



THEME 3A- PEOPLE AND PROPERTY IMPACTS

Theme leader: Katharine Haynes

Subproject: Demographic characteristics of populations affected by the 2019/2020 bushfires in NSW

Subproject leads: Josh Whittaker and Michael Bedward

OVERVIEW

1. Theme

i People and Property

2. Project question or problem statement

i What were the demographic characteristics of populations affected by the 2019/2020 bushfires in NSW?

Were there any relationships between demographic characteristics and rates of house loss?

3. Summary

i The 2019-2020 bushfires affected a diverse range of communities in urban, rural and coastal areas across New South Wales. Census data suggest that some of the most socially disadvantaged populations in Australia were directly affected by the fires. Fire affected areas with high degrees of social disadvantage include the Kempsey, Taree, Inverell-Tenterfield and Coffs-Grafton regions on the Mid North Coast and the Batemans Bay, Bega-Eden Hinterland and Eurobodalla Hinterland regions on the South Coast.

Preliminary modelling suggests that rates of house loss were highest among the least disadvantaged and most economically-resourced populations, possibly reflecting their location in high amenity and high risk coastal and rural areas.



Analysis also revealed that populations with high proportions of Indigenous people experienced significant house loss. This is consistent with the findings of Williamson et al. (2020), who note the disproportionate impact of these fires on Indigenous peoples.

4. Key findings

- i**
 - **Affected SA1s:** A total of 377 Statistical Area Level 1 (SA1¹) areas in NSW were affected by the 2019-2020 bushfires. All findings in this submission are based on 2016 Census data (see Section 5: Limitations and remaining knowledge gaps).
 - **Social disadvantage:** 38 percent of bushfire affected SA1s were among the most disadvantaged areas in Australia, while just 10 percent were among the least disadvantaged (Figure 1).
 - **Economic resources:** 16 percent of bushfire affected SA1s were among the least resourced in Australia, 62 percent were moderately resourced, and 22 percent were among the most resourced (Figure 2).
 - **Indigenous populations:** There were 4,674 Indigenous people in bushfire affected SA1s. 98 percent of SA1s had Indigenous populations of between 0 and 10 percent. Four SA1s had Indigenous populations greater than 20 percent, including the Grafton, Eurobodalla Hinterland, Armidale and the Kempsey regions (Figure 3).
 - **Populations aged 65+:** Most bushfire affected SA1s (83%) had populations aged over 65 of between 10 and 30 percent. A smaller proportion (7%) had over a third aged 65 and over (Figure 4).
 - **Rented dwellings:** Four of the five SA1s with the highest proportion of rented properties were also the most disadvantaged, including SA1s in Armidale, Batemans Bay and Moruya-Tuross Head (Figure 5).
 - **Unoccupied dwellings:** Some SA1s had around two-thirds of private dwellings unoccupied at the time of the Census, Many of these were in coastal areas and are likely to have been holiday homes or rental properties that would normally be occupied in summer (Figure 6).

¹ SA1 is typically the smallest unit for the presentation of census data. They have an average population size of approximately 400 people (ABS 2016).



- **No vehicle:** Half of the SA1s (49%) had small proportions of occupied private dwellings without a vehicle. The five SA1s with the highest proportions of dwellings without a registered vehicle were also among the most socially disadvantaged, including Holsworthy-Wattle Grove, Batemans Bay and Batemans Bay South (Figure 7).
- **No internet:** 10 percent of SA1s had 30 percent or more of their population not accessing the internet from their dwelling. These SA1s tended to be in inland, rural areas (Figure 8).
- **Non-English speakers:** Ninety-eight percent of SA1s had 0-10 percent of their populations speaking a language other than English. Areas with considerably higher proportions of non-English speaking residents included Holsworthy-Wattle Grove, Menai – Lucas Heights – Woronora, Riverstone – Marsden Park and the Bega-Eden Hinterland (Figure 9).
- **Trends in house loss:** Preliminary modelling suggests that SA1s with a relative lack of disadvantage and greater access to economic resources tended to have higher rates of house loss, possibly reflecting their location in high amenity and high risk areas. SA1s with high proportions of Indigenous people also experienced significant house loss (Figure 10).

5. Significance of findings in context of previous studies

- i** • Research has identified a range of social and economic factors that influence the vulnerability of people and communities to hazards (see Cutter 2014). For example, it is well documented that older adults, people with a disability, those who experience socio-economic disadvantage and those who are socially isolated are often disproportionately affected in emergencies and disasters (e.g. Fountain et al. 2019; Whittaker et al. 2013). Social and economic factors can influence people's ability to prepare, respond and recover (Wisner et al. 2004).
- Consistent with previous research, our analysis identified that socially disadvantaged populations were disproportionately affected by the fires. Although data suggest that rates of house loss were greater in less disadvantaged and wealthier areas, it is important to recognise



the many other direct and indirect impacts of bushfires including health effects from smoke exposure (Borchers Arriagada, 2020), mental health (Bryant et al. 2018), domestic violence (Parkinson 2015) and impacts on livelihoods (Whittaker et al. 2013). Additionally, socially and economically disadvantaged households and communities are likely to find it hardest to recover, and most importantly, reduce their risks from future bushfires.

- Results are consistent with the findings of Williamson et al. (2020), who note the disproportionate impact of the 2019-2020 fires on Indigenous peoples.

6. Limitations and remaining knowledge gaps

i In the absence of other accessible forms of social data, 2016 Census data were used to provide a basic overview of the social and demographic characteristics of populations affected by the fires. To varying degrees, all areas affected by the 2019-2020 fires will have undergone demographic change. Nevertheless, many of the characteristics of areas – such as concentrations of social disadvantage, access to economic resources, and other key demographic variables such as aged populations – are unlikely to have changed markedly.

There is more uncertainty for variables such as proportion of private dwellings that are rented or unoccupied. Many of the areas affected by the 2019-2020 fires are coastal or in other high amenity locations, and are likely to have greater occupancy rates during summer (the Census was held on August 9th 2016). Similarly, the proportion of households accessing the internet from their dwelling is likely to have increased in some areas since 2016.

