

FISCAL SHRIKE (*Lanius collaris*) FORAGING BEHAVIOUR IN NATURAL AND HUMAN-MODIFIED HABITATS

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ABSTRACT

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Among shrikes (*Laniidae*), Fiscal Shrikes are unusual because they do not appear to be following the current global trend of population declines in many other species. We studied a Fiscal Shrike population inhabiting natural (savannah) and human-modified (*Eucalyptus* groves and monoculture grasslands) habitats in South Africa, to determine whether foraging behaviour could be contributing to their population stability. The three habitats offered significantly different perch structures and perch heights. Fiscal Shrikes made significant adjustments in both their search height and foraging method accordingly, performing more aerial hunts from tall *Eucalyptus* perches and fewer from lower fence lines in grasslands. Territories were smallest in *Eucalyptus* groves, where the birds spent less time flying between perches. Hunting success and prey size did not differ amongst habitats, but capture frequency was greatest in human-modified habitats. Fiscal Shrikes living in human-modified habitats therefore capture more prey than those in natural savannah. Fiscal Shrikes are uncommon in many protected natural areas in South Africa. Their flexibility in foraging methods has allowed them to exploit new habitats and has increased their range and population size in human-modified habitats.

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Key words: *Lanius collaris*, habitat change, foraging success

INTRODUCTION

Land-use systems are known to affect the densities of raptorial-foraging birds (Brandl *et al.* 1985a, 1985b). The exponentially increasing human population has resulted in increased urbanisation and intensification of agricultural practices. Natural habitats are increasingly rare and many species of bird, especially those sensitive to landscape changes (*e.g.* Lesser Grey Shrike *Lanius minor* – Guerrieri *et al.* 1995)

or those requiring large areas for breeding (e.g. eagles – Brandl *et al.* 1985a) are declining.

The true shrikes (genus *Lanius*) are sit-and-wait hunters and require semi-open landscapes with scattered woody plants (Cramp and Perrins 1993, Rothhaupt 1995), and many species are suffering from a global decline in numbers and range (Yosef 1994). In most cases, the loss of suitable breeding or wintering habitat, because of human-modified landscape changes, is considered responsible for these declines (Yosef 1994, Schön 1995, Guerrieri *et al.* 1995). Fiscal Shrikes are common, medium-sized true shrikes that live throughout sub-Saharan Africa. Although long-term records do not exist, it would appear that while other members of the genus are declining, Fiscal Shrikes have expanded their range (Parker 1997). We report here the results of a study of Fiscal Shrike foraging behaviour in natural and human-modified habitat types in South Africa. Because Fiscal Shrikes are successful and live alongside man, we predicted that they would adapt their foraging behaviour to the habitat characteristics, and their foraging success in human-modified habitats would be no worse than in natural habitats.

METHODS

Study area

This study was conducted during 1995-1997 at Ukulinga Research Farm of University of Natal, 5 km southeast of Pietermaritzburg, South Africa (29°40'S, 30°24'E, elevation 775 m). The natural habitat of Ukulinga is classified as dohne sourveld (vegetation type 44b according to Acocks 1988), characterised by savannah dominated by *Acacia karoo*, *A. nilotica* and *A. sieberiana* savannah, and grasslands dominated by *Themida triandra* (Acocks 1988). Most of this habitat at Ukulinga Research Farm was used for grazing. The remainder was partitioned between range and forage research, which conducted trials on livestock grazing, different fodder species, crop production, horticulture, poultry and pig science, plant breeding and various agricultural and private residences.

Habitat classification

All Fiscal Shrike territories were classified into the following three categories according to the habitat in which they were found: natural savannah (= savannah), monoculture grasslands and crops (fodder) (= grassland), and *Eucalyptus* spp. grove (= grove).

Behavioural observations

Territories were chosen for observation based on accessibility, visibility, an understanding of territory boundaries and knowledge of the breeding stage of the owners. All individuals were observed between the onset of courtship and fledging.

Observations took place at least one hour after dawn and at least one hour before dusk, with most occurring during 8.00-12.00 h. Birds were observed using 10×25 binoculars. Notes were taped for later transcription. A hide was not necessary for observations as Fiscal Shrikes were tolerant of humans and quickly habituated to observer presence.

