Red-winged Blackbird Nest Success in Oklahoma Tallgrass Prairie

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I examined nest outcomes and reproductive success of Red-winged Blackbirds (*Agelaius phoeniceus*) at the Tallgrass Prairie Preserve in northern Osage County, Oklahoma during 2007 and 2008. Overall nest success was 24%, with nest height above ground the most significant factor examined related to nest outcome and reproductive success. Only 4.5% of nests built below 50cm successfully fledged young, in contrast to 40% of nests built above 100cm. The majority of nest losses in this study were due to predation, with nests built in lower vegetation subject to significantly higher levels of predation, resulting in decreased hatch and fledgling production rates.

INTRODUCTION

Red-winged Blackbirds (*Agelaius phoeniceus*) are one of the most widely distributed species in North America (Peterjohn et al., 1996). Much of their ubiquitous distribution is thought to result from human-induced landscape changes such as the clearing of forests and the intensification of agriculture (Dolbeer and Stehn, 1983). Blackbird reproductive biology has been examined in habitats ranging from tidal marshland on the East Coast (Caccamise, 1978; Meanley and Webb, 1963), upland Kansas grasslands (Shipley, 1979) to Louisiana swampland (Ortego and Hamilton, 1978). Many blackbird studies in the Great Plains have focused on the species' nesting productivity due to their role as a serious pest of corn (*Zea mays*) in the northern plains (Besser et al., 1987). In Oklahoma, widespread pond construction and flood control efforts prior to the 1970's lead to a notable increase in both blackbird nesting habitat and abundance statewide (Baumgartner and Howell, 1942; Goddard and Board, 1967). Recent studies, however, have shown a slight decline in blackbird populations in the Great Plains, attributed in part to the spread of more efficient agricultural practices (Besser et al., 1984; Blackwell and Dolbeer, 2001).

Despite recent declines, Red-winged Blackbirds remain an abundant species across Oklahoma. As part of a study of grassland management effects on nesting birds (Coppedge et al., 2008), I began a specific study of bird nest architecture at the Tallgrass Prairie Preserve (TGPP) in Osage County, Oklahoma in 2002 (Coppedge, 2009). I subsequently focused on Red-winged Blackbirds due their prevalence and ease of finding nests at the TGPP. The TGPP is managed with the goal of restoring ecosystem functioning, including the reintroduction of native grazers such as bison (*Bison bison*) and the implementation of a prescribed burning regime to restore broad-scale landscape heterogeneity (Hamilton, 2007). Given that Red-winged Blackbirds typically benefit from certain human activities such as pond construction (Dolbeer and Stehn, 1983; Goddard and Board, 1967), I examined blackbird reproductive success with respect to the unique ecological situations found within this prairie landscape undergoing restoration.

First I examined seasonal nesting success. Previous studies have shown that blackbird nest losses to predation increase gradually throughout the nesting season (Caccamise, 1978; Dolbeer, 1976; Goddard and Board, 1967). I hypothesized that nest

predation would increase seasonally at the TGPP consistent with earlier studies. Second, I examined nest success by habitat type. Once a working cattle ranch (Hamilton, 2007), the TGPP is dotted with man-made ponds. Due to their shape, ponds concentrate blackbird nesting in higher densities relative to more linear natural wetlands and drainages. Previous studies have shown that this form of clustered nesting by blackbirds reduces predation through predator swamping and shared nest defense (Picman et al., 1988). I hypothesized that blackbird nest clustering on ponds would lead to lower predation for these nests relative to nests scattered in natural wetlands. Third, I examined how nest height affected nest success for blackbirds at the TGPP as some previous studies have shown that nest success varies with height in supporting vegetation (Holcomb and Twiest, 1968; Meanley and Webb, 1963).

