

Review of NSW National Parks and Wildlife Service research utilisation practices

Operational improvement – fire science and research report
Australian Postgraduate Research Program Internship

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Version	Release history	Date
1.0	Initial release of document	07/02/2025



Australian Government

Natural Hazards Research Australia receives grant funding from the Australian Government.

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Publisher:

Natural Hazards Research Australia
 ISBN: 978-1-923057-22-7
 Report number: 42.2025
 February 2025
 Cover: NSW National Parks and Wildlife Service



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Acknowledgements

This project was supported by Natural Hazards Research Australia (the Centre), whose funding and commitment to advancing research and practical knowledge made this internship possible. I am grateful for their support, which has contributed significantly to the insights and outcomes presented in this report.



APR. Intern executive summary

Summary of research project background and objectives

The NSW National Parks and Wildlife Service (NPWS) is committed to integrating scientific research with practical environmental stewardship to prevent and manage fire risks in its parks. Recognising that the application of scientific insights can significantly enhance response capabilities, NPWS aims to bridge the gap between research and operational practice to improve bushfire management. This research project was undertaken to fulfil the requirements of an internship provided and supported by Natural Hazards Research Australia (the Centre) as part of its dedication to fostering the use of research knowledge and data to build safer, more sustainable and resilient communities.

The project specifically aimed to address challenges related to the limited awareness and inconsistent integration of bushfire research into operational planning and delivery. These challenges included organisational complexities, communication barriers and the lack of standardised processes that hinder the seamless adoption of research findings in practice. By analysing how organisational structures, individual roles and operational strategies interact within NPWS, this project sought to understand current research translation practices and identify gaps in research utilisation.

The overarching goal was to develop practical recommendations to enhance the integration and application of scientific insights in bushfire management. The expected outcomes include improved research-driven decision-making and operational enhancements within NPWS. Moreover, these findings offer potential benefits beyond NSW, contributing to national improvements in conservation and the overall response to bushfire challenges.

Summary of research undertaken

During my internship at the NSW National Parks and Wildlife Service (NPWS), from April to September 2024, I conducted a detailed research project to explore the barriers and enablers affecting the uptake of bushfire research knowledge and outcomes. The ultimate goal was to understand how bushfire research can best integrate into operational practices within NPWS. In collaboration with the industry partner, NPWS and the Centre, I designed and implemented a research methodology that involved semi-structured interviews and focus groups to capture various perspectives within the organisation.

I conducted 12 semi-structured interviews with a diverse range of NPWS staff, from field officers to branch program managers, which I designed to explore issues such as organisational structures, training impacts and the challenges of standardising research utilisation across different levels. Furthermore, I led two focus groups: one with members of the Science Division from the NSW Department of Climate Change, Energy, the Environment and Water and another with scientists and researchers who specialise in fire management and biodiversity conservation. The sessions were very



useful in understanding how research was communicated and integrated across departments.

All data from the interviews and focus groups were transcribed precisely to maintain integrity and analysed using NVivo software. This analysis involved coding emerging themes and validating patterns to understand their impact on NPWS's operational and strategic practices. My role in this internship was integral not only in data collection and analysis but also in shaping the research methodology to align with NPWS's strategic goals. This experience highlighted the complexities of translating research into actionable strategies within the context of fire management and conservation efforts.

Summary of the educational outcomes

Through the Centre's internship, I gained valuable experience in qualitative data collection and analysis and stakeholder engagement within a complex organisational structure, such as that of the NSW National Parks and Wildlife Service. Navigating the challenges of integrating academic research into practical fire management strategies has provided invaluable insights into the complexities of research translation in a real-world context. As I faced challenges in handling diverse viewpoints and synthesising them into actionable recommendations, I improved my ability to balance arguments, test these for validity and then synthesise and communicate them effectively. In this way, I learnt to adapt research methods to suit different requirements and to communicate complex information.



Intern impact statement

As a result of my internship, I have significantly increased my readiness and competitiveness for future employment. Engaging directly with NPWS in critical research initiatives sharpened my analytical and project management skills, as well as my understanding of environmental management challenges. The hands-on experience of leading interviews and focus groups has enhanced my confidence and ability to apply theoretical knowledge practically, making me a stronger candidate for roles that demand both research and operational expertise.

Moreover, my PhD research, which centres on the integration of smart city technologies with urban resilience strategies, provided a strong foundation for approaching this internship. Skills in advanced qualitative analysis, stakeholder engagement and translating complex findings into policy recommendations were pivotal during my time with NPWS. In return, the outcomes and insights gained during the internship will inform the final phase of my PhD work, refining my thesis with practical knowledge on the effective application of research to policy and strategy development. This cyclical learning experience reinforced my academic growth and provided a critical applied experience that will be invaluable as I progress into more integrated, real-world urban resilience projects.

Impact statement for the industry partner

This project aimed to enhance the integration of bushfire research into operational practices within the NSW National Parks and Wildlife Service (NPWS). By analysing the interaction between organisational structures, individual roles and strategies, this research identified gaps and opportunities in how NPWS applies scientific insights to improve bushfire management outcomes. The expected outcomes include an improved understanding of the application of research in fire management, enhancing NPWS's ability to plan and respond to bushfires more effectively and strengthening conservation efforts. This project's findings will inform decision-making processes and provide actionable recommendations for enhanced bushfire research outputs implementation, positioning NPWS as a leader in combining science with practical conservation efforts.

This research is highly relevant to National Parks and Wildlife Service NSW (NPWS), as it addresses a critical need to enhance the integration of scientific evidence into bushfire management practices. The findings are expected to boost NPWS's operational readiness, particularly by enabling our agency to create opportunities to streamline the use of bushfire research across all areas of our fire management program. The project's impact is far-reaching, offering NPWS practical strategies to improve staff training, standardise the research application process across branches and foster collaboration between scientists and NPWS staff. By strengthening NPWS's capacity to implement research outputs, this research will contribute to better bushfire preparedness and environmental and heritage stewardship, ultimately improving public safety and biodiversity conservation efforts across NSW's National Parks. Additionally, these strategies provide opportunities for broader collaboration and knowledge exchange with other agencies in NSW, enhancing collective fire management practices and fostering a unified approach to research integration.



Introduction

This study was a collaborative effort funded by Natural Hazards Research Australia (the Centre). And facilitated by the APR.Intern Program. It addresses a critical need within the NSW National Parks and Wildlife Service (NPWS) to improve its understanding of barriers and enablers to bushfire research integration into operational practices. This project aims to improve the agency's response to fire-related challenges and advance conservation efforts by optimising bushfire research utilisation. This effort is pivotal to refining fire management strategies and enhancing Australian ecosystem environmental resilience.

Research utilisation in this context refers to the systematic integration of scientific findings into operational decisions and practices. This is crucial for improving the effectiveness of land and fire management operations and programs. Despite its importance, agencies such as NPWS have difficulty translating scientific research into actionable strategies. There are many challenges associated with fire management, including complex organisational structures and the operational need for immediate action that requires rapid decision-making processes. It is also difficult to access and interpret vast amounts of research output. Often, these obstacles prevent the application of research findings in real-time operational scenarios, underscoring the importance of more integrated research to support evidence-based decision-making. The project was initiated following a strategic assessment by NPWS, highlighting the need for enhanced research integration capacity to advance operational improvements. It is common for fire and land management agencies, including NPWS, to operate within complex organisational frameworks that can make the adoption of research-based approaches difficult. To ensure that bushfire research findings are translated into practical fire management solutions, this study aimed to bridge the gap between research and practice by developing strategies that address these systemic barriers.

This project aimed to enhance NPWS's operational effectiveness and lay the groundwork for future research-driven fire management initiatives by addressing these challenges through strategic research integration. It is expected that these outcomes will enhance the NPWS fire management program by facilitating a deeper understanding of how bushfire research can be approached systematically and effectively.



Research design

This study explores the interplay between organisational structures, individual roles and operational strategies in integrating bushfire research within the NSW National Parks and Wildlife Service (NPWS). The methodology was deliberately structured to capture a wide range of perspectives across different roles and organisational levels, providing a comprehensive understanding of the dynamics involved in research utilisation.

Data collection

Semi-structured interviews and focus groups were used to collect data, chosen for their flexibility and depth in exploring complex topics. Detailed schedules for the interviews and focus groups can be found in **Appendix A** and **Appendix B**, respectively. **Appendix A** contains the semi-structured interview schedule, while **Appendix B** provides the focus group questions. This ensures transparency and replicability in our data collection process.

Interviews: Twelve semi-structured interviews were conducted with NPWS staff, ranging from Field Officers to Branch Program Managers, targeted to represent a diverse range of experiences. Participant interviews lasted approximately 45 minutes and covered topics such as organisational structures, training impacts and the challenges of standardising research utilisation across different operational levels. In the Appendix, Table 1 provides detailed information about the interview participants.

Focus groups

First focus group: The first focus group included key members of the Science and Insights Division of the NSW Department of Climate Change, Energy, Environment and Water and National Parks and Wildlife Service – Fire and Incident Operations Branch. The group included personnel directly involved in knowledge exchange capability and the application of science to environmental and conservation strategies. The discussion lasted approximately one hour and centred on collaboration dynamics between Science and Insights Division and NPWS and how research is communicated and integrated across organisational boundaries. Table 2 in the Appendix contains information on participants in focus groups.

