

**Ecology and movements of the
Australian Bustard *Ardeotis australis*
in a dynamic landscape**



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*I've wandered the world in search of life:
bird by bird I've come to know the earth:
discovered where fire flames aloft:
the expenditure of energy
and my disinterestedness were rewarded,
even though no one paid me for it,
because I received those wings in my soul
and immobility never held me down
— Pablo Neruda*

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Abstract

Australia's fauna exhibit a range of adaptations to cope with the significant climatic and environmental variability that characterises the Australian continent. Such adaptations include, among others, boom-bust population fluctuations, diet switching, tolerance of sub-optimal conditions and broad-scale movements, and may combine in different ways to determine an organism's response to prevailing environmental conditions. Among birds, arguably the most significant strategy for coping with change is their mobility. Australia's birds exhibit a variety of movement strategies ranging from regular migration to nomadism and irruptive movements. The predominance of broad-scale dispersive and opportunistic movements, and the flexibility in employment of different movement strategies within and between species, largely distinguish Australian birds from many of their better studied northern hemisphere counterparts. These movements and their drivers, however, remain poorly understood.

The Australian Bustard is representative of a suite of Australian terrestrial birds that employ complex movement strategies and responses to environmental variability. The bustard may be an amenable model for examining broad-scale distribution and movement patterns in relation to dynamic environments because of its ranging habits and widespread distribution, its large size enabling long-term satellite tracking and because it is well known and easily identifiable, making it a suitable candidate for community-based survey efforts. However, any such studies require knowledge of the basic ecology of a focal species. Accordingly, this study aimed to integrate broad-scale analyses of the distribution and movement patterns of bustard with detailed, site-specific ecological studies of the bustard at two sites in Australia's tropical savannas.

A near continental-scale mail survey of rangeland users revealed that the bustard's strongholds are in the northern tropical savannas and that the species employs variable movement strategies across its range. Seasonality of bustard occurrence and sedentariness were a feature of regions characterised by seasonally predictable conditions. Seasonal patterns were also evident in more climatically unpredictable regions, although here they appeared increasingly overlaid by more nomadic or opportunistic movements as a result of longer term variation in rainfall patterns. Survey respondents also noted that bustards were associated with fire, grasshopper outbreaks, crop agriculture and drought.

An analogous study employing satellite telemetry aimed to examine broad-scale movement patterns of individual bustards in regions that differed in their rainfall variability. Although based on a relatively small number of tracked individuals, results generally corresponded to those of the broad-scale mail survey. All individuals in the wet-dry tropics were largely sedentary or made small-scale seasonal or nomadic movements. Two individuals tracked in more climatically variable regions made broader-scale movements, with the individual in the most environmentally variable region moving most.

Complementing these broad-scale analyses were detailed ecological studies of key aspects of the bustard's ecology. Repeated systematic surveys of the bustard at two sites in northern Australia that differed in their land use and 'naturalness' revealed that numbers of bustards were substantially higher in the modified habitat compared with more 'natural' regions. Seasonal patterns in abundance generally reflected findings from the 'Top End' region from mail surveys; there were lows in abundance following the breeding season suggesting post-breeding season dispersive movements, particularly by males. These movements are likely to be intra-regional and made to exploit productive regions across the broader landscape.

Bustards exhibited a general preference for plains and open woodlands on flat terrain. A specific preference for open treeless alluvial plains was evident in the early dry season when favoured food resources were notably higher in these habitats compared to adjacent areas. Gizzard contents collected from across the northern savannas in the mid to late dry season confirmed a broad, omnivorous diet. Nevertheless, specific preferences were evident for particular foods. In general, females favoured smaller prey such as beetles and true bugs, while males preferred larger prey including grasshoppers and mantids. A large proportion of the diet of both sexes also consisted of fruits and seeds.

At both study sites bustards exhibited characteristics consistent with a lek mating system. However, dispersion patterns of displaying males included solitary males at display sites very early and late in the breeding season, exploded leks of several males for most of the breeding period and aggregations of males resembling both exploded and classical leks at peak periods following significant rainfall. Males exhibited fidelity to specific display sites within and between breeding seasons as long as habitat conditions remained favourable. Display sites were in open areas with low grass height and cover. In the early breeding season females ranged further than males primarily in order to assess displaying males on lekking grounds. By comparison, males had circumscribed home ranges centred around display sites. During the breeding season mature displaying males spent considerably more time displaying at the expense of foraging, whereas there were no significant differences in time spent foraging between seasons by females or sub-ordinate males.

Overall, a fundamental feature of the ecology and movements of the Australian Bustard is flexibility. Bustards exhibited various movement strategies and responses to prevailing conditions at both local sites in this study and across their range. The varied threats the species faces and the challenges of flexible responses and movement strategies pose complex conservation and management problems for the species. In closing, I discuss the implications of the findings for the conservation and management of the Australian Bustard and similarly mobile fauna, and address future research directions and opportunities.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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Mark Ziembicki
August 2009

Statement by co-author of published paper

Chapter 2 comprises a jointly authored paper published in *Pacific Conservation Biology*.^{*} This paper was conceived, analyzed and written by Mark with some supervisory input from myself, primarily in the analysis and writing up stages.

I give my permission for an edited version of the paper as presented to be included in this thesis.

John Woinarski
August 2009

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