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Abstract

The cryptic Eastern Bristlebird (Dasyornis brachypterus) is an endangered endemic of south-eastern Australia. Its distribution is highly fragmented with only two populations exceeding 500 individuals. Consequently, recovery planning includes translocation to increase the number of viable populations. The Eastern Bristlebird is typically found in low, dense vegetation. The species occurs in 26 different plant communities throughout its range, which suggests that it might be considered a habitat generalist. However, two studies based on aural surveys have demonstrated that it was conspicuous at heath-wood ecotones. Radiotracking was used to overcome reliance on aural surveys and to investigate the habitat of 12 Eastern Bristlebirds at 50-m wide heath-wood ecotones in two sites at Jervis Bay. Although individual birds appeared either to prefer or avoid the heath, ecotone or wood, there was no consistent pattern of habitat selection and there was no attraction to, or avoidance of, the heath-wood edge at species level. The present study provides further evidence that although heath-wood ecotones may provide suitable habitat for some individual Eastern Bristlebirds, the species is neither dependent on, nor confined to, heath-wood ecotones. This knowledge was an important consideration in the selection of two host sites for recently conducted reintroductions of the species. © 2009 Ecological Society of Australia.

Keywords

habitats, reintroductions, appropriate, understanding, assessment, eastern, bristlebird, habitat, refining

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Life Sciences | Physical Sciences and Mathematics | Social and Behavioral Sciences

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Assessment of Eastern Bristlebird habitat: refining understanding of appropriate habitats for reintroductions

By Jack Baker

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Summary The cryptic Eastern Bristlebird (*Dasyornis brachypterus*) is an endangered endemic of south-eastern Australia. Its distribution is highly fragmented with only two populations exceeding 500 individuals. Consequently, recovery planning includes translocation to increase the number of viable populations. The Eastern Bristlebird is typically found in low, dense vegetation. The species occurs in 26 different plant communities throughout its range, which suggests that it might be considered a habitat generalist. However, two studies based on aural surveys have demonstrated that it was conspicuous at heath-wood ecotones. Radio-tracking was used to overcome reliance on aural surveys and to investigate the habitat of 12 Eastern Bristlebirds at 50-m wide heath-wood ecotones in two sites at Jervis Bay. Although individual birds appeared either to prefer or avoid the heath, ecotone or wood, there was no consistent pattern of habitat selection and there was no attraction to, or avoidance of, the heath-wood edge at species level. The present study provides further evidence that while heath-wood ecotones may provide suitable habitat for some individual Eastern Bristlebirds, the species is neither dependent on, nor confined to, heath-wood ecotones. This knowledge was an important consideration in the selection of two host sites for recently conducted reintroductions of the species.

Key words *edges, ecotonal species, habitat utilisation, Eastern Bristlebird, radio-tracking, translocation.*

Introduction

The Eastern Bristlebird (*Dasyornis brachypterus*) is a small (40 g), ground-dwelling, semi-flightless, camouflaged, dull brown-grey passerine with cryptic behaviour and a general habitat requirement of low, dense vegetation (Baker 2000). The species is endemic to near-coastal south-eastern Australia and listed as endangered under commonwealth and state legislation for the jurisdictions where it occurs. Frequent, intense or extensive fires are the main threats to the remaining populations (Baker 1997; Bain *et al.* 2008) throughout its fragmented range from the Croajingalong Wilderness Area in Victoria to the Conondale Ranges in Queensland (Baker 1997). Two locations in central NSW support populations of more than 500 individuals: (i) the elevated plateau in the vicinity of Barren Grounds Nature Reserve and Budderoo National Park (hereafter Barren Grounds) and (ii) the coastal area on the south side of Jervis Bay in the vicinity of Jervis Bay National Park and Booderee National Park (hereafter Jervis Bay). A few other locations have low numbers (Baker 1997; NPWS 2003). Recovery planning for the species includes translocation of birds to establish additional populations. This is intended to overcome the difficulties of the species' poor dispersal ability and the fragmentation and isolation of its populations and to reduce the detrimental impact of fires, particularly at Barren Grounds and Jervis Bay (NPWS 2003). Reviews of animal translocations (e.g. Wolf *et al.* 1998; Fischer & Lindenmayer 2000), demonstrate the importance of high-quality habitat at the release site. Hence, a good knowledge of habitat selection by the Eastern Bristlebird is important to maximise the chance of success of translocations.