Second focus group: Three scientists and researchers who specialise in fire management and biodiversity conservation — but are external to NPWS — participated in the second focus group. The purpose of this session was to capture collective insights regarding scientific application in operational settings and strategies to improve interdisciplinary collaborations.



Analysis methods

All interviews and focus group discussions were precisely transcribed to ensure data integrity and accuracy. The transcriptions were organised and systematically categorised using NVivo software, which facilitates in-depth qualitative analysis. The first step in this process was to identify key concepts and emerging themes critical to understanding how research was being utilised within NPWS.

After initial coding, a detailed thematic analysis was conducted. This method refined initial themes and robustly validated emerging patterns, emphasising how they interact and impact operational and strategic practices within NPWS. As part of the analysis, these themes were also aligned with theoretical frameworks on research utilisation (see the detailed literature review provided in **Appendix 3**), which helped ground the findings within established research literature.

The qualitative data from interviews and focus group discussions were rigorously analysed to ensure comprehensive coverage. This approach allowed for a detailed understanding of the many facets of research application within an organisation.

Through this analysis, NPWS developed targeted recommendations for enhancing the integration and effectiveness of bushfire research into its fire management program. By providing a clear pathway to understanding the operational realities and strategic needs for effective research management and application, this structured analytical framework was pivotal in addressing the core research objectives.



Findings and discussion

The purpose of this study is to provide an in-depth exploration of the challenges and strategies associated with the utilisation of research within the NPWS, emphasising the impact that organisational structures, individual roles and operational strategies have on research utilisation. This research focuses on the integration of bushfire management practices—a focus area of NPWS aligned with its broader mandates of conservation and heritage management—as part of a rotational internship in the Fire and Incident Operations Branch (FIOB) and Operational Improvement (OI) team. In analysing qualitative data collected during this internship, four key themes were identified:

- **Organisational structure and role impact**
- **Research integration and operational strategy**
- **Collaboration and communication in research**
- **Research challenges and support**

Collectively, these themes highlight the complex landscape of bushfire research utilisation, offering a structured approach to understanding the operational realities and strategic needs of optimised bushfire research utilisation strategies. In addition to supporting NPWS's conservation and heritage preservation goals, this exploration also underscores the critical need for enhanced evidence-based bushfire management capabilities.

KEY THEMES	BARRIERS	ENABLERS
1. ORGANISATIONAL STRUCTURE AND ROLE IMPACT	<ul style="list-style-type: none"> - Decentralised structure challenges - Role-specific challenges - Need for standardisation 	<ul style="list-style-type: none"> - Strategic role utilisation - Diverse role engagement - Impact of training and development
2. RESEARCH INTEGRATION AND OPERATIONAL STRATEGY	<ul style="list-style-type: none"> - Ad hoc integration practices - Communication challenges - Systemic integration issues 	<ul style="list-style-type: none"> - Decision-support tools integration - Enhancing knowledge-sharing and learning processes
3. COLLABORATION AND COMMUNICATION IN RESEARCH	<ul style="list-style-type: none"> - Internal collaboration challenges - External collaboration limitations 	<ul style="list-style-type: none"> - Strategic engagement with external partners - Enhancing communication strategies
4. RESEARCH CHALLENGES AND SUPPORT	<ul style="list-style-type: none"> - Cultural and financial barriers - Variable support for research 	<ul style="list-style-type: none"> - Role of knowledge brokers - Enhancing systemic integration and communication

Table 1: Summary of key themes, barriers and enablers in research utilisation at NPWS



Theme 1: Organisational structure and role impact

In NPWS, the organisation structure greatly impacts research utilisation, with notable differences between branches. This theme examines the impact of these structural differences on the integration and utilisation of bushfire research, aiming to identify strategies and operational adjustments that can enhance fire management efficiency.

The findings indicate that a person's organisational role significantly influences research utilisation. Strategic roles, such as those held by senior planners, are typically well-aligned with research objectives, effectively incorporating relevant insights to enhance management strategies and decision-making processes. These roles often facilitate proactive research utilisation, reflecting an alignment with organisational goals of enhancing operational efficiency and effectiveness in managing fire risks.

Conversely, operational roles, particularly those on the ground, such as fire officers, face unique challenges in integrating new research. The urgent and reactive nature of their work, coupled with a reliance on established protocols, limits their ability to apply fresh insights during critical situations. This highlights a gap between the potential of research-driven strategies and their practical application in high-pressure environments where time-sensitive decisions are crucial.

This structural diversity within NPWS is crucial for tailoring research integration to suit varied operational and fire management needs. However, innovative solutions are required to streamline engagement and enhance the uniformity of research applications. For instance, improving governance structures to include research integration tasks explicitly in work programs can facilitate this process. Additionally, establishing clear accountability for research implementation activities could ensure that research findings are systematically incorporated into operational practices. Insights from a focus group with external researchers in the biodiversity conservation and science sector emphasise the challenges posed by the size and complexity of operations within NPWS.

Barriers to effective integration

Decentralised structure challenges

Discussions with external researchers highlighted that NPWS's diverse structure, which supports specialised research applications, also complicates effective communication channels. These challenges are often intensified by the organisation's decentralised nature, leading to varied levels of research adoption across branches. Participants in FG 2 mentioned the challenges that arise from this setup:

"We are quite challenged by the sheer breadth of research activities... This complexity complicates our engagement with national parks." (Scientist, FG 2, August 2024)

This reflects the size and complexity of operations within NPWS, which hinders consistent research integration and communication.



The growing need to address these issues requires a more robust organisational structure, governance and processes that support ongoing research utilisation. These structures should improve clarity and efficiency in research communication. Another participant elaborated on the communication hurdles, mentioning:

"Navigating in the dark with different teams leads to repeated messages to ensure they are heard, which, although improving, is slow." (Scientist, FG 2, August 2024)

This quote underscores the need for more structured and streamlined communication strategies to overcome the segmented understanding within different parts of the parks.

Role-specific challenges

Operational roles, especially during active periods of fire management activity, face challenges in applying new research due to time constraints and the need to prioritise immediate response actions. Ground operations often must adhere strictly to established protocols, limiting the integration of new methodologies. An operations officer illustrates this challenge:

"When I am at a fire, I do not have time for new research; we must focus on the task at hand with the skills we already have." (P6, interview, July 2024)

This statement underscores the reactive nature of operational roles, where the immediate need to manage crises often limits the opportunity for integrating new research methodologies.

Need for standardisation

Involvement in research integration is evident in some roles. However, the lack of standardised processes across the organisation limits consistent implementation. The decentralised structure adds to these challenges. As a fire planning officer described:

"When you are a large agency with people scattered across the state and you have not just one branch fire team but eight, each branch can do things differently." (P12, interview, August 2024)

This remark noted the difficulties in applying uniform research findings across multiple branches. This disparity highlights the necessity for more integrated and standardised approaches to research utilisation. A more robust knowledge brokering capability with dedicated roles across the fire teams could lead to more effective research implementation and operational improvement. This will ensure that innovations and findings are effectively translated into actionable strategies across all levels of NPWS.



Enablers of effective integration

Strategic role utilisation

In strategic roles, research is utilised to develop comprehensive management strategies, enhancing operational efficiency and risk management. For example, a senior project officer mentioned:

“Incorporating scientific research into our policy frameworks allows us to enhance our operational efficiency and effectiveness in managing fire risks.” (P2, Interview, June 2024)

Diverse role engagement

The involvement of diverse members of NPWS has demonstrated significant benefits, particularly when it comes to integrating research findings into practical management. A project officer notes:

“Being involved in diverse roles from ground operations to planning has significantly enhanced my capability to integrate research findings into practical management.” (P8, Interviews, July 2024)

As a result, cross-functional experiences can provide valuable perspectives that can improve research integration, especially when individuals transition between strategic and operational roles.

Impact of training and development

Training impacts research perception and implementation within NPWS. Software and tools that integrate the latest research methodologies, such as fire behaviour simulators, improve skills and understanding of the research supporting mitigation and response activities. A fire planner shared:

“The advanced training in fire behaviour modelling has not just enhanced my skills but also my appreciation for the intricate research that informs our fire management strategies.” (P2, interviews, June 2024)

This emphasises the significance of ongoing professional development in improving research-based operational strategies.

Theme 2: Research integration and operational strategy

In NSW NPWS, the integration of research into operational strategies is critical for advancing fire management practices. The agency has established processes through its Operational Improvement team aimed at facilitating research integration. However, despite structured efforts, the application of these processes varies significantly across different roles, levels and siloes, often influenced by the maturity of process implementation within the agency.

The study identifies that while NPWS has put efforts into establishing processes through its Operational Improvement team to facilitate research integration, the



application and effectiveness of these processes are inconsistent. This inconsistency is often rooted in ad hoc integration practices that rely heavily on individual initiative rather than structured, organisation-wide strategies. Such a sporadic approach can lead to missed opportunities in harnessing valuable research, especially in scenarios where structured integration could significantly enhance operational outcomes.

