Living with bushfires on the urban-bush interface

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Submitted: 19 June 2019. Accepted: 5 September 2019.

Introduction

In Australia, many people reside on the edges of cities in areas with high levels of vegetation sufficient to fuel major bushfires. These areas typically have large numbers of houses that abut or intermingle with flammable bushland vegetation (Radeloff et al. 2005). These areas are known variously as wildland-urban interfaces (Radeloff et al. 2005), rural-urban interfaces (Pearce 2019), peri-urban areas (Llausàs et al. 2016) or the urban-bush interface (Solangaarachchi, Griffin & Doherty 2012). Over the last 20 years, several Australian cities have experienced disastrous bushfires in the urban-bush interface, including the Canberra 'firestorm' in 2004, the Perth Hills fires of 2011 and 2015, the south-east Tasmania fire in 2013, the Blue Mountains fires of 2013 and the Adelaide Hills fire of 2015. Fires in the urban-bush interface are often more difficult to control than fires burning in areas with fewer houses (Radeloff et al. 2018) and have the potential to lead to very large losses of assets.

Growth in population, demand for housing and desire to live in a natural environment are leading to more people moving into the urban-bush interface, causing an increase in the threat from bushfires (Lohm & Davis 2015, Pearce 2018, Radeloff et al. 2018). While people who live in the urban-bush interface are increasingly exposed to bushfire, they may not adequately perceive the risk to which they are exposed (Every et al. 2015, Langer & Wegner 2018). There is limited research that has directly examined the experiences, beliefs and actions of residents in urban-bush interfaces in relation to bushfire risk. A study by Beringer (2000) reported low levels of bushfire preparations by urban-bush interface residents. Following the 2009 Victorian Black Saturday bushfires, surveys were commissioned and included urban-bush interface residents. Between 2009 and 2015, the Bushfire CRC and Bushfire and Natural Hazards CRC conducted nine post-bushfire surveys of householders threatened by serious bushfire events (see Table 1). Respondents included 1362 urban-bush interface residents. Survey findings indicated that prior to the bushfires, significant percentages of residents did not believe they were at risk and had no plan for what to do in the event of a bushfire. In addition, the surveys found that household bushfire safety planning and preparation levels for evacuation, house protection and property defence were lower than what fire agencies regarded as desirable (McLennan, Paton & Wright 2015). This finding is consistent with a longitudinal study of a sample of Victorian households in areas deemed to be at notably high risk of bushfire, most in urban-bush interface locations (Muir et al. 2017).

Lohm and Davis (2015) reported fewer negative findings from interviews (n = 11) with householders in at-risk locations on Melbourne's urban fringe. Using a qualitative methodology, they concluded that residents had a strong

ABSTRACT

Due to the attractiveness of living in a natural environment, more people are likely to reside in urban-bush interface areas that expose them to dangers from bushfires. Surveys conducted after fires over 2009–2015, indicated that many residents in urban-bush interface areas under-estimate their bushfire risk and do not prepare adequately for these events. For this study, householders living in urban-bush interface areas of Melbourne completed an online survey that showed that the attractiveness of the natural environment setting was the major reason for living in the location. The majority of respondents indicated bushfires as a negative feature of living in the urban-bush- interface. Compared with findings from post-bushfire surveys during 2009–2015, a greater number of respondents had a bushfire survival plan to evacuate as well as being prepared to evacuate if threatened. However, one in eight householders planned to 'wait and see' how a fire developed before taking action. Also, levels of activities to reduce house vulnerability to bushfire were low. For some householders, this was because they believed such preparations would be ineffective and, thus, pointless. This unpreparedness presents challenges to emergency management organisations and, in particular, fire agencies.

Table 1: Threatened householders in urban-bush interface locations reporting no pre-fire concern and pre-fire plans.