METHODS

The study was conducted during 2007-2008 at the TGPP, a 15,700 ha site in Osage County (36°50'N, 96°25'W) owned by the Nature Conservancy. During the study, approximately 2,400 bison freely roamed an 8,517 ha portion of the preserve where the study was conducted (Hamilton, 2007). Using topographic maps and aerial photographs, I conducted nest searches beginning April 15 of each year along both natural drainages and around ponds. Nests were also located by observing singing males and the nest building activities of females. Once a nest was located, I noted the height of the nest in the supporting substrate, the nest contents, and noted the location by conspicuous natural vegetation around the nest. Nest locations were not marked or flagged and I did not approach nests from the same direction in subsequent visits. I rechecked nests every 3-5 days weather permitting, noting nest contents until the final outcome was determined. Nest outcomes fell into four nest loss categories (predation, abandonment, weather or unknown) or success if at least one young was fledged. Criteria used for classifying nests as depredated included signs of predation such as eggshells or nestling remains, or a torn nest cup with missing contents. Although similar, criteria for determining weather losses were coupled with knowledge of severe weather events affecting the study area and signs of flooding (mud or debris in the nest cup) or broken support vegetation or dislodged nests from strong winds. Abandoned nests were those with contents that did not change between 3 consecutive visits combined with the absence of adult mobbing behavior during visits. When no definitive evidence fitting the prior three categories was present, nest outcome was listed as unknown.

For seasonal comparisons, nests were grouped for statistical analysis based on the month of initiation (May, June, or July). Nests located on ponds or immediately below spillways (<50m) were grouped as pond nests; otherwise nests were categorized as occurring in wetland habitat. Nest height categories were defined as ≤50cm, 51-99cm, or ≥100cm. Nest success rate was defined as the percentage of total nests located fledging at least one young. Hatch rate was defined as the percentage of total number of eggs laid that hatched. Fledging rate was defined as the percentage of total eggs hatched that resulted in a fledgling produced. Differences in percentage rate variables were tested with a two-proportion z-test. Where more than two categories existed, pairwise tests were calculated. Differences in mean clutch size were examined with a student's t-test or ANOVA. Differences in distributions among the five nest outcome categories were examined with a χ^2 goodness-of-fit test.

RESULTS

A total of 125 blackbird nests was located and monitored during the study. I located 43 nests in 2007 and 82 nests in 2008. As initial statistical analysis comparing nest outcomes and reproductive success parameters between years found no significant dif-

ferences, 2007 and 2008 data were pooled for subsequent analysis. Overall, 30 nests (24%) fledged at least one young. Predation was the highest source of mortality, accounting for 52 nests. The outcome of 30 nests was unknown, although it is likely that most were lost to predators. Only four nests were abandoned, and nine were lost to weather events (flooding or wind-blown). Four nests were parasitized by Brown-headed Cowbirds. None were successful and no cowbird eggs were hatched, however, as three of the parasitized nests were depredated and one was abandoned. Nearly all nests were built in emergent woody vegetation or shrubs near water. The primary species used included buttonbush (*Cephalanthus occidentalis*), smooth sumac (*Rhus glabra*), buckbrush (*Symphoricarpos orbiculatus*), black willow (*Salix nigra*), and sand plum (*Prunus angustifolia*). I located only four nests built in herbaceous vegetation. In each case, nests were woven into dense stands of western ironweed (*Vernonia baldwinii*) located along pond edges.

Seasonal nesting success

Nest building commenced in early May each year, although June was the period of highest nesting activity with half of all nests initiated during this month (Table 1). Nesting ceased in late July with only one nest persisting until fledging into early August. Overall nest success increased during the nesting season from a low of 19.4% in May to a high of 34.6% in July, although there was no statistical difference between these rates ($z = 1.51$; $P > 0.1$). The distribution of nest outcomes also did not differ between months ($\chi^2 = 9.15$; d.f. = 8; $P > 0.25$). Nor did mean clutch size differ between months ($F = 0.31$; $P > 0.7$). However, half of nests initiated in May were depredated. As a result, the hatch rate was significantly lower in May at 28.3% than in June ($z = 2.67$; $P < 0.008$). Despite these early-season egg losses, the rate of fledgling production as a function of eggs hatched was fairly constant at around 70% for the entire nesting season (Table 1).