Eastern Bristlebird habitat at Barren Grounds and Jervis Bay is characterised by a variety of extensive intergrading heathland, sedgeland and swamp communities hereafter called heath. In places, the heath forms distinct edges with adjacent woodland and forest, hereafter called wood. An edge is a line between two ecological communities, whereas an ecotone is the zone of transition between adjacent ecological communities (Clements 1907; Harris 1988; Risser 1995; Baker *et al.* 2002). The vegetation pattern that distinguishes the ecotone from the surrounding communities is considered important for a range of organisms and ecological processes (Holland *et al.* 1991). Odum (1958) proposed that some species, particularly birds, may be considered primarily or entirely ecotonal. From the time of Leopold (1933), there has been interest in the conservation and management of ecotones (Reese & Ratti 1988; Holland & Risser 1991; Whitaker & Montevecchi 1997; Temple 1998), although for a range of species the importance of ecotones is equivocal (e.g.

plants, Murcia 1995; plants and fungi, Luczaj & Sadowska 1997; invertebrates, Kotze & Samways 2001; birds, Baker *et al.* 2002).

The Eastern Bristlebird's habitat requirements are not well understood. On the one hand, Baker (2000) lists 26 plant communities in which the species has been documented throughout its range, including rainforests, eucalypt forests, woodlands, scrubs, mallees, heaths and swamps. This suggests that the species might be a habitat generalist. On the other hand, two detailed studies of Eastern Bristlebirds at heath-wood edges, have suggested that the species might be a habitat specialist. Bramwell *et al.* (1992) concluded that the species was usually found near heath-wood ecotones. Baker *et al.* (2002) found that 65% of observations were in the 50-m wide ecotone and categorised the species as ecotone conspicuous. However, because of the cryptic nature of the species, these two studies relied on detecting birds from their calls. The extent to which individual birds use the heath-wood ecotone and the importance of the ecotone as habitat remain uncertain. The aim of the present study was to overcome reliance on aural surveys by using radio-tracking data to measure habitat selection and edge affinity of Eastern Bristlebirds across heath-wood edges.

Methods

Twenty-two Eastern Bristlebirds were radio-tracked at Bherwerre Peninsula, Jervis Bay (35˚ 10' E, 150˚ 40' S), during March to June 1997 (Baker 2001). The present study considered a total of 12 of these birds because they were trapped close to heath-wood edges, at a mean distance 23 m from the edge. Six birds were trapped 10–85 m from the edge at Site 1 and six birds were trapped 5–30 m from the edge at Site 2. The sites were approximately 3.5 km apart. The birds were radio-tracked at varying times of day for a mean of 6.6 (3–21) days and a mean of 36.5 (15–107) fixes per bird. Following the design of Baker *et al.* (2002), the ecotone was defined as extending 25 m either side of the edge. Home range was estimated using minimum convex polygon (MCP; Mohr 1947) areas because they were considered to be representative of the birds' spatial utilization even though most birds were under sampled (Baker 2001). For each site, the location fixes were overlaid on a digitised vegetation map (Taws 1997), the heath-wood edge was drawn on the vegetation map after ground truthing and the ecotone was delimited by lines 25 m each side of the edge. Data manipulations were performed using the geographic information system (GIS) ArcView (ESRI 1996) and the Animal Movement extension to ArcView (Hooge & Eichenlaub 1997).

