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Patterns of Bison Hair Use in Nests of Tallgrass Prairie Birds

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ABSTRACT I examined patterns of bison (*Bison bison* L.) hair use by passerine birds nesting in the Tallgrass Prairie Preserve, Osage County, Oklahoma, 2002–2004. I collected and dissected 103 nests of 15 species into their constituent components. Nests were predominately composed of herbaceous material such as grass stems and leaves. Woody material and mud were rarely used. Bison hair was the most prominent zoological material used in nests, with lesser amounts and occurrence of arthropod silk, snake skin, feathers, jack rabbit (*Lepus californicus* Gray) fur, and man-made materials such as cellophane and string. At least one nest of 13 bird species and 42% of all nests collected contained bison hair. The proportion of bison hair composition was highest for smaller nests, and hair use was greatest for nests built higher off the ground. This suggests that bison hair may have an important role as nest insulation for both small-bodied species and for aboveground nesters more exposed to wind and precipitation on this grassland site.

KEY WORDS bird nest, bison, hair, nest, predation, tallgrass prairie

Birds are known to use a wide variety of natural materials to build their nests. Animal dung, hair and fur, feathers, snake skin, fungal material, aromatic plants and lichens are all used by various species to construct, enhance or camouflage their nests (Hansell 2000). These materials often are selected for use in nesting based on key advantageous properties they provide. For example, burrowing owl (*Athene cunicularia*) use of dung to line nest tunnels is used primarily as a tool to attract dung beetles (Coleoptera: Scarabeidae), an important food source for adults and developing nestlings (Levey et al. 2004). Use of snake skins by nesting great-crested flycatchers (*Myiarchus crinitus*) has long been thought to function as a predator deterrent (Suthard 1927, Whittle 1927). A recent experiment by Medlin and Risch (2006) supports this hypothesis, as addition of rat snake (*Elaphe obsolete*) skins reduced predation on artificial cavity nests by southern flying squirrels (*Glaucomys volans*). Feathers and fur provide excellent nest insulation, and are intensively and extensively sought after in some bird communities (Hansell 1995, Hansell and Ruxton 2002). van Riper (1977) found that a community of Hawaiian birds readily used wool from introduced sheep in their nests. Related work found that nest density and insulation efficiency varied as a function of elevation, with denser and better insulated nests being built at higher altitudes exposed to colder conditions (Kern and van Riper 1984).

In 1993 approximately 300 bison (*Bison bison* L.) were reintroduced in the Tallgrass Prairie Preserve (TGPP) in Oklahoma (Hamilton 2007). During post-reintroduction surveys of woody vegetation (Coppedge and Shaw 1997), I encountered numerous bird nests containing bison wool and hair. To my knowledge, use of bison hair by North American grassland birds has not previously been documented in the ecological literature. My objective was to document prevalence and patterns of bison hair use by a community of nesting tallgrass prairie passerines in TGPP. Because hair often is used for nest insulation (Hilton et al. 2004) and increases as nest are built higher off the ground due to increased exposure to wind and precipitation (Kern and van Riper 1984), I hypothesized that use of bison hair for insulative properties would increase as distance above ground of nests increases. Secondly, smaller birds have a higher surface-to-volume ratio, so lose body heat more rapidly than larger birds. Since smaller birds tend to build smaller nests (Slagsvold 1989), I hypothesized that proportionate use of insulating materials such as bison hair would be higher in smaller nests.

STUDY AREA

The study was conducted at TGPP in Osage County, Oklahoma (36°50'N, 96°25'W), a 15,700 ha site owned and managed by The Nature Conservancy. Bison were reintroduced in 1993 to a 1,960 ha unit of TGPP. Internal recruitment and herd additions gradually increased the population and new areas were allocated for bison access. During 2002–2004, approximately 1,500 bison occupied a 5,826 ha portion of the preserve (Hamilton 2007).

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Table 1. Structural composition of bird nests collected on the Tallgrass Prairie Preserve, Oklahoma, 2002–2004. Values represent means except for species represented by a single nest, for which actual nest measurements are presented. H represents the number of nests found containing bison hair, with N representing the total nests found for each species.

