School of Design and the Built Environment
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Adapting Bushfire Policy to Changing Conditions: A Case Study of South-West Western Australia

Simone Louise Ruane
0000-0002-1254-0923

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Author's Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made. This thesis contains no material which has been accepted for any other degree or diploma in any university.

Human Ethics

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007)—updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee, Approval Number HRE2017-0103.

Simone Ruane

Date: 1 February 2022

Abstract

Bushfire is inherent in the Australian environment, and the nation has a long history of bushfire management approaches. However, the impacts of climate change are increasingly apparent, with southern Australia experiencing unprecedented bushfire events that are becoming the new norm. Rapidly changing environmental conditions and disaster risk dynamics call into question the adequacy of traditional bushfire policy approaches. The integration of policies related to climate change, sustainable development and disaster risk reduction must be strengthened. While it has been acknowledged that planned adaptation is critical for enhancing bushfire resilience, the socio-institutional dimensions that may constrain or enable this endeavour are not widely understood. To address this research gap, this thesis presents a case study of bushfire policy in south-west Western Australia (WA) to address the central research question: *What factors influence bushfire policy change, and how can these insights be used to inform planned adaptation to increased bushfire risk?* The case study is embedded in a critical realist framework and follows a qualitative design based on document and interview analysis. This thesis by compilation comprises five journal articles, which together help to answer the research question. Article 1 builds on worldview theory and develops a conceptual framework to analyse the history of bushfire management in south-west WA. Article 2 examines whether and how adaptive governance principles have been applied to bushfire policy in south-west WA. Article 3 compares the historical trajectories of policy integration between the bushfire management and land use planning sectors of south-west WA and Victoria. Article 4 focuses on the challenges of bushfire policy integration and identifies mechanisms that may support a more successful integrated disaster risk reduction approach. Article 5 investigates the role of various bushfire policy strategies for climate change adaptation and their potential for maladaptive outcomes.

The findings from the case study suggest that the socio-institutional context of bushfire policy has changed in four main ways: the framing of the bushfire problem and policy goals, the organisational arrangements, the governance mode and the instrument mix. Bushfire policy changes have been largely influenced by underlying worldviews, major disaster events, diverse actor interactions and social learning. Patterns of bushfire policy change in south-west WA reveal important lessons that may inform planned adaptation to climate-exacerbated bushfire risk. Drawing on these insights, I propose that to successfully adapt to climate change, bushfire management policymakers should adopt a transformative agenda, focus on mechanisms that enable small but continuous changes in worldviews, design a smart mix of hybrid policy instruments, enhance opportunities for post-disaster learning and adopt a more comprehensive and foresighted risk management approach to avoid maladaptation.

Acknowledgement of Country

We acknowledge that Curtin University works across hundreds of traditional lands and custodial groups in Australia, and with First Nations people around the globe. We wish to pay our deepest respects to their ancestors and members of their communities, past, present, and to their emerging leaders. Our passion and commitment to work with all Australians and peoples from across the world, including our First Nations peoples are at the core of the work we do, reflective of our institutions' values and commitment to our role as leaders in the Reconciliation space in Australia.

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First, I extend my thanks to my original and adjunct supervisor, Laura Stocker, for the initial inspiration for the project. Your stimulating ideas and theories in our early discussions provided a strong foundation from which this research has grown.

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To all my co-authors—Mohammad Shahidul Hasan Swapan, Courtney Babb, Constanza Gonzalez-Mathiesen and Alan March—the process of writing articles collaboratively was an experience of social learning in action. It helped me to sharpen my arguments and develop professionally as an academic. Thank you.

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To my beloved husband, Nitsch, I am deeply grateful for your ability to listen and your unwavering support. To my children Noah and Yana, thank you for your encouragement and patience during such a large chunk of your childhood. I finally made it, one sentence at a time.

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Simone Ruane

Date: 1 February 2022

Statement of Contribution

I contributed to the conceptualisation, methodological design, data analysis, writing and editing of all journal articles included in this thesis by compilation.

As the sole author of the following journal articles, I conceptualised the studies and conducted all data analysis and writing:

- Ruane, S. (2018). Using a worldview lens to examine complex policy issues: A historical review of bushfire management in the South West of Australia. *Local Environment*, *23*(8), 777–779. https://doi.org/10.1080/13549839.2018.1467390

- Ruane, S. (2019). Applying the principles of adaptive governance to bushfire management: A case study from the south west of Australia. *Journal of Environmental Planning and Management*, 63(7), 1215–1240. https://doi.org/10.1080/09640568.2019.1648243

As the lead author of the following journal articles, I conceptualised and coordinated the studies and undertook the analysis and most of the writing:

- Ruane, S., Swapan, M. S. H., & Babb, C. (2020). Disaster risk reduction in bushfire prone areas: Challenges for an integrated land use planning policy regime. *Sustainability*, *12*(24), Article 10496. https://doi.org/10.3390/su122410496

- Ruane, S., Babb, C., & Swapan, M. S. H. (submitted for publication). Maladaptive consequences of bushfire policy for the wildland–urban interface.

I made a significant contribution to the conceptualisation, design, data collection and analysis and writing of the following paper:

Gonzalez-Mathiesen, C., Ruane, S., & March, A. (2020). Integrating wildfire risk management and spatial planning—A historical review of two Australian planning systems. *International Journal of Disaster Risk Reduction*, *53*, Article 101984. https://doi.org/10.1016/j.ijdrr.2020.101984

Signed documents from all co-authors confirming my contributions are provided in Appendices C, D and E.

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List of Abbreviations

CCA	Climate change adaptation
COAG	Council of Australian Governments
DRR	Disaster risk reduction
IPCC	Intergovernmental Panel on Climate Change
PPRR	Prevention, preparedness, response and recovery
SDGs	Sustainable Development Goals
SES	Social-ecological system
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
WA	Western Australia
WUI	Wildland–urban interface

Chapter 1: Introduction

1.1 Background

Bushfire is a critical public policy issue and research priority for Australia. While fire is an intrinsic feature of the Australian landscape, anthropogenic climate change is increasing the frequency and severity of bushfires in many parts of the country at an alarming rate (Akter & Grafton, 2021). In southern Australia, the catastrophic impacts of climate-related bushfire events are already apparent. Australia's Black Summer of 2019–2020, during which bushfires blazed across almost 30 million hectares in several states and territories, dismayed the world (Dickman, 2021). These bushfires resulted in the loss of 33 lives, more than 3,000 homes and 100,000 head of livestock (Norman et al., 2021). Moreover, the latest figures indicate that the fires killed more than 3 billion native animals (Dickman, 2021). There is a renewed sense of urgency to reduce bushfire risk at the wildland–urban interface (WUI) of Australia's major cities and growing regional centres, which, despite being highly prone to fire, continue to experience the greatest population growth (N. Levin et al., 2021). The impacts of climate change as well as other novel drivers of vulnerability call into question the adequacy of established bushfire and emergency management policies to deal with the changing dynamics of contemporary bushfire risk.

It is predicted that relative to 1990, extreme fire danger days could increase as much as 100-300% by 2050 if carbon emissions are not urgently reduced (NCCARF, 2015). Australia's Climate Council (2019) and Emergency Leaders for Climate Action (Mullins et al., 2020) consider climate change action the most crucial bushfire policy strategy of this century. Referring to what is expected to be the new normal, Greg Mullins, a leading Australian fire and emergency management expert with over 40 years in the sector, warns, 'We don't know how to fight these fires. Our traditional tools—hazard reduction burning, back-burns, attacking fires at night in the worst conditions—none of that works anymore' (cited in Rolfe, 2021, para. 4).

Baldwin and Ross (2020) argue that integrative policy strategies that support societal adaptation to worsening bushfire conditions are imperative. A growing body of research suggests that adaptation to climate change requires a transformation of governance systems and a redesign of public policy strategies and processes (Glasser, 2020; Novalia & Malekpour, 2020; O'Neill & Handmer, 2012). Thus, a critical investigation into the policy landscape that underpins planned adaptation to increasing bushfire risk is necessary to support this emergent imperative.

1.2 Study Context

1.2.1 A brief history of fire in Australia

Known as wildfires in other parts of the world, bushfires are not a new phenomenon in Australia. Lightning-induced landscape fires have occurred in this part of the world for more than 400 million years, ever since Australia formed part of the supercontinent of Pangaea (D. M. J. S. Bowman et al., 2012). Over long geological time frames, Australian fire regimes changed in response to the availability of flammable vegetation, fluctuations in atmospheric oxygen and natural climatic changes (Mucina & Wardell-Johnson, 2011). During these ancient, pre-human times, much of Australia's vegetation evolved to withstand, depend upon, or promote fire in the landscape (D. M. J. S. Bowman et al., 2020; Burrows, 2008).

The introduction of human-induced fire following the arrival of Aboriginal peoples to the continent some 40,000–60,000 years ago (Prober et al., 2016) had a pronounced impact on the Australian landscape (Pyne, 1991). Aboriginal people applied fire in the landscape for many reasons (Burrows, 2003). In addition to using fire for cooking and warmth, fire was used by Aboriginal people for traditional ceremony and law, to generate food resources by aiding hunting and plant regeneration, and to enable movement (Bowman, 2003; Langton, 1998). Further, according to Langton, et al. (2012), before European colonisation, Aboriginal people had long practised a form of bushfire management by purposely applying fire in the landscape during the cooler seasons to prevent extreme and uncontrolled bushfires during the warmer seasons. Although the effects of Aboriginal burning are highly debated (D. M. J. S. Bowman, 1998; Flannery, 1995; Hopper, 2003), there is evidence to suggest that Aboriginal burning altered fire regimes and the influenced the evolution of biota (Burrows, 2003; Wardell-Johnson et al., 2015). Since European colonisation, human settlement patterns and land use practices have continued to influence Australian fire regimes. More recently, anthropogenic climate change has altered Australian fire regimes by increasing the intensity and frequency of bushfire activity, reducing the opportunity to safely conduct hazard reduction burning and extending the length of the bushfire season (Climate Council, 2019). Accelerating climate change has now resulted in an era of unprecedented and extreme bushfire activity in Australia, which has significant implications for many human settlements (Norman et al., 2021).

1.2.2 Fire in the landscape: bushfire, hazard or disaster?

The term *bushfire* has been used in Australia since European colonisation to describe an uncontrolled landscape fire that spreads rapidly over a large geographical area (Rural and Land Management Glossary Working Group, 2012). Bushfires may be ignited naturally by lightning or by intentional or

unintentional human activity (Ellis et al., 2004; Rural and Land Management Glossary Working Group, 2012). Bushfire is considered a natural hazard because it is a biophysical phenomenon that has the potential to negatively affect human safety, property, assets and other values (Sharples et al., 2016).

A bushfire becomes a disaster when its scale outweighs the capacity of the emergency response to contain it, resulting in substantial negative human impacts (March, 2016) or damage to the natural environment (March et al., 2020). Given their potential to adversely affect humans, bushfires represent a disaster risk in the built environment, particularly at the WUI, where fire-prone forests and vegetation abut and/or surround residential properties and infrastructure (March et al., 2020). During a bushfire, built structures can ignite via direct flame contact, radiant heat or ember attack (Gonzalez-Mathiesen & March, 2018). Figure 1.1 shows that in the past 100 years, several extreme bushfire events in Australia have resulted in the catastrophic loss of lives and residential properties. Between 1911 and 2011, there were 825 known fatalities, the majority of which were civilians, from more than 260 Australian bushfire events (Blanchi et al., 2012). Since then, approximately 60 people have died in Australian bushfires, with 35 of these related to the recent 2020 Black Summer fires (Coates, 2020). The majority of civilian deaths have been associated with people sheltering in, defending or attempting to leave their places of residence (Blanchi et al., 2012; Coates, 2020).

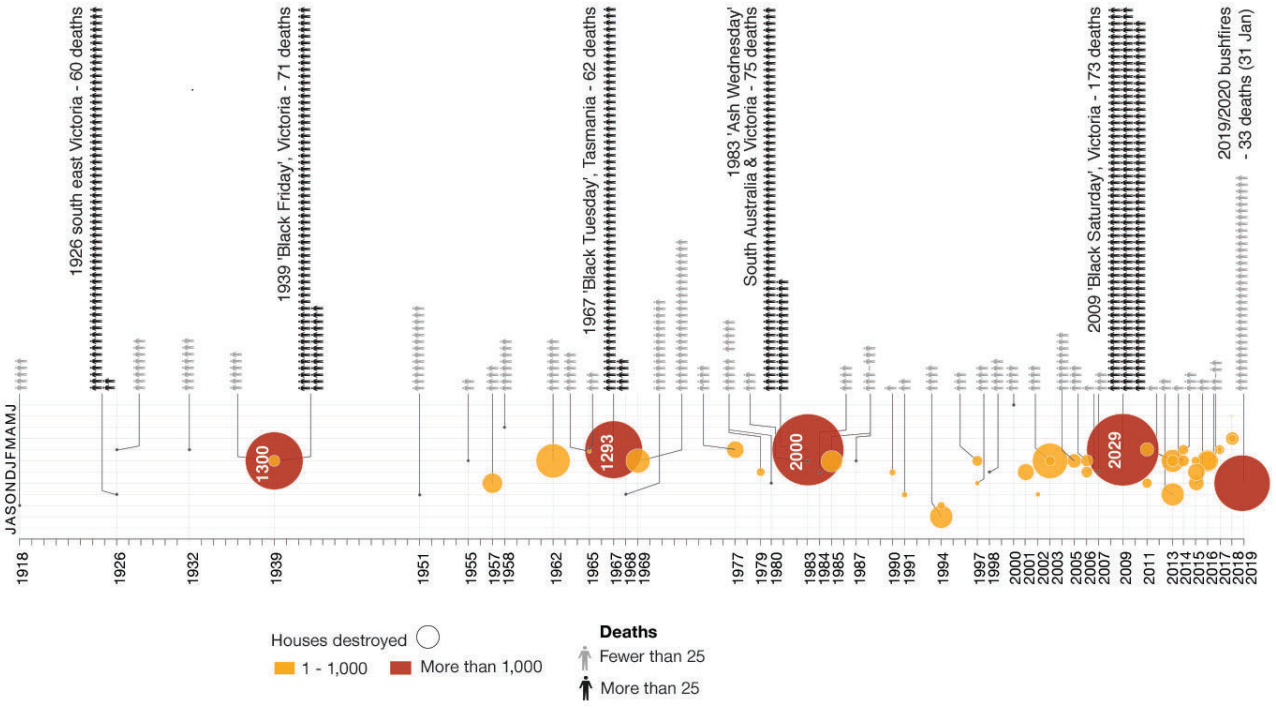

Figure 1.1: Australian bushfire fatalities and residential property loss, 1918–2019.

Note. From *Australia Fires: A Visual Guide to the Bushfire Crisis*, BBC News, 31 January 2020 (https://www.bbc.com/news/world-australia-50951043). In the public domain.

As recent events have demonstrated, the impacts of bushfires span beyond human fatalities and property loss to include injuries and adverse health effects, infrastructure damage, loss of native flora and fauna and the death and injury of livestock and domestic pets (Norman et al., 2021). Bushfires are one of Australia's most frequent and costly natural hazards, with an estimated annual cost of around 8.5 billion AUD per year (Sharples et al., 2016), accounting for 17% of the total annual cost of disasters (Handmer et al., 2018).

1.2.3 Changing fire regimes

Australia has a range of different fire regimes given the diversity of vegetation and weather conditions that characterise the various geographical regions of this vast continent (D. M. J. S. Bowman et al., 2011). Human settlement patterns and land use practices have, and continue to, impact fire regimes by fragmenting landscapes, modifying fuel types, and altering ignition rates (D. M. J. S. Bowman et al., 2011; Moritz et al., 2014). Further, the extent to which anthropogenic climate change and the associated increase in atmospheric greenhouse gases is altering fire regimes is of increasing concern (Baldwin & Ross, 2020), with bushfire activity increasing in most Australian ecosystems as average temperatures rise and rainfall declines (Cary et al., 2012).

While this thesis is a social science study concerned with the changing policy landscape and institutional dynamics of bushfire management, an understanding of how fire behaves is an important starting point. Fire regimes and knowledge of fire behaviour not only guide operational decision-making during incident response but are also critical for informing strategic bushfire policies (Sullivan, 2017) aimed at preventing bushfires or mitigating bushfire risk. In particular, knowledge of fire behaviour guides hazard reduction burning practices (Howard et al., 2020) and is necessary for planning and decision-making regarding the location and design of the built environment in such a way that reduces bushfire risk (March & Rijal, 2015).

Apart from the spatial and temporal variations of fire regimes in different ecosystems and geographical locations, various factors based on scientific principles influence how bushfires behave (Gonzalez-Mathiesen & March, 2018). For example, bushfire ignition requires fuel, oxygen and an ignition source (Nolan & Thornton, 2016). Following ignition, bushfire intensity and speed will depend on a range of factors, including the amount of fuel, weather conditions and topography (Sullivan, 2017). The term *fuel* in the field of fire behaviour describes a combustible material, which in the case of bushfire generally refers to vegetation (both living and dead). Fuel availability and characteristics influence bushfire ignition, flame size and rate of spread (Nolan & Thornton, 2016). In general, the finer, dryer and more abundant the fuel, the more intense the fire (McCaw, 2013). Topography, particularly the slope of the terrain, also plays a significant role in how a fire will behave.

Bushfires burn faster upslope than they do downslope because the heat radiating from the fire preheats and dries out the vegetation situated uphill of the flame front (March & Rijal, 2015). A bushfire front will approximately double in speed with every 10° increase in slope gradient (March & Rijal, 2015). Weather conditions such as wind, humidity, temperature and precipitation and how they interact with the available fuel greatly influence the intensity, spread and flame characteristics of a bushfire (Gonzalez-Mathiesen & March, 2018). Wind speed is the most dynamic variable involved in bushfire behaviour and can promote fire combustion and spread by drying out fuel, directing flames towards fuel and providing a continuous source of oxygen (Sullivan, 2017). Put simply, hot, dry and windy conditions generally lead to greater fire danger and increased risk to life and property.

1.2.4 The governance of bushfire management

Under Australia's federal system of government, the legislative responsibility for bushfire management falls largely within state and territory emergency and forest management departments, with some statutory responsibility delegated to local governments (Forest Fire Management Group, 2014). While the federal government has limited responsibility for bushfire management, it provides funding support and policy guidance, primarily through the National Strategy for Disaster Resilience, the National Disaster Risk Reduction Framework, the Australian Disaster Preparedness Framework and the Crisis Management Framework (Royal Commission into National Natural Disaster Arrangements, 2020).

The national policy agenda for disaster risk reduction (DRR) in Australia is underpinned by the prevention, preparedness, response and recovery (PPRR) approach (Council of Australian Governments [COAG], 2011). Further, Australia's national DRR policy framework is aligned with the international disaster policy objectives of the United Nations Office for Disaster Risk Reduction (UNDRR) (2015) Sendai Framework for Disaster Risk Reduction 2015–2030. The Paris Agreement on climate change (United Nations [UN], 2015a) and the *Sustainable Development Goals* (SDGs) agreed upon in the 2030 Agenda for Sustainable Development (UN, 2015b) have also influenced the direction of DRR in Australia (see Figure 1.2). These global agendas, which emphasise the building of disaster-resilient communities through a risk reduction approach, are being applied to state and local levels for emergency management in Australia. The notion that DRR is a shared responsibility involving a range of agencies, levels of government, volunteers and community members is forefront in the contemporary bushfire policy discourse (McLennan & Eburn, 2015).

Figure 1.2: Overarching frameworks of Australia's natural disaster strategies.

Note. Adapted from *Background Paper: National Natural Disaster Arrangements*, by Royal Commission into National Natural Disaster Arrangements, 2020, p. 6 (https://naturaldisaster.royalcommission.gov.au/system/files/2020-05/Background%20Paper%20-%20National%20Natural%20Disaster%20Arrangements.pdf). Copyright 2020 by the Commonwealth of Australia.

While saving lives is the key objective of Australian bushfire public policies, there are additional, and at times conflicting, objectives related to the protection of property, assets and biodiversity (Williams et al., 2021). Described as a 'wicked' policy problem, bushfire management is a complex and multifaceted issue involving multiple actors with divergent views on the underpinning causes of increased bushfire risk and the most effective solutions to deal with it (Gill & Scott, 2009; Head & Alford, 2015). As Rittel & Webber (1973) point out, there is never a definite solution to a wicked problem, and indeed, any solution is likely to yield consequences that are not immediately obvious, some of which may be undesirable. According to Alhaus et.al (2018), addressing wicked problems through public policy is not about solving the issue, but rather about managing the policy conflicts and unintended consequences through a process of ongoing learning and incremental change.

Significant research has been undertaken to promote adaptation-based policy approaches for DRR (Djalante et al., 2013; Heazle et al., 2013), with more recent studies emphasising the importance of planned adaptation to increasing bushfire risk (Abram et al., 2021; Bosomworth, 2015). *Planned adaptation* refers to deliberate policy actions by governments to deal with climate-exacerbated hazards (Mersha & van Laerhoven, 2018). Previous bushfire policy research has largely focus on the technocratic aspects of planned adaptation to bushfire risk, such as engineered solutions and the

physical dimensions of resilience (Douglas & He, 2019). However, less is known about the socio-institutional dimensions that are likely to influence the success of planned adaptation actions to address increased bushfire risk (Bosomworth, 2018).

Further, despite the shift towards a more precautionary approach, current bushfire policy strategies still fail to adequately address the changing nature of bushfire risk and vulnerability (Bosomworth, 2018; Williams et al., 2020).. The literature suggests that addressing bushfire risk in the face of climate change requires transformative adaptation (Bosomworth, 2018; O'Neill & Handmer, 2012). If we are to transform bushfire policy to enhance climate resilience, we need to understand how bushfire institutions can change and how bushfire policy actors and instruments interact with each other and within the broader policy landscape. Policy research can assist with this endeavour by identifying what drives and constrains policy change, thus informing how policy change can be steered towards climate change adaptation (CCA) (Termeer et al., 2017). Such knowledge is critical for informing intentional policy efforts aimed at adapting to increased bushfire risk. Moreover, an examination of historical policy developments can reveal important lessons for intentional DRR policy interventions (Dovers & Hezri, 2010).

Figure 1.3 schematically contextualises the research problem, the gap in the literature and the specific contribution that this thesis makes to this nascent field of research.

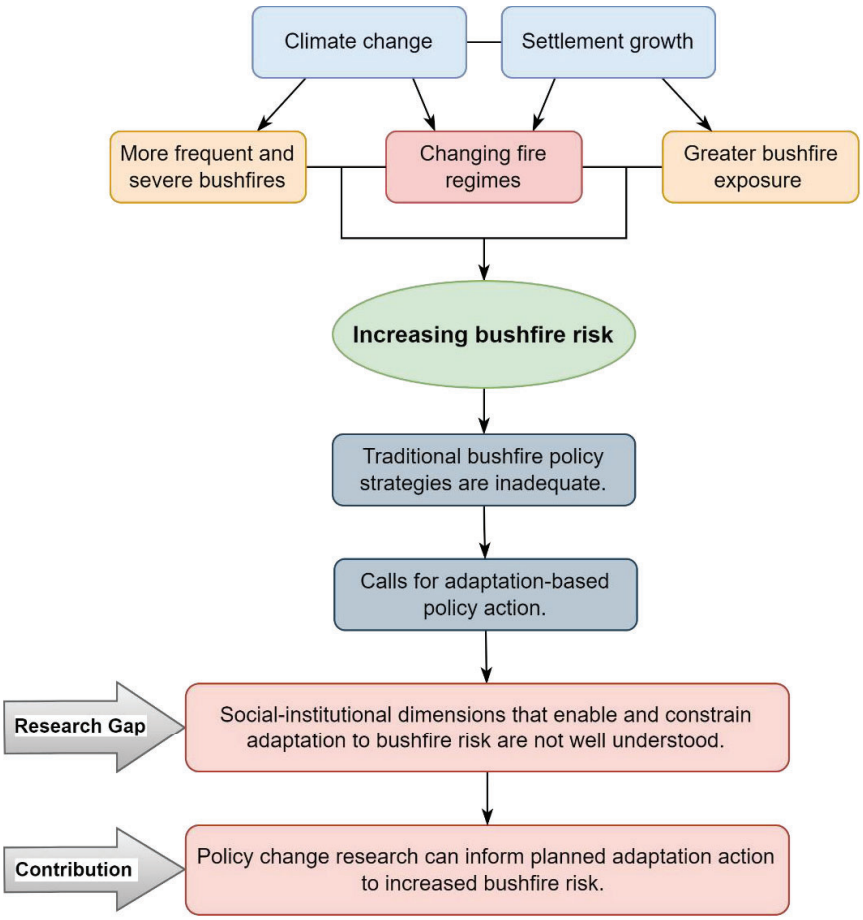

Figure 1.3: Identification of a research gap and specific contribution of this thesis.

Through an in-depth examination of the bushfire policy landscape in south-west WA, this thesis by compilation aims to contribute new knowledge to the fields of DRR and CCA. This includes insights into the socio-institutional dimensions influencing the current and future directions of bushfire policy. The following section outlines the overarching research aim and questions, and how they are addressed by each study presented in this thesis.

1.3 Research Aim and Questions

This thesis is situated in a field of research concerned with the governance of social-ecological policy problems, which are currently exacerbated by climate change and human settlement patterns. A range of discrete yet interrelated theories, reviewed in Chapter 2, form the conceptual framework guiding this research. The aim of this thesis is to enhance the understanding of the nature of bushfire policy change, which may inform planned adaptations to increased bushfire risk. The thesis does not aim to recommend specific bushfire management solutions or ideal CCA pathways; rather, it aims to inform bushfire policymaking by generating insights into the dynamics of bushfire policy change.

This thesis was guided by the following overarching research question: *What factors influence bushfire policy change, and how can these insights be used to inform planned adaptation to increased bushfire risk?* To help answer this question, it addresses the following subquestions:

1. How has the bushfire policy landscape in south-west WA changed since European colonisation?
2. What factors have enabled and/or constrained bushfire policy change in south-west WA?
3. What lessons can we learn from previous patterns of bushfire policy change in south-west WA that may inform the planned adaptation to increasing bushfire risk?

These research questions are addressed in various ways through five academic journal articles. The specific objectives of the journal articles were to examine:

- how worldviews influence bushfire policy change.
- how adaptive governance is applied in bushfire policy and practice.
- the trajectory of policy change towards increased bushfire integration for bushfire DRR.
- the challenges and barriers of an integrated bushfire policy regime.
- the consequences and trade-offs of bushfire policy actions.

An overview of each journal article that is included in this thesis is presented below.

1.3.1 Article 1

Ruane, S. (2018). Using a worldview lens to examine complex policy issues: A historical review of bushfire management in the south west of Australia. *Local Environment*, *23*(8), 777–779.

To understand the current bushfire policy landscape, it is first necessary to gain an understanding of the historical context of the institutional relationships that have contributed to shaping the present system (Petty et al., 2015). Article 1 (see Appendix A) builds upon existing worldview theory (Hedlund-de Witt, 2012) to construct a conceptual framework by which to examine the evolution of complex policy problems in the Australian context. This worldview framework was then applied to an analysis of the policy developments of bushfire management in south-west WA. The article shows how worldviews influence perceptions and problem framing of fire in the landscape and, thus, the policy goals of bushfire management. The overarching argument of this article is that reflecting on how worldviews influence complex policy fields such as bushfire management can contribute important insights into how policy priorities can both change and endure over time. Moreover, the article suggests that fostering an integrative worldview perspective via reflexive practice could assist the sector to adapt to the challenges related to climate change.

1.3.2 Article 2

Ruane, S. (2019). Applying the principles of adaptive governance to bushfire management: A case study from the south west of Australia. *Journal of Environmental Planning and Management*, 63(7), 1215–1240.

Article 2 (see Appendix B) examines the current governance setting and policy discourse of bushfire management in south-west WA. The article presents a more focused case study of the Shire of Augusta–Margaret River, a bushfire-prone local government region located in south-west WA with a rapidly expanding WUI. First, a modified systematic literature review was conducted to identify the key principles of adaptive governance. This was followed by thematic analysis of semi-structured interviews with bushfire and land management practitioners to examine whether and how these principles are applied in practice. The article provides insights into how the normative principles of adaptive governance are influencing the direction of bushfire risk reduction and identifies several factors that can enable and constrain bushfire policy change towards a more adaptive governance mode.

1.3.3 Article 3

Gonzalez-Mathiesen, C., Ruane, S., & March, A. (2020). Integrating wildfire risk management and spatial planning—A historical review of two Australian planning systems. *International Journal of Disaster Risk Reduction*, *53*, Article 101984.

Article 3 (see Appendix C) turns the attention to the adaptive process of policy integration for bushfire risk reduction at the WUI. More specifically, it focuses on the relationship between land use planning and bushfire management and examines how these traditionally independent policy sectors have evolved towards an integrated DRR policy regime. This article is the product of a research collaboration with scholars from The University of Melbourne and was approached as a comparative case study analysis of the land use planning and bushfire management systems of two Australian states—Victoria and WA. Using the qualitative methods of document analysis and process tracing, this article develops a conceptual framework that helps explain the process of policy integration. The article provides important insights into processes of institutional change and adaptation towards integrated DRR.

1.3.4 Article 4

Ruane, S., Swapan, M. S. H., & Babb, C. (2020). Disaster risk reduction in bushfire prone areas: Challenges for an integrated land use planning policy regime. *Sustainability*, *12*(24), Article 10496.

Through an in-depth case study examination of policy integration between the land use planning and bushfire management sectors in south-west WA, Article 4 (see Appendix D) focuses on the conditions that constrain and enable adaptive disaster governance. The qualitative methods of document analysis and semi-structured interviews were used to examine the changing policy landscape towards a more integrated and adaptive bushfire policy system, which is considered necessary for CCA. The article provides insights into the institutional barriers to an integrated approach to bushfire DRR and suggests several mechanisms that may assist a bushfire policy regime to address the challenges associated with integration.

1.3.5 Article 5

Ruane, S., Babb, C., & Swapan, M. S. H. (under review). Maladaptive consequences of bushfire policy for the wildland–urban interface: A case study from south-west Australia. Submitted to *Environmental Science and Policy*, 26 October 2020.

The final article of the thesis (see Appendix E) is based on the premise that while planned adaptation is critical for reducing the impacts of climate-exacerbated hazards, adaptation actions may have broader sustainability implications. Based on a case study investigation of the bushfire policy system of south-west WA, this article addresses the following research questions: What are the key policy strategies for adapting to increased bushfire risk at the WUI? Are there potential maladaptive consequences of these policy strategies that should be considered? The article highlights that while various bushfire policy strategies for reducing the risk to the WUI can be framed as adaptation actions, the potential maladaptive impacts of all bushfire policy strategies should be considered. This article makes a conceptual contribution to the maladaptation literature from a DRR perspective and argues that the successful adaptation to increasing bushfire risk requires a more comprehensive assessment of values and trade-offs across broader scales of space and time.

Table 1.1 summarises the journal articles comprising this thesis as well as their specific research objectives.

Table 1.1: Journal articles and specific research objectives

Journal article	Objectives
Ruane, S. (2018). Using a worldview lens to examine complex policy issues: A historical review of bushfire management in the south west of Australia. *Local Environment*, *23*(8), 777–779	• Develop a conceptual framework to explore how worldviews enable and/or constrain bushfire policy change • Identify mechanisms for the bushfire management sector to foster an integrative worldview perspective
Ruane, S. (2019). Applying the principles of adaptive governance to bushfire management: A case study from the south west of Australia. *Journal of Environmental Planning and Management*, 63(7), 1215–1240	• Develop a conceptual framework of four key principles for adaptive governance and apply these to a case study in south-west Western Australia • Identify mechanisms to support the bushfire policy sector to become more adaptive and integrative in its approach
Gonzalez-Mathiesen, C., Ruane, S., & March, A. (2020). Integrating wildfire risk management and spatial planning—A historical review of two Australian planning systems. *International Journal of Disaster Risk Reduction*, *53*, Article 101984	• Develop a conceptual framework of the pathways towards increased policy integration of bushfire management and land use planning • Identify key drivers of policy change towards an integrated disaster risk reduction regime
Ruane, S., Swapan, M. S. H., & Babb, C. (2020). Disaster risk reduction in bushfire prone areas: Challenges for an integrated land use planning policy regime. *Sustainability*, *12*(24), Article 10496	• Identify the conditions that enable or constrain an integrated policy approach between bushfire management and land use planning • Identify mechanisms to address the barriers and challenges of integration and facilitate more successful integrated disaster risk reduction
Ruane, S., Babb, C., & Swapan, M. S. H. (under review). Maladaptive consequences of bushfire risk policy strategies for the wildland–urban interface: A case study from south-west Australia. Submitted to *Environmental Science and Policy*, 26 October 2020	• Assess the potential maladaptive consequences of various bushfire risk reduction policy strategies • Contribute conceptual understandings and practical insights to reduce the risk of maladaptation

1.4 Significance and Scope

An emerging body of literature is recognising bushfire governance in terms of social–ecological systems (SES) (Ager et al., 2015; Hamilton, Salerno, & Fischer, 2019; Steelman, 2016), and normative models have been developed that promote adaptive and integrated governance for disaster resilience (Djalante et al., 2013; Paton & Buergelt, 2019). However, there is a paucity of evidence regarding the socio-institutional factors influencing planned adaptation to climate-exacerbated bushfire risk (Bosomworth, 2018; Hamilton, Fischer, & Ager 2019). Further, if we are to transform bushfire policy regimes to enhance disaster resilience, an in-depth understanding of how bushfire governance systems function as SESs and influence broader sustainability policy objectives is essential.

A substantial body of bushfire research has focused on the biophysical factors of fire and the corresponding scientific and technical adaptation responses (Furlaud et al., 2018; Sullivan, 2017). Moreover, emerging research is examining the potential impacts of bushfire management practices on specific ecosystem components (Bradshaw et al., 2018; Eales et al., 2018). The value of social

science research that sheds light on the human dimensions of bushfire has gained increasing support over the past decade (Bosomworth et al., 2015; McCaffrey et al., 2013). This thesis is aligned with this research agenda and is guided by an SES research framework. The goal of SES research is not to seek specific knowledge of the various parts of a system but to advance our understanding of the whole system (Folke et al., 2005).

To date, the research on bushfire policy in south-west WA is limited and a critical analysis of policy strategies aimed at reducing bushfire risk to WUI areas in the region, has yet been attempted. South-west WA is one of the most fire-prone and biodiverse regions in the world and has a unique history of bushfire management. Further, over the past five years, the region has experienced major bushfire disasters and seen significant state planning and emergency policy reforms. Therefore, this thesis, which examines the implications of these bushfire policy reforms on the ground, is timely. From a practical perspective, the research will provide Western Australian bushfire policymakers, practitioners and emerging researchers with insights into the socio-institutional and historical context of bushfire management in WA. Moreover, the findings will provide new knowledge to inform the design of adaptive bushfire policy strategies.

From a theoretical perspective, this research builds on a nascent body of research from scholars calling for a transformative adaptation of governance systems towards more sustainable pathways (Bardsley et al., 2015; Bosomworth, 2011; Brummel et al., 2012). While some scholars have sought to link DRR, sustainable development and CCA (Djalante et al., 2013; Munene et al., 2018), the empirical research applying these theories in the context of bushfire policy is limited. This thesis makes a conceptual contribution to understanding climate and disaster policy using a pluralistic approach that connects and applies worldview theory, institutional change, adaptive governance, policy integration and adaptation to provide plausible and insightful explanations of bushfire policy change. The thesis also makes a methodological contribution by applying a relatively novel paradigm of critical realism and employing the method of process tracing to provide a deeper insight into the causal mechanisms influencing bushfire policy change.

1.5 Thesis Outline

This doctoral research is based on a thesis by compilation approach in accordance with Curtin University's (2021) *Guidelines for Thesis Preparation and Submission*. This format provided the opportunity to gain experience in the academic publication process and collaborate with other scholars. Importantly, it produced specific research outputs that could be disseminated back to research participants and their respective agencies, hence informing policy and practice. The thesis comprises four journal articles published in high-quality, peer-reviewed academic journals and one

article currently under review. Each article is a standalone piece, incorporating an introduction, conceptual framework, methods, results, discussion and conclusion. The supporting exegesis situates the articles within an overarching research framework. It provides the background context to the research problem and a deeper understanding of the theoretical foundations, critically discusses the key findings in relation to the overarching thesis question and draws conclusions that summarize the main arguments.

The thesis is organised as follows: Chapter 1 introduces the research problem, the background context, overarching objectives and research questions. Chapter 2 critically reviews the literature and presents the theoretical foundations informing the conceptual framework that guided the research design. Chapter 3 outlines the overarching research paradigm, methodological approach and data collection and analysis methods. Chapter 4 synthesises the key findings of each journal article. Chapter 5 critically discusses the findings in relation to the overarching research questions. Chapter 6 succinctly summarises the findings, reflects on the significance and contribution of the research, acknowledges its limitations and makes suggestions for future work. Appendices A–E present each journal article along with signed contribution statements and copyright release authorisations.

Chapter 2: Theoretical Foundations

Chapter 2 presents the theoretical foundations of this thesis based on a review of a broad range of literature relevant to bushfire policy change and planned adaptation. It discusses several interrelated theories and concepts and explores their relevance to DRR policy development. The chapter begins by outlining SES theory and surveying the related concepts of resilience, vulnerability and adaptive capacity. It then discusses the role of institutions, governance and public policy in dealing with complex policy problems of the twenty-first century. Finally, it summarises the implications of these theoretical foundations for planned adaptation to increased bushfire risk. The objective of the chapter is to explicate various theoretical disciplines relevant to bushfire policy and construct a conceptual framework of the interconnected variables informing the research design.

2.1 Social-Ecological Systems Thinking

The interconnections between people and the environment have been explored in the fields of human ecology and sociology since the 1920s (Bruckmeier, 2016). However, the term *social–ecological systems* was not widely adopted until Berkes et al. (1998) developed a framework to study the mutual interdependency of humans and the environment. Since this time, SES theory has been applied extensively to studies that examine human–environment relationships (Colding & Barthel, 2019), particular in the areas of natural resource management (Pahl-Wostl, 2009), biodiversity conservation (Mitchell et al., 2014) and planning (Wilkinson, 2011). More recently, SES theory has informed studies in climate policy (Fedele et al., 2020), DRR (Cinner & Barnes, 2019; Sarrazin et al., 2018) and bushfire management (Hamilton, Fischer, & Ager; Prior & Eriksen, 2013; Steelman, 2016).

An SES is defined as ‘a system at any scale that includes human and biophysical subsystems in mutual interaction’ (Fennell & Plummer, 2010, p. 247). These systems can range from small-scale interactions, such as between a local community and its immediate environment, to grander-scale interactions that exist between the whole of humankind and the biosphere (Gallopín, 2006). SES scholars are particularly concerned with the feedback dynamics that occur between social and natural systems across multiple scales of space and time (Cote & Nightingale, 2012). Framed within the discourse of sustainability, Folke et al. (2005) argue that social systems and natural ecosystems cannot be understood or managed as separate entities because they ‘have powerful reciprocal feedbacks and act as complex adaptive systems’ (p. 443).

Exponential human population growth, land use and patterns of consumption and production have placed substantial pressure on the Earth system (Gallopín, 2006). Folke et al. (2005) assert that while

the future is uncertain, global SESs are expected to experience more intense natural hazard events as a result of climate change. Given the escalating scale and frequency of natural hazards, coupled with increased human exposure as the global population grows and settlements expand, it is imperative that an understanding of SES dynamics is integrated into public policy (Anderies & Janssen, 2013).

2.1.1 Building the resilience of social-ecological systems

The concept of resilience is central to SES theory. Resilience theories have been applied extensively in environmental and natural resource management since the late 1990s (Berkes et al., 1998; Briske et al., 2008; Folke et al., 2010). More recently, resilience has been adopted by diverse disciplinary fields, including DRR (Folke, 2016; Wenger, 2017) and CCA (Fisichelli et al., 2016; Fünfgeld & McEvoy, 2014). Further, in Australia, the goal of building resilience has become a key priority for governments across various public policy areas, particularly DRR (COAG, 2011; National Resilience Taskforce, 2018). However, like many popular policy concepts, the definition of resilience remains somewhat ambiguous and takes on multiple meanings in different policy sectors. The following section attempts to clarify the highly contested definition of resilience, point out its conceptual limitations and highlight its potential for contributing to policy change processes. It also discusses how the term correlates with the SES sister concepts of adaptive capacity and vulnerability.

Much of the SES literature attributes the concept of resilience to the field of ecology, tracing it back to Buzz Holling's (1973) seminal review article 'Resilience and stability of ecological systems', in which resilience is defined as 'a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables' (p. 14). Holling's ideas on resilience challenged the established assumptions in ecology and natural resource management about the stability of component populations being the key measure of the ecological state. Rather, Holling (1973) described 'another view of the world' that focuses on the 'properties of the system' (p. 1).

This turn towards resilience in ecology was underpinned by observations that ecosystems have multiple points of stability; thus, the capacity of an ecosystem to maintain its core functioning relies on complex nonlinear and cross-scale dynamics (Folke, 2016; Holling, 1973). Holling's (1973) observation that ecosystems are inherently unpredictable highlighted that conventional methods of ecosystem management, particularly in determining sustainable yields, were flawed. Based on this premise, Holling and colleagues were compelled to experiment with novel approaches to ecosystem management that incorporated experimentation, ongoing learning and management modification (Folke, 2016).

Central to the concept of ecological resilience are notions of feedback loops, ecosystem thresholds, tipping points and regime shifts. Feedback loops refer to the mutual interactions and causalities that occur between the various biotic and abiotic variables that constitute an ecosystem (Soto-Ortiz, 2015). Feedback may be either positive or negative. Positive feedback accelerates change, shifting the system towards an alternative state, thereby reducing resilience. Conversely, negative feedback reduces the impact of change by maintaining the stability of an ecosystem, hence supporting resilience (Walker et al., 2004). A trigger resulting from a particular biotic or abiotic variable or a combination of these can induce a switch from negative to positive feedback, which may decrease ecosystem resilience (Briske et al., 2008). Examples of triggers include natural hazards, the introduction of a new species, increased temperature or the use of a particular pesticide. Tipping points and thresholds represent the point at which a system can absorb a disturbance and maintain its core ecological functioning in a largely unchanged state before flipping into a completely new state of functioning (Milkoreit et al., 2018).

Once an ecosystem's threshold is passed, changes occur in the system's feedback loops, which may result in sudden and/or gradual changes towards a new ecosystem state, described as a *regime shift* (Folke et al., 2004). Examples of a regime shift include an ecosystem changing from a forested woodland to a grassland, from a clear lake system to a turbid lake system or from a wetland to a desert (Folke et al., 2004). Regime shifts can have catastrophic ecological consequences such as species and habitat loss and can compromise essential ecosystem services (Kéfi et al., 2016). It has become increasingly apparent that human activities associated with production, consumption and development and some ecosystem management interventions can trigger ecosystem regime shifts. Given the influence of humans on regime shifts, these basic ecosystem principles have been adopted to explain a broad range of social and ecological system interactions.

While the conceptual roots of resilience are commonly credited to the field of ecology, Hollnagel (2014) points out that the term's use in the field of engineering dates as far back as 1818, when it was used in relation to the strength of timber to withstand heavy loads. Thus, the engineering view of resilience relates to the ability of a system to absorb shock or return to its original state following a shock (Thorén, 2014). This interpretation of resilience is largely akin to ideas associated with mainstream economic theory. Hence, definitions of economic resilience resonate with the engineering understanding of resilience and refer to the ability of the economy to return to the status quo following a shock such as a financial crisis or destabilising event (Martin & Sunley, 2015) such as the ongoing COVID-19 disaster.

Holling (1996) asserts that these two distinct interpretations of resilience, both of which are applied in the ecological and environmental sciences, are a source of misunderstanding and conflict. According to Holling (1996), ecological resilience is largely concerned with the reorganisation and adaptation of a system, while engineering resilience is concerned with the resistance and robustness of a system. Holling (1996) argues that these diverging conceptualisations of resilience have significant implications for the management of social-ecological policy problems, and, in some cases, focusing on engineering resilience has the potential to compromise ecological resilience (Holling, 1996).

In addition to ecological and engineering conceptualisations of resilience, the term was also used in the field of psychology prior to the publication of Holling's (1973) seminal article (Olsson et al., 2015). In psychology, resilience is generally applied at the individual level to describe both a personality trait and a process of behavioural adaptation in response to trauma and stress (Olsson et al., 2015; Thorén, 2014). The concept of resilience in psychology is largely concerned with how a human functions in the face of adversity. While psychological resilience incorporates mechanistic ideas that resonate with the engineering perspective of 'bouncing back' to a stable state following an adverse event, it also reflects ecological ideas about adaptability (Vernon, 2004). Further, a systems-oriented view considers that an individual's psychological resilience is highly dependent on a combination of variables, including the interactions between individuals and a broad range of environmental factors (Pangallo et al., 2015).

Resilience has burgeoned into an interdisciplinary theory that has been applied ubiquitously to examine the dynamics of complex adaptive systems (Folke, 2016; S. A. Levin, 2002). In the late 1990s, the Resilience Alliance, a collaborative initiative between the Beijer Institute in Stockholm and the University of Florida, was established and has since published groundbreaking resilience-focused research (Folke, 2016). In this line of resilience scholarship, the basic principles of ecosystem resilience have been transposed to other fields to understand societal capacity to cope with environmental change and disturbance events (Berkes et al., 1998). Notably, over the past two decades, the concept of social resilience, defined by Adger (2000) as 'the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change' (p. 347), has been widely applied in the social sciences (Cote & Nightingale, 2012).

While resilience thinking has made valuable analytical contributions to social research, the application of ecological concepts to social systems has attracted the criticism of both ecologists and social scientists (Keck & Sakdapolrak, 2013). Many scholars argue that transposing ecological

concepts onto social entities fails to acknowledge the inherent differences that exist between the structures of social institutions and ecosystems (Cote & Nightingale, 2012). Others have expressed concern that employing the definition of resilience too broadly has compromised its original conceptual intent (Keck & Sakdapolrak, 2013). According to Chaffin and Gunderson (2016), applying an ecological theory of resilience, originally concerned with biophysical shocks, to social entities disregards the structural dynamics of society. Therefore, Cote and Nightingale (2012) argue that any analysis of resilience should carefully consider normative questions regarding the resilience of what, for whom and at what cost (p. 479).

The Resilience Alliance's research has been largely concerned with how institutional and ecological resilience may be combined for the overall benefit of SESs (Colding & Barthel, 2019; Cote & Nightingale, 2012). However, where ecosystem resilience focuses on the capacity of a system to persist and maintain its function and structure, social-ecological resilience emphasises the role of disturbance in the renewal, adaptation and even transformation of social systems towards sustainable development pathways (Folke, 2006, 2016). According to Keck and Sakdapolrak (2013), the concept of resilience has evolved through three conceptual phases: initially, in relation to ecosystems, it was focused on the persistence of system functioning; next, as it expanded to SESs, it began to focus on learning and adaptability; and most recently, it is focused on the transformation of society and governance structures in the face of global environmental crises.

Resilience has developed into what is referred to as a boundary concept—a mechanism that enables interdisciplinary communication and learning between the once discrete social and natural science communities (Baggio et al., 2015; Keck & Sakdapolrak, 2013). Moreover, given that transitions towards sustainability impinge on such a transdisciplinary endeavour, resilience has become an integral part of the sustainability vocabulary (Thorén, 2014). The related concepts of adaptive capacity and vulnerability are essential for understanding what constitutes a resilient SES and how resilience can be cultivated (Folke et al., 2002).

2.1.2 Adaptive capacity: the source of resilience

Concomitant to theories of SES resilience is the concept of adaptive capacity. From an SES perspective, the term is largely concerned with the diversity of institutions and networks (Folke et al., 2002). The term *adaptive capacity* is often applied synonymously with resilience. This is reflected in Plummer and Armitage's (2010) definition of the term as 'the capability of a social–ecological system to be robust to disturbance, and to adapt to actual or anticipated changes' (p. 6). In addition, adaptive capacity is presented in the literature as both a product and outcome of resilience. However, to differentiate adaptive capacity from resilience, some authors define it as the determinants or sources

of resilience (Keck & Sakdapolrak, 2013). In this thesis, adaptive capacity is considered the various types of resources (e.g. human, social, economic, natural and physical) available within the SES (Keys et al., 2014) as well as the social processes, networks and institutional structures available to leverage these resources (Plummer & Armitage, 2010; Smit & Wandel, 2006).

Thus, adaptive capacity may be conceptualised as a dynamic institutional process (Matthews & Sydneysmith, 2010) and an essential ingredient for enabling adaptation (Adger et al., 2005; Bettini et al., 2015). According to Folke et al. (2003), four critical factors that interact across time and space underpin adaptive capacity, hence the resilience, of an SES: (i) accepting and learning from change and uncertainty; (ii) encouraging diversity and drawing from social memory; (iii) including and combining different forms of knowledge; and (iv) enabling self-organisation and addressing cross-scale dynamics. In the face of complex social-ecological challenges, flexibility and experimentation with novel solutions as key dimensions of adaptive capacity are also emphasised in the literature (Bohensky et al., 2010; Plummer & Armitage, 2010).

While the elements of resilience and adaptive capacity vary between communities and regions (Smit & Wandel, 2006), it is generally agreed in the literature that the greater the adaptive capacity, the more resilient, thus less vulnerable, the SES will be when experiencing a sudden disturbance such as a natural hazard event (Pahl-Wostl, 2009). For example, communities characterised by high levels of adaptive capacity generally have a greater ability to prepare for hazards, distribute resources during an event and mobilise recovery efforts following a disaster (Smit et al., 2001).

2.1.3 Vulnerability

Vulnerability is another key concept central to SES thinking and, similar to the concept of resilience, has been applied specifically to ecological systems (Weißhuhn et al., 2018), social systems (Ingham & Redshaw, 2017) and SESs (Berrouet et al., 2018). However, unlike the concepts of adaptation and resilience, vulnerability has its conceptual roots in the field of natural hazards and risk assessment (Eakin & Luers, 2006). In the risk/hazard context, Blaikie et al. (2014) define vulnerability as 'the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard' (p. 11). As evident in this definition, vulnerability has conceptual links to both resilience and adaptive capacity. However, Eakin and Luers (2006) point out that the risk/hazard approach to vulnerability is primarily concerned with the likelihood of an individual or social group to be exposed to a physical threat and its negative consequences.

Following its emergence in the natural hazards field, the concept of vulnerability attracted the attention of political ecology scholars (Eakin & Luers, 2006). Political ecologists provided an alternative interpretation of vulnerability, highlighting the limitations of the focus on physical exposure in hazard research and its failure to consider the structural and political dimensions. (Adger, 2006; Eakin & Luers, 2006). The political ecology field offered what Adger (2006) refers to as 'entitlements-based explanations of vulnerability' (p. 270). In the social science realm, vulnerability is more than a function of the probability and consequences of hazard exposure but as a dynamic condition determined by a range of social inequality factors associated with resource distribution, class, historical marginalisation, gender and agency. (Adger, 2006; Eakin & Luers, 2006). Through this lens, vulnerability scholarship focused on who is vulnerable, why they are and what makes them more vulnerable than others. (Eakin & Luers, 2006). This vein of research sheds light on the reasons why the most socially marginalised groups are generally the most heavily affected by hazards (Adger, 2006).

Given the term's association with the study of natural hazards, vulnerability has become an integral priority of the Intergovernmental Panel on Climate Change (IPCC) and an assessment dimension for predicting the diverse impacts of climate change for different geographical areas and social groups (Eakin & Luers, 2006). A plethora of vulnerability assessment models have been developed by scholars to better understand a wide range of social and environmental threats and their potential to negatively affect human wellbeing (Plummer & Armitage, 2010). These threats include sudden and largely unexpected shocks to SES systems, such as the Australian Black Summer bushfires of 2019–2020, as well as slower-onset, incremental stresses that place pressure on systems over time, such as land degradation and ocean acidification (Gallopín, 2006).

Vulnerability is generally determined by three main variables: exposure, sensitivity and adaptive capacity (Adger, 2006). Exposure relates to the probability of a hazard occurring (Weißhuhn et al., 2018) and the scale and duration at which a system experiences the disturbance (Gallopín, 2006). Sensitivity relates to the susceptibility of a system (Weißhuhn et al., 2018) in terms of the extent to which the system can absorb the disturbance before reaching its threshold and shifting into another state (Adger, 2006). Adaptive capacity, as described in the previous section, refers to the ability of a system to cope with a disturbance based on its resources, diversity and characteristics that enable adaptation actions (Bohensky et al., 2010).

Vulnerability is generally framed negatively as the antithesis of resilience, a deficit of adaptive capacity, a propensity for loss (Eakin & Luers, 2006) or a susceptibility to harm (Adger, 2006). However, other scholars point out that vulnerability is not always a negative condition because it can

provide an opportunity for positive system transformation (Gallopín, 2006). Nonetheless, most of the literature on vulnerability focuses on either developing indicators for measuring vulnerability (Ellison, 2015; Fuchs et al., 2012; Malekmohammadi & Jahanishakib, 2017) or suggesting mechanisms for reducing vulnerability (Masterson et al., 2014; M. M. Rahman et al., 2018). Many scholars have discussed policy measures that enhance community resilience as crucial for reducing the vulnerability of humans to adverse climate hazards (Berkes, 2007; Janssen et al., 2006).

2.2 Institutions and Governance

Institutions and governance are critical to building community resilience, reducing vulnerability and mobilising the adaptive capacity of SESs (Munaretto et al., 2014). Adaptive capacity is ultimately determined by institutional factors, which enable or constrain social entities to cope with and adapt to change and disturbances (Gupta et al., 2010), and governance structures, which shape individual and collective behaviours and action (Brockhaus et al., 2012). However, the terms *governance* and *institutions* are used in the academic literature and government policy discourses disparately, and at times, interchangeably. In this section, these key concepts, which are integral to SESs and public policy research, are differentiated and defined.

2.2.1 The role of institutions

Institutions can be defined as the rules and norms embedded within a social system that influences how humans behave and interact (Hodgson, 2006). Some scholars argue that institutions are important for maintaining the social order, stability and predictability of a social system (Beunen & Patterson, 2016; Plummer & Armitage, 2010). However, others highlight that institutions may be either negative or positive, effectual or ineffectual (Pahl-Wostl, 2009). Institutions may also be formal (e.g. laws, constitutions and contracts) or informal (e.g. culturally embedded social norms, customs and protocols). Formal institutions tend to be overt and are established through governmental regulations, policies and guidelines, whereas informal institutions may be imperceptible and are established through tacit codes and unwritten behavioural norms (Handmer & Dovers, 2013; Pahl-Wostl, 2009).

While the term *institution* is often used interchangeably with *organisation*, institutions are more than organisational structures—they are ‘historically grown and solidified rules, values, norms, and patterns’ (Kickert & van der Meer, 2011, p. 476). However, while organisations are not considered institutions under this definition, they are what Handmer and Dovers (2013) describe as ‘manifestations of underlying institutions’ (p. 38). This is because organisations generally become institutionalised when rules, norms and values become firmly embedded and permeate organisational culture and practice (Fleck, 2007). Understanding the characteristics of institutions and how they

change over time and comparing the institutional dynamics of different geographical locations and jurisdictions is essential to public policy and governance research (Beunen & Patterson, 2016; Capoccia, 2016). Moreover, Dovers and Hezri (2010) argue that understanding the nature and functions of institutions and how they influence policy change is critical to CCA.

While institutions are characterised by a degree of persistence and robustness, new institutional theories highlight that institutions are not fixed but dynamic and can change and adapt over time (Handmer & Dovers, 2013). Understanding how institutions persist or change over time can be explained by two key theoretical concepts: path dependency and critical junctures. According to the path dependency concept, once a particular institution has been established, it can become highly stable and resistant to change (Sorensen, 2015), maintaining a state of inertia or equilibrium (Kickert & van der Meer, 2011). Numerous institutional change studies have demonstrated that the longer institutional patterns have been entrenched, thus more deeply the rules, norms and operating systems are embedded, the more resistant a system (organisational, political, economic or social) will be to change (Sorensen, 2015), resulting in what is described as the 'lock-in effect' (Kay, 2005). The path dependency concept reinforces that history matters (Pierson, 2004) because past institutional patterns and the sequencing of events may determine future arrangements and constrain the possibility of adopting alternatives (Mahoney, 2000). Thus, the historical context of organisations, institutional formation and patterns of change play a critical role in shaping governance arrangements and policy priorities (Sorensen, 2015). Historical institutionalism is the strand of institutional change research specifically interested in path dependency, critical junctures and the sequencing and timing of events, all of which are a particular focus of this thesis (Capoccia, 2016).

