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The Potential of Uncut Patches to Increase the Nesting Success of Grassland Songbirds in Intensively Managed Hayfields: A Preliminary Study From the Champlain Valley of Vermont

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Abstract - Changes in land use and intensification of agricultural practices are associated with declines of grassland songbird populations in North America. Hay harvests in the northeastern United States are occurring earlier and more frequently today than 30 years ago, resulting in substantially decreased nesting success of grassland songbirds on early-hayed fields. Few studies have examined whether uncut patches within fields cut during the breeding season can increase the nesting success of grassland songbirds. Twenty-nine artificial nests were placed in 17 uncut patches (mean = 0.337 ha, median = 0.103 ha) on four early-hayed fields in Shelburne, VT. Only one of the 29 artificial nests was depredated. Despite the small sample size, these data suggest that minimal nest cover may allow some reproductive success during hay harvest. Investigating the effect of patch size variation, patch placement, and vegetation structure within uncut patches would prove useful for potential management strategies. While most farmers will be unable to find and cut around grassland songbird nests, larger uncut patches (i.e., ≥1 ha) encompassing areas with high avian nesting densities may be a useful management strategy for grassland birds in intensively managed hayfields of the Champlain Valley of Vermont and New York or similar dairy-dominated agricultural landscapes.

Introduction

Declines of grassland songbird populations have been well documented throughout much of the United States and parts of Canada (Askins 1999, Jobin et al. 1996). Breeding bird survey data showed the abundance of 10 of 14 grassland species in eastern North America has declined significantly from 1966–2006 (Sauer et al. 2006). As with many species of wildlife, multiple factors are likely acting on grassland songbird populations simultaneously. The most frequently stated hypothesis for the decline in grassland songbird populations suggests that changing agricultural practices are a significant driving force (Bollinger et al. 1990, Dale et al. 1997, Herkert 1997, Jobin et al. 1996, Murphy 2003).

In central and eastern North America since the 1960s, the date of first hay harvests has occurred earlier, and as a result, farmers cut fields more frequently in a given year (Herkert 1997, Troy et al. 2005, Warner and

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Etter 1989). In the northeastern United States, first harvests of hayfields are usually made by early June. Troy et al. (2005) found that 72% of Vermont farmers harvested fields earlier, and 71% harvested more frequently, in recent years as compared to 30 years ago. Early haying of fields, which enables more frequent harvests, has been shown to have strong negative effects on the reproductive success of *Dolichonyx oryzivorus* Linnaeus (Bobolink) and *Passerculus sandwichensis* Gmelin (Savannah Sparrow) (Bollinger et al. 1990, Dale et al. 1997, Perlut et al. 2006). For example, in the Champlain Valley of Vermont and New York, Perlut et al. (2006) found that 100% of active Bobolink nests and 99% of active Savannah Sparrow nests failed as a result of hay harvest. In addition to these detrimental effects, between 25% and 40% of the grassland habitat in this region was hayed by 12–16 June, well before most young fledge (Perlut et al. 2006).

The most logical management strategy for increasing the nesting success of grassland songbirds breeding in agricultural fields would be to delay cutting until after the breeding season. However, due to the increased nutritional quality of early-cut grasses (Cherney et al. 1993), policy prohibiting the early cutting of hayfields would have significant negative economic impacts on dairy farmers who cannot afford to implement such management options. Beef cows, heifer stock, and horses may have less stringent nutritional requirements, creating more flexibility in cutting schedules for their forage. In cases where later cuts are appropriate, a one-week cutting delay in late June or early July may cause only slight reductions in hay nutritional quality (Nocera et al. 2005), suggesting that hay from a delayed cut would be adequate for beef cows. However, since delaying hay harvests is not a viable management strategy in dairy-dominated agricultural landscapes, other alternatives must be considered.

