

Hazard Note

Topics in this edition | communication | emergency management | planning | warnings

Community comprehension, perception and use of maps during bushfires

About this project

The way community members with experience of bushfires understood, used and took action in response to existing bushfire maps was investigated so that future maps can be better understood and utilised by members of the public. This project also supports the development of evidence-based principles to inform a nationally consistent approach to the future use of bushfire predictions in public communication during future emergencies. *Predictions in Public: understanding the design, communication, and dissemination of predictive maps to the public* was undertaken by Natural Hazards Research Australia, RMIT University, Queensland University of Technology, Deakin University, Swinburne University of Technology, Country Fire Authority Victoria and Victoria's Department of Education.

Authors

Dr Erica Kuligowski, Philippa Perry, Gita Pupedis, Dr Amy Griffin, RMIT University; Dr Chloe Begg, Country Fire Authority; A/Prof Paula Dootson, QUT; Angela Gardner, Department of Education Victoria; Dr Timothy Neale, Deakin University; Dr Graham Dwyer, Swinburne University of Technology

Contact: erica.kuligowski@rmit.edu.au

Summary

When asked about their use of bushfire maps during the 2019–2020 fire season, a participant from New South Wales recalled:

"Yeah, we were kind of living off them really. You'd see something or you'd go around to a neighbour's place and see it from a different angle, and you'd go and check the app again, just trying to get our heads around exactly what was happening – we were really living off it. It was used more – those apps were used more than the phone feature on the phone over those days."

Maps are an important way to communicate spatial information and are increasingly distributed and used in natural hazards, like bushfires. The use of maps, and in particular, fire spread prediction maps that display the likely spread of fire over time, have become an important topic of interest for fire and emergency services agencies across Australia. Therefore, the *Predictions in Public* project turned to the public to explore how community members understood, used and acted on maps during bushfire emergencies, including incident and fire spread prediction maps.

Three locations that experienced recent bushfires were identified: Cardinia, Victoria (the 2019 Bunyip Complex fires); southern Australian Capital Territory (ACT) and the Snowy Monaro, New South Wales (NSW) (2019–2020 Black Summer fires); and the

Huon Valley, Tasmania (the 2019 Riveaux Road fire). Across these locations, in-person and online interviews with 94 participants were conducted between November 2022 and April 2023. The interviews explored community members' comprehension, use and actions in response to bushfire maps in two parts:

1. during their previous experiences in bushfires; and
2. when shown two types of maps and associated warning messages with a location in their state during the interview.

Part 1 findings highlighted the different types of mapping platforms participants used and why, when and how often they would consult these maps during bushfires. Researchers found

that during a bushfire, participants used maps alongside many other types of information to make sense of the situation and decide what to do next. The challenges participants encountered in understanding bushfire maps were also collated, with participants' recommendations for improvements.

Part 2 findings identified the types of comprehension issues participants faced when viewing both incident and fire spread prediction maps, as well as the areas they assessed to be at highest risk. Participants provided suggestions for map improvements, highlighting the types of information to improve map clarity and better ways that complicated concepts on prediction maps could be communicated, such as the direction of fire spread and uncertainty.



Above: This research explored how people with previous experience of bushfire used bushfire incident and prediction maps during fires, as well as their understanding of key information. Photo: Zahlia Ligthart.