The foraging behaviour of adult Fiscal Shrikes was monitored by direct observation (mean session length: $m \pm SE = 1.14 \pm 0.11$ h, $N = 56$) and video-recording nest feeding ($N = 6$ nests, videoed on 2-4 occasions each) using a Sony 8 mm camera (video session length: $m \pm SE = 1.06 \pm 0.09$ h, $N = 17$), to observe prey sizes and types.

The following foraging parameters were recorded: height of perch structure, height perched whilst searching (height of bird in tree), perch type (e.g. tree, fence line, overhead cable, artificial perch), duration perched, perching outcome (either prey attack or give-up), hunt type (perch-to-ground, perch-to-air, or surface gleaning), hunt success and prey size. Prey size was recorded as a multiple of Fiscal Shrike beak lengths after being compared to the size of the Fiscal Shrike's beak. Beak length of Fiscal Shrikes inhabiting the Midlands region of KwaZulu-Natal averaged 18 mm ($m \pm SE = 18.2 \pm 0.3$ mm, $N = 12$).

Every perch (e.g. trees, shrubs, fence lines, artificial perches, overhead cables) within each territory was mapped by measuring distances and compass bearings to the object from a known point, and their height was estimated. Territory maps showing the location of every perch were drawn by hand as well as being overlaid onto a digitised map of Ukulinga. It was therefore possible to calculate the distance flown to the nearest meter between any two perch sites within a territory.

Male and female Fiscal Shrikes (*L. c. vigilans*) are sexually dichromatic and easily discernible in the field. The female's plumage was duller than the male's and only the female had chestnut coloured flanks. Adult Fiscal Shrikes have pied plumage, whereas juveniles are cryptic brown (Maclean 1993). The population of Fiscal Shrikes at Ukulinga was not colour-banded so individual recognition was not possible. This study does not focus on long-term territory dynamics, social associations, dispersal or inter-territory movements. We decided it was unnecessary to capture individuals for ringing and individual recognition (ASAB 1998).

Statistical analysis

Unless otherwise stated, all statistical analysis are two-tailed with $\alpha = 0.05$. Raw data were subjected to Kolmogorov-Smirnov one-sample test for normality (Steele and Torie 1980) before further analysis. Data, which were normally distributed, are described as mean \pm one standard error of the mean ($m \pm SE$). Other data are described as median and interquartile range (median, $Q1-Q3$). Sample sizes are denoted by N . Methods used for choosing an appropriate statistical test followed Sokal and Rohlf (1995) and Siegal and Castellan (1988). Associations were tested using the G -test, differences between categories were tested with Kruskal-Wallis tests and correlations were tested using Spearman's correlation.

RESULTS

We found 63 Fiscal Shrike territories: 16 in grassland type habitats, 32 in natural savannah, 6 in abandoned *Eucalyptus* groves, and 9 in house gardens and around buildings (not reported here).

There were significant differences in the type of hunting perches offered amongst the three habitats. Significantly more Fiscal Shrike searches occurred from fence lines and overhead cables in grassland habitats than in groves, where trees and shrubs were the preferred perches (Fig. 1) (G -test: $G_2 = 218.3$, $p < 0.001$). Search attempts in grassland habitats were significantly more likely to terminate with a hunt (138 of 171) than those in savannah or grove habitats (125 of 150, 125 of 180, respectively) (G -test: $G_2 = 8.4$, $p < 0.05$).

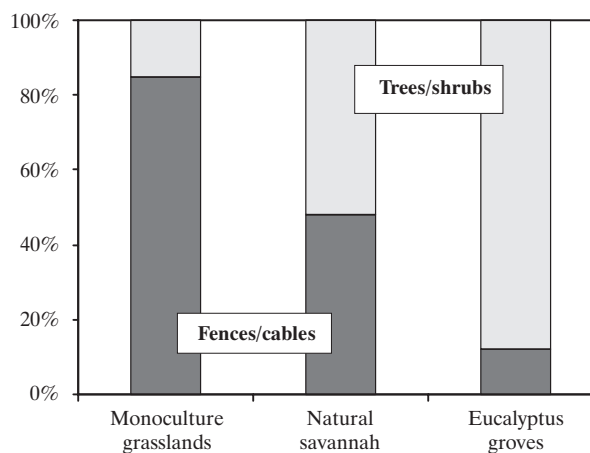


Fig. 1. Perch choice by Fiscal Shrikes in natural (savannah) and human changed (*Eucalyptus* grove and grassland) habitats. There was a significant difference in the perch structures used by Fiscal Shrikes amongst the three habitats (G -test: $G_2 = 218.3$, $p < 0.001$).

