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CHARACTERISTICS OF FORAGING PERCH-SITES USED BY LOGGERHEAD SHRIKES

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ABSTRACT.—Perch-sites are a necessary component of Loggerhead Shrike (*Lanius ludovicianus*) foraging habitat, yet little is known about the influence of perch characteristics on perch use. We hypothesized that Loggerhead Shrikes would selectively forage from taller, bare perches with less foliar obstruction to potentially increase prey detection rates. Shrikes in our study area foraged from trees ~10% taller than those available and on dead or partially dead trees more often than expected ($P = 0.005$). Deciduous trees with a leafy canopy in summer were more likely to be used when bare in winter. Removing all obstacles to prey detection did not increase perch preference. Shrikes perched more often and for more total time on constructed artificial perches surrounded by dead branches (50% of used; 166 sec/territory) than on treatments with leafy branches (14%; 32 sec) or no branches (36%; 50 sec). Our results suggest trees that are more useful are those with a good view of potential prey and which also provide cover from potential attacks by predators. This study demonstrates the relevance of perch-site characteristics to Loggerhead Shrike foraging habitat and we suggest consideration for perch-site characteristics in future conservation efforts. *Received 13 February 2008. Accepted 12 August 2008.*

Declines in grassland birds are often associated with habitat loss from the conversion of natural grasslands or low-intensity agriculture to other land uses, typically intensified agriculture (Vickery et al. 2001, Wilson et al. 2005, Buckingham et al. 2006). One adverse affect on bird populations of modified habitat may be decreased foraging opportunities from low food abundance (Britschgi et al. 2006, Buckingham et al. 2006, Taylor et al. 2006). In addition, several bird species that feed on arthropods and small animals use perch-sites while searching for prey on the ground. Thus, the absence of suitable foraging perches may limit access to an already constrained prey population in modified habitat.

Perch abundance could be a reliable indicator in predicting habitat use by raptors or passerines (Meunier et al. 2000, Lauver and Busby 2002). However, measuring total perch abundance to estimate perch availability is only accurate if birds forage indiscriminately from all types of perches. More likely, if birds use perches to search for prey, there should be a bias towards perches with few visual obstructions to prey detection. Acadian Flycatchers (*Empidonax virescens*) perched on bare dead branches instead of branches with more foliage (Guilfoyle et al. 2002), presumably to increase visibility. Brown Shrikes (*Lanius cristatus*) foraged from branches protruding from the side of the canopy rather than above the canopy (Yosef 2004) to watch for prey on the ground.

An elevated bare perch may offer better views to watch for prey, but exposed perch sites potentially increase predation risk to the forager. Studies of some passerines show a preference for foraging closer to dense cover (Walther and Gosler 2001, Lee et al. 2005), and exposure may be positively related to the risk of predation by aerial predators (Gotmark and Post 1996). A trade-off may exist in perch selection between trees with an unobstructed view and trees with a protective canopy.

We studied the foraging behavior of Loggerhead Shrikes (*Lanius ludovicianus*) with the objective of examining the importance of tree structure in perch selection and habitat use at the scale of within a territory. Specifically, we were interested in the influence of canopy cover and perch height on foraging perch use. We hypothesized that if shrikes use a perch to detect prey movement in low vegetation, perch tree features would facilitate improved views of the ground. We predicted

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that shrikes would perch on taller bare trees more often than expected and we expected leafy trees unused in summer to be used more often in winter after trees lost their leaves. We predicted that in a field experiment, artificial perches with dense cover would be avoided if shrikes select perches based largely on criteria related to visual obstruction. Alternatively, artificial perches with the most cover should be used more often if shrikes select perches for increased predator protection.

