bushfire&natural HAZARDSCRC



Influence of road characteristics on flood fatalities in Australia

ANDREW GISSING, MATALENA TOFA, SIMON OPPER AND KATHARINE HAYNES
Risk Frontiers, Macquarie University, NSW, Australia

An Australian Government Initiative

CRC AUSTRALIA

RISK FRONTIERS

MACQUARIE UNIVERSITY

Objectives




Identify the influence of roadway characteristics on flood fatalities so that risk assessment approaches can be developed to consider the prioritisation of remediation works and inform future design requirements.

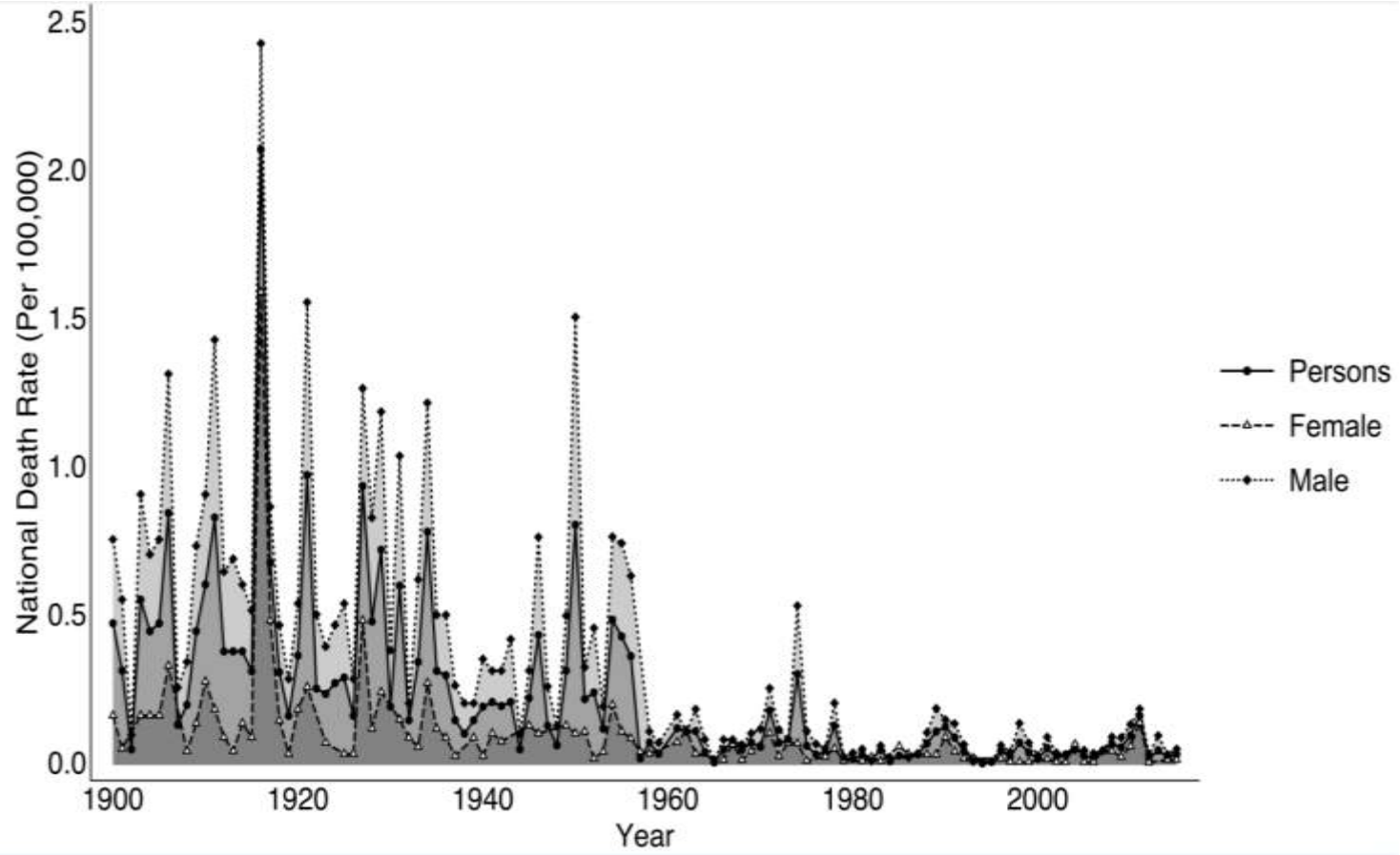
Australia's top five natural hazard killers