Barriers to effective research integration

Ad hoc integration practices

While NPWS has established structured processes for systematic research integration through partnerships with major research programs like the Centre, the Bushfire and Natural Hazards Research Centre (BNHRC) and the Applied Bushfire Science program, the integration of research findings into operational strategies often remains inconsistent across the organisation. This inconsistency predominantly arises because branches and teams can independently commission research, leading to a lack of centralised knowledge management. This decentralisation contributes to variable adoption of research, often relying on personal initiative rather than uniform processes, which causes missed opportunities for leveraging valuable research. As noted within the agency:

“We often use research reactively, applying it occasionally when problems arise rather than systematically.” (P12, interviews, August 2024)

This sporadic approach highlights the need for more consistent application and better integration of structured processes across all branches.

Communication challenges

Discussions with external researchers have underscored challenges related to ad hoc communication practices within NPWS. These issues primarily stem from navigating unclear team dynamics, which lead to repeated and sometimes ineffective communication efforts, slowing down the integration process. This situation underscores the necessity for a more robust and systematic integration strategy and clearer communication protocols to enhance effective research utilisation across the organisation.

Systemic integration issues

The individualised and variable approach to research integration practices at NPWS results in a reactive rather than systematic application of findings. Although efforts have been made to tailor research integration practices to specific needs within NPWS, these efforts often result in inconsistent application across various operational areas. The issue is further complicated by the lack of a consolidated process for identifying and addressing research needs across all business areas that interact in the fire management space. As noted by a participant:

“Although we have initiatives for research prioritisation, the lack of a centralised approach makes the system feel disjointed.” (P11, interviews, July 2024)



Additionally, aligning these research efforts with existing government frameworks presents challenges. Research prioritisation, while continuously updated, often does not align timely with the dynamic needs of park management, necessitating annual reviews to ensure relevance and effectiveness. There is also a challenge in how new research integrates into park management practices, with government frameworks frequently not reflecting the latest findings or operational needs. This misalignment calls for a more detailed and structured approach to regularly update and communicate these processes to ensure they are practical for implementation.

Enablers of effective research integration

Decision-support tools integration

The integration of research into decision-support tools and policies such as the 'Elements' system, SPARK, Phoenix and the Threatened Species Hazard Reduction List¹ is crucial for enhancing fire management planning and response. These tools and policies have the potential to streamline the use of research outputs, yet they often face challenges related to efficiency and practical application. For instance, an operations manager pointed out that:

“Elements is intended to enhance our planning capabilities, yet its cumbersome nature often complicates our processes rather than simplifying them.” (P2, interviews, June 2024)

This example illustrates that while the current inefficiencies in tools like Elements create barriers to effectively integrating research findings, they also present significant opportunities for improvement.

By aligning the design and functionality of these tools more closely with NPWS’s current policies, processes and practices, the capacity to incorporate and utilise research outputs could become more effective. For example, embedding advanced models directly into these tools could help translate complex research findings into actionable insights without additional resource allocation. These improvements are crucial not only for optimising fire management outcomes but also for ensuring that research results are practically applicable and readily available to aid decision-making on the ground. This approach could lead to a more integrated and effective research utilisation, reducing the need for ad hoc translation efforts and maximising the impact of scientific insights in operational settings.

Enhancing knowledge-sharing and learning processes

In some cases, NPWS faces challenges in effectively utilising and communicating research due to a ‘siloes’ work culture. Insights from a fire planning officer elaborate:

“Our departmental divisions impede the effective dissemination of new knowledge and insights. Our current approach to capturing and sharing lessons learned is not robust enough, leading to significant information bottlenecks.” (P12, interviews, August 2024)

¹ The Elements system, SPARK, Phoenix and the Threatened Species Hazard Reduction List are tools designed to support fire management planning and response. Each tool serves a distinct function—from data management to species preservation—collectively enhancing operational efficiency and decision-making processes in managing fire risks



If this critique is accurate, it becomes increasingly important to develop more robust mechanisms for systematically implementing research findings and for reflecting upon and learning from experiences. The external researchers in FG2 noted that building effective communication channels within NPWS was very time-consuming and, thus, limited the fluid integration of research. These observations stress the need for establishing robust structures within NPWS that support ongoing research utilisation and foster clear communication pathways.

Role of knowledge brokers

Knowledge brokers are vital in making research findings accessible and applicable across NPWS, playing a central role in translating scientific insights into practical applications. The Science and Insights Division's Fire and Cultural Science knowledge broker team has significantly expanded, growing from one to five full-time equivalents (FTEs) to manage an increasing volume of science projects adeptly. Yet, across the entire NPWS, there is only one official role explicitly devoted to brokering bushfire science knowledge within NPWS. This presents a unique opportunity to broaden its capacity for engaging with the expansive scope of scientific research conducted by partners. Proactively addressing this gap is crucial for further enhancing our research integration and transforming findings into actionable strategies that meet our operational needs.

Collective responsibility in research utilisation: It is imperative to note that while knowledge brokers are pivotal in facilitating communication and integration, the responsibility for effective research utilisation does not solely rest with them. As emphasised by a principal project officer:

“Every team member should adopt the responsibility of a knowledge broker to some extent, contributing their expertise to enhance collective understanding and application. Knowledge brokers do not possess all subject matter expertise; hence, specialists within the organisation must also act as knowledge conduits. This collaborative approach ensures that no single role bears the undue burden of ensuring research is applied, but rather it is a shared responsibility across the organisation.” (FG1, August 2024)

This refined understanding emphasises that knowledge management and application are collaborative efforts, requiring contributions from various organisational roles to effectively use research insights for improved management and policymaking.

Theme 3: Collaboration and communication in research

Effective collaboration and communication are pivotal in NPWS's integration of research into fire-management practices. Internally, NPWS relies on a blend of structured systems and informal networks. In contrast, these informal networks allow quick sharing of insights and coordination, but they sometimes compromise the efficacy of structured systematic project management. Externally, NPWS engages with academic and research centres through project-specific engagements often dictated by external funding. While beneficial, such engagements frequently lead to



discontinuities when funding ends, impacting long-term research integration and application.

Despite efforts to foster robust collaboration, NPWS faces challenges due to its decentralised structure and siloed operations. Interactions within and between departments, as well as with external research bodies, typically lack the necessary fluidity, hindering effective research dissemination and integration. These challenges have been intensified by the sporadic nature of communication. This often does not adequately support the seamless integration of research across various levels of the organisation. Addressing these barriers is crucial to ensuring that research findings are not only accessible but also effectively implemented, thereby enhancing the agency's fire management strategies and conservation efforts.

Barriers to effective collaboration and communication

Internal collaboration

Within NPWS, some teams primarily rely on informal networks for internal collaboration, enabling quick sharing of insights and coordination. While a team leader points out that:

“Our best project outcomes often stem from spontaneous, informal team meetings.” (P3, interviews, June 2024)

This approach may compromise structured, systematic project management. Relying on informal meetings leads to inconsistencies and a lack of formal communication channels, highlighting the need for more formalised interaction frameworks to enhance consistency and inclusivity across all departments.

External collaboration

NPWS maintains a robust history of collaboration with academic and research centres, drawing on external expertise in environmental and wildlife management. These partnerships, however, often rely on project-specific engagements and are influenced by external funding, particularly evident in responses to significant events like the 2019/20 bushfire season. As noted by a senior news researcher:

“Our engagement with academics tends to be on a case-by-case basis, which challenges our ability to form lasting partnerships.” (P11, interviews, July 2024)

He also added that many research centres are set up temporarily, “which complicates these relationships, resulting in the possibility of discontinuities once initial funding runs out.”

Enablers of effective collaboration and communication

Strategic external partnerships

To mitigate these disruptions and enhance research continuity, NPWS is exploring strategies to foster long-term strategic relationships with these entities. By establishing enduring partnerships, NPWS aims to not only maintain continuity in



research efforts but also to enhance its capacity to build upon prior discoveries and insights, thereby strengthening its overall response and strategies in environmental and wildlife management.

Enhancing communication strategies

Focus group 1 discussions have highlighted areas for growth in enhancing research communication within NPWS, particularly the significant efforts required to establish effective channels. These discussions underline the progress being made toward overcoming communication barriers that have previously impacted the seamless integration of research across various levels of the organisation. The ongoing development of advanced communication strategies and establishing formal interaction frameworks are key steps in making research findings more accessible and actionable across NPWS. These initiatives are critical in supporting the continuous utilisation of research findings, demonstrating NPWS's commitment to continuous improvement and effective knowledge management.

Role of knowledge brokers

Knowledge brokers are pivotal in NPWS for overcoming communication and collaboration barriers and facilitating the integration of complex research into practical applications. They act as liaisons, ensuring that research outputs are not only accessible but also relevant across the organisation, fostering understanding between researchers and operational staff.

It is important to note that, in addition to formal knowledge broker roles, subject matter experts (SMEs) within various departments often informally assume these responsibilities. These SMEs possess deep expertise and are crucial in translating technical research into actionable insights for their specific domains. However, for SMEs to effectively contribute as knowledge brokers, the organisation must provide appropriate support and recognition for these informal roles.

Moreover, the effectiveness of knowledge brokers varies significantly across divisions, indicating a need for more uniform support and targeted training to enhance their capabilities. A participant in the focus group mentioned:

“To further strengthen the role of knowledge brokers, NPWS could benefit from embedding specific knowledge brokers within operational branches fire teams. These brokers would work with fire planners and Team Leader Fires to ensure that research findings are seamlessly integrated into operational planning and execution”. (FG 1, August 2024)

This strategic placement would enhance the direct application of research insights and improve coordination during fire management activities, ultimately enhancing the organisation's overall fire management and conservation efforts.