METHODS

Study Site.—Loggerhead Shrikes were observed at Matador Wildlife Management Area (MWMA; 34° 07′ 30″, 100° 22′ 30″) in Cottle County, Texas, USA in the Rolling Plains Ecoregion (Richardson et al. 1974). Average maximum summer temperature is 36° C and average winter minimum temperature is −2° C. Average annual rainfall in the area is 562 mm with most occurring in May and June. Vegetation cover was dominated by sand sagebrush (*Artemisia filifolia*), honey mesquite (*Prosopis glandulosa*), and shinnery oak (*Quercus havardii*) in a grassland characterized by scattered individual or clumped trees, and shrubs interspersed with short grass and forb ground cover. Common woody species available as perches were honey mesquite, redberry juniper (*Juniperus pinchotii*), netleaf hackberry (*Celtis reticulata*), and shinnery oak with honey mesquite being the dominant woody species. Management strategies used at MWMA including prescribed burning, grazing, mechanical tree removal, and herbicide applications, provide a mix of trees of different ages, heights, and conditions.

Behavioral Observations.—Loggerhead Shrikes in the region defend exclusive breeding territories while nesting from late February to late June (Tyler 1992). We assumed repeated observations in a single territory in a single season were of the same two paired adults. Behavior of individuals within a pair was not considered independent and we used territories as the sampling unit. Shrikes were not banded and pairs were identified by behavior. Pairs were originally identified by their visits to the nest and territories were mapped from multiple foraging sites of the same individuals. Both adults in a breeding pair actively defended their territory from neighboring pairs in chases, flight displays, and aggressive calls. Disputes typically occurred at a clear territory boundary and, after an agonistic encounter, pairs retreated into their own territory. Shrikes usually flew to an interior perch in the territory during an observation session, even if initially observed foraging at the edge of the territory. The use of boundary disputes and foraging sites has successfully been used to map territories in shrikes (Collister and Wilson 2007). We included a measure of territory size as a general reference to compare to other breeding shrike populations. We estimated territory size by mapping a perimeter from the outermost foraging perches used by a shrike in its territory and calculated the area contained within the perimeter.

Only six study territories were found at the start of the study; these territories were visited 2–3 times at regular intervals over 14 days starting on 21 May 2005. The same six territories were revisited and sampled in the same way starting on 21 June and 21 July 2005. More territories were located as the season progressed, and 12 territories were monitored for general data on foraging perch characteristics by the end of the 2005 breeding season. The original six territories, along with two other territories, were sampled in two observation sessions during winter from 24 to 31 December 2005 for use and availability data on non-breeding behavior. The eight territories sampled in winter, plus two additional territories, were visited at 4–6 day intervals from 17 May to 16 June 2006 to collect data on use of artificial perches in a field experiment, and to obtain general data on perch characteristics.

Observation sessions occurred in at least two of three periods: early morning (0.5–2.5 hrs after sunrise), mid-morning (2.5–4.5 hrs after sunrise), and evening (0.5–2.5 hrs before sunset) when shrikes are most actively foraging (Craig 1978). Each territory was sampled during at least two different randomly assigned time periods to avoid biases due to temporal variation in behavior. A single observer used binoculars to watch the focal shrike from a distance of 60–100 m during an observation session and behavior was recorded at all perch trees used for foraging. We watched the focal bird continuously over the observation session and recorded the location and type of perch used in a capture attempt,

the number of foraging perches used, and the foraging flight distance from perch to ground. Perches were marked for later measurements after an observation session. The observer lost sight of the focal shrike, in some cases, for more than half the 1-hr session and these observation sessions were not included in the analysis. Sampling effort did not differ across territories used in the analysis for the use and availability study or the artificial perch experiment.

Use and Availability Study.—Each shrike territory contained ~100–200 trees and shrubs on which to perch. We measured the height and assigned a perch category to each substrate used by a foraging shrike. Perches were categorized as: (1) mesquite with live branches bearing leaves or buds and lacking exposed dead branches (live mesquite), (2) mesquite with some live branches and one or more dead branches extending 0.5 m beyond live branches (partially dead mesquite), (3) mesquite with <20% of branches bearing leaves or buds (dead mesquite), or (4) other, which was a single category for all other types of non-mesquite perches.