Given the inertial characteristics of institutions, many scholars agree that institutional change typically occurs incrementally unless the system experiences a significant exogenous shock (Hogan, 2019). In institutional theory, this shock is referred to as a *critical juncture*, a turning point that punctures the equilibrium of stability, forcing institutions to suddenly break down or be recalibrated (Streeck & Thelen, 2005). Much of the institutional literature posits that given the stability of institutions, critical junctures are necessary for radical institutional change to transform a social system (Sorensen, 2015). With respect to policymaking, a critical juncture event may provide a level of instability that enables policy actors and decision-makers to challenge and repudiate existing policies, introduce new policy instruments and establish alternative organisational arrangements (Roberts & Geels, 2019). However, Kickert and van der Meer (2011) assert that critical juncture moments are rare and that radical change is seldom the result of a single sudden event. Further, the authors suggest that while external shocks or disturbances such as disasters are important

breakthrough moments that can accelerate change, they are 'merely the "trigger" that shakes loose the stuck and rigid institution, while the "real" reasons for change lie elsewhere' (Kickert & van der Meer, 2011, p. 480). Several scholars assert that the accumulation of small, gradual changes to institutional configurations do matter and, over time, can result in major institutional change once a threshold or tipping point has been passed (Kickert & van der Meer, 2011; Termeer et al., 2017). This demonstrates clear conceptual links between the ideas emanating from institutional and SES theories, both of which are concerned with understanding the dimensions and drivers of system stability and change.

Other institutional scholars are more concerned with the role that actors and actor coalitions play in designing institutions (Pahl-Wostl, 2009), both consciously and unconsciously (Manzi & Jacobs, 2015). An actor, as defined in this thesis, refers to either an individual or a group of individuals (e.g. a legal entity or social group) that constitutes a particular social system or institutional domain (Knoepfel et al., 2007). Actor-centred institutionalist approaches posit that actors and institutions are mutually constitutive and interdependent (Scharpf, 1997). Advocacy coalitions are an aggregation or a network of actors who share common interests, experiences and/or values and can represent various government, private or civil society sectors that influence or are influenced by public policy (Jenkins-Smith & Sabatier, 1994). According to Jackson (2010), actors are 'players of the game', both shaping and being shaped by institutional rules; therefore, 'to understand an institution, one must look at both the rules and the players, seeing each as an interdependent context for the other' (p. 66). As noted by Beunen and Patterson (2016), institutions are maintained, eroded or altered by the ongoing interactions and behaviours of the actors that comprise a governance system.

2.2.2 Understanding governance

Although inextricably linked to the formal structures of government, governance is considered a much broader concept than government. Folke et al. (2005) define governance as the 'structures and processes by which people in societies make decisions and share power' (p. 444). Hence, governance expands beyond the structures of formal government and includes all formal and informal institutions and actors and the cross-scale interactions between them, which influence how societal matters are addressed (Adger & Jordan, 2009; Pahl-Wostl, 2009). The concept of governance is intrinsically linked to institutions, thus can be conceptualised as an institutional framework that underpins social system functioning (Rijke et al., 2012). According to Young (2013), 'governance is a social function centered on steering human groups toward desired outcomes and away from undesirable outcomes' (pp. 88–89).

While the terms *government* and *governance* are repeatedly differentiated in the public policy literature, 'governance is what governments do' (Paavola, 2007, p. 94). Governments are a major player in all governance systems through their enactment of public policy (Howlett & Ramesh, 2014). Public policy involves conscious governmental decisions that affect the behaviour of governance actors, and while public policies may be influenced and implemented by a broad range of actors, government bureaucracies generally maintain authority over public policy (Howlett & Cashore, 2014). According to Howlett and Cashore (2014), governments use public policy to 'change or maintain some aspect of the status quo' (p. 17). For Althaus et al. (2018, p. 9), public policy is 'an authoritative response to a public issue" and can be understood as a decision-making framework that is intentional, structured, political and programmatic.

Public policymaking is the process of matching specific societal goals with the means of achievement, thus is structured by a process that includes (i) a particular framing of a societal problem to be addressed by a policy; (ii) the development of specific policy goals; and (iii) the design of a policy instrument or mix of instruments, which are the various mechanisms implemented to achieve the goals (Rouillard et al., 2013). A policy instrument mix refers to a bundle of instruments used by a government to address a particular policy problem (Howlett et al., 2017). Althaus et al. (2018) present a taxonomy of seven common policy instruments that Australian governments use to achieve policy objectives which include advocacy, networking, money, action, law, behavioural economics and narrative. These authors argue that good public policy relies on government selecting the best mix of policy instruments to address the policy problem at hand, and good governance requires a functional public policy process committed to continual improvement (Althaus et al. 2018).

Throughout the sustainability and social-ecological literature, it is strongly argued that the transformational societal change needed to ensure a sustainable future requires new modes of governance (Tenbensel, 2005). Governance modes are underpinned by specific institutional logics that predetermine the degree to which governments share decision-making power with broader social actors and greatly influence the preferred instrument choices (Howlett, 2009; Pahl-Wostl, 2009). Three main modes of governance characterise modern bureaucracies: hierarchical governance, market governance and network governance (Thompson et al., 1991).

Hierarchical governance, comprising formal institutions and public bureaucracy, is the traditional form of government in Western democracies. Public policymaking and decision-making processes in a hierarchical governance system rely primarily on the 'expert' administration of governmental actors (Pahl-Wostl, 2009). Also referred to as a command-and-control regime, hierarchical governance is structured around a pyramid of top-down decision-making authority, rigid procedures and clearly

defined roles and responsibilities (Evans, 2012). This mode tends to focus on single management issues and favours regulatory instruments, which are inherently inflexible but are perceived to provide a clear directive to achieve specific outcomes (Evans, 2012).

Market governance is a more recent mode of governance that emerged in the 1980s–1990s and is largely based on the view that hierarchical governance cannot adequately address the cross-sectoral, multi-actor nature of contemporary societal problems (Meuleman & Niestroy, 2015). Market governance represents a shift from government service provision and regulation to market-based alternatives, resulting in an era of privatisation, deregulation and public sector contraction (Howlett & Ramesh, 2014). Market governance approaches are overseen by both formal institutions (e.g. taxation, insurance and property rights) and informal institutions (customer relations, cooperation and trust), thus constitute a combination of both government and non-government actors (Pahl-Wostl, 2009). However, market governance is contingent on minimal government regulation, and the main role of government is the correction of market failure (Howlett & Ramesh, 2014). This mode of governance favours policy instruments based on competition, efficiency and incentives (Evans, 2012).

In recent years, there has been a growing focus on network governance. While network governance involves both government and non-government actors, proponents of this mode strongly emphasise the role of informal institutions such as trust and shared goals for governing societal issues (Pahl-Wostl, 2009). Therefore, this mode of governance favours instruments that foster collaboration, integration and learning across diverse actor networks (Evans, 2012; Howlett & Ramesh, 2014). In contrast to the hierarchical mode of governance, network governance has a flatter, decentralised structure (Maes et al., 2018). Numerous studies postulate that network governance is important for addressing sustainability problems (Bixler et al., 2016; Scarlett & McKinney, 2016), social-ecological challenges (Lubell et al., 2017; Luthe et al., 2012) and, more recently, DRR (Bosomworth et al., 2017; Howes et al., 2015).

While this typology of market, hierarchical and network governance is a useful heuristic device for examining governance systems and instrument choices, most policy regimes and public administrations include a mix of different modes and instruments (Tenbensel, 2005). Further, Howlett and Cashore (2014) caution that all governance modes are susceptible to failure. Effective governance transitions require the consideration of the intended policy goals, the availability of resources and the alignment of various governance modes and their instrument preferences with the problem at hand.

2.2.3 Governance of social-ecological systems

An influx of SES research is calling for more adaptive modes of governance that consider inherent social-ecological relationships, acknowledge human-induced climate and environmental change and facilitate societal transformation towards a more sustainable future. Adaptive governance is a network governance approach that relies on diverse actor interactions across multiple governing scales to address complex social-ecological policy problems (Rijke et al., 2012). Adaptive governance scholars have highlighted the limitations of both hierarchical governance, which tends to focus on discrete environmental problems (Folke et al., 2005; Plummer & Armitage, 2010), and market-based approaches to privatisation, which often result in negative unintended consequences (Rijke et al., 2012). Other adaptive governance scholars criticise the dominant hierarchical and market governance approaches for failing to account for the complexity and uncertainty of the environmental problems facing contemporary society (Abrams et al., 2015; Chaffin et al., 2014). This complexity includes the multiple management objectives, diverse values and various risk perceptions that influence how a social-ecological policy problem is framed and managed (Renn & Klinke, 2013).

Since making its debut in the seminal work of Dietz et al. (2003), adaptive governance has been increasingly presented as a governance approach that is better suited to addressing the complexities of SESs and building the resilience needed to cope with environmental change and disturbances (Chaffin et al., 2014). Folke et al. (2005) argue that adaptive governance is necessary to prevent SESs 'deteriorat[ing] into undesired states' (p. 455). Moreover, adaptive governance may be helpful in building the adaptive capacity needed to address climate change successfully and sustainably (Chaffin et al., 2014; Djalante et al., 2011; Munene et al., 2018).

2.3 Disaster Governance

A recognition of changing risk dynamics and the rise of SES thinking has resulted in growing support for new disaster governance models (Cavallo & Ireland, 2014). Adaptive governance has received substantial attention in the natural resource and environmental management literature (Chaffin & Gunderson, 2016; Gunderson & Light, 2006; Schultz et al., 2015), where it is presented as a more effective governance model than the traditional command-and-control approach to addressing contemporary environmental challenges. More recently, SES theory and its underpinning concepts of resilience and adaptability have become important conceptual tools and focal policy priorities in the field of DRR, particularly with respect to natural hazards. The recognition that many hazards have interconnected and mutually dependent social and environmental dimensions, which influence the vulnerability and resilience of communities, has resulted in calls for more integrated and adaptive

approaches for DRR. (Munene et al., 2018; K. Smith & Lawrence, 2018; Walch, 2018). This section outlines the influence of resilience and adaptation-based concepts for DRR.

2.3.1 Disaster resilience

The concept of resilience has been embraced by emergency management and disaster policy scholars, both in Australia and abroad (Gajendran & Oloruntoba, 2017). During the 1990s, the International Decade for Natural Disaster Reduction, the focus of disaster management was on vulnerability (Tierney, 2012). However, by the early 2000s, the focus had turned to the need for resilience (Parker, 2020). The importance of building resilience for DRR gained international prominence following the release of the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters (UNDRR, 2005). The resilience objective was again reiterated, this time with a sense of urgency, in the UN's Sendai Framework for Disaster Risk Reduction 2015–2030 (UNDRR, 2015), the Paris Agreement on climate change (UN, 2015a) and the SDGs of the 2030 Agenda for Sustainable Development (UN, 2015b). Since then, resilience has become an overarching objective of 45 member countries of the Organisation for Economic Cooperation and Development, in what Parker (2020) describes as a 'resilience revolution' (p. 1). This includes the Australian Government, as reflected in the National Strategy for Disaster Resilience (COAG, 2011) and the National Disaster Risk Reduction Framework led by the National Resilience Taskforce (2018).

The UNDRR (2009) defines disaster resilience as

> the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. (p. 24)

This definition resonates strongly with the engineering perspective of resilience because it refers to the resistance and robustness of a system and its ability to bounce back to its previous state. However, in the more recent Sendai Framework (UNDRR, 2015), resilience is presented as both a social condition, determined by the vulnerability of a community, and a measure of the durability of the built environment. Risk reduction practices that anticipate, prepare for and reduce disaster risk are emphasised as the main mechanism for strengthening resilience and achieving sustainable development. Further, the increasing focus on reducing risk and enhancing resilience represents a paradigm shift from conventional emergency and disaster management, which relies on the formal institutions of government and focuses primarily on disaster response, to a preventative approach that relies on the shared responsibility of both government and non-government actors (UNDRR, 2015).

Most definitions of resilience in the DRR literature reflect the Sendai Framework's reference to the capacity of social systems to withstand and bounce back from disaster events. However, influenced by SES thinking, the concept of disaster resilience is shifting its focus to incorporate notions of longer-term strategic planning and transformative adaptation (Aldunce et al., 2014). It can be observed across the disaster literature and policy discourse that disaster resilience draws on all disciplinary understandings and definitions of resilience (see section 2.1.1) to a greater or lesser extent. This is evident in existing studies that have found several framings of disaster resilience in the public policy literature, each influenced by a different disciplinary understanding of the concept of resilience (Aldunce et al., 2014; Parker, 2020; Wenger, 2017).

The dominant framing of disaster resilience in the Australian policy discourse is mechanistic and technocratic (Aldunce et al., 2014; Parker, 2020; Wenger, 2017). This frame reflects a modern worldview perspective and aligns with the engineering understanding of resilience, which focuses on bouncing back after a disaster event. A mechanistic disaster resilience framework favours rational, expert-driven technical solutions for building resilience such as emergency warning systems, avoiding exposure and improved infrastructure to withstand disturbance (Wenger, 2017). Thus, it is more compatible with the traditional hierarchical governance system discussed in section 2.2.2.

A community-based framing of resilience is also prevalent in the Australian disaster policy discourse (Aldunce et al., 2014). This framing draws from the psychological and social science understandings of resilience, and solutions for building resilience generally focus on addressing underlying vulnerabilities and fostering self-reliance. Moreover, this resilience frame places a higher value on local knowledge, community engagement and social capital. Another, albeit less common, resilience frame identified by Aldunce et al. (2014) and Bosomworth et al. (2014) is the sustainability frame, which is based on a social-ecological understanding of resilience that values adaptation and learning. According to this frame, humans cannot necessarily control nature and avoid disaster exposure but must learn to live with uncertainty by enhancing their adaptive capacity.

Similarly, Parker (2020) differentiates between two perspectives of resilience—static and dynamic—in the disaster policy literature. The static view of resilience focuses on the capacity to return to pre-disaster conditions, while the dynamic perspective of resilience focuses on the adaptive building of institutional capacities to improve, adjust, change and even transform systems (Parker, 2020).

In contrast to the static resilience goal of 'bouncing back', the dynamic interpretation of resilience is generally described as a 'bouncing forward' (Wenger, 2017). However, Wenger (2017) observes that bounce forward approaches to resilience building are limited in practice, and, more commonly, disaster resilience–building policy strategies are based on reactive, technocratic, post-disaster

adaptation measures such as the upgrading of infrastructure or increasing funding allocations to an existing measure. The author highlights that while such actions may seem adaptive and are perhaps an improvement on the pre-disaster situation, they tend to focus on reducing exposure and improving resistance in the short term and may create path dependencies that could result in longer-term maladaptation (Wenger, 2017). According to Wenger (2017), disaster resilience is not a new policy framework per se but has been superimposed over the existing PPRR policy framework for emergency management that was adopted throughout Australia in the late 1970s and early 1980s. Therefore, it can be argued that the use of resilience as a guiding framework for DRR is limited unless it is integrated with a CCA framework, which provides opportunities to assess disaster resilience–building measures in light of longer-term strategic objectives (Heazle et al., 2013).

2.3.2 Climate change adaptation

Adaptation is conceptually related to social-ecological resilience, adaptive capacity and vulnerability and has emerged as a critical policy priority for addressing the climate crisis of the twenty-first century. Like resilience, the term has its conceptual roots in the natural sciences but infiltrated the social sciences following its use by the cultural ecologist Julian Steward (1955) in his seminal work, *Theory of Culture Change: The Methodology of Multilinear Evolution* (Smit & Wandel, 2006). Adaptation has subsequently been adopted by a range of disciplines, including psychology, anthropology, sociology and geography (Simonet, 2010; Smit & Wandel, 2006). While adaptation is presented as both an action and an outcome, some scholars argue that it is best understood as an ongoing process aimed at reducing vulnerabilities and achieving greater resilience (Heazle et al., 2013; Nelson et al., 2007). Thus, adaptation can be conceptualised as the process or actions taken to adjust and cope with changing conditions, while resilience may be conceptualised as the outcome or measure of those adaptation actions. Adaptive capacity is considered both a prerequisite and an outcome of adaptation action (Adger et al., 2005; Nelson et al., 2007).

While the literature on adaptation predates concerns about climate change, since the term *adaptation* appeared in the United Nations Framework Convention on Climate Change (UN, 1992), it has been used predominantly to describe how humans address the immediate and future impacts of climate change (Palutikof et al., 2019). Climate change is an unprecedented driver of environmental change and is having a monumental impact on disaster risk profiles across the world (Birkmann & von Teichman, 2010). In addition to slow-onset climate-related hazards such as sea-level rise, ocean acidification, habitat loss and species extinction, the incidence of extreme sudden-onset natural hazards such as floods, cyclones, bushfires, and heatwaves, across many parts of the planet is increasing (Glasser, 2020; Howes et al., 2012). Climate-exacerbated hazards have catastrophic

implications for humans through direct exposure, potentially resulting in fatalities, injuries and loss of livelihoods (Pelling et al., 2015). Climate-exacerbated hazards also have indirect socioeconomic impacts associated with the disruption of economic activities and the displacement of communities (UNDRR, 2017).

To limit the rate of global warming to 1.5 °C, thus reduce the consequential disaster impacts, urgent climate change mitigation action is needed to reduce the sources and enhance the sinks of greenhouse gases (Masson-Delmotte et al., 2021). Indeed, Glasser (2020) argues that reducing global greenhouse gas emissions as quickly as possible is the most crucial disaster risk policy measure of this century. However, it is now accepted that regardless of humanity's best efforts and haste at mitigating climate change, the impacts are imminent and unavoidable (Field et al., 2012) Although receiving less attention in the disaster policy discourse than mitigation, CCA has emerged as a critical policy agenda for governments and communities (UN Climate Change Conference UK 2021, 2021).

The IPCC defines CCA as the 'adjustment in natural and human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' (Watson & Core Writing Team, 2001, p. 365). Hence, CCA can be understood not only as a response to or preparation for changing climatic conditions but also as an opportunity for innovation and transformation towards more sustainable social-ecological interactions (Glasser, 2020). The adaptation literature differentiates between autonomous and planned adaptation (Mersha & van Laerhoven, 2018), proactive and reactive adaptation (Brown et al., 2017) and incremental and transformational adaptation (Novalia & Malekpour, 2020). Autonomous adaptation refers to the spontaneous actions taken by non-government actors, which are generally unassisted by government agencies, to deal with climate change and its impacts (Mersha & van Laerhoven, 2018). In contrast, planned adaptation refers to the deliberate policy actions by government actors to deal with climate change and its impacts (H. M. T. Rahman & Hickey, 2019). Reactive adaptation refers to actions taken in response to climate-related disasters by both non-government and government actors (Novalia & Malekpour, 2020). Similar to planned adaptation, proactive adaptation refers to anticipatory and precautionary actions; however, these actions can also be undertaken by private actors (Schneider, 2014). Finally, incremental adaptation refers to small-scale changes to existing policy frameworks and governance arrangements and generally focuses on the immediate impacts of climate change (H. M. T. Rahman & Hickey, 2019). Conversely, transformative adaptations are large-scale actions that require radical changes to existing policy frameworks and governance arrangements and take a longer-term view of climate change risk (Brown et al., 2017; Wilson et al., 2020).

While there is widespread agreement in the literature that CCA is critical to minimise the catastrophic impacts of natural hazards (Heazle et al., 2013; Howes et al., 2012; Wamsler & Johannessen, 2020), there is growing concern that the adaptation measures themselves may have negative impacts (Brown, 2011; Magnan et al., 2016). Thus, maladaptation, defined as the adverse effects that can result as a consequence of an adaptation action, has emerged in recent years as an important subject matter for adaptation researchers (Magnan et al., 2016). According to Glover and Granberg (2021), further inquiry into maladaptation is critical to deepen the understanding of what constitutes successful and sustainable adaptation to increasing climate change risk.

2.3.3 Integrated disaster risk reduction

There is a growing body of literature emphasising that successful adaptation is contingent on improving the policy integration between disaster risk reduction, climate change adaptation and sustainable development (Djalante et al., 2013; Munene et al., 2018). There are obvious links between CCA and DRR, which share the objective of building resilience through the application of a risk management framework (Fünfgeld & McEvoy, 2014). However, despite the shared objectives and the clear causal links between climate change and disaster risk, the policy fields of CCA and DRR have developed in isolation, and, in practice, integrative policy approaches are in their infancy (Howes et al., 2012). This may be attributed to the minimal attention given to CCA in the UN's Sendai Framework (UNDRR, 2015) and, similarly, Australia's National Strategy for Disaster Resilience (COAG, 2011). The lack of attention to adaptation in DRR policy may also be attributed to the fact that DRR (which in Australia is generally equated with emergency management) (Bosomworth et al., 2017) continues to be based on a linear, rational model of PPRR. As illustrated by Wenger (2017), the PPRR framework relies almost exclusively on expert knowledge and favours short-term, engineered, resilience-based solutions that reduce immediate risk (Bosomworth et al., 2017; Heazle et al., 2013).

Although increasingly framed as a shared responsibility, the statutory responsibility for DRR under the Australian federal government system lies with the states and territories, whereas CCA planning has largely been allocated to local governments (Howes et al., 2012). Therefore, there is currently a functional mismatch between DRR and CCA (Birkmann & von Teichman, 2010). In addition, there are temporal and spatial mismatches constraining the integration of CCA and DRR (Birkmann & von Teichman, 2010). For example, DRR stems from emergency management, which is traditionally focused on short-term responses, whereas CCA takes a longer-term approach to risk assessment and hazard planning. Thus, as Serrao-Neumann et al. (2015) point out, while there are clear links between

CCA and DRR, their integration is constrained by the diverse historical origins, methodologies and institutional frameworks underpinning each discipline.

Despite the increased calls for integrative and adaptive approaches to DRR, simultaneously addressing sustainable development, CCA and DRR is challenging and generally involves trade-offs (Munene et al., 2018), where one set of values, interests and objectives is implicitly or explicitly prioritised over another (Foerster et al., 2015). Trade-offs are inevitable in policy regimes that involve multiple objectives, actors and temporal and spatial scales (Tuhkanen et al., 2018). However, Nilsson and Weitz (2019) note that in official public policy, integrated policymaking is generally presented as a win–win solution, and the trade-offs that exist between the different policy sectors and their specific goals and operational priorities are often not openly acknowledged.

It is well recognised that development is a key determinant of disaster risk and that integrating development and disaster policies is crucial to prevent increased vulnerability (Djalante et al., 2013; Munene et al., 2018; Thomalla et al., 2018). Notably, 10 of the 17 SDGs relate to DRR and disaster resilience, which has reinforced the role of DRR as a critical strategy for advancing sustainable development (UNDRR, 2015). However, simultaneously addressing development and DRR goals is challenging and generally requires a trade-off between economic growth and human safety (Munene et al., 2018; Thomalla et al., 2018). In addition, CCA and DRR decision-making often involves trade-offs between environmental and social amenity values and the protection of private property and critical infrastructure (Foerster et al., 2015). Further, there is great potential for intergenerational trade-offs between short-term DRR measures and longer-term climate resilience (Wenger, 2017). While CCA is presented as an urgent policy imperative for DRR, it is recognised that both autonomous and planned adaptation actions can result in negative outcomes when broader sustainability issues and the long-term implications of policy actions are not adequately managed (Magnan et al., 2016; Neset et al., 2020). Nilsson and Weitz (2019) assert that it is how such trade-offs are managed that will underpin the extent to which sustainable policy outcomes are achieved. It has been argued that a more comprehensive analysis of trade-offs in integrated public policymaking is needed (Nilsson & Weitz, 2019; Tuhkanen et al., 2018).

2.4 Transformative Adaptation for Disaster Resilience: a Conceptual Framework

As the climate crisis deepens, there is growing research interest in sustainability transitions and system transformations across a diverse range of policy areas (Patterson et al., 2017). More specifically, to address the long-term uncertain and cascading impacts of climate-exacerbated hazards, scholars have called for the transformative adaptation of DRR policy and practice (Pelling et al., 2015). According to Thomalla et al. (2018), sustainable transformations in DRR policy gained

attention following the release of the IPCC report *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (Field et al., 2012). More recently, the UN *Global Assessment Report on Disaster Risk Reduction* (UNDRR, 2019) has reiterated that transformational change is needed to deal with the unprecedented nature of climate hazards and disaster events. Calls for transformative adaptation are based on the assumption that the current institutional systems and worldview paradigms that guide policymaking decisions for DRR are unsustainable and must be reconfigured (Eriksen et al., 2021; Thomalla et al., 2018). For Pelling et al. (2015), transformations describe the adaptive actions and development pathways that fundamentally change the functioning of social-ecological governance systems. Transformative adaptation requires intentional policy actions that are radically different from the status quo (Willi et al., 2020). Further, rather than reactive, short-term disaster risk treatment measures, transformative adaptation focuses on addressing the root causes of vulnerability (Eriksen et al., 2021) and seeks proactive DRR policy responses based on multiple lines of evidence and longer-term predictions (Colloff et al., 2017; Novalia & Malekpour, 2020; Scolobig et al., 2014). The United Nations Environment Programme declares there are five essential ingredients for enabling transformation:

1. Visions to guide systemic innovation towards sustainability.
2. Social and policy innovation.
3. Phasing out unsustainable practices.
4. Policy experimentation
5. Engaging and enabling actors and stakeholders (UNEP, 2019, p. 585).

Thus, transformative adaptation is a deep and intentional process of change towards a more ecologically sustainable and socially just future that requires policy innovation and capacity investment (Colloff et al., 2021; Pelling et al., 2015).

Transformative adaptation is presented throughout the literature as the antithesis of incremental adaptation, which Kates et al. (2012) define as ‘doing slightly more of what is already being done’ (p. 7516). However, Termeer et al. (2017) attempt to break down this dichotomy by asserting that small incremental changes indeed have the potential to lead to transformational change if the changes are continuous and in depth; that is, they enable governance actors to question the worldviews that underpin policy solutions and genuinely consider alternative options. Drawing on organisational theory, Termeer et al. (2017) suggest that rather than counting on sudden transformative change, a more realistic approach to facilitating CCA is to focus on the conditions and processes that enable the ‘transformation of governance systems themselves’ (p. 571). For Colloff et al. (2021), planned

adaptation requires a combination of both incremental and transformative actions; that is, having transformative goals but taking incremental steps to achieve them.

The literature review has revealed several factors necessary for transformative adaptation to climate-exacerbated hazards such as bushfire (see Table 2.1). These include fundamental changes to the worldviews underpinning current policies, the adoption of an adaptive governance framework, proactively addressing the root causes of vulnerability, taking an integrated policy approach and considering the full range of adaptation DRR options available and their potential value trade-offs.

Table 2.1: Factors underpinning transformative adaptation and questions for bushfire policy

Transformational adaptation	Related literature	Remaining questions for bushfire policy
Requires fundamental shifts in worldviews	Fazey et al. (2018); Fedele et al. (2019); Nursey-Bray (2017); O'Neill & Handmer (2012); Wilson et al. (2020)	How do worldviews influence bushfire policy, and what mechanisms could facilitate worldview transformation?
Adoption of an adaptive governance framework and related principles	Bosomworth (2018); Colloff et al. (2017); Nursey-Bray (2017); Patterson et al. (2017); Thomalla et al. (2018)	What are the key principles of adaptative governance, and to what extent are they operationalised in bushfire policy and practice?
Addressing the root causes/conditions of vulnerability	Eriksen et al. (2011); Fedele et al. (2020); O'Neill & Handmer (2012)	In what ways can policy strategies for adapting to bushfire risk increase or redistribute vulnerability?
Multi-actor/cross-sectoral collaborations and an integrated policy approach	Fedele et al. (2019); Jensen et al. (2020); Visseren-Hamakers et al. (2021)	What factors enable or inhibit integrated bushfire policy regimes?
Consideration of all adaptation options and assessment of trade-offs and potential maladaptive outcomes across spatial and temporal scales	Eriksen et al. (2011); Fazey et al. (2018); Thomalla et al. (2018)	What are the potential maladaptive consequences and value trade-offs of adapting to increased bushfire risk, and how could they be more comprehensively considered in bushfire policymaking?

A closer look at the available literature reveals that further scholarly work is required to better understand how public policy can intentionally facilitate the sustainable and transformative adaptation to increased bushfire risk. At its core, adaptation is an ongoing process of policy change; thus, a deeper understanding of the factors constraining and accelerating bushfire policy change is fundamental for informing intentional policy efforts aimed at fostering adaptation to increased bushfire risk. Several other questions pertaining to the adaptation of bushfire policy emerged from the literature review and require further attention.

First, throughout the literature, it is emphasised that transformative adaptation requires not only technological innovations but a fundamental shift in worldviews (Eriksen et al., 2021; Fazey et al., 2018; Few et al., 2017; O'Neill & Handmer, 2012; Pahl-Wostl et al., 2013; Termeer et al., 2017). Despite the central role that worldviews are believed to play, the application of worldview theory as

an analytical framework to examine a complex climate-related policy issue such as bushfire had not yet been undertaken before this study. As the literature indicates, further research is needed to understand how enduring institutional logics influence policy action for complex disaster problems (Bosomworth, 2018) and to identify mechanisms that may enable a profound shift in the long-held worldview assumptions constraining sustainable adaptation (Fazey et al., 2018).

Second, the literature suggests that the transformative adaptation to climate-exacerbated hazards requires radical governance restructuring and public policy change (Thomalla et al., 2018). Moreover, throughout the literature, it is proposed that adaptive governance is the most appropriate mode of governance to enable transformative adaptation (Visseren-Hamakers et al., 2021). However, adaptive governance for DRR and bushfire policy remains largely underdeveloped (Bosomworth, 2018; Patterson et al., 2017). What is not yet clear is the extent to which DRR policy sectors such as bushfire management agencies are adopting the principles of adaptive governance in policy and practice. Further, a deeper understanding of mechanisms that could enable the bushfire policy sector to develop the adaptive capacities to deal with rapidly changing risk dynamics is needed.

Third, there is a consensus in the literature that transformative adaptation for DRR requires an integrated policy approach to ensure policy cohesion (Biesbroek & Candel, 2020). Policy integration has been justified as necessary for dealing with a range of policy problems, including food security (Candel & Pereira, 2017; Mercure et al., 2019), urban governance (Candel & Pereira, 2017; Rode, 2019), floods (Cumiskey et al., 2019; Rouillard et al., 2013), conservation (Simeonova & van der Valk, 2016; Visseren-Hamakers, 2018) and, more recently, disaster resilience (March et al., 2018). Despite the increasing claims that policy integration plays a critical role in CCA, Biesbroek (2021) points out that few studies have examined the factors that enable or inhibit successful policy integration, which may inform the design of more successful integrated policy strategies. According to Wamsler (2017), a more critical examination of the potential for cross-scale policy integration in facilitating adaptation is needed. Moreover, Candel (2019) suggests that despite the resonance of policy integration in the adaptation literature, integrated policy approaches have the potential to be expedient. Thus, further qualitative research examining the direct experiences of integration by governance actors is warranted.

The natural hazards literature emphasises the importance of an integrated policy approach between the bushfire management and land use planning sectors (Hurlimann & March, 2012; March et al., 2018). However, while there have been significant reforms in recent years to strengthen the integration of policies with respect to bushfire management and land use planning in Australia, little is known about the enablers and challenges influencing integrated DRR measures. A deeper insight

into the causal mechanisms supporting policy integration and how integration functions in practice is critical for designing effective policy strategies and avoiding policy failure (Biesbroek, 2021). Moreover, an empirical examination of policy integration in practice may shed light on the conceptual tensions that exist between adaptive governance and policy integration (Rouillard et al., 2013).

Finally, transformative adaptation relies on decision-making processes that consider value conflicts and transparently assess the potential trade-offs and negative consequences (Eriksen et al., 2011). Wilson et al. (2020) assert that transformative CCA requires an assessment of the various adaptation options and related DRR actions and their potential effects across a broader scale than used in traditional risk management approaches. Emerging evidence suggests that current DRR and adaptation policy frameworks fail to comprehensively assess the risk of the maladaptive outcomes of specific DRR strategies and adaptation actions (Foerster et al., 2015). This indicates a need for the development of conceptual and substantive frameworks that can assist bushfire policymakers to incorporate public values and broader sustainability imperatives into policy design and professional practice (Williams et al., 2021).

Figure 2.1 illustrates the preliminary conceptual framework of interrelated ideas that was constructed following the critical literature review presented in this chapter. This conceptual framework illustrates the relationships between different variables that together help to explain the phenomenon under study and provides the scaffolding on which the research design was based.

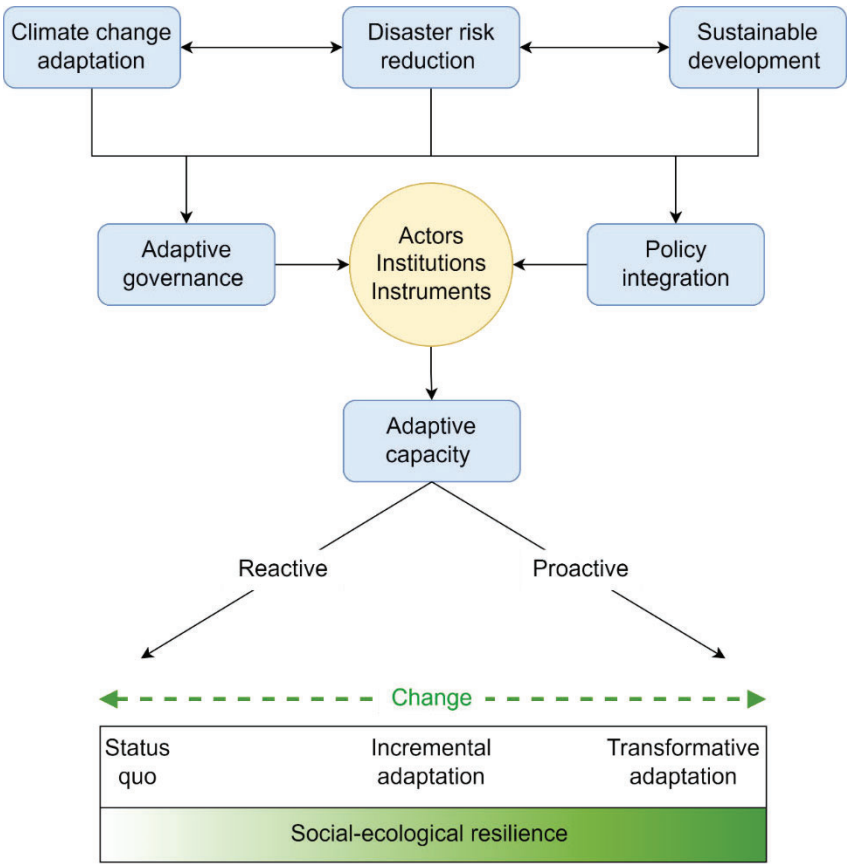

Figure 2.1: Schematic representation of the conceptual framework

2.5 Summary

This chapter has reviewed a broad body of related literature and defined and weaved together a range of key concepts and theories influencing the direction of bushfire policy. The critical literature review clearly demonstrates that the concepts underpinning SES thinking, namely resilience and adaptive capacity, are influencing the policy direction of contemporary disaster governance. While these theoretical ideas are permeating throughout the disaster policy discourse, the chapter has drawn attention to the normative nature and definitional issues of these emerging policy concepts. Further, the review revealed how the growing influence of SES thinking, coupled with the rapidly changing risk dynamics of the twenty-first century, is driving more adaptive and integrative governance approaches to disaster policy. More recently, attention has turned to the need for transformative adaptation to ensure a sustainable future. However, several unanswered questions regarding this ambitious endeavour remain, particularly in the context of bushfire policy. Through an in-depth examination of changing bushfire policies in south-west WA, the studies conducted for this thesis attempt to answer these questions and shed light on the debate. Having provided a detailed theoretical basis and conceptual framework for this thesis, the next chapter describes the research approach.

Chapter 3: Research Approach

Chapter 3 overviews the research approach and specific methods used for each study, which together contribute to answering the central thesis research question: *What factors shape changes in bushfire policy, and how can these insights be used to inform planned adaptation to increased bushfire risk?* Section 3.1 outlines the philosophical basis underpinning the research. Section 3.2 details the qualitative case study methodological approach. Section 3.3 details the case study subject, and sections 3.4 and 3.5 outline the two main methods of data collection and how the data were analysed.

3.1 Philosophical Research Paradigm

A research paradigm can be understood as the worldview beliefs and assumptions that influence how a research project is interpreted, approached and designed (Kivunja & Kuyini, 2017). Research paradigms may be differentiated by their ontologies (beliefs and assumptions about the nature of reality), epistemologies (beliefs and assumptions about what is true knowledge) and methodologies (beliefs and assumptions about which procedures can be used to obtain knowledge) (Johannesson & Perjons, 2014). This thesis is embedded within the research paradigm of critical realism, a philosophy of science largely attributed to the work of Roy R. Bhaskar (1975). Critical realism offers an alternative, middle-ground approach between the two most dominant philosophical research paradigms of the social sciences: positivism and constructivism.

A positivist research paradigm is underpinned by the ontological assumption that reality is independent of human thought and experience and that objective knowledge can only be gained through empirical observation (O'Mahoney & Vincent, 2014). Further, given that positivism is concerned with the search for facts and universal laws, positivist researchers prefer a quantitative research strategy that adheres rigorously to the scientific method, hypothesis testing and statistical analysis (Kivunja & Kuyini, 2017). In contrast, a constructivist research paradigm (also referred to as interpretivism) posits that realities are manifold and socially constructed and that knowledge is always subjective and contextual (Kivunja & Kuyini, 2017). Therefore, constructivist researchers are highly sceptical of the positivist assumption that only an empirical investigation can provide legitimate knowledge about the world (Fletcher, 2017). Constructivists favour a qualitative research strategy using inductive methods of inquiry such as action research and ethnography, which accept and value the interactions between researchers and research participants. Moreover, constructivists seek to gain a deep understanding of a particular social phenomenon in a particular context through the lived experience of the research participants (Kivunja & Kuyini, 2017).

Like constructivism, critical realism is considered a post-positivist research paradigm (Easton, 2010a); however, critical realist researchers contest the strong constructivist assumption that reality is completely constructed through discourse (Fletcher, 2017). Further, critical realists value the contributions of modern science and empirical observation in improving our understanding of the world (O'Mahoney & Vincent, 2014). However, critical realists challenge the 'epistemic fallacy' (Bhaskar, 1998, p. 27) of positivism, emphasising that knowledge cannot be comprehensively understood through empirical observation alone. A critical realist acknowledges that there are social phenomena at play that influence the production of knowledge that must be interrogated (Easton, 2010a). Despite its criticisms of the two dominant research paradigms, critical realism embodies elements of both positivism and constructivism and seeks to bridge the opposing paradigmatic positions of objectivity and subjectivity through the application of transcendental logic (Duindam, 2018). Further, critical realists have a layered and stratified perception of reality (ontology) comprising three domains: the real (structures and objects that can cause events), the actual (events that occur) and the empirical (how actual events are observed/experienced) (Fletcher, 2017; Haigh et al., 2019).

Critical realist research is primarily interested in causal mechanisms (Vincent & Wapshott, 2014), which, simply explained, refer to the intervening factors that generate outcomes and help explain a particular phenomenon (Wynn & Williams, 2020). While positivist research can provide insights into cause and effect by identifying correlations between variables through statistical analysis, critical realists hold that empirical observation provides a simplistic and problematic account of causality (O'Mahoney & Vincent, 2014). Critical realist researchers posit that no single variable can completely explain an outcome and that causation is the result of multiple interacting mechanisms, which, although difficult to disentangle, must be teased out (Mingers & Standing, 2017; O'Mahoney & Vincent, 2014). From the critical realist perspective, there are unobservable structures, power and relationships (i.e. generative mechanisms) at play that contribute to causing the observed events and outcomes (Zachariadis et al., 2013). According to O'Mahoney and Vincent (2014),

> the task of the [critical realist] researcher, then, is to work out a better and causally accurate, correct, or reliable explanation for these patterns of events via the development of more adequate accounts of the powers, entities, and mechanisms which created them. (p. 9)

Thus, critical realist researchers investigate events and outcomes by paying particular attention to the generative mechanisms that produce them (Easton, 2010a; Fletcher, 2017). The focus on causation can assist critical realist researchers to produce richer explanations of events and patterns of change than can be achieved through observation alone, thus is a suitable research framework for analysing policy change (Falleti & Lynch, 2009; Fletcher, 2017). Further, given that critical realists hold that

the world consists of open systems comprising multiple interacting layers and entities, critical realism is an appropriate ontological framework for transdisciplinary SES research (Cockburn et al., 2020).

Unlike pure empirical investigation, critical realism research designs are generally iterative rather than linear (Fletcher, 2017), moving 'between conception and application so that ideas are tested against what can be found and observed in empirical research' (O'Mahoney & Vincent, 2014, p. 13). Critical realism is neither inductive nor deductive but is understood in terms of abduction and retroduction. Abduction is the process of interpreting and redescribing empirical observations to derive explanations through theoretical inference (Eastwood et al., 2014). Retroduction is an abductive process that, through the application of existing theory, allows critical realist researchers to explain events by identifying the contextual conditions and causal mechanisms that produce them (Easton, 2010a; Fletcher, 2017; Wynn & Williams, 2020).

Unlike positivist or constructivist researchers, critical realist researchers are not bound by a particular research design and can use a range of methods and types of data—quantitative and/or qualitative—that provide insights into the causal mechanisms under study (O'Mahoney & Vincent, 2014). Critical realist research design is flexible and adaptable: according to Ackroyd and Karlsson (2014), 'successful [critical realism] research depends on intellectual creativity not on following methodological rules' (p. 22). Further, critical realist researchers must not only identify the available data that can provide insights into the causal mechanisms and processes at play but also unearth concepts that can help us understand these mechanisms more deeply (Ackroyd & Karlsson, 2014). Critical realism is a meta-theory, with researchers using a multiplicity of theories to provide a more in-depth explanation of causation than can be provided through empirical observation alone (O'Mahoney & Vincent, 2014). Moreover, by its nature, critical realist research requires a historical approach to examining how the sequencing of events, generative mechanisms and emergence of entities combine to create a particular phenomenon (Mutch, 2014).

3.2 Qualitative Case Study Methodology

While critical realism does not favour a specific research design nor prescribes methods for data collection or analysis (O'Mahoney & Vincent, 2014), Wynn and Williams (2020) note that most critical realist researchers adopt a qualitative approach. Further, the literature suggests that case studies are appropriate for critical realist research (Ackroyd & Karlsson, 2014; Easton, 2010b; O'Mahoney & Vincent, 2014; Wynn & Williams, 2020) 'because they provide a situation in which mechanisms may be to some extent isolated and then studied, allowing abductive logic to be brought fully to bear' (Ackroyd & Karlsson, 2014, p. 25). Moreover, unlike other qualitative designs, in case study research, existing theories may be used and extended to inform the research design and guide

the analysis (Meyer, 2001). At its core, this thesis is an examination of the socio-institutional dimensions and contextual conditions that enable bushfire policy change to occur and new entities (i.e. organisations, instruments and practices) to emerge. Thus, it is well suited to a qualitative case study research methodology. Further, a case study approach is appropriate for policy research because it can provide insight into decision-making processes and complex actor interactions (Molloy, 2010).

A case study is an in-depth examination of a particular phenomenon or complex issue within a specific and bounded context. Yin (2009) defines a case study as 'an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident' (p. 13). To illustrate what is particular about a case, the researcher collects data on the nature of the case, the historical background, the physical setting, the institutional context and the experience of actors (Denzin & Lincoln, 2018). Case studies are suitable for explanatory research because they can assist with answering *who*, *what, when*, *how,* and *why* questions relating to a particular phenomenon (Yin, 2009).

A case study design can comprise a single case or multiple cases. Some scholars argue that the evidence generated by multiple cases is more robust and reliable, and generalisations can be made through a comparative analysis of cases (Meyer, 2001; Yin, 2009). However, according to Easton (2010b), from a critical realist perspective, it is irrelevant whether a researcher adopts a single or multiple case study approach—of greater importance is that the case study process enables an explanation to be derived from the sequencing, causes and outcomes of events. Indeed, while the use of a single case study may be limited in terms of generalisability, it can provide an opportunity to deeply explore a particular phenomenon and create, extend and test a particular theory (Ridder, 2017). Thus, single case studies, although focusing on a distinct case, can tell us much about the world at large by contributing causal explanations of the phenomenon.

Rather than drawing conclusive generalisations, the aim of this thesis is to dig deep and provide theoretical explanations of bushfire policy change that may inform planned adaptation to increased bushfire risk. To support this endeavour, a single case study design was employed to examine the changing bushfire policy landscape in south-west WA. However, Article 3, which was the result of a collaboration with scholars from The University of Melbourne, was based on a multiple case study approach to corroborate the findings that emerged from the single case study focus of this doctoral research. According to Easton (2010b), 'in a single case, it is both possible and necessary that a number of different causal explanations are put forward and researched' (p. 13). Therefore, a single case study is an appropriate research design for this thesis by compilation—while each article is an

independent study with its own distinct theoretical framework, together they provide insights into the various causal mechanisms of bushfire policy change.

3.3 Case Study Subject

A case study subject is a concentrated unit of study that is spatially and/or temporally bounded, such as a person, an organisation, a geographical area, a problem or an event (Gerring, 2004; Ridder, 2017). The case study subject of this thesis is the bushfire policy system of the south-west region of WA (see Figure 3.1).

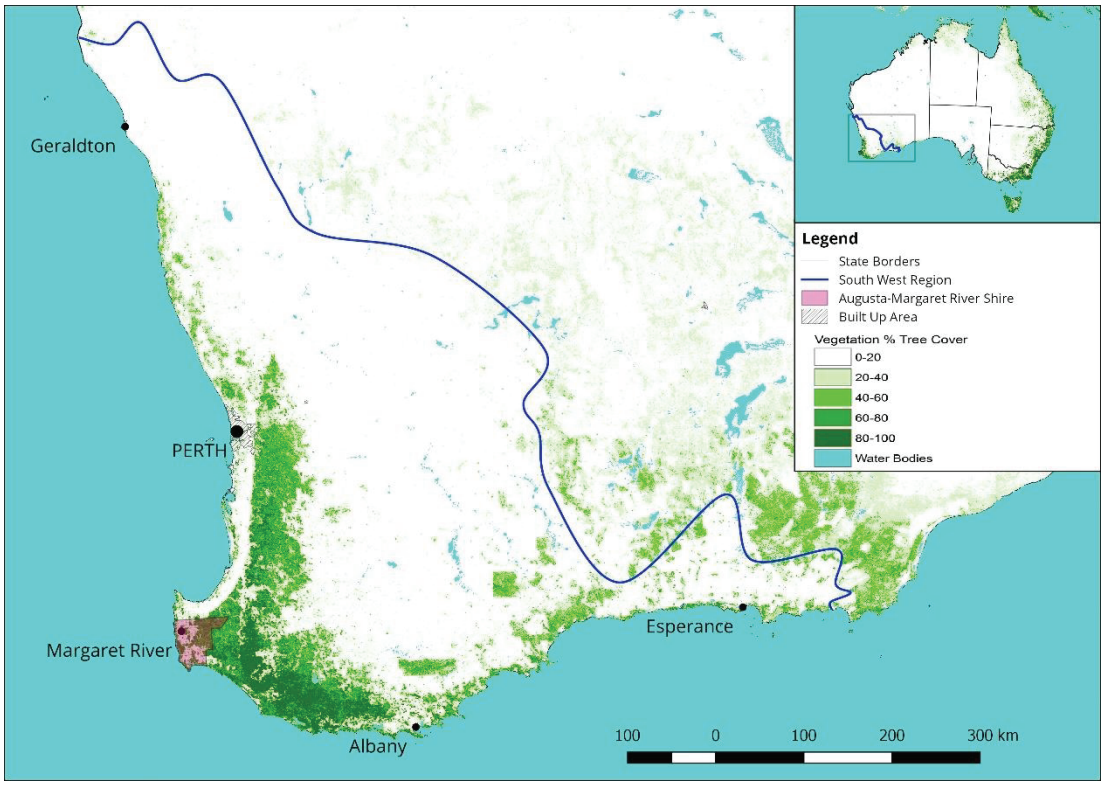

Figure 3.1: South-West of Western Australia.

Note. From 'Applying the Principles of Adaptive Governance to Bushfire Management: A Case Study from the South West of Australia', by S. Ruane, 2019, *63*(7), *Journal of Environmental Planning and Management*, p. 1217 (https://doi.org/10.1080/09640568.2019.1648243). Copyright 2019 by Newcastle University. Reprinted with permission.

This case study subject is defined by its geographical boundaries, which roughly extend from north of Geraldton to east of Esperance in the south. This geographic location broadly corresponds with the officially recognised South West Land Division, the Southwest Australia Ecoregion and the South West Agricultural Region. Moreover, this area encompasses the country (Noongar Boodja) of the Noongar people, the traditional custodians of south-west WA (Stocker et al., 2016). While the case study is demarcated by geographical boundaries, the case unit itself is the bushfire policy system that

applies to this spatially bounded location. Further, the temporal boundaries of the case study extend over the period from European colonisation in the region to the present (i.e. 1826–2021).

South-west WA was selected for an in-depth case study based on the following criteria: it is a fire-prone area with an increasing risk of bushfire resulting from climate change and settlement patterns; it has a long history of bushfire management policy; and it has been subject to significant bushfire policy reforms in recent years. Another important selection criterion was access to research participants and document data. Given that the researcher is based in this region, had an established network of potential research participants on which to draw and had access to archival data, which was only available in hard copy in libraries and public administration offices located in the region, it was an appropriate case selection.

3.4 Data Collection

Case studies can draw from multiple sources of data that may provide an understanding of the social phenomenon and contribute to the study (Ebneyamini & Moghadam, 2018). A qualitative case study approach was employed in all five articles comprising this thesis. However, in each article, a different conceptual framework guiding the investigation of the case and the types of data used was applied. While the specific data collection and analysis methods used for each article varied, the data for the thesis were primarily sourced from semi-structured interviews and documents. Figure 3.2 presents the methods employed and key objectives of each journal article comprising this thesis.

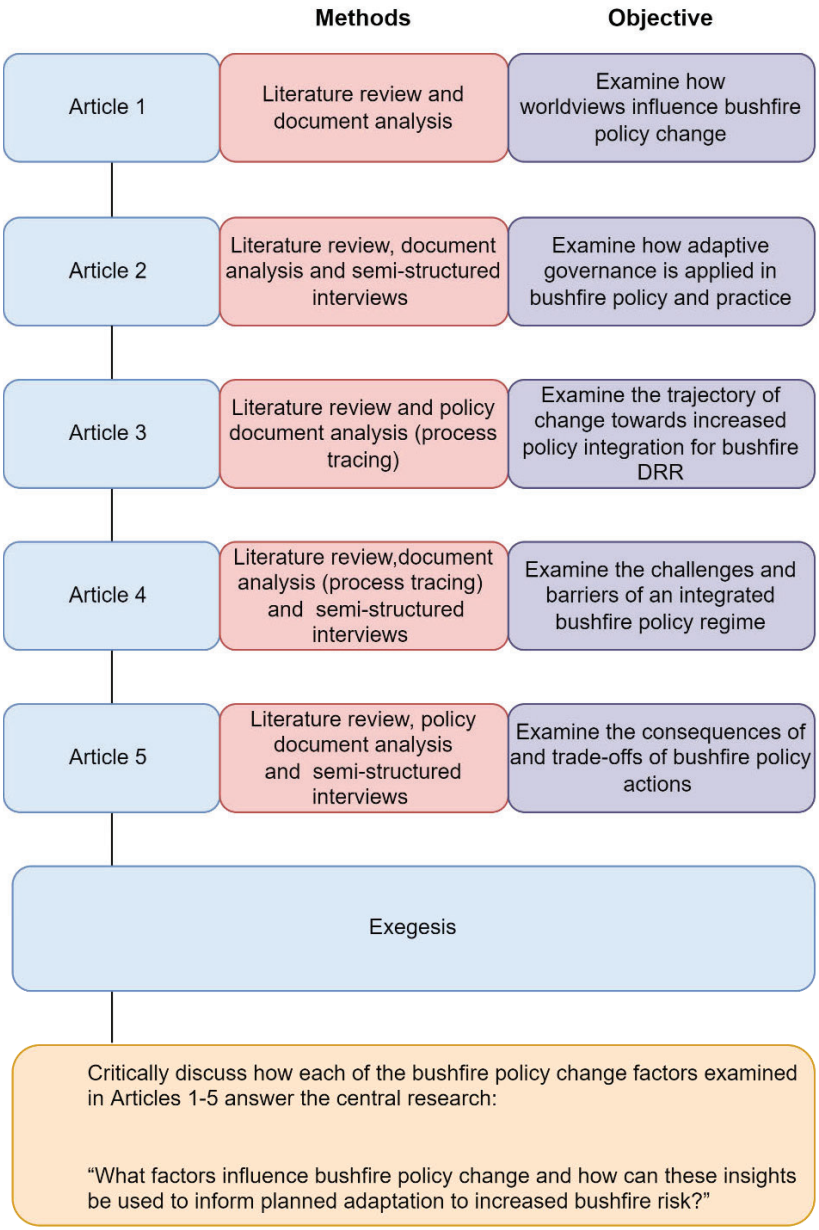

Figure 3.2: Methods used in each article to address the overarching research question.

3.4.1 Semi-structured interviews

Interviews provide a means of accessing not only the opinions and experiences of actors but also real-life accounts of events, processes and contextual conditions that may provide insights into complex, multifaceted phenomena (C. Smith & Elger, 2014). To gain an understanding of bushfire policies and institutional arrangements of the selected case and address the specific research objectives and questions of Articles 2, 4 and 5, semi-structured interviews were employed to provide a valuable source of primary data. The interview questions and probes were developed from an initial review of the literature conducted for each article, and questions were continuously improved and adjusted over

time as the interviewer's knowledge of the topic developed and the research focus was narrowed. The interview schedule contained a series of questions designed to elicit:

- the historical and institutional settings of the bushfire policy system for south-west WA
- the current roles, responsibilities and experiences of bushfire policymakers and practitioners for the case study subject
- opinions regarding the status and fundamental goals of the current bushfire policy system for south-west WA
- the underpinning assumptions related to bushfire policy arrangements and management priorities
- perceptions of bushfire risk for the case study area
- unintended consequences of bushfire policy on other policy objectives and public values
- specific bushfire policy knowledge, data, skills and resource gaps
- enablers and inhibitors of bushfire policy change and cross-scale collaboration
- mechanisms that enable bushfire policy change towards a more adaptive and integrated policy approach.

While the interview questions were guided by theory, the interviewer adopted the responsive interviewing model developed by Rubin and Rubin (2005), which fosters a conversational interaction between interviewer and interviewee. This provided the opportunity for unscripted questions to arise and generated additional data.

3.4.2 Participant selection

Interviewees were selected using a purposive snowball recruitment method. In total, 30 interviews of approximately one hour in duration were conducted for this thesis. Interviewees were selected to ensure representation of the various subsystems comprising the south-west WA bushfire policy system and to ensure that a breadth of expertise and experience was included. Interviewees included representatives from the following departments and disciplines:

- Department of Fire and Emergency Services
- Department of Biodiversity, Conservation and Attractions
- Department of Planning, Lands and Heritage
- WA Local Government Association (peak body)
- local government emergency managers
- local government planners

- local government environmental managers
- local government executive staff
- private bushfire consultants
- local bushfire brigade members
- environmental managers/non-government organisations.

Moreover, each interviewee had played an instrumental role in bushfire policy development, policy implementation, program delivery or bushfire management practice in the case study region. Two rounds of interviews were conducted. The first round of 16 interviews was conducted in 2017–2018 to inform Article 2. A second round of 14 interviews was conducted in 2019–2020 to inform Articles 4 and 5. The interview process was approved through a rigorous ethics approval process, and participant anonymity and risk was carefully managed.

3.4.3 Interview analysis

Analysis of the interview data followed Yin's (2011) five-phase approach to data analysis:

1. Compiling: The interviews were transcribed verbatim into written form. The transcripts were then carefully re-read and edited to remove typographical errors. To enable analysis, the data were organised using several software platforms, including Word, Excel and NVivo.
2. Dissembling: This step focused on the initial coding by which several labels were applied to specific sections of the text. These codes were based on existing theories and concepts that emerged from the literature review, surprising and interesting information and particular interpretive frames that provided insights into the worldviews of interviewees.
3. Reassembling: Following the initial coding, the codes were then grouped into broader thematic categories related to the conceptual framework of each article, and patterns and trends were identified.
4. Interpreting: The themes and patterns that emerged in Step 3 were related back to the theories and concepts guiding the research to address the specific article's objectives and build an explanation about the causal mechanisms of the case (i.e. how and why things happened the way they did).
5. Concluding: The empirical findings emanating from the data were then related to the original research questions and theoretical propositions, explicating meaning, significance, limitations and implications of the study.