Location, date; (number of interviews/online survey responses)[a], type of location	No pre-fire concern	No pre-fire plan	Planned to leave	Planned to stay and defend	Planned to wait and see
1. Eight fire complexes, Victoria; February 2009; (126)[b], IM, IF	25	33	25	33	3
2. Clifton Hill, WA; January 2011 (40)[c], IM	7	20	65	10	5
3. Perth Hills, WA; February 2011 (456)[c], IM, IF	nr	24	28	20	28
4. South-eastern Tasmania; January 2013 (245)[c], IM, IF	8	12	47	26	15
5. Shoalhaven, NSW; January 2013 (80)[d], IM, IF	16	28	nr	nr	nr
6. Blue Mountains, NSW; October 2013 (79)[e], IF	27	17	23	42	18
7. Port Stevens, NSW; October 2013 (52)[e], IM	44	52	8	25	15
8. Parkerville, WA; January 2014 (91)[c], IM, IF	9	19	49	25	7
9. Sampson Flat, South Australia; January 2015 (193)[f], IM	15	17	18	37	18
Unweighted average	22	25	33	28	14

Note: IM = housing bushland intermix, IF = housing bushland interface, nr = not reported.

[a] No.1–No.8 were interviews, No.9 was an online survey, [b] McLennan, Elliot and Omodei (2011), [c] McLennan, Paton and Wright (2015), [d] Mackie and colleagues (2013), [e] McLennan, Wright and Birch (2013), [f] Every and colleagues (2015).

emotional attachment to their property but were aware of the danger posed by bushfires and the likely limited effectiveness of preparations to protect their property. Lohm and Davis (2015) proposed the centrality of an ongoing existential dualism for the residents: a precarious balance of living in an environment that was both healthy and dangerous. The study suggested that bushland-dwelling residents engaged in a form of emotionally based risk management in which possible future danger from bushfire was counterpoised by love of the surrounding natural environment.

Anton and Lawrence (2016) found that while emotional place-attachment to home was related to bushfire mitigation and preparation in rural communities, this was not so in urban-bush interface communities. A study by Strahan, Whittaker and Handmer (2018) surveyed 457 mostly urban-bush interface residents in two areas that had experienced recent bushfire threats. On the basis of a cluster analysis of the information provided by the residents, seven groups or archetypes, of residents were identified. The seven archetypes were related to their stance on evacuating or remaining at their property under imminent bushfire threat:

- responsibility-denying evacuator
- dependent evacuator
- considered evacuator
- community-guided evacuator
- worried waverer
- threat-denying remainer
- experienced and independent defender.

That study concluded that the differences among the archetypes meant that fire agencies needed to adopt a range of approaches to promote bushfire safety. This would accommodate the different motivations and expectations of the different archetypal groups.

Community research after the 2009 Black Saturday fires showed that the lack of bushfire preparedness of people living in the urban-bush interface presents a challenge for fire agencies.

Image: Jim McLennan

In summary, appreciable percentages of people in the urban-bush interface sampled in the 2009–2015 post-bushfire surveys commissioned by fire agencies seriously misjudged their level of risk, had not planned what to do in the event of a bushfire threat and were not well-prepared to survive. The study by Strahan, Whittaker and Handmer (2018) suggested important differences among urban-bush interface householders in their beliefs about bushfire danger circumstances and appropriate survival options. However, what seems lacking is a broader understanding of the reasons householders reside in urban-bush interface locations, their associated everyday life issues, their perceptions of the threat posed by future bushfires and how these perceptions relate to bushfire safety preparations. Lohm and Davis (2015) go some way towards addressing these issues. However, the study involved a very small number of urban-bush interface residents and the method of recruitment (posters in public places and social networking inviting residents to contact the researchers to discuss bushfire risk and preparations) may have resulted in an unrepresentative group of interviewees who were especially concerned about bushfires.

The present study used an online survey to examine the experiences of a sample of urban-bush interface householders on the fringes of Melbourne. The study included reasons for choosing to live in the location, positive and negative aspects of living in an urban-bush interface area, perceptions of bushfire threat and plans and preparations for such an event. The aim was to understand how residents in the urban-bush interface view bushfire threat to their properties in the context of their living choices and experiences as well as how they plan and prepare for the possible threat.

The research was conducted as part of a larger study investigating how bushfire safety preparations relate to people's bushfire risk perceptions and everyday life activities. The major finding was that levels of householder bushfire safety preparation actions were linked more to their bushfire-related household priorities than to their perceptions of bushfire risk (Koksal et al. 2019).