Hazard	Period of coverage	Fatalities
Extreme heat[1]	1900-2011	4,555
Flood[2]	1900-2015	1,859
Tropical cyclone[4]	1900-2015	1,208
Bushfire[3]	1900-2011	825
Wind storm[4]	1900-2015	495

[1] Coates et al., 2014
[2] Haynes et al., 2016
[3] Blanchi et al., 2014
[4] Recent updates to PerilAUS

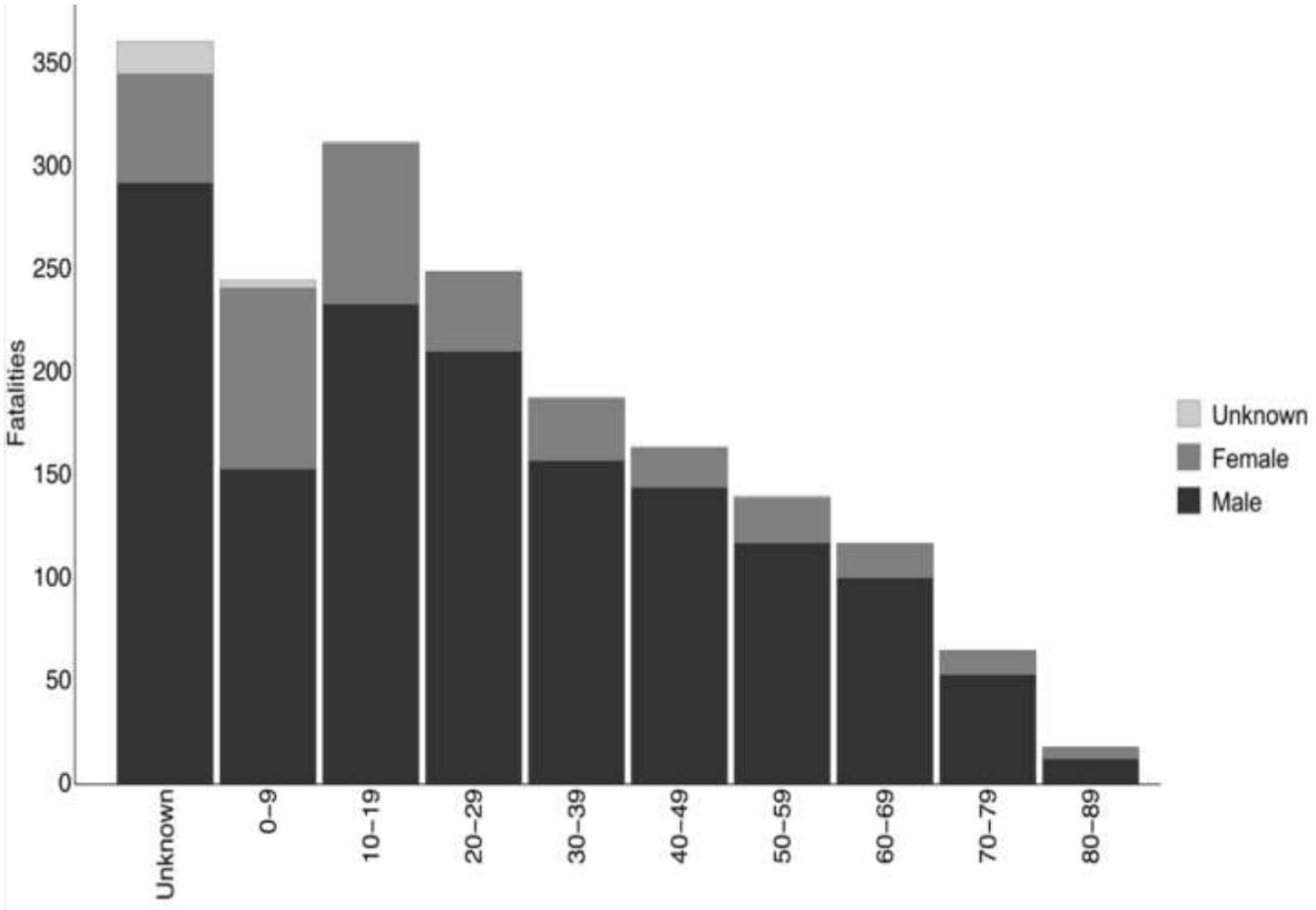
@RiskFrontiers

Death rates from flooding



@RiskFrontiers

Age and gender



@RiskFrontiers

2000-2015

- 178 fatalities
- 67% male, 30% female
- Age - highest proportion 10-19
- QLD 52%; NSW 26%; VIC 9%; NT 8%; WA 3%; TAS 2%
- Majority (54%) died attempting to cross a watercourse
- Almost 50% of fatalities were in a vehicle, 25% on foot and 12% swimming