7. Recommendations for further research

- i**
- A number of regions were identified to have notable concentrations of social disadvantage. In-depth, qualitative research is needed in these areas to understand how people prepared, responded and recovered from the fires.

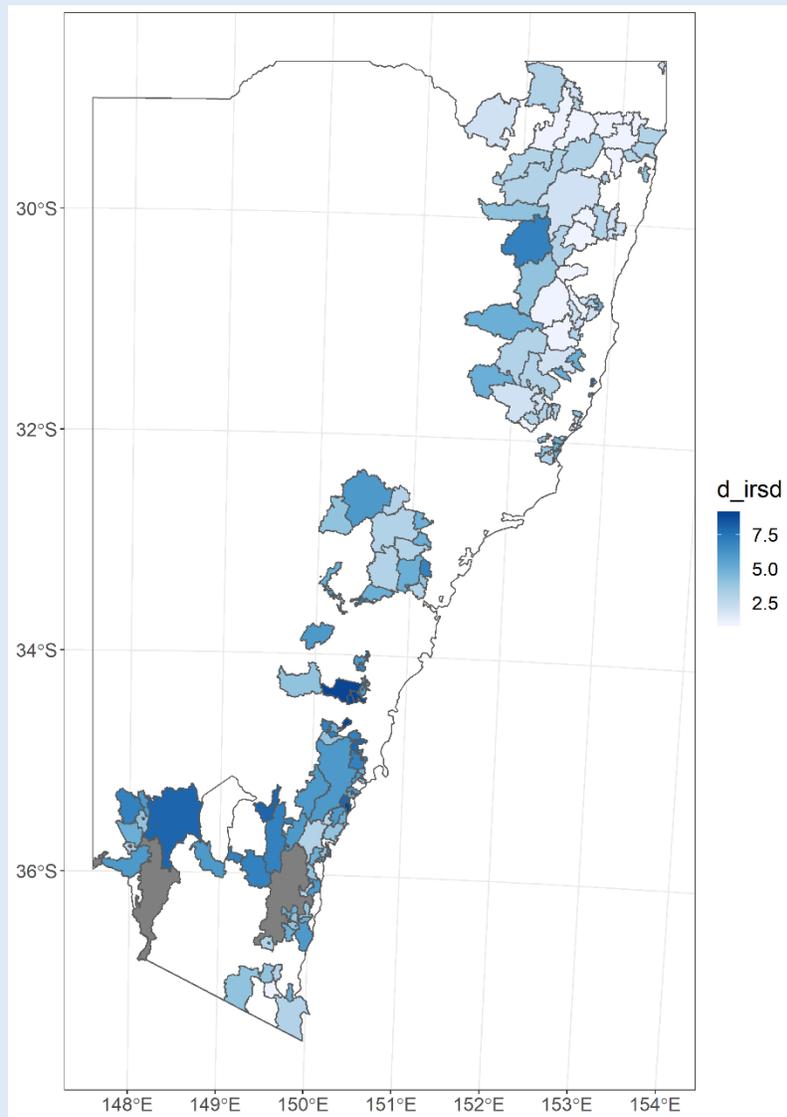


- Post-bushfire research should partner and engage with Indigenous communities to learn from their experiences and understand how they can be better supported.
- The analysis identified areas where there was a high proportion of households not accessing the internet or speaking a language other than English. Research into receipt, understanding and responses to emergency warnings and information may be valuable in these areas.



8. Figures

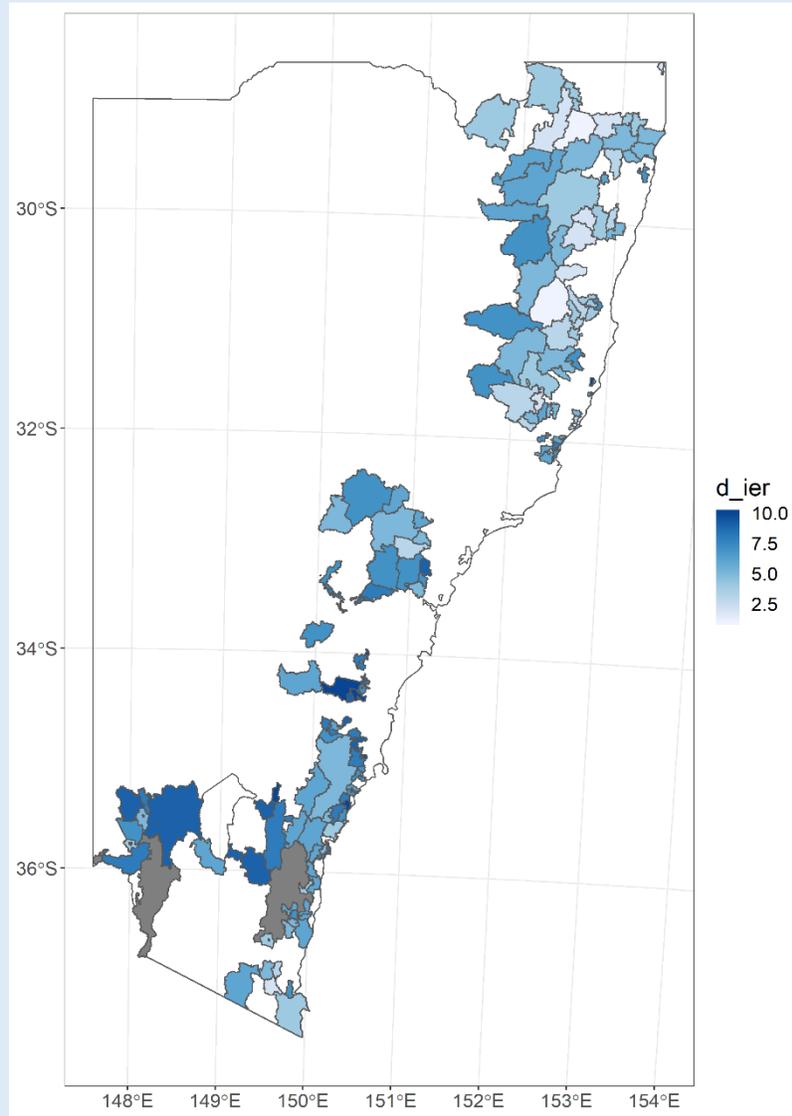
i Figure 1. Index of Relative Social Disadvantage (IRSD) deciles for affected SA1s in 2016. A low score indicates relatively greater disadvantage and high score indicates a relative lack of disadvantage. Grey indicates no data.



