Nesting Success of Grassland and Shrub-Nesting Birds on The Wilds, an Ohio Reclaimed Surface Mine

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Abstract. Recent studies on reclaimed surface mines show that the encroachment of woody vegetation may have an adverse effect on breeding grassland birds. During the 2008-2011 breeding seasons, nests of ground- and shrub-nesting birds were monitored on The Wilds, a reclaimed surface mine in east-central Ohio. The study's objectives were to compare findings with those from a similar study on this site a decade earlier and to compare the nesting success of ground- versus above-ground and shrub-nesting species. The study found 291 nests from 18 bird species. Ground-nesting species had notably higher overall annual as well as Mayfield nest success rates (60% and 55% respectively) compared to the above-ground and shrub-nesting species (42% and 32% respectively). Grasshopper sparrows *(Ammodramus savannarum)*, eastern meadowlarks *(Sturnella magna)* and bobolinks *(Dolichonyx oryzivorus)* had the greatest reproductive success rates (both annual and Mayfield), which were comparable to those reported by Ingold in 2002 for these species. Predation rates were higher in the above-ground and shrub-nesting (44%) versus the ground and near-ground nesting species (27%). Six shrub-nesting species were not found on this site a decade ago. Although these results suggest that this site continues to provide suitable nesting habitat for obligate grassland species, the increasing encroachment of autumn olive *(Elaeagnus umbellate)* may be attracting more shrub-nesting bird species as well as mammalian predators which should be a focus in future research.

Date of publication: January 2013 **OHIO J SCI 111 (2-5): 37-41**

INTRODUCTION

Although populations of grassland birds in the eastern United States have been declining (Sauer and others 2005), reclaimed surface mines have been shown to provide suitable nesting habitat for several obligate grassland species (Bajema and others 2001, Monroe and Ritchison 2005, Galligan and others 2006, Ingold and others 2010, Stauffer and others 2011). However, a growing concern regarding the management of grassland birds on reclaimed mines is the encroachment of autumn olive *(Elaeagnus umbellate)* and other woody vegetation. Several studies have demonstrated that woody encroachment may adversely affect some open grassland species (Ribic and Sample 2001, Grant and others 2004, Graves and others 2010), while providing nesting habitat for a variety of shrub-nesting species (DeVault and others 2002, Galligan and others 2006). Graves and others (2010) reported a negative association between woody vegetation and daily nest survival in grasshopper *(Ammodramus savannarum)* and Henslow's *(A. henslowii)* sparrows on reclaimed mine sites in Ohio. Galligan and others (2006) reported high daily nest survival rates not only in grasshopper and Henslow's sparrows on reclaimed sites in Indiana, but also in such shrub-nesting species as mourning doves *(Zenaida macroura)*, willow flycatchers *(Empidonax traillii)* and yellow warblers *(Setophaga petechia)*.

Although the encroachment of woody vegetation on reclaimed mines provides nesting habitat for shrub-nesting species, it may also attract mammalian nest predators such as raccoons *(Procyon lotor)* and Virginia opossums *(Didelphis virginiana)* (Winter and others 2000). Renfrew and others (2005) reported that raccoons and opossums, known grassland passerine predators, were most active along wooded edges of pastures in Wisconsin. Renfrew and Ribic (2003) found that one third of all grassland passerine nest predation events were the result of raccoons, and often occurred nearer to wooded edges.

Ingold (2002) documented the presence of 10 grassland and shrub-nesting passerine species on a reclaimed surface mine (the Wilds) in southeastern Ohio in 1997-1998. The most abundant species were grasshopper and Henslow's sparrows as well as eastern meadowlarks *(Sturnella magna)* and red-winged blackbirds *(Agelaius phoeniceus)*. Grasshopper, Henslow's and savannah *(Passerculus sandwichensis)* sparrows had the greatest reproductive success and the average nest predation rate for all species combined was 39% (Ingold 2002). Our objectives in this study were to: (1) examine the nesting success of grassland and shrub-nesting birds on this same study site 10 years later, (2) compare descriptively the reproductive success of ground-nesting vs. above-ground nesting passerine species, and (3) determine the nest predation rates of each species and whether there were differences in the overall predation rates between ground- and shrub-nesting species. We speculate that with the increasing encroachment of autumn olive during the past decade, we may see a greater diversity of shrub-nesting species and a higher predation rate on the nests of those species nesting above ground and around woody vegetation.