One alternative management strategy that could allow for successful nesting opportunities and early cutting of hay involves leaving uncut patches surrounding nests within cut hayfields. For example, in France, densities of *Crex crex* Linnaeus (Corn Crake) and *Coturnix coturnix* Linnaeus (Common Quail) increased 4.7–7.4 and 1.3–2.6 times, respectively, in 10-m-wide strips of uncut vegetation surrounding cut fields (Broyer 2003). In addition, Warner and Joselyn (1986) found that *Phasianus colchicus* Linnaeus (Ring-necked Pheasant) nesting was more successful in sections of uncut roadside vegetation compared to other cover types. While a complete hay harvest would not be possible under this management strategy, the relative cost to farmers would be small and grassland songbirds might benefit from this compromise. To allow successful nesting, uncut patches would have to provide suitable refugia from predators for nests, adults, and young.

To assess the potential benefits of this management strategy, we quantified predation rates on artificial nests placed in small patches that remained uncut following an early haying event. Despite some criticism, artificial nests can be used to illustrate basic ecological processes such as relative differences in nest success (Belthoff 2005, Moore and Robinson 2004). In addition, this technique has the benefit of greater experimental control. However, artificial nests lack visual stimuli that may be used by predators such as parental activity, defense, and distraction displays. The lack of published data regarding an uncut patch strategy in the northeastern United States indicates a need to test the efficacy of this management strategy to increase the reproductive success of grassland songbirds in intensively managed hayfields.

Methods

Study area

Our study occurred in the Champlain Valley, which includes 59,000 ha of managed grassland (US Department of Agriculture 2007), with the majority of this area dedicated to dairy farming. We conducted research at Shelburne Farms, Shelburne, VT during the summer of 2006 in habitat typical of agricultural regions in the Northeast, with relatively small (5–15 ha) patches of grass- or legume-dominated fields interspersed with similar-sized forest patches. The study fields were grass-dominated, but all contained a mix of grasses and forbs. Research took place on four early-hayed fields, cut 28–30 May.

Field methods

Two days after hay harvest on four early-hayed fields (distributed throughout a 560-ha farm), we placed artificial nests in uncut patches that were either missed by the harvest machinery inadvertently or avoided purposefully because of saturated soils or debris. Artificial nests, composed of grasses from the study site and *Colinus virginianus* Linnaeus (Northern Bobwhite) eggs, were designed to mimic the nests of grassland songbirds. Artificial nests contained either three or four eggs. We monitored nests for approximately 12 days, the typical incubation period for Bobolinks (Martin and Gavin 1995) and Savannah Sparrows (Wheelwright and Rising 1993), both of which are common grassland songbirds in the Northeast. We checked nests every 1–2 days for evidence of predation. Latex gloves were used when constructing nests, distributing eggs, and checking nests to reduce the transfer of human scent to the vicinity of the artificial nests.

Potential predators of grassland songbird nests in a post-cutting environment include *Procyon lotor* Linnaeus (Eastern Raccoon), *Mephitis mephitis* Schreber (Striped Skunk), *Corvus brachyrhynchos* Brehm (American Crow), *Corvus corax* Linnaeus (Common Raven), *Larus delawarensis* Ord (Ring-billed Gull), *Canis latrans* Say (Coyote), *Vulpes vulpes* Linnaeus (Red Fox), and *Microtus pennsylvanicus* Ord (Meadow Vole). Since most of these predators tend to depredate entire nests, predation was quantified on a per nest rather than a per egg basis.

After the experiment concluded, we made a variety of measurements at artificial nest sites including: plant species composition surrounding nests, vegetation height, distance to nearest uncut patch edge, distance to nearest wooded edge, distance to nearest road, uncut patch size, and uncut patch shape. Vegetation height and short-distance measurements (i.e., <30 m) were made with a 100-m tape, while long-distance measurements were made with a laser rangefinder. We estimated metrics of area and shape by walking the perimeter of each patch using the track function of a Garmin eTrex GPS unit and uploading the tracks into ARC-MAP 9.2.

Results

Uncut patches

Thirty artificial nests were placed in 18 uncut patches among the four early-hayed fields. Typically, uncut patches contained two or three artificial nests, separated by ≥10 m. However, six uncut patches contained a single artificial nest and one uncut patch contained four artificial nests. One artificial nest and its associated patch were destroyed by farming machinery during manure spreading within 24-hours of nest placement. Consequently, this nest, and its associated patch, was omitted from analysis.

