

RECOVERY FROM BUSHFIRES IN AUUSTRALIA

by

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## ABSTRACT

Key Words: Bushfire, Australia, Ecological restoration after disasters, Harm from bushfires, Future fire prevention methods.

This article will start from the 2019-2020 mega bushfires in Australia and discuss issues related to the Australian bushfires. Therefore, this article will focus on research and discussion around three arguments: the harm of forest fires, the causes of forest fires, and forest fire prevention and reconstruction. Finally, this article will study how to prevent the fire from being destroyed again, and how to protect the forest from fire.

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## INTRODUCTION

Forest fires are sudden and destructive natural disasters that cannot be controlled by human beings. Forest fires will spread freely and rapidly in the forest, bringing certain harm to the ecological environment and organisms of the forest. Loss can be said to be a more severe disaster. In Victoria, for example, a series of forest fires burned nearly 4 million hectares of forest between 2003 and 2014, almost the same level as the burns in the past 50 years (Beilin, and Paschen, J.-A. 2021). And between 2019 and 2020, the Australian fire broke out in Australia this year, which is called a huge disaster. They have burned 19 million hectares of land. Regardless of whether it is for the forest, the environment or the organisms, the damage caused by these fires is huge and even difficult to recover in the short term (Luke, and McArthur, A. G. 1978).

Speaking of forest fires, Australia has to be mentioned. Australia's forest fires will always bring a lot of harm and loss (O'Halloran, and Davies, A. 2020). As of mid-January 2020, this wildfire has burned 10.7 million hectares of land, at least 28 people have died, about 3,000 houses have been burnt down, and wild animal casualties are estimated to exceed 500 million (McDougall. 2020). This is a considerable human loss and environmental loss, but at the same time it is more intuitive and huge, but it is financial loss and environmental loss. According to the data, the loss cost of each forest fire is

about 70 million U.S. dollars. This is also the 101st cost of loss obtained when the loss of manpower and material resources is greatly underestimated (Blanchi, Leonard, J., Haynes, K., Opie, K., James, M., and Oliveira, F. D. de. 2014). Therefore, the loss incurred by Australia every year is at least tens of millions of dollars. This is an outrageous figure, and it is also a considerable economic burden. Of course, it also shows the destructive power and catastrophic nature of forest fires from the side. In the past but more than ten years, major forest fires in Sydney, Melbourne suburbs and other places have also burned more than one million hectares of forest and woodland, and also killed more than 200 people (Beale, and Jones, W. 2010).

But what caused the forest fires? Studies have shown that under hotter, drier and windy conditions and more severe drought conditions, the risk of fires will increase. However, it should be noted that drought does not have a high impact on fires, which means that the more direct factors that are triggered by forest fires and are difficult to extinguish should be the result of multiple conditions. If there is a very strong wind, the head fire will advance faster than the back of the flame zone, which is conducive to the rapid spread of the flame. If the wind direction changes at this time, it will also turn all directions of the flame into a head that is easy to spread forward. And if there is a steep slope in the terrain, then an explosive fire will occur in the steep slope, which will also cause the fire to intensify rapidly. When strong winds with variable wind directions meet steep slopes, they will directly interact and quickly promote the

fire in all aspects, quickly forming a large area of flame. Once the flame reaches a certain area or a certain intensity, extinguishing becomes a very difficult problem. It can only be extinguished slowly by means such as rainfall (Sharples, Cary, G. J., Fox-Hughes, P., Mooney, S., Evans, J. P., Fletcher, M.-S., Fromm, M., Grierson, P. F., McRae, R., and Baker, P. 2016).

For different forest fire risk areas in Australia, people in these areas provide two warnings. They remind people to be wary of forest fires that do not know when they will happen suddenly, and give suggestions on how to respond (the so-called prevention measures). Disaster preparedness is one of the priority actions to reduce disaster risk. Disaster preparedness is also a key factor in reducing the physical, emotional and economic impact of disasters on people. Given the severity and suddenness of forest fires, disaster preparedness becomes even more apparent. especially important (Whittaker, Taylor, M., and Bearman, C. 2020). Therefore, how the government can effectively avoid disaster losses and reduce the frequency of forest fires is an important issue. So in this article, I will discuss (1) The hazards of forest fires, the causes of wildfires and the factors that affect fires; (2) How to prevent forest fires and where ideas are needed for post-disaster reconstruction.