Distinction from science communicators

It is important to distinguish the role of knowledge brokers from that of science communicators. While knowledge brokers focus on facilitating access to and



understanding research findings within NPWS, the creation and dissemination of scientific communications should primarily be managed by dedicated science communicators within associated scientific programs or partnerships. This separation ensures that scientific information is not only generated but also communicated in an engaging and comprehensible manner, thereby enhancing its impact on park management and conservation practices.

Theme 4: Challenges and support for research

In NPWS, the level of research support varies across different branches, reflecting a mix of highly engaged branches and others that are less active. This variation impacts how research is prioritised and utilised across the organisation, impacting how research is integrated and effective. In some branches, research is actively incorporated into their practices and viewed as crucial to their operations, while in others, it is only considered peripheral and participants engage in it only when necessary.

The disparity in research support not only leads to inconsistent research applications but also affects the effectiveness of research-driven initiatives within NPWS. A number of factors influence these variations, including cultural dynamics within the workforce, where experienced staff may adhere to traditional methods and financial constraints that limit the ability to pursue and implement innovative research initiatives. It is these issues that set the stage for exploring NPWS's specific barriers and enablers to effective research support, as understanding and addressing them can lead to a more uniform research integration and enhance the service's capabilities in managing environmental and fire-related issues.

Barriers to effective research support

Cultural and financial barriers

NPWS faces challenges when it comes to integrating research due to cultural and financial barriers. There is a clear cultural divide within the workforce, with experienced staff members often sticking to traditional methods and being hesitant to adopt new, research-based ideas. On the other hand, newer employees are more receptive to innovative practices. An interviewee describes this situation:

“There is a palpable divide between our seasoned staff, who are entrenched in conventional methods and our younger staff, who are keen to adopt innovative, research-driven approaches.” (P1, Interview, June 2024)

In addition to cultural resistance, ongoing funding shortages limit the organisation's ability to pursue and implement new research initiatives.

Variable support for research

The NPWS' dedication to integrating research is inconsistent across branches and not uniformly distributed, indicating unequal support for research. A branch program manager explains:



“In some components of our work, research underpins all our strategies; in others, it is barely an afterthought, often sidelined unless directly applicable to immediate operational challenges.” (P5, Interview, July 2024)

This variation in support and engagement not only impacts the motivation of the staff but also affects the overall quality and relevance of research outputs. Following major events like the 2019/20 bushfires, support for fire research has increased significantly. A senior officer notes:

“NPWS highly values research... following major events like the bushfires, there has been a significant injection of funds into the research space.” (P11, Interview, July 2024)

This reactive funding arrangement highlights a need for more proactive and consistent financial planning to ensure continuous and effective research integration for NPWS.

Enablers of effective research support

Role of knowledge brokers

Knowledge brokers play a critical role in bridging the gap between different parts of the agency, facilitating the adoption of innovative research practices across the organisation. Despite their importance, challenges such as resistance to change and a niche perception of certain scientific fields limit their effectiveness. The discussions emphasised the need for structured processes to engage research experts more effectively within the organisation.

Enhancing systemic integration and communication

Efforts to enhance research integration and communication are crucial, especially in overcoming established siloed practices within NPWS. FG 1 participants stressed the importance of consistent communication and knowledge brokers. Strategic actions recommended include formalising relationships, improving direct communication among staff and developing clear communication channels to ensure research findings are accessible and actionable. These efforts aim to close research application gaps and foster a more integrated approach to managing and utilising research within NPWS.

Recommendations

This study has identified several critical areas for improvement in integrating research within the NPWS. Addressing these areas effectively can enhance the organisation’s operational strategies and conservation efforts. The recommendations presented below are designed to substantially improve how NPWS conducts, integrates and utilises research, ultimately supporting its conservation and management goals.

1. **Establish formal research integration roles:** Establish roles such as knowledge brokers and research coordinators across all branches. In these roles, research findings will be consistently applied and integrated into daily operations, translating scientific insights into actionable strategies. A key responsibility of this position should be liaising between research teams and operational staff to ensure that the research outputs are practical.



2. **Enhance training programs:** Develop and enhance training programs that emphasise the application of research findings into planning and operational tools such as 'Elements' and other decision making support tools. With this targeted training, staff will be more competent in applying these insights, thereby enhancing operational readiness and decision-making.
3. **Strengthen communication channels:** Implement comprehensive communication strategies that facilitate the sharing of research findings across the organisation. Digital platforms for regular updates and simplified communication tools such as infographics, fact sheets and quick-reference guides will enable complex research to be accessible and practical for all staff, thus increasing the organisation's research literacy.
4. **Refine funding strategies for research:** NPWS should allocate specific portions of its operational expenditure to support targeted research initiatives. This proactive funding approach would allow the organisation to quickly adapt to emerging research needs and ensure that crucial studies are adequately supported, thereby enhancing the overall impact of research within the organisation.
5. **Formalise research integration processes:** Standardise and formalise research integration processes within existing policy frameworks so they can be applied uniformly across diverse geographic and operational contexts. A regular review cycle and integration checkpoint could be included to monitor and evaluate research integration effectiveness.
6. **Co-design of research projects:** Include operational staff from the beginning of the research design phase to ensure that projects are practical, realistic and relevant to NPWS. As a result of this co-design process, research implementation and relevance are more likely to be successful.
7. **Long-term planning and structural adjustments:** NPWS's strategic and operational planning should include research project timelines. This will ensure that new research findings are incorporated into park management practices on time and effectively overcome barriers to their application.
8. **Leadership initiatives:** Encourage senior management to support research integration efforts. Leadership endorsements and participation in key research activities should promote a culture of evidence-based decision-making.
9. **Enhance engagement and understanding:** Encourage active participation in interdisciplinary groups to align research outputs with operational needs. This will promote innovative practices and enhance collaborative problem-solving.

These streamlined recommendations will significantly improve research utilisation and operational strategies within NPWS, fostering an integrated research culture that supports the organisation's strategic objectives and enhances its conservation efforts.



Appendix 1- Interview schedule

Introduction

Good morning/afternoon, [Interviewee's Name]. Thank you for joining me today; I truly value your time.

The main objective of today's interview is to explore how NPWS integrates scientific research into fire management practices. We'll also discuss any challenges you've encountered and potential improvements.

Please note that everything we discuss today is confidential and your name will not be used in any reports. With your permission, I would like to record our session to ensure accuracy. Is that okay with you?

If you are ready, we can begin with some questions about your role.

Section 1: Role and experience

"Could you briefly describe your role within NPWS, especially in relation to fire management?"

"How long have you been involved in fire management at NPWS? Could you discuss any training or experiences that have helped you better understand the needs of bushfire research in your area of work?"

Section 2: Research perception and engagement

"How do you perceive the value placed on research by NPWS?"

"How does NPWS identify and prioritise research needs? Are there specific processes in place for this?"

"Could you describe the mechanisms and resources that support effective engagement with academic research at NPWS?"

"Have you been personally involved in any research projects with BNHRC, the Centre, or the Applied Bushfire Science team? Please describe your involvement and the integration of these findings into operational strategies."

Section 3: Collaboration, knowledge transfer and implementation

"Can you provide examples of how different branches within NPWS collaborate on research projects?"

"What tools or systems does NPWS use to facilitate the transfer of research into practice?"

"Describe the process from assessing research relevance to its final implementation and monitoring. What are common challenges encountered?"

Section 4: Organisational challenges and resource allocation

"What primary challenges do you face in integrating new research into NPWS's fire management strategies?"

"Are specific funds allocated for research within your area and what are the main obstacles to using these funds effectively?"

Section 5: Training, culture and governance

"How have the culture and training programs within NPWS supported or hindered the use of research in fire management activities?"



"What governance processes are in place to ensure the effective implementation of research findings?"

Section 6: Feedback, evaluation and leadership

"How is the impact of research on fire management practices evaluated at NPWS?"

"Can you provide examples of how leadership within NPWS has influenced the integration of research?"

Conclusion and additional comments

"Are there strategies you've found effective in integrating research into fire management at NPWS?"

"What improvements would you suggest to enhance collaboration between NPWS and research bodies like BNHRC and the Centre?"

Is there anything else you'd like to add or anyone else you suggest we speak with?

Thank you for your time and insights. I will send you a copy of your responses for review before proceeding with data analysis and publication. Have a wonderful day!



Appendix 2- Focus group schedule

Good morning, everyone. Thank you for joining today's focus group. Your insights are invaluable and I look forward to our discussion."

Today, we are here to discuss the engagement between the Science Division and National Parks. Our goal is to identify effective practices and areas for improvement in our collaborative efforts and communication strategies."

Please note that everything we discuss today is confidential and no personal identifiers will be used in any reports. With your agreement, I would like to record our session to capture our discussion accurately. Is everyone comfortable with that?

I encourage you to view our session today as a conversation. Feel free to build on each other's ideas and share your experiences freely. Let's strive for a constructive and open exchange.

If everyone is ready, let's begin our discussion.

