

TERRITORIALITY AND HABITAT USE OF FISCAL SHRIKES (*Lanius collaris*) IN SOUTH AFRICA

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ABSTRACT

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Fiscal Shrikes are resident in South Africa and are monogamous and territorial. We studied a population of Fiscal Shrikes including 63 territories at Ukulinga Research Farm, near Pietermaritzburg, KwaZulu-Natal, South Africa. Unlike many other resident populations of shrikes, Fiscal Shrikes remain paired throughout the year. At least half of all territories were occupied by pairs outside the breeding season at Ukulinga, and during the breeding season this rose to 95%. Fiscal Shrikes maintained territorial boundaries by static marking and singing, and responded aggressively to playback of conspecific song. Territories varied in size from 0.3-6.3 ha and were found in natural and human-modified habitats. The availability of hunting perches had an important effect on habitat selection. Open land used for monoculture crops was avoided, as were heavily wooded regions. Fiscal Shrikes were able to colonise areas with no natural perches by using overhead cables, fence lines and artificial perches.

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INTRODUCTION

The true shrikes (*Lanius*) are small to medium-sized passerines. Shrikes are predatory and carnivorous in habit, feeding mostly on insects, although larger species capture small reptiles, mammals and birds (Cramp and Perrins 1993). They are sit-and-wait foragers and hunt almost exclusively from prominent perches. Most hold breeding territories as pairs, and are usually solitary and territorial outside the breeding season (Cramp and Perrins 1993). Fiscal Shrikes hold territories throughout the year in South Africa, as individuals and as pairs (Harris and Arnott 1988).

Territory size and habitat use have important implications for Shrikes in general. Many of the world's 26 species of true shrikes are in decline, threatened, or have suffered local extinctions (Yosef 1994, Harris 1998). The loss of suitable wintering and breeding habitat has been implicated as important factor in this decline. Unlike many of their family, the Fiscal Shrike is common and is expanding its range within southern Africa (Parker 1997). By studying factors affecting Fiscal Shrike habitat use and territoriality, we may gain a better understanding of the requirements of shrikes and identify measures to conserve declining populations.

METHODS

Study area

Most of this study was performed at Ukulinga Research Farm, 5 km southeast of Pietermaritzburg, Kwa Zulu-Natal, South Africa (29°40'S, 30°24'E, elevation 775 m). Ukulinga consisted of dohne sourveld, characterised by savannah dominated by *Acacia karoo*, *A. nilotica* and *A. sieberiana* (Acocks' vegetation type 44b), and grasslands dominated by *Themida triandra* (Acocks 1988). Most of the land was used for cattle, sheep and goat grazing by animal science, and range and forage resources research, and the remainder of the farm was partitioned between horticulture, poultry and pig science, plant breeding, crop production, agricultural engineering, and private residences. In addition, three game reserves in KwaZulu-Natal (Weenen Game Reserve (28°48'S, 30°07'E), Itala Game Reserve (27°35'S, 31°07'E), and Hluhluwe-Umfolozi Game Reserve (28°22'S, 32°25'E)) were used as study areas for behavioural experiments. The major habitats in all three game reserves were *Acacia* savannah and grassland, and were administered for the purpose of conservation and eco-tourism by KwaZulu-Natal Nature and Conservation Services.

Territorial behaviour

The behaviour of adult Fiscal Shrikes was monitored with a combination of approximately 15 min or 2 h observation sessions in 1995, and approximately 1 h observation sessions in 1996 and 1997 (mean session length: $m \pm SE = 1.14 \pm 0.11$ h, $N = 56$). Fifteen-minute sessions focused entirely on the behaviour of males and longer sessions concentrated on female behaviour, although it was usually possible to follow and record the behaviour of both sexes. However, it is possible that the occurrence of territorial behaviour has been underestimated if activity occurred during periods when the other sex was being observed. Males and females were easily discernible in the field as *L. c. vigilans* is sexually dichromatic – the female has chestnut-coloured flanks and duller plumage than the male. Birds were observed using 10×25 binoculars from within the territory or near to its boundary. A hide was unnecessary for observations as Fiscal Shrikes were tolerant of humans and quickly habituated to observer presence.