## LITERATURE REVIEW

### **The hazards of bushfires**

Forest fires have always been one of the most common natural disasters in Australia. Fire plays an important role in shaping the landscape and its ecological dynamics, but it can also have destructive effects, causing casualties and extensive environmental damage (Sharples, J. J., Cary, G. J., Fox-Hughes, P., Mooney, S., Evans, J. P., Fletcher, M.-S., Fromm, M., Grierson, P. F., McRae, R., and Baker, P., 2016). During the 110 years from 1901 to 2011, 260 bushfires in Australia are associated with a total of 825 known deaths of civilians and firefighters (Blanchi, R., Leonard, J., Haynes, K., Opie, K., James, M., and Oliveira, F. D. de., 2014). The most recent Australian forest fire, as of mid-January 2020, has burned 10.7 million hectares of land, which is equivalent to 80% of the land in England; about 3,000 houses are burned, at least 28 people died, and wildlife casualties are estimated to exceed 5 Billion (McDougall, D., 2020). Since October, in New South Wales, Victoria and South Australia, the Guardian reported that 17 people have been confirmed to have died as a result of the fire. On the economic side, the Insurance Commission of Australia has set the 2020 Australian bushfire insured losses at 297 million Australian dollars (US\$207 million) (Australia bushfire losses currently at \$207m., 2020). In addition, Australian Prime Minister Scott Morrison can no longer count at least A\$2

billion for bushfires, and will provide more funds if needed (Australia bushfire insured losses approach \$1bn. 2020). At the same time, the smoke from forest fires may become an important issue for the global society in the future, because it will also spread to other countries and continents. It will take many years for the economic and infrastructure recovery of the affected areas and the biodiversity of animals and plants to be read (Filkov, A. I., Ngo, T., Matthews, S., Telfer, S., and Penman, T. D. 2020). Severe air pollution incidents caused by bushfires and dust are usually short-lived, but the resulting particulate matter (PM) can reach extreme concentrations and spread over long distances, affecting densely populated areas far from its source (Johnston, F., Hanigan, I., Henderson, S., Morgan, G., and Bowman, D., 2011).

### **Causes of bushfires and factors affecting bushfires**

Although Australia is always affected by forest fires, there are at least some human factors that can prevent forest fires. In Australia, more bushfires are triggered by deliberate lighting—referring to man-made aspects (Head, L., and Atchison, J. 2015). Moreover, climate change has also played a role in the intensification and frequency of forest fire seasons, although it only promotes hot and dry conditions rather than directly triggering fires (Foster, J. E., 1976). An extreme fire can be defined as a fire that exhibits strong or extensive burning in the atmospheric environment. Therefore, the collision of the

boundary layer and the free troposphere may introduce some factors to maintain or enhance the flame. At the same time, lightning will increase the possibility of ignition. There are many reasons for the rapid spread of flames. If there is a very strong wind, the head fire will advance faster than behind the flame zone; and changing the wind direction will make the long side wings of the or turn into a rapidly spreading fire head. In addition, the explosive fire behavior on steep slopes will cause the fire to accelerate rapidly. If strong winds interact with the steep terrain to drive the fire laterally quickly, a large number of point flames will gather to form a large area of flame. (Sharples, J. J., Cary, G. J., FoxHughes, P., Mooney, S., Evans, J. P., Fletcher, M. -S., Fromm, M., Grierson, P. F., Mcrae, R., and Baker, P., 2016).