Mean uncut patch size for artificial nests was 0.337 ha (n = 17, range = 0.002–2.541 ha, SD = 0.637 ha). The median uncut patch size for artificial nests was 0.103 ha, indicating a higher proportion of smaller patches. Uncut patches showed great variability in size and shape, as they tended to be the result of unfavorable cutting conditions (i.e., moist depressions or areas with debris).

Mean vegetation height surrounding artificial nests was 107.2 cm (range = 70.0–160.0 cm, SD = 22.3 cm). Post-harvest vegetation height in newly cut fields, based on visual observation, was typically <10 cm. Grasses were the most common vegetation type in which artificial nests were placed, but other substrates included *Medicago sativa* Linnaeus (Alfalfa), *Trifolium pratense* Linnaeus (Red Clover), and grass/alfalfa or grass/clover mixes.

Artificial nests

Of the 29 artificial nests, only one was depredated during the 12-day monitoring period. Depredation occurred approximately 10 days after placement. Despite a tremendous influx of Ring-billed Gulls and American Crows into the study fields following hay harvest, all the eggs in the remaining 28 artificial nests were intact and undisturbed for the duration of the monitoring period.

Mean distance of artificial nests to the nearest uncut patch edge, wooded edge, and road was 5.8 m (range = 0.5–22.0 m, SD = 5.1 m), 59 m (range = 10.0–138 m, SD = 38.0 m), and 100 m (range = 14.0–230 m, SD = 62 m), respectively. The success or failure of artificial nests as a function of predation may be dependent upon these factors, but as only one nest was depredated, this hypothesis cannot be tested.

Discussion

Our results suggest that uncut patches have the potential to reduce nest predation in fields cut during the breeding season. Of the 29 artificial nests, only one was depredated, occurring 10 days after placement. During four previous breeding seasons, 129 of 130 Bobolink and Savannah Sparrow nests on early hayed fields failed within 48 hours after cutting (Perlut et al. 2006). Thus, our results provide basic support for the likely benefits of uncut patches for grassland songbirds.

Artificial nests are commonly used to illustrate basic ecological principles (Belthoff 2005, Moore and Robinson 2004). However, their use has been criticized by some authors (Davison and Bollinger 2000, Moore and Robinson 2004) as results from artificial-nest experiments often display poor external validity such that predation on artificial nests differs in unpredictable ways from predation on natural nests. However, Davison and Bollinger (2000) were able to show that patterns of predation on contents of artificial nests composed of grasses were similar to those of natural nests in agricultural habitats. Because the artificial nests in our study were composed of grasses from the study fields, observations from the artificial nest experiment provide one line of evidence supporting the potential effectiveness of uncut patches as refugia for natural nests.

While our observations of artificial-nest success within uncut patches are encouraging, the timing of nest placement warrants a cautious interpretation of our results. Since manure is usually spread soon after haying at our study sites, we placed nests two days after cutting in an effort to avoid nest destruction by farming machinery during manure spreading. Consequently, artificial nests were not subjected to predation during the first 48 hours post-cutting, the period during which all predation has been documented on natural nests in our study sites (Perlut et al. 2006). However, after artificial nest placement, several hundred Ring-billed Gulls and >10 American Crows were observed on the study fields each morning for up to two weeks post-cutting. Our results suggest that avian nest predators are not apt to spend time searching uncut patches for prey when prey can be easily and perhaps more efficiently found in mowed sections of hayfields.

