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Do fire and rainfall drive spatial and temporal population shifts in parrots? A case study using urban parrot populations

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ABSTRACT

Populations of several species of native parrots have been increasing in many Australian cities since the 1980s contributing to a shift in the composition of urban avian communities. Anecdotal evidence suggests that some species of parrot may move into the urban landscape during environmental disturbances, such as wild fires or periods of decreased rainfall. This study seeks to determine the extent to which fire and rainfall explain changes in the abundance of parrots in urban Sydney. Multiple regression using the Akaike Information Criterion was used to analyse a 26-year data set, beginning in 1981, to measure the change in abundance of 13 species of parrot in response to wild fire and rainfall. Wild fire, within a radial distance of 100 km, significantly predicted changes in abundance of five species of parrot in urban Sydney. Local and/or inland rainfall significantly predicted changes in abundance of six parrot species in the urban landscape, with decreases in inland rainfall resulting in an increase in abundance in the urban landscape of parrots that traditionally inhabited inland areas.

1. Introduction

Urbanisation is one of the most dramatic transformations to shape the natural landscape (Lowry and Lill, 2007), and is considered one of the greatest threats to the conservation of biodiversity (Isaac et al., 2008). Whilst 51% of the global population is expected to reside in cities by 2010 (Garden et al., 2006; Isaac et al., 2008), Australia has already surpassed this global average with 90% of the population residing in urban and suburban areas (Isaac et al., 2008). Such a rapid rate of urbanisation has resulted in an abrupt change to the landscape, with continuous tracts of native vegetation transformed into complex spatial mosaics of buildings and bitumen, interspersed with fragmented and discontinuous remnant vegetation, parks and gardens (Catterall, 2004).

Urbanisation results in a profound restructuring of the landscape (Chamberlain et al., 2009) and has been described as catastrophic for some species of birds (Meyer-Gleaves and Jones, 2007), often resulting in the elimination of many indigenous birds from the urban landscape (McKinney, 2002; Shukuroglou and McCarthy, 2006). In Australia, however, there has been a recent increase in abundance of several species of native Australian parrots in suburban areas of Australian cities (Burgin and Saunders, 2007; Lowry and Lill, 2007; Shukuroglou and McCarthy, 2006; Veerman, 1991). In the city of Sydney, New South Wales, prior to 1920, Rainbow Lorikeets (*Trichoglossus haematodus*) were considered rare (Burgin and Saunders, 2007) however they are now one of the most frequently recorded species in Sydney (Major and Parsons, 2010). During the period between 1981 and 2002, four other species of parrot increased in abundance in urban Sydney (Burgin and Saunders, 2007). Whilst some of these species have always been present in the Sydney region, such as the Sulphur-crested Cockatoo (*Cacatua galerita*), other species such as the long-billed Corella (*Cacatua tenuirostris*) and the Galah (*Eolophus roseicapillus*) were historically known only from arid areas of inland Australia (Higgins, 1999). There are several factors that may be driving these changes in abundance, one of which is drought.

Drought results in long term changes to habitat and resources, and Australia regularly experiences drought cycles lasting ten years or more (Hunt, 2009; Ummenhofer et al., 2009). Surface water in the arid zone is normally naturally restricted (Fensham and Fairfax, 2008) and may become locally unavailable during these extended periods of drought, although for highly mobile species such as parrots, available drinking water may not necessarily be a limiting resource, given the widespread distribution of artificial agricultural watering points (Fensham and Fairfax, 2008). Foraging may become increasingly difficult, however, as plant flowering and seeding may be delayed, become dormant throughout the drought or aborted

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entirely (Ellis and Sedgley, 1992; Law et al., 2000), which may result in a resource-driven movement towards the urban landscape (Saunders, 1980; Smith and Moore, 1992).

Wild fire, which is a frequent occurrence among the sclerophyllous forests and woodlands of the New South Wales coast, is another factor that may account for temporal change in Sydney's parrot community and may result in an increased abundance of local species in the urban landscape immediately following large fires (Recher, 1997). Following a small fire, surrounding vegetation may offer enough food resources so that only local evasive movements by birds are necessary. The effects of large fires (fires that burn in excess of 10,000 ha (Keane et al., 2008)), however, are twofold. There is an immediate effect of the fire itself, where populations of (vertebrate) fauna are often depleted, either as a function of mortality or through dispersal/escape mechanisms (Bradstock, 2008), and a longer term effect that is a function of changed habitat resources, such as food or cover (Whelan, 1995).