STUDY AREA AND METHODS

Study Site

The Wilds (International Center for the Preservation of Wild Animals) is a 3,700 hectare center for conservation research and education located on reclaimed mined land overlapping portions of Muskingum, Guernsey and Noble counties in southeastern Ohio. The landscape was initially mined for coal by the Ohio Power Coal Company in the 1940s and 1950s. After a 10-15 year hiatus portions of the land were again mined from 1969-1984 and subsequently reclaimed. Today, the landscape is comprised of hilly non-native grasslands with scattered unmined forest fragments, spoils forest (forest that has grown back since reclamation), moderate to heavy autumn olive, patches of sericea lespedeza *(Lespedeza cuneta)* and drainage lakes. See Ingold (2002, 2010) for a more thorough description of the study site.

Field Methods

Nests were located from early May through mid-July 2008-2011, mostly along the western boundary of the Wilds (~ 6 km) usually within 300 m of either side of a road (see Ingold 2010, map). We

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searched for active bird nests between 0800-1200 hours using a number of approaches including dragging a 15-meter (4-cm diameter) rope in the open grassland areas in an effort to flush incubating/brooding adult birds from their ground or near-ground nests. In addition we searched brushy and shrubby vegetation for above-ground nests. In many instances nests were located by observing adult behavioral cues such as birds flushing near a walking observer, feeding young, removing fecal sacs and chipping near the nest. For each nest we recorded the species, GPS coordinates, number of eggs and/or nestlings, and the approximate age of the nestlings. If the eggs or nestlings could not be positively identified at the time of initial discovery, we subsequently observed adults at or near the nest to insure correct identification. Each nest was marked with two flags, one on each side approximately 3 m from the nest. All active nests were revisited on a 2-4 day rotation in order to reduce disturbance. During subsequent nest visits we attempted to determine the outcome of the nesting effort in terms of total clutch size, the number of eggs that hatched, the number of nestlings that fledged, and/or whether the nest was abandoned or predated. A nest was considered successful if at least one nestling fledged.

Sample sizes for a particular species during a given year were generally inadequate for the development of daily nest survival models such as those employed by Graves and others (2010). As a result we determined the apparent overall nest success for each

Table 1

Annual nest success (successful nests/all nests) of 18 grassland and shrub-nesting species on a reclaimed surface mine from 2008-2011.

Species	Nest Success (%) 2008	2009	2010	2011	Average
Ground or Near Ground Nester					
Grasshopper Sp.	64 (n=11)	58 (n=12)	57 (n=14)	75 (n=16)	64%
E. Meadowlark	46 (n=13)	64 (n=11)	78 (n=18)	65 (n=17)	64%
Bobolink	25 (n=4)	75 (n=4)	80 (n=5)	60 (n=5)	61%
Song Sparrow	50 (n=2)	63 (n=8)	67 (n=3)	40 (n=5)	56%
Mallard	—	—	0 (n=3)	100 (n=3)	50%
Field Sparrow	33 (n=3)	60 (n=5)	100 (n=1)	33 (n=3)	50%
Common Yellowthroat	—	—	100 (n=1)	100 (n=2)	100%
American Woodcock	100 (n=2)	—	—	100 (n=1)	100%
Wild Turkey	—	0 (n=1)	—	0 (n=2)	0%
Henslow's Sparrow	100 (n=1)	—	—	—	100%
Shrub or Above Ground Nester					
Robin	67 (n=3)	67 (n=3)	100 (n=1)	33 (n=9)	50%
Red-wing BB	38 (n=16)	27 (n=22)	70 (n=23)	50 (n=16)	47%
Brown Thrasher	0 (n=1)	100 (n=1)	—	33 (n=6)	38%
Willow Flycatcher	—	0 (n=2)	—	50 (n=4)	33%
Yellow Warbler	—	0 (n=2)	—	100 (n=1)	33%
American Goldfinch	100 (n=1	—	100 (n=1)	—	100%
Northern Mockingbird	100 (n=2)	—	—	—	100%
Mourning Dove	—	0 (n=1)	—	—	0%

TABLE 2
Results of Mayfield analyses of reproductive success of grassland and shrub-nesting birds with five or more nests during a given year on a reclaimed surface mine across four years.