		Composition (g)					
Species (hair use)*	H/N	Herbaceous	Hair	Other	Hair (%)	Nest mass (g)	Location ht. (cm)
American goldfinch (?)	7/12	6.4	0.8	0.0	10.5	7.1	126
American robin (N)	0/1	28.3		89.7		118.0	410
Blue grosbeak (Y)	1/4	8.0	0.3	0.4	2.4	8.6	212
Bell's vireo (Y)	6/7	2.5	0.5	0.4	15.3	3.4	143
Common grackle (Y)	2/5	26.3	0.1	3.2	0.2	29.5	159
Common yellowthroat[a] (Y)	1/1	11.8	0.0		0.3	11.9	46
Dickcissel (Y)	0/7	6.6		0.0		6.6	57
Eastern kingbird (Y)	1/4	16.5	0.8		2.9	17.3	241
Field sparrow[b] (Y)	4/4	8.3	0.4	0.1	4.0	8.7	70
Gray catbird (Y)	3/3	9.5	0.8	0.1	6.9	10.3	69
Indigo bunting (Y)	1/1	6.6	0.3	0.3	4.2	7.3	145
Lark sparrow (Y)	2/2	12.4	0.1	2.5	0.4	15.0	35
Loggerhead shrike (Y)	1/2	14.5	0.1	14.3	0.2	28.9	389
Orchard oriole (N)	3/9	6.1	0.5	0.1	6.7	6.7	204
Red-winged blackbird (N)	13/41	18.6	0.3	0.0	1.3	18.9	90

*Hair usage determined from descriptions of nest materials provided by Baicich and Harrison (1997). Y = confirmed usage of animal hair, N = hair usage not mentioned, ? = use of wool, fibers or similar materials listed. Blank cells represent no data. [a] (*Geothlypis trichas*); [b] (*Spizella pusilla*).

METHODS

The TGPP is managed with a spatially and temporally variable fire-grazing model that strongly drives bison grazing location preferences (Coppedge and Shaw 1998), which consequently imparts a spatio-temporal effect on bison distribution that contributes to deposition of hair and wool (Coppedge and Shaw 1997, 2000). To standardize nest surveying efforts and avoid bias in documenting hair usage by collecting nests only in areas of bison activity, a set of 10 500 m transects were established within bison use areas. Transects were surveyed for nests each year regardless of their location relative to recently burned areas used frequently by bison (Coppedge and Shaw 1998). Two to four people surveyed each transect and search effort was standardized by adjusting the amount of time spent nest-searching on each transect. Approximately 50% of transects were established in upland prairie sites dominated by grassland, and 50% were established in riparian zones and along edges of wooded areas. Transects were not placed within the heavily-wooded Crosstimbers forest present on the preserve (Hamilton 2007). Although ground-nesting grassland birds dominate the TGPP (Coppedge et al. 2008), this group is less prevalent in their use of hair as a nest material (Baicich and Harrison 1997). Thus, surveyors focused on finding above-ground nests of open-cup nesting passerines. Cavity nests, mourning dove (*Zenaida macroura*), and raptor nests also were excluded. When located, nest builders were identified and nest locations noted but nests were not collected until the end of the breeding season. Height to the bottom of the nest cup was measured at the time of collection.

Nests were returned to the lab, placed in a drying oven for 24 h at 38°C, and weighed to the nearest 0.001 g on an analytical balance. Nests were disassembled and components were initially separated into five categories and subcategories; woody material (bark and twigs), herbaceous material (non-woody plant stems, leaves, flower parts, fibers, lichens and moss), zoological material (hair and fur, arthropod silk, snake exuviae, feathers), manmade items (string, plastics, cellophane), and soil/mud. Each category of material was bagged separately, dried again for 24 h at 38°C, and weighed to the nearest 0.001 g.