Method

Participants

A total of 127 householders completed a survey using the Qualtrics[1] online survey software platform. Respondents comprised slightly more women (n = 69, 54 per cent) than men (n = 58, 46 per cent). The median age was 58 years (*M* = 56.1, *SD* = 13.19, range = 21–84). Most (n = 121, 95 per cent) were property owners, not renters, and the median period of residency on the property was 10 years (*M* = 15, *SD* = 12.63, range = 1–50).

1   Qualtrics. At www.qualtrics.com/au/.

Survey questionnaire

The online survey was developed using information gained from interviews with 32 urban-bush interface householders about their experiences of near-bushland living (Koksal et al. 2019). The survey gathered information about eight aspects of living in the location.

Procedure

The research was approved by the La Trobe University Human Ethics Committee (Reference S17–17). In 2017, 4000 invitations were mailed to residences in six postal areas selected because of their extensive areas of bushland. The postal areas were in three local government areas on the northern fringes of Greater Melbourne being Macedon, Yarra Ranges and Nillumbik. Householders who resided in or within 100 metres of bushland were invited to participate in a study of their experiences of living in their location. The survey introduction defined bushland to include forest, grassland, scrub, parkland, farmland and state or national parks. Eligible householders accessed and completed the survey online. Householders provided the address of their property with the assurance that the information would be deleted once the distance of their home from bushland had been checked using Google Maps satellite imagery.

Results

Close to half (52 per cent) of the 127 respondents were employed and one-third (34 per cent) were retired. The majority (62 per cent) resided on properties larger in size (>0.1 hectares) than a typical urban residential block (Table 2). Most participants (89 per cent) reported they had adequate house and contents insurance against loss due to bushfire.

Table 3 summarises householder reasons for living in the bushland location, and the positive and negative aspects of living in that location. Preference for a natural environment location and the associated lifestyle were the most frequently reported reasons for choosing to live in the location. These were also the most frequently reported positive aspects of bushland living, followed by the sense of community. Concern about bushfire, as a negative aspect of the location, was reported by almost three-quarters (n = 94, 74 per cent) of respondents. While this was the most frequently reported single negative aspect of living in the location (28 per cent), other negative aspects related to daily living such as high property maintenance, lack of services and transport, power outages and poor telecommunications were also mentioned, accounting in total for 67 per cent of the negative aspects of bushland living.

In response to the question about how concerned they were about bushfires when considering whether to live in the location, 24 per cent were not at all concerned, 39 per cent were a little concerned, 31 per cent were moderately concerned and 6 per cent were very or

Table 2: Householder occupations and property types (N = 127).

Occupation		Per cent
Employed full-time		28
Employed part-time		24
Retired		34
Home duties		6
Full-time student		6
Unemployed, seeking work		2
Property type	Normal-sized residential (~0.1 hectares)	27
	Larger-sized residential (>0.1 hectares)	31
	Large 'lifestyle' property[a]	31
	Agribusiness (farm, winery, nursery, orchard, horse stable)	11

[a] Usually 1–10 hectares in size, in a peri-urban location, used primarily as a residence because of its natural environment amenity rather than as an agribusiness.

extremely concerned. Almost half the householders (n = 60, 47 per cent) reported awareness of a bushfire threat warning sometime during the previous 10 years. Of these 60 householders, 46 (77 per cent) also reported bushfires as a negative aspect of living in the location. There had been significant bushfire threats to all three local government areas over the past 30 years. Homes had been destroyed and lives had been lost in parts of the Macedon area in the 'Ash Wednesday' fires of January 1983. Homes had been destroyed and lives had been lost in more northerly suburbs of Yarra Ranges and Nillumbik local government areas during the February 2009 'Black Saturday' bushfires (these suburbs were not sampled for the study). However, there was no relationship between a householder's awareness of a previous bushfire threat and nominating bushfire as a negative aspect of living in the location: χ^2(1, N = 127) = 0.13, p>0.70.