@RiskFrontiers

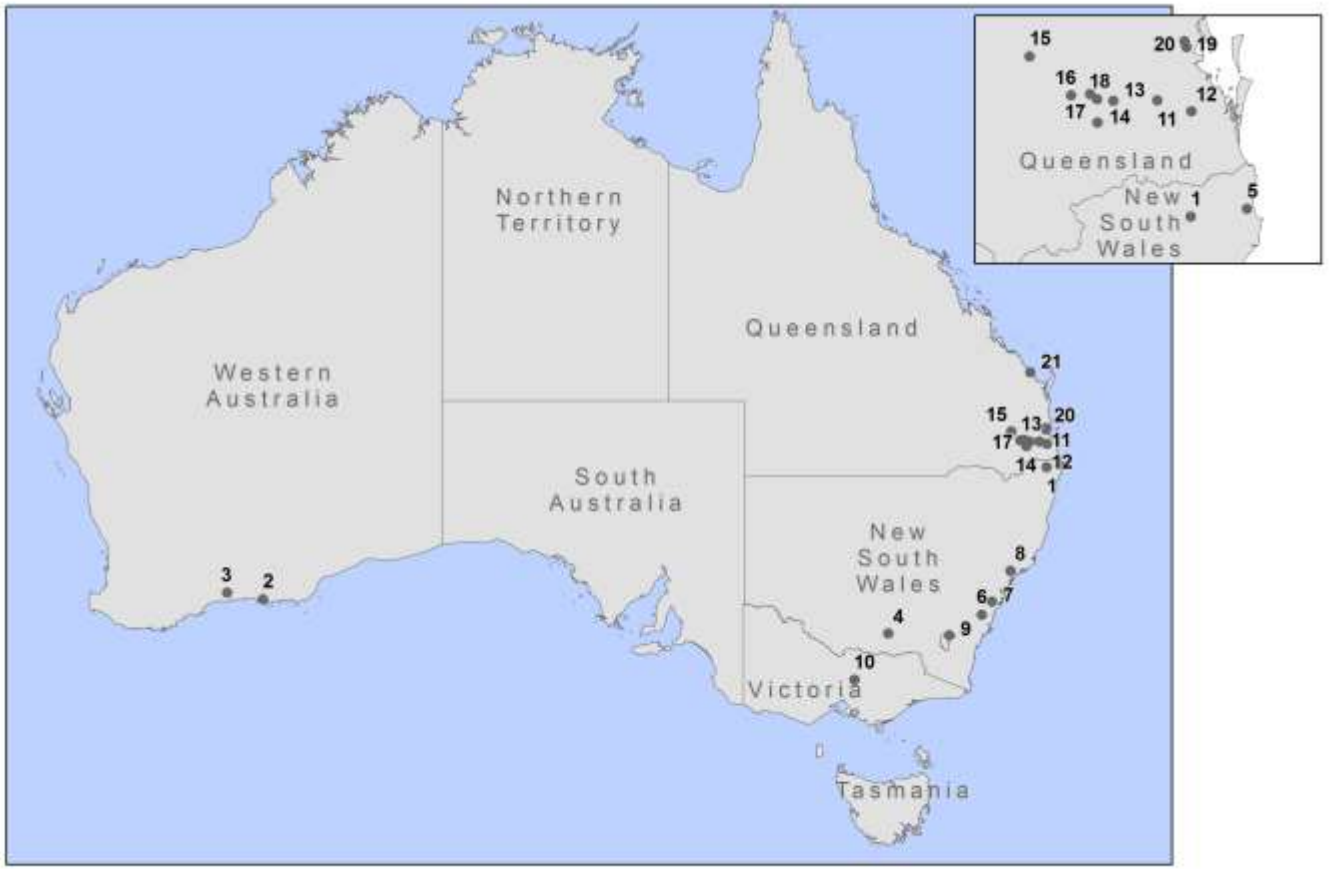
Vehicle related deaths globally

Country	Percentage of fatalities	Reference
USA	68%	Terti et al. 2016
Greece	40%	Diakakis and Deligiannakis, 2015
Portugal	14%	Pereira et al., 2017
France	30%	Vinet et al., 2016

@RiskFrontiers

Existing approaches

Research has focused mainly on why people enter floodwater, evaluation of risk communication efforts and vehicle stability in floodwater.



- 21 sites assessed. Most sites were rural (73 percent)
- Incidents were between 2010 and 2017
- Selected sites represent some 43% percent of total deaths over this period

Observational Assessment

- road structure type
- roadway side barriers
- road side topography
- downstream depths adjacent to the roadway
- signage
- warning systems
- lighting
- road pavement
- road alignment
- road grade
- speed restrictions
- traffic volume
- downstream vegetation
- ability for a vehicle to be turned around
- presence of road side markers and curb and guttering.

Results

- In 90% of cases vehicles were washed off the road pavement. The remainder likely to have driven off the road and into floodwater.
- Most frequent roadway structures where fatalities occurred were floodways (48 percent) and bridges (33 percent).
- In three cases water rose quickly around the vehicle or it was reported to have been struck by a wall of water.

@RiskFrontiers

Results

