Corella, 2000, 26(4): 110–113

MOVEMENTS OF TWO EXPERIMENTALLY DISPLACED BROWN TREECREEPERS *Climacteris picumnus* IN A MATRIX OF WOODLAND AND PASTURE

CAREN B. COOPER

Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, VA, USA 24061
Current address: Cornell Lab of Ornithology, 159 Sapsucker Woods Road, Ithaca, NY. USA 14850

Received: 3 October 2001

Previous work found that Brown Treecreepers *Climacteris picumnus* were unable to disperse to isolated woodland patches in the New England Tablelands, northern New South Wales. I attempted to understand dispersal behaviour by testing how Brown Treecreepers react to landscape patterns while moving. I radio-tagged two male Brown Treecreepers on their resident territories and released them on territories two kilometres away. I expected to follow the return paths of these birds across a matrix of pastures and woodlands within hours of release. The male that I moved to a new territory connected directly to the original territory by woodlands returned within four days. The male that I moved to a new territory which was isolated from the original territory by cleared land did not return. The post-release movements of both males were confined to woodlands. These observations reveal the limited movement behaviour of male Brown Treecreepers and provide anecdotal evidence that non-wooded habitat is a barrier to dispersal in this species.

INTRODUCTION

The mechanisms by which habitat fragmentation affects the persistence of wildlife populations have been a major focus of research and debate in conservation biology. Experimental research has revealed a wide range of species-specific responses to habitat fragmentation (reviewed by Debinski and Holt 2000). Habitat degradation as well as edge and isolation effects vary in importance in their contribution to the persistence of different species. Experimental and theoretical studies suggest that fragmentation can disrupt natal dispersal (Askins *et al.* 1990; Harrison and Bruna 1999; Cooper and Walters 2002a) and lower reproduction and survival (Lovejoy *et al.* 1984; Lynch and Whigham 1984; Saunders *et al.* 1991). Whereas lowered reproduction and survival arise through edge effects that are known to operate primarily by nest parasitism and predation (Lovejoy *et al.* 1984; Lynch and Whigham 1984; Saunders *et al.* 1991), it is unknown exactly how isolation effects disrupt dispersal.

Theoretical studies of isolation effects hinge on untested assumptions concerning dispersal behaviour, including how barriers to dispersal and movement behaviour vary among species. Bird movements occur at several scales: within territories, between territories, and between seasonal ranges. Because many passerines migrate between seasonal ranges, it may seem counter-intuitive that smaller-scale movements could be disrupted by habitat fragmentation, but the scant empirical evidence available suggests otherwise for migratory forest songbirds (Dunning *et al.* 1995; Desrochers and Hannon 1997), a variety of residents (Machtans *et al.* 1996; Sieving *et al.* 1996; St. Clair *et al.* 1998), and for short-distance migrants (Haas 1995) in North America and land birds in Australia (Saunders and deRebeiva 1985).

The Brown Treecreeper *Climacteris picumnus* is a non-migratory, co-operatively breeding passerine that inhabits *Eucalyptus* woodlands. The species forms territories ranging from 1.1–10.7 hectares (mean = 4.4 ha, Std = 2.5) (Cooper *et al.*, in review) in open woodlands, sometimes incorporating small areas of cleared land (e.g. roads) and they frequently forage at least up to 30 metres into open pastures bordering woodland patches or wooded streams (pers. obs.). Thus, their short-range movements (within territory) are not inhibited by cleared land. Nevertheless, Brown Treecreepers are declining because isolation of habitat remnants disrupts dispersal. Cooper and Walters (2002a) found that females were unable to fill breeding vacancies in isolated patches, but bred successfully in such patches when experimentally relocated there.

Dispersal could be disrupted by several mechanisms. For example, birds may be unwilling to enter novel, intervening habitats (Greenberg 1983); they may enter these habitats but experience elevated mortality rates (Matthysen and Currie 1996); or they may enter these habitats, but have a very low probability of locating suitable habitat patches in a human-dominated matrix. Cooper *et al.* (2002) used a spatially explicit simulation model of Brown Treecreeper population dynamics in the New England Tablelands to better understand how dispersal movements may interact with the configuration of habitat in the landscape. In an effort to develop movement rules for the model, I sought to observe how Brown Treecreepers react to various habitats while moving across the landscape.