3.5 Documents

Written documents play a fundamental role in structuring how modern Western societies function and evolve, thus providing a valuable source of data for policy research on complex societal phenomena (Dalglish et al., 2020). Documents can provide powerful insights into the cultural context, societal relations, discourses and larger systematic processes at play, thus may assist with gaining an understanding of the research topic and help build theory (Gross, 2018). Document analysis, a procedure for collecting and analysing documents to elicit understanding and develop knowledge, is commonly used in qualitative case study research and can provide a means of triangulation when used in combination with other methods (Bowen, 2009). Further, because document analysis is a particularly effective technique for examining how a specific policy system evolves and changes over time (Dalglish et al., 2020; Kayesa & Shung-King, 2021), it played a critical role in this thesis.

A range of document types can provide data for policy research (Bowen, 2009). Primary data, including official documents (e.g. policies, strategies and position statements), implementation documents (e.g. policy guidelines), legal documents (e.g. laws and regulations) and historical documents (e.g. archival records) (Gross, 2018) were used to inform the studies comprising this thesis.

3.5.1 Document selection

While the inclusion criteria for document selection varied between studies conducted for each of the journal articles depending on their specific objectives, the overarching time frame of document selection was the period from European colonisation in south-west WA (1826) to the year that the researcher completed the data collection phase for this thesis (2021). To ensure a systematic selection of data, relevant keywords identified in the literature review as integral to bushfire policy (including *bushfire management*, *bushfire planning*, *bushfire protection*, *fire management*, *fire control* and *bushfire inquiry*) were used to conduct a thorough search of the State Library of Western Australia and National Library of Australia catalogues, archival records, legislation databases and government websites. Using Endnote software, an inventory of 143 public documents related to bushfire policy in the case study area, including policies, guidelines, planning strategies, legislation, regulations, public inquiry reports and historical records, was compiled. These texts were further screened with criteria relevant to each of the article's subsidiary research objectives. Specifically, given the focus on identifying bushfire policy change (i.e. causal mechanisms, entity emergence and institutional change), the inclusion criteria for documents were that they (i) provided insights into the sequencing of bushfire policy developments; (ii) were formative in the establishment of bushfire policy

institutions; (iii) played an instrumental role in shaping bushfire policy change; and/or (iv) shed light on the causal mechanisms of bushfire policy change.

3.5.2 Document analysis

Document analysis strategies included both thematic analysis (Articles 2 and 5) and process tracing (Articles 1, 3 and 4). Both strategies involved an iterative process of skimming, compiling, reading and interpretation (Mackieson et al., 2018).

Process tracing is a within-case analytic strategy that involves identifying the causal mechanisms (i.e. conditions, processes and interactions) that produce or explain an observable outcome or event (Beach, 2016). Unlike other explanatory case study approaches, process tracing can be used in both single and multiple case studies (Ulriksen & Dadalauri, 2016). Process tracing is well aligned to policy change and critical realist research because it brings together theory and data in an iterative manner to enable causal explanations (Biesbroek & Candel, 2020). According to Reilly (2010), process tracing can unveil the connections that exist between the independent variables that characterise an open system, thus 'offers the possibility of mapping out one or more potential causal trajectories that are consistent with the outcome and the evidence in a case' (p. 734). Process tracing requires the researcher to analyse historical documents, archival records, interviews and other relevant data to determine whether the causal mechanisms and processes hypothesised by established theories are evident in the case under study (Bennett & Checkel, 2015).

Process tracing can be used to both build and test theory (Vennesson, 2008). Both theory-building (Articles 1 and 3) and theory-testing (Article 5) process tracing approaches were employed for this thesis. Moreover, plausible causal explanations of policy change that are implied in public policy theories (in particular worldview theory, institutional change, policy integration and adaptive governance) were verified against the empirical findings of the case studies (Ulriksen & Dadalauri, 2016). While there remains a paucity of guidance for process tracing analysis in practice (Gläser & Laudel, 2019; Ulriksen & Dadalauri, 2016), Articles 1, 3 and 4 adapted the general steps of process analysis outlined by Reilly (2010):

1. Identify existing theoretical explanations of causality and expected case observations.
2. Construct a chronological sequencing of events of the case.
3. Create a narrative about how the causal chain of events unfolded over time and space.
4. Analyse the case for evidence of consistencies and inconsistencies between the theoretical expectations of causality and the empirical observations of the case.

5. Draw conclusions by determining whether the case study confirmed the theoretical explanations and expected observations. Where the case did not confirm the preceding theoretical explanations, other theoretical explanations that could help explain the causality of the phenomena are proposed.

In addition to process tracing, thematic analysis was also used to analyse documents for Articles 2 and 5. Thematic analysis is a reflexive method of drawing meaning from the patterns and themes that emerge from a dataset to generate a story of interest from the text (Neuendorf, 2019). Thematic analysis of the collected documents followed Braun and Clarke's (2006) six-phase framework for thematic analysis as follows:

1. Familiarisation with the dataset by reading through the selected documents.
2. Identification of initial codes related to the research questions and theoretical framework; application of these codes to the document dataset with the support of NVivo, Endnote and Microsoft Word; ongoing modification and addition of codes when necessary.
3. Searching for patterns and themes that conveyed meaning and captured interesting information that was relevant to the research questions.
4. Reviewing the themes to determine whether they were coherent and relevant to the research questions, discarding themes when necessary.
5. Defining and refining the themes to derive their meanings and how they relate to each other, thus building the story from the data that helped to answer the research questions.
6. Writing up an analytical narrative by weaving together the findings with the literature, interpreting the thematic findings and offering novel theoretical and practical insights (Maguire & Delahunt, 2017; Nowell et al., 2017).

It is important to note that while the steps of data analysis, which were informed by Reilly (2010), Yin (2011) and Braun and Clarke (2006), are presented above as a series of consecutive steps, when dealing with large and complex qualitative datasets, the analysis process is never entirely linear and requires alternating and iteratively moving back and forth between steps (Maguire & Delahunt, 2017).

3.6 Chapter Summary

This chapter began by describing the philosophical paradigm underpinning the research design. It was argued that critical realism is a suitable philosophical framework for SES research given its fascination with causation and its interpretation of the world as a complex and open system consisting of multiple interacting variables. The chapter went on to argue that a qualitative case study is an appropriate methodological approach to critical realist research because it provides an opportunity to

examine causal mechanisms within a bounded context. While an in-depth single case study approach is limited in its ability to draw generalisations, it was justified by its potential to elicit a deep understanding of policy change processes and extend theories that attempt to explain the sequencing of events, causal mechanisms and the emergence of entities. The case study subject, the bushfire policy system of south-west WA, was then introduced before the main methods of data collection and analysis were outlined. Chapter 4 presents the key findings that emerged from each study presented in the journal articles comprising this thesis.

Chapter 4: Results

The preceding three chapters provided the background, theoretical foundations and research approach used for this thesis. Chapter 4 presents the results of the research and is divided into five main sections, each of which summarises the key findings that emerged from one of the five articles comprising this thesis by compilation.

4.1 Summary of Journal Articles

4.1.1 Article 1

Ruane, S. (2018). Using a worldview lens to examine complex policy issues: A historical review of bushfire management in the south west of Australia. *Local Environment*, *23*(8), 777–779.

This article explores whether and how worldviews influence bushfire policy priorities and management practice. By building on existing worldview research (De Witt et al., 2016), Article 1 develops a conceptual framework by which to examine the historical evolution of complex policy issues applicable to the Australian context. This framework is then applied to a historical analysis of bushfire policy and management practice in south-west WA. Based on a review of historical texts and analysis of archival and current policy documents pertaining to bushfire management in south-west WA, the article identifies six worldviews that have influenced bushfire policy and practice since European colonisation: an Aboriginal worldview, a settler-colonial worldview, a modern worldview, a postmodern worldview, a late-modern worldview and an integrative worldview.

This article begins by highlighting that prior to European colonisation in 1826, Aboriginal people had deliberately applied fire to the south-west WA landscape for thousands of years (Hallam, 2014). This was done for several reasons, including facilitating food supply, enabling movement and signalling (D. Bowman, 2003). Article 1 illustrates that, in contrast to Western bushfire management practices, Aboriginal burning practices reflect a relational worldview (Graham, 1999), which is based on the belief that fire is a natural part of the environment and that humans and the environment are intimately connected (Langton, 2006).

The bushfire management practices and fire regimes of south-west WA were transformed with European colonisation (Pyne, 1991). The historical analysis demonstrated that early Western bushfire management in south-west WA reflected a settler-colonial worldview. This worldview is aligned with ideas of modernity that view Western knowledge as definitive, validates the human control of nature and perceives Indigenous cultures as subordinate (Haebich, 2015). From the early settler perspective,

fire represented a great danger to livelihoods. Moreover, the main goals of the formative bushfire policy regime for south-west WA, established in the mid-to-late 1800s, was to exclude fire from the landscape, thereby saving lives and protecting property, agriculture and timber reserves.

During the early twentieth century in Australia, the modern worldview was strengthened during the Federation era, which was associated with the establishment of state governing institutions and a societal focus on scientific progress and economic growth (MacLeod, 1993). Notably, in the early 1900s, the first state governing authorities for fire response and forest fire management in WA were established. These two governing authorities had significantly different mandates. However, the results presented in Article 1 demonstrate that the policy objectives and management practices of these main bushfire policy subsystems reflected the ideals of the modern worldview, which favours a hierarchical governance approach to the control of fire in the landscape. Further, although these early government agencies were renamed and restructured during the twentieth century, their bushfire management objectives and management practices have largely persisted through to the current policy regime for bushfire management in south-west WA.

Despite the persistence of early bushfire management institutions and the policy focus of bushfire response and control, the analysis revealed that in the first half of the twentieth century, the policy goal of preventing bushfires became increasingly prominent. Notably, by the 1960s, the prescribed burning practice of the WA Forests Department had become a key policy strategy for preventing extreme bushfire events in south-west WA. While the literature shows a correlation between the state's controlled burning practices and Aboriginal landscape burning (Pyne, 2003; Ward, 2004), a deeper examination of these bushfire management practices revealed that they have different objectives and are underpinned by strikingly different worldview beliefs about the human–environment relationship. Although prescribed burning and Aboriginal landscape burning both involve humans intentionally applying fire to the landscape under specific conditions, the practices are far from synonymous and are, indeed, applied at vastly different spatial and temporal scales.

During the 1960s, the emergence of a postmodern worldview associated with the burgeoning environmental movement began to challenge established bushfire management policy and practice, particularly prescribed burning. The environmental movement highlighted the potential ecological impacts of human-induced fire in the landscape. Resonating with the Aboriginal worldview, this postmodern worldview drew attention to the interdependence between humans and the natural environment. However, in contrast to Aboriginal burning, which is based on the notion that human-induced fire is an intrinsic part of the natural environment, the postmodern ecological worldview challenged the role of humans in applying fire to the landscape, instead favouring a fire-exclusion

approach to bushfire management. Views on prescribed burning became increasingly polarised in WA during the 1980s. Despite ongoing antagonism between forest fire managers and environmentalists, the practice of prescribed burning has persisted as a dominant policy strategy for reducing bushfire risk in south-west WA.

Throughout most of the twentieth century, the fire brigade sector retained its original focus on incident response through a hierarchical command-and-control regime that reflects a modern worldview. Although the sector remained relatively stable, by the 1980s, in an era associated with market-driven solutions and public sector reforms, the fire brigade sector was restructured and adopted a PPRR emergency management framework, which continues to guide contemporary Australian bushfire policy.

During the 1990s, a late-modern worldview saw risk management gain traction across a range of Australian policy areas, particularly in the area of bushfire and emergency management. Since then, bushfire policy and management have increasingly been based on a standardised risk management framework, reinforced by regulatory instruments that seek to ensure compliance. The emergence of the late-modern worldview and its enthusiasm for risk-based policy represented a significant shift in bushfire policy by further strengthening the precautionary approach. However, this study found that bushfire risk management continues to be underpinned by the modern worldview, which is reductionist and limited by its linearity. Further, the analysis identified that the late-modern era is characterised by new types of risk, namely those associated with climate change, which apply to broader spatial and temporal scales. Moreover, the results of Article 1 highlight that bushfire risk management measures themselves can create new unintended risks that must be considered.

Concurrent with the emergence of the late-modern worldview during the late twentieth century was the advent of the integrative worldview. This worldview is associated with the rise of the sustainability paradigm and the influence of SES thinking. The emergence of the integrative worldview represents a shift in Western thought based on the realisation that humans and the natural environment are mutually dependent and intrinsically connected. While the analysis revealed that the sustainability agenda has facilitated the integrative worldview perspective and influenced many environmental policy fields, it is evident that this integrative perspective in bushfire policy is relatively incipient.

In summary, the purpose of the study conducted for Article 1 was to determine how societal worldviews have influenced the policy and practice of bushfire management in south-west WA. Overall, the findings of the historical analysis support those of other policy studies (Beddoe et al., 2009; Matutinović, 2007b) that show that policy development is greatly influenced by changing and

enduring worldview perspectives. With respect to bushfire policy, this case study confirmed that changing worldviews have significantly influenced the underlying assumptions and beliefs regarding the role of fire in the landscape, the fundamental causes of increased bushfire risk and how bushfire risk is best managed.

The main argument of Article 1 is that worldview theory provides a valuable conceptual framework for examining the historical, sociocultural and institutional dimensions of bushfire policy and other complex policy problems more broadly. The results of the study support the idea that the development of a new integrative worldview perspective based on SES thinking will play a critical role in facilitating the planned adaptation to increased bushfire risk. Based on the literature, Article 1 proposes that the principles and practices of adaptive governance may assist with the worldview transformation needed to enable more sustainable bushfire policymaking. However, it was found that empirical research examining the operationalisation of adaptive governance principles in bushfire policy and practice was lacking and that further research on this topic was needed.

4.1.2 Article 2

Ruane, S. (2019). Applying the principles of adaptive governance to bushfire management: A case study from the south west of Australia. *Journal of Environmental Planning and Management*, 63(7), 1215–1240.

Policy discourse can be simply understood as the language and narratives used in public policy that influences how complex societal problems are interpreted and communicated (Kusmanoff et al., 2017). Analysing discourse is important because it provides a deep insight into dominant worldview assumptions that greatly influence the way that social-ecological problems are addressed (Dryzek, 2005). Changes in policy discourse can be indicative of changes in worldview and reflect the emergence of new policy solutions based on alternative worldview perspectives.

The overarching aim of Article 2 was to examine whether and how the principles of adaptive governance are reflected in the bushfire policy discourse for south-west WA and applied in practice. This study was approached via an in-depth case study of a bushfire-prone local government area located in south-west WA—the Shire of Augusta–Margaret River (see Figure 2.1). Based on a modified version of a systematic literature review, Article 2 identifies four key principles of adaptive governance—polycentric institutions, collaboration, social learning and reflexivity—which formed the conceptual basis for analysis. A document analysis of past and current Western Australian policy documents was then conducted to determine whether and how the four adaptive principles were thematically framed in the bushfire policy discourse for south-west WA. Following this, an analysis

of 15 expert interviews with practitioners working in the bushfire policy system of the case study area was conducted to determine whether and how these principles are applied in practice. A thematic analysis of the key policy documents and expert interviews formed the basis of the findings.

A key finding of Article 2 is that the south-west WA bushfire policy system applied to this local government area, while retaining a hierarchical command-and-control structure, has become increasingly polycentric (i.e. institutionally diverse) since European colonisation. There has been a broadening inclusion of various policy actors across multiple governance levels and subsectors in bushfire policymaking and implementation. It was identified that the bushfire policy imperative of 'shared responsibility' rhetorically embraces a more institutionally diverse policy regime for bushfire risk reduction. However, a critical analysis of the official policy discourse identified that, in practice, the shared responsibility agenda also resonates with neoliberal ideas that promote individual self-reliance for one's own risk.

Article 2 established that while collaboration, a key principle of adaptive governance, has been emphasised in the bushfire policy discourse for south-west WA, conflicting worldview perspectives between the various groups involved has been a major barrier to effective collaboration in practice. Social learning, which may be understood as the learning that occurs through mutual interactions between the various actors that constitute a policy regime, has also been presented as a key principle of adaptive governance. However, the document analysis conducted for Article 2 revealed that while social learning is promoted in the international disaster policy agenda, the concept has not been widely embraced in the official Australian bushfire policy discourse. The results presented in Article 2 indicate that, to a large extent, the bushfire policy system under study favours a one-dimensional approach to policy learning based on the dissemination of information by experts, rather than an approach based on the exchange and co-production of knowledge through collaborative processes.

The literature review identified reflexivity as a key principle of adaptive governance. Reflexive practice refers to the processes that enable policy actors to reflect on the worldview values and problem framings that underpin their preferred policy goals and instrument preferences (Beers & van Mierlo, 2017). Further, reflexive policymaking requires the deliberate consideration of alternative worldview perspectives and multiple lines of evidence (Voß & Bornemann, 2011). While reflexive practice was not identified as a defining feature of bushfire policymaking in the case study area, the analysis of interviews conducted for Article 2 revealed a degree of reflexive awareness on how worldview perspectives can cause tension between different actors and influence policy goals. While public inquiries following extreme bushfire events enable a degree of learning and reflexive practice,

the study concluded that more opportunities for proactive reflexive practice beyond post-bushfire public inquiries are needed.

The findings presented in Article 2 reveal that the current bushfire policy discourse for south-west WA is influenced by novel governance ideas associated with SES thinking. However, a frame analysis of official bushfire policy documents and expert interviews determined that the hierarchical governance approach continues to strongly influence bushfire policy decisions and instrument preferences. In contrast to other studies that challenge the legitimacy of command-and-control governance regimes for DRR (Imperiale & Vanclay, 2019), Article 2 does not criticise the role that hierarchical governance plays in bushfire response and matters of operational emergency management. However, the results indicate that adaptive governance provides a valuable framework that could support the bushfire policy sector to strategically adapt to the rapidly changing bushfire risk dynamics. While the results of Article 2 provide some preliminary evidence supporting the premise that the bushfire policy sector would benefit from experimenting with integrative policy mechanisms that enable cross-sectoral collaboration, deliberation and reflexive practice (Bosomworth, 2015; Ockwell, 2008; Rodríguez et al., 2013), more empirical research was required to test the validity of such propositions.

4.1.3 Article 3

Gonzalez-Mathiesen, C., Ruane, S., & March, A. (2020) Integrating wildfire risk management and spatial planning—A historical review of two Australian planning systems. *International Journal of Disaster Risk Reduction*, *53*, Article 101984.

Cross-sectoral policy integration is considered an essential component of operationalising adaptive governance in the field of DRR (Djalante et al., 2013; Rouillard et al., 2013). Article 3 builds on an emerging body of research concerned with the integration of land use planning and bushfire management policy for bushfire DRR (Gonzalez-Mathiesen & March, 2018; March et al., 2020). To better understand the processes of institutional change that characterise bushfire DRR, Article 3 presents a historical analysis of the trajectory towards increased policy integration between bushfire risk management (referred to as wildfire risk management in Article 3) and land use planning (referred to as spatial planning in Article 3). Article 3 is based on a comparative historical case study of two Australian states—Victoria and WA—to identify common drivers and barriers of policy integration in the bushfire DRR sector. Based on the findings, Article 3 presents a conceptual framework to explain the process of change towards increased policy integration for bushfire DRR, which informs the broader objectives of this thesis.

The year 1850, when the Australian colonies were first granted self-governing rights (Townsley, 1951), was the starting point of data collection for the historical analysis. The study method was comparative process tracing (Bengtsson & Ruonavaara, 2016), in which a document dataset from each case was compiled and analysed to identify critical junctures, sequencing of events and causal mechanisms that have led to increased policy integration between land use planning and bushfire management. The cases were then compared to identify common themes, differences and similarities to construct a narrative that helps explain the process of policy integration. The findings of Article 3 suggest that the pathway towards greater policy integration comprises six phases.

The first phase of policy integration identified in the study relates to the establishment of independent institutions and policy instruments for bushfire management and land use planning that have encompassed sector-specific objectives. The overarching objective of the formative bushfire policy sector in Australia was to save lives and property through immediate bushfire response, while the objective of land use (town) planning was to guide the future use and development of the land. The analysis demonstrated that the sectoral origins of both bushfire management and land use planning in both states date back to the late nineteenth and early twentieth centuries, a period associated with a dominant modern worldview, the creation of state governing authorities and significant population growth. While the analysis showed no evidence of formal policy integration between bushfire management and land use planning during this formative period, it hinted at a nascent awareness of the interconnection between bushfire risk and the built environment. Nonetheless, this phase was important to include because the institutional patterns and organisational objectives established during this formative period continue to influence the policy goals, instruments and practices of both sectors.

The second phase of policy integration for bushfire management and land use planning relates to the development of a cross-disciplinary understanding of the interdependency between the specific objectives of each sector. A key finding of the analysis was that, in both cases, extreme bushfire events and the lessons that emerged from the resultant public inquiries were causal drivers of the subsequent policy reforms that strengthened the integration of bushfire protection into land use planning frameworks. The early policy integration between these traditionally independent sectors was in the form of non-binding guidance instruments that promoted the consideration of bushfire in land use planning decision-making with respect to the location and design of settlements.

The third phase of integration identified in the analysis was the operationalisation of bushfire risk consideration in local planning instruments in the form of local planning schemes and rural and

regional strategies. This phase was again found to be the result of policy learning following large bushfire events.

The fourth phase of policy integration between bushfire management and land use planning was characterised by the introduction of state-level institutional arrangements that centralised the integration of bushfire management and land use planning decision-making to improve consistency. This phase of policy integration was distinguished by the design of bushfire policy instruments that interacted across vertical and horizontal governing scales. Advancing this development, the fifth phase of policy integration was represented by the introduction of mandatory integrated decision-making processes, where the professional knowledge and expertise of actors from one policy subsector was formally integrated into the decision-making processes of another subsector. This phase was characterised by the more consistent and coordinated sharing of information and data, and the design of cross-sectoral policy instruments.

The sixth phase of policy integration for bushfire DRR was based on the recognition of the need to consider the multiple dimensions of time and space when advancing policy integration. It was evident that the integration of bushfire management and land use planning in both cases had been strengthened by formalising state-level institutional arrangements through the enactment of rules-based regulatory instruments. However, the analysis conducted for Article 4 also identified several limitations associated with a rigid, centralised approach to policy integration, which is, indeed, at conceptual odds with new governance principles that promote a higher degree of self-organisation, flexibility and experimentation (Rouillard et al., 2013).

In contrast to earlier studies that conceptualised policy integration as a desired outcome (Briassoulis, 2004; Underdal, 1980), the analysis provided additional evidence supporting more recent studies that propound the idea of policy integration as a process of institutional change that develops over time at different rates (Candel & Biesbroek, 2016). The findings presented in Article 3 also show that policy integration was influenced by broader international trends and changing worldview perspectives that promoted cross-sectoral and multiscale policy cohesion. However, in both cases, measures to advance integration were accelerated following large bushfire events and the lessons from the public inquiries that followed. Further, while the study confirmed that the process of policy integration can occur in different ways (Candel & Biesbroek, 2016), the analysis revealed similarities in the trajectory, contextual conditions and causal drivers of policy change towards more integrated bushfire DRR policy in both cases. While the article supports the idea that policy integration is critical for planned adaptation to more frequent and extreme climate-related hazards, it did not include a critical

discussion on the challenges and pitfalls of policy integration, which was identified as an important future research area.

4.1.4 Article 4

Ruane, S., Swapan, M. S. H., & Babb, C. (2020). Disaster risk reduction in bushfire prone areas: Challenges for an integrated land use planning policy regime. *Sustainability*, *12*(24), Article 10496.

Policy integration is commonly presented in the sustainability and disaster literature as a critical component of adaptation (Biesbroek, 2021) and in official policy discourse as a win–win solution (Nilsson & Weitz, 2019). However, emerging studies have questioned these normative assumptions and assert that a better understanding of the challenges and limitations of policy integration is crucial to inform the design of successful integrative policy strategies (Candel, 2019). Article 4 contributes to this emergent debate through a case study of an integrated bushfire policy regime for south-west WA. The article examines the conditions that have enabled and constrained the development of an integrated policy regime between land use planning and bushfire management to ascertain mechanisms that could facilitate more successful policy integration in the DRR context.

Policy integration is defined as

> a phenomenon whereby [two] or more interdependent policy sectors (also referred to in the literature as policy domains or subsystems) of a policy regime pursue shared or mutually supportive goals through the implementation of cross-cutting instruments and the cooperation of a network of policy actors. (Ruane et al., 2020, p. 3)

'Instruments' refer to the various government tools used to achieve prescribed policy goals (Howlett et al., 2018) and may include rules-based instruments that mandate behaviours and processes, market-based instruments that provide incentives and promote competition, information-based instruments that provide guidance and actor-based instruments that support communication, learning and collaboration (Metz et al., 2020).

Based on a review of existing policy integration studies, Article 4 identifies five dimensions that underpin successful policy integration: (i) coordinated subsystem interaction, (ii) cultural compatibility, (iii) coherence of sectoral (subsystem) goals, (iv) cross-sectoral understanding and (v) consistency of the instrument mix to meet the key policy goals. Further, several conditions that enable or constrain these policy integration dimensions were identified. This formed the analytical framework by which to examine how policy integration between bushfire management and land use planning has been enabled and/or constrained in the south-west WA case study. The research

approach included a qualitative analysis of policy documents and semi-structured interviews with policy actors representing the various subsystems of the integrated policy regime under study.

With respect to how bushfire governance arrangements have changed over time, the document analysis revealed that an integrated policy regime between bushfire management and land use planning for south-west WA first emerged in the late 1980s following the most catastrophic Australian bushfire at the time. This event raised public awareness about the role of land use planning in bushfire risk reduction. Further, this event led to the development of information-based instruments that provided guidance on the integration of bushfire considerations in land use planning decisions and outlined acceptable bushfire protection measures for the built environment of south-west WA. These incipient instruments were incrementally adjusted over time in response to the acquisition of new information and ideas and the influence of emerging international disaster policy trends. However, while they encouraged the consideration of bushfire in planning and development, these policy instruments were non-binding and only implemented when WA local governments officially identified bushfire-prone areas in their jurisdictions. A legally binding framework for bushfire management and land use planning in WA was not established until 2015 following an extreme bushfire event in south-west WA. This bushfire event, along with the subsequent public inquiry recommendations, was found to be a trigger that accelerated policy integration for bushfire DRR through the enactment of rules-based instruments that formalised cross-sectoral collaboration and increased centralisation.

Article 4 identified several conditions that have constrained the integration of bushfire management and land use planning policy in the case under study. Notably, the results of the analysis suggest that fundamental differences in the organisational goals, worldview perspectives and problem frames of the various subsectors involved presented the greatest challenges to an integrated bushfire policy regime. Further, the analysis revealed that a lack of cross-sectoral understanding and professional knowledge of actors outside of their discipline present significant barriers to successful policy integration. A key finding was that bushfire management practitioners lack relevant knowledge about how land use planning functions, and land use planning practitioners lack technical expertise on how bushfires behave in the built environment.

A further analysis conducted for Article 4 identified mechanisms that may mitigate some of the challenges and support a more successful integration of bushfire management and land use planning policies. Given that policy integration has been hindered by a lack of cross-sectoral knowledge, further opportunities for policy actors to develop skills and professional knowledge outside of their sectoral discipline are warranted. Moreover, the findings of Article 4 are consistent with those in the

literature that demonstrate that integration is much more likely to be successful when policy actors from the different subsystems have frequent opportunities to build rapport, establish joint policy goals and consider one another's perspectives (Metz et al., 2020). Therefore, the results indicate that actor-based mechanisms focusing on reflexive practice, social learning and knowledge co-production between the bushfire policy subsectors are critical for developing the integrative approach needed to address contemporary bushfire DRR.

Much of the emerging disaster governance literature advocates for a greater degree of decentralisation and the use of informal, actor-based instruments associated with network governance (Hermansson, 2019; Melo Zurita et al., 2015). However, an important finding of this study is that a combination of both centralised rules-based instruments, which support consistency and mandate collaborative action, and actor-based policy instruments, which foster multi-actor communication and policy learning, is necessary for successful policy integration (Rode, 2019). The findings also show that many unanswered questions remain with respect to ensuring that land use planning in bushfire-prone areas is consistent and coordinated while still allowing room for flexible decision-making, consideration of the local context and experimentation, all of which are essential for successful adaptation action. This article identifies a need for further research into the design and assessment of hybrid governance models and integrated DRR policies to address such dilemmas (Koppenjan et al., 2019).

4.1.5 Article 5

Ruane, S., Babb, C., & Swapan, M. S. H. (submitted for publication). Maladaptive consequences of bushfire risk policy strategies for the wildland–urban interface: A case study from south-west Australia.

Recent bushfire events in Australia have highlighted the urgency of policy action to address the increasing scale and frequency of extreme bushfires events. While adaptive governance frameworks for bushfire risk reduction have been proposed, in practice, the integration between bushfire public policy and CCA is incipient. Moreover, while bushfire policy may be considered an integral part of planned adaptation, little is known about the negative consequences and trade-offs of various bushfire policy strategies. A review of the literature for Article 5 indicated that successful adaptation to increased bushfire risk requires a greater understanding of the maladaptive consequences of bushfire policy strategies.

Planned adaptation refers to a wide range of deliberate, precautionary policy strategies that aim to reduce vulnerability, build resilience and foster adaptive capacity to climate-exacerbated hazards

(Mersha & van Laerhoven, 2018). Planned adaptation can be facilitated by various policy actions, which may be classified according to the IPCC's adaptation options framework of avoid, accommodate, protect and retreat. While adaptation actions may reduce the risk of climate-related disasters, the likely trade-offs associated with the various adaptation options need consideration. Maladaptation has emerged as a valuable topic of discussion in the adaptation literature and as a helpful concept to examine the potential negative consequences of adaptation actions to reduce the risk of climate-related hazards such as bushfire.

A review of the maladaptation literature conducted for Article 5 identified that planned adaptation actions may result in maladaptive outcomes if they increase or transfer vulnerability, have high opportunity costs, reduce the incentives to adapt, create path dependencies or erode other sustainability objectives (Barnett & O'Neill, 2010; Juhola et al., 2016). While there is a growing interest in maladaptation, the maladaptive consequences of bushfire policy have not yet been empirically examined.

Through a qualitative case study of the bushfire policy system in south-west WA, Article 5 addresses this gap by responding to the following questions: What are the key policy strategies for adapting to increased bushfire risk at the WUI? What are the institutional settings and policy frames of each of these strategies? Are there potential maladaptive consequences of these policy strategies that should be considered? The main aim of Article 5 is to shed light on the broader consequences of bushfire policy for sustainability and climate resilience using a maladaptation framework. The study was conducted in two stages. First, a document analysis identified the main policy strategies currently used in south-west WA to reduce bushfire risk at the WUI that can be considered an adaptation action and categorised using the IPCC adaptation options framework. Second, using maladaptation as a conceptual framework, a thematic analysis of 30 interviews was undertaken to identify the potential trade-offs and negative consequences of each of the bushfire policy strategies identified.

The analysis revealed three main bushfire policy strategies framed in the discourse in WA as essential for reducing vulnerability and enhancing climate resilience that could be considered a planned adaptation action. These strategies include broadscale prescribed burning, local bushfire risk management planning and land use planning in bushfire-prone areas. Given their focus on land treatment and technical measures that aim to isolate bushfire hazards from settlements, broadscale prescribed burning and local bushfire risk management planning largely correlate with the IPCC adaptation option of *protect*. In contrast, the policy strategy in relation to land use planning in bushfire-prone areas encompasses aspects of all IPCC adaptation options. Land use planning in bushfire-prone areas is supported by strategic planning instruments that encourage the adaptation

option to *avoid* residential development in high-risk bushfire-prone areas. Other market-driven policy instruments may be utilised to foster the managed *retreat* of existing settlements from extremely hazardous areas. However, this study found that the land use planning sector in the case study tended to favour the *accommodate* adaptation option by allowing residential development in bushfire-prone areas with the incorporation of appropriate bushfire urban design measures.

Overall, the empirical investigation revealed that while each of the three main bushfire policy strategies may be framed as necessary adaptation actions, all have potential maladaptive consequences that require careful assessment. While broadscale prescribed burning has continued to attract ongoing political support and significant funding, many interviewees criticised the approach because of its potential to burn large areas of ecologically valuable forest at a scale that may cause irreversible damage. Some scholars promote smaller-scale policy approaches to bushfire DRR aimed at fuel reduction within and at the edge of settlements as an alternative to broadscale burning (Norman et al., 2021). However, the analysis conducted for this study also indicates that the implementation of smaller-scale hazard reduction burning within or at the edge of WUI areas may attract public opposition given its potential to escape and result in bushfire as well as the health impacts associated with poor air quality. Further, according to some interviewees, local bushfire risk management strategies that support this smaller-scale approach has led to a highly visible loss of native vegetation along with potential impacts on wildlife corridors and environmental amenities. While land use planning has received increasing attention as the most critical adaptation action, with respect to WA's land use planning policy in bushfire-prone areas, the interviewees gave many examples of it resulting in the significant clearing of native vegetation, which was considered deleterious for climate resilience in a broader sense. Further, there was a concern that this more recent policy approach may have future financial implications for low-income households, potentially increasing the vulnerability of some communities living in bushfire-prone areas.

In summary, Article 5 argues for a more comprehensive analysis of sustainability trade-offs associated with bushfire policy from a planned adaptation and maladaptation perspective. The article concludes by recommending that bushfire policymakers enhance the integration of ecological knowledge in risk assessment methodologies, consider a wider range of public values, take a more systematic and longer-term view and adopt an adaptive governance framework. While Article 5 contributes conceptual understandings of the implications of bushfire policy for sustainability and climate resilience, further research with respect to how maladaptation assessment can be operationalised into policymaking and risk management practices is needed.

4.2 Chapter Summary

This chapter summarised and presented the key findings of the journal articles comprising this thesis by compilation. The chapter began by summarising the key findings of Article 1, a study that built on worldview theory to develop a conceptual framework through which to examine the evolution of bushfire management policy in south-west WA. The analysis conducted for this study confirms that worldviews have played a significant role in how fire in the landscape is framed in bushfire policy and management.

Article 2 identified four key principles of adaptive governance—polycentric institutions, collaboration, social learning and reflexivity—and examined the extent to which these principles are applied in the bushfire policy discourse and management in south-west WA. Overall, the study found that while a hierarchical approach to bushfire management has persisted, the policy sector is increasingly influenced by novel social-ecological governance principles. It is argued that adaptive governance provides a valuable framework by which to guide the strategic direction of bushfire policy.

Articles 3 and 4 were both concerned with the integration of land use planning and bushfire risk management policies. The analysis conducted for Article 3 shows that policy integration is a process of institutional change and that the pathway to increased integration comprises six phases: (i) establishing institutions, (ii) developing an understanding of sectoral interdependencies, (iii) operationalising bushfire considerations into local instruments, (iv) introducing state-level institutional arrangements, (v) mandating integrated decision-making processes and (vi) recognising the broader spatial and temporal dimensions of bushfire risk.

Following on from this, Article 4 examined the factors constraining the integration of land use planning and bushfire management in south-west WA and identified mechanisms that may facilitate more effective policy integration. A key finding of this article was that the strengthening of policy integration for bushfire DRR requires a combination of both rules-based and actor-based instruments. Further, the article revealed that a key challenge for this integrated DRR regime is to ensure consistent decision-making while still retaining the flexibility and contextuality needed to respond to changing conditions.

Finally, Article 5 identified three key bushfire policy strategies used to reduce risk to the WUI: broadscale prescribed burning, local bushfire risk management planning and land use planning in bushfire-prone areas. The findings highlight that while these strategies may all be considered adaptation actions, each has potential maladaptive aspects that should be considered by policymakers.

Each of the articles presented in this chapter represent a discrete study into various aspects of bushfire policy and management. Together, however, they provide valuable insights into the process of policy change that may inform the planned adaptation to increased bushfire risk. Chapter 5 weaves together the key findings of each study into a critical discussion that responds to the overarching research question and subquestions of this thesis.

Chapter 5: Discussion

5.1 Discussion in Relation to Thesis Question

The previous chapter synthesised the five articles comprising this thesis by compilation. The key findings of these articles are now critically discussed in relation to the overarching research question: *What factors influence bushfire policy change, and how can these insights be used to inform planned adaptation to increased bushfire risk?*

To answer this question, this chapter is divided into three main sections, each of which responds to the three subquestions of this thesis. Section 5.1.1 discusses how the socio-institutional context of bushfire policy in south-west WA has changed since European colonisation. Section 5.1.2 explains the factors that have enabled and/or constrained bushfire policy change. Section 5.1.3 considers the key lessons from historical patterns of bushfire policy change that may inform planned adaptation to increased bushfire risk. The chapter concludes by presenting a pragmatic theoretical framework that may assist bushfire policymakers to adapt to rapidly changing conditions.

5.1.1 How has the bushfire policy landscape in south-west WA changed since European colonisation?

The first subquestion of this thesis relates to how the socio-institutional context of bushfire policy has changed in south-west WA since European colonisation. The findings that emerged from the studies presented in Articles 1–5 indicate that the region's bushfire policy landscape has changed in four ways. These changes relate to the framing of the bushfire problem and policy goals, the organisational arrangements, the governance mode and the mix of policy instruments.

5.1.1.1 Bushfire problem frame and policy goals

The historical analyses conducted for Articles 1 and 3 demonstrate how the problem framing and goals of the bushfire policy system in south-west WA have both persisted and changed since European colonisation. Article 1 illustrates that the incipient bushfire policy regime in south-west WA, which emerged in the late nineteenth and early twentieth centuries, framed fire in the landscape as a great threat to the livelihoods of early settlers. In contrast to the objectives of Aboriginal landscape burning, which is underpinned by a relational worldview, the findings of Article 1 show that the bushfire management policy goals of early settlers focused on protecting life, property and other economic assets (Beilin & Paschen, 2020). Consistent with the institutional theory of path dependency (Fleck, 2007; Pierson, 2004), Articles 1, 2 and 5 illustrate how these historically

embedded policy goals have, over time, remained firmly ingrained in the organisational culture and practices of the two key state agencies responsible for bushfire management in WA. However, Articles 1 and 3 both demonstrate that new framings of the bushfire problem and broader goals for bushfire public policy have also emerged. These findings support the theoretical proposition that enduring institutions can adapt over time in response to new information and technologies and the emergence of alternative worldviews (Handmer & Dovers, 2013).

Article 1 highlights that early bushfire public policy was established in a period associated with a burgeoning modern worldview, which assumed that humans and the environment were mutually exclusive. As a result, the incipient bushfire policy system for south-west WA focused on excluding fire from the landscape using rules-based policy instruments that restricted human-induced burning and established a hierarchical structure of command-and-control to 'fight' fire. However, by the 1930s, another policy frame for bushfire management emerged in which human-induced fire was perceived as a necessary and intrinsic part of the south-west WA landscape. Underpinned by this policy frame, the practice of prescribed burning became an integral part of bushfire public policy for the region (Burrows & McCaw, 2013). This was a turning point for bushfire policy in south-west WA, marking the beginning of a more preventative approach to bushfire management through a discourse of fire control and bushfire protection.

While the protection of lives and properties through bushfire response persisted as the overarching objective of the state's fire brigade authority, there was an increasing focus on bushfire prevention over the twentieth century. Article 2 reveals that during the late 1970s, the preventative focus of bushfire policy was further advanced when Australia, following the lead of the United States, adopted a PPRR strategic policy framework for all hazards, including bushfire. The findings presented in Articles 1–5 illustrate that since the 1990s, the bushfire policy sector throughout Australia has increasingly adopted a risk management framework while retaining a PPRR framework. This shift aligns with what Beck (2006) describes as the 'epoch of risk' (p. 34) and was identified in Article 1 as the emergence of a late-modern worldview perspective. The findings of Articles 1 and 2 align well with those of other studies (Bosomworth, 2015; Paschen & Beilin, 2017) showing that while the framing of bushfire as a risk management problem has advanced the preventative focus of bushfire policy, it continues to be based on an assumption of human control over nature (Bosomworth, 2015; Paschen & Beilin, 2017) and favours mechanistic and technocratic policy solutions (Aldunce et al., 2014).

In line with other studies (Aldunce et al., 2015; Bosomworth, 2015), Article 2 also reveals the recent emergence of an SES frame for bushfire policy. This shift is based on the growing recognition in

Western thought that humans and the environment are mutually interdependent. This frame is based on the notion that rather than controlling nature, humans must learn to adapt to and coexist with fire in the landscape (Moritz et al., 2014). Moreover, the findings illustrate that since the 1980s, environmental conservation has become an integral consideration of bushfire policy. However, the findings of Article 2 reflect those of other studies that demonstrate that conservation values may be compromised by risk-based bushfire policy strategies that prioritise human safety and the protection of property (Bardsley et al., 2015).

Articles 3 and 4 demonstrated that the emergent, albeit less dominant, SES frame for bushfire policy is based on the view that humans can build resilience to bushfire by adopting more adaptive and integrative governance arrangements (Bosomworth et al., 2017; Djalante et al., 2011; Moritz et al., 2014). However, in line with other studies (Bosomworth, 2015), Article 2 demonstrates that despite the emergence of an SES frame for bushfire policy, emergency risk management underpinned by the modern worldview remains the dominant frame guiding bushfire policy in south-west WA.

5.1.1.2 Organisational arrangements

Reflecting the emergence of alternative problem frames and new policy goals for bushfire management, the findings of Articles 1–5 provide evidence of gradually changing organisational arrangements for bushfire policy in south-west WA. Articles 1 and 2 illustrate that since European colonisation, the institutional setting for bushfire in south-west WA has become increasingly polycentric. While the state has retained centralised control over both emergency and forest fire management, the gradual reframing of the bushfire problem as a shared responsibility has resulted in an increasingly diverse organisational landscape for bushfire DRR. The changing policy discourse, reflected by the widespread adoption of the disaster resilience concept, has highlighted that the responsibility for bushfire goes beyond the emergency and forest management sectors (Bosomworth, 2018) and that multiple drivers of bushfire vulnerability need to be addressed. Articles 3 and 4 show that new actors have been brought to the bushfire policymaking table, notably the land use planning sector, which is now recognised as a key player in bushfire DRR (Gonzalez-Mathiesen & March, 2018). Articles 3 and 4 demonstrate that the bushfire policy regime in south-west WA has become more integrated over time, with actors interacting across horizontal and vertical governance scales to address mutually interdependent policy goals and multiple dimensions of risk and vulnerability.

5.1.1.3 Governance mode

Overall, the findings in Articles 1, 2 and 3 illustrate that there has been a gradual transition in bushfire governance in south-west WA from a purely hierarchical system of bushfire response to one that also

incorporates network and market governance approaches. Bushfire governance in south-west WA has become progressively multilevelled, with increased cross-sectoral interactions between the various bushfire policy subsystems and actors that influence or are affected by bushfire policy decisions. More specifically, Article 2 illustrates that some of the principles of adaptive governance, an emerging form of environmental governance argued by many to facilitate the transformative adaptation agenda (Munene et al., 2018), are being applied in bushfire policy and practice in south-west WA.

However, reflecting the findings of other integrated policy studies (e.g. Rode, 2019), the engagement of citizens in bushfire policymaking has been limited in south-west WA. While some principles of adaptive governance have been integrated into the current bushfire policy system, these predominantly relate to a network of formal government actors (Brummel et al., 2012; Howes et al., 2015). The bushfire policy system examined does not delegate decision-making power to local communities or directly involve citizens in policymaking, which are presented as core dimensions of sustainable adaptation in the literature (Eriksen et al., 2011; Hermansson, 2019).

In the literature, policy integration and adaptive governance are presented as complementary theories (Karpouzoglou et al., 2016; van Assche et al., 2021) that are aligned with the network governance mode (Howes et al., 2015; Tosun & Lang, 2017). However, the findings of Articles 3 and 4 resonate with those of Rouillard et al. (2013), who identified a theoretical mismatch between these network governance approaches. Adaptive governance is largely concerned with informal collaboration and flexible and self-organising policy strategies (Rouillard et al., 2013). However, the findings presented in Article 4 show that the strengthening of the integrated bushfire policy regime under study relied upon on the strengthening of formal, top-down governance arrangements characterised by clearly delegated roles, centralised decision-making authority (Rode, 2019) and mandated collaboration (Brummel et al., 2012; Metz et al., 2020).

Together, the findings of all five articles comprising this thesis demonstrate that the current bushfire policy landscape in south-west WA is best described as a hybrid governance system (Rode, 2019). These results support political science studies that challenge the notion that governance structures are transitioning towards network governance modes (Koppenjan et al., 2019). More specifically, the findings of Article 3 illustrate that an integrated policy regime for bushfire DRR has, indeed, relied upon the strengthening of a hierarchical governance structure to facilitate more consistent collective action (Rode, 2019). In addition, the findings of Articles 4 and 5 indicate that rules-based policy integration has increased collaboration and knowledge sharing between diverse bushfire policy subsectors (Brummel et al., 2012; Metz et al., 2020), improved the consistency of decision-making

and mitigated some of the power associated with private interest groups (Foerster et al., 2015). However, one of the issues that emerged with respect to the bushfire policy system under examination is that the strengthening of policy integration has also compromised the flexibility and local contextuality that is promoted in the governance literature as necessary for planned adaptation (Rouillard et al., 2013). Therefore, further research to deal with such theoretical inconsistencies in the new governance and sustainable adaptation literature is suggested.

5.1.1.4 Instrument mix

Overall, Articles 1–5 reveal how the policy instrument mix for bushfire management has transformed over time into its current manifestation. In accord with the changing problem frame and new governance modes, the suite of policy instruments for bushfire DRR has shifted from predominantly comprising rules-based instruments to increasingly relying on actor-based instruments (Metz et al., 2020). Further, the policy analysis conducted for Articles 3 and 4 demonstrates that to improve the coherence of bushfire policy, there has been a shift from single-sectoral to cross-sectoral instruments in an attempt to integrate the knowledge, actions and practices of the various subsystems comprising bushfire DRR. Article 4 demonstrates that the successful integration of the bushfire DRR policy strategies of traditionally independent sectors (in this case, the land use planning and bushfire management sectors) has relied on both rules-based instruments (e.g. legislation, organisational structures and operating procedures) and actor-based instruments (e.g. working groups, advisory committees and collaborative arrangements), which have facilitated collective action and learning between diverse actors at multiple scales. Further, an integrated bushfire policy regime was found to be increasingly dependent on market mechanisms such as property rights, insurance, building standards and notification of hazards on land titles.

5.1.1.5 Summary

The findings illustrate that the bushfire policy landscape in south-west WA has changed significantly since European colonisation. While the historical institutions for bushfire management have persisted, new governance modes have emerged. In particular, the findings reveal that while early policy frames and goals continue to strongly influence bushfire policy in south-west WA, new policy goals for bushfire management have been added, and the discourse has shifted towards a more resilience-based approach. Further, while many of the current institutions of bushfire policy remain underpinned by a historically constructed modern worldview and enduring organisational objectives, the institutional diversity of bushfire policy has expanded significantly, with roles and responsibilities distributed across multiple actors and scales. Similar to other studies (Rode, 2019), the findings demonstrate that while a hierarchical governance approach has continued to strongly influence

bushfire policy goals and instrument preferences, the sector has evolved over time to become what may be described as a hybrid governance system (Koppenjan et al., 2019). This hybrid bushfire policy system includes a diverse mix of rules-based, actor-based and market-based policy instruments.

5.1.2 What factors have enabled and/or constrained bushfire policy change in south-west WA?

An understanding of the factors that have enabled and constrained bushfire policy change is useful for informing the design of intentional public policy interventions (Penning-Rowsell et al., 2006) that can support CCA. This subsection focuses on the factors that have influenced bushfire policy development in the case examined and critically discusses the findings in relation to several theories that attempt to explain policy change.

5.1.2.1 Worldviews

The findings of this thesis are consistent with those of other studies (Jenkins-Smith et al., 2014) that assert that worldviews play a central role in the dynamics of policy change. The historical analysis conducted in Article 1 further supports the idea that the prevailing worldview will generally underpin the formal institutional configurations and policy preferences of a governance system at a given time (Matutinović, 2007b). However, while Article 1 supports the idea that, like institutions, worldviews are resistant to change, the historical analyses conducted for Articles 1 and 3 confirm that they are not fixed and can change over time (Hart, 2010). Further, the findings from Articles 1, 2 and 4 confirm that worldviews, institutions and policy instruments are mutually constitutive (Beddoe et al., 2009); thus, a change in one of these dimensions can lead to a change in another.

The findings that emerged from Articles 1 and 2 align with those of other studies that show that the dominant worldview that prevails during a particular period will shape the institutional frameworks and policy preferences to address societal problems (Matutinović, 2007a). However, Article 1 demonstrates that different worldviews can exist simultaneously and, when mobilised, can challenge the status quo and gradually enable new policy discourses to emerge (Jenkins-Smith et al., 2014). Despite this, Article 1 supports previous studies that have found that while dominant worldviews are temporal, they have enduring elements (Van Opstal & Hugé, 2013). The study conducted for Article 1 identified that the modern worldview perspective, which views humans as separate to and in control of nature and is aligned with a hierarchical approach to policymaking, has persisted as the dominant worldview in Australia since European colonisation. This modern worldview perspective is deeply embedded in the governance structures of Western societies (Hedlund-de Witt, 2014). Reflecting studies of bushfire governance in other jurisdictions (Bosomworth, 2015), the modern worldview perspective continues to strongly influence bushfire policymaking in WA.

The findings that emerged from Article 1 align with the worldview theories that posit that a new collective worldview can emerge from the blending of two or more worldviews (Johnson et al., 2011) or by building on previous worldviews through the attainment of new and diverse insights, ideas and perspectives (Matutinović, 2007a). Article 1 demonstrates evidence of this in the case of the emergence of the late-modern worldview, which gave rise to a more risk-obsessed society, thus providing the impetus for a more precautionary bushfire policy approach. However, while it can be differentiated from the modern worldview perspective, the late-modern worldview perspective has retained the deep beliefs and assumptions associated with the modern worldview, which favour rules-based policy instruments and a hierarchical governance system. Articles 1 and 2 argue that the integrative worldview perspective, which has been influenced by SES thinking and the sustainability agenda, offers new conceptualisations of bushfire management for policymakers and is critical for planned adaptation to increased bushfire risk. However, the results also indicate that the persistence of the modern worldview perspective, which by its nature is difficult to change, presents a significant barrier to transforming bushfire policy towards more sustainable pathways.

The results of Article 1 support the proposition that with the attainment of new information and ideas, alternative worldviews that influence how societal problems are perceived and challenge the effectiveness of established institutions and dominant policy positions can gain traction (Matutinović, 2007b). Despite this, the findings of Articles 1 and 2 tie in well with those of Jenkins-Smith et al. (2014), who found that while exposure to new ideas can influence policy actors to change their secondary beliefs (i.e. beliefs about policy tactics and initiatives), underlying worldview beliefs about the cause of the problem, fundamental goals and instrument preferences are more difficult to change. While some scholars assert that crisis events such as disasters can result in policy actors repositioning their worldview assumptions and beliefs (Matutinović, 2007b), the empirical findings of the present study match those that suggest that changes in the worldviews of actors following a single disaster event are unlikely (Penning-Rowsell et al., 2006).

5.1.2.2 Disaster events

A great deal of attention in the SES and institutional change literature is given to the role of exogenous events such as disasters and crises in driving policy change. Aligned with the institutional change concepts of punctured equilibrium and critical junctures (Pierson, 2004) and the SES concepts of triggers, tipping points and critical thresholds (Milkoreit et al., 2018), the findings of all five articles comprising this thesis demonstrate that major bushfires have been a key driver of bushfire policy change. There have been significant bushfire policy reforms in south-west WA in response to large bushfire events in the region. However, Articles 3 and 4 illustrate that, for the most part, existing

policy instruments and organisational structures were simply revised and adjusted rather than radically transformed or replaced following bushfire events. Contrary to initial expectations that the external shock from a bushfire disaster could initiate transformative bushfire policy change (Hay, 1999), the change process revealed in these studies may be best described as what Streeck and Thelen (2005) refer to as 'institutional layering', in which new instruments and elements are attached or stacked onto already established institutions.

While the studies presented in this thesis were unable to confirm the theory of punctuated equilibrium, which posits that a disaster event can result in radical policy transformation (Baumgartner & Jones, 1993; Pierson & Skocpol, 2002), Articles 3 and 4 indicate that large bushfire events can provide a window of opportunity to accelerate policy change (Kingdon, 1984; Penning-Rowsell et al., 2006). Further, the analyses conducted for Articles 3 and 4 illustrate that a bushfire event can change the diversity of actor coalitions (Sabatier & Pelkey, 1987) and increase policy negotiations, both of which are important factors driving policy change (Metz et al., 2020). Overall, the findings of this thesis accord with those of other studies that have concluded that disasters and crises can act as a trigger for policy change because they provide an opportunity for actors to challenge existing institutional frameworks and paradigms and consider alternative policy solutions (Hogan & Feeney, 2012).

Nevertheless, in accordance with other studies (Kickert & van der Meer, 2011; Penning-Rowsell et al., 2006), the present study confirms that bushfire policy change in south-west WA has, in general, been gradual and incremental. Moreover, Articles 3 and 4 show that the significant reforms that have taken place following large bushfire events are, in fact, path dependent on previous institutional arrangements. Although these bushfire events provided a catalyst, the wheels of change were already in motion (Kickert & van der Meer, 2011). This aligns with Kingdon's (1984) observation that while an exogenous event can trigger a policy change, the latter is most often based on 'an idea whose time had come' (p. 1). This is not to suggest that the bushfire policy changes observed in the case study were insignificant. The longitudinal analyses conducted for both Articles 1 and 4 demonstrate that gradual policy change along with spikes of accelerated change can lead to major changes in a policy regime over time (Termeer et al., 2017).

A surprising finding that emerged from the analyses conducted for Articles 1 and 5 is that while bushfire events were identified as important drivers of policy change, there were occasions in which extreme bushfire events reinforced the existing institutional bushfire policy arrangements. This was most notable in the case of prescribed burning in Article 5, which shows that despite the emerging evidence challenging its effectiveness (Enright & Fontaine, 2014) and highlighting its negative ecological impacts (Bradshaw et al., 2018), the strategy of prescribed burning received a significant

boost in funding commitments following a recent bushfire disaster in south-west WA. This is referred to in the institutional change literature as the 'lock-in effect' (Sorensen, 2015). In summary, the findings of this thesis indicate that disaster events may not only drive but also constrain policy change by sinking significant resources into existing policy strategies, thus strengthening future path dependencies that limit the possibility of considering alternative solutions (Novalia & Malekpour, 2020).

5.1.2.3 Actor interaction

Multilevel actor interaction was identified in the literature as a critical mechanism for addressing complex policy problems (Howlett et al., 2017; Pahl-Wostl et al., 2013; Roberts & Geels, 2019). Further, given its potential to foster knowledge exchange, resource sharing, social learning and innovation, collaboration has been proposed as a key enabler of policy change (Brummel et al., 2012; Howes et al., 2015; B. May & Plummer, 2011). Consistent with the literature, the findings of Articles 2, 3 and 4 confirm that collaboration has been embraced as a strategic imperative for bushfire policy in south-west WA based on the premise that it improves interagency coordination and interoperability. Moreover, policy integration, a more structured form of collaboration that involves the development of cross-cutting instruments (Meijers & Stead, 2004), is considered critical if genuine policy change to enable adaptation is to occur (Candel, 2019). The results of Articles 3 and 4 shed light on various collaborative mechanisms that can facilitate a transition in policy towards more integrated and adaptive DRR. In particular, the findings of these articles tie in well with those of other studies showing that collaboration can be enhanced by both rules-based and actor-based instruments and that rules-based mechanisms can indeed be used to legislatively mandate actor collaboration to ensure a more coordinated and integrated policy approach (Metz et al., 2020).

