**A year after Australia’s wildfires, extinction threatens hundreds of species**

When Isabel Hyman heads out in coming weeks to the wilds of northern New South Wales, she’s worried about what she won’t find. Fifteen years ago, the malacologist — or mollusk scientist — with the Australian Museum made an incredible discovery among the limestone outcrops there: a tiny, 3-millimeter-long snail, with a ribbed, dark golden-brown shell, that was new to science.Subsequently named after her husband, Hugh Palethorpe, Palethorpe’s pinwheel snail (Rhophodon palethorpei) “is only known from a single location, at the Kunderang Brook limestone outcrops in Werrikimbe National Park,” she says. Now it may become known for a different, more devastating distinction: It is one of hundreds of species that experts fear have been pushed close to, or right over, the precipice of extinction by the wildfires that blazed across more than 10 million hectares of southeastern Australia in the summer of 2019–2020.“This location was completely burnt,” says Hyman, who is based in Sydney. “We expect the mortality at this site could be very high and … there is a possibility this species is extinct.”A year after the last of the fires were doused, their toll on species is becoming increasingly clear. Flames devoured more than 20 percent of Australia’s temperate forest cover, according to a February 2020 analysis in Nature Climate Change. Even if plants and animals survived the flames, their habitats may have been so changed that their survival is at risk (SN: 2/11/20). As a result of the scale of the disaster, experts say that more than 500 species of plants and animals may now be endangered — or even completely gone. Australia’s iconic koala became the poster child of the crisis as images of rescuers carrying these singed marsupials out of the flames went global: As many as 60,000 of the nation’s estimated population of 330,000 koalas perished in the fires, ecologists concluded in December in a report for World Wildlife Fund Australia. While there’s no doubt that such charismatic megafauna suffered enormously, the greatest toll is likely to have been in other groups of species, such as invertebrates and plants, which often escape the public’s attention.As Kingsley Dixon, an ecologist at Curtin University in Perth told the Associated Press last year: “I don’t think we’ve seen a single event in Australia that has destroyed so much habitat and pushed so many creatures to the very brink of extinction.”Even before the fires, many vertebrate species were already on downward trends, says John Woinarski, an ecologist at Charles Darwin University in Darwin. The blazes have “exacerbated the threats that were driving the declines,” he says.For example, fluffy arboreal marsupials called greater gliders (Petauroides volans) had already experienced a 50 percent population decline in recent decades. The fires then burned a third of their remaining habitat along Australia’s eastern coastline. An ongoing assessment may lead to the gliders being recategorized from vulnerable to endangered.Overall, 49 vertebrates that previously were not endangered now qualify for being listed as threatened under Australia’s guidelines for that designation, researchers reported in July in Nature Ecology & Evolution. That shift alone would increase the tally of nationally protected nonmarine vertebrate species by about 15 percent, from 324 to 373.Another 21 already threatened vertebrates had more than 30 percent of their ranges burned, and some may now qualify for being reassessed to higher categories of threat, the authors found. One species that may need to be recategorized is the koala (Phascolarctos cinereus), with some state’s populations that were hardest hit under consideration to be upgraded from vulnerable to endangered. Besides the impact on koalas, the WWF Australia report suggests that as many as 3 billion individual mammals, birds, reptiles and frogs died or were displaced during the crisis. Though those figures are astounding, the impacts on lesser-studied groups such as invertebrates and plants may have been even greater.“Many of those have much smaller ranges [than vertebrates], which means they are going to be even more impacted when a big fire goes through,” says James Watson, a conservation scientist at the University of Queensland in Brisbane and an author of the Nature Ecology & Evolution paper on vertebrates. “I am willing to bet that there’s many species … that may disappear forever.”In February, more than 100 biologists convened the first of several online workshops to assess whether 234 Australian invertebrates now need to be added to the International Union for Conservation of Nature’s Red List — a global who’s who of threatened species. Snails, similar to many invertebrates, are particularly susceptible to wildfires, as they are unable to outrun flames and can’t survive intense heat, Hyman notes. Many also have small ranges that were completely incinerated, leaving no survivors that can recolonize the burned area.“A snail can’t do much to escape,” she says. “You could expect more than 90 percent mortality in a high-intensity bushfire.” In October, Hyman’s team published one of the first papers quantifying the impacts on invertebrates in New South Wales in the Technical Reports of the Australian Museum, Online.Their surveys showed that 29 species in the state — including dung beetles, freshwater crayfish, flies, snails and spiders — had their entire ranges burned. Another 46 species had at least half their known habitat within the fire zones. These 75 species were among the 234 under consideration for adding to the IUCN Red List during the biologists’ first online workshop.