Responses to the question about how likely respondents believed that their property would be threatened by a bushfire in the next five years were:

- extremely unlikely, 1 per cent
- highly unlikely, 4 per cent
- somewhat unlikely, 14 per cent
- somewhat likely, 32 per cent
- highly likely, 25 per cent
- extremely likely, 11 per cent
- almost certain, 13 per cent.

Survey questions:

- Demographic information.
- Please indicate: (a) the main reasons you chose to live in the location, (b) the most important things you enjoy about living in the location and (c) any negatives associated with living in your location.
- When you were deciding whether to live here, how concerned were you about dangers from bushfires? (1) not at all concerned, (2), a little concerned, (3) moderately concerned, (4) very concerned or (5) extremely concerned.
- How vulnerable do you think your house is to loss or damage due to a bushfire if one threatened your property? (1) not at all vulnerable, (2) very low, (3) low, (4) moderately vulnerable (5) quite vulnerable, (6) highly vulnerable or (7) extremely vulnerable.
- How likely do you think it is that your house will be seriously threatened by a bushfire in the future - say in the next five years? (1) not at all likely, (2) extremely unlikely, (3) highly unlikely, (4) somewhat unlikely, (5) somewhat likely, (6) highly likely or (7) extremely likely.
- Has there been a bushfire in the area since 2007? Yes or No.
- Would you say that you have a household plan for what you will do if the property is threatened by a bushfire? Select from (i) All members stay to defend the property, (ii) all members leave as soon as possible for a safer destination, (iii) some members leave as soon as possible, others stay to defend the property, (iv) wait and see how serious the threat is then decide to either leave or stay to defend the property or (v) no definite plan.
- Completion of a 15-item version of the Bushfire Safety Preparation Checklist (BSPC-15). This was a shortened version of the 23-item measure developed by McLennan and Elliott (2011). The 23-item measure was used in a pilot interview study. However, many of the householders interviewed were unclear about what constituted adequate bushfire safety preparations for their circumstances and inappropriately chose a 'Not Applicable' option for several of the items. It was decided to use a shortened version of the measure. Only items that were about evacuation or house protection preparations that had been answered appropriately during the pilot study were used. These 15 items are listed in Table 3. The internal consistency reliability was adequate for a checklist measure: α = 0.65. The BSPC-15 comprised two sub-scales of Evacuation Preparations (five items, α = 0.55) and House Protection (ten items, α = 0.60).

Table 3: Living in the bushland location: initial reasons, positive aspects, negative aspects (N = 127)

Reasons for initially choosing to live at the location (total number of reasons, n = 454)	Percentage of number of reasons[a,b]
1. The natural environment	18
2. The lifestyle opportunities	18
3. Quiet, little traffic	16
4. Healthy, no pollution	13
5. Familiar with the area, liked it	13
6. Affordability of the property	12
7. The nature of the community	4
8. Near to work	3
9. Close to transport	3
Positive aspects of living in the location (total number of reasons, n = 267)	
1. The natural environment	42
2. The large size of the property, lifestyle	27
3. The sense of community	25
4. Public transport and accessibility	7
Negative aspects of living in the location (total number of reasons, n = 335)	
1. Threat of bushfire	28
2. High maintenance needs of the property	21
3. Distance from shops and facilities	12
4. Poor telecommunications service	12
5. Lack of utilities and services, power outages	11
6. Lack of public transport	11
7. Unsatisfactory road access	3
8. Poverty, crime	2

[a] Participants gave multiple responses, [b] Percentages may not sum to 100 due to rounding.

Responses to the question about how vulnerable their house was to loss due to bushfire were:

- low, 7 per cent
- moderately, 23 per cent
- quite, 31 per cent
- highly, 23 per cent
- extremely, 16 per cent.

Reported frequencies of household plans in the event of a bushfire threat were:

- all members leave (n = 76, 60 per cent)
- all members stay and defend the property (n = 15, 12 per cent)
- some members leave while others stay and defend the property (n = 18, 14 per cent)
- all members wait and see how serious the threat is before making a final decision to leave or stay and defend the property (n = 17, 13 per cent)
- no household plan (n = 1, 1 per cent).