### **How should I prevent bushfires**

Sometimes, catastrophic bushfires can cause significant loss of life and property in southern Australia. Although natural disasters such as bushfires are difficult to prevent, effective disaster reduction strategies can manage and reduce the impact on humans and the environment (BOND, T., and MERCER, D., 2014). Therefore, adaptive governance has become a model for solving social and ecological problems such as disasters. The four principles of adaptive governance are: polycentric system, collaboration, social learning, and reflection (Ruane, S., 2020). But because all species are embedded in a complex but interacting network, they all depend on each other directly or in

brief. Therefore, after a forest fire, the simultaneous loss of a large number of plants and animals will have a cascading effect on the interaction of species, thereby affecting the ability of the ecosystem to resume normal operations after high-intensity wildfires. Therefore, people must consider how to enhance the resilience of the ecosystem when carrying out post-disaster reconstruction after devastating forest fires. To this end, I also need to consider the ecological interaction network, rather than specific species. The discontinuous network approach that examines the complex ways in which the entire species community interacts can and should help (The Conversation: An Independent Source of Analysis from Academic Researchers, 2018). But of course, prevention is the best reconstruction, and it is better to prevent problems by eliminating threats or strengthening preventive measures than trying to restore the situation after losing control. If problems are detected and restricted, it is possible to eliminate or minimize the effects of all bushfires by up to 30% (Jazebi, S., de Leon, F., 2020). Take the Victoria Forest Fire in 2209 as an example. It was a fire that moved extremely fast, with multiple fronts, beyond the scope of previous experience, and almost completely beyond the control of firefighters. Secondly, it does have many unforeseen and unfortunate consequences. So in this view, early prevention and warning is particularly important (Choo, C. W. 2014).



**Australia's preventive measures and reconstruction of the ecological environment after the disaster, etc.**

For a long time, bushfires have been Australia's main concern. The effects must be mitigated to eliminate the harmful effects on climate and create a sustainable and healthy environment for wildlife. Among them, drone swarms can be used to map and monitor forest fires. This is a jungle fire mitigation framework with drones as the main body. Because it is very important to quickly monitor and extinguish fires in remote areas where the fire started, it is also a very difficult challenge (Ullah, F., 2021). In addition, the frequency and intensity of extreme weather caused by extreme fires will increase, so people's future emergency management strategies should be based on achieving organizational and ecological resilience (Harms, L., 2021).

## METHOD

I need to start with a rough range based on forest fires. The first step is to look for key words related to fires, but fires are also divided into different fires, so in the end, I need to carefully identify the scope of forest fires. To identify forest fires, I must understand the definition of forest. The Food and Agriculture Organization of the United Nations (FAO) defines a forest as: "The area is more than 0.5 hectares, the trees are more than 5 meters, the canopy coverage is more than 10%, or the trees can reach up to This threshold of land. Does not include land mainly for agricultural and urban purposes.". On this basis, searching for information related to forest fires will be more precise and accurate. After finding the key words of forest fires, I can proceed to narrow the scope of action. There are forests all over the world, and I are studying the forest fires in Australia, so I can directly narrow the global scope to Australia.

After searching the keywords, facing the still many literature materials, first of all, I need to quickly browse the title. What I need to find is the impact of the Australian forest fire on the environment and the subsequent restoration and protection measures, so I can refer to the "human The humanities materials such as "Psychology" and "Government Responsibilities" are skipped, and the rest of the titles looked at the literature related to my paper needs. Then I need to click in each article for reading research, so that I can make targeted

choices. One of the articles is titled about wild animals after a forest fire. After clicking to read it, I will find that this article is about the scarcity of volunteers for wild animals after the disaster. In this case, this does not meet the paper's documentation requirements. So this article was naturally discarded. Click to read another article to get the reasons for the formation of Australia's forest fires and the influencing factors of their rapid spread. In this paper, how to prevent a fire from recurring is also considered to be one of the important directions, so if I can understand the causes and spreading factors of the fire, it can be of great help to effectively prevent fires or how to suppress fires after they occur. After understanding this, this article was smoothly included in the list of references. Follow this analogy to read other documents until I get enough documents to support the thesis.

In this way, I carefully read and select each article, and finally get enough references, then read each article again, this time it is more detailed and intensive reading than the previous step. When doing this step, it is necessary to clarify which part of the article is needed, and this part will support the argumentation of which point of the thesis. After taking these ideas to read purposefully, record and summarize the necessary places of each document. After all the selected documents have been read, the summarized notes will be analyzed and collected. For the required materials and notes, I will analyze how these materials are helpful to my two research questions, find helpful data and materials in the literature, and organize them into categories. Synthesize or

select documents that can meet the same needs of the paper, and finally sort these summaries according to the argumentation order and argumentation needs of the paper.