Table 1. Summary of seasonal Red-winged Blackbird nest outcomes and reproductive success at the Tallgrass Prairie Preserve, Osage County, Oklahoma, 2007-2008. Parameters marked with an asterisk (*) had significant statistical tests as explained in the text.

Nesting parameter	May	June	July
NEST OUTCOMES			
Nests located	36	63	26
Nest losses			
Predation	18	23	11
Abandonment	2	1	1
Weather	3	6	0
Unknown	6	19	5
Successful nests(% of located)	7(19.4)	14(22.2)	9(34.6)
REPRODUCTIVE SUCCESS			
Eggs laid	92	133	68
Mean clutch size	3.1	3.0	3.2
*Eggs hatched(% of laid)	26(28.3)	61(45.9)	33(48.5)
Fledglings produced(% of hatched)	19(73.1)	44(72.1)	23(69.7)

Nesting success by habitat

Blackbird nests were built in approximately equal numbers on ponds and natural wetlands (Table 2). There was no difference in nest outcome distribution between habitat types ($\chi^2 = 2.68$; d.f. = 4; $P > 0.25$) nor in mean clutch size ($t = -0.37$; $P > 0.36$). Although overall nest success was slightly higher for natural wetland nests at 26.6%, this rate was not significantly higher than the pond nest success rate of 21.3% ($z = 0.74$; $P > 0.4$). There was no difference in hatch rate ($z = 1.74$; $P > 0.08$) or fledgling production rate between the habitat types ($z = 0.89$; $P > 0.3$).

Nest success by height

The distribution of nest outcomes differed significantly between nest height groups ($\chi^2 = 22.59$; d.f. = 8; $P < 0.01$), with only one nest of 22 located below 50cm successfully fledging young (Table 3). This was a success rate of 4.5%, significantly lower ($z = 1.61$; $P = 0.05$) than the 19.0% success rate of nests located between 51-99cm. Lower nests also had the lowest hatch rate at 14.5% ($z = 4.05$; $P < 0.0001$). In contrast, blackbird nests built above 100cm had the highest success rate at 40.0% ($z = 2.33$; $P < 0.01$) and the highest rate of fledgling production, with 94.3% of eggs hatched resulting in a fledgling ($z = 5.01$; $P < 0.0001$). Although mean clutch size was slightly higher for lower nests, this difference was not statistically significant ($F = 1.17$; $P > 0.3$).

DISCUSSION

Overall, 24% of the nests located fledged at least one young. This success rate falls within the wide range of those reported in previous studies: 14% in Louisiana (Ortego and Hamilton, 1978); 17.2-34.8% in Ohio and Michigan (Holcomb and Twiest, 1968); 26.7% in Oklahoma (Goddard and Board, 1967); 27.4% in South Dakota (Besser et al., 1987); 28-33% in Ohio (Dolbeer, 1976); 37% in New York (Westneat, 1992) and 45-62% in Maryland (Meanley and Webb, 1963). But in

Table 2. Summary of Red-winged Blackbird nest outcomes and reproductive success by habitat type at the Tallgrass Prairie Preserve, Osage County, Oklahoma, 2007-2008. Parameters marked with an asterisk (*) had significant statistical tests as explained in the text.

	Habitat type	
Nesting parameter	Ponds	Natural wetlands
NEST OUTCOMES		
Nests located	61	64
Nest losses		
Predation	23	29
Abandonment	3	1
Weather	5	4
Unknown	17	13
Successful nests(% of located)	13(21.3)	17(26.6)
REPRODUCTIVE SUCCESS		
Eggs laid	140	153
Mean clutch size	3.04	3.12
Eggs hatched(% of laid)	50(35.7)	70(45.8)
Fledglings produced(% of hatched)	38(76.0)	48(68.6)

Table 3. Summary of Red-winged Blackbird nest outcomes and reproductive success by nest height at the Tallgrass Prairie Preserve, Osage County, Oklahoma, 2007-2008. Parameters marked with an asterisk (*) had significant statistical tests as explained in the text.