Trees and shrubs offered significantly taller observation posts for hunting than fence lines and overhead cables (Kruskal-Wallis test: $H_1 = 240.1$, $p < 0.001$). *Eucalyptus* groves, with their preponderance of natural perches, offered significantly higher perches (median, $Q1-Q3 = 8$ m, 3.5-15 m) than savannah (median, $Q1-Q3 = 3$ m, 2-6 m) or grassland habitats (median, $Q1-Q3 = 3$ m, 1.5-3 m) (Kruskal-Wallis test: $H_2 = 151.2$, $p < 0.001$). Accordingly, Fiscal Shrikes perched at higher positions in grove habitats (median, $Q1-Q3 = 3$ m, 2-5 m) than in natural savannah (median, $Q1-Q3 = 3$ m, 2-4 m) or grasslands (median, $Q1-Q3 = 3$ m, 1.5-3 m) (Kruskal-Wallis test: $H_2 = 26.6$, $p < 0.001$).

Fiscal Shrikes used three hunting methods at Ukulinga. The most common was perch-to-ground hunting. After locating terrestrial prey from an elevated perch Fis-

cal Shrikes flew, glided or hopped to the ground and attempted to capture the prey. Occasionally they hovered over the prey before attacking or appeared to flush prey from undergrowth by flapping their wings. Most prey was captured on landing but some that escaped was pursued on the ground. Prey was either consumed on the ground or on returning to a perch, or transported in the beak to a mate, offspring, or a cache. Perch-to-air sallying (hawking) occurred when prey was located from an elevated vantage point and pursued and captured in flight. Surface gleaning (perch gleaning – Fitzpatrick 1980) was uncommon and was characterised by searches within tree canopies where prey was picked off foliage whilst the Fiscal perched.

There was a significant difference in the hunting method employed by Fiscal Shrikes amongst the three habitats (Fig. 2) (G -test: $G_2 = 47.1$, $p < 0.001$). Perch-to-ground foraging was the most common capture method in all three habitats. However, perch-to-air capture frequencies varied from almost none in grassland habitats to a quarter of all hunt attempts in groves. Surface gleaning was only observed four times in 628 hunt attempts, and only in savannah habitats.

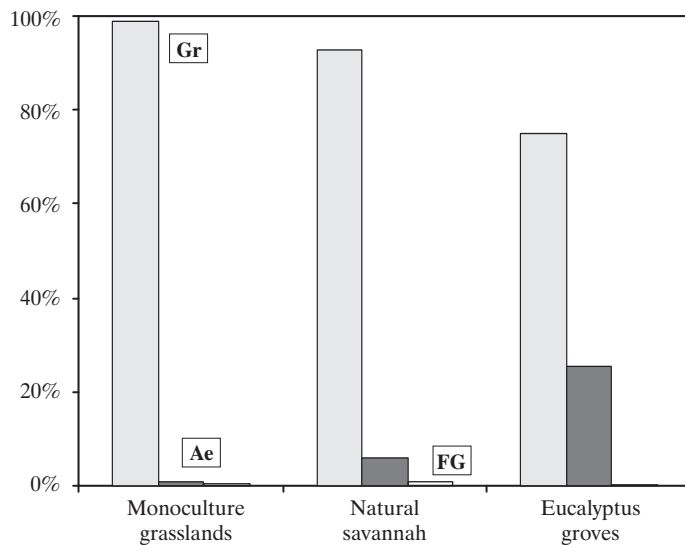


Fig. 2. The choice of hunting method (percent of hunts) by Fiscal Shrikes in natural (savannah) and human-modified (*Eucalyptus* grove and grassland) habitats. Hunting methods employed by Fiscal Shrikes (Gr – ground, Ae – aerial, FG – foliage glean) differed significantly among the three habitats (G -test: $G_2 = 47.1$, $p < 0.001$).