The median BSPC-15 total score was 7. That is, half the householders had undertaken half or fewer of the 15 bushfire checklist safety actions (Table 4). The mean BSPC-15 total score was 7.4 (SD = 3.26). BSPC-15 total score was related significantly to householder age (r = 0.22, p = 0.013) and to residing on a larger-than-standard-sized residential property (r = 0.21, p = 0.020). It was not related significantly to retired occupational status, years of residence at the location nor to awareness of previous bushfire threat warnings.

BSPC-15 total scores were not correlated significantly with perceived bushfire probability ratings (r = 0.10, p = 0.126) but were related negatively, though not strongly, to perceived house vulnerability ratings (r = -0.18, p = 0.046). The finding of a negative relationship was unexpected. However, it seemed plausible that some householders who judged their house was notably vulnerable to bushfire attack might be reluctant to spend time, effort or money on potentially fruitless attempts to improve the survivability of the house during a bushfire.

In order to test this, separate analyses were conducted using the five-item evacuation preparations sub-scale and the ten-item house protection sub-scale of the BSPC-15 (Table 5). Scores on the house protection sub-scale were significantly negatively correlated with the perceived house vulnerability rating (r = -0.26, p = 0.003) but were not significantly correlated with perceived bushfire probability ratings. Scores on the evacuation preparations sub-scale were not significantly correlated with perceived house vulnerability ratings, nor with perceived bushfire probability ratings. All relationships in Table 5 were tested for curvilinearity, but no evidence was found.

Comparison of responses to the two BSPC sub-scales indicated that some respondents viewed the relative importance of the two aspects of bushfire safety preparation differently. The median score for the five-item evacuation preparations sub-scale was 4: that is half the householders had undertaken 80 per cent or fewer of the five listed preparation actions. The median score for the ten-item house protection sub-scale was 3: that is, half the respondents had completed only 30 per cent or fewer of the ten-listed preparation actions. Reporting adequate house insurance was not related meaningfully to evacuation preparation sub-scale score (r = 0.09), nor to house protection sub-scale score (r = 0.01).

Google satellite imagery was used to categorise homes as being at high-to-medium danger (<80 metres from

Table 4: Percentage of respondents who had implemented bushfire safety preparation actions.

Preparation action[a]	Household bushfire safety plan			
	Evacuation[b] (N = 76)	Defence[c] (N = 33)	Wait and see (N = 17)	All (N = 127)[d]
	%	%	%	%
House protection preparations				
Removed combustibles	57	48	65	55
Cleared grass and leaf litter	51	52	71	53
Installed water supply (tank, pond)	46	79	53	56
Removed tree branches and bushes	39	55	47	44
Covered gaps in roof and walls	34	45	29	36
Installed seals to external doors	30	39	35	34
Installed self-powered water pump	29	70	24	39
Landscaped to reduce bushfire fuels	26	39	35	31
Installed house protection sprinkler	14	45	18	23
Installed screens or shutters to windows	1	3	6	2
Evacuation preparations				
Chosen a safe evacuation destination	87	82	65	82
Planned safe evacuation route	75	67	76	72
Decided on a trigger to leave	75	45	53	64
Obtained a battery-powered radio	59	58	59	58
Prepared important documents and valuables ready to go	51	44	29	46

[a] In descending order for those planning to evacuate, [b] All members evacuate, [c] One or more members stay and defend, [d] One household did not have a bushfire plan.

Table 5: Correlations, means and standard deviations.

Measure	2	3	4	5	M	SD
1. House protection preparations[a]	0.24**	-0.26**	0.04	0.12	3.8	2.29
2. Evacuation preparations[b]		-0.02	0.09	0.09	3.3	1.39
3. Perceived house vulnerability[c]			0.52***	0.22*	5.2	1.17
4. Perceived bushfire likelihood[d]				0.17	5.6	1.36
5. Distance-based house danger[e]					0.46	0.50

*$p<0.05$, **$p<0.01$, ***$p<0.001$

[a] Score range 0–10, [b] Score range 0–5, [c] Score range 1 (not at all)– (extremely), [d] Score range 1 (not at all)–7 (extremely), [e] 0 (>80 metres from vegetation) and 1 (<80 metres from vegetation).

bushland) or at lower danger (>80 metres from bushland). This was based on findings by Blanchi and colleagues (2012) from historical Australian bushfire house loss data where the probability of house loss decreased markedly when the distance of the house from bushland was greater than 80 metres. House danger category was related significantly to perceived house vulnerability ratings (r = 0.22, p = 0.015) but not to scores on any of the other measures (Table 5).