Studies of invertebrate movements suggest that observations of individual behaviour at edge boundaries can predict the movement and distribution of a species among habitat types (e.g. Haddad 1999; Jonsen and Taylor 2000). From observations of foraging Brown Treecreepers, I expected that cleared land was not a complete barrier to movement. Because dispersal behaviour is almost impossible to observe, I attempted to manipulate Brown Treecreepers into performing movements on an inter-territorial scale by displacing territorial birds two kilometres and following their return paths. I had previously observed Brown Treecreepers moving at least 500 metres in less than half an hour during forays (Cooper, unpubl. data) and assumed they had homing ability like many other passerines. Therefore, I anticipated that each bird would return to its territory within hours of release.

METHODS

For this manipulation, I identified several pairs of territories in woodland patches approximately 40 kilometres west of Armidale, New South Wales (30°27'S, 151°13'E). I planned to displace male Brown Treecreepers between each pair of territories and observe their return paths. Here I report on the only two displacements that I undertook, having ended the experiment after the two displacements revealed more limited movement behaviour than I expected.

The first pair of territories (referred to as the Direct displacement) were 2 kilometres apart with the straight-line distance comprised of woodlands (Fig. 1). The second pair of territories (referred to as the Circuitous displacement) were also 2 kilometres apart, but with the straight-line distance comprised of mostly cleared land, yet the territories were connected by woodlands through a circuitous route (Fig. 1). For the Circuitous displacement, both territories bordered cleared land or scattered trees and the displaced male frequently foraged in cleared land or roads prior to displacement.

In Brown Treecreepers, females are the predominant dispersing sex. I relocated helper males rather than females in order to avoid breaking up breeding pairs and to minimize the risk to fledging success. On 9 November of the 1996 breeding season (for the Direct displacement) and 19 November 1996 (for the Circuitous displacement), a field assistant and I fitted two helper males with radio-transmitters (0.90 g, Holohil Systems, Ltd.) and a unique combination of colour bands. Transmitters were attached with leg harnesses as described by Rappole and Tipton (1991).