Territory size differed significantly between habitats (Fig. 3) (Kruskal-Wallis test: $H_2 = 15.1$, $p < 0.001$). Territories were smallest in groves, intermediate in size in savannah and largest in grasslands. Fiscal Shrike foraging trips (to and from the hunting perch) were significantly shorter in groves (median, $Q1-Q3 = 28$ m, 18-47 m) than in savannah (median, $Q1-Q3 = 40$ m, 18-70 m) and grassland habitats (median, $Q1-Q3 = 41$, 20-55 m).

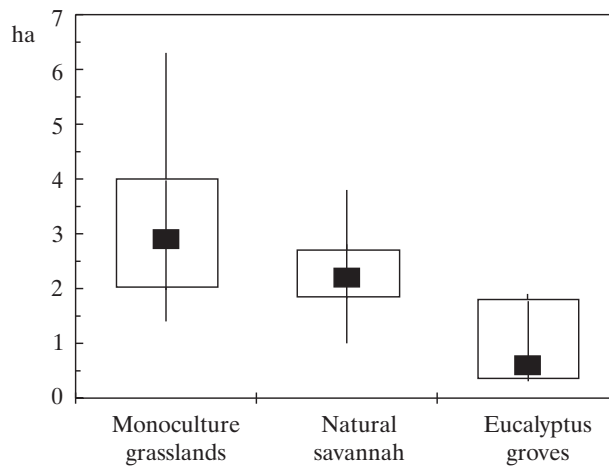


Fig. 3. Territory size of Fiscal Shrikes in natural (savannah) and human-modified (*Eucalyptus* grove and grassland) habitats. Median, quartiles and range are shown. Territory size of Fiscal Shrikes differed significantly amongst the three habitats (Kruskal-Wallis test: $H_2 = 15.1$, $p < 0.001$).

Neither foraging success (the proportion of hunt attempts that ended in prey capture) (G -test: $G_2 = 5.9$, $p < 0.1$) nor prey size (Kruskal-Wallis test: $H_2 = 5.63$, $p < 0.1$) differed amongst the habitats. However, although there was no difference in search frequency (Kruskal-Wallis test: $H_2 = 4.86$, $p < 0.1$), Fiscal Shrikes residing in grove and grassland habitats performed significantly more hunts per hour than those in savannah (Fig. 4) (Kruskal-Wallis test: $H_2 = 6.22$, $p < 0.05$). Therefore, Fiscal Shrikes living in groves and grasslands captured a greater prey biomass than those living in savannah habitats.

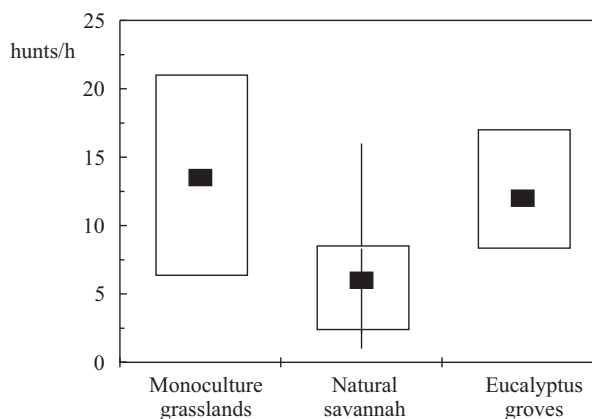


Fig. 4. Hunting frequency of Fiscal Shrikes in natural (savannah) and human-modified (*Eucalyptus* grove and grassland) habitats. Median, quartiles and range are shown. In grassland and grove habitats hunt frequency was significantly greater than in savannah habitats (Kruskal-Wallis test: $H_2 = 6.2$, $p < 0.01$).

DISCUSSION

This study demonstrates that habitat characteristics, important in Fiscal Shrike foraging, vary between natural and human-modified landscapes, and Fiscal Shrikes are able to change their foraging behaviour accordingly. The true shrikes appear to be declining globally, although few studies to date have concentrated on shrikes residing outside Europe or North America (Yosef 1994). Fiscal Shrikes, however, appear to be flourishing, and have expanded their range in southern Africa (Parker 1997). They have adapted to a range of human-modified/anthropogenic habitats and are especially common in gardens, parks and road verges. However, they are relatively scarce in some natural habitats, including arid woodland and lowland savannah (Parker 1997). In these habitats, they face competition with other shrikes, such as the Longtailed Shrike (*Corvinella melanoleuca*) and Lesser Grey Shrike. In addition, they appear to be sensitive to other types of land uses, and are less common where human population pressures have caused the removal of bushes and trees (Parker 1997).