All territorial and agonistic behaviour was recorded on audio cassette and classified as follows:

- (1) Static marking (perching in a prominent location with an upright position with the scapular pattern exposed, without singing, foraging or scanning for prey);
- (2) Territorial song for advertisement and defence (call types 5 and 11 – Harris 1995, sometimes accompanied by exaggerated bowing);
- (3) Physical attack (chasing or being chased by a conspecific or heterospecific, occasionally terminating with physical contact).

Fiscal Shrikes were subjected to playback experiments in order to establish the existence and intensity of a vocal territorial response to conspecific song, as part of a larger study on geographical variation in Fiscal Shrike song (Devereux and Slotow unpubl. data). Territorial song for stimulus tapes was elicited from 10 male Fiscal Shrikes at four locations (Ukulinga (U), Weenen Game Reserve (W), Itala Game Reserve (I) and Hluhluwe-Umfolozzi Game Reserve (HU)) by broadcasting Gibbon's (1996) Fiscal Shrike song from a loudspeaker placed inside the territory. Any vocal response was recorded using a Tect UEM83R unidirectional microphone connected to a Sony TC5 cassette recorder. A 30 s burst of each male's response (males: $N_U = 4$, $N_W = 3$, $N_I = 2$, $N_{HU} = 1$) was compiled on separate playback tapes, interleaving 30 s with 30 s silence for three song bursts. This was repeated after 210 s silence a further three times so that the total experimental period was 24 min. The format of short, repeated bursts of song was designed to minimise adverse effects of aggression (ASAB 1998), whilst the interspersed periods of silence allowed quality recording of the subject's response.

The conspecific song of local but non-neighbouring males was broadcast to 15 male subjects ($N_U = 7$, $N_W = 5$, $N_I = 2$, $N_{HU} = 1$) between 7.00 and 12.00 hours during November 1996 – June 1997. Subjects were chosen when sighted along a road from a vehicle and playback only occurred if the subject was not singing on arrival and did not sing during the two-minute period before the experiment began. During this time, the loudspeaker was placed in an elevated position within 10 m of the vehicle (*e.g.* on a rock) or on the roof of the vehicle if no such location was available. The number of songs uttered by each male in response to the playback was counted for the duration of the experiment.

Territory mapping

Fiscal Shrike territories were surveyed throughout the year at Ukulinga and were assigned an identification number. The boundaries of each territory were determined by observing the territory holder for a period of 3 h or more and recording the outermost points defended or hunted from. If the Fiscal Shrike was inactive or did not use part of its suspected territory during this period, the bird was displaced by repeatedly moving towards where it perched, until it turned back on itself at a boundary or was chased from an adjacent territory.

Territory boundaries were overlaid onto a 1 : 2500 map using landmarks (*e.g.* fence lines) as references, and digitised and measured using Geographical Informa-

tion Systems software (Bentley Workstation). Digitised Fiscal Shrike territories were superimposed onto Ukulinga's vegetation features and human structures (estimated) (mapped by Department of Agricultural Economics, University of Natal), to assess their effects on territory distribution and size.

In 13 Fiscal Shrike territories, every tree, shrub, and forb (> 0.5 m above grass height) was mapped by measuring bearings and distances to the object from a known point, and heights were estimated to the nearest 0.5 m. Densities were calculated (overall, and into the following height classes: < 1.49 m, 1.50-2.99 m, > 3 m) by dividing the number found in a territory by territory size.

Statistical analysis

Unless otherwise stated, all statistical tests are two-tailed with $\alpha = 0.05$. Raw data were subjected to the Kolmogorov-Smirnov test for normality (Steele and Torrie 1980) prior to further analysis. Normally distributed data are described as mean \pm one standard error of the mean ($m \pm SE$). Sample sizes are denoted by N . Statistical analyses followed Sokal and Rohlf (1995) or Siegal and Castellan (1988).

The population of Fiscal Shrikes at Ukulinga was not colour-banded so individual recognition was not possible. As this study did not focus on long-term territory dynamics, associations, dispersal, or inter-territory movements, we decided not to capture and ring individuals (ASAB 1998).