We compared perches used by foraging shrikes to random perches available in the May 2005 sampling period. Each of 50 observed perches in six territories was paired with the tree closest to a point 100 m distant in a random direction and at least 1.5 m in height. A 100-m distance was likely to remain in the shrike territory, within reasonable interperch flying distance, but did not provide access to the same ground vegetation and prey. Random perches did not include any perches that we observed being used by a shrike. Available trees included any natural tree or shrub species but were limited to those >1.5 m tall because shrikes tend to perch on trees higher than 1.5 m (Novak 1989). Only 30 of 437 used perches, in our study population, were below 1.5 m and only eight of the shorter perches were natural vegetation and not fence posts or fencing.

The use and availability study was repeated in winter on 57 perch trees in eight territories. Deciduous mesquite trees lost their leaves in winter but were still identifiable as one of the three mesquite perch categories based on presence or absence of buds and living stems; we used the same criteria for assigning perch categories in summer and winter. Trees in the dead mesquite category also appeared to have fewer and stiffer branches than living trees. We field-checked 25 randomly selected perch trees from winter 2005 the following spring; only two of 25 trees were incorrectly categorized. Those two individual trees had survived a prescribed fire in August 2005 that caused bud mortality, leaving the tree alive but without new leaves.

Artificial Perch Experiment.—We erected artificial perches in the 10 study territories in May 2006. Artificial perches were constructed of a 3.05 m long by 1.2 cm diameter metal pole, painted black, and mounted vertically on a metal stake. A forked mesquite branch with branches 15–25 cm long from the fork was placed in the top of each pole for natural perching material. Artificial perch treatments differed in type of vegetative cover at the base of the pole. Poles were erected above either (1) a living mesquite tree (foliage cover), (2) a bundle of upright dead mesquite branches from local trees (bare cover), or (3) without any branches at the base (no cover). Dead branches had the same length and basal circumference as living mesquite trees to standardize the height and branching density of the foliar and bare cover treatments. The bare cover treatment had the same number of dead branches as living mesquite trees.

Placement of the foliage cover treatment within a territory depended on the location of an existing live mesquite tree. We used a live mesquite tree closest to a random point between 40 and 100 m and at a random bearing from an active nest. A minimum distance of 40 m from an active nest was less likely to disturb nesting activity, and 100 m approximated the average distance between consecutive natural foraging perches in 2005. A bare cover perch and a perch with no cover were erected 10 m from the foliage cover perch in an equilateral triangle (Fig. 1). Orientation of the bare cover perch and no cover perch from the living mesquite tree was random for every triangle. Shrike foraging flights are typically less than 10 m and the same vegetation within a triangle was accessible to a shrike perched on any artificial perch in the group of three. Two groups of three artificial perches were erected in 10 territories.

Behavioral observations started 4 days after

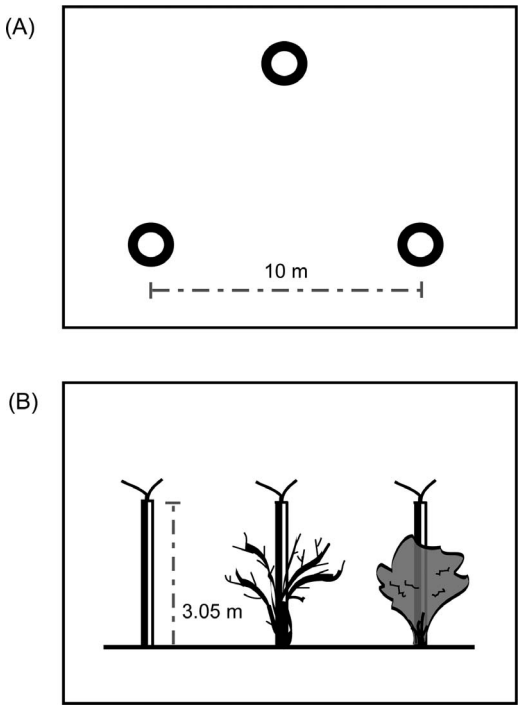

FIG. 1. Experimental design for artificial perch treatments in 10 Loggerhead Shrike territories showing the spatial arrangement of a group of artificial perches (A) and the dimensions of three types of artificial perches (B).