Subsamples of hair and fur and any unknown materia were examined microscopically to confirm identificatior Both published sources and a reference collection mad

from road-kill carcasses and live trapping of local fauna were used to aid in identifying hair and fur found in nests (Bruner and Coman 1974, Deedrick and Koch 2004, Dreyer 1966). After initial sorting and weighing of nest components, it became evident that composition of most nests could be simplified into three categories based on mass; herbaceous materials, hair and fur, and miscellaneous, an inclusion of all remaining materials.

Previously documented hair use for species in this study was noted from nest descriptions provided by Baicich and Harrison (1997). Initial statistical summaries of nest composition, total mass, and location height were calculated for each nesting species. Because red-winged blackbird (*Agelaius phoeniceus*) nests were collected most frequently, I analyzed this species separately from a pool comprised of all other species to avoid biasing subsequent statistical analyses. Frequency distributions were then used to classify nests for 1-Factor ANOVA significance tests of hair usage patterns relative to nest mass and location (height). Natural breaks in the distribution of nest height data were used to assign nests into 3 height classes: low (≤75 cm), intermediate (75–125 cm), and high (>125 cm). These height classes were used for both the pooled species group and red-winged blackbird nests. Natural breaks in nest mass (dry weight) data produced three mass classes for the pooled species group: light (<7 g; n = 27), moderate (7–10 g; n = 17) and heavy (>10 g; n = 18). However, these classes could not be used for red-winged nests as this relatively large species built larger nests. Thus, I partitioned red-winged nest mass data into moderate (<20 g; n = 21) and heavy (>20 g; n = 20) categories for subsequent analyses. During initial summaries I also encountered a nearly 10-fold difference in mean nest mass, so I calculated percent hair composition by dividing hair mass by total nest mass, thereby standardizing hair use across this broad nest size range.

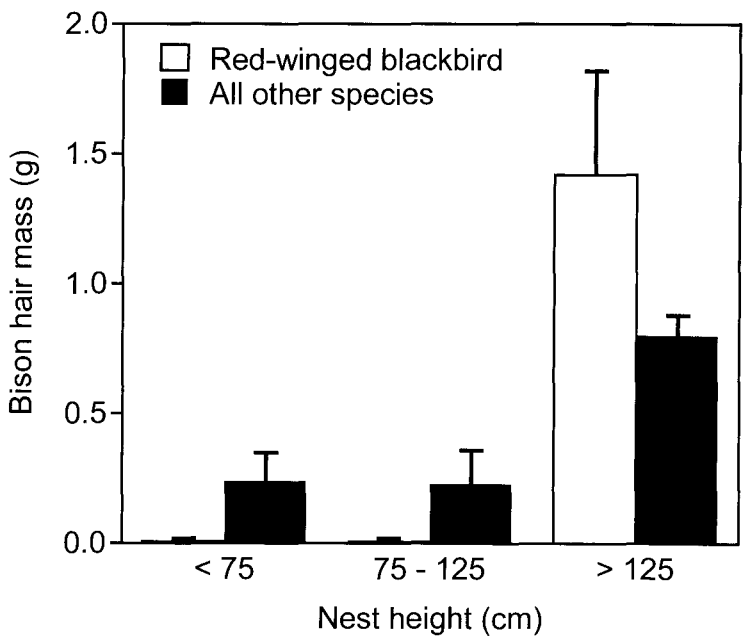

Figure 1. Relationships between bison hair use and nest height for bird nests collected on the Tallgrass Prairie Preserve, Oklahoma, 2002–2004.

RESULTS

I collected and dissected 103 nests of 15 species into their constituent components (Table 1). Red-winged blackbird nests were collected most often, followed by nests of American goldfinch (*Carduelis tristis*), orchard oriole (*Icterius spurius*), dickcissel (*Spiza americana*), and Bell's vireo (*Vireo bellii*). Herbaceous material constituted the majority of the mass of most nests of most species. Exceptions included a large amount of soil/mud found in nests of the American robin (*Turdus migratorius*) and common grackle (*Quiscalus quiscala*), and large amounts of woody material in lark sparrow (*Chondestes grammacus*) and loggerhead shrike (*Lanius ludovicianus*) nests, resulting in a notably higher mean nest mass for these species. Other notable nest materials included various amounts of snake skin and cellophane in nests of the blue grosbeak (*Passerina caerulea*), indigo bunting (*Passerina cyanea*), and Bell's

vireo and feathers in loggerhead shrike and American goldfinch nests. Common grackles and red-winged blackbirds constructed the largest herbaceous-dominated nests. The smallest nests were those of Bell's vireo with a mean mass of 3.43 g (Table 1).