Discussion

This study examined urban-bush interface householder experiences of living in or near to bushland. Despite the negatives associated with living in an urban-bush interface location it seems these were more than outweighed by the amenity value of the natural environment location. Compared with the overall findings from nine previous studies of urban-bush interface residents (Table 1) the responses from this study were similar with respect to the percentages reporting low levels of concern about a future bushfire, planning to defend property and planning to 'wait and see' when aware of a bushfire threat. However, in this study, all but one of the 127 urban-bush interface respondents reported having a plan and, for almost two-thirds, the plan was to evacuate—a pattern very different from that in Table 1. This suggests an increased level of awareness among residents in the urban-bush interface of the bushfire safety messages issued by the Country Fire Authority: bushfires are extremely dangerous, it is essential to have a bushfire survival plan and the safest plan is to evacuate.[2]

Perhaps the most interesting aspect of the findings was the negative relationship between perceived vulnerability of homes to bushfire attack and preparations to reduce what Cohen (2000) characterised as 'home ignitability'. This is consistent with findings by Lohm and Davis (2015) that many urban-bush interface residents accept the possible sacrifice of their home in return for the perceived benefits of living in the natural environment; some concluding there is nothing they can do to mitigate the threat to their homes. In some cases, the conclusion may be well-founded. However, for others, their pessimism may not be warranted. Judicious vegetation management and modifications to the house might reduce the probability of destruction, while also preserving the natural environment. How to encourage residents in the urban-bush interface to reduce the 'ignitability' of their homes through vegetation management and 'hardening' houses against ember attack is a challenge for fire agencies. Changes to regulations governing construction of homes following the 2009 Victorian bushfires help mitigate the problem to some degree for new houses. However, the problem remains for houses built prior to 2009. Development of new and less expensive ways to retro-harden older houses is an option worth encouraging.

Limitations of this research are acknowledged. The recruitment methodology required residents to actively 'opt-in' to the online survey by typing a link into an internet search engine. This needed a level of motivation that may have resulted in the sample having higher levels of interest in issues associated with near-bushland living, including bushfire threat, compared with neighbouring residents who did not take part. Caution should be exercised in generalising the findings to urban-bush interface residents in other areas. Time constraints and limited funding did not permit use of other approaches such as a randomly generated telephone survey and visiting properties to conduct interviews that may have produced a more representative sample.

The median age of respondents (58 years) was older than the median age of adult Victorian residents, based on 2016 Census data of 52 years (Australian Bureau of Statistics 2016). This could be due to younger residents in the selected postal areas being more likely to live in rental accommodation and not close to bushland; only five per cent of respondents were renters.

Conclusion

The attractiveness of the natural environment and associated lifestyle means that people live in urban-bush interface locations, despite their awareness of the threat of bushfire. As more people move to the urban-bush interface, there will be increasing numbers of people exposed to bushfires. This study showed that many residents in the Melbourne urban-bush interface are aware of the risk, know that evacuation is the safest option and understand the basic preparations they need to undertake to evacuate. This is consistent with previous study findings but presents a more positive picture than previous post-bushfire studies. However, work still remains to help people in Melbourne's urban-bush interface understand the dangers posed by bushfire during last-minute evacuation that result from a 'wait and see' plan and how to better prepare their homes to resist bushfire threat. It is important for researchers to examine the issues affecting levels of bushfire preparation for residents in other Australian urban-bush interface areas.

At the time this paper was published, serious and significant bushfires were affecting many communities in NSW, South Australia, Tasmania and Victoria. Initial reports indicate that numerous homes, business and properties had been destroyed, many at the edges of rural townships.

2 Country Fire Authority website: www.cfa.vic.gov.au/plan-prepare/before-and-during-a-fire.

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