The median decile on the Index of Relative Social Disadvantage (IRSD) was 4, indicating a degree of relative social disadvantage among affected SA1s. 38 percent of affected SA1s were among the most disadvantaged areas (decile 1-3), while just 10 percent were among the least disadvantaged (decile 8-10). Areas on the Mid North Coast with notable concentrations of social disadvantage include the Kempsey, Taree, Inverell-Tenterfield and Coffs-Grafton regions. On the South Coast, the Batemans Bay, Bega-Eden Hinterland and Eurobodalla Hinterland regions had a number of SA1s with high degrees of social disadvantage.



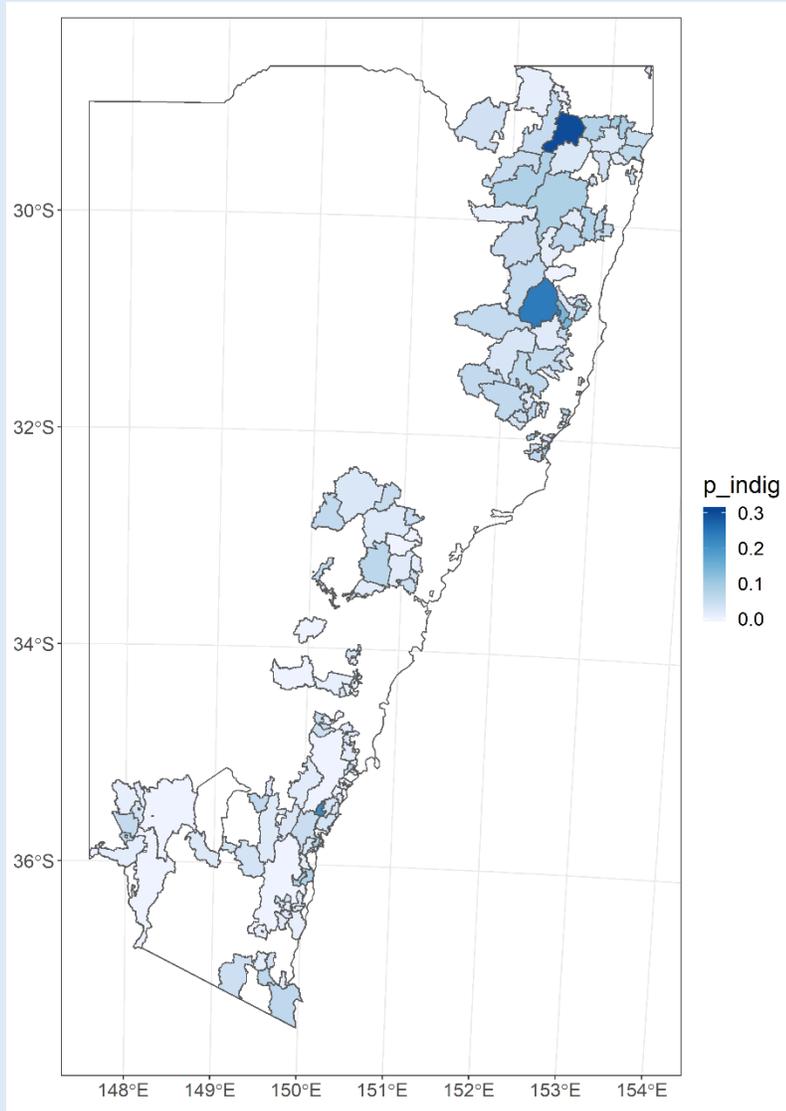
i Figure 2. Index of Economic Resources (IER) deciles for affected SA1s in 2016. A low score indicates a relative lack of access to economic resources and a high score indicates relatively greater access to economic resources. Grey indicates no data.



The median decile on the Index of Economic Resources (IER) was 6, with 16 percent of SA1s ranked among the least resourced (deciles 1-3); 62 percent among the middle (deciles 4-7); and 22 percent among the most resourced (deciles 8-10). Bushfire affected areas with the least access to economic resources included SA1s in the Lithgow-Mudgee region in the Central West, the Kempsey-Nambucca and Coffs-Grafton regions on the Mid North Coast, and Batemans Bay and Bega-Eden Hinterland regions on the South Coast.