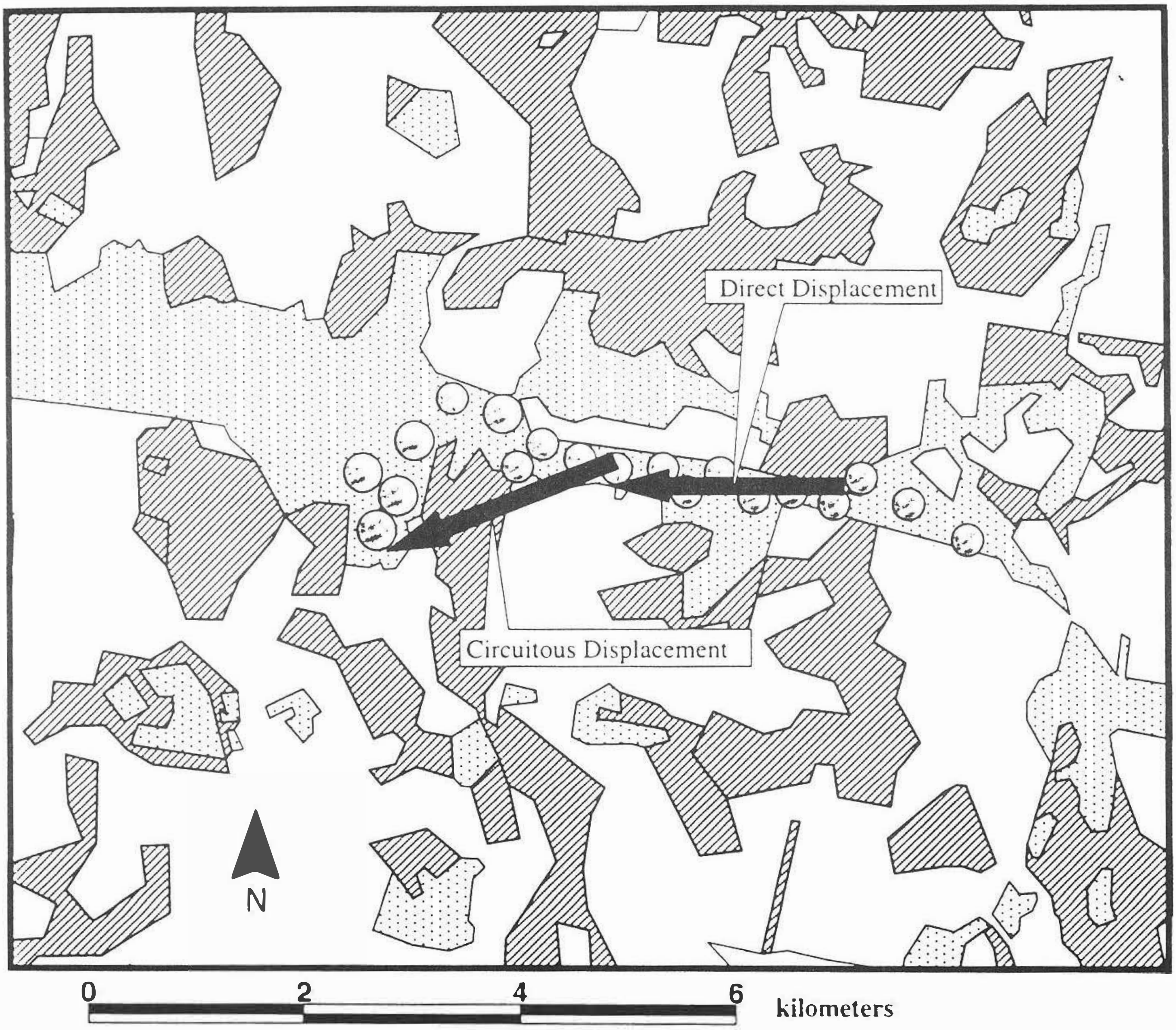

Figure 1. *Map of landcover types and displacement routes. Dotted area represents woodland patches (>50 trees/ha), white area represents scattered trees (10–50 trees/ha), and hatched area represents cleared land. Woodlands in this region contain high densities of Brown Treecreeper territories (circles), except woodlands to the south of the Direct Displacement. Base of arrows indicate the original territory and the point of arrows indicate the displaced location.*

Males were placed in a cloth bag and moved from their respective resident territory to territories 2 kilometres away in a westerly direction (Fig. 1). For each bird, we observed it as continuously as possible from dawn until dusk until we no longer received a radio-transmission. When the radio signal was lost, we checked the original territory for the bird's return each day.

RESULTS

Neither bird was able to return home readily. The male that underwent the Direct displacement vocalized upon release and was immediately detected by other Brown Treecreepers. The resident birds attacked and chased the displaced male until he left their territory. He was frequently detected and chased from other territories as well. He roosted the night of release in an area of young trees where there were no Brown Treecreeper territories. He travelled to the edge of woodlands, but never entered cleared land. The next day, he was detected by Brown Treecreepers while intruding on their territory. During the ensuing fight, his transmitter was pulled off. We lost sight of the male and did not see him on his original territory until four days after release.

The male that underwent the Circuitous displacement was never detected by other Brown Treecreepers. He rarely vocalized and froze and pressed himself close against a tree trunk whenever Brown Treecreepers came near. He made repeated forays of approximately 1 kilometres in every direction comprised of woodlands, yet spent much of his time resting on logs and foraging on the ground at the release site. He was last seen on the fourth day after his release in the late afternoon at the release site, after which we no longer received a signal from the transmitter.

DISCUSSION

These observations suggest that movement of male Brown Treecreepers is strongly affected by habitat structure. Unfortunately, I cannot determine whether this inference applies to females, whose dispersal behaviour is more critical to population dynamics than that of males. Male Brown Treecreepers rarely disperse beyond their natal territory, generally obtaining a breeding vacancy by inheriting their natal territory or by budding (claiming a portion of their natal territory) (Noske 1980; Doerr and Doerr 2000; Cooper *et al.* 2002).

If female movements are also restricted by cleared land, then breeding vacancies in isolated patches should remain unfilled and competition should be high for breeding vacancies among connected woodland patches. Furthermore, the population in fragmented habitat should slowly decline due to lack of recruitment. This finding is consistent with the observed response of Brown Treecreepers to habitat fragmentation (Walters *et al.* 1999; Cooper *et al.* 2002; Cooper and Walters 2002b). Brown Treecreepers are declining in isolated patches. Breeding vacancies remain unfilled in isolated patches, but not in patches which are relatively contiguous and in a matrix of scattered trees rather than cleared land (Cooper and Walters 2002a).