## RESULT

After investigation, it was found that:

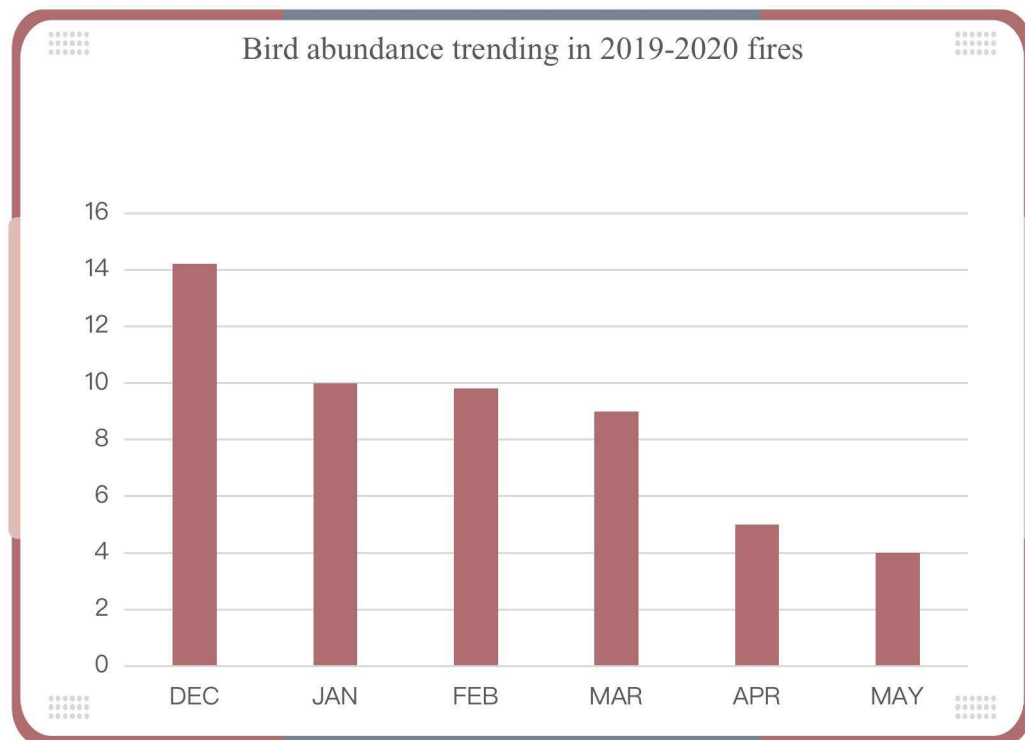


Figure 4 Trends in bird abundance before and after fire. (GREEN and SANECKI, G., 2006)

This picture shows the change in the number of birds before and after the fire, and it can be clearly seen from the picture that the number of birds is a visible reduction in the naked eye.