RESULTS

Territorial behaviour

Fiscal Shrikes pairs held exclusive territories throughout the year at Ukulinga. Territory boundaries were advertised by static marking and vocal displays. Conspecific intruders were actively chased from the territory, often through adjacent territories, although physical contact was rare. After intrusions, both parties perched prominently at the boundary of their respective territories and sang, accompanied by the counter-song of neighbours.

Territorial song was used by both sexes of Fiscal Shrike at Ukulinga, although most frequently by males, in response to actual and perceived intrusion threats, playback, and as advertisement. Fiscal Shrikes responded to the broadcast (playback) of a local non-neighbouring Fiscal Shrike by counter-singing. Fourteen of fifteen male subjects who were exposed to the song responded and sang on average 150 songs ($m \pm SE = 151.0 \pm 37.7$ songs, $N = 14$). In addition, the subjects approached the loudspeaker during playback and three males landed on the playback apparatus whilst singing and displaying. Territorial song was exhibited during and outside the breeding season at the four study sites, and subjects responded to playback during November-June. There is no difference in the intensity of male territorial behaviour during early and late stages in the breeding season (Devereux 1998).

Fiscal Shrikes were not only aggressive to conspecifics, but also attacked similar-sized and smaller heterospecifics. Twenty-two interspecific and two intra-specific agonistic interactions involving Fiscal Shrikes were recorded during 31 h observation. Fiscal Shrikes directed attacks towards Black-eyed Bulbuls (*Pyconotus barbatus*), Yellow-eye Canaries (*Serinus mozambicus*), Red Bishops (*Euplectes orix*) and Spotted-backed Weavers (*Ploceus cucullatus*). After chasing a heterospecific opponent out of the territory, 18 of 21 Fiscal Shrikes continued with non-territorial behaviour, whereas after being chased the Fiscal Shrike performed a static and vocal display. This trend was reversed for intraspecific encounters and was statistically significant (G -test: $G_i = 5.17$, $p < 0.05$). However, it lost significance after William's correction was applied (G -test: $G_{adj} = 1.99$, ns), indicating that it might be a biologically significant result but not statistically significant due to low power.

Territory organisation

Territories were held by individuals or pairs of Fiscal Shrikes at Ukulinga, and although boundaries fluctuated slightly, the location of territories remained similar throughout the study. Territories were exclusive and did not overlap during or outside the breeding season. Sixty-three Fiscal Shrike territories were described at Ukulinga during 1994-1997. Territories ranged in size from 0.27 ha to 6.31 ha ($m \pm SE = 2.15 \pm 0.16$ ha, $N = 61$). Not all territories were used for breeding, 11 out of 47 territories for which territory ownership was fully known did not contain a nest during 1994-1997. Territories that contained a nest during the study are termed breeding territories, and those that did not contain a nest are termed non-breeding territories. Breeding territories were significantly smaller ($m \pm SE = 1.9 \pm 0.2$, $N = 36$) than non-breeding territories ($m \pm SE = 3.2 \pm 0.5$, $N = 11$) (ANOVA: $F_{(1,45)} = 11.37$, $p < 0.01$). In addition, breeding territories were occupied throughout the year in all cases ($N = 36$), whereas six non-breeding territories (55%) were only occupied during winter, four (36%) throughout the year and the occupancy of one territory was not known ($N = 11$).

Fiscal Shrike territories were located among man-made structures as well as in natural habitats at Ukulinga (Fig. 1). Buildings and sheds were located in 21 territories, tarred roads ran through ten territories and a further 13 were traversed by a main dirt road. Fence lines intersected 61 territories (97%). Overall, only one of 63 territories did not contain roads, buildings or fence lines.

Fiscal Shrike territories were found in areas of grassland with and without scattered trees and in areas of open or semi-open bush (Fig. 2). No territories were located in areas of thick bush where tree densities exceeded 1200/ha. Fiscal Shrikes held territories where trees were scarce but fences were abundant (Fig. 3). Fence lines are therefore a valuable resource and offer alternative observations posts to trees and shrubs. Areas of Ukulinga used for crop silage and hay production were characterised by very low densities of trees and shrubs (Fig. 4). Fiscal Shrikes did not hold territories wholly within these areas.