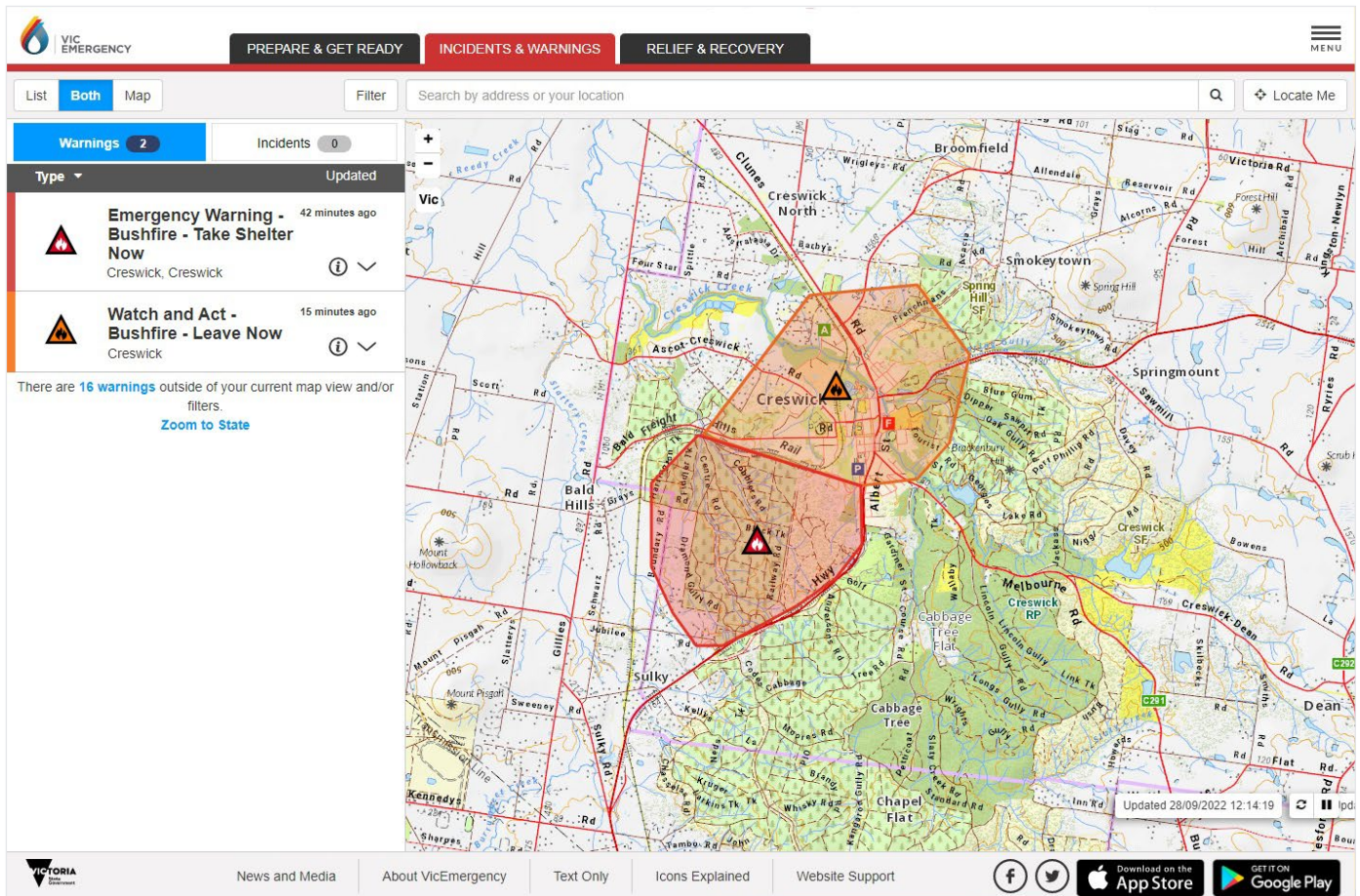


Figure 1: A mocked up incident map shown to Victorian interview participants

Background

The 2019-2020 bushfire season was the first time that the NSW and ACT Rural Fire Services regularly shared fire spread prediction maps with the public as part of their public information and warning communication. Other fire agencies previously released similar maps on an ad hoc basis, while the Country Fire Authority (CFA) in Victoria sometimes released maps of potential impact zones (for example, in East Gippsland during the 2019-2020 season).

Previous research by Natural Hazards Research Australia and the Bushfire and Natural Hazards CRC identified support from Victorian operations staff for the dissemination of fire spread prediction maps to the public, while post-event inquiries recommended greater use of fire spread predictions in public messaging. To aid the development of evidence-based guidelines on how predictive maps should be designed and communicated to the public, a clear understanding of how community members comprehend, use, and act upon fire spread prediction maps was needed.

While previous studies explored the effectiveness of hazard maps for communicating bushfire warning information to the public, none looked at if and how fire spread prediction maps could help community members understand their risk from the bushfire and take action accordingly.

Research methodology

From November 2022 to April 2023, semi-structured interviews were conducted in areas that experienced bushfire in 2019-2020: Cardinia in Victoria; southern ACT and the Snowy Monaro, NSW; and the Huon Valley, Tasmania. In total, 94 participants were interviewed in-person or online and these sessions explored how participants used, understood and acted on bushfire maps, including fire spread prediction maps while their communities were at risk of bushfire. Participants were also shown fire incident and prediction maps with their associated warning messages to determine what they saw and understood when looking at these types of maps.