	Nest height		
Nesting parameter	≤50cm	51-99cm	≥100cm
NEST OUTCOMES			
Nests located	22	58	45
*Nest losses			
Predation	9	27	16
Abandonment	2	2	0
Weather	3	3	3
Unknown	7	15	8
*Successful nests(% of located)	1(4.5)	11(19.0)	18(40.0)
REPRODUCTIVE SUCCESS			
Eggs laid	55	125	113
Mean clutch size	3.44	3.01	3.05
*Eggs hatched(% of laid)	8(14.5)	59(47.2)	53(46.9)
*Fledglings produced(% of hatched)	4(50.0)	32(54.2)	50(94.3)

contrast to earlier studies reporting details of Red-winged Blackbird nest predation (Caccamise, 1978; Dolbeer, 1976; Robertson, 1973), including one conducted in Oklahoma (Goddard and Board, 1967), my results do not indicate a gradual seasonal increase in predation occurred at the study site. Rather, there was some evidence of the opposite. Predation pressure appeared to occur earlier and peak slightly during May, a period with reduced hatch rate and lowered nest success relative to later months. Although specific predators were not identified, the study site is home to diverse mammalian (Payne et al., 2001) and avian communities (Coppedge et al., 2008). The abundance and diversity of potential predators at this site appears to have maintained predation pressure at a fairly constant level throughout the nesting cycle each year. There was also no evidence to support my second hypothesis that blackbird nests clustered on man-made ponds experienced lower predation than nests built in natural wetlands. Although I did not assess nest density in each habitat type, I divided my search time equally between them, found similar numbers of nests, yet failed to demonstrate any habitat differences in nest success parameters. However, this is consistent with studies showing that synchronous nesting in Red-winged Blackbirds is beneficial if the primary nest predators are avian (Westneat, 1992) but less so if mammalian predators are involved (Weatherhead and Sommerer, 2001). As with the seasonal (temporal) pattern, it appears that blackbird nest predation is also spatially constant in the study area due to a varied predator community which is not specifically influenced or limited by habitat features or resulting nest distributions.

Unlike seasonal and habitat factors, almost all nesting parameters varied significantly by nest height. Higher nests had the highest rate of nest success and fledgling rate, and lower nests had the poorest hatch and nest success rates. This is consistent with some, but not all previous studies. Holcomb and Twiest (1968) and Meanley and Webb (1963) reported a consistent increase

in success rate with nest height. In contrast, Ortego and Hamilton (1978) found lower nests were most successful in Louisiana. Interestingly, they reported most blackbird nests occurred in buttonbush, the same woody species most commonly used for nesting by blackbirds in this study. Goddard and Board (1967) also reported lower nests were more successful than higher nests. However, most of their nests occurred in cattails, in which higher nests were in greater danger of tipping during high winds. In a review of Red-winged Blackbird nesting studies, Francis (1971) concluded from these contradicting results that sturdier nesting substrates such as woody plants explained the higher nest success rate better than nest height alone. However, previous studies were confounded in that many lower nests were built in less stable herbaceous vegetation while higher nests were usually placed in woody trees and shrubs (Francis, 1971). Unlike previous studies, the majority of nests I located were in the same general type of woody substrate and results clearly show that height was a significant factor in blackbird nest success.

An important implication of these results is that Red-winged Blackbird nest success is enhanced by the presence of abundant woody shrubs in a landscape dominated by herbaceous vegetation managed and under restoration with prescribed burning and grazing. Historically, woody vegetation would have been very limited in a tallgrass prairie landscape. The abundance of woody vegetation present now in the study area is likely due the recent history of cattle grazing which favors woody plants (Bragg and Hulbert, 1976). Earlier work has shown that bison horning and rubbing can inflict high mortality on small trees and shrubs at the study site (Coppedge and Shaw, 1997). Bison, coupled with seasonally-variable prescribed fire, may eventually significantly reduce or eliminate the shrubs so preferred by nesting Red-winged Blackbirds in this unique prairie landscape.

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