Questions

1. "Can you describe how your research engages with National Parks? How does this engagement vary across different projects or initiatives?"
2. "How do you tailor your interactions with different branches within National Parks, such as the Fire and Incident Operations Branch, operational branches, or the Bushfire Risk and Evaluation team? Are there specific strategies that you find more effective with different teams?"
3. "Discuss the varying approaches the Science Division employs when engaging with different roles or levels within operational branches—from field staff to managers to executives. Which strategies have proven most successful?"
4. "Can you outline the structured processes the Science Division uses to identify and engage the appropriate experts from National Parks for collaborative projects?"
5. "What mechanisms are in place to ensure that collaboration with National Parks is sustained, especially when there are changes in personnel or roles within the Science Division?"
6. "What methods do you use to ensure that research results are actionable and meet the needs of National Parks? Which practices have been effective and where do you see opportunities for improvement?"
7. "How does the Science Division communicate with National Parks to ensure research findings are effectively utilised? Are there particular communication tools or methods that have been especially effective?"
8. "What challenges has the Science Division encountered in applying research within National Parks and how have these been addressed? Are there ongoing challenges that still need to be resolved?"



9. "From your perspective, what could enhance the effectiveness of communication between the Science Division and National Parks? Are there new strategies or technologies you believe could improve this process?"
10. "How do you perceive NPWS's openness to collaboration and research integration? What strengths and areas for improvement have you identified?"
11. "How does the Science Division gather and incorporate feedback from end-users to enhance the relevance and application of research? How does this feedback influence ongoing and future projects?"

That concludes the questions I have prepared. Is there anything else anyone would like to add or discuss further?"

Thank you all for your time and valuable contributions today. Your insights are crucial to our continuous improvement and success."



Appendix 3

Table 1: Interview Participants

Participant ID	Role	Experience	Involvement in Research
P1	Senior project officer	5-10 years	sometimes involved
P2	Fire planning officer	More than 20 years	frequently involved
P3	Team leader	More than 20 years	sometimes involved
P4	Branch programs manager	More than 20 years	sometimes involved
P5	Branch programs manager	More than 10 years	sometimes involved
P6	Fire planning officer	More than 20 years	sometimes involved
P7	Ranger	More than 20 years	sometimes involved
P8	Area manager	More than 20 years	frequently involved
P9	Team leader	More than 20 years	sometimes involved
P10	Senior project officer	More than 20 years	sometimes involved
P11	Senior project officer	5-10 years	frequently involved
P12	Fire planning officer	5-10 years	frequently involved

Table 2: Focus Group Participants

First Focus Group

Participant ID	Role
FG1	Knowledge broker
FG2	Knowledge broker
FG3	Knowledge broker
FG4	Knowledge broker
FG5	Knowledge broker

Second Focus Group

Participant ID	Role
FG6	Research scientist
FG7	Senior scientist
FG8	Research scientist



Appendix 4 - Literature review



Operational improvement -Fire science and research report

Australian postgraduate research program internship

Review of NPWS research utilisation practices

Literature review

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1. Dr Felipe Aires – NSW National Parks and Wildlife Service – Fire and Incident Operations Branch - Fire Science Interpretation Officer
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September 2024



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Introduction

Bushfires are a natural and paradoxical part of the Australian landscape, serving as both agents of destruction and renewal. While bushfires can cause significant property damage, loss of life and environmental degradation, they also play a crucial role in regenerating ecosystems as they stimulate the growth of fire-adapted plants and help cycle nutrients. Additionally, bushfires assist in managing disease loads in plant and animal populations (Bradstock et al., 2012).

In recent decades, the size and severity of these fires have increased due to factors such as climate change, more extreme weather conditions and accumulated fuel loads, posing unprecedented challenges (Jolly et al., 2015). The 2019–2020 Australian bushfire season, known as Black Summer, was extremely devastating. About 200 bushfires occurred simultaneously or successively, impacting large areas and crossing state boundaries. In New South Wales alone, 5.52 million hectares were affected, contributing to a total of 18.6 million hectares across Australia. The fires caused 33 deaths and destroyed around 3,000 homes, businesses, livestock and infrastructure. Additionally, smoke from the fires led to an estimated 417 excess fatalities and 3,151 hospitalisations. (Borchers Arriagada et al., 2020). The season also had severe environmental impacts, threatening the extinction of some native species, reducing water quality in catchment areas and causing widespread fish kills. The scale of this disaster highlighted significant weaknesses in current fire response plans, underscoring the urgent need for more effective fire management strategies (Gissing et al., 2022).

In response to the crisis, the NSW Bushfire Inquiry (2020) made several key recommendations to enhance fire management practices. These recommendations include improving inter-agency communication, integrating cultural burning practices and making significant investments in long-term ecosystem research (Inquiry, 2020). These recommendations are intended to help build resilience and adjust management practices to the changing bushfire landscapes (Inquiry, 2020)

A key challenge in bushfire management, as in many fields, is the "research-practice gap" – a significant disconnect between academic research findings and their application in operational settings. This gap is characterised by delays in communication between researchers and practitioners, difficulty translating scientific findings into actionable guidelines and organisational structures that impede knowledge integration. It represents a fundamental barrier to effective fire management (Thompson & Calkin, 2011).

The purpose of this literature review is to investigate how fire management agencies can use scientific research to improve fire management. By studying how academic research on bushfires is turned into practical strategies, this review aims to connect theoretical knowledge with real-world applications. The effective translation and application of research are crucial for improving the resilience of ecosystems and communities to bushfire threats. This can be achieved by integrating the latest scientific findings into fire management policies (Graham et al., 2006; Rogers et al., 2014).

The literature review is organised to help achieve a thorough understanding of how scientific research can be integrated into fire management. It starts with Theoretical



Foundations and Conceptual Frameworks, discussing important models such as the Knowledge-to-Action Framework and Diffusion of Innovations Theory, which explain how research can be put into practice.

The Methodology section describes the approaches used to gather and analyse academic and practical data. Following this, the Case studies and Applications section illustrates instances where research has been effectively applied in fire management. **Barriers and Facilitators explores the obstacles and factors that influence the use of research in the field. The paper then integrates these elements in the Discussion section, reflecting on how research can be practically implemented.**

It concludes with recommendations, offering strategies to enhance research applications in fire management, aiming to strengthen ecosystem and community resilience against bushfires.

Theoretical foundations and conceptual frameworks

The purpose of this section is to introduce key conceptual frameworks that are critical to understanding and improving the translation of scientific research into effective fire management strategies. By examining how knowledge is transformed into practice, we can gain a better understanding of the mechanisms and strategies that facilitate this process. The frameworks discussed here - Knowledge-to-Action and Diffusion of Innovations - provide insights into the dynamics of knowledge transfer and application, especially within the context of emergency response and environmental management.

Knowledge-to-Action Framework

Knowledge-to-Action (KTA) is a dynamic model developed by Graham et al. (2006) to bridge the gap between knowledge creation and practical application. This framework is particularly useful in several fields, including emergency response and environmental management, where rapid and effective translation of research into action can significantly impact outcomes. A KTA framework is comprised of two main components: the Knowledge Creation phase and the Action Cycle, each containing a number of steps that ensure the systematic and thoughtful application of research findings. (Graham et al., 2006). These are illustrated in Figure 1.

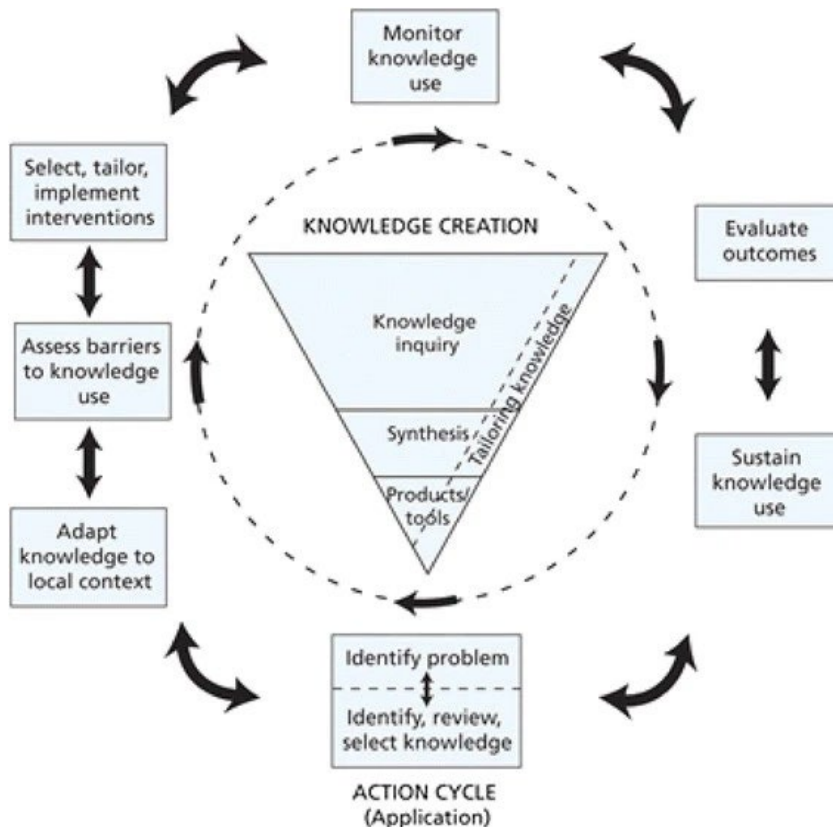


Figure 1: The Knowledge to Action Framework (Graham et al., 2006).