Participants comprised 50% female/male respondents and skewed slightly older across all locations (with only 10% of respondents younger than 45 years old). The majority held a minimum of a bachelor's degree and were frequent users of all types of maps, not just bushfire incident and prediction maps. Additionally, 39% of participants' households were members of an emergency service agency, 40% experienced at least five bushfires before the 2019-2020 fires, and approximately 60% had evacuated at least once due to bushfire.

Research findings

Participants indicated that they used different types of maps during bushfires, including local fire agency maps, the Bureau of Meteorology, Google Maps and third-party weather or hazard mapping platforms, like the Windy app, Digital Earth Australia (DEA) hotspots map and bushfire.io.

Maps were checked more often at certain times during the bushfire, especially for early information (when the fire had not yet spread to participants' immediate areas) or when the fire was moving quickly. Many participants used maps frequently, between 20 to 50 times each day.

A combination of information sources was used by participants to get a broader picture of their bushfire situation, with maps only one tool in their information toolbox. Community meetings were particularly useful in increasing understanding of fire spread prediction maps, as fire agency experts were on hand to explain the maps in more detail and answer questions.

Participants used maps for different purposes:

- to self-localise, or identify where they were in relation to the bushfire;
- gather information about the bushfire and what to do next;
- Monitor the extent or rate of spread using the burnt areas shown on the map;

- cross-reference map information with other sources;
- confirm or explain the physical cues that they were seeing around them (for example, smoke or emergency response crews and vehicles responding to the fire);
- make judgements about how the fire might spread and the level of risk;
- inform or warn others who may be at risk; and
- monitor the impact of the fire on their or others' properties, especially after evacuation.

Several main challenges in participants' use of maps were identified, including difficulty ascertaining whether information was up to date; missing, inconsistent or inaccurate information; and inaccessibility of information due to lack of internet or coverage, device used, or comprehension issues. Participants indicated that this often reduced their confidence in the mapped information.

When shown an incident or fire spread prediction map, participants couldn't consistently identify the location at greatest risk of harm from bushfire. The meaning of the warning polygons (Figures 1 and 3), triangle symbols and the meaning of the triangles' locations (Figure 3) and the risks associated with certain areas on the maps, such as the grey or burnt areas, and the areas of potential fire spread (Figure 2), were also confusing for participants.

Regardless of map type, all participants requested more information to help them understand and act:

- Wayfinding and navigation information to help self-locate, including city and town names, landmarks, topographical information, parks and road names; as well as traffic information, road closures, refuges and potential routes for evacuation;
- Environmental conditions, including fire size, intensity, activity (including burnt areas), location, spread and direction;
- Weather information and forecasts; and
- Emergency response information (including the number of responding vehicles, their locations within the affected areas and the areas of intervention [e.g., backburning and containment lines]).

Participants also requested map features such as a scale bar, compass, legend, increased resolution and clear colouring to help improve their use and understanding of the mapped information.

Research impact

This part of the *Predictions in Public* project's findings provide significant insight into the public's needs in understanding and acting on bushfire predictive and incident maps.

The inclusion of additional information suggested by participants in future bushfire maps may depend on map type and purpose – wayfinding and emergency response information may be best shown on a localised incident map (Figures 1 and 3), rather than a state-wide prediction map (Figure 2). Users' inference of missing information is key to how and where these types of information should be included in future bushfire maps. When information was missing, participants made inferences about future fire spread predictions, fire locations, weather or wind conditions, and the scale of the bushfire, extent of damage and firefighting resources needed based on their own knowledge and experience. In some cases, this didn't lead to accurate conclusions.

The ability of map users to self-locate was identified as important by participants.

Fire spread prediction maps can enable users to understand their location in relation to the area of greatest risk by clearly communicating the direction of fire spread and including information about the fire front and areas of fire activity. This would help residents to understand the risk around them and make the best protective action decisions for themselves and their families.

The suggestions made by participants about different ways that fire spread prediction maps could more effectively communicate risk and uncertainty will be tested in Phase 2 of this project via laboratory experiments, surveys and focus groups.