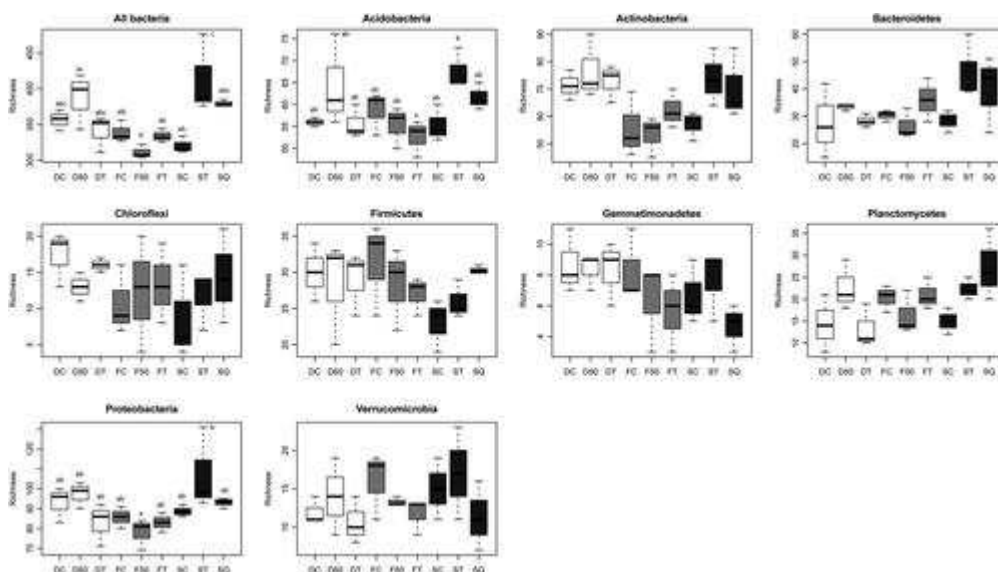


Figure 5 Effects of forest fire protection treatments on bacterial phylum richness (OTU numbers). Site history (n = 3): F, young burned; D, young cleaned; S, aging. Treatments: C, control; 50 and T, partial and full liquidation; Q, controlled burn. Different letters above the bars within each gate indicate statistically significant differences in richness between treatments. (Mediavilla, Geml, J., Olaizola, J., Oria - de - Rueda, J. A., Baldrian, P., and Martín - Pinto, P., 2019)

Environmental response to bushfires			
Identify the situation in advance when the fire occurs	Take the initiative to put out the fire	Recovery after fire	
Use a forest fire hazard index calculated from temperature, rainfall, humidity and wind speed to issue warnings and fire bans to limit accidental ignitions	Take immediate measures to put out the fire when it comes	To better protect biodiversity, high-value environmental assets need to be inventoried	Decades-long forecasts of ecosystem fate are needed given projected extreme climate change A better understanding of how fire interacts with drought and other hydrological changes in the landscape is needed

Table 1 How to deal with fire

## DISCUSSION

I looked at animal deaths in this 2019-2020 bushfire, in which I chose birds as the show species for the conclusion.

Birds play an important role in forests and are an indispensable part of forests. Birds can prey on some insects in the forest, and some plants; at the same time, birds may also be preyed on by some small predators. This food chain relationship between all animals in the same environment helps to prevent overpopulation of one species, which also means that birds play a vital role in maintaining natural ecological balance.

In view of this, the good reproduction of birds plays a very important role in protecting the biodiversity of a forest. The most important part of the sustainable development of the forest is to protect the biodiversity of the forest. Therefore, the destruction of birds by fire is equivalent to a major blow to the biodiversity of the forest, which is extremely harmful to the forest, and at the same time makes it difficult for the forest to recover from the damage of the fire.

From Figure 1, I can see that the fire caused a significant reduction in the abundance of birds in the forest, that is, the content of birds in the forest was greatly destroyed by the fire. This also means that fires do great harm to birds. Given that birds are very important and indispensable to biodiversity, it can be concluded that fires do great harm to biodiversity. The gigantic fire made it difficult for animals to escape and had to be forced to die from the heat of burning and suffocation by dust. When animals die in large numbers, the biological balance is disrupted. The balance of biodiversity is an important part of maintaining the normal operation of forests. Once some species of organisms are hit by fires far

from the equilibrium curve, it will seriously affect other species related to such species, so that they are interlinked. The impact will make the forest's species balance completely disordered, causing the forest to fall into greater harm.

Many factors affect fire, and it can be seen from Figure 2 that there are many reasons for the fire. Climate-wise, the environmental causes of Australia's black summer fires need to be understood in the context of climate change, particularly in hotter, drier, and windier conditions and the severe cumulonimbus events caused by fires leading to catastrophic fires. The flow effect of increased risk. own thunderstorms and hinder containment efforts. Two years of drought and low soil moisture left the vegetation very dry and built up fuel. Record high temperatures (over 40°) and strong warm winds increase the risk of lightning strikes spreading rapidly. (Celermajer, Lyster, R., Wardle, G. M., Walmsley, R., and Couzens, E. 2021)

Geographically, deep burns can be produced by a variety of mechanisms, using enough heavy fuel for various operations on flat, undulating, or rough terrain. These include: (Sharples, Cary, G. J., Fox-Hughes, P., Mooney, S., Evans, J. P., Fletcher, M.-S., Fromm, M., Grierson, P. F., McRae, R., and Baker, P. 2016.)

very strong winds - so the fire moves faster than the back of the burning zone;

Change the wind direction - so the long side of the fire becomes a fast-running head fire;

Outbreak fire behavior - steep slopes can cause fires to accelerate rapidly;

Eddy-driven lateral spread - strong winds and steep terrain interact to rapidly push fires laterally, with downwind spots;

Mass Point - Multiple ignitions coalesce to form a large area of flame.