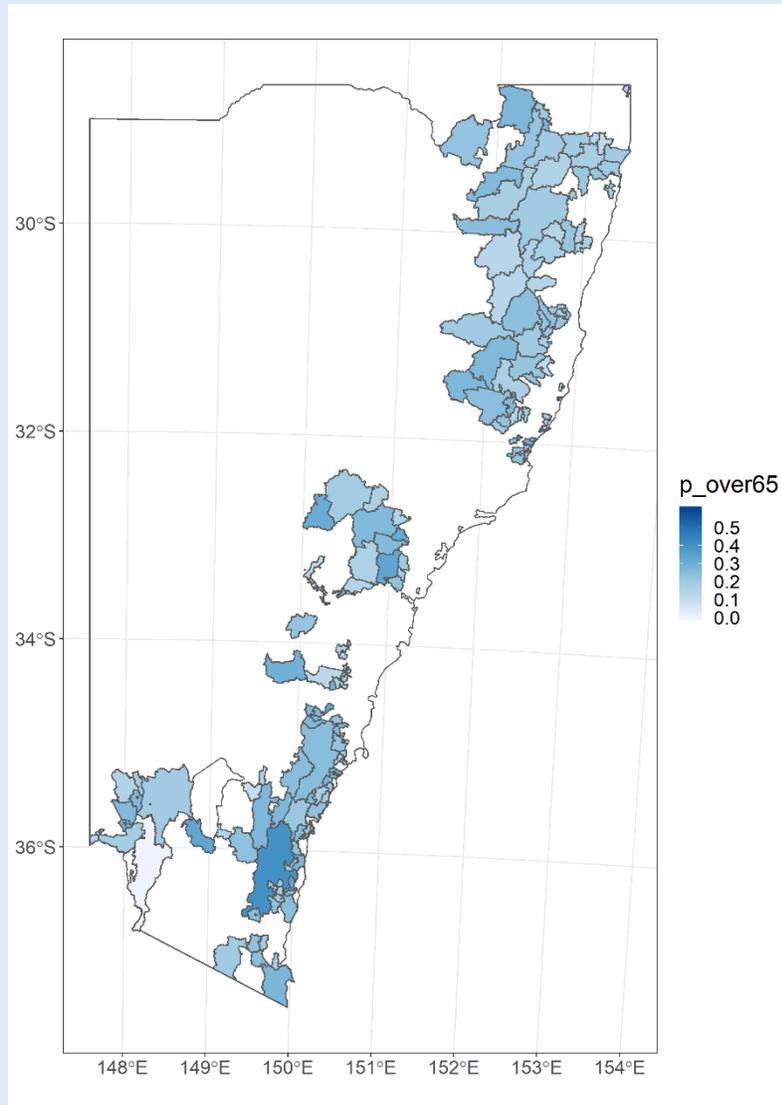
Figure 3. Proportion of affected SA1 population that was Indigenous (2016).



There were 4,674 indigenous people in the affected SA1s. The vast majority (98%) had Indigenous populations of between 0 and 10 percent. SA1s with considerably higher proportions of Indigenous people included Armidale (52%; SA1-1118646), Eurobodalla Hinterland (31%; SA1-1102403), Grafton Region (30%; SA1-1108103) and Kempsey Region (24%; SA1-1115628).



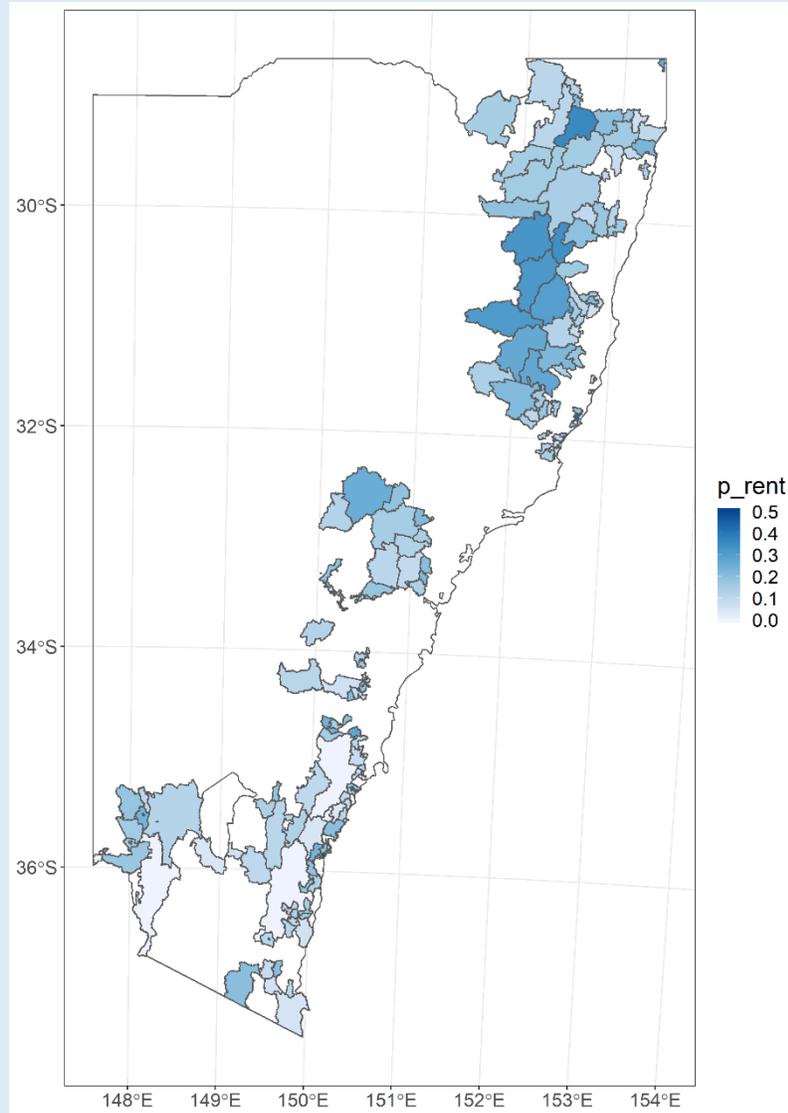
i Figure 4. Proportion of affected SA1 population aged 65 and over (2016).



The majority of affected SA1s (83%) had 10 to 30 percent of their populations aged 65 years and over. A smaller proportion (7%) had more than a third of their populations aged 65+.