Through the stories and experiences of residents who experienced bushfire in these three communities, *Predictions in Public* provides critical insights into future bushfire map

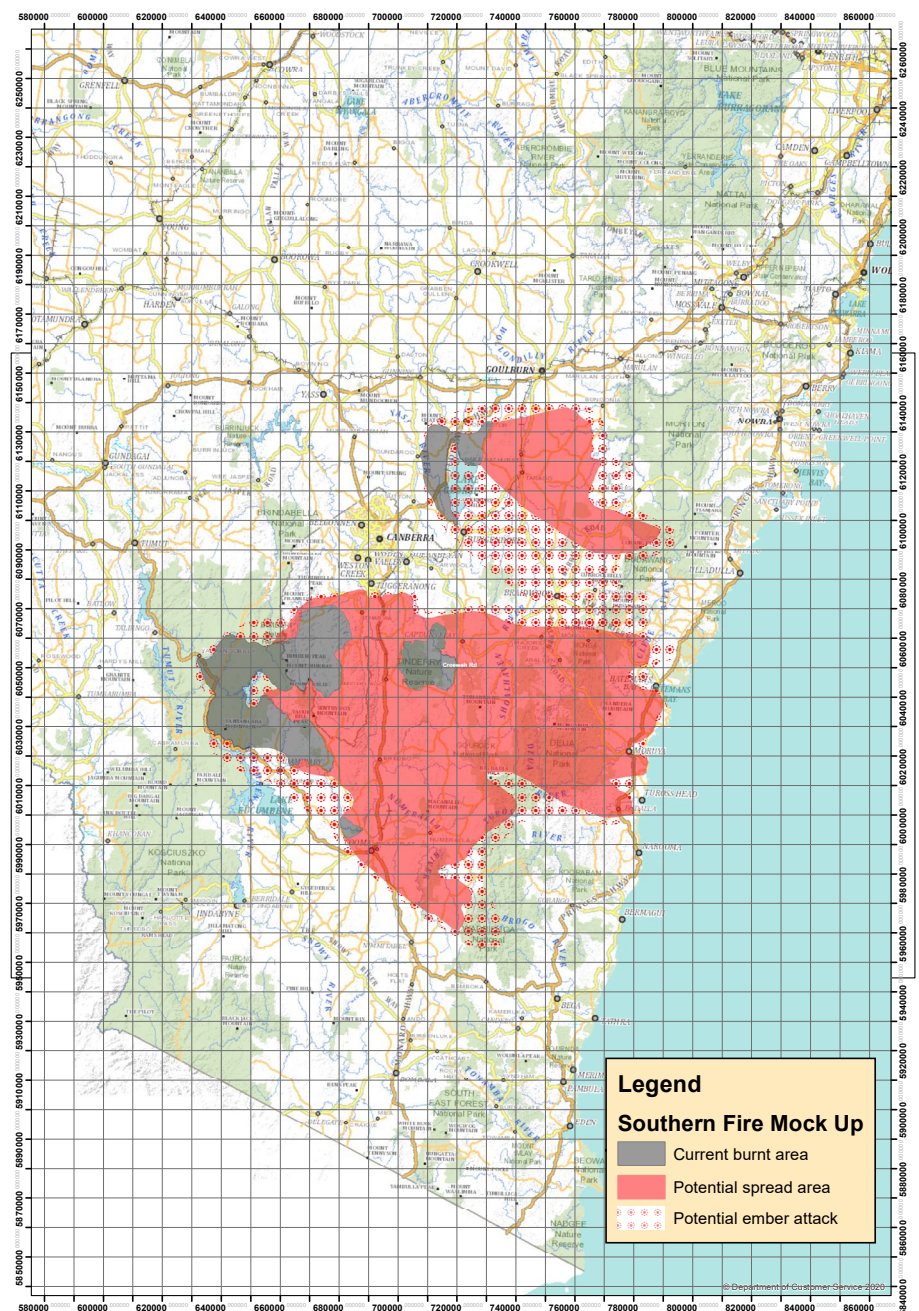


Figure 2: A mocked up fire spread prediction map shown to NSW/ACT interview participants

design that will benefit communities around Australia. In conjunction with other parts of this project (*Work Package 3: Interviews with fire agency personnel about the role and value of predictive services products and Work Package 5: First National Community Survey*), these findings will inform the design of fire spread prediction maps that will be tested and refined in subsequent *Predictions in Public* projects.

