Biological Conservation 159 (2013) 321–331

Contents lists available at SciVerse ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Illuminating the dawn of pastoralism: Evaluating the record of European explorers to inform landscape change

J.L. Silcock [a,*], T.P. Piddocke [b], R.J. Fensham [a,b]

[a] The Ecology Centre, School of Biological Sciences, University of Queensland, St Lucia, 4072 Queensland, Australia
[b] Queensland Herbarium, Department of Environment and Resource Management, Brisbane Botanic Gardens, Mt Coot-tha Road, Toowong, 4066 Queensland, Australia

ARTICLE INFO

Article history:
Received 17 May 2012
Received in revised form 30 September 2012
Accepted 28 November 2012
Available online 23 January 2013

Keywords:
Explorers
Rangelands
Vegetation change
Fire
Kangaroos
Waterholes
Geo-referencing

ABSTRACT

The rapid spread of pastoralism across Australian and North American rangelands and the lack of reference sites mean that recurring arguments about the cause and magnitude of landscape change are frustrated by the rarity of records that predate the critical watershed of European settlement. The journals of European explorers from the 1840s are the first written descriptions of inland Australia. Prevailing paradigms based on a synthesis of published material relating to five key themes of environmental change are presented: vegetation structure, fire regimes, waterhole permanence, macropod abundance and medium-sized mammal assemblages. Six hypotheses relating to these themes were tested against the explorer record for inland eastern Australia. Nearly 4500 observations from fourteen journals spanning twelve expeditions between 1844 and 1919 were geo-referenced, using landscape features, distances, bearings and latitudes, combined with topographic maps and high-resolution satellite imagery. Careful evaluation of the record suggests little change in broad vegetation structure or waterhole permanence, running counter to prevailing paradigms. The sparse observations of fire suggest burning was infrequent and mostly restricted to creek-lines and higher-rainfall grasslands in the east and north of the study area and spinifex-dominated vegetation. Kangaroos were apparently uncommon in semi-arid areas where they are abundant today. The journals contain important observations of medium-sized mammals that are now extinct or rare. Our results highlight the importance of accurate geo-referencing compiled from entire journals of multiple explorers and contrasting the record with contemporary observation. Systematic evaluation of the explorer record for a region can provide ecological insights that are difficult to obtain by other means, and can be used to test prevailing assumptions common to arid systems that have been subject to abrupt management upheaval.

1. Introduction

Across rangelands in Australia and North America, where the spread of European pastoralism was omnipresent and abrupt, recurring arguments about the cause and magnitude of landscape change are frustrated by the rarity of records that predate this momentous biogeographic watershed (Goforth and Minnich, 2007; MacDougall, 2008; Swetnam et al., 1999; Witt et al., 2000). In the absence of reference sites unaffected by pastoralism, ecologists have turned to the historical record to better understand contemporary ecosystems and their dynamics (Bowman, 2001; Foster, 2000; Swetnam et al., 1999). Historical sources provide a temporal perspective far exceeding that enabled by long-term field studies, and are especially valuable where ecosystem alterations or upheavals predated formal studies (Goforth and Minnich, 2007; Jackson et al., 2001; Luiz and Edwards, 2011). Historical ecologists have employed a diverse array of sources spanning timescales from millennial to centennial and decadal, encompassing natural and documentary sources. The former include stratified sediments, pollen cores, deposits of material constructed by animals, tree-rings marking annual growth cycles and fire scars (see Swetnam et al., 1999 for examples). Documentary archives consist of written and visual records or historical landscapes, and are particularly powerful because they provide graphic imagery that resonates with a broad audience including non-scientists.

Interpretations of pre-pastoral landscapes from historical records are often used to support arguments about contemporary land management and conservation. Substantial degradation of Australian rangelands over the past 150 years has been attributed to European land management practices (Gasteen, 1982; Letnic, 2000; Marshall, 1966; White, 1997). Symptoms include soil erosion (Fanning, 1999; Gale and Haworth, 2005; Mills, 1986) and associated silting of rivers and waterholes (Pickard, 1994; Tolcher, 1986), thickening of woody vegetation (Burrows, 2002; Noble, 1997; Rolls, 1999) and altered fire regimes (Gammage, 2011;

* Corresponding author. Tel.: +61 07 3896 9547; fax: +61 07 3896 9624.
E-mail address: jennifer.silcock@uqconnect.edu.au (J.L. Silcock).

0006-3207/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biocon.2012.11.030

Russell-Smith et al., 2003). Changes in the composition and abundance of plant and animal species have also been flagged (Friedel et al., 2003; Landsberg et al., 2003; Woinarski and Fisher, 2003), including a catastrophic decline of medium-sized mammals (Johnson, 2006) and an increase in numbers of larger macropods in some areas (Newsome, 1975). These issues, particularly soil erosion and changes in woody plant density, are common to arid lands globally (Archer, 1989; Ayyad, 2003; Reynolds et al., 2007). While many examples of environmental change are irrefutable, others are not supported by empirical evidence but have nevertheless become enshrined in the scientific literature and popular imagination as 'conventional wisdom' (Mitchell, 1991). If the basis for these assumptions is unsound, attempts to understand these landscapes will be stymied and management misguided (Foster, 2000).