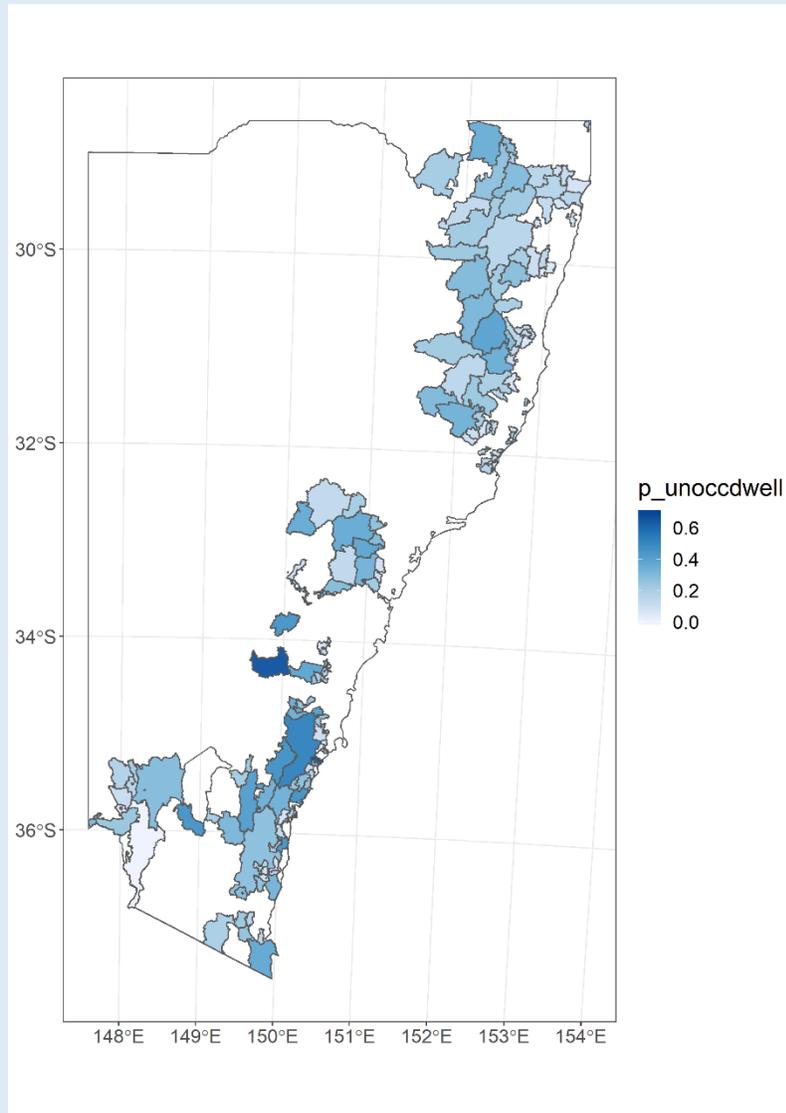
i Figure 5. Proportion of occupied private dwellings that were rented (2016)



The median percentage of rented occupied private dwellings was 16. A small proportion (7%) of SA1s had greater than 30% of dwellings rented. Four of the five SA1s with the highest proportion of rented properties were also among the most disadvantaged, including: Armidale (SA1-1118646; 64% rented, IRSD decile 1); Batemans Bay (SA1-1101718 and 1101706; 57% and 49% rented, IRSD decile 1); and Moruya-Tuross Head (SA1-1102623; 46% rented, IRSD decile 2).



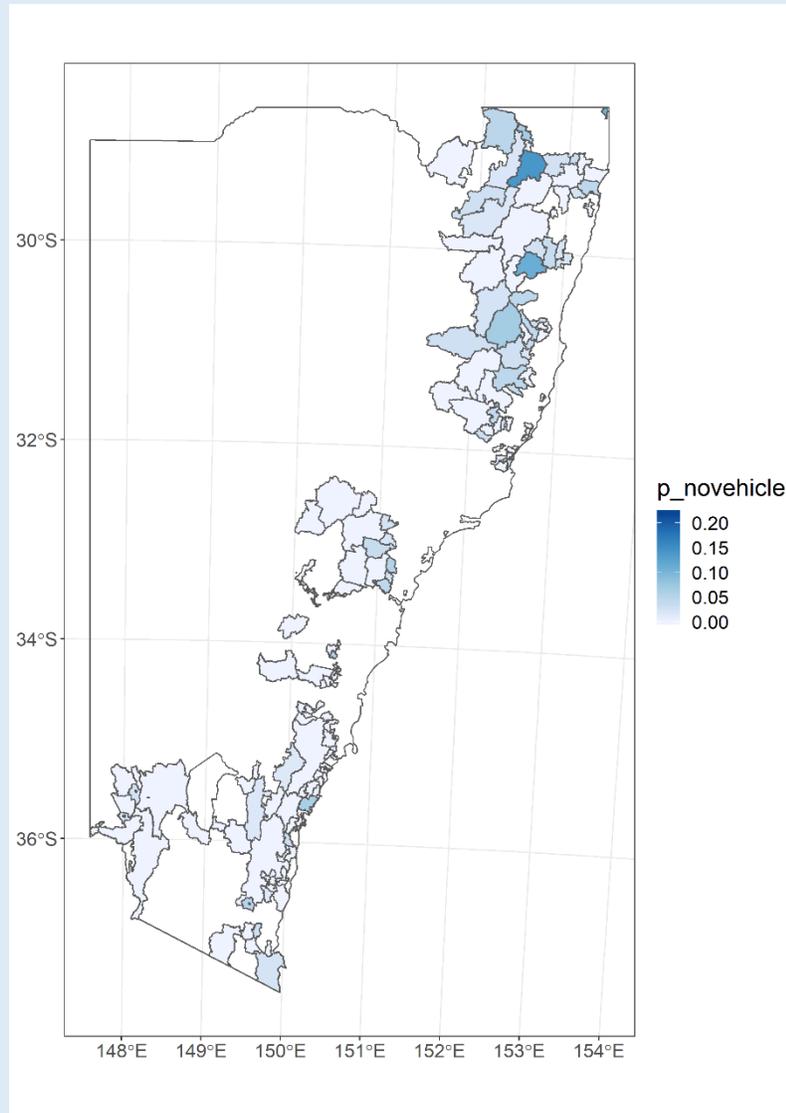
i Figure 6. Proportion of private dwellings that were unoccupied (2016).