Species	Nest Success (%) 2008	2009	2010	2011	Average	Ingold 2002 Average
Ground or Near Ground Nester						
Grasshopper Sp.	52 (n=11)	41 (n=12)	61 (n=14)	58 (n=16)	53%	46%
E. Meadowlark	38 (n=13)	51 (n=11)	67 (n=18)	52 (n=17)	52%	30%
Bobolink	—	—	71 (n=5)	50 (n=5)	60%	93%
Song Sparrow	—	69 (n=8)	—	44 (n=5)	57%	—
Shrub or Above Ground Nester						
Robin	—	—	—	33 (n=9)	33%	—
Red-wing BB	35 (n=16)	26 (n=22)	52 (n=23)	40 (n=16)	38%	30%
Brown Thrasher				26 (n=6)	26%	—
Willow Flycatcher				31 (n=4)	31%	—

species (successful nests/total nests for all years combined) as well as the Mayfield (1961, 1975) nest success during each year for each species with at least five nests during a given year (one exception was willow flycatcher with four nests in one year). Specifically Mayfield (1961) success was determined by multiplying the probability of egg survival during the incubation period by the probability of nestling survival to fledging, and the probability of nestling survival during the hatching period. The Mayfield approach has recently been shown to provide estimates of nest survival comparable to those produced by more analytic intensive approaches such as logistic-exposure (Lloyd and Tewksbury 2007). In addition this approach has the advantage of accommodating smaller data sets with the tradeoff of not yielding detection probabilities.

For comparative purposes we classified each species as either a ground or near-ground nester versus a shrub or above-ground nester (Table 1). This distinction is somewhat arbitrary since song sparrows *(Melospiza melodia)* occasionally nest in shrubs well above ground level (Arcese and others 2002) while red-winged blackbirds occasionally place their nest close to ground level (Yasukawa and Searcy 1995). In this study however, all the song sparrow nests we located were on or near the ground and the majority of red-winged blackbird nests were 0.5 m or higher above ground level.

RESULTS

We located a total of 291 nests from 18 bird species. For those species with more than five nests, grasshopper sparrows, eastern meadowlarks, bobolinks *(Dolichonyx oryzivorus)* and song sparrows had the greatest overall nest success, while red-winged blackbirds, brown thrashers *(Toxostoma rufum)*, and willow flycatchers had the least (Table 1). Mayfield analyses revealed notably higher nest success in the ground-nesting versus the above-ground and shrub nesting species (Table 2). For those species with at least five nests during each of the four years, grasshopper sparrows and eastern meadowlarks had the highest Mayfield values (53% and 52% respectively) while red-winged blackbirds had the lowest (38%). Excluding mallards *(Anas platyrhynchos)*, overall mean clutch size was highest in bobolinks ($\bar{x}$ = 4.6, n = 18) and eastern meadowlarks ($\bar{x}$ = 4.2, n = 16) and lowest in brown thrashers ($\bar{x}$ = 3.0, n = 8),

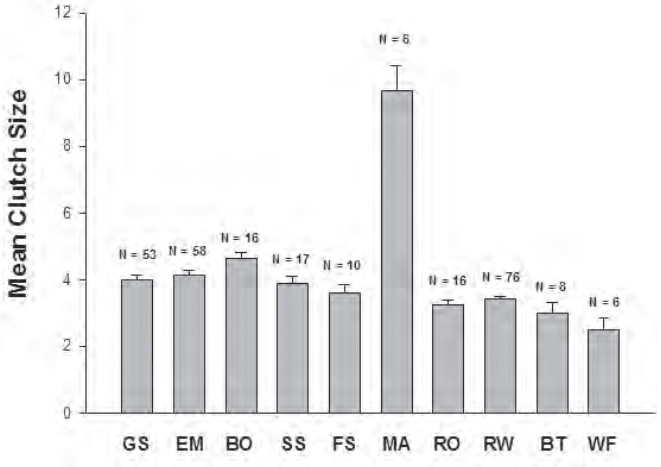

FIGURE 1. Mean clutch size across years (2008-2011) for all species found on an Ohio reclaimed surface mine. GS = grasshopper sparrow, EM = eastern meadowlark, BO = bobolink, SS = song sparrow, FS = field sparrow, MA = mallard, RO = American robin, RW = red-winged blackbird, BT = brown thrasher and WF = willow flycatcher (bars = SE).