We did not place nests in areas that were harvested, so artificial nest success in uncut patches cannot be directly compared to nest success on cut fields. However, the results of such a comparison would be easy to predict, which we can illustrate by examining two ancillary datasets. First, of 24 Bobolink and Savannah Sparrow nests on one of the four early-hayed fields we studied during the 2006 breeding season, 15 nests were destroyed by haying machinery and nine survived intact. Of the nine intact nests, five were depredated and four were abandoned (N.G. Perlut, unpubl. data). Thus, no natural nests that were active just prior to initiation of the artificial nest experiment survived the cutting event. Second, with regard to the stress and disturbance of the cutting event and subsequent "fragmentation" of their habitat, the results of an additional experiment conducted simultaneously using natural nests suggests that Bobolinks, and perhaps other grassland songbirds, are resilient to such disturbances provided some cover is left standing. Bobolink nests on a field cut in late June were found, marked, and mowed around. Of the three nests that did not fledge young prior to mowing, two remained active for ≥5 days post-cutting and one successfully fledged four young. By contrast, Perlut et al. (2006) found that Bobolinks quickly abandoned fields that were completely cut, and did not return for ≥2 weeks. Thus, despite the lack of controls, there is circumstantial evidence that, at least in this landscape, active nests in cut fields do not survive and nests in uncut patches have the potential to successfully fledge young.

Perlut et al. (2006) observed extremely high levels of nest failure immediately post-cutting, primarily due to significant increases in predation, nest abandonment, and nest destruction by haying machinery. In contrast, McMaster et al. (2005) reported moderate levels of nesting success for waterfowl (13–20%) and *Pooecetes gramineus* Gmelin (Vesper Sparrow) (33–39%) in mowed haylands of southern Saskatchewan. However, these authors acknowledged that delayed harvest due to inclement weather likely limited the negative impacts of harvest operations on nesting success. In west-central New York, Bollinger et al. (1990) documented 94% nest mortality for Bobolinks in hayed fields compared to 100% nest mortality reported by Perlut et al. (2006) in the Champlain Valley of Vermont. The extremely high levels of nest failure immediately post-cutting documented by Bollinger et al. (1990) and Perlut et al. (2006) may be unique to the Northeast. For example, the proximity of study sites to Lake Champlain may lead to greater Ring-billed Gull activity immediately post-cutting compared to more inland sites. Consequently, predation by Ring-billed Gulls could be greater on these study fields compared to areas away from waters with breeding gull populations. Furthermore, differences in harvest intensity could potentially account for the extreme levels of nest mortality observed by Perlut et al. (2006).

Since nesting success on early-hayed fields in this region is near zero for Bobolinks and low for Savannah Sparrows (Perlut et al. 2006), the results of the artificial-nest experiment, supplemented by the survival and successful fledging of Bobolinks in small, uncut patches could have important management significance. However, greater sample size and replication is needed before we can unequivocally advocate widespread implementation of uncut-patch management for grassland songbirds. Rather, the encouraging nature of our observations calls for further study of uncut-patch management techniques, which would also benefit from assessing additional species.

Investigating the effect of different-sized uncut patches, uncut patch placement, and vegetation structure within uncut patches would prove useful for potential management strategies. For example, Herkert (1994) found that area and vegetation structure significantly influence midwestern grassland bird populations. Microhabitat variables, such as percent bare ground, litter depth, and vegetation density, which correlate with increased nesting success (Warren and Anderson 2005) should also be considered in an effort to ensure that structurally suitable habitat is encompassed by uncut patches.

We feel there is potential for the adoption of this management strategy in the Champlain Valley. For example, Troy et al. (2005) found that Vermont farmers had little flexibility in their cutting schedule, but 49% of farmers surveyed expressed a willingness to adopt alternative management practices on some portions of their land. To facilitate adoption, we suggest that rather than locating active nests, the activity of conspicuous species like Bobolinks could be used as a surrogate. Selecting larger (≥1 ha) patches in marginally productive agricultural sites away from edges to maximize nest densities (i.e., Bollinger and Gavin 2004, Renfrew et al. 2005) would also simplify site selection and minimize forage loss. While nesting success of grassland songbirds was not different in areas cut after the breeding season compared to areas that were left uncut (Warren and Anderson 2005), it would be beneficial to harvest uncut patches at the conclusion of the breeding season in an effort to maintain habitat integrity by prohibiting natural succession. Since responses of grassland songbirds to agricultural practices vary geographically, a holistic approach including multiple management strategies that address the unique issues facing populations in given regions is likely needed for adequate management. The observations we present in this study illustrate the need for more research into the potential use of uncut patches for grassland songbird management.

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