Fiscal Shrike territories were smaller in groves than in other areas and, as a result, the occupants of these territories spent less time in flight. Territory size has important implications for the nutritional condition and reproductive success of shrikes. Loggerhead Shrikes (*L. ludovicianus*) residing in large territories spent larger proportions of their time changing perch, and the benefit/cost ratio of holding the territory declined with increasing territory size (Yosef and Grubb 1992). Nutritional condition was positively correlated with the benefit/cost ratio, and was negatively correlated with territory size. Reduction in territory size by the introduction of artificial perches, and the associated increase in nutritional condition of owners, allowed Loggerhead Shrikes to increase their reproductive success (Yosef and Grubb 1994). Unfortunately, breeding data collected for the Fiscal Shrike during this study do not allow a thorough comparison of reproductive success between natural and human-modified habitats, because of a small sample number of nests in grove habitats. However, indications suggest that other factors may also play a role in influencing the reproductive success of Fiscal Shrikes. All three nests discovered in groves were unsuccessful. Fiscal Shrike nests in exposed positions are less successful than those in more concealed places because of increased exposure to inclement weather (Devereux 1998), and two of the nests in groves were lost during storms.

As expected, the foraging success of Fiscal Shrikes in human-modified habitats was not less than in natural habitats. In fact, although success rates and prey sizes did not differ amongst the habitats, hunt frequency was greater in groves and grasslands. Hunt frequency could have been greater in modified habitats because of a greater abundance of prey, or because prey was more visible and accessible. Fiscal Shrikes are only found in habitats with short or sparse ground cover (Parker 1997). Natural habitats at Ukulinga tended to have taller grass layer than groves and grass-

lands, because both of the latter habitats were used regularly for intensive grazing and the natural habitats there lacked native herbivores or were unburned. Although prey densities were not measured, shorter groundcover should increase prey detection in grasslands and groves. Tall grass is a factor limiting the ranges of many raptorial species, including shrikes (Bechard 1982, Gawlik and Bildstein 1990), and can reduce reproductive success (Brandl *et al.* 1986).

In summary, in South Africa, Fiscal Shrikes maintain high densities in modern commercial land-use systems (Brandl *et al.* 1985b) and, unlike many species of shrikes, appear to have expanded their range in recent years (Parker 1997). Fiscal Shrikes adapt their hunting methods according to habitat characteristics and exploit opportunities for increased foraging success alongside human disturbance.

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A fossil of a shrike-like bird (*Lanius miocaenus*) found in Lower Miocene deposits in France, indicates that the genus *Lanius* existed in Europe 25–30 million years ago. African origins have been suggested by various authors who consider that, out of the 74 species classically retained in the shrike family, only 10 have no link with Africa. The more common and widespread west-palaearctic red-backed shrike (*L. collurio*) may be a much more recent invader, or re-invader, of northern latitudes after the retreat of the last glaciers about 12,000 years ago. Recent studies of genetic material and behavior, as well as observations of morphological and plumage characteristics, however, suggest that the above classifications may not reflect the true relationships among shrikes. In human-altered environments, organisms may preferentially settle in poor-quality habitats where fitness returns are lower relative to available higher-quality habitats. Such ecological trapping is due to a mismatch between the cues used during habitat selection and the habitat quality. Here, we examined the link between habitat preference and fitness in the Red-backed shrike (*Lanius collurio*), a migratory passerine that occupies two distinct types of breeding habitats in northwest Europe. The Red-backed shrike is typically considered as a farmland bird inhabiting open areas under a management regime of extensive farming [23], [24]. For example, red-backed shrikes (*Lanius collurio*) that breed in Scandinavia and migrate to southern Africa during the nonbreeding season, make extensive stops before reaching their final destination. While migration south, red-backed shrikes spend two weeks in southeastern Europe and almost 2 months in central Africa during autumn migration (Tjottrup et al., 2012). Among Eurasian-Afrotropical migrants, chats, wheatears and shrikes generally occur in African habitats devoid of resident species, and segregate from one another, while various silviid warblers overlap broadly with residents, but forage in different parts of the habitat (Moreau 1972). In the New World, such patterns are commonplace, and ecological segregation is often evident from detailed study.