Project acknowledgements

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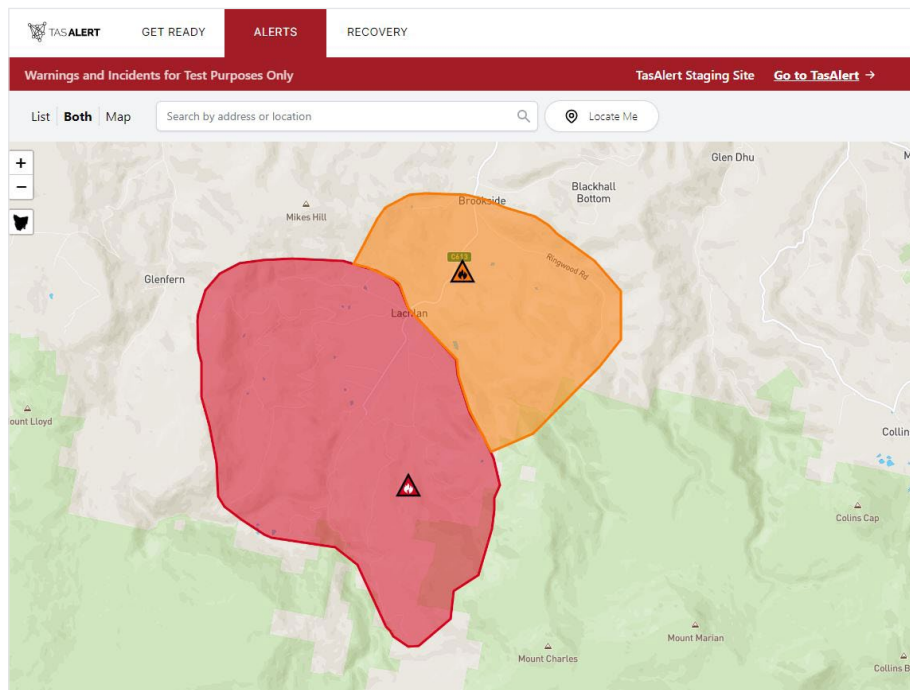


Figure 3: A mocked up incident map shown to Tasmanian interview participants

local fire agency units for their help in finding places to hold interviews and sending out information about the study to participants.

End-user statement

Marc Unsworth, Lead Officer, Operational Communication Capability, Emergency Management Victoria

Bushfire maps, including incident and fire spread prediction maps, are a critical tool in communicating life-saving emergency information to the Australian public during bushfires. However, limited empirical evidence and guidance exist on appropriate predictive map design and use during bushfires, especially in an Australian context. The research findings presented in this report provide a unique opportunity to understand how members of selected communities in Victoria, NSW/ACT and Tasmania use, comprehend, perceive, and act upon bushfire maps and associated warning messages.

With findings from this research, in combination with the findings from other work packages within the *Predictions in Public* project, emergency and fire services agencies can design bushfire predictive maps and associated warnings to meet the needs of communities during fire events. This research can assist us in designing and disseminating maps to guide safe and effective early protective action decision-making in affected communities, and in turn, better protect people from injury and loss of life. Also, these and future findings from this project will be instrumental in the development of evidence-based guidelines and recommendations for how to design, communicate, and disseminate fire spread prediction maps to Australian communities exposed to bushfires.

Further reading

The following resources are available at www.naturalhazards.com.au/predictions-in-public

Predictions in Public Phase 1 Report (2024), Natural Hazards Research Australia Morrison, R., Kuligowski, E., Dootson, P., Griffin, A., Perry, P., Pupedis, G., Begg, C., and Gardner, A. (Under Review).

Understanding the challenges in bushfire map use and effective decision-making amongst the Australian public.

International Journal of Wildland Fire

Begg, C., Gardner, A., Kuligowski, E., Griffin, A., Dootson, P., Neale, T., & Dwyer, G. (2022). AFAC Conference: News and Views: *Co-designing predictive maps for community use during a bushfire*. The *Australian Journal of Emergency Management*, 37(4), 63-64.

Dootson et al., *AFAC extended abstract* Neale, T., Miller, G., Begg, C., Dootson, P., Kuligowski, E., Griffin, A., Dwyer, G., & Gardner, A. *Role and value of predictive services products (2023)*, Natural Hazards Research Australia



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