Fig. 1. Arrangement of Fiscal Shrike territories at Ukulinga Research Farm during July 1997 in relation to tarred roads and dirt roads (solid lines), tracks and paths (dashed lines), and buildings (black polygons).

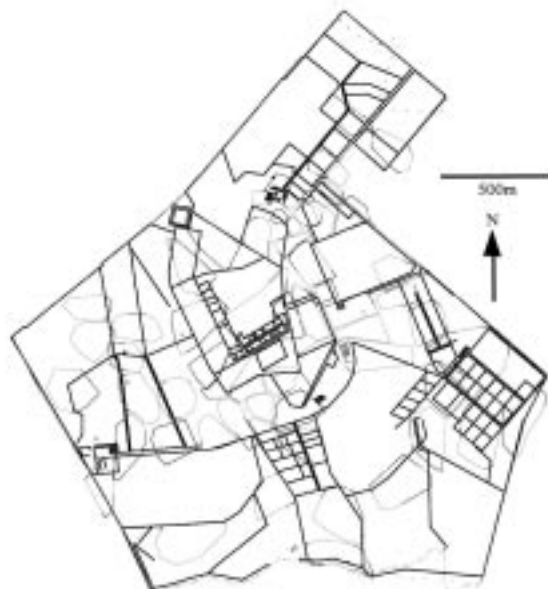


Fig. 2. Arrangement of Fiscal Shrike territories at Ukulinga Research Farm during July 1997 in relation to fence lines (heavy lines).



Fig. 3. Arrangement of Fiscal Shrike territories at Ukulinga Research Farm during July 1997 in relation to tree and bush density (lines indicate the approximate position of scattered trees, light stippling indicates dense bush, and heavy stippling indicates open bush).

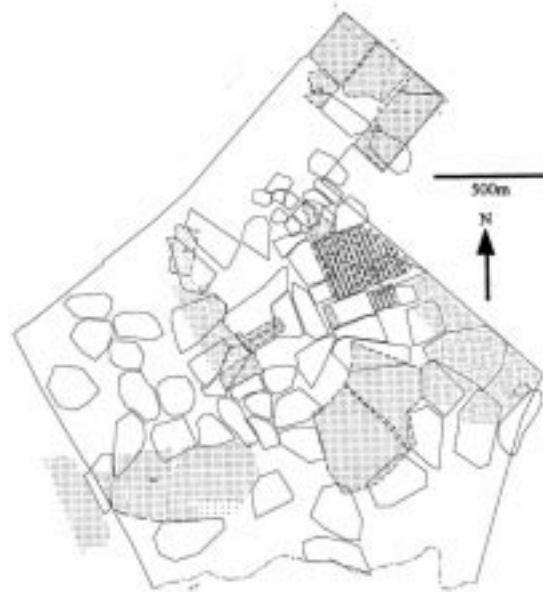


Fig. 4. Arrangement of Fiscal Shrike territories at Ukulinga Research Farm during July 1997 in relation to annual crops, hay and silage (stippling).

Fifty species of trees and large shrubs were found in mapped Fiscal Shrike territories. Twenty percent of the trees (by number) were not indigenous although these contributed to 28 of the 50 recorded species. Territory size decreased significantly with increasing density of tall trees (> 2.99 m) (Regression: $R^2 = 0.51$, $F_{(1,12)} = 12.24$, $p < 0.01$). Territory 2 (1997) contained a high density of trees for its size due to recent bush encroachment, and this had a large influence on the relationship between density of tall trees and territory size. When this data point was removed, there was a significant relationship between overall tree density and territory size (Regression: $R^2 = 0.35$, $F_{(1,11)} = 5.99$, $p < 0.05$). Large territories contained a lower total density of trees and a lower density of tall trees than smaller territories.