Knowledge creation: Knowledge creation involves systematically gathering, analysing and synthesising research data to create practical tools for direct field application.

- **Knowledge inquiry:** The first step involves compiling all the relevant research and data on a particular topic.
- **Synthesis:** After collecting data, synthesis involves distilling and combining it into a coherent body of evidence. It involves systematic reviews and meta-analyses that integrate findings from multiple studies to produce practical tools and products.
- **Products/tools:** The knowledge creation phase leads to the development of practical products or tools intended to facilitate decision-making. These products are specifically designed for direct application in the field, ensuring efficient resolution of identified problems.

Action cycle: The Action Cycle translates synthesised knowledge into practical steps, ensuring effective implementation and sustainability of research findings.

- **Identify problem:** This phase signifies the shift from knowledge to action, where the specific issues requiring research application are clearly defined.
- **Select, tailor and implement interventions:** Based on the identified problems and developed tools, suitable interventions are chosen and customised to fit the local context and specific conditions of the situation.
- **Monitor knowledge use:** As interventions are implemented, monitoring systems are established to document how knowledge is used and its effectiveness.



- **Evaluate outcomes:** Along with monitoring, this phase evaluates the interventions' outcomes and impacts to assess their effectiveness and identify any unforeseen consequences or areas for improvement.
- **Sustain knowledge use:** This last step involves integrating feedback from the evaluation phase to refine and enhance the application of research findings.

KTA framework in fire strategy

By following the KTA framework rigorously, complex research findings can be translated into practical strategies that can be implemented quickly in emergency response and environmental management situations. The process not only allows for the direct application of research but also for continuous refinement and adaptation based on feedback from real-world users and outcomes.

In the context of fire management, the KTA framework has demonstrated its potential for integrating cutting-edge research into practical strategies. To implement research findings, the action cycle must be followed, since it facilitates tailored interventions that address specific environmental conditions and management needs. For instance, research on fire behaviour and vegetation management can be translated into effective fire management plans through this framework. Moritz et al. (2014); (Pyne, 2001) provide examples of how ecological and environmental dynamics were integrated into fire management strategies to significantly improve effectiveness and capacity.

Through the systematic application of the KTA framework, fire management practitioners can identify and overcome key barriers to the implementation of research. It also entails enhancing stakeholder engagement through targeted communication strategies and training staff to apply new knowledge effectively. A continuous monitoring and evaluation process ensures that fire management strategies are not only effective but also adaptable to new research and evolving environmental challenges (De Abreu, 2021; Graham et al., 2006).

Diffusion of innovations theory

The Diffusion of Innovations Theory, developed by Everett Rogers in 1962, provides a comprehensive framework for understanding the adoption of new ideas, technologies and practices within and across social networks. The theory is especially relevant in fields such as fire management, where adopting new practices can greatly improve operational effectiveness and safety. Rogers outlined five key attributes that affect the adoption of innovations: relative advantage, compatibility, complexity, trialability and observability. As explained below, each attribute plays a crucial role in determining how quickly and to what extent stakeholders in fire management embrace new technologies and methods (Rogers et al., 2014).

Relative advantage: This is the extent to which an innovation is seen as superior to the idea, program, or product it replaces. In the context of fire management, an innovation's relative advantage could be its ability to predict fire spread more accurately, leading to improved preparedness and potentially saving lives and property.



Compatibility: Refers to how well the innovation aligns with the values, experiences and needs of potential adopters. For fire management agencies, compatibility might involve how well a new fire suppression technology integrates with existing tools and strategies and how it aligns with the agency's operational protocols.

Complexity: Rogers suggests that simpler innovations have higher adoption rates. In the context of emergency management, complexity refers to how difficult it is to understand and use new technology or practices. Agencies are more likely to adopt user-friendly technologies that are straightforward and do not require extensive training.

Trialability: This attribute refers to the extent to which an innovation can be experimented with on a limited basis. Fire management agencies often benefit from innovations that can be trialled in controlled settings before full-scale implementation. This allows them to evaluate the effectiveness and adaptability of the technology to their specific environmental and operational conditions

Observability: The degree to which the outcomes of an innovation are apparent to others affects the probability of adoption. For example, in fire management, if the benefits of a new tool or practice are readily noticeable, such as through enhanced firefighting efficiency or reduced damage, it is more likely to be accepted by other agencies.

Understanding these attributes can assist fire management and emergency services in effectively assessing and adopting new innovations. Each attribute offers a perspective through which the feasibility and potential impact of new technologies and methods can be evaluated. This ensures that only the most advantageous innovations are implemented in high-stakes environments.

Innovations adoption in fire management

The process of adopting new technologies and methodologies in fire management, as guided by the Diffusion of Innovations Theory, begins with initial awareness and progresses through several evaluative stages before full integration. In the early stages, the focus is on assessing the innovation's advantages and testing it in controlled settings to determine its effectiveness and adaptability to specific fire management needs.

Effective communication channels are vital in this process. Workshops, training sessions and digital platforms extend the reach of innovative ideas, facilitating rich discussions that are crucial for iterative development and customisation of new technologies to local contexts.

The way fire management departments are organised and structured has a big impact on how easily they can adopt new practices. Engaging with influential individuals and change agents, whose job is to drive adoption, can help reduce resistance to change. These leaders often demonstrate the benefits of new approaches, making it easier for others to accept and integrate them into the existing frameworks (Rogers et al., 2014).



This multifaceted approach not only enhances operational effectiveness and safety but also ensures robust, responsive and scientifically grounded fire management strategies, making them more adaptable to evolving environmental and operational challenges.

Synergies and practical integration

This section delves into how combining the Knowledge-to-Action (KTA) Framework and the Diffusion of Innovations Theory can improve the implementation and dissemination of research findings in fire management. These frameworks offer complementary insights that enable fire management agencies to effectively incorporate research into their operations. By aligning the systematic approach of the KTA Framework with the social system insights provided by the Diffusion of Innovations Theory, this section explores strategies to enhance both the adoption and effectiveness of innovative practices in fire management. This integration addresses internal operational needs and external factors influencing acceptance, ensuring comprehensive adoption and sustainable application of research-derived strategies.

Combining frameworks for enhanced impact

Knowledge-to-Action (KTA) and Diffusion of Innovations Theory provide complementary perspectives that can enhance the implementation and spread of research findings in fire management. Through a systematic process involving problem identification, adaptation to local contexts and rigorous monitoring, the KTA Framework focuses on turning knowledge into action (Graham et al., 2006). Rogers et al. (2014) provide insights into how these innovations gain traction and are disseminated across different layers of social systems through the Diffusion of Innovations Theory.

Integrating these frameworks allows fire management agencies to benefit from a holistic approach that addresses not only the internal processes necessary for applying research but also the external factors that influence acceptance and widespread adoption. As an example, the KTA Framework's action cycle can be supported by the Diffusion of Innovations Theory's use of communication channels and social systems, ensuring that new strategies are implemented effectively within organisations and adopted by the wider fire management community.

Strategies for overcoming barriers and engaging stakeholders

Integrating research into fire management practices requires overcoming numerous barriers and actively engaging a wide range of stakeholders. A number of strategies can be derived from the KTA Framework and Diffusion of Innovations Theory, including:

1. **Understanding and identifying barriers:** Both frameworks emphasise the importance of identifying the barriers that impede the adoption of new practices. Fire management challenges can include logistical constraints, financial constraints, or resistance to change. It is possible to mitigate these



barriers, for example, through stakeholder analysis, resource allocation and tailor-made training programs (Graham et al., 2006; Rogers et al., 2014).

2. **Stakeholder engagement:** Communication and the involvement of key stakeholders are crucial to the innovation process. As part of this engagement, participatory workshops, collaborative decision-making and continuous feedback mechanisms can be used that align with the action cycles of the KTA Framework and the dynamics emphasised by the Diffusion of Innovations Theory. Through such engagement, new technologies and practices are implemented more smoothly and are accepted more readily by those who will be affected by them.
3. **Utilising opinion leaders:** Both frameworks acknowledge that opinion leaders and change agents play a crucial role in facilitating innovation adoption. By identifying and involving respected figures within the fire management community, it is possible to speed up the dissemination of new findings and technologies. Leaders can serve as ambassadors, enabling their peers to see the benefits of new approaches and reducing scepticism and resistance.
4. **Continuous monitoring and feedback:** An ongoing evaluation of the implementation process can identify areas for improvement and demonstrate the value of new innovations. Strategies can be refined in real-time and concrete data can be provided to convince additional stakeholders of the benefits of adopting new approaches through regular assessments.

By combining these strategies, land and fire management organisations can create a conducive environment for the adoption of innovative practices. This ensures that research findings are not only understood and applied but also propagated within and across organisations. The integrated approach maximises the impact of research on fire management practices, making them more effective, efficient and adaptive.

Application and Outcomes

This section explains how fire management organisations can apply iterative adaptation and utilise organizational enablers to improve the effectiveness and adaptability of their fire management strategies. By incorporating the principles of the Knowledge-to-Action (KTA) Action Cycle and insights from the Diffusion of Innovations Theory, this discussion focuses on the dynamic adaptation of fire management practices in response to continually evolving challenges. It examines how ongoing iterative processes and a supportive organisational culture contribute to the effective implementation of research into practice, ultimately enhancing operational outcomes in fire management.