artificial perches were introduced to territories in May 2006. We recorded the perch treatment and length of time the shrike perched before a capture attempt (perched time) when a shrike foraged from an artificial perch during an observation session. Foraging flight distances were estimated from the base of the perch to the landing point using the height of the artificial point as a fixed length reference. The amount of time a shrike remained on the ground was recorded in seconds.

Data Analyses.—Tree height was compared in six territories for used perches and available trees in a one-tailed paired *t*-test. Heights included in the paired analysis were averaged within a territory by treatment (used, available). It is unlikely that within a territory, shrikes used one perch category independently from the other three categories. Therefore, we used a two-way ANOVA with repeated measures to account for the possible lack of independence between categories. The critical test was the interaction between tree category (live mesquite, partially dead mesquite, dead mesquite, other) and treatment (used, available). Data were square root transformed to homogenize the variance across groups. Transformed data met the assumptions of equal variances and normal distribution. *F* statistics were Greenhouse-Geisser (Zar 1999) corrected for a conservative α probability value.

A test statistic from an ANOVA on differences in perch categories in the use and availability study is only able to show a difference between how often categories were used and how often categories were available. We used Ivlev's Selection Index (Krebs 1989) where the difference in used and available perches is divided by the sum of perches used and perches available for each category, to quantify which perches were preferred within the four categories. Values greater than zero indicate a preference and values less than zero indicate avoidance. The effect of season on preferences for perch categories was tested in a two-way ANOVA with repeated measures using values from Ivlev's Selection Index to examine if shrikes preferred different types of trees in the breeding and non-breeding seasons. Only the six territories observed in both summer and winter were included in analysis of seasonal effects.

We used Friedman's non-parametric test of ranked data to look for relative differences in number of times shrikes used each artificial perch treatment. All 10 study territories with artificial perches were included in the analysis even if resident shrikes did not perch on all artificial perch treatments. A corrected x_r^2 value was calculated to account for the presence of tied ranks (Zar 1999). The length of time shrikes perched on each artificial perch treatment was summed within each territory to include behavior by both individuals in a pair during multiple observation sessions. The differences in time perched on the three treatments were tested with a two factorial ANOVA using territory as the sample size. Shrikes did not use all the artificial perch treatments sufficiently often to statistically compare flight distances and ground time between treatments, and we only present our summarized observations for these variables.

TABLE 1. Features ($\bar{x} \pm$ SE) of trees used by foraging Loggerhead Shrikes in 1-hr observation sessions and paired random trees available within shrike territories in Texas, USA from 21 May to 5 June (breeding) and from 24 to 31 December (wintering) 2005.

	Breeding (n = 6)		Winter (n = 8)	
Perches	Used	Available	Used	Available
Dead mesquite	3.8 ± 1.4	2.8 ± 1.5	2.0 ± 0.9	1.8 ± 1.0
Partially dead	2.8 ± 0.9	1.3 ± 0.6	2.8 ± 0.7	1.0 ± 0.4
Live mesquite	1.0 ± 0.3	3.5 ± 0.8	1.5 ± 0.4	3.8 ± 0.9
Other	0.7 ± 0.4	0.7 ± 0.3	0.9 ± 0.4	0.6 ± 0.4
Tree height (m)	3.4 ± 0.2	3.1 ± 0.2	3.3 ± 0.2	2.9 ± 0.2

RESULTS

Use and Availability Study.—Loggerhead Shrikes in 16 study territories foraged from 482 perches in 154 observation sessions. The number of natural perch trees used to forage within territories over a 31-day period in 2006 ranged from 10 to 32 ($\bar{x}$ = 21, SD = 6, n = 10 territories). The area covered by foraging perches in 10 territories was 11.08 ha (SD = 5.90) in 2006. The height of perches ranged from 0.9 to 7.5 m ($\bar{x}$ = 3.5, SD = 1.2, n = 437). Shrikes foraged from taller than expected trees in the breeding season (t = 2.142, df = 5, P = 0.043) and also during winter (t = 2.042, df = 7, P = 0.040; Table 1).