Habitat utilization (observed) was compared to habitat availability (expected) using a χ^2 goodness of fit test as described by Neu *et al.* (1974). Habitat utilisation was taken to be the number of fixes per habitat. Habitat availability was calculated as the areas of heath, ecotone and wood within the study area at each site. Definition of the study area is of critical importance to χ^2 calculations because it determines the areas of the available (expected) habitat; analysis using arbitrary boundaries may give spurious results (Johnson 1980; Porter & Church 1987). For the present study, the study area at each site was defined as the union of the home range MCP areas of the six birds being studied. Where individual animals differ in their use of the available habitats, pooling data across animals tends to cancel out the evidence for habitat selection among animals. To avoid this problem, the χ^2 values for individuals were summed to test the null hypothesis that there was no habitat selection among all animals (White & Garrott 1990; Aebischer *et al.* 1993; K. Russell pers. comm.). The Bonferroni *z* statistic (Miller 1966) ($\alpha = 0.05$; k = 3 habitat types) was used to determine habitat selection, either preference or avoidance.

A measure of edge affinity was also used to assess Eastern Bristlebird habitat selection because it removes the bias associated with specifying the width of the ecotone. It was developed by Kremsater & Bunnell (1992) and modified by Tufto *et al.* (1996), who considered individual animals as the sample unit to overcome the problem of pooling data across animals. The method was used to compare the distribution of actual fixes of the 12 Eastern Bristlebirds with a uniform distribution of points within each animal's home range MCP area. In the present study, 2 500 uniformly distributed points per ha were used, which is 200 times the density of actual fixes. The set of the 12 birds' edge affinity indices was tested for normality using the Shapiro-Wilk test and their mean was tested against unity, the hypothetical index for no edge affinity, using a two-tailed t test (Zar 1984).

Results

At both sites combined, among all birds, there was significant habitat selection ($\chi^2 = 129.7$, $P < 0.001$). Furthermore, there was significant habitat selection at each site (Site 1 $\chi^2 = 103.9$, $P < 0.001$; Site 2 $\chi^2 = 25.85$, $P < 0.02$) (Table 1). However, overall there was no consistent pattern of birds preferring or avoiding particular habitats. Instead, eight birds preferred or avoided one or more of the habitats and four birds were detected at the three habitats as often as expected considering the proportion of each habitat that was available. Two birds preferred ecotone habitat, one avoided it and the remaining nine were detected in the ecotone habitat as often as expected. Three individuals showed a preference for the heath and three avoided the heath habitat. One individual preferred the wood and five avoided the wood habitat.

The edge affinity indices for all birds did not depart significantly from a normal distribution (Shapiro-Wilk test W = 0.927, *P* = 0.331). The mean (± se) of the edge affinity indices 1.06 (± 0.062) was not significantly different from what would be expected for a uniform distribution of tracking points ($t_{0.05, (2), 11}$ = 2.201; t = 0.933, *P* > 0.342). In other words, the pattern of radio-tracking fixes for Eastern Bristlebirds did not show an increase or reduction towards the heath-wood edge.

Discussion

The present study was limited to 12 Eastern Bristlebirds from the Jervis Bay population radio-tracked during one autumn. It was a detailed study in the habitat of these birds, which were trapped at an average of 23 m from a heath-wood edge and hence, were considered more likely to utilize ecotones than birds trapped hundreds of metres from an edge. However, although individual birds appeared either to prefer or avoid the heath, ecotone or wood, there was no consistent pattern of habitat selection and there was no attraction to the heath-wood edge. These results are at variance with the earlier evidence that the Barren Grounds population was ecotonal during one spring (Bramwell *et al.* 1992) and, more generally, that across the four seasons the species was ecotone conspicuous (Baker *et al.* 2002). This disparity may have arisen in two ways. First, the earlier studies were based on aural surveys and may have been biased by Eastern Bristlebirds calling, thus being detected, more frequently at heath-wood ecotones than in the adjacent heath or wood. This explanation is likely, given that the present study removed the reliance on aural surveys. It also seems plausible, as Eastern Bristlebirds react to human presence by moving to and calling from taller vegetation, including mallee clumps in heath and shrubs at heath-wood edges (J. Baker pers. obs.). Secondly, seasonality may influence habitat selection. This can’t be tested for the 12 birds in the present study nor for the data from Bramwell *et al.* (1992). However, the data presented in Baker *et al.* (2002) have been re-analysed (Fig. 1). For each location, the pattern of Eastern Bristlebird detection is similar among seasons, particularly comparing spring and autumn, which suggests that seasonality has little influence on habitat selection.