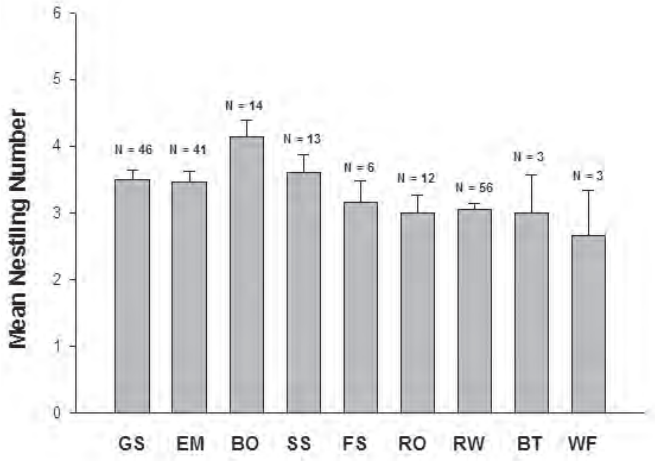

FIGURE 2. Mean nestling number (1-3 days post hatch) across years (2008-2011) for all species on a reclaimed surface mine. GS = grasshopper sparrow, EM = eastern meadowlark, BO = bobolink, SS = song sparrow, FS = field sparrow, MA = mallard, RO = American robin, RW = red-winged blackbird, BT = brown thrasher and WF = willow flycatcher (bars = SE).

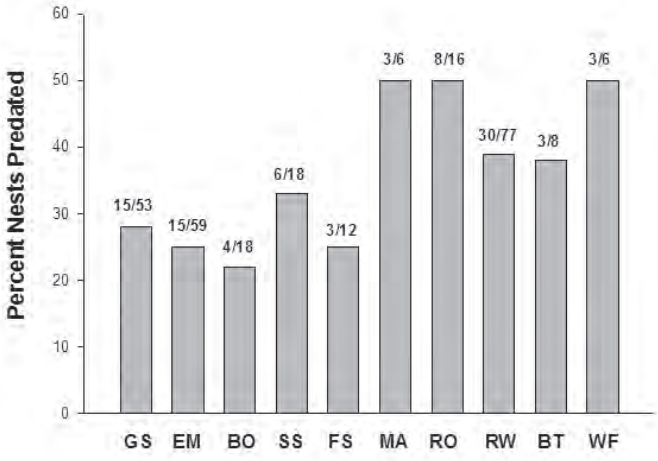

FIGURE 3. Percent of nests predated for each species for all years combined (2008-2011) on a reclaimed surface mine. GS = grasshopper sparrow, EM = eastern meadowlark, BO = bobolink, SS = song sparrow, FS = field sparrow, MA = mallard, RO = American robin, RW = red-winged blackbird, BT = brown thrasher and WF = willow flycatcher.

American robins *(Turdus migratorius)* ($\bar{x}$ = 3.3, n = 16), and willow flycatchers ($\bar{x}$ = 2.5, n = 6) (Fig. 1). Overall mean nestling number was highest in bobolinks ($\bar{x}$ = 4.1, n = 14) and song sparrows ($\bar{x}$ = 3.6, n = 13), and lower in the above-ground and shrub-nesting species (Fig. 2).

Overall nest failure across all species was 45%. Approximately 9% of this loss was the result of factors other than predation (e.g. abandonment and adverse weather) and 4% of this loss occurred in red-winged blackbirds alone. The overall nest predation rate across all species was 36% and was lowest in the five most common ground-nesting passerines (27% across species) and highest in mallards (50%) and the four most common above-ground and shrub-nesting species (44% across species) (Fig. 3). Bobolinks had the lowest overall predation rate (22%) and among the passerines, American robins had the highest (50%). A 2 x 2 contingency table chi-square revealed a significantly higher predation rate in the four shrub-nesting species combined across years (Fig. 3) vs. the five ground nesting species (mallards were excluded) ($\chi 2 = 7.09$, df = 1, $P < 0.01$).