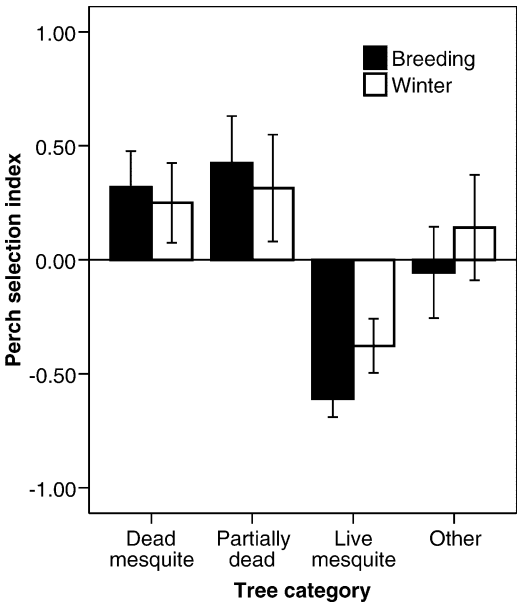

FIG. 2. Trees preferred or avoided ($\bar{x} \pm$ SE) by foraging Loggerhead Shrikes in six territories during the breeding and winter seasons, Texas, USA, 2005. Values approaching 1.0 indicate preference and values approaching −1.0 indicate avoidance.

Partially dead mesquite was the most commonly used category of the four perch tree categories (40%) followed by dead mesquite (31.8%), all other types of trees and non-natural materials (19.6%), and full canopy mesquite (8.6%; n = 469). Fence posts constituted 4.3% of perches and were the most common type of non-mesquite perch. Shrikes also foraged from the dead branches of juniper, hackberry, shinnery oak, and occasionally a yucca (*Yucca angustifolia*) inflorescence or the dead stem of sand sagebrush.

Breeding shrikes foraged more from partially dead mesquite trees even though live mesquite was the most common available tree category (used vs. available × tree category interaction: F = 9.03; df = 2.1, 10.5; P = 0.005; Table 1). Shrikes foraging in winter did not use tree categories in proportion to their availability (used vs. available × tree category interaction: F = 5.77; df = 1.7, 12.2; P = 0.020; Table 1) and dead or partially dead mesquite were used most often. Shrikes preferred dead or partially dead mesquite trees and avoided live mesquite in both seasons (Fig. 2). Tree preferences did not differ between the breeding season and winter (season × tree preference interaction: F = 0.846; df = 6, 32; P = 0.517; Fig. 2).

Artificial Perch Experiment.—Shrikes in eight of 10 study territories perched on the artificial perches 28 times in 64 observation sessions. Shrikes perched on the bare cover treatment (50%) and the no cover treatment (35.7%) more often than the foliage cover treatment (14.3%: x_r^2 = 7.22, df = 2, P = 0.027). Shrikes perched on the bare cover treatment for more time than the other two

cover treatments ($F = 5.130$; df = 2, 14; $P = 0.021$). Foraging flight distances, estimated in proportion to perch height, were similar for the foliage (1.5 ± 0.3 m), bare (1.6 ± 0.2 m), and no cover (1.6 ± 0.4 m) treatments. The observed time that shrikes remained on the ground during a capture attempt was highest for the foliage treatment (4.3 ± 1.9 sec), followed by bare cover (3.3 ± 1.9 sec), and no cover (2.5 ± 0.7 sec) treatments.