Whether the Eastern Bristlebird is a heath-wood ecotone specialist seems much less likely in view of these results, albeit that heath-wood edges are a feature of the locations of the two largest populations of the species. Furthermore, the Eastern Bristlebird occurs in a wide variety of landscapes and vegetation communities throughout its range (Baker 2000; Higgins & Peter 2002). The vegetation around Jervis Bay is heterogeneous and the map (Taws 1997) demonstrates that it is impossible to be more than 500 m from the edge of any patch of a major vegetation community and that there is variation in floristics, structure and fire age within the communities. The vegetation community mapping for Barren Grounds (Tozer *et al.* 2006) shows similar heterogeneity, although there is one large area of heath in which Eastern Bristlebirds have been recorded at a relatively high density 700 m from the nearest heath-wood edge (Baker 1997). As Eastern Bristlebirds at Jervis Bay have been radio-tracked making daily sallies of up to 525 m (Baker & Clarke 1999) and having home range MCP areas of up to 10 ha (Baker 2001), it is likely that many of them have some heath-wood ecotone within their home range and that others rarely if ever encounter ecotones. Baker (2000) concluded that the Eastern Bristlebird is cover-dependent and Baker *et al.* (2002) classified it as a habitat generalist and ecotone-conspicuous species. The present study provides further evidence that while heath-wood ecotones may provide suitable habitat for some individual Eastern Bristlebirds, they are neither dependent on, nor confined to, heath-wood ecotones.

In the recovery program for the Eastern Bristlebird there have been two translocation proposals, both of which have been guided by the assumption that heath-wood ecotones were not critical habitat but that the vegetation communities and low dense vegetative cover at the release site should be similar to the source site. This knowledge was an important consideration in the selection of the release sites for two recent reintroductions of the Eastern Bristlebird. In the first, 45 birds were released to the northern side of Jervis Bay and relatively high counts and evidence of breeding indicated the medium-term success of this reintroduction (Bain 2006). In the second, 50 birds were released to the Woronora Plateau early in 2008 (DECC 2008) and monitoring will be conducted over the next few years to gauge the success of this reintroduction.

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Table 1. Habitat selection

Bird	χ^2	υ		*Habitat and n(fixes)*			*Total fixes*
			Site 1 (p)	*Wood (0.371)*	*Ecotone (0.183)*	*Heath (0.446)*	*(days of tracking)*
#51	9.12	2		Avoid (6)	- (12)	- (15)	33 (6)
#52	8.13	2		- (3)	Avoid (0)	Prefer (12)	15 (3)
#53	12.4	2		Prefer (17)	- (5)	Avoid (3)	25 (5)
#54	7.17	2		Avoid (1)	- (5)	- (11)	17 (3)
#55	32.5	2		- (34)	Prefer (42)	Avoid (31)	107 (21)
#56	34.5	2		Avoid (2)	Prefer (12)	Avoid (2)	16 (3)
Total	103.9	12					
			Site 2 (p)	*Wood (0.243)*	*Ecotone (0.216)*	*Heath (0.541)*	
#66	10.6	2		Avoid (0)	- (4)	Prefer (21)	25 (5)
#67	1.46	2		- (12)	- (7)	- (29)	48 (7)
#69	7.06	2		Avoid (1)	- (5)	Prefer (20)	26 (5)
#70	0.0820	2		- (11)	- (9)	- (22)	42 (6)
#71	3.30	2		- (15)	- (18)	- (26)	59 (11)
#72	3.37	2		- (8)	- (8)	- (9)	25 (4)
Total	25.85	12					
Total all	129.7	24					

υ is the degrees of freedom for each χ^2 test; *p* is the proportion of available habitat at each site

Figure 1. Number of Eastern Bristlebirds detected (two years pooled) over four seasons in wood (w), ecotone (e) and heath (h) at Barren Grounds (shaded bars) and Jervis Bay (open bars).