Fire in arid and semi-arid Australia

1998 – 2004

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Thesis submitted for the degree of

Doctor of Philosophy

Dorothy Turner

School of Earth and Environmental Sciences
The University of Adelaide

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THE UNIVERSITY OF ADELAIDE AUSTRALIA

DESERT KNOWLEDGE CRC

Landgate

Frontpiece: Grass fire in central Australian grassland

Source: Malcolm Paterson, © CSIRO

http://www.publish.csiro.au/onborrowedtime/sections/ref_gallery.html

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.

Turner, D., Lewis, M. and Ostendorf, B., 2009. Spatial indicators of fire risk in the arid and semi-arid zone of Australia. Ecological Indicators. Available online at http://dx.doi.org/10.1016/j.ecolind.2009.09.001

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Signed: ____ Date: _________________.

Statement of Authorship

Chapter 4: A comparison of NOAA AVHRR fire data with three Landsat datasets in arid and semi-arid Australia.

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Turner, D. (candidate)

Performed analysis on all samples, interpreted data, wrote manuscript and acted as corresponding author.

I hereby certify that the statement of contribution is accurate.

Signed: ______________________________ Date: ______________.

Ostendorf, B.

Supervised development of work, and and manuscript evaluation.

I hereby certify that the statement of contribution is accurate and I give permission fot the inclusion of the paper in the thesis.

Signed: ______________________________ Date: ______________.

Lewis, M.

Data interpretation, and manuscript evaluation.

I hereby certify that the statement of contribution is accurate and I give permission fot the inclusion of the paper in the thesis.

Signed: ______________________________ Date: ______________.

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Chapter 5: An introduction to patterns of fire in arid and semi-arid Australia, 1998-2004.

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Turner, D. (candidate)

Performed analysis on all samples, interpreted data, wrote manuscript and acted as corresponding author.

I hereby certify that the statement of contribution is accurate.

Signed: ______________________________________ Date: _______________.

Ostendorf, B. (co-author)

Supervised development of work, helped in data interpretation and manuscript evaluation.

I hereby certify that the statement of contribution is accurate and I give permission fot the inclusion of the paper in the thesis.

Signed: ______________________________________ Date: _______________.

Lewis, M. (co-author)

Data interpretation and manuscript evaluation.

I hereby certify that the statement of contribution is accurate and I give permission fot the inclusion of the paper in the thesis.

Signed: ______________________________________ Date: _______________.

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Gratitude goes to the DK CRC 'Desert Fire' research program, and the University of Adelaide, who funded this project.

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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