In line with other studies (Williams et al., 2021), the findings of Articles 3 and 4 show that mandated collaboration can enable policy change by fostering the development of interagency relationships. However, these articles also indicate that the success of integrated policy approaches is highly dependent on the institutional logic of the sectoral subsystems involved (Metz et al., 2020) and whether the central policy actors have a history of conflict (Brummel et al., 2012). The findings of Article 2 illustrate that collaborative bushfire policy strategies for south-west WA have been significantly constrained by the divergent institutional logics of the various subsystems involved. Another important finding with respect to collaboration in Article 4 is that while rules-based instruments can lead to more consistent and coordinated multi-actor interactions (Rode, 2019), they can also lead to power imbalances because one sector subsystem generally retains the decision-making power or establishes the parameters of interaction (Brummel et al., 2012; Rouillard et al.,

2013). Moreover, a recurring finding of Articles 2, 3 and 4 is the conundrum that exists between ensuring consistent and coordinated multi-actor interactions through the use of a centralised and legislatively mandated approach to collaboration (Foerster et al., 2015), while maintaining the adaptability needed to address the bushfire problem in the context of rapidly changing risk dynamics (Brummel et al., 2012; Rouillard et al., 2013).

Together, the findings of the articles suggest that legislation is critical to advance policy integration and ensure interagency communication and collective action for bushfire DRR where it has been inadequate in the past. Further, in line with Brummel et al. (2012), Articles 2 and 4 indicate that mandating actor collaboration and policy integration for bushfire DRR is beneficial and may have lasting benefits. However, it can be assumed that in their current form, the collaborative mechanisms analysed in this study are unlikely to foster innovative policy solutions unless the relational aspects of collaboration, which encourage deliberation and reflexivity, are supported.

5.1.2.4 Learning

The findings from Articles 2, 3 and 4 are consistent with those of other studies that show that bushfire policy change may be facilitated by social learning (Brummel et al., 2010; Williams et al., 2021). Most notably, the findings in Articles 1, 3 and 4 indicate that public inquiries following major bushfire events (e.g. special inquiries, royal commissions and coronial inquests) have been salient learning mechanisms that have generated significant bushfire policy reform (Article 1), new organisational arrangements (Article 2) and the redesign of policy instruments (Articles 1, 2, 3 and 4). Taken together, the findings demonstrate that public inquiry is an important mechanism for policy learning and can help reduce the chance of policy failure in the future (Inwood & Johns, 2016). However, while the studies show that public inquiries have engendered bushfire policy reform, they resonate with previous studies (Stark, 2019) that show that the lessons derived from public inquiries are heavily focused on the effectiveness of extant policy instruments and their implementation. Further, the findings support the idea that while these policy-related lessons can lead to changes in formal institutional arrangements, those examined in the present study did not provide a deliberative learning forum for governance actors to reflect on the underpinning worldviews of bushfire practice, reframe the bushfire policy problem or develop new policy goals (Eburn & Dovers, 2015). Hence, the overall findings indicate that while public inquiries following bushfires have enabled single-loop learning (Pahl-Wostl et al., 2013) and led to the recalibration of existing policy instruments (Hall, 1993; B. May & Plummer, 2011), they have failed to foster transformative bushfire policy change.

Consistent with other studies (Eburn & Dovers, 2015; Elliott & McGuinness, 2002), Articles 2, 3 and 4 show that public inquiry as a mechanism for policy learning focuses heavily on the failure of the

current policy regime to meet its specified goals, which, in the case of bushfire policy, remains focused on protecting lives and properties. Despite this, the study conducted for Article 2 revealed that the process of public inquiry can facilitate a level of reflexive awareness because of the diversity of stakeholders involved and the requirement for key stakeholders to reflect on the reasons underpinning their actions. However, on closer appraisal, the study identified that relying on public inquiry as the main mechanism for bushfire policy learning and reform is problematic (Eburn & Dovers, 2015; Elliott & McGuinness, 2002). Article 2 cautions that the terms of reference of a public inquiry can, indeed, reinforce the dominant discourse. Further, Article 4 found that while public inquiry provides an opportunity for learning, in turn enabling policy change, this mechanism focuses heavily on determining who is at fault, thus can perpetuate a blame game (Bosomworth, 2018). Article 4 also shows that fostering a culture of blame and infallible decision-making may constrain the capacity of the bushfire policy sector to act experimentally, which is considered a crucial component of adaptation (Cundill & Rodela, 2012; Bosomworth, 2018).

The findings corroborate those of other studies (Eburn & Dovers, 2015) that show that public inquiries following disasters predominantly focus on learning from policy failure. However, the results of Articles 3 and 4 differ from those of earlier studies (Elliott & McGuinness, 2002) that show that public inquiries fail to incorporate the lessons learned from policy successes. It is important to note that while the significant changes to south-west WA bushfire policy have been reactive responses to policy failure, Articles 3 and 4 show that, rather than being novel, subsequent policy reforms have largely imitated policy designs that had been successfully adopted in other Australian states. These findings further support the notions of policy diffusion (Shipan & Volden, 2008) and lessons drawing (Rose, 1991), which demonstrate that policy learning often revolves around exploring whether and how policies implemented elsewhere have been successful (Rose, 1991; Shipan & Volden, 2008).

Overall, the present findings support the explanation presented by Walsh (2006), who asserts that while focusing on policy failure can enable policy change, alternative policy strategies must be available to address such failures or attract political support. In the case of bushfire policy change for south-west WA, Article 3 demonstrates that the eastern states of Australia provided alternative strategies that were considered progressive and could be largely replicated in WA.

Some policy learning scholars limit the application of social learning to that which takes place between actors in formal policy settings (Brummel et al., 2010). In contrast, others extend the concept more broadly to the informal learning processes that occur within diverse networks of governance actors (expert, traditional and local) (Pahl-Wostl et al., 2007) in what Pelling et al. (2008) describe as ‘shadow spaces’, where policy learning is not constrained by the formal institutions responsible for

public policymaking and implementation. Article 2 identifies several informal social learning processes that are facilitated by boundary or bridging organisations such as volunteer brigades, peak bodies and non-government organisations. However, to date, these learning processes have had limited influence on policy goals or instrument design. These concepts further support the idea that systemic transformation relies on supporting the links between informal and formal institutional learning (Pahl-Wostl et al., 2013).

Overall, Article 2 provides some evidence to suggest that the current policy instruments comprising the bushfire policy system in south-west WA foster a degree of single-loop learning (Pahl-Wostl et al., 2007), which focuses primarily on evaluating the effectiveness of instruments and making adjustments to improve them (P. J. May, 1992) without questioning their underpinning worldview assumptions (Pahl-Wostl et al., 2013). The studies presented in this thesis did not identify any triple-loop social learning processes, which incorporate a deep reflection of professional practice and consideration of alternative worldview perspectives (Pahl-Wostl et al., 2013). The findings provide preliminary evidence suggesting that more deliberative forms of social learning between diverse governance actors that enable the reframing of the bushfire problem and the development of a common vision should be integrated into bushfire policymaking. Further, the bushfire policy system in south-west WA may benefit from new post-disaster learning approaches that focus on both mistakes and successes (Eburn & Dovers, 2015).

5.1.2.5 Summary

Taken together, the findings presented in Articles 1-5 of this thesis illustrate that there are several interrelated factors that drive policy change. Significant drivers for bushfire policy system change identified in this study included shifts in worldviews, the experience of an extreme disaster event, increased actor interaction between different bushfire policy subsystems through collaborative planning and mechanisms such as public inquiry that enabled policy learning. It is important to note that while these change factors are presented as individual drivers of change, it is clear from the discussion above that these drivers are closely linked and mutually reinforcing.

5.1.3 What lessons can we learn from previous patterns of bushfire policy change in south-west WA that may inform planned adaptation to increasing bushfire risk?

After discussing how the bushfire policy landscape in south-west WA has changed since European colonisation and identifying several factors that have influenced this change, this section relates to the third subquestion: *What lessons can we learn from previous patterns of bushfire policy change in south-west WA that may inform planned adaptation to increasing bushfire risk?* When using a single

case study research design, caution must be taken when interpreting the results to avoid making sweeping generalisations. However, the empirical observations that emerged from this case study of bushfire policy in south-west WA reveal several insights that may inform bushfire policy decision-making. These key insights, which are discussed below, form the basis for a pragmatic theoretical framework (see Figure 5.1) that may assist bushfire policymakers to adapt to rapidly changing risk dynamics and environmental conditions.

5.1.3.1 A transformative bushfire policy agenda

In line with other studies examining policy regime change (Penning-Rowsell et al., 2006), the findings of this thesis show that since European colonisation, bushfire policy has evolved incrementally, with periods of significant reform following major bushfire events. Based on previous patterns of bushfire policy change observed in this case study, it is possible that unless there are intentional public policy interventions focusing on transformative adaptation, bushfire policy change is likely to continue through a process of institutional layering, in which small-scale changes are made to existing policy instruments. As touched on in Article 4, this well-observed pattern of policy change often results in an incompatible mix of policy instruments that are suboptimal but difficult to change because of deeply entrenched institutional logic and the vested interests of powerful actors (Rayner & Howlett, 2009). The results of the thesis imply that the continuation of policy layering will limit the potential to develop innovative and adaptive bushfire policy solutions (Howlett et al., 2017) and increase the risk of suboptimal (Howlett, 2009) maladaptive outcomes (Novalia & Malekpour, 2020).

As demonstrated in all articles comprising this thesis, the bushfire policy system in south-west WA has become increasingly integrated, with a complex mix of interacting, cross-sectoral and multiscale instruments. Therefore, a key policy priority for planned adaptation to increased bushfire risk should be to pay greater attention to a mix of policy instruments for bushfire DRR. That is, rather than assessing the merits of each individual policy strategy for bushfire risk reduction in isolation (a common practice in public administration), it is recommended that the bushfire policy sector take a more system-wide approach. Based on the studies presented in Articles 4 and 5, a starting point may be to build a better understanding of the interactions that exist between the current mix of the instruments for bushfire risk reduction, their strengths and weaknesses and whether they can be improved or need to be replaced with alternative solutions (Howlett et al., 2017). Addressing the rapidly changing bushfire risk dynamics and avoiding the problems associated with policy layering and maladaptation requires policymakers to pay careful attention to instrument policy design. Redesigning the bushfire policy regime around emerging social-ecological governance principles and

assessing the viability of instruments against broader sustainability objectives may assist policymakers to avoid some of the pitfalls associated with policy layering (Rayner & Howlett, 2009).

5.1.3.2 Continual but in-depth bushfire policy change

Based on the analysis of the path towards greater policy integration as presented in Article 3, it may be assumed that incremental bushfire policy change is an inevitable and ongoing characteristic of policy change. Some scholars conclude that incremental policy change is no longer viable and that immediate, transformative adaptation is needed to address the scale of contemporary environmental problems (Fedele et al., 2019; Novalia & Malekpour, 2020). However, the overall findings of this thesis suggest that sudden, large-scale transformative bushfire policy change is unlikely. Despite this, the longitudinal analyses conducted in Articles 1, 3 and 4 are consistent with those of other studies (Kickert & van der Meer, 2011; Termeer et al., 2017) that show that the accretion of small changes to bushfire policy can lead to major changes to instruments, policy frames and institutional arrangements over time.

The findings provide further support for the proposition that planned adaptation to increased bushfire risk may be best supported by facilitating small but continual policy changes (Termeer et al., 2017) with transformative characteristics; that is, those that deeply question a policy regime's goals, instrument mix and worldview assumptions and explore alternatives that 'may enable more sustainable futures to emerge' (O'Neill & Handmer, 2012, p. 6). This ties in well with Termeer et al.'s (2017) 'continuous change perspective' (p. 558), which suggests that policy interventions aimed at fostering planned adaptation should focus on conditions that enable small but continual changes in values, problem frames and discourses. The findings of the present case study suggest that policies aimed at facilitating adaptation to increased bushfire risk would benefit from adopting a strategy of what Patterson et al. (2017) describe as 'incremental change with a transformative agenda' (p. 4).

Despite an emphasis on reflexive practice and social learning in the existing disaster policy literature (Voß & Bornemann, 2011), the results of this thesis show that there have been limited opportunities for actors in the bushfire policy system under study to question their worldview perspectives and consider alternative bushfire solutions. Therefore, it is proposed that for the bushfire policy sector to successfully adapt to increased bushfire risk, it may benefit from adopting a reflexive practice framework (Bosomworth, 2018).

5.1.3.3 A smart, hybrid combination of bushfire policy instruments

The studies conducted for this thesis do not identify a specific policy mechanism to support the planned adaptation to increased bushfire risk. Rather, the combination of findings indicates that

planned adaptation to increased bushfire risk will be based on a hybrid of new and existing policy instruments (Koppenjan et al., 2019), which will require ongoing evaluation, experimentation and adjustment as conditions change. In line with other studies (Metz et al., 2020), the findings suggest that in addition to legislative mechanisms that change the 'rules of the game', successful adaptation to increased bushfire risk will require actor-based mechanisms that foster diverse network interactions, social learning and collective action. A prominent issue that emerged from the findings is that while legislative reform will play a critical role in planned adaptation action, without challenging the underpinning assumptions of the modern worldview perspective that dominates bushfire policy, the transformative change needed to adapt to rapidly changing risk dynamics will be constrained.

The studies identified a range of actor-based policy mechanisms that may enable reflexive learning and assist the bushfire policy sector to adapt to changing conditions. These mechanisms include partnerships between Indigenous and Western bushfire management stakeholders, deliberative forums, formal and informal collaborative initiatives, interagency projects, interdepartmental teams and co-working spaces, community engagement initiatives, cross-sectoral secondments and transdisciplinary research. However, more research on this topic should be conducted to better understand the extent to which such policy instruments will enable transformative adaptation to climate-exacerbated bushfire risk (O'Neill & Handmer, 2012).

5.1.3.4 Post-bushfire reflexive learning

Articles 1, 3 and 4 demonstrate that bushfire events are a key driver of bushfire policy change, particularly in terms of the role they have played in strengthening the integration of bushfire management and land use planning policies. However, while the bushfire planning reforms examined in this study initially appeared to be a radical overhaul of former bushfire policy arrangements, a deeper analysis of the policy trajectory leading up to these bushfire events revealed that these accelerations were not based on novel ideas but were influenced by broader policy trends and designs that had been implemented elsewhere (Penning-Rowsell et al., 2006). Moreover, the reforms that took place did not result in an immediate change of the overarching goals or a reframing of the bushfire problem. Rather, they were based on a redesign instead of a replacement of existing policy instruments and institutional arrangements. Further, the analysis identified occasions in which major bushfires did not accelerate change but rather reinforced the status quo and established path dependencies that may have constrained the exploration of alternative bushfire policy solutions.

The findings of the studies conducted for this thesis do not support earlier historical institutional studies of punctuated equilibrium (Pierson, 2004) nor the SES studies of perturbations (Gallopín,

2006), which suggest that an exogenous event can trigger the sudden transformation of a system by sparking radical policy change. However, taken together, the findings support the idea that disaster events can provide a temporary window of opportunity in which adaptive policy change may be accelerated (O'Neill & Handmer, 2012). The findings suggest that in the period immediately following a bushfire disaster, in addition to public inquiry, there is a definite need for policy-oriented learning mechanisms that provide an opportunity for actors to critically reflect on both shortfalls and successes (Eburn & Dovers, 2015), collectively revaluate existing policies and explore a breadth of proactive policy responses based on new information from a range of diverse actors (Novalia & Malekpour, 2020).

5.1.3.5 Consider the potential for maladaptation of bushfire policy strategies

The findings of all studies conducted for this thesis indicate that if bushfire policy strategies are to support successful adaptation, the broader consequences of these strategies must be considered. The results are consistent with those of other studies that have argued that successful and sustainable adaptation will rely on an interrogation of the vested interests, power dynamics, dominant worldviews and types of knowledge associated with different adaptation options (Eriksen et al., 2011; Glover & Granberg, 2021). Further, the findings of Article 5 indicate that to be successful, planned adaptation actions must not compromise longer-term sustainability objectives or increase or transfer vulnerability across spatial or temporal dimensions (Brown, 2011). With respect to bushfire policy strategies aimed at reducing risk to the WUI, Article 5 illustrates that while the main policy approaches for south-west WA identified may be considered adaptation actions, all have trade-offs and potential maladaptive aspects that must be carefully assessed and managed. Articles 3, 4 and 5 reveal that while bushfire policy strategies may be deemed successful in terms of their ability to reduce risks to human safety, the broader implications in terms of biodiversity conservation, environmental amenity, local economic development and public health need consideration. Overall, in the case studied, views on the most appropriate and effective bushfire policy strategies in light of a changing climate were polarised. What is most evident, however, is the need for a more comprehensive and proactive approach to bushfire policymaking. Further, the results indicate that to ensure that planned adaptation to increasing bushfire risk does not result in maladaptation, bushfire policymakers should:

- incorporate a greater integration of ecological knowledge (both Indigenous and non-Indigenous) in bushfire policy design and risk assessment methodologies
- include an assessment of a wider range of public values and sustainability trade-offs in bushfire decision-making processes

- consider the potential maladaptive consequences of bushfire policy across the broader scales of space and time.

Figure 5.1 presents a pragmatic theoretical framework that may assist bushfire policymakers to adapt to rapidly changing conditions.

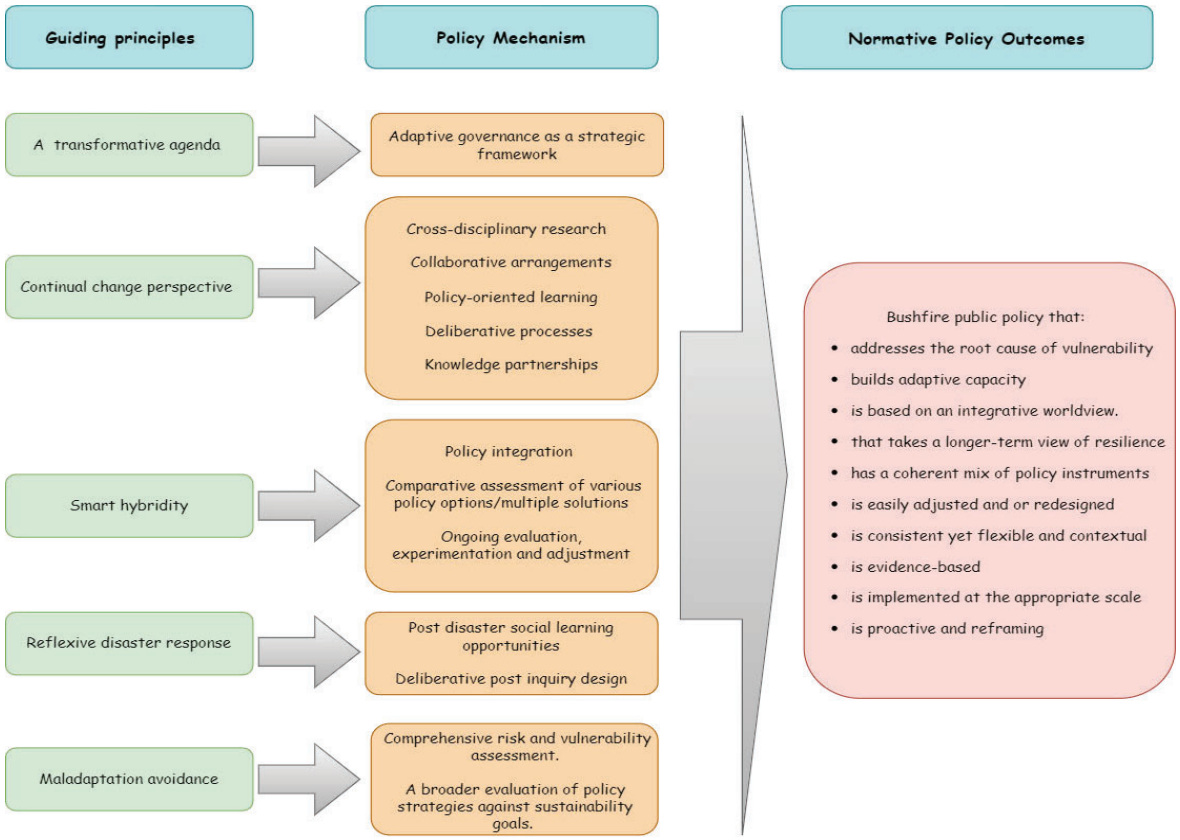

Figure 5.1: Adapting bushfire policy to changing conditions: a theoretical framework.

This theoretical framework highlights the importance of both policy integration and adaptive governance as key mechanisms to support planned adaptation to increasing bushfire risk. While the integration of bushfire management and land-use planning was a key focus of Articles 3, 4 and 5, the thesis also highlights the importance of integrating bushfire management more comprehensively with a range of policy sectors including land-use planning, environmental conservation, climate change adaptation, Aboriginal land management and sustainable development. Further, as illustrated in Article 5, a consideration of the trade-offs between the goals of bushfire policy and those of other policy sectors that contribute to sustainability is necessary to enhance community resilience and avoid maladaptation.

5.2 Chapter Summary

This chapter responded to the overarching research question by critically discussing how bushfire policy in south-west WA has changed since European colonisation and the factors influencing this change. It began by outlining how the problem framing and policy goals, organisational arrangements, governance mode and mix of instruments in the bushfire policy system of south-west WA have gradually changed since European colonisation. It then discussed how worldview perspectives, bushfire disaster events, actor interactions and learning mechanisms have helped shape the changing landscape of bushfire policy in the region. Based on an analysis of how the empirical findings that emerged from this case study reflect the theoretical propositions presented in the relevant literature, the final subsection of this chapter drew on lessons from past patterns of bushfire policy change that may inform planned adaptation to increasing bushfire risk. Based on these insights, a theoretical framework was constructed that may be used to guide adaptive bushfire policymaking in the face of climate change. To adapt to changing conditions, bushfire policymakers should adopt a transformative agenda that supports continual, in-depth changes to worldviews through deliberative and reflexive practice, focus on designing a smart, hybrid mix of instruments, enhance opportunities for post-disaster learning and avoid maladaptation through a more comprehensive assessment of the various bushfire policy options.

Chapter 6: Conclusions

6.1 Reflections on the Research

With the aim of informing planned adaptation action, this thesis has presented the factors that have influenced bushfire policy change in south-west WA since European colonisation. The study was designed to explore how socio-institutional dimensions (i.e. underpinning rules, structures and values) influence how fire in the landscape is perceived and governed. Embedded in a critical realist paradigm, this thesis provides a mechanistic explanation of bushfire policy change (Wynn & Williams, 2020). A critical realist perspective was appropriate for this SES research (Cockburn et al., 2020), which was grounded on the premise that change cannot be explained by a single variable but that events and outcomes (phenomena) are generated by interactions between the multiple variables that comprise a complex system (O'Mahoney & Vincent, 2014).

A case study of the bushfire policy system of south-west WA provided an opportunity to deeply scrutinise the causal mechanisms of policy change within a bounded context. The thesis was informed by a plurality of theories associated with institutional change and complex adaptive systems. Testing and expanding on these theories helped to provide a more plausible explanation of the development of bushfire policy in south-west WA than could be achieved through empirical observation alone. Further, this research approach facilitated the development of theoretical frameworks and the identification of several mechanisms that may help support a more adaptive approach to bushfire policymaking in the face of climate change.

6.2 Answering the Central Research Question

Various aspects of bushfire policy change and planned adaptation to increased bushfire risk were examined and presented in the five journal articles comprising this thesis by compilation. While each article is based on a discrete research objective, all helped to answer the overarching thesis question: *What factors influence bushfire policy change, and how can these insights be used to inform planned adaptation to increased bushfire risk?*

Together, the findings of the articles show that the socio-institutional context of bushfire policy in south-west WA has changed in four main ways. First, while the modern worldview perspective and the policy goals of protecting lives and property have persisted over time, new framings of the bushfire problem as a social-ecological issue to which humans must learn to adapt by enhancing their resilience have emerged. Second, while the state government departments of fire and emergency

management and forest fire management remain key players in the bushfire policy system of south-west WA, the sector has become increasingly diverse, with new agencies such as land use planning becoming integral subsystems of the bushfire policy system. Further, the level of interaction between the various actors and subsystems at various governance scales has increased over time to address mutually interdependent goals and drivers of vulnerability. Third, while the bushfire system under examination has retained elements of a hierarchical governance mode, the sector has increasingly incorporated network and market-based governance approaches. Therefore, the current bushfire policy system in south-west WA can be described as a hybrid governance system. Fourth, the instrument mix for bushfire policy has evolved from comprising predominantly rules-based mechanisms to increasingly relying on actor-based mechanisms that support collaboration, learning and knowledge sharing. The study also shows that there has been a gradual shift from single-sectoral to cross-sectoral policy instruments that seek to improve policy cohesion.

This study identified several factors that have constrained and enabled bushfire policy change. One of the most significant findings is that the dominant modern worldview has continued to strongly influence the institutional setting, governance mode and instrument preferences for bushfire policy in south-west WA and may be constraining bushfire policy innovation. However, it is also evident that the emergence of alternative worldview perspectives and SES thinking has led to the inclusion of a broader set of policy goals, actors and frames. The case study also demonstrated that while large bushfire events have often accelerated bushfire policy change, they have occasionally reinforced the status quo via the sinking of resources into existing practices. The study also revealed the relevance of actor interaction in driving policy change. However, the extent to which collaboration has fostered novel solutions for bushfire risk reduction has been largely dependent on the historical relationships between the actors involved and the extent to which their worldview values were aligned.

Finally, bushfire policy change in south-west WA has also been facilitated by learning processes that have enabled the acquisition of new ideas, a consideration of alternative perspectives and the co-production of knowledge. The results indicate that post-disaster public inquiries have possibly been the most significant learning mechanism, often resulting in bushfire policy reform. However, the findings suggest that these inquiries have focused predominantly on the failure of existing bushfire policy instruments and have not resulted in radical policy change. Overall, post-disaster inquiries have led to the adjustment of existing instruments and a reconfiguration of pre-established organisational arrangements. Further, when significant reforms did take place, they were not novel but largely imitated those that had already been implemented in other jurisdictions. Overall, the results suggest that policy changes emerging from post-disaster bushfire inquiries in south-west WA

have been reactive and focused on the short term, resulting in broad-brush approaches that reinforce path dependency.

Together, the analysis of bushfire policy change in south-west WA has validated and challenged several theoretical presuppositions associated with policy regime change. Moreover, the findings provide several insights that may inform bushfire policymaking as it seeks to adapt to increasing bushfire risk. This study has generated the following conclusions, which should be considered by bushfire policy practitioners:

- Planned adaptation to climate-exacerbated bushfire risk is likely to be reactive, short sighted and path dependent unless bushfire policymakers adopt a transformative agenda (Colloff et al., 2021).
- A transformative bushfire policy agenda will most realistically be enabled by focusing on mechanisms that enable small-scale but continual and in-depth changes (i.e. shifts in deeply held beliefs that underpin current bushfire practices) (Bosomworth, 2018; Termeer et al., 2017).
- Adaptation to increased bushfire risk requires a system-wide interrogation of the mix of bushfire policy instruments rather than an evaluation of specific bushfire policy strategies in isolation (Howlett & Rayner, 2007).
- Bushfire disasters provide a window of opportunity for learning in which adaptation actions can be accelerated; however, to avoid reactive responses, post-disaster inquiries should include or be informed by reflexive learning and deliberative practice (Eburn & Dovers, 2015; Stark, 2019).
- To avoid maladaptation, bushfire policymaking requires a more comprehensive risk assessment of sustainability trade-offs and potential negative consequences across broader scales of space and time (Glover & Granberg, 2021).

6.3 Contributions of the Research

This thesis extends the knowledge on bushfire public policy in the context of rapidly changing environmental conditions and risk dynamics. The study makes several noteworthy and original contributions to the literature. First, the research presented in Article 1 builds on worldview theory (De Witt et al., 2016) and develops a conceptual framework that may be used to analyse the trajectory of complex policy issues. Second, the findings presented in Article 2 provide additional empirical evidence to support the proposition that Australian bushfire policymakers would benefit from adopting adaptive governance as a strategic framework (Bosomworth et al., 2017). An adaptive

governance framework values and supports measures that foster collaboration, reflexivity, institutional diversity and social learning. Third, the analysis of policy integration undertaken in Articles 3 and 4 contributes new knowledge about the factors that enable and constrain integrated and adaptive approaches to DRR. Finally, the empirical findings of Article 5 contribute to the emerging scholarship on maladaptation and provide a conceptual basis on which to inform a more comprehensive approach to bushfire policymaking.

By testing and building upon existing change theories, this thesis advances socio-institutional understandings of adaptation that are not yet well understood (Bosomworth, 2018). While this case study confirms the findings of many existing studies that demonstrate that policy change most often occurs incrementally (Kickert & van der Meer, 2011), it also challenges earlier assumptions that disasters trigger sudden radical change (Baumgartner & Jones, 1993; Pierson & Skocpol, 2002). The findings provide additional evidence that while bushfire disasters provide an important and underutilised window of opportunity for policy adaptation (Kingdon, 1984), radical change is most likely to occur when a policy sector adopts a transformative agenda based on ongoing learning, reflexive practice and continual change (Bosomworth, 2018; Termeer et al., 2017).

The thesis makes an important methodological contribution through the application of the innovative method of process tracing in Articles 1, 3 and 4. The use of this analytical method enabled the identification of causal mechanisms, which helped to construct a historical explanation of bushfire policy change for the case under study. This is the first time that process tracing has been used to explore bushfire policy, and it may serve as a base for future studies.

While this thesis is highly theoretical, the findings have significant implications for bushfire policymaking. It provides additional evidence to support claims that successful adaptation requires policymakers to consider a range of worldview perspectives and types of knowledge, include a more comprehensive and longer-term assessment of values in bushfire policy decision-making and engage in reflexive professional practice. The thesis by compilation format enabled the production of succinct research outputs in the form of journal articles, which, compared with a traditional thesis, are easier for practitioners to assimilate. All published journal articles comprising this thesis have been disseminated to research participants, informing policymakers and their agencies about the historical roots and the various components comprising the bushfire policy system studied. Finally, the theoretical model presented in Figure 5.1 may be used to inform targeted interventions aimed at a more sustainable approach to bushfire policymaking and support the transformative change needed to adapt to climate change.

6.4 Limitations and Recommendations for Further Research

While a single case study enables theoretical generalisability, the most obvious limitation of this thesis is that generalisations about broader populations cannot be drawn (Easton, 2010b). While O'Mahoney and Vincent (2014) argue that 'theoretical generalizations are more enduring and can be applied through time and space' (p. 18), many scholars would argue that a multiple case study strengthens the robustness of the policy research findings by increasing external validity (Pierre, 2005; Yin, 2009). While this thesis includes one study (Article 3) that adopted a comparative case study approach, both case studies were located in Australia. A cross-national study of bushfire policy systems that compares approaches to policy integration and CCA is warranted.

In addition, the research conducted for this thesis was purely qualitative. The importance of qualitative social research for bushfire management and policy research is being increasingly recognised (McCaffrey et al., 2013) for its ability to contribute deep insights into risk perceptions, values and behaviours that are essential for informing bushfire policy decisions (Beilin & Paschen, 2020). However, there are well-documented limitations of qualitative research that must be acknowledged (Ochieng, 2009). Qualitative research is highly dependent on interpretation, thus has a higher risk of researcher bias compared with the quantitative approach (Collier & Mahoney, 1996). Further, while 30 interviews were conducted for this thesis, only a small sample of participants from each actor group was identified; thus, the results may be influenced by representational issues. While the findings of this thesis are insightful, they are nevertheless preliminary and should be further validated by a larger sample of interviews with each actor group. Additionally, it is recommended that a mixed-methods approach comprising both qualitative and quantitative methods be employed to further confirm and build on the findings of this thesis.

It was unfortunate that the study did not include the perspectives of Noongar people with knowledge about fire management practices in south-west WA. The contribution of Indigenous fire management practices in addressing the bushfire problem has become widely acknowledged in recent years (Norman et al., 2021). It has been encouraging to witness the implementation of traditional fire programs in which Noongar peoples with knowledge of cultural burning have connected with conventional Western bushfire management stakeholders (Department of Fire and Emergency Services, 2021). It would be interesting to assess the impacts of these partnership programs on bushfire policy learning and adaptation.

Western Australia has a unique structure of bushfire brigades and relies heavily on volunteer brigades who are managed by local governments for bushfire mitigation and response. This thesis outlined the critical role bushfire brigades play in emergency management and touched on the tension that exists

between volunteer and career firefighters. However, an in-depth examination of the policy implications of increasing bushfire risk on the governance of bushfire brigades was beyond the scope of this research. The most effective governance structure for the management and resourcing of bushfire brigades to cope with more extreme bushfire conditions as the climate changes and volunteerism declines is an area that needs further investigation.

Finally, this thesis offers far-ranging insights into what encompasses a bushfire policy system and how it may function as an SES. This macro perspective may be considered both a strength and a weakness of the research. While the breadth of the study has enabled an insight into the multiple actors, institutions and instruments comprising a bushfire policy system, it has only touched lightly on some aspects. Thus, future research could focus on the role of the bushfire policy strategies discussed herein in a more comprehensive manner. Further, applied research that examines the key recommendations for bushfire policymaking suggested in this thesis in various contexts is warranted.

6.5 Concluding Comments

The recent UN Climate Change Conference UK 2021 (2021) (COP26) has further highlighted the urgency of adaptation action for sustainability and climate resilience. Like many other parts of the world, Australia must adapt to what is becoming a 'new normal' era of unprecedented bushfire activity. Bushfire policymakers must focus on enhancing the adaptive capacities needed to cope with rapidly changing environmental conditions and risk dynamics. This thesis has gone some way towards enhancing our understanding of the causal mechanisms of and barriers to bushfire policy change. Moreover, the study has unveiled important socio-institutional insights that may inform how planned adaptation to increasing bushfire risk can be supported. Importantly, the findings of the study demonstrate that successfully adapting to changing conditions requires a deep questioning of the worldview assumptions that underpin current bushfire policy practices and highlight the need for a more comprehensive consideration of alternative ideas, knowledge and values in bushfire policymaking. This study gives rise to many unanswered questions that warrant further research on the integration of bushfire DRR and CCA policies. It is hoped that this thesis will serve as a foundation for future studies and inform the significant policy changes needed to address the monumental challenge of adapting to climate-exacerbated bushfire risk.

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Appendix A: Article 1 and Supporting Documents

Ruane, S. (2018). Using a worldview lens to examine complex policy issues: A historical review of bushfire management in the South West of Australia. *Local Environment*, *23*(8), 777–779. https://doi.org/10.1080/13549839.2018.1467390

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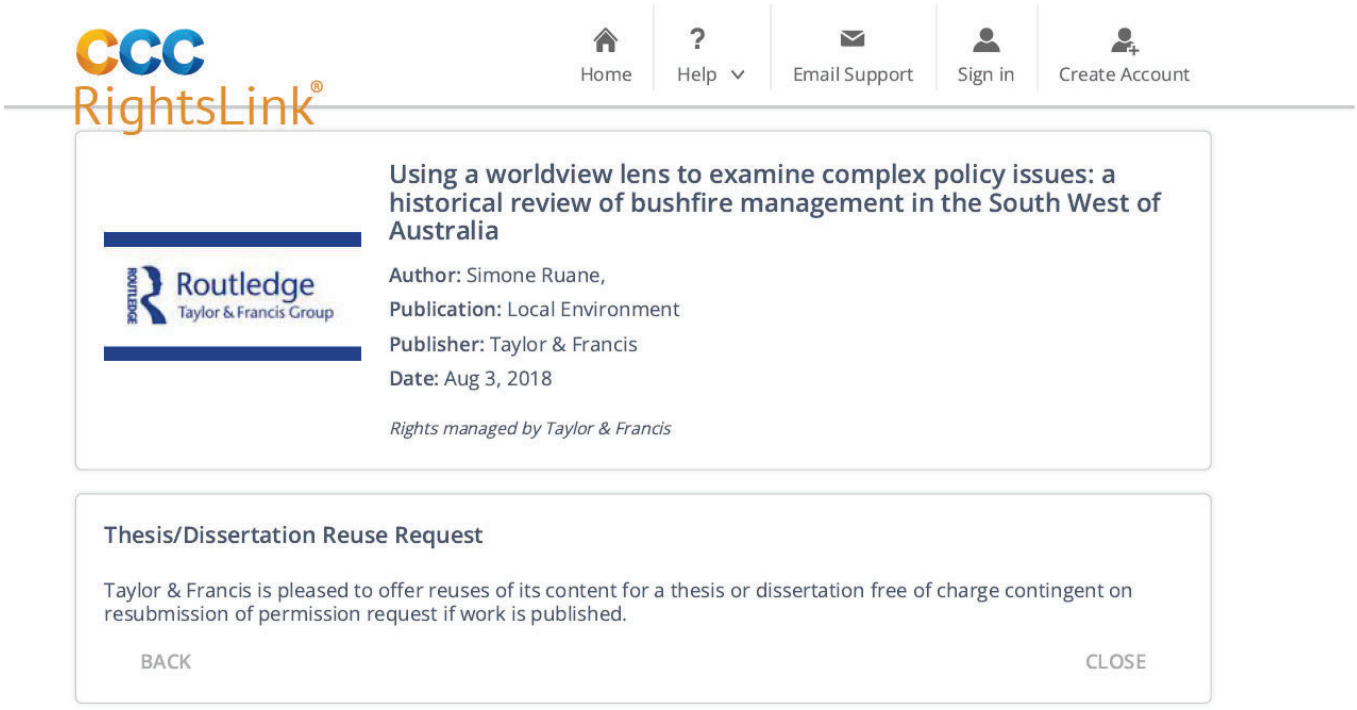

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Using a worldview lens to examine complex policy issues: a historical review of bushfire management in the South West of Australia

Simone Ruane

Curtin University Sustainability Policy Institute and the School of Built Environment, Curtin University, Perth, Australia

ABSTRACT

The scale and intensity of bushfire activity in Australia is likely to increase as a result of climate change. Effective bushfire management policy measures are therefore essential to minimise the interrelated social, environmental and economic impacts of fire in the landscape. This paper presents a historical review of bushfire management in the South West of Australia (SW): a bushfire prone and biodiverse region. Using a worldview framework to analyse key policy documents and literature, the paper demonstrates that the evolution of complex policy sectors such as bushfire management, is influenced not only by scientific and technical developments but also as a result of changing worldviews. Adapting the Integrative Worldview Framework (IWF), seven worldview categories that dominated particular periods of history in Australia are presented. These worldview categories are then used to examine the evolution of bushfire management practice, policy and institutional arrangements relevant to the SW. The argument presented herein is that a better understanding of worldviews and how they influence complex and contentious policy fields such as bushfire management, is useful for policy analysis, reflexive practice and research. The paper suggests an integrative worldview approach, which enables opportunities for exchanges and constructive conflict between stakeholders and agencies with diverse worldviews, could contribute to creating more sustainable bushfire management. Finally, it is argued that opportunities for Indigenous and Western worldview exchanges in the bushfire management sector, through collaborative knowledge partnerships could assist the sector in both management practice and policy formulation.

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1. Introduction

Fire is an inherent part of the Australian environment and plays a determining factor in shaping landscapes of this region (Pyne 1991; Bowman 2003). Recently, however, southern parts of Australia have experienced extreme bushfires, with significant social, environmental and economic impacts. The scale of bushfire activity in Australia is expected to intensify due to climate change and urbanisation in bushfire prone areas (Moritz et al. 2014; Sharples et al. 2016). According to Flannery (2015, 28) "[t]he age of the mega-fire, it seems is about to arrive, if indeed it is not already here". Bushfire management has therefore gained significant attention as both a critical policy issue and research priority.

CONTACT Simone Ruane simone.ruane@postgrad.curtin.edu.au Curtin University Sustainability Policy Institute and the School of Built Environment, Curtin University, Perth, Australia

Bushfire management is defined as all "activities directed to prevention, detection, damage mitigation and suppression of bushfires" (Forest Fire Management Group 2014, 21). This complex field includes diverse perspectives regarding both bushfire mitigation and response. Agreement on bushfire policy and management strategies is challenging given the diversity of stakeholders and their values (Gill and Bradstock 2003; McLennan and Eburn 2015). Disparity also exists in bushfire science, and different contenders draw on various sources of evidence to support their views (Buizer and Kurz 2016). Tensions in the sector peak after extreme bushfire events, often resulting in a blame game between parties trying to determine causes and accountability (McLennan and Handmer 2012). Like other complex policy issues, such tensions arise due to disagreements over facts, but also because of conflicting values and assumptions (Hedlund-de Witt 2014).

The South West of Australia (SW) is highly prone to bushfires (Burrows and McCaw 2013), demonstrated by the 2016 Waroona fires that burned almost 70 000 hectares, resulting in two deaths (The Government of Western Australia 2016). The SW used herein, refers to the country (*boodja*) of the Nyungar people: extending from Jurien Bay in the North, to the east of Esperance on the Southern Coast (South West Aboriginal Land and Sea Council 2017) as shown in Figure 1 (sourced from Lullfitz et al. 2017). This area closely corresponds with the boundaries of the South West Land Division, the

Figure 1. The South West of Western Australia – Location of Nyungar country and South West Australian Floristic Region (sourced from Lullfitz et al. 2017).

SW floristic region and is located within the South West Eco-region. The SW includes the capital city Perth, which supports 90 percent of Western Australia's population (Burrows and McCaw 2013) and is growing rapidly particularly in the bushfire prone fringe (ABS 2013). The SW is renowned for its amenity (Economist Intellience Unit 2015) and natural values (Dhakal 2014), being recognised as a biodiversity hotspot (Gole 2006). Bushfire policy and management measures for the SW need to consider a range of interconnected social, economic and environmental dimensions to ensure the protection of human life, assets and biodiversity.

The SW has a long history of bushfire management. In Western terms, bushfire management emerged in the early years of European colonisation. However, as Aboriginal people used fire as a survival tool for some 50,000 years prior to colonisation (Abbott and Burrows 2003; Bowman 2003), bushfire management dates back to ancient times. However, due to impacts of recent bushfires and projections of increased bushfire activity, contemporary bushfire management in the SW is under scrutiny. There are appeals for a restructuring of bushfire management practices and a critical analysis of underpinning policy frameworks (Bush Fire Front 2017). This concern is reflected in the 2016 Waroona Fire Inquiry report which states "the current system for managing bushfire in Western Australia is failing citizens and the government" (The Government of Western Australia 2016, 12).

Important lessons can be derived by examining past responses to complex policy issues, such as bushfire management (Dovers 2000). Drawing from the field of environmental history (Worster 1977; Pyne 1991; Dovers 2000), this paper examines how societal worldviews have influenced perceptions of landscape fire and, correspondingly, the policy and practice of bushfire management in the SW. Furthermore, this study highlights how dominant worldviews can be reflected in bushfire management practice, policy discourse and institutional arrangements of the time. Given the bushfire management sector is fraught with antagonism, stemming from diverging worldview perspectives, the paper concludes by proposing the merit of an integrative worldview approach for sustainable bushfire management. This approach is enabled by governance models and management practice which enable pluralism, collaboration, reflection and constructive conflict for policy learning and institutional change.

2. Theoretical background

2.1. Worldview theory

Worldviews have been defined as "the inescapable, overarching systems of meaning and meaning-making that substantially inform how humans interpret, enact, and co-create reality … " (Hedlund-de Witt, de Boer, and Boersema 2014, 40). A worldview can be conceptualised as an interpretive filter (van Egmond and de Vries 2011; De Witt et al. 2016) shaping how humans view the world and their place in it (Koltko-rivera 2004).

Different worldview typologies have been found to influence an individual's cognitive and behavioural processes (Hedlund-de Witt, de Boer, and Boersema 2014). However, given a worldview is a relational construct, formed through individuals' interaction with other members of society, the concept of worldviews is also relevant at a collective level (Van Opstal and Hugé 2013; Lachapelle, Montpetit, and Gauvin 2014). This societal aspect of worldviews is defined by Matutinović (2007a, 1111) "as a set of beliefs, symbols, values and segments of objective knowledge that are widely shared in a given society over a considerable period of time … ".

While several collective worldviews usually coexist in any given society, a dominant worldview, which is supported by the majority of the society often prevails (Matutinović 2007a; van Egmond and de Vries 2011). Worldviews are, however, dynamic and change over time (Hart 2010; Du Plessis and Brandon 2015). In response to new information and pressures, a dominant worldview can be replaced with a new, alternative worldview (Matutinović 2007b; Beddoe et al. 2009).

The term worldview is used across many disciplines notably psychology (Freud 1933) and cultural theory (Douglas and Wildavsky 1982; Kahan, Jenkins-Smith, and Braman 2011). Recently, the concept

of worldview has been used to analyse a range of sustainability issues (Matutinović 2007b; van Egmond and de Vries 2011; Hedlund-de Witt 2012; Van Opstal and Hugé 2013). This emerging body of research examines how different worldviews influence public responses to complex sustainability issues such as climate change (Shi, Visschers, and Siegrist 2015; De Witt et al. 2016).

Worldview research has focused largely on the influence worldviews have on individual behaviour and policy preferences and paid little attention to the subject of institutional change. Prevailing worldviews are however embedded in institutions of governance, defined as the "arrangements, laws, processes or customs serving to structure political, social, cultural or economic transactions and relationships in a society" (Dovers and Hezri 2010, 222). According to Beddoe et al. (2009, 2482) "[w]orldviews, institutions and technologies are mutually interdependent and mutually reinforcing". Matutinović (2007b) further expounds this link by suggesting the interaction between institutions and worldviews underpins processes of institutional adaptation, collaboration and transition towards sustainability (Matutinović 2007b). By setting rules and norms, institutions play a critical role in regulating the human–nature relationship. Given that institutions are generally products of history that epitomise previous worldviews (Matutinović 2007a; Dovers and Hezri 2010), more research regarding how worldviews influence changing institutional arrangements and hence policy and management priorities is needed.

De Witt et al. (2016) developed the Integrative Worldview Framework (IWF) as a model to understand differences in Western worldviews. This model is used to examine how worldviews impact perceptions of human–nature relationships, influence behaviours and create partiality towards particular policy responses (Hedlund-de Witt 2012; De Witt et al. 2016). The IWF delineates four major worldviews: *traditional, modern, post-modern* and *integrative*. According to Hedlund-de Witt (2014), polarised perspectives are evident across a range of sustainability issues; and different contenders, depending on their worldview, will draw on evidence that defends their own position and refutes that of others. Hence, discord within complex policy domains is reinforced by "interpretive flexibility" based on an individual's worldview when determining which evidence to accept as truth (Lachapelle, Montpetit, and Gauvin 2014, 675).

Although the four categories of worldviews are "a sweeping generalization of the complexities and ambiguities of reality" (Hedlund-de Witt 2014, 8361), the framework provides a starting point for analysing complex and contentious policy issues. Building on the worldview categories of the IWF, this paper also presents an *Aboriginal worldview, a settler-colonial worldview, and a late modern worldview* to make our analysis more applicable to the Australian context.

2.2. Worldview categories

Thus, our paper presents seven distinctive, yet sometimes overlapping, worldview categories. While different worldviews dominated particular historical time periods, these worldviews continue to influence contemporary worldviews (Hedlund-de Witt, de Boer, and Boersema 2014) and institutional arrangements (Matutinović 2007b). Different worldview categories can be distinguished by differences in epistemologies (what is truth and how is knowledge created?), ontologies (what is real and how did the universe come into being?) and axiologies (what constitutes a good life and what is valuable?) (Hedlund-de Witt 2012). The worldview categories used in this analysis are summarised below:

2.2.1. A traditional Western worldview

A *traditional* Western worldview dominated Europe prior to the age of enlightenment (De Witt et al. 2016) and is rooted in Christianity (Hedlund-de Witt 2014). A *traditional* worldview is underpinned by a belief in God as a separate entity who exists outside of the human world in an elusive, non-human world represented as heaven (Grieves 2008). Central to a *traditional* worldview are family and community values (Hedlund-de Witt 2014) and morals of devotion, humility and self-sacrifice (Golec de Zavala and Van Bergh 2007; Hedlund-de Witt 2014).

With regards to the human–nature relationship, this worldview places humans separate from and above the natural world, in managerial stewardship (De Witt et al. 2016). Life events under a *traditional* worldview are perceived as destined by God's will, and hence future prospects are accepted as fate or fortune (Beck 1999; Lidskog and Sundqvist 2012).

2.2.2. An Aboriginal worldview

Remarkable diversity exists across Aboriginal Australia, as reflected in the melange of customs, stories and languages. However common to all Aboriginal groups is a relational worldview: a belief system where an intimate relationship exists between humans and the sacred land (Graham 1999; Grieves 2008; Stocker, Collard, and Rooney 2016). According to Graham (1999), from an Aboriginal perspective " … all meaning comes from land" and for Dodson (cited in Havemann 2005, 68) "[l]and gives you the essence of who you are". Notions of land, often referred to as "country", are considered to be multi-dimensional, broader than physical space (Rose 1996; Ens et al. 2012) also encompassing "a cultural and spiritual landscape" (Stocker, Collard, and Rooney 2016, 845).

An *Aboriginal* worldview shares some traits of a *traditional* worldview: an emphasis on family and community, a validation of non-empirical forms of knowledge and an ontology based on a sacred creation of the world. However, the relational aspect of an *Aboriginal* worldview, where the human, physical and spiritual world are mutually constitutive, starkly contrasts with the hierarchical *traditional* Western worldview.

2.2.3. A modern worldview

Modernism describes a post-enlightenment philosophical movement or worldview which dominated the West in the late nineteenth century to mid-twentieth century, (Moghaddam and Rahman 2012). A *modern* worldview conflicts with a *traditional* worldview by devaluing religious values and embracing positivism (De Witt et al. 2016). God as the ultimate creator of truth and knowledge is rejected in favour of knowledge creation through empirical science and reason (Kim, Fisher, and McCalman 2009). A *modern* worldview is associated with industrialisation, progress through science and the institutionalisation of the nation state (MacLeod 1993; Kim, Fisher, and McCalman 2009). A *modern* worldview contrasts with a *traditional* worldview where humans' role in nature was one of stewardship (De Witt et al. 2016); and an *Aboriginal* worldview where humans and nature are intrinsically connected (Graham 1999). A modern worldview instead legitimises human control over nature.

2.2.4. A settler-colonial worldview

A *settler-colonial* worldview, extended the *modern* worldview dominating Europe during Australian colonisation. The discourse of modernity positioned European society as modern, civilised and superior and colonised cultures as primitive, barbaric and subordinate (Ashcroft and Salter 2000). European colonisation in Australia encouraged the exploitation of resources (Haebich (2015, 20) and rested on the "Logic of Elimination" of indigeneity (Wolfe 1999). This perspective, strengthened by the myth of *Terra Nullius,* which deemed the land as belonging to no one, enabled the dislocation and genocide of Aboriginal people (Havemann 2005).

The *settler-colonial* worldview espoused values of survivalism and the domination of nature. *Settler-colonialism* is a "homesteading worldview", which relied upon sovereignty of the land (Eve and Yang 2012, 6). The "space conquering" relationship to land through a *settler-colonial* worldview starkly contrasts to an *Aboriginal* worldview's connection to country (Havemann 2005, 57). Under a *settler-colonial* worldview, land is regarded as property with assigned ownership and rights: a resource that can be converted into wealth. Under a *settler-colonial* worldview, Indigenous "[e]pistemological, ontological, and cosmological relationships to land are interred, indeed made pre-modern and backward. Made savage" (Eve and Yang 2012, 5).

2.2.5. A postmodern worldview

Postmodernism can be described as a philosophical movement that emerged in the 1960s, as a countermovement to modernity (DeKoven 2004; Moghaddam and Rahman 2012). Postmodernism represents a turning point in social thought involving a critique of modernist assumptions that science is value-free, objective truth (Kuntz 2012). A *postmodern* worldview highlights the uncertain and complex nature of reality and emphasises that truth is subjective and socially constructed (Warf 1993). Under a *postmodern* worldview, there are multiple ways of knowing and perceiving reality (Foucault 1980). Postmodernism is cautious of metanarratives (Lyotard 1984), such as science and progress, which modernists consider to be theories conveying universal truth. Foucault (1980) contends these grand narratives fail to acknowledge the effects of power and the marginalisation of other ways of knowing.

A *postmodern* worldview can be reflected in many social movements of the 1960s (DeKoven 2004; Benedikter and Molz 2012) including the rise of modern environmentalism (Hedlund-de Witt 2014). Modern environmentalism was based on a recognition of the dependence of humans on the natural world for their survival, challenging modernist notions of human progress at the detriment of the environment (Worster 1995). Environmentalism perceived the natural environment as threatened and needing defence (Worster 1977).

2.2.6. A late modern worldview

Beck (1999) and Giddens (1990) reject postmodernism based on its assertion that it signifies the end of modernism. They argue the late twentieth century is a continuation of modernity, albeit distinct from earlier forms. This late modern period is characterised by a demise of the nation-state through globalisation, transboundary environmental catastrophes, economic free trade and rapid communication (Beck 1999). These factors have given rise to what is referred to herein as a *late modern* worldview, which represents a transition from an industrial to a risk-averse society (Beck (2014). A *late modern* worldview is associated with a period of radical uncertainty, insecurity, and rational scepticism.

Risk, defined as the anticipation of a negative future event, is a modern concept. Beck (2014) points out that probabilistic models associated with modernity have been used since the nineteenth century to predict the possibility of future events. According to Beck (2014, 84), "[t]he security dream of nineteenth century European modernity was based on the scientific utopia of making the unsafe consequences and dangers of decisions ever more controllable". However, it was not until the later part of the twentieth century, with the emergence of a *late modern* worldview, that Western societies became increasingly risk obsessed (Lidskog and Sundqvist 2012).

Giddens (1999, 3) speaks of the transition into a risk society not only as the end of traditional social institutions but also the "the end of nature". The idea of a world post-nature connotes an era where human intervention in the natural environment is pervasive and detrimental (Giddens 1999). Furthermore, this human–nature intervention has created new forms of risk (or perceived risk) that are no longer contained by state or national boundaries (Beck 2014).

2.2.7. An integrative worldview for sustainability

Concurrent with the emergence of a *late modern* worldview is the rise of the sustainability paradigm. The permeation of sustainability across a breadth of policy areas also demonstrates a shift in worldviews in Western society. Sustainability, as a recent policy discourse, can be conceptualised as a new worldview. This worldview shift is a revolution of social thought, based on a reappraisal of the human–nature relationship, with recognition that humans and the natural world form an integrated social–ecological system (Du Plessis and Brandon 2015).

Sustainability reflects claims that worldviews evolve by fusing and integrating previous worldviews (Matutinović 2007b). For Van Opstal and Hugé (2013, 692) sustainability "is a construct of different worldviews in itself". Sustainability espouses principles associated with a relational worldview

akin to an *Aboriginal* worldview: both cognisant of human–nature interconnectivity. However, sustainability also retains the rationality associated with a *modern* worldview and acknowledges the contribution of science and technology in addressing environmental problems (Du Plessis and Brandon 2015). Furthermore, a worldview based on sustainability principles acknowledges the complex and uncertain nature of the world and calls for the inclusion of multiple perspectives, characteristic of a *postmodern* worldview. Sustainability also recognises global interdependence and new forms of risk requiring global action, which typifies a *late modern* worldview.

Sustainability has increasingly been applied across a range of policy areas where governance approaches seek to integrate social, environmental and economic imperatives. According to the IWF framework developed by Hedlund-de Witt (2014), sustainability is not considered a worldview *per se,* but the author highlights how different worldviews held by various stakeholders will influence perceptions of sustainability issues.

A modern, scientific worldview has dominated the agenda of sustainable development and, as such, the field has been criticised for failing to be inclusive of alternative worldview perspectives and knowledge (Coffey and Marston 2013; Hedlund-de Witt 2014). Such criticisms have invoked calls for a more integrative worldview for the sustainability agenda: one based on worldview pluralism and the inclusion of diverse forms knowledge (van Egmond and de Vries 2011; Benedikter and Molz 2012; Hedlund-de Witt 2014).

2.3. Worldview summary

The worldview categories outlined above are neither absolute nor unique. There are obvious limitations associated with worldview categorisation. However, these categories provide a useful framework for analysis. The IWF has demonstrated how these historically constructed worldviews continue to influence contemporary worldviews in the West (Hedlund-de Witt 2014). The additional *Aboriginal* and *settler-colonial* worldview categories presented, enable deeper insight into the distinctive historical and cultural influences of colonisation in Australia. A *late modern* worldview category was included because significant worldview shifts occurred in the late twentieth century that were reflected in bushfire management policy in Australia.

This paper uses these worldview categories to analyse the history of bushfire policy and management in the SW. The paper is based on a critical literature review of a range of texts including policy documents, legislation, special inquiry reports, historical accounts and academic articles relating to bushfire management in the SW. This review paper analyses how the institutional arrangements, discourse orientations and management practices mutually reinforced particular worldview categories associated with respective time periods.