Iterative adaptation and organisational impact

The concept of iterative adaptation in fire management, as explored by Rawluk et al. (2020), emphasises the continuous refinement of research and its applications to meet the evolving needs of fire management organisations. This process aligns closely with the Knowledge-to-Action (KTA) Action Cycle, where each phase—from identifying problems to monitoring and evaluating the effectiveness of interventions—requires



revisiting and revising strategies based on ongoing feedback and changing conditions (Graham et al., 2006).

In practice, iterative adaptation involves the dynamic adjustment of fire management strategies, such as fire behaviour modelling or vegetation management techniques, to accommodate new insights and external changes like climate variability. This approach ensures that fire management practices are not only based on the latest scientific research but are also adaptable to new challenges and discoveries, thus enhancing their sustainability and effectiveness in the field.

Cultural and organisational enablers

Cultural and organisational context plays a significant role in the successful implementation of innovative fire management strategies. According to both the KTA Framework and the Diffusion of Innovations Theory, a receptive organisational culture is conducive to learning and adaptation (Graham et al., 2006; Rogers et al., 2014). This section will delve into how a supportive organisational culture can help to implement research findings into fire management practices. It will outline strategies that improve organisational learning and knowledge management, which are essential for addressing the evolving challenges of fire management.

- 1. Organisational learning and knowledge management**
Fire management organisations prioritise continuous learning and actively integrate new knowledge into their operational practices. This commitment to innovation is crucial for adapting to the dynamic challenges of fire management. The strategies employed to facilitate this include:
- 2. Communities of practice:** These collaborative groups are where practitioners share insights, challenges and best practices. Wenger-Trayner and Wenger-Trayner (2015) Emphasise that these communities improve collective learning and promote the practical application of innovative strategies within the organisation.
- 3. Regular training classes:** Regular training sessions are important to keep teams informed about the latest research findings and technologies. In their 2008 publication, Garvin, Edmondson and Gino emphasise that systematic training programs improve an organisation's capacity to learn and adapt, ultimately enhancing its overall performance and ability to respond to new challenges (Garvin et al., 2008).
- 4. Knowledge-sharing platforms:** Both digital and physical platforms are crucial for sharing operational information and enabling interactive feedback. Bolisani and Bratianu (2018) explain how these platforms help connect individual knowledge with organisational practices. This is essential for establishing an evidence-based decision-making culture within fire management. Involving all organisational levels in the knowledge adaptation process increases the likelihood that innovation will be sustained and supported. It is possible to overcome resistance to change by involving multiple stakeholders. This ensures



not only theoretically sound but also practicably viable and widely accepted adaptations.

A supportive organisational culture and the integration of iterative adaptation processes are essential to the successful application of research into sustainable fire management practices. By aligning the iterative processes described by Rawluk et al. (2020) with an enabling environment, fire management agencies can enhance their capability to implement effective and adaptive strategies that are responsive to internal and external changes.

Developing effective communication and knowledge exchange mechanisms

Effective communication and knowledge exchange are crucial in turning research findings into practical fire management strategies. This section explains the different ways and roles that contribute to this process, with a focus on the strategic functions of advocacy, networking and integration within fire management practices.

Advocacy for evidence-based practices

Advocacy is crucial for promoting fire management policies and operations that are based on scientific research. Researchers and knowledge brokers advocate for evidence-based practices by effectively presenting current research findings to stakeholders and policymakers. This helps to align fire management strategies with the latest scientific insights (Brownson et al., 2018).

Networking for enhanced knowledge flow

Networking involves creating and maintaining strong relationships among researchers, fire managers, policymakers and community leaders. These networks enable efficient information flow and best practices exchange, enhancing collaborative problem-solving and strategic planning in fire management (Provan & Kenis, 2008).

Training and development

Regular training sessions are crucial for keeping fire management teams up to date with the latest research and technologies. These sessions are essential for promoting an evidence-based decision-making culture and improving the team's ability to implement innovative strategies effectively (Salas et al., 2012).

Governance and discussion forums

Effective governance structures and specialised discussion forums are crucial for engaging stakeholders in meaningful dialogue, refining fire management practices according to emerging needs and insights (Ansell & Gash, 2008).

Science communicators vs. knowledge brokers

While science communicators concentrate on making complex scientific information accessible and understandable to a wide audience, knowledge brokers play strategic roles in ensuring the practical application of this knowledge. Science communicators use various media to convey important information, supporting informed decision-making during emergencies (Trench, 2008).



On the other hand, knowledge brokers play a key role in integrating scientific research into operational practices. They work closely with researchers and operational teams to tailor research findings to specific contexts. They also promote organisational changes that can help the agency effectively implement new knowledge (Turnhout et al., 2013).

Integrating roles for enhanced fire management

Ensuring that fire management agencies enhance their knowledge brokering function is vital for connecting research with practical application. This requires a strategic partnership between science communicators and knowledge brokers to ensure that research findings not only reach their target audiences but are also implemented to improve fire management results (Meyer, 2010).

Fire management agencies can develop a more dynamic and responsive approach to integrating cutting-edge research and innovations into their operational practices by understanding and harnessing the complementary skills of science communicators and knowledge brokers.

Barriers and facilitators to research utilisation

It's important to understand and address the factors that either hinder or help in using research findings effectively in fire management practices. This understanding is crucial for improving the ability to respond to fire-related threats. This is especially essential within the New South Wales National Parks and Wildlife Service (NPWS) for maximising the benefits of scientific insights. This section explores the factors that can either hinder or improve the ability of NPWS to adopt and implement evidence-based strategies. By examining these factors, we can pinpoint specific interventions to overcome obstacles and bolster strengths, ultimately leading to better integration of research into operational and strategic frameworks. This analysis not only helps identify critical gaps in current practices but also lays the groundwork for nurturing a more adaptive and knowledge-driven organisational culture within NPWS.

Organisational culture

Organisational resistance to change impedes the adoption of new research. In environments where there is a deep-rooted adherence to traditional methods, introducing new scientific insights can be challenging. This resistance is often due to a lack of understanding of the benefits that these new approaches bring (Hunter et al., 2020; Schein, 1990) On the other hand, a culture that resists change or is intolerant of external research can significantly slow down these processes.

It is crucial to promote a culture of integrating scientific insights within NPWS to improve adaptability and responsiveness to changing environmental challenges (Williams et al., 2009). The importance of this is particularly apparent in emergency management contexts, where organisations with an open culture and evidence-based decision-making have demonstrated greater resilience and effectiveness (Waugh Jr & Streib, 2006).



Integrating cultural diversity and knowledge

De Abreu (2021) underscores the importance of integrating local and indigenous knowledge into organisational cultures to transcend conventional federal approaches. This inclusion not only helps mitigate cultural barriers but also significantly enriches management strategies by incorporating diverse ecological insights, which are vital for nuanced and culturally sensitive fire management practices (De Abreu, 2021). An example from Australia is the incorporation of Aboriginal fire management methods into current practices, such as the projects supported by the NSW Bushfire Hub. These efforts show how traditional knowledge can improve modern fire management strategies, leading to a more comprehensive approach to ecosystem management and fire safety (Bushfire Hub, 2021).

Learning as a catalyst for change in organisations

Rawluk et al. (2020) emphasise that an organisation's culture significantly influences its ability to implement research into effective strategies. Organisations that encourage openness and foster a learning environment are more likely to succeed in assimilating new research into their operational frameworks effectively (Rawluk et al., 2020). Black et al. (2020) highlight the critical role of organisational learning in adapting and applying research within fire management. They argue that strategically incorporating research findings into daily practices and systematically addressing barriers significantly enhances an organisation's adaptability and proactive management.

Knowledge mobilisation strategies

To effectively integrate research into NPWS practices, it is essential to deploy specific knowledge mobilisation strategies. These strategies are designed to facilitate the practical application of research and enhance organisational adaptiveness:

Co-production: This strategy involves stakeholders from various levels of the organisation working together to create knowledge that directly meets their specific needs. This collaborative process ensures that research outputs are not only relevant but also customised to address the unique challenges faced by NPWS. Co-production transforms traditional research dissemination into a dynamic, interactive process that promotes organisational learning and change (Signy, 2022).

Knowledge brokering: Another effective strategy involves using knowledge brokers, who act as intermediaries between researchers and practitioners. These brokers aid in translating complex research findings into understandable and actionable insights that can be easily implemented within the organisation's operational framework (Meyer, 2010).

Systems thinking approach

The systems thinking approach provides a comprehensive framework for understanding the intricate dynamics within an organisation. It analyses how various components of a system interact and how these interactions can either support or impede the effective use of research.

Identifying leverage points: Systems thinking involves identifying the key leverage points within the organisation, such as influential relationships or critical decision-



making junctures, that can significantly impact the success of research integration. Understanding these points allows NPWS to develop targeted strategies to enhance the adoption of research findings and overcome potential resistance (Haynes et al., 2018).

Holistic problem solving: By embracing a holistic approach, systems thinking allows NPWS to tackle issues not in isolation but as interconnected components of the entire system. This method empowers the organisation to develop solutions that take into account all aspects of the operating environment, resulting in more sustainable and efficient outcomes.