- In 35% of cases, multiple persons were inside the vehicle at the time of the incident and at least one person was able to escape the vehicle.
- At two sites two fatal incidents occurred during the same flood event.
- In 38% of incidents emergency services or passers-by were available within seconds to minutes.

@RiskFrontiers

Results

- In the majority of cases, the roads were local and were likely to normally accommodate low traffic flows (66 percent).
- In 19 percent of cases the roads were identified as major roads that would usually accommodate a high traffic flow.
- Average speed limit 70km/h (Range 50km/h to 110km/h).

@RiskFrontiers

Results

- 48% of cases, the deceased was discovered inside the flooded vehicle.
- 43% of cases the deceased was discovered outside of the vehicle indicating that they either had attempted to escape from the vehicle or were washed from it.
- Remainder unknown.

@RiskFrontiers

Results

	Small catchment size	Side barriers at point of entry	Deep water adjacent to roadway	Downstream vegetation or obstacle	Turn around with ease
Characteristic observed	20	0	17	17	6
Total observations	21	21	20	21	20
Percent	**95**	**0**	**85**	**81**	**30**

Results

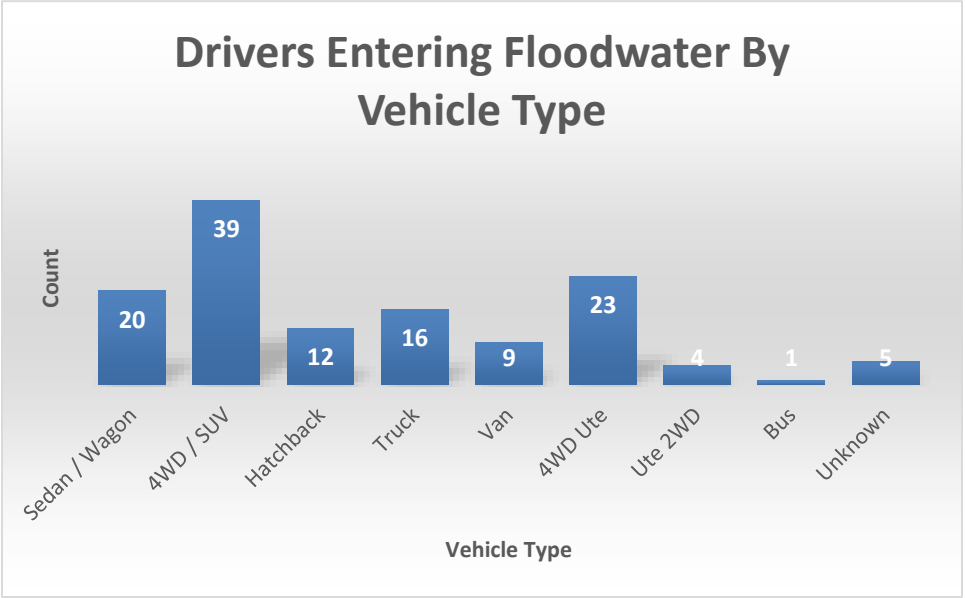
	Road sealed	Lighting	Bend in road before point of entry	Dipping road grade	Signage
Characteristic observed	18	2	6	11	12
Total observations	21	7	21	21	20
Percent	**86**	**29**	**29**	**52**	**60**