DISCUSSION

We hypothesized that shrikes would forage from taller trees with less foliage to increase observable area to detect prey. Shrikes used trees that were ~10% taller than trees available in the territory. A vantage point from a taller tree can increase the area viewed on the ground or provide a more penetrating view into ground vegetation (Stillman and Simmons 2006).

Few studies have identified characteristics of shrike natural perching substrate with reference to condition of the perch tree. Shrikes at our study site used the most common tree species available, honey mesquite, but use of individual mesquite trees related positively to the presence of dead branches. Shrikes made capture attempts on the ground from dead mesquite or partially dead mesquite a disproportionate amount considering their availability. The absence of foliage on lower branches may provide a wider view of the ground and increase the visible area in which to detect prey. Loggerhead Shrikes in north-central Florida frequently perch on high utility wires and on bare trees more often than live trees (Bohall-Wood 1987). Gawlik and Bildstein (1993) found shrikes perch mainly on high utility wires but use of shorter trees and shrubs increased in winter.

The amount of foliage on a tree may limit its attractiveness as a foraging perch, thus, removing foliage should bring shrikes to trees with a previously full canopy. We observed shrikes in winter using more live mesquite trees that formerly had a complete canopy in summer. However, all mesquite trees were bereft of foliage in winter and, rather than use each assigned tree category in proportion to its availability, shrikes continued to forage more often from trees with at least some dead branches. Shrikes repeatedly used the same foraging perches within a territory and may have continued to use summer perch trees in winter. In addition, decayed thorns and lateral branches tend to break off dead branches resulting in less structurally complex cover and perches with fewer visual obstructions, even in winter.

We removed these potential biases to perch selection by controlling for branch structure and within-territory location in the artificial perch experiment. All artificial perch treatments shared a common metal pole and forked stick on which a shrike could perch, and were placed in a random, novel location within the territory. The shrikes' preference for artificial perches without leafy cover supports the hypothesis that foraging perches are selected for fewer visual obstructions. These results are consistent with flycatchers that perched on branches with fewer leaves (Guilfoyle et al. 2002) and Brown Shrikes that foraged from lateral branches in a position to see more of the ground (Yosef 2004). Contradictory to our prediction that perches with fewest visual obstructions would be used most, shrikes perched on artificial perches with bare cover more times than on perches without any cover.

Use of perches with bare cover was expected from our alternative hypothesis that shrikes would be more likely to use perches with some escape cover from predators. Kim et al. (2003) reported Loggerhead Shrikes spent more time in plots with woody escape cover in areas of overlap with a larger raptor, Northern Harrier (*Circus cyaneus*), possibly as a predator avoidance strategy. The length of time shrikes in our study waited on an artificial perch before a capture attempt might be an indication that perches with cover provide some protection from predators. Shrikes perched longest on the bare cover treatment (mean = 95 sec) prior to a foraging flight to the ground and shortest on the exposed artificial perch without cover (mean = 45 sec). Foraging birds perched for longer periods on feeders in wooded areas or along forest edges with cover than at feeders in open fields without adjacent cover (Lee et al. 2005).

Shrikes in our study population clearly selected perches with less foliage but with at least some cover. Attempts to use artificial perches to improve shrike habitat should consider the extent of cover surrounding the

perch. Artificial perches are relatively easy and inexpensive to construct, and their addition to habitat without natural perch substrate could make foraging habitat more accessible and more likely to be used by shrikes (Lynn et al. 2006) or small raptors (Sheffield et al. 2001). Other species, including American Kestrels (*Falco sparverius*) and larger raptors (Kim et al. 2003), may use artificial perches intended for shrikes and could increase competition or predation risk. The possible negative effects of increased perch abundance on shrike populations would be worth studying. Attention to characteristics of natural perches may also be important in Loggerhead Shrike habitat where machinery, chemicals, or fire modify the structure or abundance of available perch sites (Ansley and Castellano 2006). The influence of natural perch characteristics and introduced artificial perches on shrike densities and distribution at a larger scale than within territories warrants further research.

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