DISCUSSION

Our nesting success rate for grasshopper sparrows is similar to those reported by Ingold (2002) on the same site over a decade ago, and for grasshopper sparrows on other reclaimed mines (Wray and others 1982, Galligan and others 2006, Stauffer and others 2011). Our Mayfield nest success rate for bobolinks was high but lower than that reported by Ingold (2002), which is likely the reflection of a small sample size (n = 3) in 2002. The Mayfield nest success of eastern meadowlarks in this study was notably higher than that reported by Ingold (2002) and Giocomo and others (2008), but similar to that reported by Galligan and others (2006). Unlike Ingold (2002), we found no savannah sparrow, Henslow's sparrow or short-eared owl *(Asio flammeus)* nests although we detected singing male Henslow's sparrows on our study site and singing male savannah sparrows in lightly grazed cattle pastures adjacent to our study site. These findings suggest that this site continues to provide adequate nesting habitat for most of the obligate grassland species reported by Ingold (2002). However, generally small sample sizes in both studies limit the scope of our comparisons.

Our overall estimates of apparent as well as Mayfield nest success were consistently higher in ground or near-ground nesting species versus above ground and shrub-nesting species. These findings contrast with those of Galligan and others (2006) who reported generally higher daily nest survival rates in shrub-nesting versus grassland species on reclaimed mines in Indiana. One potential explanation for this is that Galligan and others (2006) included red-winged blackbirds as a grassland (ground or near-ground) species while we placed it in the above-ground nesting category. However we found, as did Galligan and others (2006), that red-winged blackbirds were notably less reproductively successful than the grassland sparrows and bobolinks.

Our nest predation rate for all species (36%) was similar to that reported by Ingold (39%; 2002) on this site a decade ago although here we include nesting data from six additional shrub-nesting species not previously reported on. Nest predation rates for shrub-nesting species in this study were consistently higher than those of ground-or near ground nesting species although our sample sizes are fairly small. Our findings are similar to those reported by Galligan and others (2006) in which open-cup, above-ground nesting species suffered higher predation rates. Like Galligan and others (2006) we found a particularly high predation rate in robins and brown thrashers which have larger more conspicuous nests often placed in the interior portions of larger shrubs and trees.

It is possible that the abundance and species diversity of shrub-nesting passerines have increased on this study site during the past decade concomitant with the gradual but steady encroachment of autumn olive shrubs. Such woody encroachment is potentially detrimental to obligate grassland birds in part because it may lead to an increase in the number of mammalian predators (Grant and others 2004, Renfrew and others 2005, Graves and others 2010). During this study, we found numerous raccoons, usually under or in autumn olive shrubs. It is possible that raccoons contributed to the high predation rate of shrub-nesting birds in this study, although it does not appear that raccoons or other predators had an adverse effect on ground-nesting species at a rate greater than they did a decade ago. Nonetheless, numbers of grassland passerines including bobolinks as well as grasshopper, savannah and Henslow's sparrows have been shown to be negatively associated with percent cover of woody vegetation (Grant and others 2004, Graves and others 2010). Thus, if a management goal on reclaimed mines is

to maintain healthy populations of obligate grassland passerines, then the encroachment of woody growth, particularly autumn olive, should be carefully evaluated and the focus of future studies. A question tangential to this objective might be to address the effects of raccoon and other mammalian predation on grassland birds in open versus autumn olive encroached upon areas.

Acknowledgments. We are indebted to a number of student field assistants and volunteers including Emily Aesandrini, Alissa Anderson, Kyle Axe, Jimmy Siford, Greg Chumney, Jarrod Girod, Keith Bergreen, John Bourne, Rachel Hentz, Doug McClain, Tommy Malott, Jeff Storz, Jeremy Whitson, Paige Williams, Julie Long, Alex Roth, Matt Moberly, and Donny Ingold without whom this research would not have been possible. We thank Nathan Stricker and two anonymous reviewers for making helpful suggestions that improved this manuscript. We also thank Shana Byrd and Nicole Cavender for their outstanding conservation efforts at the Wilds and for encouraging this research. Funding was provided through the Homer A. Anderson Distinguished Professor of Natural Sciences Endowment and the Muskingum University Summer Muskie Student Fellowship Program.

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