By employing these knowledge mobilisation strategies and utilising a systems thinking approach, NPWS can greatly improve the effectiveness of its fire management strategies. These methodologies ensure that practices are founded on evidence, adapted to their specific context and capable of enhancing the agency's resilience and operational capabilities.

Awareness and accessibility

Overview of awareness and stakeholder roles

Efficient fire management at NPWS depends greatly on having easy access to and understanding of the most recent research findings. Overcoming obstacles such as a general lack of awareness, expensive subscription fees and the complexity of scientific reports is crucial. To tackle these challenges, a collaborative effort is necessary across different roles within the fire management system (Davies & Nutley, 2000; Hunter et al., 2020).

Specialist researchers and science communicators: These professionals are responsible for advancing research and translating it into easy-to-understand summaries and actionable insights to ensure that complex information is accessible at all levels of NPWS (Krupek et al., 2022; Logan & Graham, 1998).

Fire management agencies' responsibilities: NPWS should facilitate easy access to research findings, possibly by creating specific roles for science communication to improve organisational knowledge and operational effectiveness (Wilson et al., 2010).

Strategies for enhanced communication

Adopting proven communication strategies inspired by Natural Hazards Research Australia, NPWS is set to implement long-term, comprehensive methods to enhance research communication, crucial for translating knowledge into actionable insights.

- **Targeted workshops and seminars:** Customising educational sessions to address specific departmental challenges helps NPWS enhance the relevance and uptake of new knowledge, making complex findings practical and immediately applicable.
- **Regular research updates:** By utilising digital platforms for ongoing updates, NPWS keeps all organisational levels well-informed, promoting a culture of knowledge-sharing and facilitating the adoption of innovative practices (Greenhalgh et al., 2004).



- **Utilisation of local case studies:** Examples such as the Australian Fire Danger Rating System (AFDRS) demonstrate the practical application of research. They motivate staff and show the real-world benefits of scientific engagement.

Diverse communication methods

Effective dissemination of research findings within NPWS should utilise a variety of communication methods:

Formal communication channels: Including structured workshops and seminars to explore new research and its implications thoroughly.

Informal communication channels: Facilitating casual meet-ups and forums that promote spontaneous exchanges of ideas and foster a culture of continuous learning (Illingworth, 2023).

By refining these strategies, NPWS can significantly improve its effectiveness and efficiency in fire management. This holistic approach ensures continuous updates with the latest scientific insights and best practices, enhancing the agency's responsiveness and capability to manage fire-related risks effectively.

Availability of resources

The availability of financial, human and infrastructure resources plays a significant role in an organisation's ability to implement research-based fire management strategies. There are limitations to the ability to pilot new approaches, invest in training, or allocate time for staff to engage in research (Walsh et al., 2019). Providing dedicated funding helps translate research into action by providing personnel with the necessary resources to translate research into practice (Goldman et al., 2001).

A number of emergency and hazard management agencies have stressed the importance of allocating resources specifically to the implementation and innovation of research. The allocation of resources and personnel for the exploration and adaptation of new research findings can serve as a model for NPWS to overcome resource-related barriers (Drabek, 2018).

The success of the AFDRS demonstrates the impactful results of over a decade of collaborative research and targeted funding. This initiative has been crucial in establishing a country-wide system that incorporates strong, science-based strategies into fire management practices. The organised and strategic allocation of resources used in developing the AFDRS can be a model for NPWS, ensuring that adequate funding, personnel and infrastructure are available to support the adoption and effective implementation of research-driven strategies (Council, 2022).

By learning from the successes of the AFDRS and similar initiatives, NPWS can enhance its ability to effectively manage fire-related risks through scientifically informed and resource-backed strategies.



Leadership support

Developing an organisational culture that prioritises evidence-based practices and overcomes resistance to change requires leadership support. The role of effective leaders is to facilitate a receptive environment for innovative ideas by integrating research into decision-making processes. This support is crucial not just in endorsing the importance of research but also in allocating resources and setting strategic priorities that align with research-based findings, thus enhancing the organisation's capability of responding efficiently and effectively to fire-related challenges (Kotter, 1996; Walsh et al., 2019).

Leadership examples in research utilisation

Australian Fire Danger Rating System (AFDRS): The leadership of the Australasian Fire and Emergency Service Authorities Council (AFAC) was pivotal in developing and implementing the AFDRS nationwide. By offering strategic direction and ensuring necessary resources, AFAC played a crucial role in integrating the system across different Australian fire management agencies. This example of sector-wide leadership highlights the effectiveness of a coordinated approach in adopting significant innovations in fire management practices in Australia.

Emergency services: Leadership plays a decisive role in prioritising and utilising research in emergency management. Leaders who promote a learning culture and evidence-based practices empower their teams and facilitate structural changes that enable research to be integrated into operational strategies. Developing an environment that values and pursues innovation derived from research requires proactive leadership (Boin & Hart, 2003).

Strategic application to NPWS

By leveraging successful examples from emergency and hazard management, NPWS can enhance its research utilisation capacity. By leveraging facilitators and navigating leadership barriers, NPWS can develop a more resilient and adaptive fire management approach. Through these cross-domain insights, NPWS can enhance its ability to effectively utilise research, resulting in more robust and informed fire management strategies.

Application of research in fire and land management

Integrating scientific research into fire and land management practices is an essential endeavour that greatly influences fire management effectiveness. Several other jurisdictions, including NSW, have had difficulty translating research findings into management actions. This section synthesises the history of such efforts, highlighting successes, identifying challenges and focusing on NSW.

Successes in research application

A notable success in the application of research into fire management in NSW has been the development and implementation of Fire Management Strategies (FMS) within the NSW National Parks and Wildlife Service (NPWS). Underpinning these strategies is solid fire ecology research, which informs prescribed burning practices, fire suppression tactics and biodiversity conservation efforts. The work of Dr Richard J.



Williams, as detailed in the *Review of NSW Office of Environment and Heritage investment in bushfire research* (Williams, 2016), exemplifies the effective translation of ecological research into policy and practice, significantly improving the management of fire in NSW's national parks (Williams, 2016).

An excellent example of putting fire management research into practice in Australia is the development and use of the Fire Tools platform by the NSW Bushfire Hub. This innovative tool, guided by Dr. Grant Williamson, is a cloud-based GIS processing platform for planning prescribed burns. Users can upload GIS data packs containing fire history, vegetation type and fuel management zones and Fire Tools processes the inputs to create maps showing vegetation fire intervals. These maps indicate areas that are burnt too frequently, near a threshold, or have not been burnt for a long time and help in planning hazard reduction burning programs. This system shows how research can be effectively integrated into fire management strategies. It demonstrates the significant enhancement of operational capabilities through collaborative research. More information about this initiative and its impact can be found on the NSW Bushfire Hub and through various AFAC webinars discussing its real-world application (Hub, 2021).

Another success story is the implementation of geographic information systems (GIS) and remote sensing technologies for fire management. The applications of these technologies for mapping fire extents, understanding fire behaviour and planning prescribed burns have now become integral to fire management operations. By doing so, the NPWS has become more precise and informed in its decision-making processes, resulting in better fire management results (Valero et al., 2018).

Focusing on NSW

Through collaborative research partnerships and initiatives such as the Bushfire Risk Management Research Hub, NSW has made efforts to bridge the gap between research and practice. As a result of these collaborations, research agendas are closely aligned with the needs of fire and land managers, facilitating the co-production of knowledge that is both relevant and easily applicable (NSW, 2019).

Furthermore, the establishment of the NSW Bushfire and Natural Hazards Research Centre (BNHRC), a partnership between the NSW Government and Western Sydney University, shows a proactive approach to implementing research-driven solutions. In response to the NSW Bushfire Inquiry and the 2022 NSW Flood Inquiry, this Centre was formed to deliver actionable research recommendations to improve hazard management.

Knowledge exchange mechanisms, such as workshops, webinars and interactive decision-support tools, have also played a crucial role in enhancing the application of research in fire and land management in NSW. The purpose of these platforms is to disseminate research findings, encourage dialogue between researchers and practitioners and support the continuous education of fire management personnel on the latest research developments (McFayden et al., 2023).



Conclusion

Significant progress has been made in translating research into fire and land management practices in New South Wales. However, there are still numerous challenges that need to be addressed. The application of scientific research in fire management requires continuous efforts to strengthen the connection between research and practice, improve the relevance and accessibility of research and establish effective knowledge-sharing mechanisms. These efforts are crucial not only for meeting the operational needs of agencies like NSW National Parks and Wildlife Service (NPWS) but also for advancing the broader goal of sustainable and resilient ecosystem management in the face of increasing fire risks.

The Fire Tools research project, led by the NSW Bushfire Risk Management Research Hub, is a local initiative that demonstrates the successful integration of scientific research into practical management strategies. This project shows how strategic investments in technology and collaboration can enhance the capacity of fire management agencies to implement research-based solutions effectively. These local examples highlight the importance of strong support systems, cooperative efforts and flexible organisational cultures to facilitate enhanced research utilisation.

By focusing on local examples and the specific strategies they employ, NPWS and similar agencies can enhance their ability to adapt to and manage fire-related challenges effectively, ensuring that their approaches are both scientifically grounded and practically viable.



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