Because many passerines have homing ability, I expected Brown Treecreepers to return quickly to their original territory. Because Brown Treecreepers foraged in pastures, I expected displaced birds to move across cleared land if necessary. Why were both expectations unmet? It is difficult to discern the reason that displaced male Brown Treecreepers had difficulty returning to their original territories. One interpretation is that cleared land is a barrier to between-territory movements. Several hypotheses could account for the discrepancy between this interpretation and the observations that Brown Treecreepers frequently forage in cleared land. The first hypothesis is that Brown Treecreepers may enter cleared land when it is a familiar area, but not when it is a novel location. The second hypothesis is that Brown Treecreeper foraging movements, which often occur on the ground (Walter *et al.* 1999), can occur in cleared land, but dispersal movements, or any medium-range movements, may involve travelling from tree to tree. Several other understory birds are resistant to move into open areas (Bierregaard *et al.* 1992; Desrochers and Hannon 1997; St. Clair *et al.* 1998). If this hypothesis is correct, then whether individual behaviour at edge boundaries can predict movement and distribution of Brown Treecreepers appears dependent on the motivational state of the individual when observed. In other words, when observations at edges are of birds with the motivation to disperse, then the observations may translate into predictions of movements in fragmented landscapes. However, when the observations at edges are of birds with the motivation to forage, then the observations may not translate to larger scale movements.

A second interpretation of why both my expectation were unmet is that Brown Treecreepers lack homing ability. Under this scenario, the male in the Direct displacement treatment may have returned home only because he was released in was a narrow linear strip of woodlands and he happened to move in the general direction of his territory rather than away from it. If Brown Treecreepers generally foray up to 1 kilometre from their territories, then after exploring for 1 kilometre in the direction toward his original territory, the Direct displacement male would have been in familiar surroundings. Conversely, the male in the Circuitous displacement treatment would not be in familiar surroundings from his 1 kilometre forays unless he had forayed 1 kilometre into cleared land and scattered trees. Nevertheless, because post-release movements of both birds were confined to woodlands, these anecdotal observations still suggest that Brown Treecreepers do not enter cleared land for between-territory movements.

The two displaced treecreepers differed in their vocal response and detectability after release. There may have been pre-existing differences in behavioral tendencies between these two individuals. If this were the case, the male that underwent the Circuitous displacement appeared more able to disperse (because he avoided detection when intruding on territories) than the male that underwent the Direct displacement. Therefore, if individual differences were partly responsible for the patterns observed, it should have been more likely for the male that underwent the Circuitous displacement to return. It is also possible that the differences were a consequence of the breeding stage of the receiving territory. The male that underwent the Direct displacement was released on a territory with nestlings, at which time parents actively defend territories, whereas the male that underwent the Circuitous displacement was released on a territory with fledglings, at which time territory boundaries are rarely defended (pers. obs.).

If Brown Treecreepers do not disperse through cleared land, then an intervening habitat of scattered trees or woodland corridors are necessary for dispersal between woodland remnants. The conservation of Australian birds will benefit from more research to determine the relationship between bird movements and the composition of habitats in the landscape.

ACKNOWLEDGMENTS

I thank J. Lyons for the discussions of relocating birds that inspired my attempt at this experiment. Many thanks to A. Stikkel for spending long hours in the field radio-tracking birds that seldom move. J. Cranford, C. Haas, B. Jones, J. Walters and J. Webster helped plan this research. A. Bennett, R. Bishop, E. Doerr and J. Walters helped improve this manuscript. J. Walters provided the radio-transmitters. I also thank H. Ford for providing logistical support in carrying out the field research. The New South Wales Center for Land Management kindly granted access to aerial photographs of the study region. Financial support was provided by Sigma Xi, a Graduate Research and Development Program grant from VPI and SU, a National Science Foundation Dissertation Improvement Grant (DEB-9801083), and the H. T. Bailey Foundation of VPI and SU. The University of New England Animal Ethics Committee, the Australian Bird and Bat Banding Scheme, and the NSW National Parks and Wildlife Service granted permission for this experiment. Finally, I thank the landowners for permitting this work on their property.

REFERENCES

Askins, R. A., Lynch, J. F. and Greenberg, R. (1990). Population declines in migratory birds in eastern North America. *Current Ornithol.* **7:** 1–57.

Bierregaard, Jr., R. O., Lovejoy, T. E., Kapos, V., dos Santos, A. A. and Hutchings, R. W. (1992). The biological dynamics of tropical rainforest fragments. *BioSci.* **42:** 856–866.

Cooper, C. B. and Walters, J. R. (2002a). Experimental evidence of disrupted dispersal causing decline of an Australian passerine in fragmented habitat. *Cons. Biol.* **16:** 1–8.

Cooper, C. B. and Walters, J. R. (2002b). Habitat and landscape effects on Brown Treecreeper distribution: independent effects of woodland loss and fragmentation at multiple scales. *Biol. Cons.* **105:** 1–10.