It appears that certain species of Australian Psittaciformes may be responding to such environmental events as drought and rainfall, and may be entering the urban landscape in search of shelter or food resources that are limited or unavailable in the surrounding natural vegetation. This study aims to document changes over a 26 year period in Sydney's parrot community and to determine the extent that drought and wild fire explain annual variation in parrot abundance. The specific aims are to:

1) analyse population dynamics of 13 parrot species in the Sydney region, New South Wales Australia over a 26 year period;
2) determine the extent to which rainfall explains patterns of abundance of urban parrot populations; and
3) determine the extent to which fire explains patterns of abundance of urban parrot populations.

If large wild fires are a driver of changes in parrot abundance in the urban landscape, we predict an increase in abundance of species that have traditionally been present in the Sydney urban landscape (such as the Rosellas (*Platycercus* spp.) and Australian King Parrot (*Alisterus scapularis*)) immediately following large wild fires. If rainfall contributes towards changes in abundance in the urban landscape, we predict an increase in the abundance of arid zone species (such as Corella species and the Galah) in the Sydney urban landscape up to two years following decreases in inland rainfall.

2. Materials and methods

2.1. Study site

The study site encompassed the Sydney urban region on the east coast of New South Wales, Australia. Sydney extends over an area greater than 12,000 km^2 and is characterised by a warm, temperate climate. It is an urban island, bounded by the Pacific Ocean to the east and three major national parks to the north, south and west (Fig. 1). The area of natural vegetation within these parks surrounding Sydney exceeds 2700 km^2 and is predominantly dry sclerophyll woodland or forest, and heath (Keith, 2006). Sydney and its suburbs contain numerous recreational parks and gardens as well as a number of small remnants of native vegetation (shaded in Fig. 1) which provide habitat for a range of native bird species (Parsons et al., 2003).

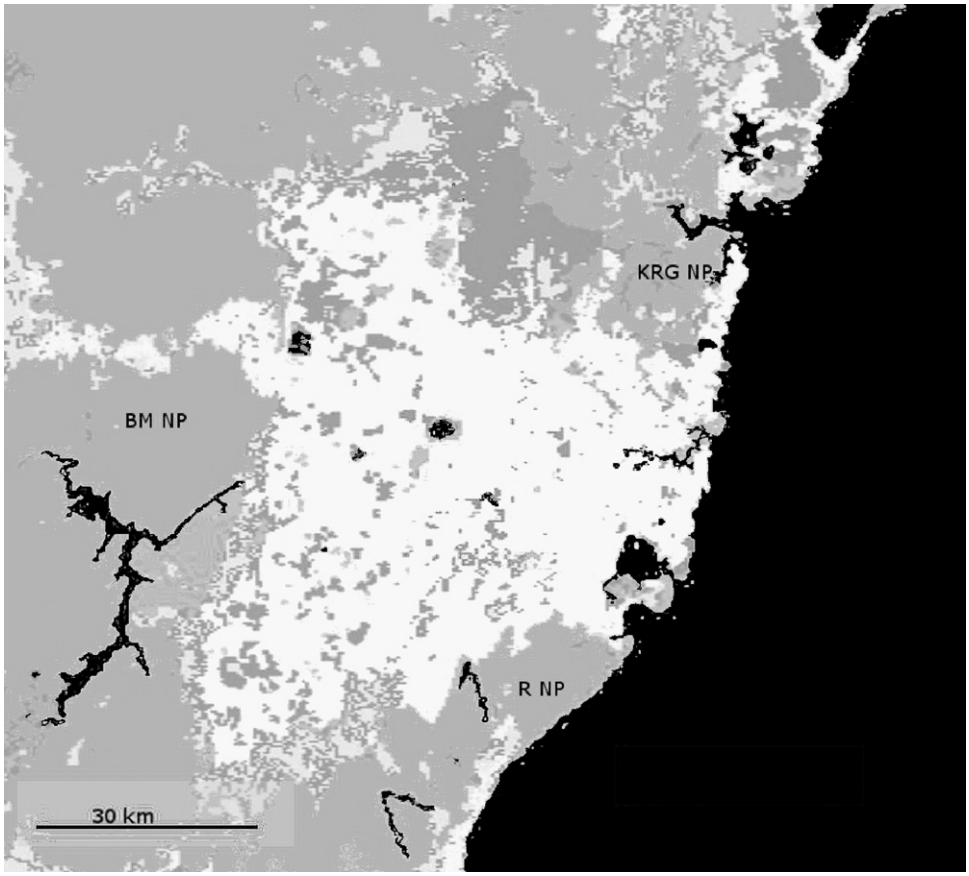

Fig. 1. Sydney, Australia, showing the Sydney urban landscape (white) and surrounding vegetation (grey) with Royal National Park (Royal NP), Ku-ring-Gai Chase National Park (KRG NP) and the Blue Mountains National Park (BM NP). Water is coloured black.