when an adequate, informed and collective response is most urgently needed.

Key implications

The novel nature of the 2019–20 wildfires revealed several challenges. To address these challenges and respond more effectively, we frame these issues as opportunities for the future:

- Developing and implementing emergency response plans and strategies that more effectively coordinate and guide efforts across stakeholder groups is critical to ensuring resources are available and targeted towards the protection and recovery

of priority natural values. The enormous community concern about wildlife and threatened species, particularly in relation to the wildfires in eastern and southern Australia, was outside many of our experiences, and while this provided an enormous impetus for agencies to mobilise significant resources towards recovery, it also challenged some with how best to respond and support the desire of the community to contribute meaningfully. This was particularly the case for wildlife rescue operations.

- Agencies were also variably able to apply lessons from previous, recent fire events, particularly with respect to planning and governance. The particular lessons learnt from the 2019–20 wildfires have resulted in an increased emphasis on continuing to improve our policies and frameworks, with such ongoing monitoring and adaptation critical for ensuring that biodiversity is more effectively managed before, during and after wildfire events.
- There is a need to further build ecological and fire operational knowledge, capacity, planning and partnerships between and external to state and territory agencies to meet the challenge of a future in which fire management and biodiversity conservation is increasingly influenced by climate change. The role of anthropogenic climate change in the scale and severity of the wildfires in 2019–20 is now well established (e.g. van Oldenborgh *et al.* 2021). In an increasingly warm world, the experience, capacity and expertise held within state and territory agencies will become increasingly important for biodiversity conservation management before, during and after similar fire events.

References

- ACT/NSW Rapid Risk Assessment Team (2020) Ororral Valley fire rapid risk assessment Namadgi National Park. Environment, Planning and Sustainable Development Directorate, ACT Government, Canberra, <https://www.environment.act.gov.au/__data/assets/pdf_file/0003/1495236/ororral-valley-fire-rapid-risk-assessment-namadgi-national-park.pdf>.
- AFAC (2019) *A Review of the Management of the Tasmanian Fires of December 2018–March 2019*. Australasian Fire and Emergency Service Authorities Council, Melbourne.
- Bain K, Harvey M, Utber D, Comer S (2021) ‘Stirling Range post-fire threatened invertebrate survey report. Targeted reconnaissance survey and post-fire impact assessment for threatened and endemic invertebrates in the eastern Stirling Range National Park’. Report prepared for Department of Biodiversity Conservation and Attractions, Parks and Wildlife Service Albany. Python Ecological Services, Walpole Western Australia.
- Barrett S, Yates CJ (2015) Risks to a mountain summit ecosystem with endemic biota in southwestern Australia. *Austral Ecology* **40**, 423–432. doi:10.1111/aec.12199
- Burbidge AH, Comer S, Lees C, Page M, Stanley F (Eds) (2016) Creating a future for the western ground parrot: workshop report. Department of Parks and Wildlife, Perth, <http://www.cbsg.org/sites/cbsg.org/files/documents/WGP_Report_FINAL_Sept2016.pdf>.
- Comer S, Burbidge A, Berryman A, Thomas A, Blythman M, *et al.* (2021) A new chapter for kyloring. *Landscape* **37**, 18–22.
- DELWP (2017) Protecting Victoria’s environment – biodiversity 2037. The State of Victoria Department of Environment, Land, Water and Planning, Melbourne, <https://www.environment.vic.gov.au/__data/assets/pdf_file/0022/51259/Protecting-Victorias-Environment-Biodiversity-2037.pdf>.
- DELWP (2020) Victoria’s bushfire emergency: biodiversity response and recovery. The State of Victoria Department of Environment, Land, Water and Planning, Melbourne, <https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0030/484743/Victorias-bushfire-emergency-Biodiversity-response-and-recovery-Version-2-1.pdf>.

- Department of Agriculture, Water and the Environment (2020) National indicative aggregated fire extent dataset (v20200428) current to 28 April 2020, <<https://www.agriculture.gov.au/abares/forestsaustralia/forest-data-maps-and-tools/fire-data#fire-area-and-area-of-forest-in-fire-area-by-jurisdiction>>.
- DPIE (2020) Wildlife and Conservation Bushfire Recovery, Immediate Response January 2020. Department of Planning, Industry and Environment, Sydney, Australia, <www.environment.nsw.gov.au/research-and-publications/publications-search/wildlife-and-conservation-bushfire-recovery-immediate-response>.
- DPIE (2021a) NSW Wildlife and Conservation Bushfire Recovery Medium-term response plan, Department of Planning, Industry and Environment, Sydney, Australia, <<https://www.environment.nsw.gov.au/research-and-publications/publications-search/wildlife-and-conservation-bushfire-recovery-medium-term-response-plan>>.
- DPIE (2021b) Saving our Species Year in Review 2019–20. Department of Planning, Industry and Environment, Sydney, Australia, <<https://www.environment.nsw.gov.au/research-and-publications/publications-search/saving-our-species-year-in-review-2019-20>>.
- Environment, Planning and Sustainable Development Directorate (2020) ACT bushfire and flood recovery plan. Environment, Planning and Sustainable Development Directorate, ACT Government, Canberra, <https://www.environment.act.gov.au/__data/assets/pdf_file/0011/1622855/act-bushfire-and-flood-recovery-plan-2020.pdf>.
- Rogers D, Rumpff L, Huang J (2021) Kangaroo Island wildlife and habitat recovery planning workshop – workshop summary report. NESP Threatened Species Recovery Hub, Brisbane, <https://www.nespthreatenedspecies.edu.au/media/2snbrwxc/8-0-kangaroo-island-wildlife-and-habitat-recovery-planning-workshop-report_v4.pdf>.
- The State of Queensland (Queensland Reconstruction Authority) (2020) *2019 Queensland Bushfires State Recovery Plan 2019–2022*. The State of Queensland, Queensland Reconstruction Authority, Brisbane.
- van Oldenborgh GJ, Krikken F, Lewis S, Leach NJ, Lehner F, *et al.* (2021) Attribution of the Australian bushfire risk to anthropogenic climate change. *Natural Hazards and Earth System Sciences* **21**, 941–960. doi:10.5194/nhess-21-941-2021