3. A historical analysis of bushfire management in the South West

3.1. Landscape burning: identifying an Aboriginal worldview

Landscape fire became increasingly prevalent in Australia at the time of Aboriginal settlement (Bowman 2003). Records suggest the Nyungar people, the original inhabitants of the SW, applied fire to the landscape from as far back as 60,000 years ago (Hassell and Dodson 2003; Hallam 2014). The introduction of human-induced fire had an extraordinary impact on the Australian landscape (Pyne 1991). Although a highly debated subject, Aboriginal burning undoubtedly played a role in the evolution of Australian biota (Burrows 2003; Wardell-Johnson et al. 2015).

Across Australia, Aboriginal burning was not applied haphazardly, but rather, in a planned and purposeful way (Langton 1998; Bowman 2003; Burrows, Ward, and Robinson 2010; Gammage 2011). Aboriginal people burnt country to facilitate food supply and for trail making, tracking, signalling, ceremony and traditional law (Abbott 2003; Bowman 2003) Hence, Aboriginal people through

their burning practices, undertook a form of bushfire management in the region for thousands of years (Gammage 2011).

European settlement occurred in the SW in 1826, initially at King George Sound, which became the town Albany and shortly after, in 1829, the "Swan River Colony" was established (Rundle 1996), which extended from the Fremantle port to Perth, the capital of Western Australia (Barteaux 2016). At the time of colonisation, Aboriginal burning had minimised undergrowth and cultivated park-like landscapes (Gammage 2011; Hallam 2014; Bunbury 2016).

Nyungar burning in the SW often took place in summer (Abbott 2003; Bunbury 2016) and occurred across the coastal plain and jarrah forests of the Darling Scarp (Roger 1961; Hallam 2014). Nyungar elders of the SW, Noel Nannup and Terry (Koodah) Cornwell (as cited in Bunbury 2016), recount that the Nyungar people applied fire at the right time, when the season, weather and vegetation conditions were suitable for the purpose of each particular burn. This created mosaic patterns that provided open areas and shelter to protect the animals and plants which sustained them. According to Gammage (2011, 185), Aboriginal burning "was planned; it was precise, it was organised locally; and it was universal – like songlines it united all Australia".

Indigenous fire management reflects the relational worldview of Aboriginal people. Langton (1998, 43) asserts "Indigenous knowledge of fire and its uses is part of their dynamic relationship with their environment". This is reflected in the holistic term "Caring for Country" that has become a preferred descriptor of Aboriginal land management, reflecting a broader concept than the linear, siloed model of Western land management (Hunt 2012). "Caring for Country" reflects a mutually constitutive, spiritual human–nature relationship (Stocker, Collard, and Rooney 2016). Thus, an *Aboriginal* worldview is distinct from any Western worldviews and this is reflected in the way fire was managed in Australia prior to European settlement.

3.2. Fire protection and firefighting: identifying a settler-colonial worldview

A period of transformation for Australian landscapes took place with European colonisation (Wardell-Johnson et al. 2015), resulting from the application of Western worldviews and lifestyles vastly different to that of Aboriginal Australia (Pyne 1991). As the majority of SW settlers emanated from Britain, they lacked the experience of dealing with landscape fire (Burrows and Abbott 2003). Early settlers perceived fire to be a threat to timber supplies and agriculture and a danger to lives and property (Pyne 1991; Christianson 2014). In contrast to the multi-dimensional nature of "country" that guided Aboriginal burning, the *settler-colonial* worldview of landscape fire was one-dimensional. Settlers failed to comprehend that the landscape appropriated for their own livelihoods was in fact largely shaped through the fire they so feared (Christianson 2014).

Early "firefighting" efforts focused on saving lives and property, reflecting the survivalist attitude associated with the *settler-colonial* worldview. In the early years of colonisation, given the lack of public resources, piped water and firefighting equipment, there were little means of extinguishing fire (FESA 1999). In 1882, WA imported its first manual fire engine and in 1885, the first official, local authority fire brigades were established in the Town of Fremantle and the City of Perth (Wood 1989).

With colonisation there was an abrupt reduction in landscape burning that had been applied by humans for thousands of years. Nyungar people were massacred or displaced from their land, and their cultural knowledge and land use practices replaced with those based on a *settler-colonial* worldview (Haebich 2015). The *Aboriginal* worldview that underpinned Aboriginal fire management, based on a relational understanding of the human–nature connection, was now in conflict with a worldview based on survivalism and the domination of nature (Graham 2013).

In 1847, just two decades after the settlement was established, the first bushfire regulation was introduced in the form of an ordinance to prohibit the application of planned fire in summer and eradicate Aboriginal burning (Abbott and Burrows 2003). This legislation made provision for anyone setting fire to vegetation, within the summer period to be fined 50 pounds, except for an

Aboriginal or boy under 16 who could be sentenced to a public flogging of up to 50 lashes (Governor of Western Australia 1847).

Ironically, non-Indigenous landowners were exempt from these burning laws and permitted to continue to light fires within property boundaries (Governor of Western Australia 1847). Private land ownership was in itself foreign to an *Aboriginal* worldview, nomadism and Indigenous fire management. This legislation reflected the *settler-colonial* worldview connected with settler sovereignty of land.

This legislation also demonstrated the disdain for Indigenous knowledge and the brutal treatment of the Nyungar people during colonisation. Such legislation, amongst other colonial processes, reflects the *settler-colonial* worldview's "Logic of Elimination" (Wolfe 1999). This assisted the dislocation of Aboriginal people from the land and disrupted important cultural practices which, through an *Aboriginal worldview,* gives meaning to life (Stocker, Collard, and Rooney 2016).

In 1885, Western Australia passed the first Bush Fires Act. The Act continued to focus on regulating burning in summer but removed the clause to publically lash Aboriginal people. In 1902, a new Bush Fire Act was passed giving power to the Governor to declare prohibited burning times and imposed regulations for burning on private property (Roger 1961).

The first formal governance structure for a fire brigade service in WA was inaugurated with the Fire Brigades Act 1898. This Act saw the establishment of a Fire Brigades Board who acquired "[t]he duty of extinguishing fires and protecting life and property in case of fire" (Governor of Western Australia 1898, 5–6). This Act signified the first coordinated approach to fire response in Western Australia and provided for public funding (FESA 1999). The Fire Brigades Act 1898 was replaced by the District Fire Brigades Act 1909. Under this new Act, the Western Australian Fire Brigades Board (WAFBB) was established and persisted as the governing body for fire prevention and response in Western Australia until the later part of the century (Department of Contract and Management Services 1996).

The Western Australia (Volunteer) Fire Brigades Association was registered in 1910 and advocated for volunteer rights (FESA 1999). Shortly after, in 1916, the Western Australia Fire Brigades Employers' Union was established, insisting on better worker conditions for permanent officers. Tensions escalated between volunteers and permanent staff, represented by the Volunteers association and Union respectively. There was a clash of interests between the two groups, and permanent officers were aggrieved by the payment arrangements given to volunteers (FESA 1999). In 1922, the Union took action against volunteer brigades, and by 1924 all metropolitan fire brigades were disbanded apart from a few on the Perth fringe (Wood 1989).

The emergence of bushfire legislation that formalised the sector and the establishment of the union and volunteer associations in the early twentieth century can be associated with the strengthening of a *modern* worldview during this period. Increasingly State institutions and established laws and regulations guiding public behaviour, assumed responsibility for social control that, in the West, had traditionally been the role of the Church (Bordoni 2013). Furthermore, burgeoning modern principles of freedom and individuality led to new forms of social organisation, as individuals were no longer constrained to the traditional institutions into which they born. In particular, voluntary associations enabled new forms of political and social identities to emerge (Eyerman 1992). So with increased State institutionalisation, also came more formalised concessions and rights in the form of wage rates and working conditions. According to MacLeod (1993), the period from Federation to post First World War was a turning point in Australia where support for scientific rationalism, underpinned by a *modern* worldview, surged. The ascendance of a *modern* worldview during this period was also reflected in the developments of bushfire management in the SW from the 1920s.

3.3. A modern worldview of fire control

Early in the twentieth century, a nascent forestry sector emerged in Western Australia. Forestry was intrinsically linked to bushfire management and according to Pyne (1991, 173) "Australian forestry and Australian fire shaped each other". In 1916, Charles Lane-Poole, Conservator of the Forests,

was tasked with preparing the Forest Act 1918 in order to establish a regulated forestry industry (Western Australia Forests Department 1969; Burrows and McCaw 2013). This Act gave rise to the Forest Department of Western Australia that played a pivotal role in bushfire management for years to come (Western Australia 1918, 1). Lane-Poole challenged *settler-colonial* attitudes which supported the exploitation of timber; instead he advocated for a conservationist approach to forestry on the premise that the forest had utilitarian, and also aesthetic value (Bunbury 2016).

The Forest Act 1918 enabled the classification of State forests and a large proportion of land in the SW became publically owned and managed (Western Australia Forests Department 1969; Pyne 2003). This public acquisition of land reflected *settler-colonial* worldview values and was undertaken on the premise that land in the SW was *terra nullius*, belonging to no-one. The classification of State forests failed to acknowledge the connections and care for country, based on a relational Aboriginal worldview, which had occurred in the region for thousands of years. Furthermore, this land classification was based on the perspective associated with a *modern* worldview: that new State controlled institutions were required to administer the human–nature relationship "in the name of the common good" (Pyne 2003, 3).

By the 1930s, nearly three million acres (1.2 M ha) were classified State forest (Western Australia Forests Department 1969). The primary goal of forestry was to protect future timber yield. As early foresters perceived fire as a threat to this resource, fire management became a critical concern for this emerging sector (Western Australia Forests Department 1969).

The fundamental goal of bushfire management, under the leadership of Lane-Poole, was framed in the policy as "fire protection". From a bushfire management perspective, Lane-Poole supported a "fire exclusion" approach to "fire protection", underpinned by theories that reduced fire disturbance in the bush would make it less flammable (Griffiths 2001). Under this fire exclusion model, planned burning was primarily used to create fire breaks around protected State forests in order to keep fire out (Burrows and McCaw 2013).

However overtime it became increasingly apparent that settlement activities and the introduction of exotic species was changing vegetation composition and providing new sources of fuel. Some settlers, notably pastoralists, began to advocate for controlled fire to be integrated into forest management (Pyne 1991). Therefore two policy approaches for "fire protection" were evident in the early years of SW forestry: "fire exclusion", aimed at completely preventing all forest fire; and "controlled burning", aimed at burning the forest regularly to decrease fuel and reduce the likelihood of destructive bushfires (Western Australia Forests Department 1969).

Lane-Poole was a vocal opponent of controlled burning (Griffiths 2001). However, in 1923 he was succeeded as Conservator of the Forest by Stephen Kessell, who contended that controlled burning played a role in fire protection (Pyne 1991). Kessell (cited in Western Australia Forests Department 1927, 27) asserted, "[c]ontrolled burning, together with popular education, should go far towards solving the fire problem". Under Kessell's leadership, Western Australia developed an organised system of fire management that became renowned across Australia (Pyne 1991).

The new management focus under Kessell's leadership foreshadowed a change in policy discourse: the term "fire control" was used in favour of "fire protection" (Pyne 1991). The "fire control" model is apparently more congruent with an *Aboriginal* worldview and burning practices. However, the fundamental goal of fire management under a "fire control" approach remained underpinned by a *modern* worldview of "[nature as instrumental, devoid of intrinsic meaning and purpose. [A] resource for exploitation" (De Witt et al. 2016, 102). "Fire control" as a management model was still firmly based in economics, aimed at protecting timber assets. The value of biodiversity was not yet considered. Although retaining elements of Aboriginal burning methods, Kessel's approach to fire control did not embody the relationality and connection to country central to an *Aboriginal* worldview.

In 1937, a new Bush Fires Act in Western Australia was passed; local authorities were assigned responsibility for "fire control" and granted "power to appoint bushfire control officers, maintain bush fire brigades, and enforce the provision of fire breaks by the occupiers of land" (Roger 1961,

2135). This Act gave Forest Control Officers power over fires occurring within two miles of a State Forest (Roger 1961, 2135) Hence, the State continued to acquire more responsibility and influence in bushfire management (Pyne 1991).

In 1954, the current Bush Fires Act was passed, giving State foresters the status of fire officers and increased power to incorporate controlled fire into forest management (Pyne 1991). Despite extensive controlled burning during the 1950s, 1961 was a catastrophic year for bushfires in the SW, which burned across 1.5 million hectares (Roger 1961). Although devastating the town of Dwellingup, there were no fatalities and the support for controlled burning practices grew. By the mid-1960s the Forests Department embarked upon large-scale aerial controlled burning in the SW forests for which the State became globally renowned (Pyne 2003).

The policy narrative of the WA Fire Brigades Board (WAFBB), which initially focused on the protection of life and property, shifted towards prevention (Department of Contract and Management Services 1996; FESA 1999). Fire prevention focused on increasing public awareness of fire hazards and by the mid-1930s the WAFBB were attempting to improve public safety through education. This focus continued through the Second World War (Duckham 2011) and remains a core policy goal of Fire and Emergency services today. The change in policy narrative represents a shift in responsibilities for bushfire management in WA. Responsibility was no longer solely the role of the expert authorities through bushfire response; rather, citizens were increasingly expected to take responsibility through preventative measures.

The period from the 1920s represented a turning point in worldviews in Australia, with increased support for science, technological innovation and the formalisation of new public institutions (MacLeod 1993). Australia was no longer defined as a settler-colony but had become a modern nation. This evolution influenced SW bushfire management: despite two wars and a depression, significant innovations in science, technology and legislation transformed the sector. By the 1960s, there were multiple agencies and levels of governments involved in bushfire management in WA. Concomitantly however, the environmental movement, influenced by an emerging *postmodern* worldview, began to change perceptions of fire in the landscape and challenge previous presumptions about SW bushfire management practice.

3.4. A postmodern worldview: an ecological turn

By the 1960s, a number of political movements were emerging in the Western world that challenged the assumptions of a *modern* worldview (DeKoven 2004). The 1960s marked an important cultural turning point: from the domination of modernism to the emergence of postmodernism (DeKoven 2004). The modern environmental movement can be associated with a *postmodern* worldview (Worster 1995). With regards to bushfire management, the certainty of scientific knowledge was challenged and perceptions of landscape fire and the human–nature relationship changed.

The environmental movement of the 1960s and new scientific knowledge emerging outside of mainstream forestry, highlighted that fire regimes were more complex than previously understood (Pyne 1991). Towards the late 1960s, controlled burning was attracting criticism (Duckham 2011), particularly from environmentalists who associated the practice with logging (Pyne 2003). It became apparent that controlled burning not only affected fuel loads but had ecological impacts (Pyne 1991). Many environmentalists echoed the conservation principles championed by Lane-Poole, who advocated for publically protected reserves that excluded fire (Pyne 2003). However, where Lane-Poole's principles were based on forests' economic value, the environmental movement of the late 1960s highlighted the heritage value of nature that should be preserved for future generations (Chapman 2011).

During the mid-1970s–1980s, community dissatisfaction grew regarding the inadequacy of forest conservation in the SW (Rundle 1996). As the concept of "biodiversity" emerged, public interest in how fire impacted the environment increased (Abbott and Burrows 2003). In 1985, the National Parks Authority of Western Australia, the Wildlife Branch of the Department of Fisheries and Wildlife

and the Forests Department merged to form the Department of Conservation and Land Management (CALM) (Dell, Havel, and Malajczuk 1989). Simultaneously, debates regarding the impact of controlled burning on biodiversity escalated (Duckham 2011). Many environmentalists advocated against controlled burning while foresters argued that the practice had no long-term impacts (Duckham 2011). In 2006, CALM was restructured to become the Department of Environment and Conservation (DEC); in 2013 it became the Department of Parks and Wildlife (DPaW). Now as the Department of Biodiversity, Conservation and Attractions, it continues to play the lead role in forest management, conservation and fire management in WA. Despite it being a contentious practice, controlled burning (now known as prescribed burning) has remained the predominant approach for fire management in the SW (Burrows and McCaw 2013).

The fire brigade service in Western Australia evolved discretely from the developments of the Forest Department. From the 1960s–1980s, the WA fire brigade sector was relatively stable (Wood 1989). However, during the 1980s and 1990s, the sector experienced a period of destabilisation and restructuring (FESA 1999). From the mid-1980s, government departments came under scrutiny and emergency services were pressured to clarify their roles (FESA 1999). In 1987, based on a review of WA emergency services, the WA Fire Brigade Board's (WAFBB) role expanded to become the key agency for emergency rescue (FESA 1999). In 1995, after 86 years under the same title, WAFBB was renamed the Fire and Rescue Service of Western Australia to better describe its role (FESA 1999). In 1997, the Bushfire Service, the State Emergency Service and the Fire and Rescue Service amalgamated into a new agency: the Fire and Emergency Services of Western Australia (FESA) (Mitchell 1999).

From the outset, FESA's policy objectives centred around Prevention, Protection, Response and Recovery (PPRR), an agenda that remains the national focus for Australian emergency and disaster management (Council of Australian Governments 2011). In principle, FESA espoused a participatory approach to fire and emergency services in WA (Mitchell 1999, 2). However over time, FESA developed a reputation for a top-down, authoritarian approach synonymous with a *modern* worldview, and for failing to work collaboratively with other agencies (Perpitch 2011). This reputation came into the public spotlight as a result of the Perth Hills Fires 2011 Special Inquiry in which FESA received a scathing depiction for failing to follow policies and collaborate with other key agencies (Government of Western Australia 2011b). Given the concerns regarding FESA's governance model, a key recommendation of the Perth Hills Fire 2011 Inquiry (Government of Western Australia 2011b) was that FESA be restructured to become a Department, and in 2012 the current Department of Fire and Emergency Services (DFES) was established.

In Australia, during the period of the late twentieth century there were significant changes that took place as a result of public sector and structural reform. Globalisation and an emerging neoliberal policy agenda resulted in a scaling back of State institutionalisation and moved towards market-driven solutions and privatisation of public services (Beeson and Firth 1998). These changes influenced a range of policy areas, including bushfire management. The following section illustrates how the societal changes during this period can also be conceptualised as the emergence of a new worldview: a *late modern* worldview. The emergence of this *late modern* worldview has influenced the direction of bushfire management, in particular through a growing policy focus on risk and responsibility.

3.5. A late modern worldview: bushfire risk management

From the 1990s, risk management became increasingly prominent in the Australian policy discourse of disaster and emergency management (McLennan et al. 2014). This risk management model involves a centralised, command and control approach compatible with a *modern* worldview. However this increased focus on risk can be associated with the emergence of a *late modern* worldview and a risk society (Beck and Grande 2010).

In Western Australia, the emergency management sector was not formally institutionalised until 2002, when an inquiry into the State's fire and emergency services expressed concern the lack of

legislation could lead to "[r]isks of uncertainty within command structures" (Western Australia Legislative Assembly 2002, xi) Based on recommendations from this inquiry, the Emergency Management Act 2005 was passed which legislated for a more coordinated approach to emergency management for all hazards, including bushfires, across WA.

While emergency management in WA continues to be underpinned by the policy agenda of prevention, preparedness, response and recovery (PPRR), the policy focus more recently emphasises notions of risk, shared responsibility and resilience. This is reflected in the SW bushfire management policy discourse. The Special Inquiry into the Perth Hills Bushfire 2011 "A Shared Responsibility" and the Special Inquiry into the Margaret River 2011 Bushfires "Appreciating the Risk" both advocate for aligning risk management across the sector (Government of Western Australia 2011a; Government of Western Australia 2011b). This recommendation is based on the premise that " … risk assessment is the cornerstone of a robust approach to emergency management" (Government of Western Australia 2012, 25). Within this policy agenda, risk management is considered as the basis for building resilience (2012 Emergency Preparedness Report). In response to the recommendations of aligning bushfire management agencies with the Australian Standard (ISO 31000:2009), in 2012 the Office of Bushfire Risk Management (OBRM), was established. OBRM, an independent office within DFES, plays a key role in establishing a more systematic approach to bushfire risk management throughout Western Australia.

The increased focus on bushfire risk management in Australia reflects the emergence of a *late modern* worldview. Standardised risk management approaches have, no doubt, made a valuable contribution to the bushfire management sector of the SW; however such an approach is not without its methodological limitations (Cavallo and Ireland 2014; Paschen and Beilin 2017). Critics of a risk-based approach argue that managing fire regimes within a risk management framework alone can be problematic and may have negative implications for ecosystems (Bowman 2003; Dovers 2003). Concern has been raised regarding the negative impact bushfire risk management may have on biodiversity conservation due to a greater clearing of native vegetation around property in peri-urban areas (Gill and Scott 2009; Bardsley et al. 2015) and from applying short-interval prescribed burning programmes across ecologically diverse landscapes (Altangerel and Kull 2013; Enright and Fontaine 2014; Gill, McKenna, and Wouters 2014).

Other scholars argue that risk assessment, and the regulatory risk management responses, are inadequate as they fail to acknowledge the social and historical dimensions of risk which gives it meaning (van Asselt and Renn 2011). Kennedy, Stocker, and Burke (2010) argue that conventional risk management is based on a reductionist paradigm far too simple and linear to deal with socio-ecological systems affected by climate change. These authors propose risk governance models that enable participatory processes based on principles of inclusion of both experts and the public; knowledge integration and reflection about the potential risks at hand. Similarly, Cavallo and Ireland (2014) argue for the need for disaster management to expand its positivist approach and consider other epistemological and ontological perspectives.

3.6. An integrative worldview for sustainable bushfire management

The policy discourse of contemporary bushfire management across Australia attempts to address interrelated social, environmental and economic objectives associated with human safety, asset protection and biodiversity conservation (Bosomworth 2015; Buizer and Kurz 2016). Despite the multifaceted dimensions of contemporary bushfire management, and the multiplicity of agencies involved, the sector has not embraced the discourse of sustainability as evident in other areas of environmental management. Despite this, Dovers (2004) argues that the policy fields of sustainability and disaster management, including bushfire management, share similar governance challenges. There are valuable lessons that these cognate policy areas can learn from each other and from a reflection on past policy interventions (Dovers and Hezri 2010). Furthermore, an integrative worldview approach for sustainable bushfire management, applied as both a research framework and

policy analysis tool, could assist the sector better understand sources of existing tension, public responses to policy interventions and processes of institutional change.

New forms of environmental governance, that are adaptive and integrative, are increasingly proposed as more effective for addressing complex environmental issues and disasters, than the traditional command and control management approach (Djalante, Holley, and Thomalla 2011; Tierney 2012; Renn and Klinke 2013). Integrative governance embraces collaborative planning and deliberative processes which bring together diverse worldview perspectives and knowledge to better understand and address policy issues (Bischoff-Mattson and Lynch 2017). Integrative governance is facilitated through management practices and policy mechanisms that are inclusive, participatory and reflexive and which foster social learning (Brummel et al. 2010), the co-production of knowledge (Bischoff-Mattson and Lynch 2017) and worldview transformation (Van Opstal and Hugé 2013). Integrative and adaptive governance models have informed a range of environmental management areas, notably the field of water governance (Pahl-Wostl 2008). The bushfire management sector may benefit from adopting principles and practices of integrative and adaptive governance that have been applied across other environmental management areas which embrace worldview pluralism.

Enabling opportunities for dialogue, deliberation and decision-making that includes various worldview perspectives has the potential to lead to more mutually acceptable solutions for complex policy challenges (Van Opstal and Hugé 2013; De Witt et al. 2016). Operationalising the policy objectives of bushfire management inevitably requires various stakeholders, who hold deep rooted and often competing worldviews, to collaborate and address multiple management objectives. While conflict grounded in stark worldview differences can be unresolvable and consensus not always possible, opportunities for respectful debate and exchange between actors with various perspectives can be perceived as a constructive process that can lead to creative problem solving and innovation (Buizer and Kurz 2016; Nursey-Bray 2017).

A better understanding of Indigenous worldviews is also required to gain a deeper understanding of sustainability issues (Hedlund-de Witt 2014) such as bushfire management. This paper concurs with Stocker, Collard, and Rooney (2016) who argue that relational *Aboriginal* worldviews should be central in sustainability and environmental management. While it may not be realistic to replicate Aboriginal fire management as practiced prior to colonisation, given the extreme landscape and settlement changes that have occurred (Burrows and Abbott 2003; Hopper 2003), contemporary bushfire management has much to learn from Aboriginal burning and the underpinning relational worldview that guides it (Bowman 2003).

An integrative worldview approach for bushfire management would ensure collaborative and reflexive opportunities for Indigenous and Western worldview perspectives to convene (Stocker, Collard, and Rooney 2016). At a practical level this could be achieved through supporting knowledge partnerships and integrating principles of caring for country, reflection and storytelling in both bushfire management practice and policy formulation (Hill 2003; Ens et al. 2015).

4. Conclusion

This paper has analysed the history of bushfire management in the SW and demonstrated that complex policy issues are influenced not only by scientific and technological advancement, but also by prevailing worldviews. This paper has shown how societal worldviews that dominated in particular time periods in Australia influenced both the perception of fire in the landscape and the related bushfire policy and management responses.

The current agenda for bushfire management across Australia, as reflected in the policy discourse, centres on risk management, resilience building and responsibility sharing. The limitations of this risk-based approach, which can be linked to a *late modern* worldview, were highlighted. Furthermore, it was argued that an integrative worldview approach for bushfire management, which explicitly considers other worldview perspectives, could assist the sector's ability to address this complex policy

issue. More research is needed to examine if an integrative worldview approach, institutionalised through governance and management practices such as collaborative planning, deliberative processes, reflexive practice and knowledge partnerships could assist the bushfire management sector in achieving its multiple policy objectives.

Integrative governance and collaborative processes that enable stakeholders with multiple and competing worldviews to engage in processes of policy learning and worldview reflection has the potential to aid bushfire management policy formulation, behaviour change strategies and decision-making processes. A better understanding of the spectrum of worldviews and how they influence policy and practice also provides a valuable research framework to better understand the cultural dimensions of complex policy issues and institutional change. Processes that enable various stakeholders with different worldviews to learn from each other, debate what is at risk and negotiate solutions for managing bushfires will become increasing critical for the SW as it deals with new challenges arising from climate change and urbanisation.

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ORCID

Simone Ruane http://orcid.org/0000-0002-1254-0923

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Appendix B: Article 2 and Supporting Documents

Ruane, S. (2019). Applying the principles of adaptive governance to bushfire management: A case study from the south west of Australia. *Journal of Environmental Planning and Management*, 63(7), 1215–1240. https://doi.org/10.1080/09640568.2019.1648243

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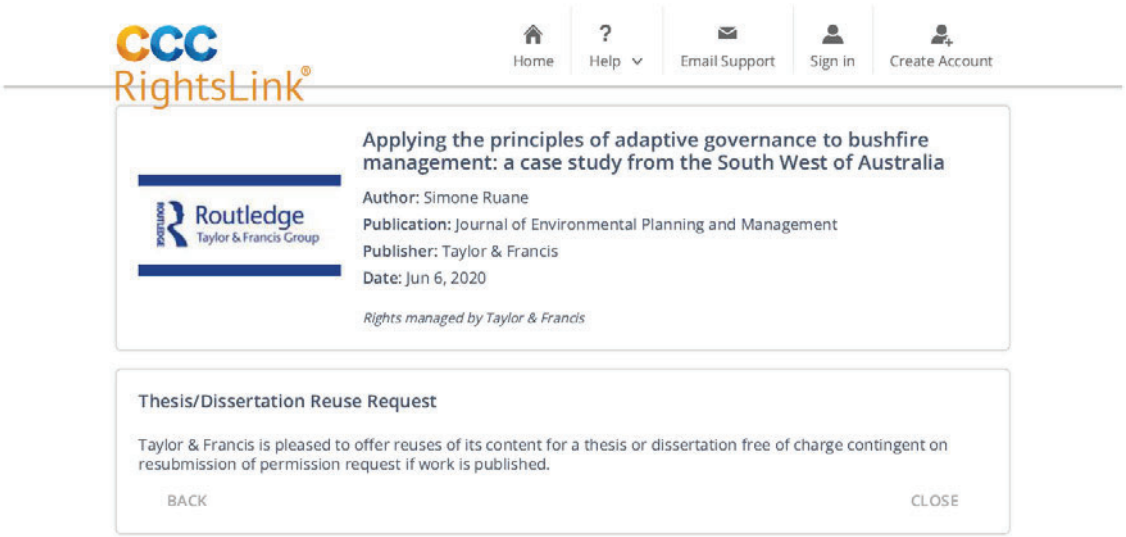

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Applying the principles of adaptive governance to bushfire management: a case study from the South West of Australia

Simone Ruane

Curtin University Sustainability Policy Institute (CUSP) and the School of Design and the Built Environment, Curtin University, Perth, Australia

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Bushfires are a global climate change challenge and a critical disaster issue for Australia. Adaptive governance has emerged as a model to address socio-ecological issues such as disasters. This paper discusses four principles of adaptive governance: polycentric institutions, collaboration, social learning, and reflexivity and examines how these are reflected in the policy and practice of bushfire management in the South West of Australia. Findings demonstrate that current disaster policy discourse, which influences bushfire management, increasingly advocates for principles associated with adaptive governance. However, a case study on the Shire of Augusta-Margaret River found that the extent to which these principles translate into bushfire management practice is largely influenced by interpretive worldview policy frames. The paper suggests that governance for bushfire management could become more adaptive in its approach by incorporating more collaborative management activities, deliberative policy processes and reflexive practice.

Keywords: bushfire; disaster; adaptive governance; collaboration; reflexivity

1. Introduction

Over the past two decades, major bushfire events in the southern parts of Australia have resulted in a devastating loss of life and property (Sharples *et al*. 2016). The most fatal was the Victorian Black Saturday event of 2009, which resulted in 173 fatalities and 2,000 properties being destroyed (Parliament of Australia 2009). This event demonstrated the cataclysmic impact of bushfire and the vulnerability of settlements located in bushfire prone areas.

Like many parts of the world, climate change is also increasing the frequency and intensity of bushfires across Australian regions (Steffen, Hughes, and Pearce 2015). This was exemplified over the previous summer of 2018/2019, where the country confronted its warmest record temperatures, with major bushfires occurring across all of its southern states (Steffen *et al.* 2019). Bushfire activity is expected to escalate in the southern region, with high to extreme fire danger days predicted to rise up to 70% by 2050 (Enright and Fontaine 2014; Lucas *et al.* 2007). It is, therefore, imperative to address bushfire risk, particularly in urban bushland interface areas, which are bushfire-prone with rapidly growing populations (Anton and Lawrence 2016; Edwards and Gill 2015). However, the expansion of settlements into bushland areas that have both

Email: simone.ruane@postgrad.curtin.edu.au

environmental and cultural value, raises many complex bushfire governance challenges.

Since colonisation, a command and control regime, characterised by an authoritative governing structure focussed on incident response, has been the dominant approach to bushfire management in Australia (Beilin and Reid 2015; Ruane 2018). In the 1970s, however, following the lead of the United States, Australia adopted the Prevention, Preparedness, Response and Recovery (PPRR) framework for bushfire management (Crondstedt 2002). The PPRR framework was intended to foster a more coordinated approach and increase the attention given to mitigation and recovery (Wenger 2017). While broadening its scope, the PPRR model continued to approach bushfires as isolated events, which could be addressed through a linear sequence of action and discrete management phases (Crondstedt 2002). While, PPRR continues to provide an overarching policy framework for bushfire management, by the late 1990s, responding to global disaster trends, Australia embraced a risk management framework (McLennan *et al.* 2014).

A risk management framework has been since been initiated for 'all hazards', including bushfire, throughout Australia (Rogers 2011). Risk management addresses some of PPRR's limitations by acknowledging that, in many circumstances, disasters cannot be prevented, only prepared for. This framework recast the emergency management sector to adopt a more anticipatory governance approach than the reactive approach which had endured in PPRR (Rogers 2011). It has also been argued that risk management provides a more appropriate policy framework than PPRR as it factors in socio-demographic factors such as vulnerability (Cronstedt 2002). Risk management is increasingly seen as the cornerstone for building disaster resilience, a term which has become ubiquitous in the overarching policy for bushfire management.

However, a risk management framework, driven by a sector that has an entrenched command and control culture, is not without limitations (Cavallo 2014; Dovers and Handmer 2012). According to Renn and Klinke (2013), standardised risk frameworks focus too narrowly on regulation and fail to engage the diversity of stakeholders needed to effectively govern risk. For Beilin and Reid (2015), bushfire risk management focuses too heavily on singular events and asset protection and inadequately incorporates local knowledge. Some critics highlight that bushfire risk management, in fact, poses new forms of risk to other important cultural and environmental values (Bardsley *et al.* 2015; Dovers 2003).

While the emergent risk management model may be effective in dealing with predictable disaster events, it is argued that the complexity of contemporary disasters requires a more flexible and adaptive approach (Dovers and Handmer 2012), based on systems thinking (Cavallo and Ireland 2014). There is a growing body of research championing new forms of environmental governance for policy issues that can be understood as forming part of a social-ecological system (SES), and that are affected by climate change (Armitage and Plummer 2010; Brunner and Lynch 2010; Folke *et al.* 2005). Adaptive governance is proposed as one model that can more effectively address the inherent complexity associated with contemporary disaster and emergency management (Djalante *et al.* 2013; Munene, Swartling, and Thomalla 2018; Walch 2018).

In the literature, adaptive governance is presented as a transformative, flexible and multi-level governance model aimed at building socioecological resilience (Chaffin, Gosnell, and Cosens 2014; Folke *et al*. 2005; Gunderson and Light 2007). Adaptive governance seeks to facilitate cross-scale networks that enable collective action,

knowledge integration and ongoing learning (Gunderson and Light 2007). Relevant to disaster management, this includes a more holistic approach where shared responsibility can build resilience to disaster events (Djalante, Holley, and Thomalla 2011).

While the promise of adaptive governance has become visible in disaster literature and policy, (Munene, Swartling, and Thomalla 2018), empirical research examining how adaptive governance can be applied in bushfire management practice is limited. This paper aims to address this gap by compiling from the literature a set of four key principles for adaptive governance and applying these in a case study of bushfire management in the Shire of Augusta-Margaret River (SAMR), located in the south west of Australia. Through an empirical approach, this paper makes an important contribution to disaster governance research by, first, examining the how policy priorities for bushfire management reflect the adoption of adaptive governance principles and; secondly, analysing the extent to which these principles can be applied and operationalised in bushfire management practice. While the case study is Australian based, the findings could be applicable to a broad range of contemporary disaster policy problems in countries faced with similar issues.

2. Methods

2.1. Study site

The South West (SW) region refers to the south western corner of Western Australia, spanning roughly from Geraldton to Esperance (see Figure 1). The SW, as defined herein, includes the capital Perth and supports 80% of the state's population (Burrows

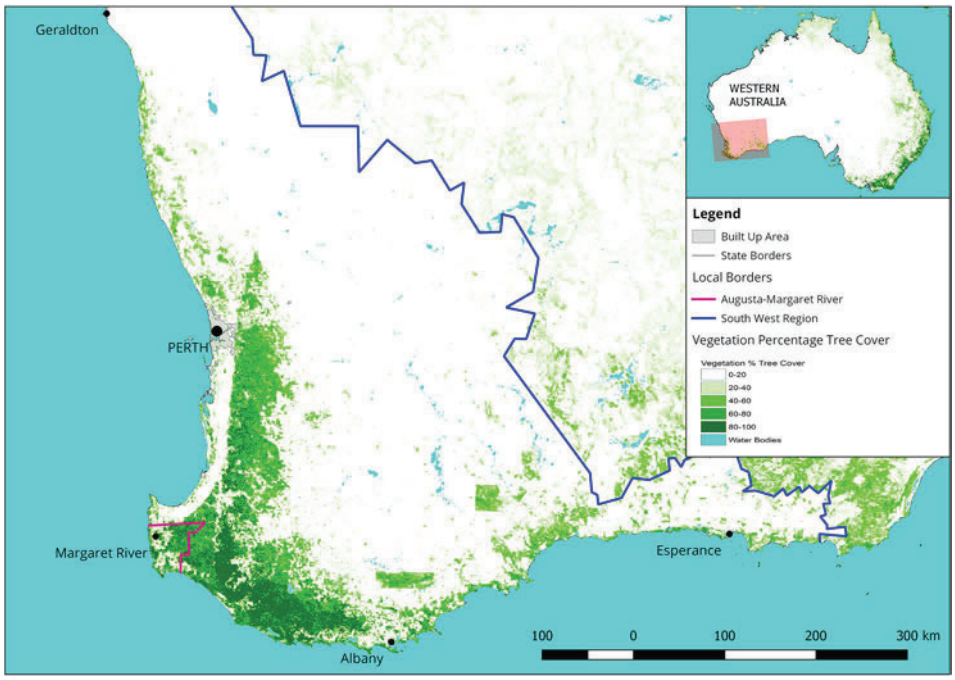

Figure 1. South West Region and the Shire of Augusta-Margaret River (created by Norbert Niedertscheider).

and McCaw 2013). The region is a global biodiversity hotspot (Hopper and Gioia 2004) and is extremely bushfire prone (Steffen, Hughes, and Pearce 2015), demonstrated by the Waroona 2016 bushfire that burned across almost 70,000 hectares (The Government of Western Australia 2016).

The case study for this research was the Shire of Augusta-Margaret River (SAMR) located in the far SW corner (also refer to Figure 1), approximately 250 km south of Perth. The Shire has an area of 2,240 square kilometres, a population of approximately 14,000 and is renowned for its forests, which comprise almost 50% of the area (Shire of Augusta Margaret-River 2017). Its Mediterranean climate, seasonal winds and endemic vegetation, create a propensity for bushfires in the landscape. Bushfires have been identified as the "highest risk factor to the community" (Shire of Augusta Margaret-River 2017, 12). This was demonstrated by the November 2011 Margaret River Fires, that burned across 3,400 hectares and destroyed nearly 40 homes (Steffen, Hughes, and Pearce 2015).

Bushfire governance issues are multifaceted for SAMR, and the sector must consider factors of climate change, urbanisation, tourism, viticulture and a changing demographic characterised by an ageing population and absentee landowners. This study area was chosen on the basis that it is a bushfire-prone area with strong population growth, high biodiversity value and has an economic base sensitive to the impacts of bushfires.

2.2. Research approach

The aim of this study was to examine how bushfire management policy in Western Australia reflects principles of adaptive governance, and to assess whether these principles are operationalised in bushfire management practice for SAMR. Given the complexity of bushfire management, and the intention to critically reflect on the institutional arrangements that influence the sector, a qualitative case study methodology was employed. A qualitative approach allows the researcher to examine 'how and why' questions associated with societal problems and the measures that are adopted to address them (Maginn, Thompson, and Tonts 2008). Case studies are particularly appropriate for policy research, as they can provide a deeper understanding into the complex interactions between actors and institutions (Manzi and Jacobs 2008).

Methods used included, first, a review of scholarly literature pertaining to adaptive governance. A systematic review approach was applied to ensure the theoretical principles derived were representative of the breadth of adaptive governance literature published. Several databases (i.e. Web of Science, Scopus, ProQuest and Google Scholar) were searched using the term "adaptive governance" within the parameters that the term would appear in the title, keywords or abstract, and that the item must be a peer reviewed article or e-book published between 2000 and 2018. The initial search yielded 410 items of literature. To filter these items further, an inclusion criterion was applied being that the item must deal explicitly with the theoretical underpinnings of adaptive governance and provide examples of key principles and related theories. Forty two items of literature were then analysed thematically to determine the most common adaptive governance principles emerging from the literature. Second, using this framework, an examination of disaster policy trends and key Western Australian bushfire management policy documents was conducted to determine if and how adaptive governance principles are represented.

Finally, 15 in-depth semi-structured interviews were conducted over 2017–2018 with key bushfire management, land management and planning practitioners working in SAMR. This included representatives from the SAMR local government authority, local brigades, the Department of Fire and Emergency Services (DFES), the Department of Biodiversity, Conservation and Attractions (DBCA) and Nature Conservation Margaret River. Interviewees were selected using a purposive and snowballing recruitment method with the intention of gaining a selection of representatives from the various sub-sectors of bushfire management. Both senior and middle management, as well as volunteers, were represented in the sample to investigate the responses in relation to roles and sub-sectors. Willing interviewees were informed prior to the interview that questions would centre on their views and understandings regarding: bushfire management goals; institutional arrangements; sector challenges; experiences of collaboration; and opportunities for learning and reflection. Questions were grouped broadly into the criteria of the four key principles and additional questions were asked to enable a frame analysis.

This study was approved through a rigorous ethics assessment to ensure that issues regarding the anonymity and risk to participants were managed appropriately. To protect the interviewees from being specifically identified, names and specific job position titles have been omitted and only more general roles and management levels of the agency representatives are included. The small sample size and limited number of interviewees from each representative sub-sector is acknowledged as a key limitation of this study.

Frame analysis underpinned the thematic analysis of the interview data. Frames in policy research, refer to the sense-making (Hulst and Yanow 2015) and schematic interpretations (Goffman 1974) of a particular problem that is influenced by various values, assumptions and political agendas (McEvoy, Fünfgeld, and Bosomworth 2013) Frame analysis is a useful technique for governance research, as it can provide insight into how dominant policy frames can create systematic biases (Bosomworth 2015; McEvoy, Fünfgeld, and Bosomworth 2013) and institutional barriers (Fünfgeld and McEvoy 2014).

The data analysis process was assisted with the use of NVivo software which enabled the coding of interview transcripts to themes based on the conceptual framework and the emerging frames. Interview quotes, which give an insight into the perceptions and opinions of practitioners, and how they represent particular interpretative frames relating to the governance of bushfire management, are presented verbatim.

3. Principles of adaptive governance

The theoretical roots of adaptive governance can be traced back to ecological theories of adaptive management (Gunderson and Light 2007) and the concept has been influenced by co-management theory (Cundill and Fabricius 2009) and social theories of collaboration (Djalante, Holley, and Thomalla 2011). Adaptive governance theory initially emerged as an analytical tool in natural resource management (Karpouzoglou, Dewulf, and Clark 2016) as a way to better understand and manage common pool resources (Dietz, Ostrom, and Stern 2003). However, more recently, adaptive governance theory has been applied widely to other policy areas, including climate change (Brunner and Lynch 2010; Munaretto, Siciliano, and Turvani 2014), health (Pelletier

et al. 2018) and disaster management (Djalante, Holley, and Thomalla 2011; Munene, Swartling, and Thomalla 2018; Smith and Lawrence 2018).

In much of the literature reviewed, adaptive governance is presented as a silver bullet solution to address complex policy problems. However, more recent critiques raise concern regarding the normative aspects of adaptive governance (Armstrong and Kamieniecki 2017; Cleaver and Whaley 2018). These scholars have noted that adaptive governance literature has failed to consider issues of power relations (Cleaver and Whaley 2018); focussed too heavily on bottom-up systems; and has ignored the critical role that politics plays in setting policy agendas (Armstrong and Kamieniecki 2017). While these scholars do not discount adaptive governance as a useful theoretical framework, they argue that more work needs to be done to develop logical tools and strategies to operationalise its principles into practice (Armstrong and Kamieniecki 2017; Rijke *et al*. 2012). By identifying how the principles of adaptive governance identified in this study have or could be operationalised in practice, this paper aims to shed light on potential policy mechanisms for adaptive governance.

Four key principles emerging from the adaptive governance literature are considered paramount when dealing with complex policy issues, including: polycentric institutions, collaboration, social learning and reflexivity (Chaffin, Gosnell, and Cosens 2014; Gill, McKenna, and Wouters 2014; Jacobson and Robertson 2012). There is significant overlap among these principles, each a theory in itself. However, they nonetheless provide a useful framework for an empirical analysis of adaptive governance. Despite the analytical challenges, there are cross-cutting benefits associated with theoretical multiplicity in dealing with socio-ecological issues (Karpouzoglou, Dewulf, and Clark 2016).

A summary of the sometimes overlapping, yet distinct, theoretical principles that form the conceptual framework for analysis in this paper is presented below:

3.1. Polycentric institutions

Polycentrism is a key principle of adaptive governance and can be defined as a nested governance system where decision-making authority is distributed across diverse institutional scales and between a multiple network of actors (Ostrom 1990). It is suggested, this institutional diversity, referred to as polycentrism, allows the management of particular problems and solutions to be dealt with at the appropriate governance scale (Moritz *et al*. 2014). Self-organisation and flexibility underpin a polycentric system (Jacobson and Robertson 2012). In contrast to a command and control system, where the higher levels of government make the decisions (Cole 2015), a polycentric system involves the decentralisation of some decision-making power to local governing bodies who have insight into the local context (Djalante, Holley, and Thomalla 2011).

While the multiple entities of a polycentric system may act autonomously they generally form part of an interrelated network (Djalante, Holley, and Thomalla 2011). Polycentrism implies the dispersion and sharing of responsibilities and power across the various scales of the network and between public and private actors (Morrison *et al*. 2017). Through this networked system, it is contended that polycentricism fosters cross-institutional learning, trust and communication and hence facilitates resource sharing, collective problem solving and innovation (Cole 2015; Ostrom 2010a). Polycentric systems are considered to be more resilient to collapse given that they do not rely on one central node of control (Pahl-Wostl 2009).

3.2. Collaboration

The importance of collaboration across and between various institutional scales features throughout the adaptive governance literature (Scholz and Stiftel 2005). Collaborative governance is closely linked to communicative planning (Healey 2003) and deliberative democracy theory (Gollagher and Hartz-Karp 2013). Collaborative governance can be defined as processes of intercommunication and multilateral decision-making between various actors on societal matters (Ansell and Gash 2008). According to Ansell and Gash (2008), collaborative modes of governance must fulfil several criteria, namely, that they are formal deliberative forums initiated by public agencies, include the participation of public and private stakeholders and involve consensus-orientated decision-making in public policy issues and their management. While collaborative governance processes are often orientated towards consensus decision-making, this paper takes a broader view of collaboration to include both the formal and informal mechanisms whereby diverse governance actors, at multiple levels, exchange information and knowledge, work jointly or in conjunction, and share resources for a common purpose (Emerson and Gerlak 2014; O'Flynn 2009; Wanna 2008).

3.3. Social learning

The importance of social learning is presented as a central tenet in the adaptive governance literature. Social learning refers to learning that takes place through mutual interaction (Cooper and Wheeler 2015). It is suggested that social learning can emerge from experiential and experimental activities (Brunner and Lynch 2010; Bulkeley and Castán Broto 2013) and knowledge integration (Folke *et al*. 2005). Pahl-Wostl *et al.* (2013) contend that social learning can occur through various deliberative processes, networking and collaborative activities, and also through informal networks. Other scholars argue that social learning processes enable the sharing of different perspectives between diverse actors that facilitates new understandings, trust and knowledge co-production (Berkes 2009), and can lead to more mutually acceptable outcomes (Rodela 2013). Ensor and Harvey (2015) argue that social learning has the potential to be transformative by taking learning beyond the level of an individual, and enabling new forms of knowledge to be co-created, ultimately resulting in changes to practice.

3.4. Reflexivity

While the importance of reflexivity is postulated throughout environmental governance literature (Dryzek and Pickering 2017), more recently adaptive governance scholars have emphasised the imperative of reflexivity as we enter a period of urgent climate change adaptation (Cooper and Wheeler 2015; Termeer, Dewulf, and Breeman 2013). Reflexivity requires what Beck (2006) describes as a self-confrontation of the patterns of governance that, in the name of development, have in fact created unintended consequences or new risks. Reflexivity hence calls for a critical examination of how particular worldview assumptions underpin how societal matters are framed and addressed (Voss and Kemp 2006). A reflexive approach enables policy sectors to better understand interconnections and interdependencies (Voss and Kemp 2006) and can assist with generating new visions for the future (Bosomworth, Handmer, and Dovers 2014). Reflexive governance is perceived by Kemp and Loorbach (2006) as essential for the institutional change needed to transition towards sustainability. Dryzek and Pickering

(2017) believe reflexivity can be realised through various deliberative and transdisciplinary methodologies, which facilitate the integration of various worldview perspectives and knowledge systems in policy making and its implementation.

4. Analysis and discussion: applying the principles of adaptive governance to bushfire management in the South West

The following section outlines how the four interrelated principles of adaptive governance, outlined in section 3 above, are reflected in broader disaster policy trends and represented in Western Australian bushfire management policy discourse. Furthermore, the extent to which these adaptive governance principles are operationalised through bushfire management practice is illustrated through a case study of the Shire of Augusta-Margaret River located in the south west of the state.

4.1. Polycentric institutions: sharing responsibility for bushfire management

In international disaster policy, a multi-level governance system is seen as pivotal to building disaster resilience. This is reflected in the United Nations Sendai Framework for Disaster Risk Reduction (UNISDR 2015, 21), which emphasises the importance of "the cooperation of diverse institutions, multiple authorities and related stakeholders at all levels". It has also been suggested that polycentric arrangements in disaster management are essential as they enable a level of self-organisation and flexibility necessary during and after a disaster event (Djalante *et al*. 2013).

Formally, under Western Australian legislation, the roles and responsibilities of bushfire management are shared between various agencies and levels of government. In 2012, the Department of Fire and Emergency Services (DFES) became Western Australia's lead agency for emergency management, based on the recommendations of the Perth Hills Fires 2011 Special Inquiry report which had identified issues with the governing structure of the former Fire and Emergency Services Authority (FESA) (Government of Western Australia 2011). In the case of SAMR, like other regional areas, DFES relies heavily on volunteer brigades. The Department of Biodiversity, Conservation and Attractions (DBCA) is responsible for bushfire mitigation and response on public lands. Local governments play an important role in bushfire management in Western Australia and, therefore, the SAMR local authority has key responsibilities in bushfire management mitigation, response and recovery. Under the Western Australia Bush Fires Act 1954, local governments may maintain brigades, appoint bushfire control officers, establish advisory committees, undertake mitigation on local reserves and issue fire break notices to landowners. More recently, local governments with bushfire prone landscapes must also undertake bushfire risk management planning (Office of Bushfire Risk Management 2015) and ensure that land use planning applications and building proposals comply with state planning policy guidelines for bushfire prone areas (Western Australian Planning Commission 2015).

The institutional arrangements for bushfire management in Western Australia have become increasingly multi-levelled, an important trait of polycentric systems, since the sector became formally established in the colonial years. While statutory responsibility of bushfire management remains with the state, with federal government support and guidance, contemporary bushfire risk management is increasingly considered a shared responsibility between a multiple governance bodies: including various government

agencies, private businesses, community organisations, individuals and households (Lukasiewicz, Dovers, and Eburn 2017; McLennan *et al*. 2014).

While the notion of shared responsibility is not synonymous with polycentrism, there are conceptual links that have been made between the two concepts with particular reference to bushfire management (McLennan and Handmer 2012b). Bushfire risk is increasingly presented as a collective action problem which, as conveyed in the policy discourse, is most effectively addressed through a shared responsibility approach (McLennan and Handmer 2012b). McLennan and Handmer (2012b) point out, however, while shared responsibility for collective action is a widely held position in bushfire management policy, how exactly responsibility can be shared in practice remains unclear.

The focus on shared responsibility as a requisite for building resilience and reducing risk is forefront in Western Australia's bushfire management policy that emanates that "bushfire risk management is a shared responsibility, which relies upon all relevant agencies and community members working together effectively" (Government of Western Australia 2011, 252). Here, the shared responsibility agenda of bushfire management indicates a move towards a more institutionally diverse system of governance. Shared responsibility seemingly aligns with polycentricism, by promoting institutional diversity and the role of citizens as a critical governance actor.

However, emerging critiques of the concept of shared responsibility point to the trend of the shifting of risk responsibility away from government agencies and on to individuals, concomitant with a neo-liberal emphasis on self-reliance (Lukasiewicz, Dovers, and Eburn 2017; McLennan and Handmer 2012a). This shift raises questions regarding the actual balance of how risk responsibility can be shared between various governance actors, who determines this balance and to what extent decision-making power, resources and accountability are also redistributed (Newell *et al*. 2015).

This trend was found to be reflected in WA bushfire policy discourse. The Special Inquiry to the recent Waroona Bushfire that states current bushfire "[p]olicy encourages a philosophy of 'Shared Responsibility' and asks citizens to act on their own risk." (The Government of Western Australia 2016, 132). The trend of shifting risk responsibility from emergency services and towards individuals was also reflected in the case study of SAMR. Interviewees asserted that individuals should assume more responsibility for bushfire risk. According to one interviewee, "each person needs to have a degree of responsibility for their own life and their property … whether it's hazard reduction or making their property more resilient to fire" (Environmental Manager). The interview responses echoed widely used policy statements of "you own the fuel, you own the fire" (Eburn and Cary 2017) or described by one of the interviewees as "you own the land you own the risk" (DFES Officer). The general view emerging from interviewees was that "the individual landholder should be responsible … It's just one of those things: you run the risk, you run the problem … you need to do something about it." (Brigade Member)

While there are reports of an increased awareness of bushfire risk within the community (Shire of Augusta-Margaret River 2017), there was concurrence amongst interviewees that landowners, particularly absentee landowners, were not taking adequate responsibility for their own bushfire risk. This, according to interviewees, had significant implications for the wider community. Unrealistic community expectations regarding the protection that emergency services would provide in case of a bushfire event

were highlighted as a major problem by interviewees. Concern was expressed that a culture of reliance on emergency services existed in the community. These cultural attitudes were largely attributed by interviewees to a naivety of new residents relocating from the city, with no prior experience of land management, and a decline in brigade volunteerism. The majority of interviewees voiced an urgency to raise the awareness of individual responsibility for personal risk, so landowners, according to one interviewee "… can protect their house and themselves if they're going to stay, because we're not going to turn up, because we'll be next door saving somebody else." (Brigade Member).

The policy discourse of shared responsibility, which emphasises increasing community preparedness and aims to dispel unrealistic expectations that emergency services hold full responsibility for bushfire events, was a position well supported by SAMR practitioners. However, factors relating to community capacity, resources and vulnerability when shifting responsibility should be of utmost consideration (Lukasiewicz, Dovers, and Eburn 2017). The SAMR bushfire sector could benefit from examining the more complex matters regarding transferring responsibility towards individuals in bushfire management, including the implications for accountability. Deliberative governance mechanisms, which include the participation of a broader range of government and non-government actors to debate and negotiate how risk and responsibility can be shared, could help facilitate this in SAMR and other local government areas with similar challenges.

Analysis of Western Australian bushfire management policy documents provided evidence that a shift towards a more participatory approach to shared responsibility is emerging in the discourse. In particular, the DFES community engagement framework revealed a notable change in policy discourse from "raising the awareness of the community to the risks they face" (Government of Western Australia, n.d.-a, 6 accessed 10th May 2015) to more recently supporting "individuals and communities to actively participate in identifying risks, proposing solutions and deciding on management strategies in partnership with DFES" (Government of Western Australia, n.d.-b, 4). There was also some evidence that this more inclusive policy approach to shared responsibility is manifesting in bushfire management practice, and according to one interviewee "in the past DFES had the approach of the community can come to us for information but now it's really we're going to them… our approach is to really understand the community first… and then understand what the approach should be based on feedback from the community." (DFES Officer)

The findings demonstrate an increasingly multi-level governance structure for bushfire management in Western Australia, which includes a recognition of multiple governance actors promoted through the rhetoric of shared responsibility. However, important questions remain regarding who sets the agenda for bushfire risk management priorities and responsibility distribution and to what extent individuals have adequate capacity to manage their own bushfire risk.

The conceptual links between shared responsibility and polycentrism would be worth examining further, particularly with regards to how each speak of contributing to behaviour change and collective action. It is argued here, however, that to be considered as a move towards polycentrism, as defined by Ostrom (2010b), shared responsibility should not be understood simply as a transfer of risk from government to individuals. Ostrom (2014) argues that cooperation relating to a particular policy problem cannot manifest through government imposition alone, but can only be achieved when those affected by the problem agree on the need for behaviour change, and

recognise that they themselves are jointly responsible for future outcomes. A shared responsibility approach could, hence, be supported through various, localised community bushfire planning activities that enable information sharing and communication regarding bushfire issues between all of the diverse actors that form part of the governance network. By empowering all actors to discuss and debate the 'ideals' associated with shared responsibility, a more effective multi-level, collective action approach to bushfire management, based on mutual understanding and trust, could emerge.