Cooper, C. B., Walters, J. R. and Ford, H. A. (2002). The demography of Brown Treecreepers in connected and isolated, large and small woodland patches. *Emu* **102:** 249–256.

Cooper, C. B., Walters, J. R. and Priddy, J. Effects of landscape patterns on dispersal success: a simulation of Brown Treecreeper population dynamics in a spatially realistic landscape. Ecological Applications: in press.

Debinski, D. M. and Holt, R. D. (2000). A survey and overview of habitat fragmentation experiments. *Cons. Biol.* **14:** 342–355.

Desrochers, A. and Hannon, S. J. (1997). Gap crossing decisions by forest songbirds during the post-fledging period. *Cons. Biol.* **11:** 1204–1210.

Doerr, V. A. J. and Doerr, E. D. (2001). Brown Treecreeper. In 'Handbook of Australian, New Zealand and Antarctic Birds. Vol. 5: Tyrant-flycatchers to Chats.' (Eds P. J. Higgins, J. M. Peter and W. K. Steele.) (Oxford University Press, Melbourne.)

Dunning, J. B., Jr., Borgella, R. Jr., Clements, K. and Meffe, G. F. (1995). Patch isolation, corridor effects, and colonization by a resident sparrow in a managed pine woodland. *Cons. Biol.* **9:** 542–550.

Greenberg, R. (1983). The role of neophobia in determining the degree of foraging specialization in some migrant warbler. *Am. Nat.* **122:** 444–453.

Haas, C. A. (1995). Dispersal and use of corridors by birds in wooded patches on an agricultural landscape. *Cons. Biol.* **9:** 845–854.

Haddad, N. M. (1999). Corridor use predicted from behaviors at habitat boundaries. *Am. Nat.* **153:** 215–227.

Harrison, S. and Bruna, E. (1999). Habitat fragmentation and large-scale conservation: what do we really know for sure? *Ecography* **22:** 225–232.

Jonsen, I. and Taylor, P. D. (2000). *Calopteryx* damselfly dispersions arising from multiscale responses to landscape structure. *Cons. Ecol.* **4**(2): 4. [online] URL: http://www.consecol.org/vol4/iss2/art4

Lovejoy, T. E., Rankin, J. M., Bierregaard, R. O., Brown, K. S., Emmons, L. H. and Van der Voort, M. E. (1984). Ecosystem decay of Amazon forest remnants. In 'Extinctions' (Ed. M. H. Nikechki). Pp. 295–325. (University of Chicago Press, Chicago, IL, USA.)

Lynch, J. F. and Whigham, D. F. (1984). Effects of forest fragmentation on breeding bird communities in Maryland, USA. *Biol. Cons.* **28:** 287–324.

Machtans, C. S., Villard, M.-A. and Hannon, S. J. (1996). Use of riparian buffer strips as movement corridors by forest birds. *Cons. Biol.* **10:** 1366–1379.

Matthysen, E. and Currie, D. (1996). Habitat fragmentation reduced disperser success in juvenile nuthatches *Sitta europaea*: evidence from patterns of territory establishment. *Ecography* **19:** 67–72.

Noske, R. A. (1980). Cooperative breeding by treecreepers. *Emu* **80:** 35–36.

Rappole, J. H. and Tipton, A. R. (1991). New harness design for the attachment of radio transmitters to small passerines. *J. Field Ornithol.* **62:** 335–337.

Saunders, D. A. and deRebeiva, C. P. (1985). Turnover in breeding bird populations on Rottnest Island, Western Australia. *Aust. Wildl. Res.* **12:** 467–477.

Saunders, D. A., Hobbs, R. J. and Margules, C. R. (1991). Biological consequences of ecosystem fragmentation: A review. *Cons. Biol.* **5:** 18–32.

Sieving, K. E., Willson, M. F. and De Santo, T. L. (1996). Habitat barriers to movement of understory birds in fragmented south-temperate rainforest. *Auk* **113:** 944–949.

St. Clair, C. C., Bélisle, M., Desrochers, A. and Hannon, S. (1998). Winter responses of forest birds to habitat corridors and gaps. *Cons. Ecol.* [online] **2**(2): 13. URL: http://www.consecol.org/vol2/iss2/art13

Walters, J. R., Ford, H. A. and Cooper, C. B. (1999). Variation in population structure and ecology of brown treecreepers between contiguous and fragmented woodland: a preliminary assessment. *Biol. Cons.* **90:** 13–20.