These geographic factors all contribute to the occurrence and spread of fires.

At the same time, human factors are also a very important cause of fires, such as deliberate lighting for a long time at night or not paying attention to fire prevention measures that should be paid special attention in dry climates, resulting in large-scale fires.

Many factors lead to fires, but there are also many reasons for the expansion of fires. The fires are not contained in the early stage. With the help of geographical factors that facilitate the increase of fires, and the characteristics of trees that are always easy to ignite, it also indicates the difference between forest fires and other fires. They are harder to spot, harder to control, and harder to prevent.

Nutrient levels and mineralization rates in affected soils decline after prescribed burning years, so I can see from Figure 3 that young burnt plots show the lowest bacterial richness. (Mediavilla, Geml, J., Olaizola, J., Oria - de - Rueda, J. A., Baldrian, P., and Martín - Pinto, P. 2019) This may be because most phyla detected at the study sites prefer acidic soils. However, fires tend to increase soil pH due to ash deposition, so young burnt plots may have higher pH than other plots. Therefore, fire can cause changes in bacterial community structure due to an increase in pH, i.e., an increase in soil pH caused by the fire has a significant effect on bacterial community composition.

Therefore, the fire will affect the soil by affecting the microorganisms, and the soil is the cornerstone of the forest composition. The destruction of the substances contained in the soil will cause the forest to suffer considerable damage so that the recovery of the forest after the fire in hand also appears quite difficult.

Because fires are such a serious threat to forests, how to prevent forest fires is very important.

The environmental response to bushfires is divided into three phases: pre-fire preparation; proactive fire suppression; and post-fire recovery. Prevention includes issuing warnings and fire bans to limit accidental ignitions using a forest fire hazard index calculated from temperature, rainfall, humidity, and wind speed. To better protect biodiversity, high-value environmental assets need to be inventoried to guide fire management during the planning and active fire suppression phases. Assets include endangered ecological communities, critical habitats for endangered species, remnant vegetation in good condition, and areas of outstanding environmental value. Given the projected extreme climate change, predictions about the fate of ecosystems over decades are required. I also need to better understand how fire interacts with drought and other hydrological changes in the landscape. Adaptive management processes should be used to conduct ecosystem adaptation experiments and feasibility studies. And governments need to develop and implement policies for injured wildlife response, rescue, and rehabilitation. This includes: Coordinating a framework for emergency management structures; ensuring that wildlife rescue and rehabilitation is integrated into incident management plans and providing guidance to firefighters in handling injured wildlife. (Celermajer, Lyster, R., Wardle, G. M., Walmsley, R., and Couzens, E. 2021)

## CONCLUSION

Bushfires continue to be one of the most common natural disasters in Australia, with devastating effects, causing loss of life and widespread environmental damage. Climate change also plays a role in the intensification and frequency of forest fire seasons, with dry and hot climates greatly increasing the probability of fires. And terrain will also affect the probability of fire, and some terrain will contribute to the spread of fire and lead to further losses caused by fire. At the same time, some human factors such as lighting can sometimes lead to fires.

Fire preparation, active fire suppression, and post-fire recovery are three important responses to fires. When people rebuild after destructive forest fires, they must consider how to enhance the resilience of ecosystems. At the same time, it is also necessary to pay attention to the protection of biodiversity in ecological restoration after fire and to restore residual vegetation and areas with outstanding environmental value. And given projected extreme climate change, predictions about the fate of ecosystems over decades are needed. Finally, complete fire prevention and a correct, reasonable, and efficient reconstruction and recovery plan is carried out.

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