DISCUSSION

Territorial behaviour

Visual and vocal signals can reduce the occurrence of intraspecific antagonistic interactions that could result in injury, as injury may reduce reproductive success by reducing parental care or mating effort. Static marking and singing were common behaviours exhibited by male Fiscal Shrikes and, although less commonly, by females. Playback of just 30 s of local song caused strong counter-singing response in males. As at Ukulinga, Fiscal Shrikes in Pretoria, South Africa, used a loud grated „jert” call during territorial defence and advertisement, which was usually given from an exposed or prominent position and accompanied by exposed scapulars in the male or concealed chestnut flanks in the female (Harris 1995). The low occurrence of intraspecific antagonistic encounters relative to interspecific conflicts observed in Fiscal Shrikes at Ukulinga is an indication that song and static marking reduce the occurrence of intraspecific territorial conflicts. Interspecific territorialism occurs in species with overlapping ecology (Simmons 1951, Krebs and Davies 1993), and although Black-eyed Bulbuls are not brood parasites and do not kill Fiscal Shrike nestlings, their diets do overlap (Maclean 1993).

Territory organisation

It is generally accepted that animals hold territories to gain access to limited resources, and only do so when the benefits of holding a territory outweigh the costs (Brown 1964, Davies and Houston 1984, Krebs and Davies 1993). Birds employ a variety of territorial strategies with varying degrees of territoriality, and territorial strategies are flexible and can change with resource abundance and time.

The *Laniinae* are territorial and pairs usually defend exclusive, non-overlapping territories during the breeding season (Cramp and Perrins 1993), although Italian populations of the Red-backed Shrike (*L. collurio*) employ the alternative strategy of a defended core area and shared home range (Fornasari *et al.* 1994, Massa *et al.* 1995). Most palaeartic and nearctic species of *Lanius*, for which most of the infor-

mation on the genus has been acquired, are migratory. Wintering individuals either hold territories that are usually smaller than pair-held breeding territories, or are non-territorial (Harris and Arnott 1988). Even species that are resident (e.g. Loggerhead Shrike – *L. ludovicianus* in California) hold individual territories during the non-breeding season (Craig 1978).

Fiscal Shrike populations at Ukulinga and in South Africa were stable throughout the year, indicating that they were non-migratory (Parker 1997). Over half of the territories at Ukulinga were held by pairs throughout the year. Breeding territories, in contrast to most species of shrike, were smaller than non-breeding territories. However, non-breeding Fiscal Shrike territories were often held by pairs, in contrast to individual-held wintering territories of other species of the *Laniinae*, and so would require more resources than individual territories and hence would be larger. Non-breeding territories were located where observation posts, an important resource, were scarce, and may have offered insufficient resources for reproduction. By remaining paired and holding territories throughout the year, Fiscal Shrikes benefit from increased opportunities to reproduce should favourable conditions prevail, as Fiscal Shrikes are known to breed opportunistically throughout the year in South Africa (Devereux 1998).

Many of the *Laniinae* are suffering from a global decline in population numbers, and changes in breeding and wintering habitats are believed to be major causal factor (Yosef 1994). Many other raptorial species are negatively affected by land-use systems. In southern Africa, Black-shouldered Kite (*Elanus caeruleus*) and Black Kite (*Milvus migrans*) numbers were enhanced by human activities, whereas most other raptors, especially eagles and hawks, were detrimentally effected by human-induced habitat destruction (Brandl *et al.* 1985a). In Italy, Red-backed Shrikes, Woodchat Shrikes (*L. senator*) and Lesser Grey Shrikes (*L. minor*) exhibited decreasing degrees of urban tolerance, respectively, with the Lesser Grey Shrike only present in areas without urbanisation (Guerrieri *et al.* 1995). Following this, human-induced urbanisation and land-use changes could adversely affect the future of these species. Fiscal Shrikes, however, maintain high densities in commercial land use systems in South Africa (Brandl *et al.* 1985a) and exhibit a high degree of tolerance towards human-induced changes.

In summary, Fiscal Shrikes hold territories at Ukulinga by monopolising the limited perch sites that were primarily used for foraging. Fiscal Shrikes held territories in areas with few trees by using fence lines as hunting posts. Although perches are important, Fiscal Shrike distribution is influenced by the abundance of other resources. For example, an area saturated with, but containing only man-made perches would offer optimal foraging sites, but as territories are multipurpose and used for breeding in addition to foraging, an area would also need to encompass nest sites. Trees were also used by Fiscal Shrikes as a refuge from overhead predators. However, in areas already populated by shrikes, habitat suitability may be enhanced by introducing perches where perch sites are limited, thereby allowing shrikes to forage in previously unsuitable areas.

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