The median percentage of unoccupied private dwellings was 16, with 14 percent having a third or more unoccupied. Some SA1s had around two thirds of private dwellings unoccupied at the time of the Census including Batemans Bay South (60-70%; SA1-1101804, 1101813, 1101814), Ulladulla Region (63-65%; SA1-1128301, 1128303) and Sussex Inlet-Berrara (66%; SA1-1128013), most likely reflecting the large proportion of holiday homes and holiday rentals in these coastal areas.



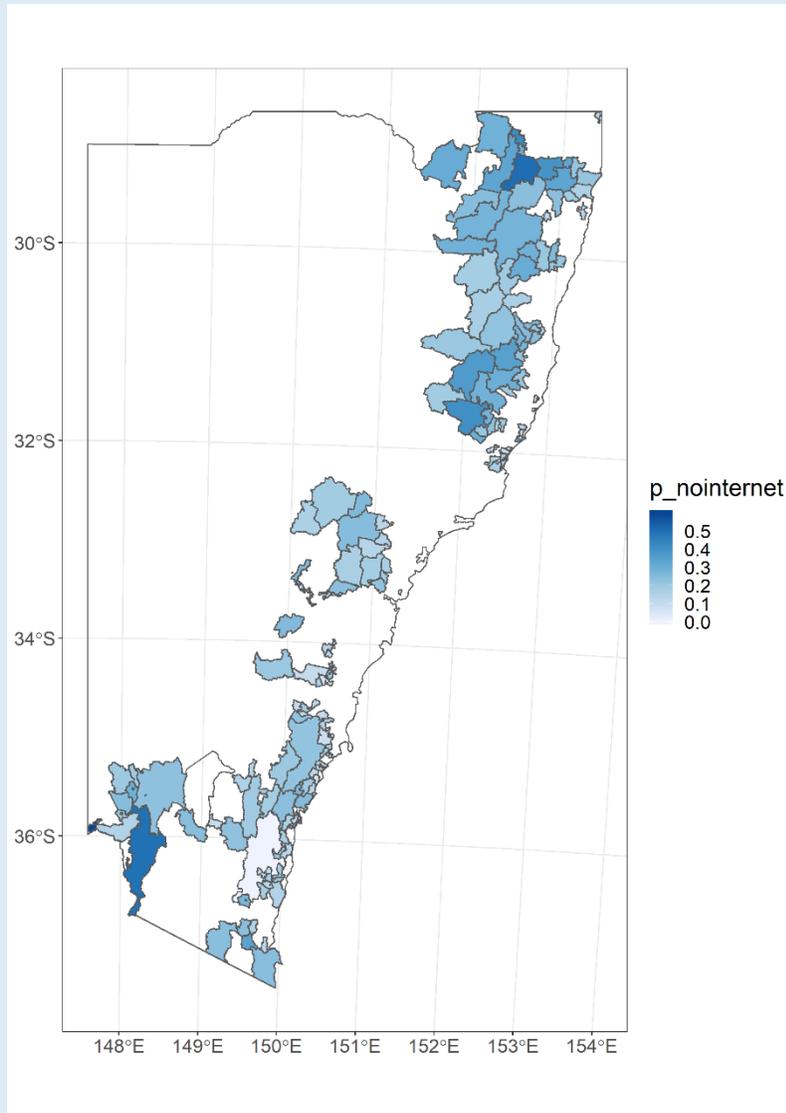
i Figure 7. Proportion of occupied private dwellings without a registered vehicle (2016).



Half of the SA1s (51%) did not contain occupied private dwellings without a registered vehicle. Most had small proportions without a vehicle, including 39 percent of SA1s with between .1 and 6 percent. Four percent of SA1s had 10-20 percent of dwellings without a registered vehicle. The five SA1s with the highest proportions of dwellings without a vehicle were among the most socially disadvantaged, including: Holsworthy-Wattle Grove (SA1-1152449; 24% no vehicle, IRSD decile 2); Batemans Bay (SA1-1101706 and 1101718; 20 and 22% no vehicle, IRSD decile 1); Lithgow (SA1-1107003; 19% no vehicle, IRSD decile 1); and Batemans Bay South (SA1-1101806; 17% no vehicle, IRSD decile 2).



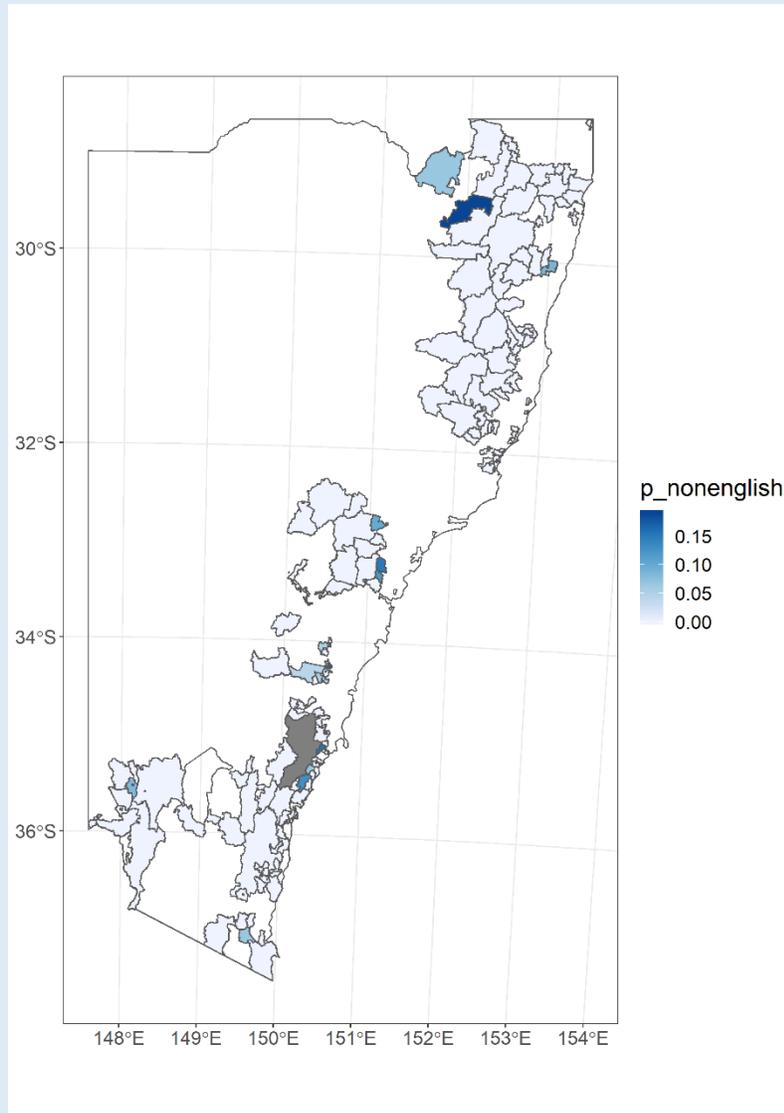
i Figure 8. Proportion of households where internet was not accessed from the dwelling (2016).