Eleven species whose nests were located in this study are known to use animal hair in their nests, but at least one nest of 13 species and 42% of all nests collected contained bison hair (Table 1). Eastern kingbirds (*Tyrannus tyrannus*) used the highest absolute amount of bison hair ($\bar{X}$ = 0.83 g/nest, SE = 0.41) followed by gray catbirds (*Dumatella carolinensis;* $\bar{X}$ = 0.78 g/nest, SE = 0.30) and American goldfinches ($\bar{X}$ = 0.76 g/nest, SE = 0.24). Only the single nest of the American robin and dickcissel nests contained no bison hair. Aside from bison, hair from only one other mammal was found in a nest. A red-winged blackbird nest collected in 2003 contained fur from a black-tailed jack rabbit (*Lepus californicus* Gray) mixed with an equal quantity of bison wool.

Hair constituted the highest percentage composition of nests of Bell's vireo, American goldfinch, gray catbird, and orchard oriole, respectively. Hair constituted as little as 0.2% of loggerhead shrike and common grackle nests, but >15% of Bell's vireo nests (Table 1). Hair use patterns in this bird community also varied with nest location height and nest mass. Hair use increased significantly with nest height for red-winged blackbirds ($F_{2,32}$ = 8.94, P = 0.001) and the pooled species group ($F_{2,42}$ = 3.40, P = 0.04), averaging nearly 1.5 and 0.9 g, respectively, for nests built above 125 cm (Fig. 1).

Percent hair composition was higher ($F_{2,59}$ = 3.18, P = 0.05) for smaller nests of the pooled species group and declined as nests became larger. In contrast, hair composition increased ($F_{1,39}$ = 4.60, P = 0.04) as nest mass increased for red-winged blackbirds (Fig. 2).

DISCUSSION

Thirteen species of passerine birds nesting at the TGPP used bison hair as a nest component. Hair use was highest in smaller nests and those built higher off the ground. This suggests bison hair could have an important role as nest insulation for both smaller-bodied species and aboveground nesters that are more exposed to wind and precipitation on this grassland site. Nest insulation is a key concern for nesting birds, and no other material is as efficient or sought after by nesting birds as feathers (Hansell 1995, Hansell and Ruxton 2002). However, feathers lose this advantage over other materials when they are wet. Experiments have shown that the best insulators when wet are hair and grass (Hilton et al. 2004). This may explain why feathers are more commonly used by cavity nesters whose nests are less exposed and less likely to get wet, whereas hair use is common in open cup nesters exposed to precipitation (Baicich and Harrison 1997). Although I was unable to investigate nest insulation in this study as nests were destructively sampled, additional research may reveal bison hair use has a significant impact on nest thermodynamics, especially in smaller nests comprising a higher percentage of hair. It is also worth noting that the largest nests of red-winged blackbirds contained the highest percentages of hair in contrast to other species. However, this may result from the fact that many of these nests also were located higher off the ground. Thus, there may be an interaction between nest height, size, and insulation efforts for this species at this site that deserves further study.