4.2. Collaborative bushfire management

The principle of collaboration is emphasised throughout the adaptive governance literature (Michael and Michael 2018). In Australian public policy, collaboration became a priority focus in the early 2000s, manifesting itself in the advent of joined-up and whole of government initiatives, partnerships and community engagement (Althaus, Bridgeman, and Davis 2018; Wanna 2008). In 2007, emanating from a plan to enhance collaborative action for climate change, the Council of Australian Governments (COAG) endorsed the National Climate Change Adaptation Framework, which included natural disaster management as a potential action area (Council of Australian Governments 2007). The importance of collaboration is also mentioned throughout the Sendai Framework (SF) and features in the National Strategy for Disaster Resilience (NSDR) which states "[i]f we gather our collective resources in a coordinated and collaborative way, we can achieve the disaster resilient nation to which we aspire" (Council of Australian Governments 2009, 14). Collaboration among diverse stakeholders and agencies is viewed as critical throughout the different phases of disaster planning, response and recovery (Djalante, Holley, and Thomalla 2011). Improving collaborative governance mechanisms is said to facilitate the sharing of resources and expertise (Howes *et al*. 2015), build capacity, increase public confidence and reduce community reliance on emergency services (Peter *et al.* 2016).

There is increasing pressure for various bushfire management stakeholders, both government and non-government, to collaborate in order to achieve various objectives (Council of Australian Governments 2009). The importance of collaboration is highlighted through the bushfire policy objectives of interoperability, partnerships and interagency coordination. Brummel, Nelson, and Jakes (2012, 513) state that collaboration is particularly relevant to bushfire management given fires "'burn through' organisational, ecological, and geopolitical boundaries." However, while it is critical that key governance actors work collaboratively, conflict often arises between these various stakeholders as a result of differences in organisational mission, interests and culture (Fleming, McCartha, and Steelman 2015; Howes *et al*. 2015).

A more collaborative approach has certainly been embraced in the policy discourse for bushfire management in Western Australia, particularly since the Special Inquiry to the Perth Hills Bushfire in 2011, which identified substantial problems associated with a lack of collaboration between key state agencies (Government of Western Australia 2011). This inquiry identified a "lack of cooperation between the agencies" and stressed that "effective coordination depends upon professional and collaborative relationships between agencies" (Government of Western Australia 2011, 161).

In SAMR, the main bushfire management agencies include DFES, DBCA, and the local government authority. Community members were also positioned by interviewees as critical governance players, reflected in a statement from one interviewee that

"the community … their ability to act and respond to bushfires and to undertake the necessary planning and prevention strategies means they're one of the most important stakeholders" (DFES Officer).

When questioned about governance processes that facilitate collaboration, interviewees highlighted the role of formal mechanisms and advisory committees such as the Local Emergency Management Committee (LEMC) and the Bushfire Advisory Committee in SAMR, which provides a structured forum for problem identification, scenario planning and inter-communication between its diverse members. One interviewee claimed:

> (In LEMC) you've got State services, bushfire services, Shire staff, child protection and ambulance staff. All those agencies come together and do simulation activities and scenario planning … so that's a very good structure (AMR Shire staff, Executive Team).

However, interview discussions revealed a divergence in values and institutional culture between the key government agencies, believed by some interviewees to create a barrier to collaboration. For one interviewee, the different institutional cultures of agencies inhibit the ability of the SAMR to develop a shared vision for bushfire management and collaborate effectively.

This interviewee stated: "The largest barrier is that the agencies don't share a common view, they don't even share a common language" (AMR Shire staff, Executive Team).

With regards to interagency collaboration another interviewee stated:

> There are different institutional cultures, so things are always going to be a bit different … We (DBCA) are land managers … whereas DFES are responsible for this intensive infrastructure, so they're more militant in their processes. These cultural differences can be challenging (DBCA Fire Manager).

In order to bridge the cultural differences that were perceived by some interviewees as a barrier to collaboration, one interviewee asserted:

> There needs to be much more time spent working between groups to see where the alignment is rather than the difference and for people to actually come to an understanding of what it is we're trying to achieve as a group, as a whole. (AMR Shire Staff, Executive Team)

However, despite the reports of cultural differences at a higher bureaucratic level, the majority of interviewees noted that on the ground in the SAMR, collaboration between the various agencies and volunteers on a practical level functioned well. Communication and informal networks were identified as playing an important role in supporting positive inter-agency relationships and as a contributing factor in facilitating a collaborative culture. One interviewee stated:

> Communication is a big thing … making sure we all talk about what's going on … Here we know most of the people in different agencies and meet with them socially and so it's not a problem. (Brigade Volunteer)

Another interviewee noted: "Here there's different interconnections than just bushfire management. So, that's probably part of the collaboration, but along with that there's also structured systems where we'll meet" (DBCA, Fire Manager).

The discussions with interviewees highlighted that, similar to the findings of Brummel *et al.* (2010), positive outcomes for interagency communication and learning can emerge from formal collaborative mechanisms. However, other factors such as local context and leadership play an important role in fostering collaboration and learning. In particular, the interview responses resonated with Pahl-Wostl *et al*. (2013) who found that informal networks play a key role in facilitating the vertical coordination needed to foster collaboration. More research examining the role of informal social networks, their links to formal policy processes and influence on collaborative bushfire management is warranted.

In summary, while collaboration is often presented as an ideal in governance literature, several of the interview statements aligned with other research (Fleming, McCartha, and Steelman 2015; Howes *et al*. 2015) that has identified how a lack of shared values and goals presents a barrier to collaboration, and indeed a source of conflict. As outlined in Ruane (2018) the lack of shared values in the WA bushfire management sector can be attributed largely to historically constructed worldviews that remain deeply ingrained in the organisational culture of different agencies. In order to support a more collaborative culture in the bushfire management sector, opportunities for organisational interaction such as joint training, inter-agency working spaces and collaborative planning activities, as suggested by Howes *et al*. (2015), could foster a more collaborative culture and potentially break down some of the sector's tensions.

4.3. Social learning in bushfire management

While social learning is highlighted as a key principle of adaptive governance, research investigating the role of social learning in bushfire management is limited (Reid, Beilin, and McLennan 2018). According to Pahl-Wostl (2009), in order for social learning to foster the institutional change needed to transition to a sustainable governance regime, it needs to undergo an iterative process of multi-level learning, presented as a triple loop cycles learning model. In this model, single loop learning refers to the incremental learning that leads to "a refinement of actions to improve performance without changing guiding assumptions and calling into question established regimes"; double loop learning refers to "reflection on goals and problem framing … and assumptions how goals can be achieved" utilising group learning processes and; triple-loop learning "refers to a transformation of the structural context and factors that determine the frame of reference (Pahl-Wostl 2009, 359)". This kind of societal learning refers to transitions of the whole regime.

Social learning, referred to as mutual learning, is stipulated as a policy priority in the Sendai Framework (UNISDR 2015). However, social learning is less of a focus in Australia's National Strategy for Disaster Resilience which emphasises learning more as a result of "[c]ommunicating with and educating people about risks" (Council of Australian Governments 2009, 7) in order to change behaviour rather than learning through multi-actor interaction.

While the concept of social learning has not yet been appropriated into WA bushfire management policy discourse, the Special Inquiry into the Waroona Fires acknowledges the potential of social learning models for bushfire management (The

Government of Western Australia 2016). This report suggests the sector could benefit from developing community-based initiatives that offers "opportunities for collaborative learning and encourages joint decision-making, giving the community greater say in what is important and what needs to be done." (The Government of Western Australia 2016, 114)

In practice, the majority of interview responses reflected the policy discourse of NSDR, which, according to Lukasiewicz, Dovers, and Eburn (2017), favours top down educative instruments, based on the premise that the provision of appropriate information will raise community awareness of their shared responsibility. In contrast to the emerging focus on social learning, as presented in the Sendai Framework, SAMR interviewees generally advocated for learning processes which are one-directional, whereby expert knowledge is transferred to lay community members. For example, one interviewee stated: "They've [the community} got to be educated in what communication is out there for different agencies and how to access that information and how to prepare their house and their properties" (Brigade Member).

A Shire representative's statement reflected the sentiment of the majority of interviewees that: "There needs to be a reality check for community … the more information provided about bushfire management and planning the better … there's some naivety in the community" (AMR Shire Staff, Executive Team).

Despite continued support for top-down community education, which was expressed by the majority of interviewees, there was evidence that the Community Engagement program coordinated by DFES and delivered throughout the SAMR aimed at increasing bushfire preparedness, is based on social learning. A key community engagement program, Bushfire Ready, is led by a local brigade volunteer who facilitates a group learning process at a neighbourhood level. An interviewee explains: *"They are people that are already connected in their community. We don't stipulate what they should and shouldn't be doing. It's about what they want to learn more about how they want to get together … then we support that and value-add"* (DFES Officer). This represents an important paradigm shift for an agency widely regarded as an epitome of a command and control culture who, in its many incarnations since the 1950s has focussed on prevention through public education (Ruane 2018).

Social learning refers to activities that go beyond information dissemination, public education and professional development. Social learning processes, where citizens actively participate in important public policy issues can assist with knowledge co-production, generated when citizens are enabled to negotiate responsibility, formulate solutions and lead in action (McLennan 2018). Aldunce *et al.* (2015), point out that a focus on a top-down, unidirectional process of educating the community is reminiscent of a command control regime. These authors suggest that this approach is problematic as it positions the community as "passive victims" and fails to consider how information can be transformed into knowledge (Aldunce *et al*. 2015, 9). Aldunce *et al*. (2015) argue that multi-directional, learning processes which integrate a diversity of experiences and perspectives of different actors, both experts and non-experts, should be adopted. Experimental approaches that bring together science, policy, researchers, business and citizens together, in what has been described as a "living lab", which enables learning, innovation and "purposive intervention", are increasingly presented as an important platform for governance to be actualised (Bulkeley and Castán Broto 2013, 363).

Discussions with bushfire management practitioners in SAMR indicated that learning that took place in the sector was predominantly facilitated through formal avenues such as special inquiry reports, written documentation and data access provided by State departments. One interviewee, however, asserted that there was a need for more multi-stakeholder group learning activities, asserting: "it's not enough to just have it written down or have a bit of a card or description, it's the experience of being out doing it and doing it together and learning from each other that's important" (Environmental manager).

Discussions with SAMR bushfire practitioners revealed that bushfire management in the region predominantly relies on single loop learning which aims to improve current practice and routines through an evaluation of established targets and policy goals. More recently there has been some evidence on double loop learning, facilitated through DFES' community engagement work. This paper now turns its attention to triple loop learning, to examine the extent to which the SW bushfire management sector is applying the adaptive governance principle of reflexivity.

4.4. Reflexive bushfire management and policy

Voss and Kemp (2006) characterise the process of "reflexive governance" as open and learning oriented. While social learning refers to any cognitive learning that takes place through social interaction, reflexivity is only enabled through triple loop social learning (Pickering 2018). Pahl-Wostl (2009) argues that the transition from command and control management to a more adaptive governance regime entails social learning processes that move through the different phases of learning, and ultimately involves a reflexive process of triple loop learning. Triple loop learning implies the very structures of governance themselves are questioned; underlying institutional values reconsidered and; new paradigms are formed resulting in governance transformation. Hence, reflexive learning processes have a focus on institutional change in which governance institutions and actors critically reflect on how their values and practices impact the socio-ecological system in question (Pickering 2018). This transformation is enabled through an interrogation of dominant policy discourses and existing management practices and by encouraging multi-scale, multi-stakeholder interaction.

While the merits of reflexivity are promoted throughout the adaptive governance literature (Cooper and Wheeler 2015), the concept remains elusive and abstract (Beers and Mierlo 2017), making it difficult to apply empirically. For Pickering (2018), indicators of reflexivity include firstly recognition through an awareness of an institution's impact both on and by the socio-ecological system, including scrutinising how particular worldviews influence the framing of policy issues. Second, a rethinking through learning, which entails critically examining institutional values, goals and practices and envisioning new possibilities, solutions and scenarios. Finally, reflexivity requires a response through rearticulating core values, discourse and goals which finally leads to a reconfiguration of policy and practice. Defined by Ockwell (2008), reflexivity can be operationalised in two ways: first, that there is a forum where diverse perspectives regarding a particular policy issue can be considered; and second, that there is critical reflection on how various values and assumptions influence the path of policy and management.

In order to operationalise the concept of reflexivity for empirical purposes, this paper draws on the work of Pickering (2018) and Ockwell (2008). In the case of SAMR, this

study analysed a) the ability of interviewees as governance actors to identify existing worldviews and interpretive policy frames influencing the sector; b) the level of reflection of how values and assumptions associated with these dominant interpretive frames guide policy direction c) the presence of processes which enable the integration of the various worldview perspectives, including marginalised discourses, in problem framing, shared visioning and joint action and finally d) the extent to which integrative processes are contributing to system learning and institutional change.

The analysis of Western Australian bushfire management policy documents identified that a bushfire fire management model, underpinned by a command and control regime and risk management frame dominates the WA policy discourse. However, interviews with bushfire practitioners identified that in the case study of SAMR there are clearly alternative policy discourses and management perspectives. These divergent perspectives on bushfire management were believed by one interviewee to be dependent on institutional values that were deeply embedded within the Western Australian bushfire management sector. This interviewee stated:

> Environmentalists want to protect the environment as much as possible and they see a death through a thousand cuts from development and want to protect endangered species. The planners, see themselves trying to develop sustainable communities: balancing the environment with the pressures they get from developers … DFES are very keen on fire management but are largely in the profession of urban firefighters … The local government brigade firefighters are volunteers with a very different culture … and DBCA have the concern about protecting their assets, their national parks, their timber reserves … and balancing the burning with the protection of the assets they see need to be protected with protection of the community … So, we got this real, higgledy piggledy of people but it all comes down to what it is you're trying to achieve and what your values are. (AMR Shire Staff, Executive Team)

Discussions with the interviewees resonated with findings from other scholars (Bosomworth, Handmer, and Dovers 2014; Ockwell 2008; Ruane 2018) who have highlighted how particular interpretive frames and worldviews influence how humans perceive fire in the landscape and consequently how they manage it. The influence of how worldview values sway bushfire management opinions, perspectives and interests were raised by many of the interviewees as a source of conflict or an inhibitor of collaboration in SAMR. A common theme conveyed across the interviews was that opposing institutional values and organisational culture has a significant influence on the SAMR bushfire management sector's ability to develop a shared vision of bushfire management for the region.

According to one participant: "The issue is different philosophical positions are unresolved and that creates tension … I don't think that's good because I think you need to have a common goal" (AMR Shire Staff, Executive team).

There were notably different responses regarding the fundamental goals of bushfire management between those representing the various bushfire management agencies and stakeholder groups in SAMR, which also indicated different policy frames. While all interviewees highlighted the importance of minimising bushfire risk, parallel with Bosomworth (2015), this study found that bushfire was predominantly framed by practitioners as either a sustainability/socio-ecological (SSE) problem (humans connected to nature) or an emergency risk management (ERM) problem (humans defending against nature). The ERM frame is based on a modernist worldview which positions humans as

separate and in control of nature and places human safety as the highest priority. This contrasts with a SSE frame which positions humans as part of nature and recognises fire in the landscape as forming a complex, socio-ecological system (Bosomworth 2015). Within an SSE frame, bushfire management is generally emphasised as a balancing act of multiple and interacting social and environmental objectives (Bosomworth 2015).

Discussions with SAMR practitioners highlighted that individuals from different agencies or disciplines tended to frame the problem of bushfires in different ways. In particular, the emergency management sector framed the issue as an ERM problem and the fundamental goal of bushfire management was from this perspective: "[p]rotection of assets (humans and critical infrastructure) using a risk management process to direct resources and reduce risk" (DFES Officer).

Through an ERM frame, bushfire management priorities are presented in a hierarchical ranking of importance. The first and foremost goal is protection of life and property and the environment is generally considered of lower priority. When asked about the main goal of bushfire management, these priorities were clearly understood by all the SAMR practitioners: "… on a hierarchy … The first thing is the protection of life; the second one is the protection of property and the environment is important but it is not as important as the protection of life and property" (AMR Shire Staff, Executive Team).

And similarly: "Protection of life and property is, and probably always will be, first and foremost" (Environmental Manager).

Goals of bushfire management through the ERM frame were largely anthropocentric and expressed through mechanistic language using terms such as fuel reduction and asset protection. It seemed well understood by all interviewees that an ERM frame continued to dominate the overall bushfire policy direction in Western Australia.

In contrast, while accepting the need for a risk management approach, the planners and land managers interviewed tended to frame bushfire management as an SSE problem which needed to achieve a more even balance between social, economic and environmental objectives. From this perspective, one interviewee believed the goal of bushfire management as "… a matter of trying to do the best we can for the environment whilst protecting life and property" (Environmental Manager). Similarly, another interviewee stated the goal being to "maintain maximum biodiversity and conservation in conjunction with protecting life, property and business" (Environmental Manager). For a representative of the Department of Biodiversity, Conservation and Attractions: "[f]ire management has multiple goals … around protecting the community and people's lives and property but managing fire for environmental outcomes is really important" (DBCA Researcher).

For many of the interviewees who framed bushfire management through an SSE lens, there was concern that the dominance of an ERM frame placed human safety as the highest priority and failed to adequately consider other important values in SAMR. For these interviewees, an ERM approach alone was problematic given its potential to create a new set of social and ecological risks that are not adequately weighted. Similar to the findings from Bosomworth (2015), for those who understood bushfire as a socio-ecological issue there was concern that the current risk management system was leading to an imbalance of management objectives and environmental values were being compromised in order to achieve an *"acceptable risk"*.

One interviewee stated "the seesaw, the balance between conservation and mitigation works is out of kilter" (Environmental Manager). For this interviewee there

needed to be more opportunity for stakeholders to debate the subjective nature of acceptable risk. This interviewee argued: "There's always going to be [bushfire] risk, but perhaps it's not an unacceptable risk, if there's other things that they're doing, then that risk might be acceptable and we can retain some of our other values" (Environmental Manager).

While the hierarchy of bushfire management objectives was clearly understood by interviewees, there was concern from several interviewees, particularly from the environmental managers and planners, regarding this. In particular, concern was expressed that the environment is ranked as a lower priority, which has the potential to compromise both biodiversity and cultural values inherent to SAMR.

To address this issue one interviewee asserted: "it's a matter of getting the balance shifted. Because at the moment … the environment and cultural values aren't weighted heavily enough" (Environmental Manager).

A Shire planner stated that bushfire management should be about "[m]aking places where people are likely to be, live and work, as safe as possible but balancing this value with environmental and community values."

A degree of reflexive awareness in the SAMR bushfire management sector was evident as the majority of interviewees discussed the divergent institutional perspectives and opposing values that exist in the sector. It was generally agreed that a dominant ERM policy frame underpins WA bushfire management policy priorities and practice. It was also recognised that differences in institutional values can be a source of tension and a barrier to collaboration between the key bushfire management actors.

There were limited mechanisms identified that facilitated the various agencies and stakeholder groups to actively engage with each other and critically reflect on how the diverse values influence the various bushfire management policy priorities and impact collaboration. However, one of the interviewees discussed how their involvement as a respondent in subsequent bushfire event special inquiries had provided a mechanism for them to critically reflect on both their own actions and the values and interests of the agency they represented. A special inquiry can, indeed, be considered a reflexive practice given that the hearing and additional consultations include diverse stakeholder input, various deliberative mechanisms such as public meetings and focus groups, and have resulted in significant institutional change for the sector. In particular, the restructuring of FESA into a Department, the implementation of risk-based land-use planning reforms for bushfire-prone areas and, more recently, the establishment of the Rural Fire Division have all resulted from recommendations of special inquiries into bushfire events. Despite their potential to function as a reflexive tool, there are other questions regarding the extent to which public inquiries, in fact, reinforce the dominant discourses and policy frames of the state, but these are beyond the scope of this paper (Gilligan 2002). This paper, however, suggests more deliberative and collaborative governance activities, learning from, but independent of, special inquiries, which have long been utilised by other environmental sectors, could assist the Western Australian bushfire management sector become more reflexive in its approach.

There is much to be gained through a reflexive approach to governance where public policy sectors reflect on how policy frames structurally underpin institutional arrangements, policy priorities and management practice (Bosomworth, Handmer, and Dovers 2014). A more reflexive approach may benefit the SAMR bushfire management sector, and other local government areas with similar challenges, generate new

ideas and develop a shared vision for bushfire management acknowledging the future challenges of climate change and urbanisation.

5. Conclusion

This paper analysed how four principles of adaptive governance: polycentric institutions, collaboration, social learning and reflexivity are represented in the policy discourse of disaster and bushfire management and, more specifically, through a case study on the Shire of Augusta-Margaret River (SAMR), the extent to which these have been operationalised by bushfire management practitioners on the ground.

The case study has illustrated how the current governance model for bushfire management has become increasingly multi-level, given the diverse array of governance actors at multiple levels that comprise the sector, an indicator of polycentrism. It was also noted, however, that while the policy agenda of shared responsibility has some conceptual ties with the adaptive governance principle of polycentrism, the emergence of this policy term has also been linked to a neoliberal agenda of transferring risk responsibilities from government onto individuals. This raises important questions about accountability, vulnerability and capacity which requires further consideration. The importance of collaboration, across government agencies and between government and non-government actors, was emphasised in both the overarching international and national disaster policy and Western Australian bushfire management discourse. The SAMR case study identifies that, in addition to formal collaborative mechanisms, informal networks also play an important role in facilitating a collaborative culture. There was evidence that deeply embedded institutional cultures exist within various agencies and groups that present a barrier for collaboration in the sector. It was proposed that increased opportunities for collaborative planning and joint management initiatives could help improve communication and stakeholder relationships.

Social learning, while found to be articulated as an important policy imperative in international disaster policy, was not strongly identified as a policy focus in Australian disaster policy and Western Australian bushfire management policy. This was also illustrated in the SAMR case study, where practitioners overall tended to favour a more top down, educative approach to changing community behaviour, rather than facilitating learning processes through multi-stakeholder interaction and experience sharing. However, it was identified that emerging community engagement programs are adopting a social learning based approach to enhance community bushfire preparedness.

The SAMR case study, identified a level of reflexive awareness in the bushfire management sector with regards to a recognition of how institutional values impact policy frames and management goals. It was also identified that while a sustainability/socioecological policy frame for bushfire management exists in the SW, an emergency risk management frame dominates both the policy direction and management priorities. It was posited that more deliberative and participatory governance processes, which enable a diversity of perspectives, knowledge and alternative solutions to be considered, could assist the sector to become more reflexive in both policy and practice.

Overall, there was evidence that the bushfire management sector is increasingly influenced by novel governance theories which embrace adaptive governance principles, in particular the ideas of institutional diversity and collaboration. Despite this however, further examination highlighted that what policy terms actually mean in practice is largely dependent on which policy frame or worldview lens they are interpreted

through. This study highlights the influence that interpretive frames have on policy priorities and management preferences. While the shifting discourse and institutional arrangements of contemporary bushfire management in Western Australia indicate incremental change occurring in the sector, which is influenced by theories of socio-ecological systems and sustainability, a culture of command and control persists.

The intention of this paper was not to present adaptive governance as a panacea for the governance of bushfire management. In agreement with Andersson and Ostrom (2008, 73), "no perfect governance arrangements exist", and the success of particular institutional arrangements are highly dependent on context. Nor has the paper intended to discount the contributions of risk management and the critical role of incident command systems in disaster management. This paper, however, outlined first how adaptive governance principles, in theory, have relevance to bushfire management and, second, examined how these key principles are reflected in bushfire management policy priorities and applied in practice. Adaptive governance as an emerging model does not necessarily replace the essential elements of the current model that delineates statutory obligations and provides authority to act with clear communication channels. However, adaptive governance provides new ways of conceptualising and strategically addressing policy problems that could help facilitate the institutional change needed to deal with the multiplicity of issues associated with contemporary bushfire management.

In conclusion, this paper suggests that as it confronts an inflamed era of bushfire activity, exacerbated by climate change and urbanisation, the bushfire management sector would benefit by experimenting with adaptive governance principles and processes, specifically multi-scale, collaborative and deliberative policy mechanisms that can foster social learning. Finally, if the bushfire management policy sector is to become more adaptive in its governance, a more reflexive approach, which enables an ongoing reflection of how worldviews and policy frames influence bushfire management direction is needed.

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ORCID

Simone Ruane http://orcid.org/0000-0002-1254-0923

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Appendix C: Article 3 and Supporting Documents

Gonzalez-Mathiesen, C., Ruane, S., & March, A. (2020). Integrating wildfire risk management and spatial planning—A historical review of two Australian planning systems. *International Journal of Disaster Risk Reduction*, *53*, Article 101984. https://doi.org/10.1016/j.ijdrr.2020.101984

Statement of Contribution

Journal Article 3

I, Simone Ruane, contributed 45% to the publication:

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Conceptualisation and design, data collection and analysis, interpretation of results, drafting, writing, revising, and editing.

Signature of Candidate: [redacted] Date: 12/11/2021

I, as a co-author, endorse that the level of contribution by the candidate indicated above is appropriate.

Constanza Gonzalez-Mathiesen [redacted] Date: 10/11/2021

Alan March [redacted] Date: 11/11/2021

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Integrating wildfire risk management and spatial planning – A historical review of two Australian planning systems

Constanza Gonzalez-Mathiesen [a,b,c,*], Simone Ruane [d], Alan March [b,c]

[a] Facultad de Arquitectura y Arte, Universidad del Desarrollo, Concepcion, Chile
[b] Faculty of Architecture, Building and Planning, University of Melbourne, Victoria, Australia
[c] Bushfire Natural Hazards Cooperative Research Centre, Australia
[d] Curtin University Sustainability Policy Institute, School of Design and the Built Environment, Curtin University, Bentley, 6102, WA, Australia

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ABSTRACT

Recent wildfires burning throughout Australia highlight the vulnerability of settlements located in wildland urban interface (WUI) areas. Spatial planning has a critical role in operationalising wildfire risk reduction considerations in a territorial manner across the WUI. Accordingly, more integrated approaches to wildfire management and spatial planning are necessary. However, there is limited literature examining the historical interactions between wildfire and spatial planning policy sectors and how institutions and policy instruments adapt over time to integrate mutually dependent considerations. To address this gap, this research examines how Australian spatial planning institutions and instruments evolved since European settlement to incorporate wildfire considerations, through a qualitative comparative case study approach of two Australian states. Based on the findings of the case study comparison, this paper presents a conceptual framework of the pathways towards increased policy integration of spatial planning and wildfire risk reduction that consists of six phases. It is argued that the path to greater policy integration is grounded on the development of common knowledge, a cross-disciplinary understanding, and agreed policy goals between different policy sectors, that, with time, translate into new institutional arrangements and instruments that integrate the work and decision-making processes of different sectors.

1. Introduction

Wildfires (referred to as bushfires in Australia) are inherent to the Australian landscape. Australia's fire regime is dominated by frequent low-intensity fires, with less frequent but extremely intense fires in the southern continent where the majority of the population reside [1,2]. The potential for high intensity fires to become catastrophic disaster events was demonstrated by the Black Summer fires of 2019–2020 which burnt over ten thousand hectares, resulting in 33 deaths and the loss of more than 3000 properties [3]. Contributing to this trend, climate change is generating higher, more prolonged fire danger conditions and increasing the frequency of extreme wildfire events in Australia's southern regions [4–6].

Australian settlement patterns have created a morphology of low-density urban sprawl, and rural-residential developments that encroach into fire-prone wildland areas and increase wildfire risks. Many Australian wildland urban interface (WUI) settlements contain significant fire fuel; most structures were built before the inclusion of wildfire risk consideration in planning and building regulations [7]; there has been extensive land fragmentation [8]; and road layouts are often constrained. These settlement patterns have altered fire regimes across southern Australia, contributing to more catastrophic wildfire events [9,10]. Furthermore, significant urban growth in southern Australia is correlated to higher rates of human-caused ignition [11]. WUI areas imply greater disaster risk because here more lives and properties are exposed to wildfires. Therefore, it is imperative to address wildfire risk reduction through the management and planning of settlements.

Approaches to wildfire management in Australia have evolved remarkably over time, as a result of technical and scientific developments, shifting policy priorities and changing worldview perspectives [12], and it is now acknowledged that more all-encompassing

* Corresponding author. Facultad de arquitectura y arte, Universidad del Desarrollo, Concepcion, Chile.
E-mail addresses: mariagm@student.unimelb.edu.au (C. Gonzalez-Mathiesen), simone.ruane@postgrad.curtin.edu.au (S. Ruane), alanpm@unimelb.edu.au (A. March).

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approaches are imperative. Aboriginal people, through their mosaic burning practices to maintain landscapes and facilitate resource supply, managed fire in the region for some 40,000–60,000 years [13,14]. With European settlement, a very different approach to wildfire management was established [15], which focused primarily on incident response [16]. Incident response long persisted as the dominant approach to minimising wildfire impacts. However, the sector has increasingly shifted towards preventative and risk-based wildfire management [17]. More recently, the adoption of a resilience-based policy approach has widened the scope of wildfire management to consider broader factors relating to vulnerability and adaptation [18]. Hence, Australian wildfire risk reduction is no longer viewed as the sole responsibility of the emergency management sector, but as a shared responsibility of a range of actors [19].

Spatial planning can contribute to operationalising wildfire risk reduction considerations in a territorial manner across the WUI. Spatial planning refers to the broad processes and mechanisms for dealing with the spatial distribution of activities and coordinating spatial policies to achieve improved settlements [20]. Research has established that settlements' characteristics, location, and physical design, affect both the likelihood and consequence of wildfires [21,22]. Disaster policy in Australia, and abroad, has therefore recognised spatial planning as a critical player for reducing wildfire risk in WUI areas [18,23]. However, while emergency managers are urged to consider spatial planning as a risk reduction measure, they often lack appropriate spatial planning knowledge and land-use decision-making authority.

Traditionally, spatial planning in Australia focused on the physical characteristics of settlements and the distribution of land-uses through the production of end-state plans. Over time, the sector's focus has broadened, moving to a more holistic discipline [24]. Spatial planning occurs through instruments such as legislation, regulations, agendas, policies, visions, designs and strategies at various spatial scales, from national to local [25]. Spatial planning can play an important role in operationalising disaster resilience by including wildfire risk considerations when directing settlement growth, use and design [21,26]. However, while spatial planners are urged to address wildfire risk reduction, they have a subsidiary role in this [27]. Furthermore, they are constrained by legacy issues from earlier spatial planning decisions, development pressure and a reliance on traditional planning instruments that focus on new development rather than existing settlements [20].

There is consensus that an integrated policy approach between wildfire management and spatial planning is critical for disaster risk reduction (DRR) [1,22]. Policy integration requires coordinated efforts between at least two sectors to more effectively address a mutually interdependent policy issue [28]. Understood as an ongoing process of institutional change rather than a policy outcome in itself [29], policy integration entails the design and recalibration of policy instruments to achieve more consistent and coherent policy goals [30].

There is emergent research about conditions that facilitate linkages between interdependent actors [31], and enable effective policy integration between sectors [29]. From a DRR perspective, key dimensions of policy integration identified in the literature include: (a) recognition of the need for an integrated approach and cross-disciplinary understanding; (b) strengthening of a coordinated governance structure and cross-sector collaboration of spatial planning and DRR institutions, interacting vertically, horizontally and functionally; (c) establishment of mixed policy instruments that cut across the sectors; (d) improvement of knowledge and information through comprehensive and systematic risk assessments for integrated decision-making; (e) encouragement of institutional learning from implemented policies and experiences; and (f) consideration of the multiple scales of space and time in which actions can be taken [22,29,32].

Over the past decade, spatial planning systems across Australia have undergone policy reforms to strengthen the integration of spatial planning and wildfire management [20]. However, to date, few studies have examined the historical interactions between wildfire management and spatial planning. To address this gap, this paper examines how the sectors of spatial planning and wildfire management in two Australian states have evolved and interacted since European settlement towards a more integrated approach to wildfire risk reduction. Turning to the past can contribute insight into the different drivers and impediments of policy integration between sectors, enabling us to better understand complex policy problems and assess the feasibility of possible solutions [33]. This paper builds upon emerging policy integration literature [22,29,32]. Using the findings of the case study comparison, a conceptual framework of the key phases towards increased policy integration of spatial planning and wildfire risk reduction is presented. While this framework is specific to spatial planning in wildfire-prone areas, it has the potential to be used as an analytic tool for broader DRR and policy integration research.

2. Method – two Australian case studies

This qualitative study was approached using a comparative case study strategy [34]. The spatial planning system and wildfire management systems of the Australian states of Victoria and Western Australia (WA) were selected as case study subjects. Given WA's size and environmental variation, the study focussed on the South-West of Western Australia (see Fig. 1), where the majority of the state's population reside. The criteria for selecting these two cases include: both territories are prone to severe wildfires; the growth of peri-urban settlements within the cases is increasing wildfire risk, and both spatial planning systems have addressed the wildfire challenge through ongoing policy reform.

2.1. Case study 1: Victoria

The state of Victoria, located in the south-east of Australia's mainland (Fig. 1), has large fire-prone areas, and a wildfire regime dominated by occasional very high-intensity fires [2,35]. Historically, several devastating events impacted populated areas: Red Tuesday (1898), Black Friday (1939), Ash Wednesday (1983), Black Saturday (2009), and Black Summer (2019-2020). Settlement patterns have affected wildfires' frequency and severity [9]. Currently, Victorian WUI areas are among the most vulnerable to wildfires worldwide [8].

Victoria's spatial planning system is framed at the state level and administered at the local level. At the state level, the Planning and Environment Act [36] is the legislative framework and the Victoria Planning Provisions (VPP) are subsidiary legislation providing a template of standardised state-wide planning schemes. At the local level, planning schemes establish strategies, policies and provisions for land's use, development and protection, through ordinances, maps, and incorporated documents based on the VPP template. Victorian planning agencies are characterised by a three-way relationship: (1) state; (2) local; and (3) a series of sectoral or project-oriented agencies [37]. The Department of Environment, Land, Water and Planning (DELWP) is the key statutory authority for planning and development for the state. Local governments usually prepare planning schemes and decide on development applications on land included in the corresponding local planning scheme. The Country Fire Authority (CFA) is Victoria's primary wildfire emergency management agency outside inner Melbourne.

2.2. Case study 2: South-west of Western Australia

The south-west of Western Australia (south-west WA)[1] (Fig. 1), home to around 80% of the state's population, is vulnerable to large wildfire

[1] The south-west of WA defined herein refers to a geographical area of Western Australia that closely corresponds with the boundaries of South West Land Division, the South West Agricultural Region and the South West Australian Ecoregion.

Fig. 1. Map of Australia and the States of WA and Victoria (Source: adapted from Ref. [49]).

events [38,39]. Since the 1960s, the fire regimes of south-west WA have been dominated by prescribed burns of low to moderate intensity with decadal frequency, with occasional high-intensity wildfires [40]. WA has not historically experienced the same extent of wildfire devastation as Victoria, however, past wildfire events such as the Dwellingup fires (1961) and the more recent Waroona Fires (2016) demonstrate the propensity of extreme wildfires in the area with potentially catastrophic impacts.

Spatial planning in WA is framed at the state level with some administration delegated to the municipal level. At the state level, the Planning and Development Act [41] is the legislative framework and the State Planning Policies (SPPs) support an integrative decision-making framework between the various levels of planning [42]. At the local level, planning schemes establish the way land is to be used and developed, supported by strategies, policies and provisions (mandatory or indicative), including ordinances, maps, and incorporated documents. WA planning agencies are also characterised by a three-way relationship: (1) state; (2) local; and (3) sectoral or project-oriented agencies. The Western Australian Planning Commission (WAPC) is the statutory authority for planning and development for the whole state. Local governments usually prepare planning schemes and decide on development applications on land included in the corresponding local planning scheme. The Department of Fire and Emergency Services (DFES) is WA's primary wildfire emergency management agency.

2.3. Data collection and analysis

This study explores the changing foci of spatial planning and wildfire management over time and examines the evolving interactions between these two sectors towards a more integrated policy approach. The research employed a qualitative content analysis (QCA) approach [43], to examine textual data in the form of archival and contemporary policy documentation relating to spatial planning and wildfire management. QCA is a flexible methodology that aims to identify patterns and parallels that characterise a particular phenomenon [44]. This study uses the method of process tracing, a QCA technique concerned with examining the sequencing of particular events and identifying causal mechanisms [45], which link particular antecedent conditions to specific outcomes [46]. Process tracing involves the longitudinal analysis of chronological events and is concerned with what happens over a period of time and why [47]. Accordingly, each case was analysed to elicit causal factors driving policy integration and to identify different phases that characterised the process of policy integration. Furthermore, comparative case studies are appropriate for process tracing because when similar underpinning conditions and patterns in the sequencing of events are observed repeatedly in different contexts, likely causal mechanisms can be revealed [45]. Periodization, whereby temporal phases are distinguished to allow for the comparison of similarities and differences between cases, is an important part of process tracing [48]. Thus, the cases were compared to identify common trends, influencers and barriers of integration.

This study takes the starting point of 1850; a period identified with the incipient self-government of the Australian colonies. Using keywords relating to spatial planning and wildfire management, a thorough desktop search of Victorian and Western Australian public library catalogues, legislation archives, and government department websites was undertaken and an inventory of texts that included strategies, guidelines, records, legal documents, special inquiries, research and historical texts from each of these states was compiled. An initial screening of these texts was undertaken to identify key policy documentation that was considered 1) integral to the formation of each sectors' institutional configurations 2) represented significant sectorial changes or increased integration between the two sectors; and 3) was linked to a particular condition or event (a causal trigger or driver) that initiated the change and strengthened policy integration. A total of 54 documents were analysed for this study (Victoria n: 26; WA n: 23; National n: 5)

presented in Tables 1–6

3. Results – policy pathways towards greater integration

Based on the analysis of the different phases that characterised the process of policy integration per case study, and a cross-case synthesis of them, a conceptual framework of key trajectory phases for the policy integration of wildfire management and spatial planning was developed (presented in Fig. 2). This framework provides a characterisation of the different historical periods and institutional interactions and gives a snapshot of critical events and actions associated with the policy integration of spatial planning and wildfire risk management. The limitations associated with process framing and this analysis' temporal periodization of integration are acknowledged, including that policy developments are often non-linear and are influenced by a combination of factors. Nevertheless, this framework provides a valuable analysis tool for examining processes of policy integration for DRR. Furthermore, Tables 1–6 list the key policy instruments, characteristics, and changes as well as the key drivers and triggers towards integration per case for each of the six phases.

3.1. Independent beginnings of spatial planning and wildfire management

The early stages of European settlers' wildfire management across Australia focussed predominately on wildfire response. A formal wildfire management sector in both Victoria and WA originated through the enactment of fire brigade legislation during the late 19th century (see no. 1 and 8, Table 1). This entailed the establishment of fire brigade boards that were granted the governing authority for wildfire response. The overarching objective of these early institutions was to protect life and property from fire incidents, and this priority persisted throughout the 20th century as the key focus of wildfire management systems in both cases.

In the early 20th Century, the origins of archetypal planning can be identified in both cases. Like many Australian policy sectors, the roles of local and state government in spatial planning were determined during this post-Federation era. The requirement for local governments to prescribe residential zones, prohibiting or regulating certain activities or developments, can be traced to seminal legislation passed during the 1920s in both cases (see no. 4 and 12, Table 1). Procedures for preparing, amending, and revoking planning schemes, and planning approval processes were further formalised in Victoria during the 1940s with the enactment of town planning legislation (see. no. 6, Table 1), and during the late 1960s in WA with subsidiary town planning legislation (see no. 13, Table 1). Many of the institutional processes that were established during the early to mid-twentieth century by these legislative instruments, despite important adjustments, have been retained in both Victoria's and WA's current statutory planning systems.

Despite the lack of integration between the two systems during this period, there is evidence of a nascent awareness regarding the interrelationship between wildfire risk and building and site location and design during this period (see no.7, Table 1). This suggests an emergent recognition of the mutual interdependency of spatial planning and wildfire management systems and the need for a coordinated approach. For example, a Victorian Royal Commission into the Black Friday events (1939) recommended better cooperation between agencies, for sawmills to be directed away from fire danger areas, and the need for turning points on narrow roads for fire brigade vehicles [50]. Similarly, the Royal Commission for the 1960/1961 Dwellingup wildfires in south-west WA emphasised the importance of firebreaks between forests and private properties and recommended sufficient separation between properties to reduce fire spreading and to support firefighting operations [51].

3.2. Developing common knowledge and a cross-disciplinary understanding

In Victoria, guidance for the design and siting of rural subdivision emerged during the late 1970s, early 1980s (see no. 1 and 2, Table 2). The critical role that land-use planning could play in wildfire risk reduction, by designating fire-prone areas, was reinforced by research and inquiries following the Ash Wednesday wildfire that impacted Victoria in 1983 [67]. Following this, Australia's first National Inquiry into wildfires highlighted the inadequate attention given by the states to

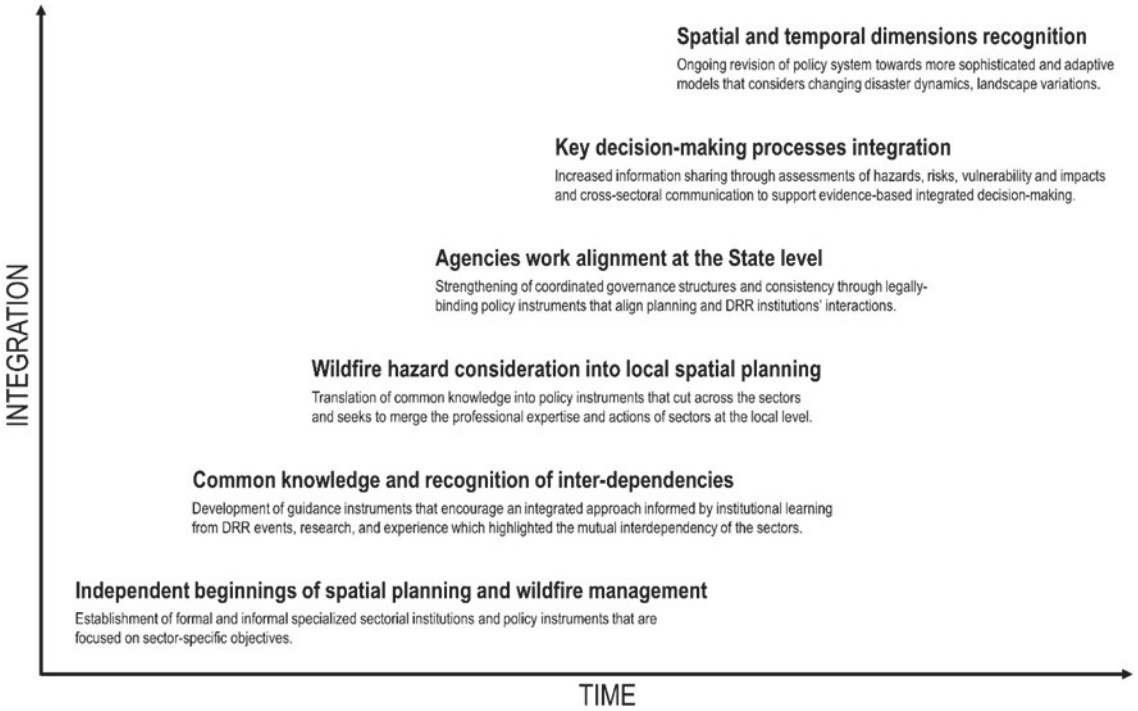

Fig. 2. Spatial planning systems' trajectory to gradually adapt to integrated wildfire risk management.

Table 1
Summary of key characteristics and changes, and key influences and triggers during the independent beginnings of spatial planning and wildfire management.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	Wildfire risk management:		International trends associated with progressing a modern economy. Federation (1901) Black Friday (1939). Victoria Royal Commission & Stretton Report [50]
	1. Fire Brigades Act [52]	➢ Established first formal fire management institutions.	
	2. Country Fire Authority Act [53]	➢ Established state-wide authority for fire management outside metropolitan area.	
	3. Forest Act [54]; the Metropolitan Fire Brigades Act [55]; and the Country Fire Authority Act [56]	➢ Consolidated fire management legislative framework.	
	Spatial planning:		
	4. Local Government Act [57]	➢ Authorised local government to prescribe residential zones and regulate land use.	
	5. Slum Reclamation and Housing Act [58].	➢ Enabled local government to develop plans, maps, schemes, and zoning for future development.	
	6. Town and Country Planning Act [59]	➢ Introduced schematic and statutory planning, established processes for planning scheme preparation and the planning permit decisions.	
South-West WA	7. A Survey of Houses Affected in the Beaumaris Fire, January 14, 1944 by Barrow [60]	➢ Verified the correlation between house survival to a wildfire and its construction, design and siting characteristics for the first time.	
	Wildfire risk management:		International trends associated with progressing modern economies. Federation (1901) Population growth during gold rush. Great Coolgardie Fires (1885). Series of damaging wildfires in south-west WA (1923–1924). Dwellingup wildfires (1960/1961). Royal Commission [51].
	8. Fire Brigades Act [61]	➢ Established first formal fire management institutions.	
	9. District Fire Brigade Act [62]	➢ Established state-wide authority for fire response	
	10. Forest Act [63]	➢ Established Forest Department responsible for fire control in state forest	
	11. Bushfire Act [64]	➢ Granted local governments more fire management powers.	
	Spatial planning:		
	12. Town Planning and Development Act [65].	➢ Positioned state Town Planning Board as central planning authority and made provision for local Town Planning Schemes.	
	13. Town Planning Regulations [66]	➢ Established procedures for the preparation of local schemes and planning permit decisions.	

Table 2
Summary of key characteristics and changes, and key influences and triggers during the development of common knowledge and disciplinary understanding.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1. "Design and Siting Guidelines: Rural Subdivision Principles" [70].	➢ Provided guidance for the design and siting of rural subdivision in wildfire-prone areas.	International and national trend towards disaster prevention. Ash Wednesday (1983). Inquiries on Ash Wednesday (1984). National standards for construction of buildings in bushfire-prone areas [69].
	2. "Design and siting guidelines: bush fire protection for rural houses" [71]	➢ Provided guidance for the design and siting of rural houses in wildfire-prone areas.	
	3. "Planning conditions and guidelines for subdivisions" [72].	➢ Provided guidance for the preparation and assessment of subdivision plans in wildfire contexts that could be incorporated in local planning schemes.	
South-West WA	4. SAA HB36 - Building in bushfire-prone areas: information and advice [73].	➢ Provided advice about the design, construction, siting, landscaping, and maintenance of buildings in wildfire-prone areas	
	5. The Homeowner's Bushfire Survival Manual [74].	➢ Provided guidance for wildfire sensitive building design, site selection and protection measures.	International and national trends towards disaster prevention. The knowledge emanating from Victoria and NSW about wildfire planning Recommendations from the first national inquiry into wildfires to advance wildfire consideration in planning. House of Representatives Standing Committee on Environment and Conservation [68] National standards for construction of buildings in bushfire-prone areas [69].
	6. "Planning for Better Bushfire Protection Guidelines" [75].	➢ Provided guidance for the design and siting of rural subdivision in wildfire-prone areas.	
	7. 1991 - Policy for Development Control (4.2), Planning for Hazards and Safety [76]	➢ Provided guidance for planning decision-making in wildfire-prone areas.	

wildfire risk in land-use planning frameworks across Australia and recommended urgent action to address this [68]. Interestingly, there was no evidence of guidance for the design and siting of subdivisions specifically published for WA in the late 70s and early 80s as was the case in Victoria.

During the late 1980s and early 1990s, the operationalisation of wildfire risk management into planning instruments started to be considered and a set of guides and standards were developed in Victoria (See no. 3 and 4, Table 2) and WA (see no. 5 and 6, Table 2). At a national level, the first construction standards for building in wildfire-prone areas were published in 1991 to improve the performance of buildings to ember attack [69]. In the case of WA, wildfire considerations in spatial planning were further advanced through a state-level development control policy (see no. 7, Table 2), which required local planning decisions to consider wildfire probability and avoid development in areas where fire protection could not be achieved.

3.3. *Including wildfire considerations and knowledge into local plans*

Informed by the growing awareness of spatial planning's potential role in wildfire DRR, wildfire considerations for spatial planning began to be translated into local planning instruments during the late 1980s and early 1990s. In Victoria, based on research and recommendations following Ash Wednesday, the first indication of a local planning scheme (see No 1, Table 3) incorporating wildfire regulations such as water provision, site separation, access and egress, and building and site

Table 3
Summary of the key characteristics and changes, key influences and triggers during the stage of including wildfire considerations and knowledge into the planning system.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1.1985 – Shire of Upper Yarra Planning Scheme [76,77]. 2.1987 – Planning and Environment Act [36]. 3.1992 – Amendment no. 29 to the Yarra Ranges regional strategy plan [78].	➢ Applied wildfire protection measures at the local level. ➢ Introduced the submission of planning permit application to referral authorities. ➢ Indicated that fire prevention and suppression must be coordinated across agencies and that Planning Authorities must consider wildfires in local planning schemes.	Growing awareness of spatial planning's potential role in wildfire DRR. Ash Wednesday (1983). Research following Ash Wednesday. First National Inquiry into Bushfire recommending land-use planning to apply greater wildfire protection measures.
South-West WA	4.1992 – Augusta-Margaret River Rural strategy [79]. 5.1998: the Leeuwin-Naturaliste Ridge State Planning policy (PS 1.12) [80]	➢ Applied wildfire protection measures at the local level. ➢ Advised that wildfire protection strategies be incorporated in all rural residential planning proposals.	Growing awareness of spatial planning's potential role in wildfire DRR. Research following Ash Wednesday.

design emerged in 1985. In WA wildfire hazard assessments and fire protection planning requirements were incorporated into a 1992 rural planning strategy for a particularly wildfire-prone shire district located in south-west WA. (see no. 4, Table 3). Furthermore, by 1998 (see no. 5, Table 3) a state policy was enacted in WA requiring wildfire protection strategies be incorporated in all rural residential and clustered settlement proposals in a wildfire-prone sub-region of south-west WA. In the case of Victoria, the regional strategic planning level (no. 3, Table 3), started to include some consideration about wildfires indicating that development within identified buffer zones be prohibited when considering permit applications in wildfire-prone areas.

3.4. Formalising the state-level institutional arrangements to align the work of the agencies

In both cases, the spatial planning systems progressed to establish state-level institutional arrangements – regulatory for Victoria and indicative for WA – that framed lower tiers of planning and aligned their work with wildfire risk reduction. In Victoria, the Wildfire Management Overlay (WMO) – the first state-wide wildfire specific statutory planning tool – was established within the overall restructuring of the planning system in 1997 and the introduction of the Victoria Planning Provisions (VPP) (see no.1, Table 4). Each council was responsible for adopting the WMO into its planning scheme through mapping wildfire-prone areas. It established extra-statutory requirements for development to include wildfire protection measures. Furthermore, it stipulated that the responsible decision-making authority must determine whether a planning permit proposal satisfied requirements, or needed further assessment by the relevant wildfire authority, predominately the Country Fire Authority (CFA). In WA, changes were also emerging at the state level to formally align spatial planning and wildfire management through the development of cross-sectoral policy guidance and strategic non-binding instruments. Wildfire risk considerations were reinforced as a key responsibility of spatial planning in 1999 (see no. 2, Table 4), with guidance stipulating that in approving planning applications local governments should consider wildfire risk and include Special Control Areas (SCA) to deal with specific issues such as wildfire protection. Moreover, in 2001, wildfire protection planning guidelines (see no. 3, Table 4) were revised with the intent to 'formalise the integration of fire protection into the planning process' [81] p. iii. These guidelines provided procedural recommendations for local government to identify wildfire-prone areas and set out performance criteria for subdivision and development depending on the wildfire risk. Following the restructure of WA's planning system in 2005, which included the provision for State Planning Policies (SPPs), a State Planning Policy for Natural Hazards and Disasters (see no. 4, Table 4) was released. This development reinforced the role of local governments in identifying and restricting development in wildfire-prone areas.

Limitations associated with the operationalisation of these first state-level institutional arrangements to align the work of spatial planning and DRR are evident. Victoria's WMO mitigation measures were regularly reduced to facilitate other objectives such as vegetation retention. Furthermore, the WMO mapping was applied only to areas where high-intensity wildfires were expected to be difficult to control. This meant that by 2009 the WMO was only applied in 35 of Victoria's 82 planning schemes using inconsistent mapping criteria between local governments [82]. Furthermore, the policy setting for planning in wildfire-prone areas in WA during this time imposed no legal obligations on local governments to declare wildfire-prone areas. While local governments were encouraged to declare wildfire-prone areas, by 2011 only 2 out of 139 local governments in WA had done so and were, hence, required to comply with the performance criteria presented in the guidelines and the wildfire construction standards [83].

Table 4
Summary of key characteristics and changes, key influences and triggers during the formalization of the state-level institutional arrangements to align the work of the agencies.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1.1997 – Wildfire Management Overlay (WMO).	➢ Introduced first state-wide wildfire specific planning tool.	Planning re-structuring and introduction of Victoria Planning Provisions (VPP) International trend of adopting a preventative, risk-based approach in DRR
South-West WA	2.1999 – Town Planning Regulations amendment [84]. 3.2001 – "Planning for Bush Fire Protection Guidelines" [81]. 4.2006 – SPP 3.4 for Natural Hazards and Disasters.	➢ Stipulated that local government schemes consider wildfire and designate Special Control Areas (SCA) for wildfire-prone areas. ➢ Attempted to formalise the integration of wildfire protection into WA spatial planning system. ➢ Advised that all planning instruments and decisions must give due regard to wildfire risk.	Planning re-structuring and introduction of Planning and Development Act [41]. The International trend of adopting a preventative, risk-based approach in DRR

Table 5
Summary of key characteristics and changes, key influences and triggers during the integration of key the decision-making process within and between agencies.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1. 2011 – VPP Amendment VC83 (November 18, 2011).	➢ Replaced the WMO with the Bushfire Management Overlay (BMO), establishing mandatory conditions, exemptions, and general decisions guidelines for BMO areas. ➢ Established CFA as a determining referral authority for BMO areas.	Black Saturday wildfires (2009). Victoria Royal Commission [82] key planning and building controls recommendations. The limitations associated with operationalisation of these first state-level institutional arrangements.
	2. 2011 – Regulation 810 of the Building Regulations 2006, [86,87].	➢ Transferred responsibility for BPA and BMO mapping to DELWP.	
	3. 2014 - VPP Amendment VC109 (July 31, 2014).	➢ Recommended the CFA as a referral authority for BMO areas.	
	4. 2017 – VPP Amendment GC13 (October 3, 2017)	➢ Updated BMO mapping based on criteria updated in 2013.	
South-West Western Australia	5. 2010 – 'Planning for Bush Fire Protection Guidelines' (2nd Edition) [88].	➢ Introduced referral of high-risk planning applications to State Fire and Emergency Services Authority.	Black Saturday wildfires (2009). Perth Hills Wildfire (2011). Special inquiry report for the Perth Hills Bushfire recommendations to give planning in wildfire-prone areas legislative effect [83].
	6. 2015 – State Planning Policy (SPP) 3.7 Planning in Bushfire Prone Areas [85]	➢ Provided highest-level policy guidance to integrate wildfire risk into spatial planning.	
	7. Planning in Bushfire Prone Areas Guidelines [89]	➢ Introduced state endorsed standards for assessing planning proposals within wildfire-prone areas.	
	8.2015 – State Bushfire Prone Area Map. [90].	➢ Transferred responsibility for designating wildfire-prone areas from local governments to the state.	
	9.2015 – Amendment to the Planning and Development (Local Planning Schemes) Regulations [91].	➢ Established a legally binding framework for the integration of wildfire risk and spatial planning.	

3.5. Integrating key decision-making processes within and between agencies

The recommendations emanating from the Victorian Royal Commission into the Black Saturday wildfire (2009), the worst recorded wildfire in Australia's history had a far-reaching impact. In Victoria, in 2011 the requirements for wildfire areas were adjusted and the responsibilities across the planning and wildfire agencies in key decision-making processes were revised (see no. 1, Table 5). Notably, the WMO was replaced by the Bushfire Management Overlay (BMO), and the role of the CFA, as the key wildfire management agency, in planning permit decision-making and wildfire-prone mapping was strengthened. Since the 2011 reforms, spatial planning's wildfire considerations have been adjusted, corrected and relaxed, yet have maintained the general intentions. Another critical change is that responsibilities for mapping were re-allocated and the mapping criteria were changed several times. Instead of local governments, a single state agency –The Department of Environment, Land, Water and Planning (DELWP) – is now responsible for mapping the BMO to ensure consistent criteria are applied across the State.