The majority of SA1s had 10-20 percent (45%) and 20-30 percent (32%) of their population not accessing the internet from their dwelling. Some SA1s had considerably higher proportions of their population not accessing the internet, with one-in-ten having more than 30 percent not accessing the internet. SA1s with the highest proportions of their population not accessing the internet tended to be in more inland, rural areas.



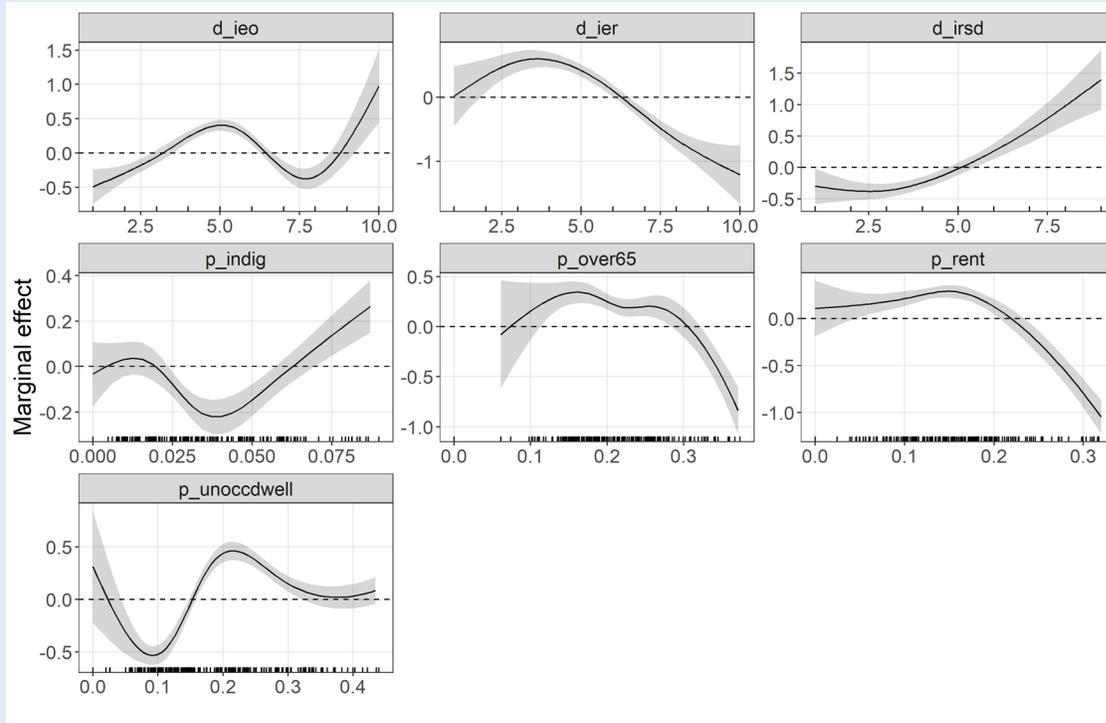
i Figure 9. Proportion of households where a non-English language was spoken (2016).



91 percent of SA1s had between 0 and 10 percent of their populations speaking a language other than English. SA1s with considerably higher proportions of non-English speaking residents included Holsworthy-Wattle Grove (29%; SA1-1152442), Menai – Lucas Heights – Woronora (27%; SA1-1153507), Riverstone – Marsden Park (25%; SA1-1131235) and Bega-Eden Hinterland (21%; SA1-1102030).



i Figure 10. Marginal effects of variables on probability of house destruction. Effect above zero means increased rates of house destruction. d_ieo is the Index of Employment and Occupation. d_ier is the Index of Economic Resources. d_irsd is the Index of Relative Socio-economic Disadvantage. p_indig is percentage of population that was indigenous. p_over65 is percentage of population aged 65 years and over. p_rent is percentage of occupied private dwellings that were rented. p_unoccdwell is percentage of private dwellings that were unoccupied.



The marginal influence of each variable on the likelihood of house loss was examined by graphing its fitted smooth function against the variable values. The purpose of the model is to infer trends relating to social variables rather than to accurately predict house loss. In these graphs, fitted values greater than zero indicate an increased risk of house loss for the corresponding range of variable values, while fitted values less than zero indicate decreased risk. Notable trends include:

- SA1s with a relative lack of disadvantage and greater access to economic resources tended to have higher rates of house loss, possibly reflecting their location in high amenity and high risk coastal and rural areas.
- SA1s with the largest proportions of Indigenous populations experienced significant house loss. This is consistent with the findings of Williamson et al. (2020), who note the disproportionate impact of these fires on Indigenous peoples.

Some other trends are somewhat counterintuitive, such as lower rates of house loss among SA1s with high proportions of renters and people aged 65 years and over. This may be due to spatial effects, such as the location of these households within SA1s relative to bushfire hazards. Nevertheless, these trends warrant further investigation.