Bison hair use in nests also may affect nest detectability and predation. Birds employ a number of strategies to decrease olfactory signals emitted during nesting (Conover 2007). During incubation, ground-nesting red knots (*Calidris canutus*) change the chemical composition of their preening wax secretions to a form less detectable by olfactory-searching predators (Reneerkens et al. 2005). Most species quickly remove eggshells and fecal sacs from their nests to reduce cues predators could use to locate nests. Bison hair may function like carnivore dung added to nests of the common waxbill in Africa, serving as an olfactory camouflage or predator deterrent for the nest, subsequently incubating adult and developing young (Schuetz 2004). Limited studies have addressed the potential of nest materials such as feathers and hair to alter the detectability of open-cup nests to predators. Moller (1987) found that open-cup nests with added feathers suffered more predation than nests lined with hair from the European hare (*Lepus europaeus*). In contrast, Huhta et al. (1998) reported no difference in predation between nests lined with reindeer (*Rangifer tarandus*) hair and feathers from domestic chickens (*Gallus domesticus*). Additional research will be undertaken to investigate the potential influence of bison hair on nest detectability and predation.

Bison hair was widely used by birds nesting at TGPP and found in 42% of nests collected during this study. However, local availability of bison hair was not quantified in this study. To what extent nesting birds at the TGPP will travel in search of bison hair and the level of competition for hair is unknown. Also unknown is the novelty of these observations and the historical context of bison hair use by birds nesting in the Great Plains. Bison historically numbered nearly 60 million (Shaw 1995), so presumably bison hair would have been available each spring to some nesting birds. No prior published records exist of this phenomenon, though most of the species in this study are known to use animal hair as nesting material (Table 1). Loggerhead shrikes, for example, are even known to use cattle hair for nest lining (Porter et al. 1975). Thus, like other fibrous materials used in nests (McFarland and Rimmer 1996), bison hair may simply be a locally abundant natural material readily used by nesting birds. Additional research also will be undertaken to examine museum nest specimens to determine if those collected in the Great Plains before bison extirpation in the late 1800s also may have contained bison hair.

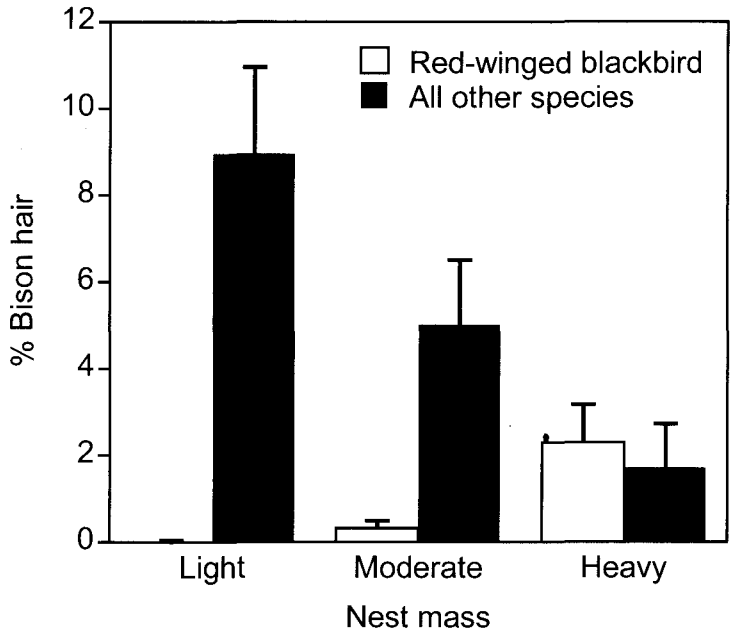

Figure 2. Relationships between percent bison hair nest composition and nest mass for bird nests collected on the Tallgrass Prairie Preserve, Oklahoma, 2002–2004.

MANAGEMENT IMPLICATIONS

Use of bison hair by nesting birds also may have important management and conservation implications. Populations of many grassland birds and neotropical migrants are rapidly declining in North America (Brennan and Kuvlesky 2005). Many species with notable population declines, such as the orchard oriole (Reinking 2004) and Bell's vireo (Sauer et al. 1996), were found to use bison hair in substantial quantities in this study. Thus, future research may find that the novel phenomenon of bison hair use directly improves local nest success for avian species of conservation concern. This indirect effect of bison on the local avifauna may differ substantially from that of cattle who have generally replaced bison across the Great Plains. Results of this study add an additional perspective to the keystone role bison are noted to have played historically in Great Plains grasslands (Knapp et al. 1999).

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