Explorer journals provide the first written descriptions of inland Australia at a critical time just prior to an abrupt management upheaval. They have been used to reconstruct aspects of the pre-European landscape across Australia including: vegetation structure (Benson and Redpath, 1997; Croft et al., 1997; Denny, 1987; Fensham, 2008; Lunt, 1998; Ryan et al., 1995); fire regimes (Bowman and Brown, 1986; Braithwaite, 1991; Crowley and Garnett, 2000; Fensham, 1997; Gammage, 2011; Kimber, 1983; Preece, 2002; Vigilante, 2001); mammal declines (Denny, 1994; Kerle et al., 1992; Lunney, 2001); native species that are thought to have increased in range and abundance (Auty, 2004; Barker and Caughley, 1993; Denny, 1980; Gammage, 2010); and colonisation patterns of feral species (Griffin and Friedel, 1985; Abbott, 2002).

Given the absence of reference sites unaffected by changes associated with European land-use in arid and semi-arid eastern Australia, perceptions of widespread environmental change, and the relatively rich exploration history, a systematic examination of explorer journals for this area holds substantial potential for understanding landscape change. This paper examines the extent to which the observations of nineteenth and early twentieth century explorers can inform inferences about five key themes of environmental change: vegetation structure, fire regimes, waterhole permanence, medium-sized mammal assemblages and kangaroo numbers. Six prevailing hypotheses based on these themes were synthesised from the literature, and tested against the explorer record (Table 1).

2. Methods

2.1. Study area and exploration history

The study area is defined as the semi-arid and arid region of Queensland, and the adjacent arid zone of north-eastern South Australia and north-western New South Wales (Fig. 1). Average annual rainfall decreases on a south-westerly gradient, from 500 mm in the north and east to just 100 mm in the Simpson Desert. Summer temperatures are hot with maximum temperatures throughout December–February averaging 35 °C, while short winters are characterised by cold nights often falling below zero and warm days averaging 20 °C (Bureau of Meterology, 2012). Higher rainfall areas support *Acacia* and, to a lesser extent, *Eucalyptus* woodlands, while the more arid portions are dominated by gibber plains, rolling downs, wide floodplains, low-relief sandstone ranges, open shrublands dominated by *Acacia* species and extensive linear dunefields.

Europeans had been in Australia for over 50 years before a concerted attempt was made to explore the interior of the continent. In 1840, Edward John Eyre was thwarted in his attempt to reach the centre of the continent by the chain of salt lakes which stretch through central South Australia. Exploration in western New South Wales, north-eastern South Australia and inland Queensland continued through the 1840s and 1850s, with expeditions led by Captain Charles Sturt (in 1844–1845), Major Thomas Mitchell (1845–1846), Edmund Kennedy (1847), the ill-fated Ludwig Leichhardt (1848) and Augustus Gregory (1858). The 1860 Burke and Wills expedition spawned four 'recovery' expeditions in 1861–1862, led by William Landsborough, Frederick Walker, John McKinlay and Alfred Howitt, all of which served the twin aim of assessing the pastoral potential of the inland.

Concomitantly, Governments in South Australia and Queensland were passing legislation designed to encourage settlement of the 'waste-lands', resulting in a period of rapid pastoral expansion.

Table 1
Prevailing paradigms and hypotheses tested using explorer record for five major themes (references are provided in Appendix 1).

Prevailing paradigm	Hypothesis tested	Conclusions and interpretation
A. There has been a general thickening of woody overstorey vegetation in the semi-arid zone of Queensland, especially *Acacia aneura* and *A. cambagei*	1. There will be numerous examples where explorers passed through open country that is now thickly wooded	Explorers passed through many areas of dense woodland and scrub, with no geo-referenced observations of open country now characterised by thick vegetation, refuting the paradigm of unidirectional vegetation change
B. (i) Fires are less frequent across the semi-arid zone, especially the mulga forests and Mitchell grasslands, due to lower biomass and active suppression	2. Burning was regularly noted by explorers in areas where fire is uncommon today	Fire was rarely mentioned by explorers in the semi-arid zone, with the exception of Aboriginal burning of grasslands on the eastern edge of the semi-arid zone. Aboriginal burning in spinifex landscapes recorded by three explorers
(ii) In spinifex-dominated ecosystems, small, regular 'patchy' fires have been replaced by large, destructive wildfires following good seasons	3. Burning was regularly noted in spinifex landscapes today characterised by infrequent large wildfires	
C. Waterholes in some regions have 'silted up' since pastoral settlement due to the loss of groundcover and subsequent accelerated erosion, resulting in a decrease in depth and therefore permanence	4. Long-lasting waterholes were recorded by explorers in reaches where there are now no long-lasting waterholes	No change in permanence was evident from the explorer record for the majority of rivers and creeks
D. The range and abundance of macropods have increased in semi-arid areas since pastoral settlement. Macropods were always abundant in wetter areas of eastern Australia prior to European settlement. Red kangaroo numbers fluctuate with seasons but have not changed greatly in the arid zone	5. Few macropods were recorded by explorers in the semi-arid and arid zone, but they saw relatively large numbers in areas above 500 mm rainfall	Kangaroos were abundant in areas of >500 mm, but there are very few references to macropods in semi-arid Queensland
E. The range and abundance of medium-sized mammals have contracted across the study area	6. Medium-sized mammals will be present in the explorer record in areas where they no longer occur	There are numerous explorer records of medium-sized mammals that are now locally extinct