9. Key reference list

- Australian Bureau of Statistics (2016) Australian Statistical Geography Standard (ASGS): Volume 1 – Main Structure and Greater Capital City Statistical Areas, July 2016. www.abs.gov.au
- Borchers Arriagada, N. (2020). Smoke and Human Health. NSW Bushfire Risk Management Research Hub Reports to the NSW Bushfire Inquiry3a.4
- Bryant, R.A., Gibbs, L., Gallagher, H.C., Pattison, P., Lusher, D., MacDougall, C., Harms, L., Block, K., Sinnot, V., Ireton, G., Richardson, J., Forbes, D. (2018) Longitudinal study of changing psychological outcomes following the Victorian Black Saturday bushfires. *Australian & New Zealand Journal of Psychiatry* 52 (6), 542-551.
- Cutter, S. L., Schumann, R. L., III and Emrich, C. T. (2014) 'Exposure, Social Vulnerability and Recovery Disparities in New Jersey after Hurricane Sandy', *Journal of Extreme Events*, 1(1).
- Fountain, L., Tofa, M., Haynes, K., Taylor, M., Ferguson, S., (2019) Older adults in disaster and emergency management: What are the priority research areas in Australia? *International Journal of Disaster Risk Reduction*. 39.
- Parkinson, D. (2015) Women's experience of violence in the aftermath of the Black Saturday bushfires. PhD Thesis, School of Social Sciences, Faculty of Arts, Monash University, Clayton.
- Whittaker J, Handmer J, Mercer, D (2012) Vulnerability to bushfires in rural Australia: a case study from East Gippsland, Victoria. *Journal of Rural Studies* 28 (2): 161-173.
- Williamson, B., Markham, F., Weir, J.K. (2020) Aboriginal peoples and the response to the 2019-2020 bushfires. Centre for Aboriginal Economic Policy Research, ANU College of Arts & Social Sciences. https://caepr.cass.anu.edu.au/sites/default/files/docs/2020/3/CAEPR_WP_no_134_2020_Williamson_Markham_Weir.pdf
- Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (2004) *At Risk: Natural Hazards, People's Vulnerability and Disasters*. 2nd edn. London: Routledge.

10. Appendix

Methods

Data from the 2016 Australian Census of Population and Housing were used to describe the socio-economic characteristics of the 377 Statistical Area Level 1 (SA1) areas affected by the 2019-2020 fires.

The Australian Bureau of Statistics *Socio-Economic Indexes for Areas* (SEIFA) were used to characterise the socio-economic status of bushfire affected SA1s. The following indexes were used:

- The Index of Relative Socio-economic Disadvantage (IRSD), which comprises indicators related to disadvantage such as low income, low qualifications and low skill occupation.
- The Index of Economic Resources (IER), which comprises indicators related to income and wealth.
- The Index of Employment and Occupation (IEO), which comprises indicators related to the educational and occupational level of communities.



Additionally, data were sourced on the following Census variables:

- Number of Indigenous people
- Proportion of population that was Indigenous
- Proportion of population aged 65 and over
- Proportion of households where a non-English language was spoken
- Proportion of occupied private dwellings that were rented
- Proportion of private dwellings that were unoccupied
- Proportion of occupied private dwellings without a registered vehicle garaged or parked at their address
- Proportion of occupied private dwellings where the internet was not accessed (via a desktop/laptop computer, mobile or smart phone, tablet, music or video player, gaming console, smart TV or any other device).

These indexes and variables were selected to provide a basic overview of the social and demographic characteristics of populations affected by the fires. Number and percentage of Indigenous people was included as a recent report identified that Indigenous people were disproportionately affected by the 2019-2020 fires (Williamson et al. 2020). Other variables were selected for their potential to provide insights into possible vulnerability, such as areas where there are concentrations of older adults vulnerable to smoke or fire, or where factors such as car ownership or internet access might influence evacuation or access to information and warnings.

Generalized additive model

The influence of selected socio-economic variables on the likelihood of house loss was investigated using generalized additive modelling.² This approach allows for the possibility of non-linear trends without the need for trend shapes to be specified *a-priori*.

Data were compiled for ABS Statistical Areas Level 1 (hereafter referred to as SA1s). The number of pre-fire houses for each SA1 was assigned by taking the maximum value of ABS Census 2016 data for number of dwellings, and the count of mapped buildings with footprint area 80-700 square meters taken from the Geoscape NSW Buildings spatial layer.³ The number of destroyed houses was taken from Building Impact Assessment records. Socio-economic predictor variables consisted of four proportional measures (proportions of: indigenous people; people over 65 years of age; rental dwellings; unoccupied dwellings), and three SEIFA variables expressed on a decile scale (indices of: relative socio-economic disadvantage; economic resources; education and occupation). Two further variables were included to represent the fire conditions experienced by each SA1: the proportion of the SA1 included in mapped fire

² Wood, S.N. (2017) Generalized Additive Models: An Introduction with R (2nd edition). Chapman and Hall/CRC.

³ PSMA Australia Ltd (2017) Geoscape product description.



progressions; and the maximum local FFDI value recorded during the fire period. The purpose of these variables was to partition out the effect of local fire conditions on house loss from the effects of socio-economic variables.

The generalized additive model was based on a binomial distribution with a logit-link function. The response data were, for each SA1, the paired values of number of houses destroyed and number of houses not destroyed. This allows the model to take into account both the proportion of houses destroyed, and the weight of evidence pertaining to that proportion. All predictor variables were fitted as smooth functions using cubic regression splines, with the decile SEIFA variables being treated as pseudo-continuous. The complexity of the response shapes fitted by the model was constrained by setting the basis dimension to a relatively small value in order to aid interpretation.

The marginal influence of each variable on the likelihood of house loss was examined by graphing its fitted smooth function against the variable values. In these graphs, fitted values greater than zero indicate an increased risk of house loss for the corresponding range of variable values, while fitted value less than zero indicate decreased risk.