Comparatively, based on the recommendations of the inquiry into Perth Hills (2011) wildfire [83], greater changes were introduced to increase decision-making integration for wildfire risk reduction. A new policy reform package was released in 2015, which included a specific State Planning Policy for planning in wildfire-prone areas (see no. 6, Table 5). This new policy provided guidance to address wildfire risk at all levels of planning [85]. Wildfire prone areas started to be identified at the state level by the Fire and Emergency Services (FES) Commissioner through the State Bushfire Prone Area Map and revised guidelines were given legislative effect (see no. 7, 8 and 9, Table 5). Furthermore, the advice from the state's wildfire management agency, the Department of Fire and Emergency Services (DFES), as a referral agency must now be sought when the proposal involves an unavoidable, vulnerable or high-risk land use in a wildfire-prone area.

3.6. Recognising the systems' different dynamic spatial and temporal scales

The need to consider different spatial dimensions has informed recent developments in both cases. These recent developments seek to consider the landscape scale of wildfires and context-specific characteristics in the strategic planning process as well as the planning permit and development approval processes. In Victoria, this trend is illustrated by minor adjustments at the strategic level accompanied by extensive training (see no. 1 and 2, Table 6) to promote greater consideration of the landscape scale. These are intended to strengthen the system's capacity to direct new development to low-risk areas and reinforce the legal grounds to refuse a planning permit when the landscape context is considered too risky. In WA, a recent review of the policy framework (see no. 3, Table 6) highlighted the limitations of the current wildfire-

Table 6
Summary of key characteristics and changes, key influences and triggers during the recognition of the systems' different spatial and temporal dimensions.

	Policy Instrument	Key characteristics and changes	Key influences and triggers
Victoria	1. 2017 – VPP Amendment VC140 (December 12, 2017).	➢ Adjusted the VPP at the strategic level to prioritise human life, direct development to low risk locations, and strengthen wildfire consideration at the landscape scale.	Recognition of current system limitations to direct development to low-risk areas and of the capacity of planners to deal with wildfires matters.
	2. 2018–2019 – Education program for planners provided by DELWP.	➢ Improved planners' wildfire knowledge. ➢ Emphasised consideration of the landscape level to direct development to low wildfire risk areas.	
South-West WA	3. 2019 – "Bushfire Planning and Policy Review: A Review into the Western Australian Framework for Planning and Development in Bushfire Prone Areas" [93].	➢ Identified key issues of the current system and recommended a more moderate mapping standard that considers specific landscape issues and wildfire risk levels.	Criticisms of the WA wildfire planning framework being too risk-averse and failing to consider wildfire at the landscape scale.

prone mapping system and recommended a new methodological approach that recognises the different scales of development and landscape contexts. Based on the review's recommendations, some urban areas have been removed from the map to ease development restrictions and a new edition of the map for bushfire prone areas is currently being developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) [92].

4. Discussion

Using the example of spatial planning and wildfire risk management systems, this study revealed that the path to greater policy integration for DRR is grounded on the development of common knowledge, a cross-disciplinary understanding, and agreed policy goals between different policy sectors. With time these developments translate into new institutional arrangements and instruments that integrate the work and decision-making processes of different sectors, as conceptualized by the framework of six trajectory phases towards policy integration developed by this research.

The first phase identified corresponds to the similar independent sectorial origins of wildfire management and planning systems in Victoria and WA, which were formalised in an era associated with the establishment of state authorities and the defining of governmental roles. The sectoral origins were likely to have been influenced by several factors, including the dominance of a modern worldview, the limited availability of equipment and infrastructure, and a growing population that required services and housing [12]. Furthermore, several extreme wildfires occurred during this period in both cases, including Black Friday wildfires that impacted Victoria in 1939 and a series of extreme fires that impacted south-west WA in 1960–1961. These events and the subsequent inquiries led to key changes to wildfire management practice and raised awareness about the importance of wildfire prevention including the interconnections between wildfire and the design and location of settlements.

The second phase of policy integration identified is characterised by the progressive development of knowledge about spatial planning's role in wildfire DRR, from an emergent concern to the first attempts to provide guidance and standards for operationalisation. These findings indicate the emergence of common knowledge regarding the need for an integrated approach and a cross-disciplinary understanding, which Djalante et al. [32] and Candel and Biesbroek [29] argue is a critical dimension of integration. Large wildfire events and subsequent inquiries were found to be a key driver for wildfire management reform and for advancing policy integration between the sectors of wildfire management and spatial planning. Furthermore, experiences and knowledge from other contexts also influenced these changes, including an international trend from disaster management and response towards preventive measures and DRR. Interestingly, changes in WA policy developments to progress integration between the two sectors occurred later than in Victoria and were based on the knowledge and practices of the eastern Australian states. This suggests that as WA had not experienced a significant wildfire event during the 70s–90s, there was not the same impetus to undertake policy reforms during this period as in the case of Victoria. This reinforces the role of disaster events as a catalyst for advancing policy integration between these once independent sectors.

The third phase of integration identified was the inclusion of wildfire considerations and knowledge into local plans. The first local planning schemes and rural and regional strategies that integrated wildfire protection measures were emerging during this period for locations that were renowned for wildfire activity in both Victoria and WA. The policy developments of this phase illustrate how the spatial planning systems started to progressively integrate wildfire considerations into local planning instruments that operationalised wildfire DRR mechanisms to individual developments via planning approval processes. These local examples were forerunners in the establishment of mixed policy instruments that cut across the sectors and governing scales. Furthermore, these instruments set the basis for future policy integration developments that relied upon the inclusion of wildfire management sectorial advice into planning decisions for wildfire-prone areas. These changes again demonstrate that inquiries following large wildfire events have been a key driver for spatial planning changes to integrate wildfire considerations in decision-making processes, illustrating the system's institutional learning capacity as another key integration dimension [32].

The introduction of state-level institutional arrangements for wildfire integration into the planning system in both Victoria and WA, identified as the fourth phase of policy integration, was the culmination of the experience gained from several wildfire events and wildfire behaviour knowledge being transferred, tested and applied in spatial planning contexts. The development of cross-cutting policy instruments acknowledged spatial planning's importance for wildfire mitigation, establishing clearer frameworks and procedures to identify and treat wildfire risk and to integrate the wildfire management agencies' expertise into planning. Furthermore, wider institutional changes and planning systems' re-structuring provided the opportunity to implement wildfire-related changes based on accumulating knowledge and local experiences. Overall, the state-level institutional arrangements in both cases initiated the alignment of planning and wildfire management institutions, interacting vertically, horizontally and functionally, which is considered a key dimension of integration [22,29,32].

The results illustrated how a more coordinated approach to decision-making represented the fifth phase of integration. This phase represents an acceleration of integration between the spatial planning and wildfire management sectors, as the expertise of actors from one policy sector is formally integrated into the instruments and decision-making processes of another sector. Furthermore, structural changes during this phase promoted the systematic and centralised assessment of wildfire risk to inform integrated decision-making. This strengthening of cross-institutional arrangements and the sharing of more consistent data for evidence-based decision-making can be considered a key dimension of integration. Furthermore, these changes demonstrate that post-incident inquiries and research facilitate institutional learning and policy reform. This relates to another key dimension of integration being the role of institutional learning for the readjustment of policy goals and redesign of instruments [29,32].

Finally, the sixth phase of policy integration identified in the study indicates an increasing recognition of the need to consider the different and dynamic spatial and temporal dimensions when integrating wildfire management and spatial planning. The consideration of the multiple scales of space and time in which actions can be taken is considered herein as a key dimension of effective integration [22]. It must be noted that this phase of integration is still in a nascent stage and that the spatial planning systems in Victoria and WA are still rigid and limited in their integration of the different spatial and temporal scales of wildfire risk reduction. More sophisticated approaches are still needed in both cases. For instance, further recognition of the systems' different dynamic spatial scales could translate into a system that more effectively directs new development to suitable locations and considers context-specific nuances. Changing weather conditions – affected by long-term trends like climate change; medium-term ones like droughts; and very short-term ones such as the temperature, humidity and wind on a given day – are not considered by either state's planning system. Acknowledging that weather conditions and available fuels – influencing fire behaviour – dynamically vary through time, there is a need to increase the adaptability of the planning system to consider the temporal dimension of wildfires and their changing behaviour. Exploration of more sophisticated models for wildfire risk assessment between forestry and planning agencies are currently taking place in Victoria, although their outcomes are uncertain. In WA, the need to better integrate the temporal dimensions of wildfires and vegetation changes for spatial planning is an area that has not received sufficient attention.

Furthermore, more consideration needs to be given to future climate change impacts and wildfire risk at the higher strategic planning levels to determine which areas are suitable for development, given that many areas not currently considered wildfire-prone are likely to become so as the climate changes.

5. Conclusion

Through a historical comparative case study of two Australian states' spatial planning and wildfire management systems, this qualitative study has contributed to DRR research by developing a conceptual framework for the trajectory towards policy integration, which consists of six phases. The first one corresponds to the ***independent origins of spatial planning and wildfire management systems***, associated with the establishment of an archetypal spatial planning system and a wildfire management system focused on response activities. These early stages set the institutional bases for spatial planning and wildfire agencies' current ways of working. The second stage corresponds to ***developing common knowledge and cross-disciplinary understandings***, which is identified as the first indication of integration. This phase is characterised by increasing awareness of spatial planning's potential for wildfire risk reduction and the need for cross-sectoral collaboration. Grounded on the development of cross-disciplinary understandings, the third stage of integration is the ***inclusion of wildfire considerations and knowledge into the planning system*** through local instruments. Local initiatives are exemplars in the operationalisation of seminal policy instruments that cut across the sectors. The fourth stage distinguished is ***formalising state-level institutional arrangements to align the work of spatial planning and wildfire management agencies*** based on the culmination of experience gained from several wildfire events and knowledge being transferred, tested and applied to spatial planning contexts. This phase marks the start of the formal alignment of spatial planning and wildfire management institutions, with policy instruments and actors interacting vertically, horizontally, and functionally. The fifth phase identified corresponds to ***integrating key decision-making processes within and between agencies*** through the delineation of clearer roles and responsibilities of the wildfire management agencies in the planning processes, and in a more centralised approach to hazard identification, referral advice and mapping. This phase's changes strengthened cross-institutional arrangements, data sharing and the formalization of wildfire expertise into planning decision-making. Lastly, the sixth phase of the ongoing trajectory towards integration identified is ***recognising the systems' different dynamic spatial and temporal scales.*** This is considered an indication of an emergent move from the traditional static hazard mapping and spatial planning towards more sophisticated approaches that allow greater consideration of the different landscape scales, local context, and the dynamic spatial and temporal dimensions of wildfire risk.

The analysis demonstrates that development of these case study subjects towards the integration of spatial planning and wildfire management systems follow a similar trajectory (sequencing of events), which have been influenced by similar trends, underpinning conditions and events (causal mechanisms). It is suggested that changing international spatial planning and disaster policy trends have, and continue to, influence approaches towards spatial planning in wildfire-prone areas. Demographic changes and pressures to develop in WUI areas are recognised as key determinants of wildfire risk and will continue to present a challenge for wildfire management agencies and spatial planning decision-makers, compounded by the climate change impacts of higher fire danger conditions. Learnings from past experiences, accumulative knowledge, and policy reviews of systems' limitations have also influenced changes. In particular, this study has shown that inquiries and research following large wildfire events are a key driver for spatial planning changes, playing a critical role in the systems' institutional learning and instrumental adjustments.

Evidence emerging from the case studies also highlights key challenges for integration, historical and current. This historical examination shows that the lack of common wildfire knowledge and cross-sectoral understandings about the mutual dependencies of spatial planning and wildfire risk management is a barrier for the integration of the two policy sectors. Furthermore, the absence of formal arrangements for integrated decision-making, different sectoral priorities and operational scales, and diverging institutional cultures can limit the integrative capacity of agencies. Shifting to integrated DRR approaches involves changing the ways disasters are dealt with, and learning from different disciplines, contexts and events. In disaster-prone scenarios, as in any other context, adjusting to changing conditions and learning from experience is inherent to the policy cycle. This paper has highlighted that wider institutional changes, independent reviews and systems' restructuring provide an opportunity to implement changes and develop cross-cutting instruments that facilitate integration across traditionally, independent sectors. In concluding, it is suggested integrated disaster policy approaches are becoming increasingly critical as we are faced with more frequent and complex hazard events. Further research into the factors that enable or constrain policy integration in a range of DRR contexts in practice is therefore needed.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix D: Article 4 and Supporting Documents

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Statement of Contribution

Journal Article 4

I, Simone Ruane, contributed 90% to the publication:

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Specifically, I contributed the following:

Coordination, conceptualisation and design, data collection and analysis, writing of the original draft, revising, and editing.

Signature of Candidate: [redacted] Date: 16/12/2021

I, as a co-author, endorse that the level of contribution by the candidate indicated above is appropriate.

Mohammad Shahidul Hasan Swapan [redacted] Date: 15/12/2021

Courtney Babb [redacted] Date: 15/12/2021

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Article

Disaster Risk Reduction in Bushfire Prone Areas: Challenges for an Integrated Land Use Planning Policy Regime

Simone Ruane [1,2,*], Mohammad Shahidul Hasan Swapan [1] and Courtney Babb [1]

[1] School of Design and the Built Environment, Curtin University, Kent Street, Bentley, WA 6102, Australia; m.swapan@curtin.edu.au (M.S.H.S.); c.babb@curtin.edu.au (C.B.)

[2] Curtin University Sustainability Policy Unit (CUSP), School of Design and the Built Environment, Curtin University, Kent Street, Bentley, WA 6102, Australia

* Correspondence: simone.ruane@postgrad.curtin.edu.au

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Abstract: The need for an integrated approach to disaster risk reduction (DRR) is widely promoted across the contemporary disaster literature and policy discourse. In Australia, the importance of integrating bushfire management and land use planning systems is a growing priority as bushfire risk in urbanized areas increases. This paper examines the changing policy landscape towards an integrated DRR regime for land use planning and bushfire management in south-west Western Australia. The research is based on a qualitative analysis of policy documents and in-depth interviews with policy actors associated with this regime. The results identify several challenges of policy integration for an integrated land use planning and bushfire management DRR regime, including incompatible worldviews, sectorial objectives and knowledge sets. A lack of cross-sectoral understanding, different risk tolerances and instrument preferences also constrained integration efforts. Based on our findings, we argue that rule-based mechanisms, which establish a legal framework for integration, are necessary when different policy goals and worldviews prevail between policy sectors. However, we conclude by emphasizing the value of actor-based mechanisms for integrated DRR policy regimes, which enable ongoing cross-sectoral communication and policy learning and facilitate a systems-oriented perspective of disaster resilience in the built environment.

Keywords: disaster risk reduction; bushfire management; land use planning; policy integration; resilience

1. Introduction

Bushfires (also known as wildfires) are an intrinsic feature of the Australian landscape; however, as a result of changing climatic conditions, the southern regions are experiencing an increased incidence of extreme bushfire events [1]. The recent catastrophic bushfires, referred to as the "Black Summer" of 2019–2020, burned over 10 million hectares, mostly around the south-east of Australia, resulting in 33 deaths and the loss of more than 3000 homes [2]. These devastating impacts highlight the vulnerability of wildland urban areas (WUI), where human settlements are interspersed within or adjacent to bushland. Bushfires in WUI areas can have profound ramifications for human safety, property and other important values. Furthermore, urban development can increase bushfire risk, by changing the rates of ignition, modifying vegetation types, fragmenting landscapes and by introducing new forms of fuel [3,4]. These interacting variables raise many complex public policy questions regarding how to reduce the disaster risk of bushfire in the built environment.

Historical bushfires in southern Australia have demonstrated the detriment of past land use planning decisions, which allowed development within bushfire prone areas without incorporating

adequate protection measures [5]. Over the past decade, Australian states have undergone significant policy reforms of their planning systems to address this issue by strengthening bushfire considerations in planning controls and new development processes [6–8]. In Western Australia, this manifested with the release of the "Living in Safer Places" policy reform package of 2015 for planning in bushfire prone areas [9]. These reforms included the comprehensive redesign of instruments that cut across the bushfire management and land use planning sectors to reduce bushfire risk. While bushfire-related policies and instruments differ between Australian states, the overarching goal of bushfire planning instruments is to reduce disaster risk by locating settlements away from potential fire fuel hazards, and to incorporate design elements that support emergency response, asset protection, safe refuge and evacuations during a bushfire event [10].

Informing the policy reforms that have transpired across Australia is an emerging body of literature that illustrates why an integrated bushfire management and land use planning policy approach is crucial for disaster risk reduction (DRR) [5,11,12]. The foci of studies include the historical interactions between land use planning and bushfire management [13], implications of bushfire risk management for planning professionals [14], fundamental design principles for bushfire resilient urban planning [11] and other theoretical and practical issues of planning in bushfire prone areas [6]. It is emphasized that bushfire becomes a greater risk, and a potential disaster event, when it interacts with the built environment, threatening lives and properties [15].

Despite consensus for an integrated policy approach for bushfire DRR, in practice, integrating traditionally specialized policy sectors can be challenging given the various policy actors involved and their different organizational mandates and operational scales [6]. To date, few studies empirically examine the conditions that can enable and constrain policy integration in practice for this increasingly critical policy regime. This study contributes to the emerging field of knowledge for integrated bushfire DRR by using an in-depth qualitative case study approach to address the following research questions: firstly, how did the policy landscape in the case study area change towards an integrated policy regime for bushfire DRR? Secondly, what conditions enable and constrain an integrated DRR policy regime for land use planning and bushfire management? Thirdly, what mechanisms could help address some of the integration challenges and facilitate a more effective integrative policy approach? Using the content analysis method of process tracing, we first map out the sectorial background of policy integration of a land use planning and bushfire management regime that emerged in Western Australian during the late 1980s. Secondly, we draw on expert interviews to examine the factors that have challenged integrative policy measures for this regime. Finally, we present some mechanisms that could assist with addressing some of these challenges and facilitate a more effective integration approach for planning in bushfire prone areas policy. A better understanding of the factors that constrain and facilitate policy integration for land use planning and bushfire management could help inform the formulation of more effective bushfire DRR policy approaches into the future.

2. Theoretical Background and Conceptual Framework

2.1. Cross-Sectoral Synergies—Rise of an Integrated Approach to Disaster Risk Reduction

Since the 1990s, there have been increased calls for integrated policy approaches to address issues arising from public policy fragmentation and governmental silos [16,17]. Much of the earlier literature regarded integration as a necessary component of sustainable development [18,19] and focused predominately on the policy domains of natural resources and environmental management [20]. However, more recently, the need to move away from a top down, command and control regime associated with traditional emergency response and adopt an adaptive and integrated disaster risk reduction approach has received growing attention [21]. Advocates for integrated DRR argue for the involvement of multiple sectors and governmental levels, the inclusion of diverse forms of knowledge and the collective action of citizens, policy makers, experts and scientists across the full spectrum of disaster prevention, preparedness, response and recovery (PPRR) [22,23].

An integrated approach to DRR has featured as an imperative of several international policy agendas. Notably, the United Nation's Sendai Framework for Disaster Risk Reduction emphasizes the urgency of integrating DRR "within and across all sectors" of society [24] (p. 36). Further, the United Nations Sustainable Development Goals (SDGs) highlight the interrelationship between DRR and sustainable development and the importance of integrated policy strategies for sustainable DRR [25]. In Australia, reinforcing the international policy agenda, the National Disaster Risk Reduction Framework (2018) calls for integrated action across various sectors to achieve better solutions [26]. More specifically, the framework emphasizes as a national DRR priority that "[i]nfrastructure, land use and development planning and practices must be integrated, strategic and adaptive to avoid creating new disaster risk" [26] (p. 15).

2.2. Defining Policy Integration

Despite widespread support for integrated DRR, the term integration is broadly interpreted in the DRR literature and has been criticized for being ill-defined and an elusive ideal [27]. Furthermore, the concept of policy integration, a narrower term specifically concerned with intentional policy design for cross-cutting policy issues [28], has received minimal attention in the DRR literature. Only recently has policy integration been presented as a critical element of shifting from reactive emergency management to a DRR model that addresses the root causes of disaster risk [22] and as a necessary component of adaptive disaster governance [29].

Policy integration has been defined as a phenomenon whereby one or more interdependent policy sectors (also referred to in the literature as policy domains or subsystems) of a policy regime pursue shared or mutually supportive goals through the implementation of cross-cutting instruments and the cooperation of a network of policy actors [30]. Policy regimes can be conceptualized as overarching public policy objectives that entail the addressing of a particular problem or set of problems (for example, environmental protection, education, biosecurity and disaster risk reduction) [31,32]. Meijers and Stead [33] emphasize policy integration as the recognition of sectorial interdependencies and the collaborative attempts to pursue mutual consistency between policy sectors' various goals. While policy integration has been construed as an output or end state [34,35], other scholars maintain that policy integration is not inevitably a desired, static outcome, but a dynamic process of institutional change towards more cohesive policy regimes [28,36].

Integration within a policy regime can occur horizontally (occurring between different government agencies and departments at the same level) and or vertically (between the different levels of government and sectors of society) [37]. An integrated policy regime will often comprise a mix of both vertical and horizontal integration [16,33]. Furthermore, policy integration generally involves interest coalition subsystems comprised of non-government organizations and private actors, who function as knowledge brokers, peak bodies and political advocacy groups who are key to the decision-making processes and influence implementation [36,38].

It is important to note that although related notions of collaboration and coordination are intrinsic to policy integration, policy integration is a much more comprehensive term than these concepts. Collaboration and coordination refer more to the administrative structures that facilitate joint activities and holistic working between diverse sectors and agencies [17]. In contrast, policy integration generally entails the development of new policies [33] and the restructuring of governing arrangements associated with public sector reform [37]. More specifically, it is policy integration's focus on the creation or redesign of specific cross-cutting policy instruments, which merge the professional practice of sectors [17], which sets it apart from the broader objectives of collaboration and coordination.

2.3. Conditions that Enable and Constrain Policy Integration

A review of the policy integration literature examining policy regimes other than bushfire DRR outlined similar conditions that can facilitate or constrain reforms to strengthen policy integration. For example, in a study of a flood management regime in Switzerland, integrating the policy sectors of

land use planning, forest management and water protection, Metz, Angst and Fischer [29] showed that policy integration relies upon both legal frameworks (laws and regulations that institutionally mandate or incentivize integration) and actor-based coordination (administrative structures, working portfolios and communicative arrangements). While legal frameworks can promote effective actor-based integration, shared values and goals across the regime's subsystems are critical to its success. Another comparative study of transport policy in London and Berlin [16] suggested several integration mechanisms. These included governance structures based on legislative frameworks; network structures that facilitate communication and coordination of actors; procedural elements which include scheduling tasks and stakeholder engagement; instrumental elements such plans and policies; and, finally, broader enabling conditions, particularly the capability of actors to work in a cross-sectoral policy context [39,40].

Many authors concur that policy integration is strongly influenced by levels of political will and the governance mode of the time [41,42]. While much of the literature claims that policy integration is best supported by a networked governance mode [34,39], in the case of integrating urban form and road transport, Rode [16] argues that a hybrid form of governance, which combines both a networked governance approach with hierarchical centralization, may be more effective for policy integration. Interestingly, this author found that, in some cases, integration relied upon the reinstatement of a hierarchical, top-down approach [16].

What also emerges from the policy integration literature is that the success of integration appears to depend not only on administrative and structural mechanisms, but also largely on several "soft" elements including trust, a culture of collaboration, policy learning and an openness to new ideas and ways of working. It is suggested that these softer elements can be constrained by the diverging institutional logics and cultural worldviews of the various subsystems that comprise a policy regime, as these underpin how the different policy actors frame the problem at hand, their instrument preferences and their willingness to work collectively [43]. Based on a review of the literature, five key policy integration dimension categories where identified: a coordinated subsystem interaction, cultural compatibility, coherence of goals, cross-sectoral understandings and consistency of instrument mix. Table 1 presents a comprehensive overview of key conditions that can enable or constrain policy integration in practice under these categories.

Table 1. Conditions enabling and constraining policy integration.

Dimension	Enabling Condition	Constraining Condition	Key Literature
Coordinated subsystem interaction	Political will and a government mode supportive of policy integration.	Lack of political support and a government favoring sector specialization.	Rode [16], Candel and Biesbroek [28], Rouillard et al. [44], Meijers and Stead [33], Briassoulis [34], Stead and Meijers [45]
	Effective administrative, financial and legislative structures.	Administrative fragmentation, insufficient resources and inadequate legislation.	Rode [16], Briassoulis [34], Rouillard, Heal, Ball and Reeves [44], Nordbeck and Steurer [19], Metz, Angst and Fischer [29], Stead and Meijers [45]
	A lead subsystem and other committed subsystems.	Lack of leadership and subsystem commitment.	Briassoulis [34], Meijers and Stead [33], Rode [16], Stead and Meijers [45]

Table 1. *Cont.*

Dimension	Enabling Condition	Constraining Condition	Key Literature
Cultural Compatibility	Subsystems share similar worldviews.	Subsystems have diverging worldviews.	Briassoulis [34], Candel and Biesbroek [28], Metz, Angst and Fischer [29]
	Subsystems have a collaborative culture and willingness to share decision-making.	Subsystems prefer sectorial specialization and retaining decision-making power.	Metz, Angst and Fischer [29], Nordbeck and Steurer [19], Cumiskey, Priest, Klijn and Juntti [27], Stead and Meijers [45]
	Subsystems share a common understanding of the policy problem/s.	Subsystems frame the policy problem/s differently.	[27], Nilsson and Persson [46], Candel and Biesbroek [28], Stead and Meijers [45]
Coherence of sectorial goals	Congruent and compatible policy goals.	Incoherent goals and an absence of an overarching strategic vision.	Candel and Biesbroek [28], Metz, Angst and Fischer [29], Rouillard, Heal, Ball and Reeves [44], Candel and Pereira [39], Meijers and Stead [33], Cumiskey, Priest, Klijn and Juntti [27], Rayner and Howlett [20], Briassoulis [34]
	Subsystems' specific specialized responsibilities align with overarching policy regime goals.	Misalignment of subsystems' specialized responsibilities with overarching policy regime goals.	Meijers and Stead [33], Briassoulis [34], Cumiskey, Priest, Klijn and Juntti [27]
	All relevant subsystems of the regime are involved in developing policy goals.	Failure to involve all relevant subsystems in developing policy goals.	Stead and Meijers [45], Candel and Biesbroek [28]
Cross-sectoral understandings	Policy actors willing to engage with new knowledge, and information is shared across subsystems.	A reluctance of policy actors to embrace new knowledge, and information and data sharing is constrained.	Cumiskey, Priest, Klijn and Juntti [27], Briassoulis [34], Stead and Meijers [45]
	Various opportunities available for cross-disciplinary learning for actors.	Limited opportunities for actors to gain knowledge outside of their core discipline.	Metz, Angst and Fischer [29], Cumiskey, Priest, Klijn and Juntti [27], Metz, Angst and Fischer [29], Briassoulis [34]
	New knowledge and policy frames produced through instrument co-design and policy learning processes.	Instruments designed by the dominant subsystem with limited opportunities for policy learning and knowledge sharing.	Cumiskey et al. [27], Briassoulis [34], Rayner and Howlett [47]
Consistency of instrument mix	Policy instruments are compatible with the overarching policy goals.	Instruments are inconsistent and fail to address the overarching regime policy goals.	Rayner and Howlett [20], Briassoulis [34], Candel and Biesbroek [28], Trein, Meyer and Maggetti [17]

Table 1. *Cont.*

Dimension	Enabling Condition	Constraining Condition	Key Literature
	Instruments mix cuts across the subsystems and merges the professional expertise of subsystems.	The instrument mix is the result of policy layering and characterized by duplication, gaps and failure.	Candel and Biesbroek [28], Trein, Meyer and Maggetti [17] Howlett, Vince and Pablo del [37]
	Flexible instruments with review and monitoring mechanisms that allow for readjustment and adaptation.	Rigid policy instruments with inadequate review and monitoring mechanisms to enable readjustment and adaptation.	Meijers and Stead [33], Briassoulis [34],Stead and Meijers [45]

In line with the overarching theoretical direction and identified criteria in Table 1, the following sections examine the integration of land use planning and bushfire management policy by presenting a case study from south-west Western Australia (south-west WA).

3. Materials and Methods

Over the last decade, Australia has experienced many bushfire events with catastrophic impacts that have highlighted the need to strengthen land use planning's role in bushfire risk reduction. In particular, an inquiry into a major bushfire in the Perth Hills in 2011 resulted in the Western Australian government introducing a whole government policy reform package, "Living in Safer Places", in 2015, to better integrate bushfire protection considerations into planning decisions at all levels [9]. It is now 5 years since the implementation of these policy reforms and a critical reflection on the developments of an integrated policy approach for land use planning and bushfire management in WA is warranted and timely.

While the recent policy reforms discussed in this paper apply to the whole state of Western Australia, the focus area of this study is south-west WA (The south-west of Western Australia defined herein refers to a geographical area broadly correlating with the South West Land Division, the South West Agricultural Region and the South West Australian Floristic Zone.) (Figure 1). South-west WA not only comprises around 80% of the state's current population [48] but is a highly bushfire prone geographical area with the frequency of high-intensity bushfires with catastrophic impacts predicted to increase as a result of climate change [49]. The selection of this case is also justified given the dearth of empirical research conducted to date examining the interactions between the bushfire management and land use planning in this geographical area.

This research employed a qualitative case study approach, which involved the analysis of both policy documents and semi-structured interviews. Taking European settlement in south-west WA (1826) as a starting point, an extensive desktop search of state library catalogues, archives of WA legislation, national bushfire inquiries and online information available for public agencies in south-west WA was undertaken and a comprehensive database of bushfire management and land use planning documents was compiled. Furthermore, experts from each of the key agencies involved were consulted with to suggest historical policy documents considered significant to this research.

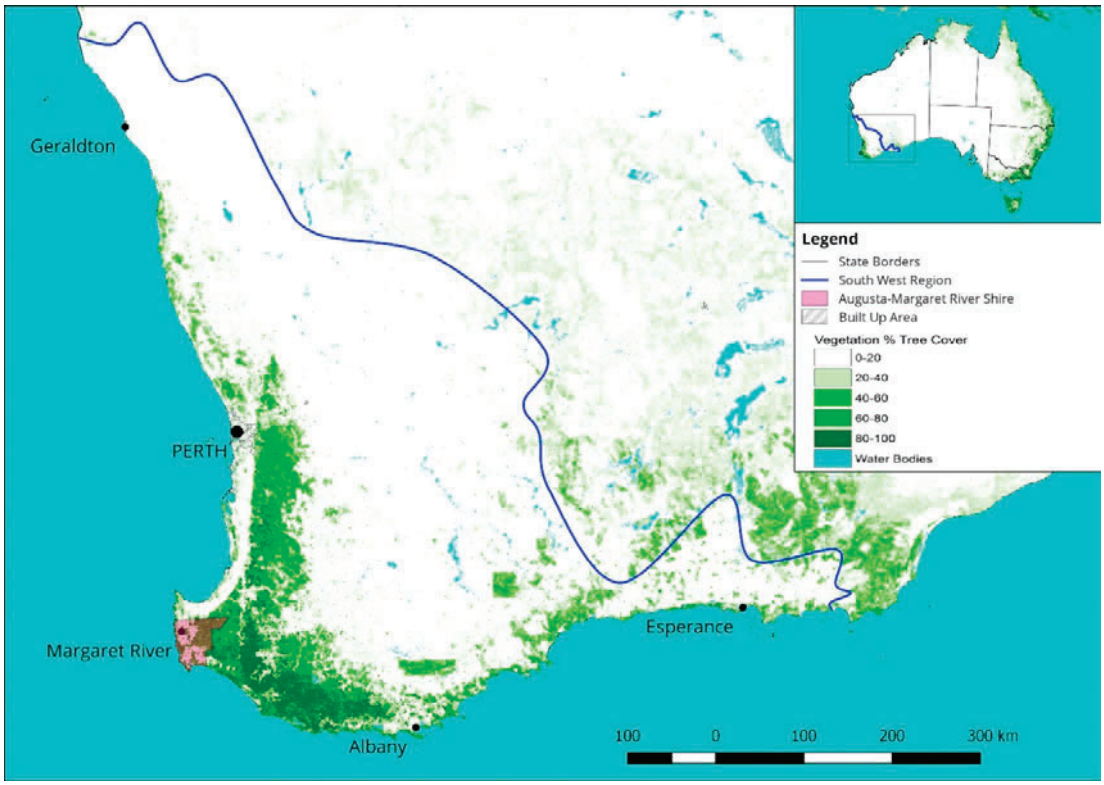

Figure 1. South-west Western Australia (Sourced from Ruane [50]).

Interviewee selection used both purposive and snowballing methods, culminating in twenty in-depth semi-structured interviews conducted over 2017–2020 with policy actors representing the integral subsystems of the case study policy regime (Table 2). In Australia, under a federal system of government, both land use planning and fire and emergency services are administered by state government agencies, with core responsibilities delegated to local government. Interviewees therefore included representatives from south-west WA local governments including the Shire of Augusta-Margaret River, the City of Kalamunda, the Shire of Mundaring and the City of Cockburn, and state government agencies involved in the policy development and or implementation of the recent planning in bushfire prone areas policy reforms. Furthermore, interviews with representatives from other non-government sectors, including private bushfire consultants and peak body the Western Australian Local Government Association (WALGA), who were considered an integral part of this policy regime, were also included to get a broad perspective. The interview schedule was framed around the research questions and sought to garner critical insight into the enabling and constraining conditions of policy integration associated with the policy reform package introduced in 2015 for planning in bushfire prone areas.

Table 2. Sector organization/policy subsystem and number of representatives interviewed.

Sector Organization/Policy Subsystem	Number of Interviewees
Department of Fire and Emergency Services (DFES)	3
Department of Planning Lands and Heritage (DPLH)	2
Western Australian Local Government Association (WALGA)	1
Bushfire Consultants	4
Local Government Planners	6
Local Government Senior Executive Staff	2
Local Government Environmental Managers	2

Note: All local governments included in the study were located in south-west Australia (Figure 1) with designated bushfire prone areas.

The qualitative analysis of documents was approached using a case study method of process tracing to determine how the interactions between the bushfire management and land use planning policy sectors emerged and changed overtime. Process tracing focuses closely on determining the sequencing of events and identifying causal mechanisms that explain specific outcomes [51]. Drawing from historical institutionalism, the process tracing technique was used to identify path dependencies, critical junctures and other intervening variables that were considered drivers and impediments of change [51,52]. Interviews were recorded and transcribed, and statements were categorized and analyzed thematically using the conceptual framework presented in Table 1. The themes used for coding related to actor interactions, policy framing, sectorial and regime policy goals, cross-sectoral understanding and knowledge transfer and instrument preferences and perspectives. Particular attention was given to how the different dimensions of policy integration, which had been identified in studies of other policy regimes, were enabled or constrained in the case study subject. The results of the interviews are presented in Section 4 and critically discussed in relation to the findings of previous policy integration studies in Section 5.

4. Results

This section sets the context for an integrated policy regime for land use planning and bushfire management in Western Australia. Firstly, we present a historical account for the emergence of a policy regime referred to at the time as "bushfire protection", highlighting key drivers and policy developments that instigated change and strengthened the integration of these traditionally autonomous sectors in WA. Following this, we analyze and discuss interviews conducted with policy actors representing the organizational sectors/policy subsystems who were involved in the development and or implementation of the 2015 bushfire planning policy reforms. More specifically, the interview analysis elicits key challenges of disaster policy integration for bushfire risk reduction arising in this particular case study.

4.1. The Emergence of an Integrated Policy Regime for "Bushfire Protection"

In 1983, Australia's worst bushfire event at the time, Ash Wednesday, burned over more than 300,000 hectares in Victoria and South Australia, resulting in 75 deaths and the loss of more than 2000 homes [53]. Recommendations emanating from a Royal Commission investigation into Ash Wednesday emphasized land use planning's critical role in bushfire risk reduction [54]. Following this catastrophic bushfire, Australia's first national inquiry into bushfires drew attention to the inadequate attention state governments had given to bushfire risk in land use planning frameworks across Australia [55]. This report recommended that state and local governments apply land use planning controls for the design and siting of housing and introduce zoning mechanisms to guide development in bushfire prone areas [55]. Consequently, there was an acceleration of policy action in many Australian states to strengthen the integration of bushfire protection into their land use planning systems [56].

Following the lead of Australia's south-eastern states, in 1989, WA's State Planning Commission (the statutory authority for planning decision making for WA) in conjunction with the Western Australia Fire Brigades Board (WAFBB) (the governing authority for fire and emergency management) jointly released the "Planning for Better Bushfire Protection" guidelines [57]. This seminal publication, which encouraged the consideration of the bushfire hazard into rural-residential development, was the first attempt at operationalizing bushfire protection into WA's planning system. This guidance instrument introduced a methodology for local governments, which relied upon the professional expertise of WAFBB, for undertaking bushfire hazard assessments to identify areas suitable for residential intensification. For areas identified as suitable for development, the guidelines recommended that bushfire protection measures, including vehicle access, water supply and strategic fire breaks, be implemented during the zoning and subdivision phase [57]. The release of this publication represents the emergence of a nascent policy regime for "planning for bushfire protection". This regime relied upon the integration of the land use planning and bushfire management sectors through knowledge

sharing and the transfer of professional expertise across traditionally specialized and independent sectorial subsystems.

In the early 1990s, there were further attempts in WA to advance the weighting of bushfire protection in land use planning decision making. In particular, a higher-order strategic state policy on planning for hazards stated that local planning decisions should consider bushfire risk and include fire protection measures in bushfire prone areas [58]. During this period, however, our analysis found little evidence to suggest this policy goal and framing instrument was widely applied by WA local governments. However, in a highly bushfire prone forested region of south-west WA, the Shire of Augusta-Margaret River (Figure 1), the study identified pioneering bushfire protection measures integrated into a local planning instrument, in the form of a rural planning strategy [59].

Following the devastating Victorian Black Saturday 2009 bushfires, which resulted in 173 deaths and 2156 properties destroyed, the imperative of better integrating bushfire risk into land use planning decision making made its way up on the political agenda [5]. In WA, this resulted in the release of an updated, joint edition of the "Planning for Bushfire Protection Guidelines" between the Fire and Emergency Service Authority (FESA) (formally the WAFBB) and the Western Australian Planning Commission (WAPC, formally the State Planning Commission) [60]. Despite encouraging "local governments to adopt the guidelines as policy" [60] (p. 2), these guidelines continued to have no legislative effect [61].

The Perth Hill's Fire in 2011, an extreme bushfire in the WUI of Western Australia's capital city Perth, resulting in more than 500 homes being evacuated and 79 homes being destroyed, was a critical juncture for planning in bushfire prone areas in WA [61]. The need to redesign land use planning instruments to reduce bushfire risk was emphasized throughout the special inquiry report into this bushfire event [61]. In particular, concern was raised in the report that the key planning instruments for bushfire risk reduction were not legally mandated through WA's land use planning system and that local governments had the discretion to declare bushfire prone areas and adopt the recommended measures in their local schemes and policies. It was noted that although local governments had been encouraged to designate bushfire prone areas within their districts, at the time of the Perth Hill's Fire, only two out of 138 WA local governments had done so and thus were required to comply with the bushfire planning and construction requirements, despite south-west WA's propensity for bushfire [61]. Hence, a core recommendation of the special inquiry report included transferring the authority for declaring bushfire prone areas from local governments to the state government and giving the "Planning for Bushfire Protection Guidelines" legislative effect [61].

As a result of the recommendations emanating out of the Perth Hill's Fire special inquiry, a state-wide bushfire planning policy reform package, "Living in Safer Places", was released in 2015 [9]. To give bushfire protection the highest level of planning control, these reforms entailed the development of a new State Planning Policy, "Planning in Bushfire Prone Areas" (SPP 3.7). This higher-level framing instrument provided guidance for land use planning decisions to address bushfire risk at all levels of planning, both strategic and statutory, to "have the effect of increasing community resilience" [62] (p. 1).

In summary, our historical review of policy developments revealed that the integration of bushfire management and land use planning policy did not emerge as a completely new policy regime in 2015. In fact, integration developed incrementally as the result of the learnings gained from several significant bushfire events, through to the recent planning reforms, which accelerated integrative policy action. Indeed, our analysis found that an integrated policy regime for planning in bushfire prone areas was first established in the form of non-binding guidance and recommended procedures in 1989, and that these early instruments laid down a path dependency for future policy integration developments.

4.2. The Challenges of Policy Integration for Planning in Bushfire Prone Areas

In the following sections, we present the key policy integration challenges that emerged from expert interviews. Using the conceptual framework presented in Table 1, we examine how the five core

dimensions of policy integration have been enabled or constrained in an integrated land use planning and bushfire management DRR regime for south-west WA.

4.2.1. Coordinated Subsystem Interaction

As outlined in Section 2, policy integration relies upon the interactions of two or more sectorial subsystems to address a boundary spanning problem, through the design or redesign of cross-cutting policy instruments [17]. As part of the whole of government "Living in Safer Places" policy reforms (2015), the state governing authorities for land use planning (DPLH and the WAPC) and the Fire and Emergency Services (DFES, formally FESA) remained the two key state governmental agencies in WA for an integrated policy regime now referred to as "planning in bushfire prone areas". The interviewees provided critical insights into this dimension of policy integration. According to one of its representatives, the state's planning department was best placed to be the lead agency to coordinate the development of a new planning policy for bushfire prone areas. It was noted by this interviewee that it was critical to convene a core working group that included representatives from the planning, fire and emergency and building sectors in the early stages of developing a new state planning policy for planning in bushfire prone areas (SPP 3.7) and an updated version of the policy guidelines. This also entailed significant consultation of DPLH, as the lead agency, with peak planning bodies and broader policy actors such as the Western Australian Local Government Association (WALGA) and the Urban Development Industry Association (UDIA). It was reported that the few local governments who had already designated bushfire prone areas prior to the reforms were also engaged to provide their input into the development of a new version of the guidelines. The extent of subsystem engagement (both formal and more broadly) was highlighted by interviewees as being more rigorous than for other public policy issues. It was commonly agreed that the success of integration for this regime was largely dependent on the engagement of the various subsystems who would ultimately be responsible for policy implementation.

In terms of development control, local governments continued to play a crucial role in operationalizing policies within their jurisdictions and remained as an integral subsystem of this bushfire planning regime. However, the legislative changes that were part of the 2015 reform measures changed the rules of the game for both the horizontal and vertical interactions between the regime's sectorial subsystems. In particular, the responsibility for designating bushfire prone areas was transferred from local governments to the state through the Fire and Emergency Service (FES) Commissioner and as a result, a State Bushfire Prone Area Map was produced [63]. This binary map covers the whole state of WA, delineating bushfire prone areas which require further assessment for planning and development approvals [62]. Furthermore, DFES became the referral agency for new development applications that involved vulnerable, unavoidable and high-risk land uses in bushfire prone areas.

Interviewees highlighted the inclusion of bushfire consultants for additional technical expertise as a significant change to the regime's governance structure. Notably, because of the 2015 reforms, bushfire consultants became an increasingly important private sector actor for this policy regime. As the majority of the state was declared bushfire prone, these changes increased the demand for bushfire hazard assessments and Bushfire Management Plans (BMPs) that were required to accompany development application proposals, providing an assessment of the bushfire risk for the site, and outlining how the development will comply with the bushfire protection criteria outlined in the policy guidelines.

4.2.2. Cultural Compatibility

Successful integration between diverse sector subsystems is greatly dependent upon an agreed problem framing, a sense of a common purpose between actors and an alignment of worldviews and institutional logic [28,29,31]. Overall, the view that bushfire DRR should be integrated within the planning system was common across all interviewees, regardless of what sector subsystem they represented. It was agreed that bushfire risk reduction was a responsibility of planning practice at

both a strategic and operational scale and that the recent reforms were necessary to address the failings of the preceding mix of policy instruments to meet the regime's overarching goal of reducing bushfire risk. For example, one interviewee asserted:

> *"bushfire risk should have been considered in all planning decisions . . . but it wasn't . . . No-one was enforcing it . . . the guidelines talked about local government designating bushfire prone areas, which they didn't do" (DFES).* This situation, according to another interviewee, *"was increasing the vulnerability of communities at risk" (DFES).*

In general, interviewees concurred that the policy reforms released in 2015 were a step in the right direction because, as one interviewee explained:

> *" . . . a lot of development in the past happened in vegetated areas where development should have NEVER ever happened from a bushfire point of view . . . At least there's a check and balance now . . . it's great for community protection" (Bushfire Consultant).*

However, despite evidence of this agreed upon overarching strategic purpose, discussions with interviewees revealed a misalignment of core worldview perspectives and problem frames between the two main policy sectors of this bushfire DRR regime. Reflecting previous studies, actors that represented land use planning in this case study tended to frame bushfire management as a sustainability or socio-ecological issue [50,64] and favored solutions based on a human coexistence with bushfire [65]. Emerging from interviewees representing this sector was a strong narrative of balance and flexibility, i.e., the importance of addressing multiple objectives and balancing the many risks associated with urban development. While interviewees representing the land use planning sector supported a risk reduction approach, there was greater willingness to accept a higher level of risk and give equal consideration to other risks inherent in the built environment.

According to the literature, policy integration relies upon an institutional culture characterized by a willingness to engage in cross-sectorial collaboration and communication [33]. Our findings are broadly consistent with other studies [66–68], which suggest that the fire and emergency services sector in WA has retained a hierarchical institutional culture that is not considered conducive to collaborative policy approaches. Comments were made by several interviewees regarding the institutional culture of the fire and emergency management sector and how it was perceived as a significant barrier to an integrative policy approach. One interviewee noted:

> *"DFES have a very strong command and control structure. Similar to the army, similar to the police. People should obey their orders and they should do what they want" (Local Government Planner).*

However, the culture and bias of the land use planning sector was also criticized by interviewees, described by some interviewees as being economically driven and politically influenced. Furthermore, the mantra of a "balanced" approach was challenged when the needs of the development industry were included in the mix:

> *the WAPC planning area is often quite pro-development . . . the development industry, which is incredibly powerful, has a huge amount of influence on government, promotes land development as economic growth . . . The state government certainly sees [land development] as a very strong economic driver for growth and for local governments it can be too (Local Government Planner).*

Similarly, from the perspective of an interviewee representing the state fire and emergency services sector:

> *"There's a lot of vested interested in development, and preventing development at a local government level by designating any areas as bushfire prone [would result in] political backlash for [local governments], because [the developers] are often their local rate payers and voters" (DFES).*

4.2.3. Coherence of Subsystem Goals

While discussions with interviewees indicated that the overarching goal of reducing the risk of "loss of life and property" was aligned at a general level, opinions conflicted at the conceptual, strategic and operational framing of policy objectives. From a state land use planning sector representative, the biggest challenge the cross-sectoral and intergovernmental working group faced was:

> *"to try and figure out what our shared goals would be. And that is ongoing . . . there's goodwill there, but each agency is looking at its own patch."*

The fire and emergency sector's overarching objective is to protect life and property, and the land use planning sector is to facilitate urban development and direct the distribution of different land use activities at various spatial scales. Simultaneously achieving both of these sectorial objectives without significant trade-off has proved difficult for the integrated policy regime examined. For a DFES interviewee, referring to the state's planning sector: *"They've got a different role than us. They facilitate planning opportunities, tourism, and new development and so forth . . . .and we've got a role to protect people, protect lives."* From the perspective of a local government planner, the role of local governments is *"to achieve a justifiable, development outcomes that balance various risks."* This need for planning to balance multiple and competing objectives was contrasted with DFES's singular objective of protecting lives. A DPLH interviewee considered that this singular objective does not align well with "*the varying shades of grey, which is the planning system."*

According to another state land use planning representative:

> *DFES's role is to ensure that people and property are not put at any risk. For planning, though, in decision-making, we need to consider a whole raft of things. We need to consider the demand for housing. We need to consider risks including bushfire. But there's a whole raft of risks, other environmental policies, and protection of vegetation is a key one for planners (DPLH).*

For DFES, however, the issue regarding the accountability for loss of life and property in the case of a bushfire event was emphasized:

> *"[Planners] are not responsible for the response when things go wrong . . . they won't be the ones that get pulled out in front of the coronial inquiry . . . It's DFES and DFES' leadership that will be held accountable. But the actual problem was caused through planning decisions" (DFES).*

This perspective is consistent with Bosomworth [64], who found that the fire and emergency services sector tends to attribute much of the current bushfire problem to planning legacy issues that have permitted development to occur in bushfire prone areas. Furthermore, our study resonates with a more recent study by Bosomworth [69], who identified that unrealistic expectations that decisions made by the fire and emergency management sector must be infallible have resulted in a culture of "blame avoidance", thus limiting experimentation and flexible decision making within the sector.

4.2.4. Cross-Sectoral Understandings

Policy integration requires cross-sectoral understanding, facilitated through knowledge sharing and information exchange, to achieve more coherent policy outcomes [27,29]. There were several perspectives offered by interviewees regarding the production and use of knowledge in policy work. Interviewees noted aspects of the reformed regime that supported the ongoing development of knowledge practices to support integration, highlighting the importance of regular meetings, working groups and networking seminars, particularly those provided by important boundary-spanning organizations such as WALGA. However, an incompatibility of knowledge sets was raised as a key barrier to effective policy integration by interviewees from the different sector subsystems. Identifying a challenge to integration relating to knowledge, one DPLH participant noted:

> *"So, we have planners with no bushfire experience and then we have DFES staff, who are the reverse, they have a lot of technical expertise in the fire space and not so much in the planning space."*

Several interviewees expressed that a lack of cross-disciplinary understanding, i.e., the understanding of other sectors' systems and processes, presented a significant challenge for policy integration in this case study. A DPLH interviewee noted: *"at the time (of policy development) there was very little knowledge in DFES of planning systems and processes, so it was a bit of planning 101 for the [working] group."* There was some suggestion that ensuring more cross-disciplinary knowledge be included within university curricula could help remediate this issue. Talking about this issue, one interviewee asserted: *"there needs to be the integration of bushfire training and expertise in your planning course and in other courses, . . . and if you're training in bushfire science, you need to have some sort of post-grad in planning, so that you come out with experts in the field, both as consultants and as decision-makers."*

Furthermore, several interviewees questioned the competency and knowledge base of other subsystems involved. In particular, with regard to DFES' role as a referral agency and their assessment of a development application's compliance with the bushfire performance criteria or alternative solutions to these, a local government senior planner reported:

> *So when I've questioned [DFES] on the assumptions and been told, 'you'll need this much amount of research to back that up before DFES will support that.' And when I asked them what research supports their current position, they have none . . . so you start to question the integrity of the whole thing.*

This view was echoed by the bushfire consultants, with one who felt that:

> *DFES doesn't appear to have the expertise or resources to assess an alternative solution-so they can't approve it . . . DFES is always going to be risk averse . . . it's in their nature, they're never going to go out on a limb and say, "Oh look, we don't really understand this alternative solution, but yeah, it looks fine . . . go for it."*

Overall, interviewees from all subsystem sectors emphasized the importance of evidence-based practice for policy work that spans across the bushfire management and planning domains. In particular, our study resonates with previous studies that have found that the fire and emergency sector tends to frame bushfire as a technocratic, emergency risk management problem best dealt with using scientific and evidence-based DRR methods [64,70,71]. For example, one DFES interviewee stated:

> *"Let's have a scientific basis for our mapping or a new methodology and that's how we should proceed, not on any other basis."*

However, discussions with interviewees revealed a tension regarding who was best positioned to provide the technical bushfire evidence. From the perspective of a DFES interviewee, the quality of technical advice provided by bushfire consultants in their bushfire management plans for development proposals was substandard, and they believed that the bushfire planning consultant accreditation process should be more heavily regulated through a licensing system administered by a government body. Other interviewees, however, felt that the rational, evidence-based approach taken by the fire and emergency sector in their assessment of bushfire management plans was too "*black and white*", limiting the opportunity for more flexible, alternative solutions for developments in bushfire prone areas, which adequately considers other risks and factors that underpin a resilient community.

In summary, our analysis revealed that interviewees from the different sectorial subsystems tended to draw on different sources of "evidence" to support their already embedded views on the bushfire problem and best solutions. These findings highlight that expert knowledge claims do not simply erase tensions between conflicting values and agendas [70].

4.2.5. Consistency of Instrument Mix to Address Policy Goals

It is reiterated throughout the policy integration literature that achieving a greater level of policy integration is dependent, not only on subsystem collaboration, but relies upon a supportive mix of cross-cutting policy instruments that address the regime's overarching policy goals [20]. The mix of instruments that were implemented as part of the 2015 policy reform package resulted in a centrally-driven and legally-binding framework for planning in bushfire prone areas in WA. While the majority of interviewees agreed a more consistent and mandatory approach was needed, some local government planning and bushfire consultant interviewees contended that the standardized bushfire instruments were indifferent to local variation and the needs of local government to balance a range of land use planning objectives. According to a bushfire consultant:

> *"They've brought it all back to central advice point. But what that also means is the people providing that advice are not familiar with the location."*

Another challenge identified in the case study regime regarded the ownership of instruments, particularly evident within matters that concerned the implementation of policy. As one interviewee (DPLH) noted, the policy guidelines were "co-badged" between the state's key planning and fire and emergency agencies but were *"turn(ed) into a state planning policy to give it the highest effects."* While the policy integration literature emphasizes the importance of a lead or "parent" agency to steer the integration process [33], unanticipated power relations were identified in the new policy settings and mix of instruments by interviewees of this case study. According to a DFES interviewee:

> *the crux of the development of the policy, and the guidelines is that the policy is developed under the Planning Development Act … So, even though the guidelines are co-badged, it can be frustrating because it's not done under our regulation, it's not done by our agency, the state planning policy is not out policy. So, our ability to influence the content is curtailed.*

Another DFES interviewee explained:

> *Our role is to assess the Bushfire Management Plan against the policy and the guidelines and provide advice—not back to the consultant, but to the decision maker—and it's advice only. So, it's not mandatory … We're just one referral agency and planning proposals get referred to other organizations, environment and so forth.*

However, despite the limitations of the fire and emergency services sector legislative decision-making power regarding land use planning decisions, DFES largely defines the parameters of risk in which decisions regarding strategic planning and land development are now made. It was revealed by an interviewee from the peak body for local governments in WA (WALGA) that despite the "advice only" role of DFES, many local government planners are hesitant to go against the advice provided by DFES, even though they have the discretion to do so, for fear of going against any advice related to people's lives. This fact calls for a more coordinated and flexible mix of policy instruments to address such a complex but immensely important risk management sector.

5. Discussion

The first question of this study sought to determine how the policy landscape in the case study area changed towards an integrated DRR policy regime. Interestingly, the findings of our analysis found that while the recent 2015 "Living in Safer Places" policy reforms significantly accelerated the integration of the bushfire management and planning sectors, this integrated policy regime first emerged in 1989 following Australia's most catastrophic bushfire at the time and subsequent inquiry recommendations. As evident in other policy research, the "bushfire protection" regime was strengthened overtime through a series of small and gradual policy developments [72], what has been referred to as incremental adaptation for DRR [71]. Furthermore, the policy changes to strengthen the

integration of this regime continued to be based on recommendations of inquiries emanating from significant bushfire events and were also influenced by the growing trend towards a more preventative approach to DRR.

Our study substantiates previous institutional change research that demonstrates how once a particular institutional configuration of a policy regime is established, it generally becomes highly stable, resistant to change and path-dependent [73,74]. The results of this case study reveal that although the 2015 policy reforms accelerated institutional and policy change, these changes were not entirely novel, but were based on a redesign of existing instruments and assessment methodologies and relied upon already established institutional roles. Hence, the evolution of an integrated bushfire management and land use planning regime towards greater integration in the case of south-west WA represents what Streeck and Thelen [75] refer to as the result of layering, where new rule structures and instruments are gradually superimposed over existing ones. Our findings therefore support the claim by Rayner and Howlett [20] (p. 99) that the integration of a policy regime does not occur on a "clean slate" but is "embedded in pre-existing contexts where the relics of earlier policy initiatives are found in paradigms, institutions, practices and established actor networks." The influence the Perth Hills Fire (2011) had on accelerating institutional change in WA to strengthen the integration of bushfire management and land use planning is consistent with other research indicating that the transformation of a policy regime is often the result of a crisis or destabilizing event [32], referred to as a critical juncture [74].

The second question of this study sought to identify conditions that enable and constrain an integrated DRR policy regime for bushfire planning which is intensively reported through the interview results. It is contended that integrative policy regimes are much more likely to be successful when policy actors and sectors agree on policy goals, share worldview values and have an aligned institutional logic [29,34]. Our findings suggest that the different historically embedded sectorial responsibilities of the various sectors and their diverging worldviews present a significant challenge for the integrated DRR planning regime between land use planning and bushfire management. In particular, a recurrent theme emerging from the interviews was that the underpinning values and culture of the fire and emergency services sector were not conducive to an integrated policy approach [71]. In contrast, the WA land use planning sector seemed to be notably influenced by a sustainable worldview perspective and versed in collaborative approaches [76] that seek to balance the various risks and the multiple objectives of urban development. However, despite this finding, there was concern raised that the WA land use planning sector's greater risk tolerance, at both the state and local government level, is heavily influenced by broader factors of economic growth, political agendas and developer rights. Furthermore, significant tensions were identified regarding the legitimacy of actors positioned as bushfire experts, providing the technical advice to assist the regime in making appropriate "evidence-based" decisions. This tension was particularly notable between bushfire consultants and the state's fire and emergency services lead agency (DFES) who repeatedly questioned each other's competencies.

