

Fire in arid and semi-arid Australia

1998 – 2004

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Thesis submitted for the degree of

Doctor of Philosophy

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Frontpiece: Grass fire in central Australian grassland

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Abstract

Fire is a crucial element in shaping our world, whether caused naturally by lightning or by humans, either accidentally or on purpose. These fires can have both positive and negative consequences and impacts on our natural environment, human health, society and its economics, and global climate through carbon emissions.

In arid and semi-arid Australia (70% of the continent), individual fires frequently exceed 1 million hectares, and have collectively burnt up to 9% of this total area in a single year. Stakeholders all have different outlooks and priorities about these phenomena. Little objective information about the fire regime and its drivers has been available for this vast area with its very low population density, with previous analyses limited in spatial and/or temporal extent. This lack of knowledge has hampered attempts at effective management.

Satellite imagery enables active fires to be detected as fire hotspots, and burnt areas to be mapped as patches from the change of surface reflectance properties in successive images. The National Oceanographic and Atmospheric Administration's (NOAA) Advanced Very High Resolution Radiometer (AVHRR) imagery has recently been used to map both fire hotspots (FHS) and fire affected areas (FAA) for the entire Australian continent dating back to 1998.

In this dissertation, validation of these two datasets is performed in arid and semi-arid Australia for the first time. Results show that mapping accuracy can be highly variable between areas, and from year to year within the same area. There are many factors which may contribute to the errors of omission and commission. Some are common to all remote sensing, while other issues are more specifically related to conditions in arid and semi-arid environments.

The distribution, seasonality, frequency, number and extent of fire hotspots (FHS) and fire affected areas (FAA) across arid and semi-arid country of Australia were analysed from 1998 to 2004, giving us a picture of fire patterns across the entire area for the first time. This includes a number of high fire years in certain areas following above-average rainfall. This analysis highlights similarities and differences between regions, giving policy makers and managers a basis from which to make more informed decisions in the present, and with which to compare future regimes.

Exploratory regression analysis helps to gain a predictive understanding of the spatial and temporal pattern of risk of large uncontrollable fires. Results show that the strongest influence is exerted by biomass or fuel load. As this is highly dependant on antecedent rainfall, we can anticipate a strong effect of climate change on the fire regime. The strongest combinations of relationships may be used as spatial indicators in the development of long-lead fire risk models for these areas. This can help improve the timing of pro-active strategies to manage fire, and in the allocation of sparse funds and resources. This analysis has highlighted regional patterns of fire across different land tenures. Heightened awareness of these patterns may encourage a more cooperative and coordinated approach to fire management amongst stakeholders.

Declaration

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Turner, D., Ostendorf, B. and Lewis, M., 2008. An introduction to patterns of fire in arid and semi-arid Australia, 1998-2004. *The Rangeland Journal*, 30(1): 95-107.

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Dedication

I wish to dedicate this dissertation to my mother Eleanor Gorman Lee, who died in my hometown Arklow, Ireland, halfway through this project. It would have made her very proud to have a 'doctor' in the family.

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(Maps on Compact Disk)

Fire Affected Area by arid and semi-arid IBRA (Interim Biogeographical Regions of Australia) 1998 to 2004 - Last Year Burnt

FAA in IBRA 1:	Murray Darling Depression
FAA in IBRA 2:	Naracoorte Coastal Plain
FAA in IBRA 7:	NSW South Western Slopes
FAA in IBRA 8:	Riverina
FAA in IBRA 17:	Darling Riverine Plains
FAA in IBRA 18:	Mulga Lands
FAA in IBRA 19:	Simpson Strzelecki Dunefields
FAA in IBRA 21:	Channel Country
FAA in IBRA 22:	Brigalow Belt North
FAA in IBRA 24:	Cobar Penepplain
FAA in IBRA 25:	Broken Hill Complex
FAA in IBRA 28:	Central Ranges
FAA in IBRA 29:	Finke
FAA in IBRA 30:	Stony Plains
FAA in IBRA 31:	Gawler
FAA in IBRA 32:	Great Victoria Desert
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FAA in IBRA 35:	Eyre Yorke Block
FAA in IBRA 36:	Flinders Lofty Block
FAA in IBRA 37:	Kanmantoo
FAA in IBRA 38:	Mount Isa Inlier
FAA in IBRA 39:	Gulf Plains
FAA in IBRA 41:	Mitchell Grass Downs
FAA in IBRA 44:	Einasleigh Uplands
FAA in IBRA 45:	Desert Uplands
FAA in IBRA 46:	Gulf Fall and Uplands
FAA in IBRA 47:	MacDonnell Ranges
FAA in IBRA 48:	Burt Plains
FAA in IBRA 49:	Tanami
FAA in IBRA 50:	Sturt Plateau
FAA in IBRA 51:	Ord Victoria Plain
FAA in IBRA 52:	Victoria Bonaparte
FAA in IBRA 53:	Gascoyne
FAA in IBRA 54:	Carnarvon
FAA in IBRA 55:	Central Kimberley
FAA in IBRA 56:	Coolgardie
FAA in IBRA 57:	Esperance Plains
FAA in IBRA 58:	Dampierland
FAA in IBRA 59:	Gibson Desert
FAA in IBRA 60:	Great Sandy Desert
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FAA in IBRA 64:	Mallee
FAA in IBRA 65:	Murchison
FAA in IBRA 66:	Northern Kimberley
FAA in IBRA 67:	Geraldton Sandplains
FAA in IBRA 68:	Pilbara
FAA in IBRA 70:	Avon Wheatbelt
FAA in IBRA 71:	Yalgoo
FAA in IBRA 72:	Gulf Coastal
FAA in IBRA 76:	Brigalow Belt South
FAA in IBRA 78:	Victoria Midlands
FAA in IBRA 84:	Davenport Murchison Ranges