“We’ve gathered together 230-odd species that are believed to now be of concern. These include a range of different taxa from land snails to millipedes to arachnids to insects, and this 230 is growing rapidly,” says Jess Marsh, an arachnologist at Charles Darwin University who was one of the conveners of the workshop. “I expect it will massively increase.”Some of the spiders she studies were the first to be added to that list. She’s already spent several months on South Australia’s Kangaroo Island hunting without luck for the Kangaroo Island assassin spider (Zephyrarchaea austini). Dependent on leaf litter suspended in the understory, and restricted to just a few locations that were razed in early 2020, she suspects that the species may be extinct.“There’s no understory vegetation left, let alone any leaf litter suspended in it, so that species is really hanging in the balance,” says Marsh.Generally, the species being considered for recognition as endangered had more than 50 percent of their ranges burned, lived in flammable parts of the habitat and have little ability to disperse to other areas. More than 150 of the 234 species being urgently assessed had their entire range burned. And it’s not just the flames themselves that are problematic; so is the reshaped environment following fires. Millipedes, for example, are very vulnerable not only to fire but also to drying out in the reduced shade and shelter of the post-fire environment.“A lot of invertebrates are very susceptible to desiccation, and need cover and humidity to survive a hot summer, which are obviously lacking following the fire,” Marsh says. “Taking into account all of the threats … we could be looking at significant numbers going extinct.”Lost vegetation hasn’t just put animals in danger. Many plants themselves may also be at risk, though experts have yet to compile an official list.Rachael Gallagher, a plant ecologist at Macquarie University in Sydney, has been prioritizing endemic plant species — those found nowhere else on Earth — that are in most urgent need of conservation for the Australian government. Perhaps surprisingly, she’s particularly worried about some trees that actually depend on fire to survive. Eucalypts known as alpine ash (Eucalyptus delegatensis) and mountain ash (E. regnans), for instance, are typically killed by fire and then regenerate from surviving seeds in the aftermath. Australia has many trees that must complete their entire life cycle from germination through to reproductively mature adult before the next major bushfire passes through (SN: 2/11/20). For some species, this may take 15 to 20 years.The problem now is that climate change has increased the frequency of fires to the degree that many of these plants are unable to reach adulthood and set seed before the next fire passes through, meaning they may be lost from these ecosystems (SN: 3/4/20).The fires burned 25–100 percent of the ranges of 257 species of plants for which “the historical intervals between fire events across their range are likely to be too short to allow them to effectively regenerate,” Gallagher says. These species, which have some degree of fire tolerance, are at “increased risk of extinction.” These include shrubs and trees such as the granite boronia (Boronia granitica), Forrester’s bottlebrush (Callistemon forresterae), dwarf cypress pine (Callitris oblonga) and the Wolgan snow gum (Eucalyptus gregsoniana).Nevertheless, as researchers head out into the field to assess what’s lost, what they are sometimes finding are glimmers of hope. “Australian plants are remarkably resilient and there’s been regeneration in places where nobody thought there would be,” Gallagher says.One species that survived against all the odds is the Gibraltar Range waratah (Telopea aspera), a drought-resistant shrub with leathery leaves and bright red flowers. “This species has a very small range, being specialized to granite outcrops in one mountain range, which was burnt during the fires,” she says. “However, it has been noted as resprouting after the fires by park rangers and, in the absence of another fire in coming years, is likely to be able to recover.”Several animal species that were thought to be in grave peril following the fires that burned nearly half of the 4,400-square-kilometer Kangaroo Island have survived better than expected too (SN: 1/13/20). In the particularly badly burned reserves of the western end of the island, tiny marsupial carnivores called Kangaroo Island dunnarts (Sminthopsis aitkeni) are frequently appearing on camera traps. Swiftly erected predator-exclusion fences now protect survivors from feral cats.Similarly, large flocks of the glossy black-cockatoo (Calyptorhynchus lathami) have adapted by moving to unburned areas with food trees, says Karleah Berris of Natural Resources Kangaroo Island, who heads the crew that manages the endangered birds. Better news yet, a surprising number of birds bred and fledged young in mid-2020. “The important thing now is to protect what is left from fire until the burnt areas regenerate,” she says. “But I think, at present, all signs are that they are coping.”Hyman says that, hearteningly, her team found handfuls of survivors of some snail species during several surveys in New South Wales in late 2020. The snails turned up in small patches of unburned habitat, sometimes at the bottom of gullies or in deep leaf litter around the bases of large trees. And that gives her hope that other snail species may have held on in other, larger unburned patches with greater numbers of survivors.“But the question then becomes, what sort of recovery can they make from that?” she says. “Whether they can recover and breed up and start to move back into surviving areas again perhaps depends on how dry the weather is in coming years and if there are more fires.”She’s still hoping that a handful of Palethorpe’s pinwheel snails may have clung on against all the odds. “My husband is on tenterhooks wondering if his snail is still there or not,” she says.