The dearth of knowledge that policy actors possessed outside of their core sectorial disciplines and a lack cross-sectoral understanding of other sectors' organizational specialized objectives were also identified as key constraints to policy integration for the case study examined. In particular, it emerged that although the fire and emergency sector is positioned as a key referral authority for this regime, the sector was perceived to possess an inadequate understanding of how the planning system functioned and what it was trying to achieve. More frequent interactions within academic and professional domains to explore cross-cutting issues between fire management and land use planning are highly recommended by the participants. Such initiatives were noted as a possible mechanism in overcoming constraints in policy integration as well as formulating more context-sensitive solutions.

It was revealed that the instrument mix for bushfire protection through WA's land use planning system prior to the policy reforms of 2015 relied primarily upon framing instruments that were not legally binding. These mechanisms were implied in the special inquiry into the Perth Hills Fire as being a policy failure. This failure was attributed by interviewees to the fact that very few local governments

had declared bushfire prone areas, and where they had, there were substantial inconsistencies in their approach [61]. It was suggested that WA local governments had been reluctant to designate bushfire prone areas due to political and economic reasons contributing to additional costs for new development. These findings correlate with other research that has found that property rights are a strongly protected value within Australian states' planning systems and that this strongly influences the sector's instrument preferences for the management of natural hazards such as bushfire [77].

Another important finding of our study was the presence of important administrative, structural and communicative instruments that enabled policy integration between the two key sectorial subsystems and between the other various policy actors involved in the integrated DRR planning regime. This included framing instruments that articulated overarching policy goals, legal instruments that dictated procedures and obliged specific subsystem roles and responsibilities and communicative instruments such as working groups, information and networking seminars and regular interagency meetings that facilitated dialogue and deliberation. It was indeed noted by interviewees that opportunities for communication on the design and revision of policy instruments and planning decisions for this regime went above and beyond those that characterized other integrated planning regimes due to the potential impact of bushfires on human life.

According to Howlett, Vince and Pablo del [37], instruments that centralize control over local policy issues can assist with supporting vertical integration and consistency, particularly when there are diverging political interests and shared values. However, Meijers and Stead [33] point out that efforts to increase integration through a higher degree of central control can have the consequence of reducing the flexibility that is often required to deal with the local context of complex policy problems. Our findings are in line with studies that identify an unresolved tension within the literature regarding the need to formalize policy integration through legally binding instruments such as regulation and coordinated centralized control, while still maintaining the flexibility, adaptability and local level context [44]. In agreement with Rode [16], we suggest that, particularly for DRR, policy integration requires a hybrid governance model of both networked and hierarchical and centralized and decentralized structures and processes that are supported by both legally-binding instruments that support consistency but are supplemented by communicative, actor-based instruments that allow for some flexibility, local consideration and adaptive decision making.

The final question of this paper sought to identify the different types of mechanisms that facilitate policy integration as applied to a DRR policy regime of bushfire management and land use planning. Figure 2 summarizes the process/mechanisms and normative policy outcomes stemming from the interviews and the case study findings to promote policy integration. The framework demonstrates how key policy integration dimensions are applied and perceived in south-west WA, as well as aspired policy outcomes towards an integrated policy regime for bushfire and land use planning. It was evident in the case study that policy integration relied upon a coordinated system of both horizontal and vertical integration. Furthermore, the reforms to strengthen policy integration between bushfire management and land use planning required increased interactions and a co-produced planning approval system between public and private actors (i.e., bushfire planning consultants on behalf of development proposal applicants) to implement the policy and provide evidence-based expertise to assist decision making.

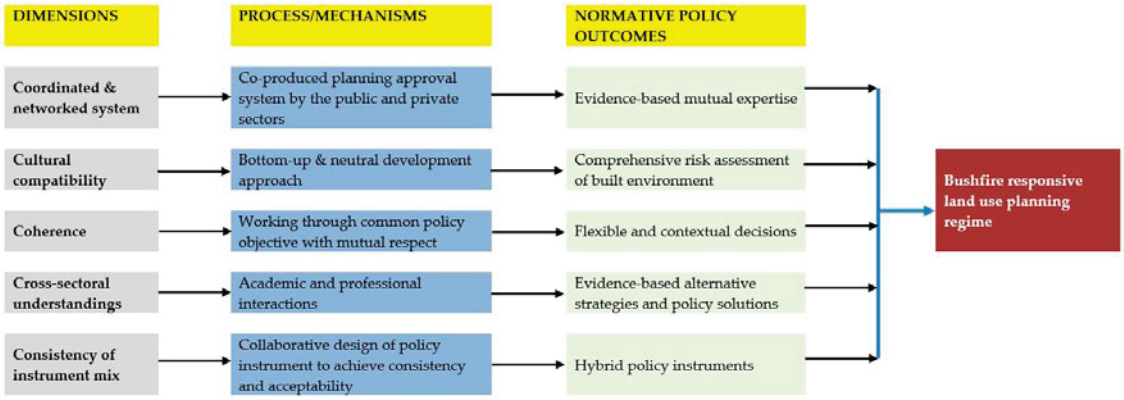

Figure 2. An overview of process and policy outcomes required for integrated bushfire and land use planning policy.

6. Conclusions

Through an empirical examination of a bushfire management and land use planning policy regime, applied to a case study area of south-west WA, this paper has contributed to an emerging body of research concerned with integrated DRR. This paper set out to identify: how the policy landscape in the case study area has changed towards an integrated DRR bushfire management and land use planning regime; the key enabling and constraining conditions of policy integration for this regime; and mechanisms that can facilitate policy integration in a DRR context.

We presented a framework (Figure 2) of five policy integration dimensions, process mechanisms and normative policy outcomes that can be used to promote policy integration. It is contended that policy integration is a process of institutional change and policy reform rather than a set of fixed policy arrangements [28]. The process and outcomes outlined for each dimension are inter-related and mutually inclusive.

In addition to essential resource-based mechanisms for policy integration including an appropriate level of funding, in-kind resources and the availability of qualified staff and training to implement integrative policy actions [27,28], our results confirm that a combination of both actor-based mechanisms and rule-based mechanisms [27,29] underpins the success of DRR policy integration. Actor-based communication and policy learning mechanisms such as working groups, on-going meetings, seminars and networking conferences were identified as critical enabling conditions for policy integration in this case study. Furthermore, it was suggested that additional policy learning opportunities could be facilitated by cross-sectoral secondments, joint-working arrangements, interdepartmental teams [27], cross-disciplinary university courses and other measures that support knowledge diffusion and a deeper cross-sectoral understanding.

Finally, our findings corroborate that of Metz, Angst and Fischer [29], who demonstrated that rule-based mechanisms in the form of a legal framework, which formalize and encourage actor interaction and delegate roles and responsibilities, are particularly important for policy integration for regimes characterized by diverging values and policy goals. Such rule-based mechanisms, including laws and regulation, statutory obligations, memorandums of understanding and cooperation agreements, standards, accredited assessments, information and data sharing protocols and procedural guidelines [27,43,44], have proven to be essential mechanisms for policy integration in this case study. However, we suggest that actor-based mechanisms that facilitate communication, policy learning and reflexivity across and within subsystems are critical to the success of an integrated DRR policy regime. Such policy learning mechanisms will support the diffusion of specific subsystem knowledge across sectors and between scientists, policy makers and other key policy actors, fostering the systems-orientated DRR perspective crucial for addressing the current and changing dynamics of complex disaster issues such as bushfire.

Author Contributions: This study was conceptualized by S.R. who also developed the methodology, collected and curated the data and prepared the original draft. M.S.H.S. contributed to the literature review, data analysis, discussion and conclusion. C.B. contributed to the literature review and data analysis. All authors contributed to developing the framework of five policy integration dimensions and their enabling and constraining conditions and identified process mechanisms and normative policy outcomes. All authors contributed to review and editing. All authors have read and agreed to the published version of the manuscript.

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Appendix E: Article 5 and Supporting Documents

Ruane, S., Babb, C., & Swapan, M. S. H. (submitted for publication). Maladaptive consequences of bushfire risk policy strategies for the wildland–urban interface: A case study from south-west Australia.

Statement of Contribution

Journal Article 5

I, Simone Ruane, contributed 90% to the article:

Maladaptive consequences of bushfire risk policy strategies for the wildland-urban interface: a case study from south-west Australia

Specifically, I contributed the following:

Coordination, conceptualisation and design, data collection and analysis, writing of the original draft, revising, and editing.

Signature of Candidate: [redacted] Date: 16/12/2021

I, as a co-author, endorse that the level of contribution by the candidate indicated above is appropriate.

Mohammad Shahidul Hasan Swapan [redacted] Date: 15/12/2021

Courtney Babb [redacted] Date: 15/12/2021

TITLE: Maladaptive Consequences of Bushfire Policy for the Wildland-Urban Interface

By Simone Ruane, Courtney Babb, Mohammad Shahidul Hasan Swapan

Author names and affiliations.

Author 1. Simone (given name) Ruane (family name) [a] Curtin University Sustainability Policy Unit (CUSP), [b] School of Design and the Built Environment, Curtin University, Kent Street, Bentley, WA 6102, Australia. simone.ruane@postgrad.curtin.edu.au

Simone Ruane is a PhD candidate at the Curtin University Sustainability Policy Unit (CUSP), School of Design and the Built Environment, Curtin University. She has worked in the field of sustainability for more than twenty years, with a research interest in climate change adaptation and natural hazards. Her PhD investigates the changing policy landscape for bushfire management towards more integrated and adaptive governance approaches.

Author 2: Courtney (given name) Babb (family name) [b] School of Design and the Built Environment, Curtin University, Kent Street, Bentley, WA 6102, Australia. Email: c.babb@curtin.edu.au

Bio Dr Courtney Babb is a senior lecturer in Urban and Regional Planning at the School of Design and the Built Environment, Curtin University. His teaching and research focus on the relationships between land use and transportation systems; the governance of placemaking and urban regeneration; and institutional dynamics in the planning for urban and regional futures.

Author 3: Mohammad Shahidul Hasan (given names) Swapan (family name) [b] School of Design and the Built Environment, Curtin University, Kent Street, Bentley, WA 6102, Australia. Email: m.swapan@curtin.edu.au

Bio Dr Mohammad Shahidul Hasan Swapan is a senior lecturer in Urban and Regional Planning at Curtin University. He received academic degrees from Australia, New Zealand and Bangladesh. Swapan's research interests include urban environmental management (public open space), community engagement in planning & international comparative urbanism.

Corresponding author. Simone Ruane: Curtin University Sustainability Policy Unit (CUSP), School of Design and the Built Environment, Curtin University, Kent Street, Bentley, WA 6102, Australia simone.ruane@postgrad.curtin.edu.au

Maladaptive consequences of bushfire policy for the wildland-urban interface

Abstract

In Australia, bushfire risk in the wildland-urban interface (WUI) is increasing due to the effects of climate change and urbanisation. Like other complex societal issues, policy strategies for addressing bushfire risk are multi-faceted, involve diverse stakeholders, and are highly contested. Based on a case study of south-west Western Australia (south-west WA), we identify three key policy strategies for adapting to increased bushfire risk in WUI areas: broad-scaled prescribed burning in public lands, local integrated bushfire risk management and land-use planning in bushfire prone areas. We examine each of these policy strategies to, firstly, contrast their underpinning institutional arrangements and framing of goals and actions, and, secondly, to identify and explore potential maladaptive consequences. In this analysis, we found that all current policy strategies for adapting to increased bushfire risk in WUI areas have sustainability trade-offs and, thus, potential maladaptive outcomes that need to be considered. In particular, the research identified that the current policy regime for bushfire risk reduction in WUI areas has longer-term consequences for biodiversity conservation, nature-based interactions, health and wellbeing and local economic development. While the paper does not discount the role that each of the policy strategies plays, we argue that more sophisticated models of risk assessment, that consider maladaptation, are needed to successfully adapt to increased bushfire risk.

Keywords: bushfire, risk, policy, climate change, maladaptation, trade offs

1. Introduction

The southern region of Australia is experiencing more severe bushfires with disastrous impacts (Climate Council, 2019). Recent events in the region have demonstrated the dire consequences of bushfires in wildland-urban interface

(WUI) areas, where human settlements are situated in, or close to, bushland. During the Australian Black Summer of 2019-20, multiple bushfires burned almost 19 million hectares across southern Australia, resulting in 33 deaths, the loss of more than 3000 homes, and an estimated $20 billion impact on the economy (Filkov et al., 2020). While bushfire is intrinsic to the Australian landscape, these events have confirmed climate change predictions of aggravated fire danger weather, more extreme fires, longer bushfire seasons and the propensity for bushfires to affect locations not historically impacted (BOM & CSIRO, 2020).

Australia's policy regime for bushfire management is influenced by an international disaster risk reduction (DRR) agenda that stresses on precautionary principles to address uncertainty and enhance resilience (Commonwealth of Australia, 2018). Furthermore, a wider call for integrating disaster risk reduction, climate change adaptation and sustainable development policy is underway (Djalante et al., 2013; Munene et al., 2018). However, in response to bushfire disasters, governments continue to react with broad brush policy approaches that fail to consider longer-term considerations of maladaptation (O'Neill & Handmer, 2012). A study of the potential consequences of bushfire policy strategies is therefore critical to inform the successful adaptation to increased bushfire risk.

There has been increasing interest in maladaptation in public policy research concerned with climate resilience. Maladaptation has most notably been investigated in the area of coastal management (Barnett & O'Neill, 2013; Foerster et al., 2015; Macintosh, 2013), but also water supply (Barnett & O'Neill, 2010), electricity supply (Quezada et al., 2014), drought (Magnan et al., 2016; Novalia & Malekpour, 2020), tourism (Hopkins, 2014), agriculture (Neset et al., 2020; Upadhaya & Arbuckle, 2021) and deforestation (Ehara et al., 2018). However, the maladaptive consequences of bushfire policy are yet to be examined comprehensively. While maladaptation research is embryonic, Jones et al., (2015) assert that the concept provides a useful framework for assessing the sustainability trade-offs and negative consequences of climate risk policy strategies and planned adaptation (Neset et al, 2019). According to Glover and Granberg (2021), a deeper

understanding of maladaptation is essential for informing and enhancing the successful adaptation to climate change.

To contribute to this research gap, this paper presents a study of the south-west of Western Australia (south-west WA) - a highly bushfire prone and biodiverse region with a rapidly expanding WUI. Drawing on critical review of key bushfire policy documents and interviews with practitioners involved in the development and implementation of various policy strategies to reduce bushfire risk in WUI areas, this paper addresses the following research questions: What are the key policy strategies for adapting to increased bushfire risk at the WUI, what are the institutional settings and policy frames of each of these strategies, and are there potential maladaptive consequences of these policy strategies that need to be considered? It is contended that responding to these critical research questions will enhance the application of maladaptation as both a conceptual and a substantive assessment framework for the planned adaptation to increased bushfire risk. The paper is organised in five sections. The current section provides the background of this study. Section two outlines the theoretical framework and defines planned adaptation and maladaptation. The third section illustrates the steps carried out in conducting the desktop and empirical studies. Analysis and discussion of policy findings and interviews are offered in the sections four and five. The last section summarises key contribution of this paper and discusses the policy implications.

2. Theoretical framework

2.1 Planned adaptation for climate resilience

Climate change adaptation (CCA) refers to 'the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities." IPCC (2014, p. 76). CCA includes actions that reduce climate vulnerability, enhance social-ecological resilience, and foster adaptive capacities to deal with the impacts of climate change (Bosomworth, 2015). Adaptation can be the result of autonomous actions of non-government actors in

direct response to a climate-related hazard or through planned actions that are based on predictive assessments of risk and vulnerability (Mersha & van Laerhoven, 2018). Planned adaptation relies predominantly upon government actors and the instruments that constitute public policy (Rahman & Hickey, 2019). Moreover, planned adaptation generally involves the assessment of different adaptation options against specific policy and development objectives (Noble et al., 2014; Smit & Pilifosova, 2003), and the design of a pathway of implementation actions that are flexible and adaptable (Werners et al., 2021)

There is a suite of policy strategies that can facilitate the planned adaptation of human settlements to the impacts of climate change. A recognised classification system of planned adaptation options, developed by the IPCC, provides a useful tool to examine public policy strategies for climate-exacerbated hazards. This framework consists of four categories: avoid, accommodate, protect, and retreat. Avoid options include policy strategies that prevent urban development in hazardous areas. Accommodate options continue to support urban development in hazardous areas but integrate measures that build the resilience of the settlement with non-defensive measures. Protect adaptation strategies involve defensive measures such as land treatment and technical solutions that aim to keep the hazard away from settlements. Finally, managed retreat adaptation strategies involve measures where settlements are purposely relocated. (Doberstein et al., 2019; Foerster et al., 2015).

Integrating the policy agendas of disaster risk reduction, climate change adaptation and sustainable development is considered essential to successfully adapt to climate-exacerbated hazards (Djalante et al., 2013). However, simultaneously addressing sustainable development, CCA and DRR specific policy objectives is a challenging endeavour (Birkmann & von Teichman, 2010). Integrated DRR is presented throughout the literature as a normative goal (Djalante et al., 2013), and in international disaster policy as a 'win-win' solution (Nilsson & Weitz, 2019). However, in practice, the integration of DRR, CCA and sustainable development policy requires trade-offs, where certain values, interests and objectives are prioritised over another (Foerster et al., 2015). For Nilsson and

Weitz (2019) it is how these sustainability trade-offs are reconciled that underpins successful policymaking.

2.2 Maladaptation in climate change policy

It is agreed that planned adaptation to climate change is crucial to build disaster resilience (Birkmann & von Teichman, 2010; Djalante et al., 2013; Heazle et al., 2013; Howes et al., 2012). However, several scholars assert that not every adaptation action is inevitably beneficial (Eriksen et al., 2011; Smit & Pilifosova, 2003). Eriksen et al. (2011) stress that while a planned adaptation measure may effectively reduce disaster risk, it may compromise other important sustainable objectives, namely social equity, and environmental integrity. Thus, planned adaptation policy actions to enhance disaster resilience can result in broader trade-offs of system resilience (Magnan et al., 2016). For example, policy action aimed at reducing a climate-hazard risk in one geographic location or sector, may increase the risks and vulnerability of another location or sector (Juhola et al, 2016). Likewise, a risk-based intervention aimed at reducing risk in the short term, may have adverse consequences for the longer-term sustainability of future generations that need consideration (Adger et al., 2018). Given this conundrum, Eriksen et al. (2011, p. 10) contend that for a planned adaptation action to be successful, it must consider "the wider effects of adaptive responses on other groups, places and socio-ecological systems, both in the present and in the future."

The concept of maladaptation has been applied to examine the adverse outcomes that can result from a planned adaptation action (Glover & Granberg, 2021; Magnan et al., 2016) Barnett and O'Neill (2010), consider policy interventions aimed at enhancing the adaptation to climate change hazards to be maladaptive if they: 1. increase greenhouse gas emissions; 2. burden the most vulnerable; 3. have high opportunity costs; 4. the reduce incentives to adapt; or 5. creates a path dependency that is difficult to change. Juhola et al. (2016) further suggest that outcomes can be considered maladaptive when an adaptation action increases the vulnerability of targeted actors to climate change impacts, increases the

vulnerability of external actors, and or erodes sustainability by negatively impacting environmental, social, and economic values.

There is some contention in the literature regarding how the concept of maladaptation should be applied (Juhola et al., 2016; Magnan et al., 2016). Juhola et al. (2016) indicate that the application of maladaptation should be limited to planned adaptation policies and actions. However, we argue herein that the concept of maladaptation is useful for the consideration and comparison of trade-offs between the various policy strategies for climate-exacerbated hazards more broadly, regardless of whether climate change adaptation is a stated as a primary purpose of the policy strategy. This is particularly important in Australia given the framing of bushfire as a climate change adaptation issue is incipient (Bosomworth, 2015; Forino et al., 2017).

3. Research approach

3.1 Context

This study investigates the various bushfire policy strategies for WUI areas using an adaptation/maladaptation conceptual framework. The research was approached as a qualitative case study of the bushfire policy system for south-west WA. Case studies are particularly effective for policy research given the spatial focus of the subjects, their propensity to provide a deeper understanding of the socio-cultural context that influence the case, and the flexibility of research design (Muir 2008). The selection of south-west WA as the case study subject was based on the criteria that it is a highly bushfire prone and biodiverse region, and climate change is significantly increasing bushfire risk in the region.

South-west WA, as defined herein, encompasses a vast geographical area, broadly correlating with the South West Land Division (see Figure 1), which includes Western Australia's capital city Perth and supports around ninety per cent of the state's population (Burrows & McCaw, 2013). The region, which is internationally recognised as a biodiverse hotspot experiences some of the most intense fires in

the world (Steffen, Hughes, & Pearce, 2015), as demonstrated by the Waroona 2016 fires that burned across almost 70,000 hectares, destroying 181 properties, and killing two people (The Government of Western Australia, 2016).

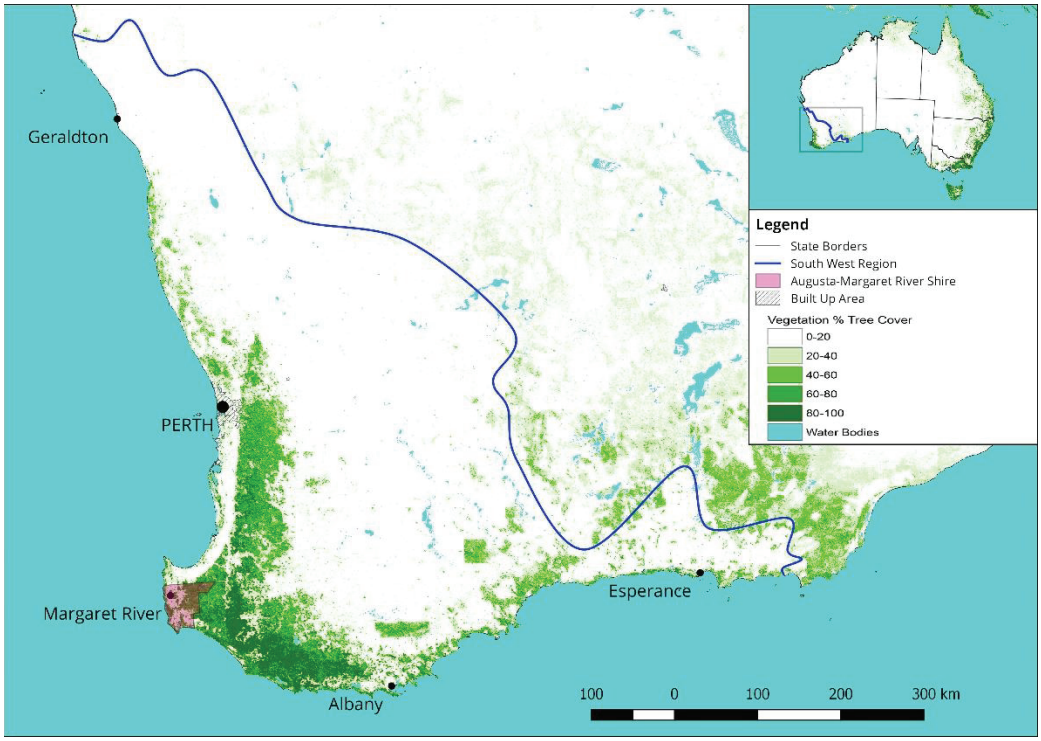

Figure 1: South-west Western Australia: Sourced from Ruane (2019)

While many large bushfires over the past few years in south-west WA have occurred in regional areas, there have been an increasing number of bushfires occurring in or near the WUI (Steffen et al., 2015). The recent Wooroloo bushfire (2021) burned over 10,000 hectares only 45 km from the CBD, resulting in 86 properties being destroyed in the outer fringe of Perth (City of Swan, 2021). Driven by home affordability and an increase in the popularity of semi-rural and nature-based living, there has been significant population growth in the bushfire-prone WUI areas of south-west WA (Anton & Lawrence, 2015). Furthermore, the region is earmarked for significant urban growth to accommodate a predicted increase in the population of 3.5 million by 2050 in the greater Perth area alone (Government of Western Australia, 2018). Enright and Fontaine (2014, p. 34) assert that the SW region's "rapidly expanding wildland-urban interface, is faced with the formidable challenge of increased fire likelihoods due to increased fire danger weather under

a warming climate, and more human-caused ignitions as population growth proceeds."

3.2 Methods

This research was conducted as a two-stage process. Stage 1 involved a document analysis to identify the key policy strategies for bushfire risk reduction at the WUI of south-west WA. Policy documents from the key state government departments involved in bushfire risk reduction; bushfire-prone local governments; WA legislation archives; bushfire special inquiry reports and other documentation related to bushfire risk management were compiled into a database. Based on a review of these policy documents, three dominant policy strategies for Western Australian bushfire risk reduction in WUI areas were identified 1. Broad-scale prescribed burning in public lands 2. Local bushfire risk management planning; and 3. Land-use planning in bushfire prone areas. For each strategy, we identified their institutional origins, overarching objectives, the key policy actors responsible for the development and implementation of actions, and the policy instruments that underpin each of the strategies.

In Stage 2, thirty interviews (presented in Table 1) were conducted with emergency management personnel, land-use planning practitioners, fire managers and environmental managers during the period from 2016-2020. These representatives were involved in the development and or implementation of at least one of the various bushfire risk management strategies identified in Stage 1. The interview selection involved both purposive and snowballing methods to ensure representation of each of the responsible sectors for the bushfire risk management policy strategies identified in Stage 1 of the research. The total number of interviews conducted was determined through a point of data saturation, i.e., when no new themes were emerging from the interviews (Fusch & Ness, 2015).

Table 1: Stakeholder/subsector group and number of interviewees represented

Stakeholder/sub-sector group	**Number of Representatives Interviewed**
Western Australia's State Department of Fire and Emergency Services (DFES)	4
Western Australia's State Department of Biodiversity, Conservation and Attractions (DBCA)	4
Western Australia's State Department of Planning, Lands and Heritage (DPLH)	2
Local government emergency managers	2
Local government planners	6
Local government environmental managers	2
Local government executive staff	2
Private bushfire consultants	3
Local bushfire brigade members	3
Environmental NGOs	1
Western Australia Local Government Association (peak body)	1

The interview schedule consisted of questions exploring actor perspectives on the overarching policy goals, implementation challenges and improvement opportunities for each of these policy strategies. More specifically, the interview schedule was designed to elicit possible trade-offs of each bushfire risk policy strategy that warrant further consideration in the context of maladaptation. The interviews were audio-recorded and transcribed verbatim. The transcriptions were coded deductively to, firstly, identify key goals, challenges, and opportunities for each policy strategy and, secondly, to identify trade-offs with other sustainability values. Codes were then regrouped into thematic categories relating to the maladaptation literature which included: the potential for the bushfire risk management policy action to increase or shift vulnerability; transfer the risk across time or space; increase greenhouse gas emissions; result in opportunity costs; reduce incentives to adapt; create path dependencies; and erode sustainability.

4. Results

The document analysis identified three main policy strategies for reducing bushfire risk in WUI areas: broad-scale prescribed burning on public lands; local bushfire risk planning; and land-use planning in bushfire prone areas. Table 2 illustrates how each of these policy strategies aligns with the adaptation options framework of IPCC. The following sections extend the policy analysis and draw on interview findings to describe the institutional settings, outline the framing of policy goals and actions, and identify impacts, risks and trade-offs associated with each of the three key bushfire strategies.

Table 2: Alignment of bushfire policy strategies with the adaptation options framework

Policy Strategy	**Policy Goal**	**Avoid**	**Protect**	**Accommodate**	**Retreat**
Policy Strategy 1: Broad-scale landscape	To protect communities and natural assets from bushfire by conducting		Landscape fuel reduction/fire management treatment to		

prescribed burning	200,000 hectares prescribed burning in public lands per year.		reduce fire size and intensity before it approaches WUI areas.		
Policy Strategy 2: Integrated local bushfire risk management	An integrated, multi-sector and cross tenure approach to reduce bushfire risk across local government areas.		Removal of fuel around structures and assets within WUI areas. Strategically planned burns on the edge or within WUI areas. Identify assets and identify priority treatments. Fire breaks and defendable space on private properties to support firefighting. Community engagement		
Policy Strategy 3: Land-use planning for bushfire risk reduction	To implement effective, risk-based land use planning and development to preserve life and reduce bushfire impact on property and infrastructure.	Strategic planning and zoning that directs development away from bushfire risk areas. Development proposals not	Removal of fuel around structures and assets through the protection zone buffers. Engineered solutions at subdivision stage such as roads, human-	Building and construction standards for fire resistance. Urban design measures incorporate evacuation, water supply, emergency	Government compensation/land acquisition. Calculative insurance discourages rebuilding in bushfire prone areas.

		supported in high-risk areas. Calculative insurance on bushfire risk discourages building	made water bodies to provide separation between built structures and the fire risk. Traffic management and street layout that supports emergency response and evacuation.	egress and ingress. Reduced density to ensure adequate separation between dwellings. Provision of safe refuge.	

4.1 Broad-scale prescribed burning on public land

4.1.1 Institutional setting

South-west WA has a long history of state-managed prescribed burning, where fire is purposely applied to the landscape to reduce fuel and, thus, mitigate against bushfire (Burrows & McCaw, 2013). Prescribed burning was first established by the state's forest department during the late 1930s to protect timber assets (Ruane, 2018). By the 1950s, broad-scale prescribed burning had become an essential component of forest fire management and was widely applied across south-west WA state forests (Burrows & McCaw, 2013). Although a highly controversial practice, with regards to its impact on conservation value (Bradshaw et al., 2018) and air quality (Lyth, Spinaze, Watson, & Johnston, 2018), prescribed burning has remained a key policy strategy for reducing bushfire risk to WUI areas in the region (Bradshaw et al., 2018; Howard, Burrows, Smith, Daniel, & McCaw, 2020). Moreover, south-west WA's prescribed burning programs have been promoted as an exemplar that could inform bushfire policy and practice for other Australian states and abroad (Burrows & McCaw, 2013; Pyne, 2003).

Currently, the Department of Biodiversity, Conservation and Attractions (DBCA) is responsible for the bushfire management of approximately 2.5 million hectares of state forests, timber and conservation reserves and national parks (Conservation Commission of Western Australia, 2013). While prescribed burning has retained its original focus of reducing bushfire risk to protect human assets and settlements, it is also considered by some scholars as an important tool for biodiversity conservation (Burrows & McCaw, 2013). More recently, the State's prescribed burning program adheres to the Australian and New Zealand risk management standards (AS ISO 31000: 2018) (Howard et al., 2020). Currently, the state has an annual burns target of 200,000 hectares of prescribed burning per year to ensure that 60% of DBCA managed lands have fuels less than 6 years old at any given year (V. Florec, 2016). Following the recent Worooloo bushfire of 2021, the State government committed a further 22 million dollars in addition to the current 11-million-dollar budget allocation for the next four years to ensure that these targets are met (Department of Biodiversity, 2019).

4.1.2 Framing of policy goals and actions

DBCA interviewees framed the "bushfire problem" through the lens of fire being a natural part of the Australian landscape. The main policy goal of broad-scale prescribed burning was *"reducing the likelihood of large fires occurring and having an impact on things of value"* (DBCA). A distinction was drawn between 'good' fire, which is planned, controlled, and strategically applied, and 'bad' fire, which is unplanned fire and has the potential to become uncontrolled and dangerous to human settlements, a finding that is reflected in other studies (Buizer & Kurz, 2016). For DBCA interviewees, broad-scale prescribed burning was validated by fire behaviour research, confirming that prescribed burning significantly reduces bushfire risk to WUI areas by lessoning a fire's intensity before it approaches the built environment (AFAC, 2015). The use of prescribed burning at a broad scale was justified by a DBCA interviewee as *"managing fuel loading…not necessarily next to houses, but away from houses where the fire starts and can then come into town. We want to prevent that being able to happen."* (DBCA). Thus, from a climate

change adaptation perspective, broad-scale prescribed burning reflects a 'protect' adaptation option.

4.1.3 Maladaptive considerations

The interviews revealed that broad-scale prescribed burning had a range broader of trade-offs or possible consequences including the risk of a fire becoming uncontrollable, poor air quality, and the negative effects of smoke on the viticulture and tourism industries. There was also concern expressed by some interviewees, outside of DBCA, that the practice has likely negative consequences such as species extinction, soil degradation and loss of habitat. These concerns were in accord with Bradshaw et al. (2018) who assert that current prescribed burning programs focus on the goal of hazard reduction for asset protection, despite there being the availability of science that points to undesirable ecological consequences.

Changing risk profiles in the WUI areas of south-west WA associated with the effects of climate change was a recurring issue in the discussion of prescribed burning practices, suggesting that risks inherent in prescribed burning are in a state of flux. According to DBCA interviewees:

> *"Since the 2000s we have seen an increase in large scale, high-intensity fires that have been quite damaging… … there is a drying of the environment with reduced rainfall and shorter wet seasons in the south-west…(DBCA)."*

> *"These changing climatic conditions are not only increasing bushfire risk but also "decreasing the window of opportunity for undertaking prescribed burning activities (DBCA)".*

According to interviewees involved in its implementation, patterns of land development in WUI areas present a major challenge for prescribed burning practice. The increased fragmentation of the property landscapes in the WUI is also reducing the possibilities for fuel reduction in nearby public lands. According to one DBCA interviewee:

> *"increasing development of semi-rural blocks and spreading the urban interface where people want to actually live in amongst the trees and close to the bush creates a range of problems for managing forest fire and keeping people safe."*

Some DBCA interviewees considered that there was a gap between the public perception and evidence of risks, noting that growing opposition to prescribed burning was being fuelled by the media's representation of the practice. One (DBCA) representative noted:

> *"when something goes wrong with prescribed fire it always creates a lot of attention through the media…you can easily point to someone and say you made a mistake that actually caused this fire to happen…you don't tend to hear nearly the same amount of commentary when you have a large bushfire that was ignited through natural causes…"*

The impact of prescribed burning on biodiversity was noted by several interviewees as an issue of public concern. DBCA interviewees considered their agency was perceived negatively by environmental groups, who framed prescribed burning as *"environmental vandalism"*. However, while *"there is pressure from community and environmental groups about the impacts of prescribed burning being greater than the risk"* (DBCA), DBCA representatives considered uncontrolled high-intensity bushfires to be a much greater risk to ecological values than the current scale of prescribed burning. One DBCA interviewee noted:

> *"I think probably the most threatening agent for conservation is high-intensity bushfire…and regular applications of high-intensity bushfire. That's something that the ecology is not well adapted to"*

While DBCA interviewees argued that prescribed burning is "evidence-based", environmental managers presented a different view of the impacts of prescribed burning on conservation values and challenged its overall efficacy to save lives and property. These views were rationalised by research that indicates that weather conditions play a more influential role in determining bushfire risk than fuel load (Enright & Fontaine, 2014), and that fuel reduction would be more effective at mitigating the loss of lives and property, with less ecological impacts, when it is targeted in or on the edge of human settlements (Bradshaw et al., 2018; Moritz et al., 2014). Accordingly, one interviewee stated:

> *"[T]here are researchers who have concluded that the prescribed burning is not proven to achieve what it does... it's not going to prevent the big extensive bush fires, it's not going to protect assets. There are even those who've concluded our vegetation isn't largely evolved to be promoted by fire, it's more been able to withstand fire and it's not necessary to have burning." (Environmental NGO)*

Moreover, reflecting the sentiment of Western Australian environmental NGOs more broadly, there was concern from an interviewee that:

> *"DBCA are burning a lot of areas for which there is not the necessity, where the risk is not high but they have got to get their [annual burn] numbers up... We know it's not the best for risk management or conservation but, in the end, we don't think the taxpayer is prepared to pay for anymore finer management."*

The economic trade-offs of burning closer to settlements were also expressed by a DBCA interviewee who confirmed:

> *"you can use exactly the same resources to do a 10,000 hectare burn out in the middle of the forest as it takes to do a 200 hectare burn hard up against the town. Whilst a small burn is very expensive, very labour intensive, it provides only provides protection to that small community, in the scale of things it's not addressing the risk at the landscape scale."*

4.2 Local bushfire risk management planning

4.2.1 Institutional setting

Local governments and communities play a critical role in bushfire risk management for WUI areas in south-west WA. In addition to the traditional role of maintaining local fire brigades and appointing bushfire control officers, local governments have increasing responsibilities for bushfire risk. Local governments are obliged to carry out fuel reduction on their local reserves, ensure private landowners comply with the fire break requirements and are authorised to prohibit burning in their jurisdiction (Western Australia Bush Fire Act, 1954). Moreover, local governments are required to maintain Local Emergency Management Arrangements (LEMAs), coordinate recovery, and undertake local-level risk assessments for the hazards likely to affect their communities (Western Australia Emergency Management Act, 2005).

A more recent bushfire policy strategy has been the requirement for bushfire-prone local governments to undertake bushfire risk management planning (BRMP) for their local jurisdiction, adhering with the Australian and New Zealand Risk Management Standards (AS ISO 31000). The BRMP is a tenure blind strategic process that identifies local assets at risk of bushfire, determines who owns the risk, identifies priority areas for treatment and develops a multi-agency treatment plan (SEMC, 2020). DFES is responsible for assisting the local government to undertake this process and for assuring ongoing compliance with the risk management standard. There is a range of strategies that can be implemented at the local government level to treat the risks identified in bushfire risk management planning process including fuel management, ignition management, planning, preparedness, and community engagement. However, the emphasis of bushfire risk management planning according to a DFES representative was primarily identifying the *"mechanisms to manage that fuel and therefore bushfire risk"*.

4.2.2 Framing of policy goals and actions

Given the diversity of policy actors involved, the fundamental goal of bushfire risk management planning at the local level was given different emphases by the different sector representatives interviewed. From an emergency manager's perspective, bushfire risk management planning was considered a rational process for determining resource allocations by:

> *"identifying the assets at the highest risk using the risk management process and then directing the resources [for risk treatment] appropriately, so we are reducing the risk and getting the best bang for our buck" (Local government, emergency manager).*

From the perspective of other local government representatives, bushfire risk management planning was simply equated with *"bushfire mitigation"* and reflected a shift towards a more precautionary approach. Many of the local government representatives interviewed agreed that the goal of bushfire risk management planning could be understood as a hierarchy of priorities: *"firstly the protection of life, secondly the protection of property, and the environment is important but not as important as protection of life and property."* (Local government, CEO). The goal

of bushfire risk management planning from the perspective of environmental managers, representing both local government and the NGO sector was, however, framed by a more balanced view as *"protecting life and property… without adversely impacting the environment'* (Local Government, Environmental Manager).

4.2.3 Maladaptive considerations

Several potential maladaptive consequences of local bushfire risk management planning emerged in the interviews. One interviewee explained (Local Government, Senior Planner) that people in their local government considered the related fire management practices as a threat to environmental and community values: *"…putting in fire breaks on reserves removing vegetation for a certain distance close to the road… it's very visible to them".* A small, targeted fuel reduction burn within a WUI townsite was highlighted as an example as it had *"ended up with a really bad result. Significant environmental harm and social outrage".*

The concern about biodiversity and bushfire risk treatments within or at the edge of WUI areas extended beyond the concern of broad-scale prescribed burning, but also related to the increased focus of fuel reduction in WUI areas on both local government reserves and private property. An environmental manager (NGO) noted that:

> *"people with their own urban blocks are clearing them to the point where they have just removed all their vegetation. You can't blame people when every newspaper every week in the summer is saying we have got people who aren't fire ready and are you fire ready? have you got a risk?…[however] some of these properties create corridors of connectivity for wildlife"*

Recent reforms that allow private property owners to clear native vegetation within twenty-five metres from their residence without a permit were considered by some interviewees as deleterious in the face of climate change:

> *"the treescape is continuing to decline across our landscape…in all of the urban parks and gardens and housing developments…Trees are really important, and the larger blocks of garden do allow some trees to survive and provide some dense understory… [the challenge is] how we*

> *as a community deal with bushfire and deal with the desire to be living in a rich conservation area and at the same time feel safe and be safe."*

Echoing these sentiments, a representative from the Western Government Local Government Association (WALGA) expressed:

> *"It needs to be explained to communities as to why it's important to keep this bush, why it's important that biodiversity wins over the bushfire risk in this particular situation or how, even though it's a bushland area, the risk can be managed anyway."*

An aligned issue that emerged from the interviews was the potential for local bushfire risk treatments to reduce amenity and increase anti-social behaviour. One interviewee held the view these values conflicted with one another under the current bushfire policy regimes.

> *"As a planner, I feel conflicted in having to require people to undertake clearing in the name of safety. Particularly when there is growing evidence which advocates for the retention of trees for their shading/cooling benefit in slowing fires and an understanding that over a long term, large trees shade understory which then naturally thins to create a more fire safe ecosystem."*

The efficacy and overall benefit of other local bushfire management practices were also questioned. Requirements such as firebreaks were considered beneficial, however, there was a risk that the widening firebreaks to assist with access could lead to further vegetation loss and attract anti-social behaviour.

> *" the state says this should be a right of way for emergency access...But, it's a dirt track that often become rat runs, or people with motorbikes keep going up and down, so it becomes a nuisance issue or a maintenance issue for the local government to inherit. "*

4.3 Land-use planning in bushfire-prone areas

4.3.1 Institutional setting

Land-use planning has become a crucial bushfire policy strategy for WUI areas due to its ability to steer the location and form of urban settlements (Gonzalez-Mathiesen & March, 2018). While bushfire considerations have been encouraged in the Western Australian land-use planning system since the late 1980s, during

the 1990s and 2000s there was expansive development throughout the south-west WA, without adequate incorporation of bushfire protection measures (Ruane et al., 2020). In 2011, a special inquiry into a major fire that occurred in Perth's WUI, found that land-use planning for bushfire protection was inconsistent and non-binding (Gonzalez-Mathiesen et al., 2020), and recommended significant reforms to the state's planning framework (Government of Western Australia, 2011). This led to the development of high-level *State Planning Policy (3.7) Planning in Bushfire Prone Areas* which now applies to all strategic planning proposals, subdivisions and development applications designated by the state as bushfire prone (Western Australian Planning Commission, 2015).

These policy changes have further embedded a precautionary approach to land-use planning in WUI areas in south-west WA. Planning proposals for development located in high-risk bushfire prone areas are no longer supported unless they are unavoidable or comply with stringent bushfire protection criteria. While land-use decision-making remains with the state's planning authority and local governments on their behalf, decisions pertaining to development in bushfire prone areas now require the input of bushfire behaviour expertise and the support of the state's Department of Fire and Emergency Services (DFES).

4.3.2 Framing of policy goals and actions

The overarching goal of the land-use planning bushfire policy strategy is "to implement effective, risk-based land-use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure." (Western Australian Planning Commission, 2015, p. 1). Implementation of the policy relies on diverse policy actors, including the state planning authority (WAPC), local governments in their role as planning decision-making, the state's emergency management department (DFES) as a referral agency, and private bushfire consultants who provide technical expertise. From the perspective of the land-use planning sector, the goal of this bushfire policy strategy is nuanced, and interviewees from this sector emphasised that the goal for land-use planning policy

was trying to balance the management of bushfire risk amongst a range of other important policy considerations. One state planning representative explained:

> *"our policy objective is to achieve an appropriate balance between bushfire risk management measures, biodiversity conservation values, environmental protection, biodiversity management, landscape amenity, with consideration of the potential impacts of climate change."*

From a local government perspective, the careful balance of trade-offs was emphasised as an important objective of this bushfire policy strategy. As one interviewee explained land-use planning in bushfire prone should be about:

> *"making places where people are likely to live and work as safe as possible but there's a line to be drawn…you could make a particular residential area safe by requiring the removal of all vegetation outside of it for a hundred meters but that's unacceptable from an environment perspective and it's not acceptable from a community perspective either. So, there's a balance there".* (WALGA)

The main goal of land-use planning in bushfire-prone areas from the perspective of the state's emergency management department (DFES), however, was more directly *"the protection of life and property"* (DFES), aligning with the agency's historical focus on bushfire response.

Land-use planning in bushfire prone areas was considered a critical policy strategy for reducing risk in WUI areas by all interviewees. However, when the actual ways that bushfire risk should be institutionalised into land-use planning frameworks were explored, there was less consensus. State fire and emergency managers presented a more risk-averse policy framing, supporting an 'avoidance' adaptation option to increased bushfire risk, favouring the siting of settlements and other assets away from bushfire-prone WUI areas (Foerster et al., 2015). In contrast, planning representatives were more willing to accept a higher level of risk and permit development in bushfire prone areas on the proviso that bushfire protection measures were incorporated (Foerster et al., 2015). Commenting on the goals of the two key state government agencies responsible for planning in bushfire-prone areas, one DPLH interviewee considered they were "*not so complimentary" and "…to find a middle ground is challenging."*

4.3.3 Maladaptive considerations

Several maladaptive outcomes were associated with land use planning as a bushfire policy strategy. As with broad-scale prescribed burning and local bushfire management planning, the potential risks to environmental values and amenity were identified as a consequence of land-use planning in bushfire prone areas. In the siting and design of development in a bushfire-prone area, the inclusion of buffer zones of sufficient size is required to protect built structures and provide a defendable space for firefighting. This generally requires the significant clearing and modification of vegetation and can thus have significant consequences for conservation values (Little, 2017). Moreover, an interviewee from the local government sector believed this bushfire policy strategy incentivises the clearing of natural vegetation by land developers as a way of reducing building costs on adjacent property.

Restrictions on new development in high-risk bushfire prone areas were noted as a barrier to new housing, housing diversity and compromised other planning objectives like achieving dwelling targets. New developments were at risk of being delayed, overly complex or proposals refused due to bushfire risk. Stronger regulations on housing construction and building materials were considered a risk to social inequity, and as having an impact on housing accessibility due to the added costs of new housing in bushfire prone areas. While interviewees (Senior Planner 1) pointed out that housing markets were already inaccessible to low-income earners "*irrespective of costs associated with bushfire."* And that *"…most people choosing to live in these areas are able to shoulder some additional build costs associated with BAL ratings and other policy provisions.* (WALGA representative), there was concern expressed about the implications of this strategy for residents wanting to rebuild their homes after a bushfire: *"As we have seen in the Wooroloo fire and the recent eastern states bushfires the cost of rebuilding often outstrips the level of insurance for many established homes."* (WALGA representative).

Further inequities for low-income households that resulted from the land-use planning in bushfire-prone areas policy were identified by the interviewees. The

bushfire planning policies and regulations were considered administratively complex and was noted by a couple of interviewees as creating *"ambiguity"* that, *"gives rise to inequities"* by privileging those that can afford to navigate the system. These inequities were explained by one interviewee:

> *"...it possible for some with the knowledge to achieve outcomes, and those without access to professional advice to be potentially taken advantage of / or miss opportunities that should be freely available to all." (Local government, Senior Planner)*

Although planning advice is available, due to the complex nature of the bushfire planning policy system, the advice is expensive and available only to those who have resources.

The capacity for land-use planning as a bushfire risk management strategy was hindered, according to some interviewees, who noted it applies only to future development and currently cannot be applied retrospectively. For one interviewee, the current policy strategy of land use-planning for bushfire risk management is:

> *"...almost like trying to shore up a sinking ship ... it will only affect new development...There's so much supply as a lot of areas were identified for development...it's saying, no more, but it's not actually giving any real direction about what we do to fix the current problem." (Local government, Senior Planner).*

It has been suggested that to deal with legacy planning issues, 'retreating' from bushfire risk areas may be necessary (Norman et al., 2021). However, legacy planning has already zoned vast bushfire prone areas of south-west WA 'urban deferred', and as a DFES interviewee expressed:

> *"...you're really locked in. There are lots of areas of urban deferred that we never want to develop for bushfire prone reasons and environmental reasons. (DFES)"*

Whilst adaptation by retreat is likely to reduce the risk of bushfire to WUI communities and be less detrimental to environmental values than accommodation options, land acquisition and compensation schemes are expensive and likely to have significant opportunity costs (Foerster et al., 2015).

5. Discussion

Our empirical research shows that all three of the policy strategies for reducing bushfire risk in the WUI areas of south-west WA have potential maladaptive consequences that need to be carefully considered. Broad-scale prescribed burning has remained a dominant, path-dependent policy strategy for reducing bushfire risk in south-west WA, attracting increased political support following extreme bushfire events (Clode & Elgar, 2014). The view from critics about the broad-scale nature of this bushfire policy strategy is that fuel reduction is more effective and less ecologically damaging when carried out closer to settlements (Bradshaw et al., 2018; Moritz et al., 2014), and at a smaller-scale aligned with Indigenous traditional burning practice (Norman et al., 2021).

Consistent with other studies (Williams et al., 2021), local bushfire risk management planning was framed by interviewees more positively due to the consideration of a broader set of values and the tendency towards collaboration in practice. Interviewees highlighted how risk assessment processes facilitated multi-stakeholder collaboration, ensured landowners were better informed about the risk they own, identified assets of value, and provided an evidence-based road map for risk treatment according to priority.

Yet despite a more positive representation of this bushfire policy strategy, interviewees identified several sustainability trade-offs of local bushfire risk management. These included trade-offs in nature conservation (Brummel et al., 2012; Paschen & Beilin, 2017), cultural values associated with living in peri-urban settlements (Bardsley et al., 2015), and public health through compromised air quality (Lyth et al., 2018). Furthermore, the risk of fuel reduction burns in or close to WUI areas escaping and becoming uncontrolled has increased due to shorter windows for safe application due to climate change (Florec et al., 2020). Thus, while emerging literature argues for more targeted fuel reduction measures closer to WUI (Bradshaw et al., 2018; Norman et al., 2021), in practice it attracts considerable public opposition (Bardsley et al., 2015; E. C. Moskwa et al., 2016), and

is generally not as economically viable as fuel reduction applied at a broader scale (Florec et al., 2020).

Land-use planning as a policy strategy to reduce bushfire risk is considered by many scholars as a crucial adaptation action (Bond & Mercer, 2014; Hurlimann & March, 2012; Norman et al., 2021). While this policy strategy had considerable support from interviewees, the results also showed that land-use planning in bushfire-prone areas can compromise other important sustainability goals and hence result in maladaptation (Macintosh, 2013). Interviewees provided several examples of the unintended consequences of more stringent bushfire planning regulations including trade-offs in local economic development, urban green spaces, wildlife corridors and species habitat, sense of place values, nature-based experiences, and the mitigation of urban heat effects. Substantiating previous findings (de Vet & Eriksen, 2020), increased burdens on low-income households caused by higher building costs and insurance premiums were considered by some interviewees as a potential maladaptive consequence of the land-use planning strategy that is perhaps yet to be fully realised. Furthermore, the limitations of land-use planning to retrospectively address climate-exacerbated risk in existing settlements was emphasised by interviewees (Robb et al., 2018).

There was also a sense of path-dependency associated with land-use planning's capacity to support adaptation (Hurlimann & March, 2012), with provision for housing in high-risk bushfire areas already locked into zoning schemes. Moreover, the findings confirm that the influence of private property rights in local government decision-making hinders the shift from accommodating urban development in bushfire-prone WUI areas, to the implementation of the adaptation options of 'avoid' and 'managed retreat' (Foerster et al., 2015; Macintosh, 2013). Restricting development in areas already deemed as urban would result in unacceptable trade-offs for economic growth and opportunity costs both locally, and for the State (Macintosh, 2013). While a 'managed retreat' option, by restricting the rebuilding of properties in risky WUI locations after a bushfire event (Norman et al., 2021), or by using calculative insurance instruments as a disincentive for rebuilding may be the most appropriate adaptation strategy from

a longer-term climate resilience perspective, there are significant social impacts on vulnerable groups and bushfire victims which need to be more carefully considered (de Vet & Eriksen, 2020).

According to Bardsley et al. (2015), dominant policy measures for mitigating bushfire risk at the WUI are predominantly based on cultural values associated with creating safe and economically viable human settlements, often to the detriment of the local ecology. Correspondingly, the most prominent finding that emerged from the interviews was that all three bushfire policy strategies have potential maladaptive outcomes for biodiversity conservation and environmental amenity. The current hectare targets for prescribed burning were heavily criticised by some of our interviewees for creating incentives for the burning of large areas of forested areas with high ecological value, at a scale and interval that may have irreversible damage on biodiversity and ecosystem services (Bradshaw et al., 2018). There was, however, also concern that local bushfire risk management may result in a highly visible loss of native vegetation from fuel reduction and vegetation modification, and protective measures such as buffers and firebreaks. This is leading to a situation where some local communities consider local bushfire risk management to be a significant threat to other important sustainability goals. Furthermore, despite a stated objective of WA's land-use planning policy for bushfire prone areas being to achieve a balance between bushfire risk reduction measures and biodiversity consideration and environmental amenity, many examples were provided by the interviewees where a significant clearing of vegetation was required to obtain development approval.

Given this research was approached as a single case study, the generalisability of the results is limited. However, the findings do highlight the need for a more sophisticated analysis of broader sustainability trade-offs of the various bushfire policy strategies from a maladaptation perspective. Moreover, the combination of findings supports an earlier proposition expressed by Dovers (2003, p. 43) who argues that bushfire policy must consider "risks to biodiversity, and ecosystem services, and the risk that management interventions may not work or may make

things worse by exacerbating adverse fire events, encouraging unwise land-use in fire prone areas, or instilling a false sense of security".

6. Conclusion

This paper has presented a qualitative study on the consequences of bushfire policy for WUI areas in south-west WA. The results from a document analysis identified three main bushfire policy strategies for reducing risk in WUI areas: broad-scale prescribed burning, local bushfire risk management planning and land-use planning in bushfire prone areas. Using the adaptation options framework as a conceptual basis, the study has shown how each of these bushfire policy strategies correlates with the broader agenda of planned adaptation. The study has extended our knowledge of bushfire public policy by identifying and comparing the goals, frames, and institutional settings of specific bushfire policy strategies. Furthermore, using a maladaptation lens, the findings enhance our understanding of the potential consequences of bushfire policy actions. The findings that emerged from the analysis of interviews with key policy actors have revealed that while all the bushfire policy strategies can be framed within the discourse of climate change adaptation, there are potential maladaptive consequences associated with all the various strategies examined that warrant careful consideration. Taken together, the findings of this study suggest that planned adaptation actions to address increasing bushfire risk have the potential to increase aspects of vulnerability, transfer risk across time and space, incur high opportunity costs, create path dependencies that reduce adaptive capacity, and impact several sustainability policy goals.

Conceptualising bushfire risk reduction through a maladaptation lens highlights that there are no definitive policy solutions in reducing bushfire risk, and that there are trade-offs and negative consequences from most bushfire policy actions that need to be negotiated. We conclude by suggesting that bushfire public policy adopts a comprehensive assessment of values and possible trade-offs, across broader scales of space and time. Moreover, the study provides further evidence to support previous studies that recommend bushfire policymaking:

- enhances the integration of ecological knowledge (both Indigenous and non-Indigenous) and environmental impacts into bushfire policy development and risk assessment methodologies (Bardsley et al., 2015; Bradshaw et al., 2018; Moskwa et al., 2018).
- considers a wider range of public values and sustainability trade-offs across broader spatial and temporal scales (Williams et al., 2021).
- integrates adaptation planning and maladaptation principles and assessments into bushfire policymaking to ensure a more proactive, longer-term approach (Heazle et al., 2013; Howes et al., 2015).
- adopts an adaptive governance framework that encourages cross-sectoral policy learning, frame-reflexive practice, experimentation, flexibility, and continual improvement (Bosomworth, 2018; Howes et al., 2015; Ruane, 2019)
- incorporates meaningful community engagement, deliberative dialogue, and social research into bushfire policy decision-making (Beilin & Reid, 2015; Rawluk et al, 2020).

Climate change adaptation is helping to reframe the bushfire problem, offering longer-term strategic perspectives that require integrated and adaptive policy solutions. Knowledge of the types of maladaptive outcomes associated with various policy strategies to adapt to increasing climate-exacerbated hazards can help identify potential trade-offs against other sustainability goals that need to be considered in the broader agenda of resilience. Further research into how the concept of maladaptation can applied in policy practice and integrated into risk management processes is needed.

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