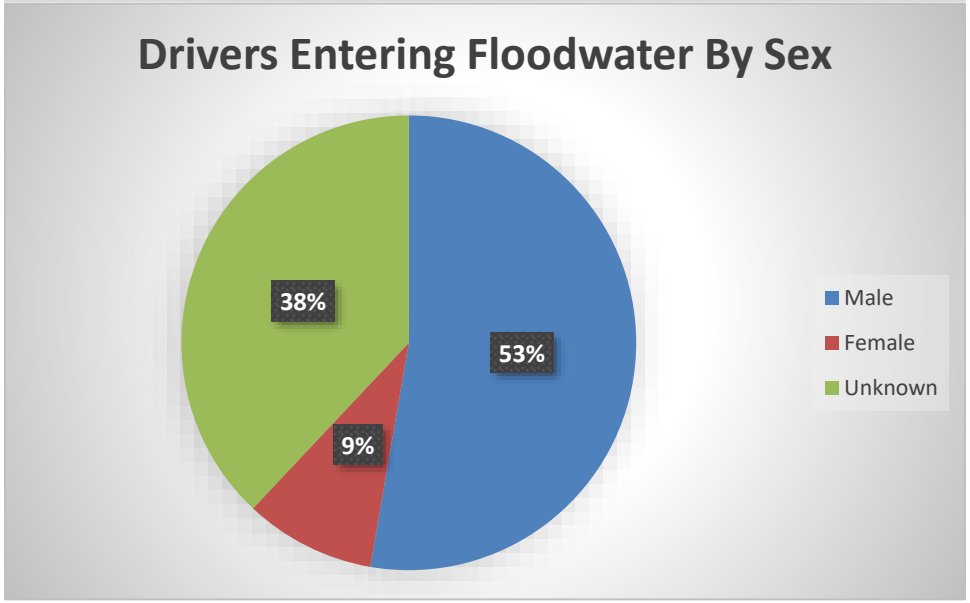
How effective is signage?

@RiskFrontiers

Results

- 84% of motorists ignored road closure signs and travelled through floodwater
- Large majority of drivers were male
- Most frequent vehicle type were 4WDs
- Age varied





@RiskFrontiers

Key findings

- Flood risk across roadways is not uniform.
- Key factors include:
  - Probability of flooding exceeding key depth and velocity criteria
  - Presence of road side barriers
  - Rate of rise
  - Traffic flow
  - Immediate depths adjacent to road surface
  - Ability to turn around
- Could roadside barriers be utilised more often?

@RiskFrontiers

Next steps

- Validate findings utilising data about flood rescues. What is different at these locations? Why do people survive?
- Develop a risk assessment method to identify "black spots" to prioritise remediation works and road closure during flood events.

@RiskFrontiers

Andrew Gissing
ph: +61-408 211 697; email: andrew.gissing@mq.edu.au
website: www.riskfrontiers.com; twitter: @andegiss

Reports and papers

Haynes, K., Coates, L., Dimer de Oliveira, F., Gissing, A., Bird, D., van den Honert, R., Radford, D., D'Arcy, R, Smith, C. (2016). An analysis of human fatalities from floods in Australia 1900-2015. Report for the Bushfire and Natural Hazard Cooperative Research Centre.

Gissing, A., Haynes, K., Coates, L., Keys, C. (2016) Motorist Behaviour During 2015 Shoalhaven Floods. Australian Journal of Emergency Management. April 2015, 31 (2).

WRL vehicle stability research
www.wrl.unsw.edu.au/news/vehicle-stability-testing-for-flood-flows