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Bobolink reproductive response to three hayfield management regimens in southern Ontario

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ABSTRACT

Incidental mortality of bobolinks (*Dolichonyx oryzivorus*) breeding in agricultural grasslands has long been known to contribute to population declines, though generalized recommendations for conservation that balance bird reproduction and farmer production needs have remained elusive. We evaluated three hayfield management strategies in southern Ontario by tracking hay quality, bobolink breeding success and phenology, and post-breeding dispersal from uncut fields, using sites that were (A) cut along a typical schedule at the manager's discretion, (B) harvested late, on or after July 15, and (C) harvested early, before June 1, and again after 65 days. First harvests on discretionally managed fields generally occurred during the nestling stage or while fledglings were mostly flightless (mean = June 23 ± 2.45 SE), likely resulting in very low bobolink reproduction. On late harvested fields, most bobolinks dispersed from breeding sites before 15 July and had high reproductive success; however forage quality declines make this regimen generally infeasible for farmers, as hay protein content generally dropped below 10% in late June. No bobolinks (re)nested on early cut fields in the 65 days interim between harvests, in contrast to success with this strategy in Vermont. In southern Ontario, a modest delay in first harvest may be the most appropriate strategy to balance needs of breeding bobolinks and farmers, translating to small declines in hay quality and substantial increases in reproductive success. Our work highlights the need for geographically refined agro-ecosystem management approaches for supporting grassland birds due to regional differences in hay maturation timing, breeding bird phenology, and habitat availability.

1. Introduction

Grassland is among the most threatened habitat worldwide due to anthropogenic activity (White, Murray, & Rohweder, 2000). Populations of grassland birds in North America have declined precipitously in the past half-century, especially in recent decades (Sauer et al., 2014). Historical population declines were a result of replacing native grasslands with non-native grasses for livestock forage and other crops; as native grasslands were destroyed, many grassland bird species adopted non-native hayfields and pastures as surrogate habitats (Bent 1958; Martin & Gavin 1995; Askins 1999). Recent declines in grassland bird populations have been attributed to hazards they experience when they are treated as pests on agricultural fields during migration and over-wintering (Bent 1958; Martin & Gavin 1995; Renfrew & Saavedra 2007), use of pesticides across their range (Renfrew & Saavedra 2007; Mineau & Whiteside 2013), a net loss of habitat (Bollinger, Bollinger, & Gavin, 1990; Askins 1993; Herkert 1997; Di Giacomo, Di Giacomo, & Contreras, 2005), and the intensification of management on the agro-ecosystems where they breed (Bollinger et al., 1990; Martin & Gavin 1995).

Most conservation and management efforts for grassland birds in North America focus on agricultural land-use on the breeding grounds. Shifts in the agriculture industry, such as shifts in beef demand (Nocera & Koslowsky 2011), increased mechanization and productivity for growing forage crops, and greater economic benefits of growing row crops (Sargeant, Leslie, Shoukri, Martin, & Lissemore, 1998; Agriculture and Agri-Food Canada, 2005; Eilers et al., 2010), have decreased the area of land used for hayfields and pastures in favor of monoculture crops and other human development, and an increasing amount of land has been left fallow (Askins 1993; Herkert 1997). In the last half-century, hay harvests have become more frequent and happen earlier, commonly overlapping with the nesting period of many grassland birds and inducing complete nest failure (Bollinger et al., 1990; Perlut, Strong, Donovan,

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& Buckley, 2006). Over this period, first dates for hay have become 14–21 days earlier due to earlier maturing grass varieties, increased mechanization, and more frequent mowing (at intervals of 30–45 days on average). This prevents birds from completing full nesting cycles (Bollinger et al., 1990; Martin & Gavin 1995; Herkert 1997; Giuliano & Daves 2002; Troy et al., 2005).

Management options that benefit grassland bird reproduction and still meet farmer production needs have remained elusive. Delaying hay harvest until birds have finished breeding clearly benefits grassland bird reproduction (Bollinger et al., 1990; Herkert 1997), but losses in hay nutritional quality for maintaining livestock are a concern for farmers (Vickery et al., 2001; Nocera, Parsons, Milton, & Fredeen, 2005; Troy et al., 2005). Livestock needs vary, as dairy-cattle require greater hay protein content than beef-cattle and certain breeds have higher energy requirements (NRC 1996). Further, rates of grass maturation and the timing of peak fledging periods for nesting birds may vary regionally, making it difficult to provide broad-scale conservation and management recommendations.

A recent model by Perlut, Strong and Alexander (2011) illustrated that, in Vermont, USA (44°28′N 73°12′W), an early first hay harvest before most grassland birds began breeding was a viable solution that mitigated the risk of incidental mortality of grassland birds and improved reproductive success. The rationale for this harvest regimen is that first harvests occurring by the beginning of June would be expected to interrupt birds at a time when they have yet to invest much in reproduction, allowing them time to renest elsewhere. After the early first hay harvest, the second harvest is delayed for 65 days to allow bobolinks (*Dolichonyx oryzivorus*) to complete a full nesting cycle. This delay allows 15 days for substantial hay regrowth, 9 days for bobolinks to (re) colonize, pair, and begin nest building, 29 days for nesting and brooding, and 12 days for a fledgling care period (Perlut et al., 2011). This regimen should be more suitable for farmers than a strategy where the first harvest is delayed. Compared to a typical harvest regimen that is not focused on bird conservation, the early harvest strategy generates a smaller than average but higher quality first hay harvest, and a second harvest of slightly lower quality but larger yield.

Because grass maturation and breeding bird phenology varies regionally, our objective was to evaluate the generality of the early harvest strategy developed in Vermont by testing it in southern Ontario. We also sought to compare the early harvest strategy to delayed and typical harvest strategies by examining the response of bobolinks and their habitat. Southern Ontario is an appropriate region to test these strategies as bobolinks have experienced steep population declines and are now listed as threatened at the provincial level in Ontario (COSSARO, 2010) and federally in Canada (COSEWIC, 2010), with southern Ontario supporting ~13% of the global population (Ontario Partners in Flight 2008). We studied bobolinks on hayfield plots that (a) implemented an early first harvest followed by a 65 day waiting period, (b) acted as control plots under normal (non-conservation) management regimens, or (c) delayed first harvest until 15 July (after peak breeding season). Among these three management regimens, we monitored forage quality of the hayfield crops and evaluated bobolink breeding phenology, relative breeding success, and timing of post-breeding dispersal, to examine the feasibility of these strategies for both farmers and grassland breeding birds in the region.

2. Material and methods

2.1. Study sites

We conducted our study on privately owned hayfields on farms in Peterborough, Kawartha Lakes, and Hastings Counties of southern Ontario (centered around 44°18′N 78°19′W) from May through July in 2011 and 2012. This region hosts one of the highest density bobolink populations in Ontario, as it corresponds with a high density of cattle and a large proportion of hayfields and pastures (Cadman, Sutherland, Beck, Lepage, & Couturier, 2007).

Hayfields varied in size (2.0–13.5 ha), surrounding edge type, May vegetation height (due to last harvest timing in previous year), and hay composition, and all were seeded from one to over 15 years prior to study. Hay harvested from our study sites was used mainly for feeding beef-cattle (five farms) and sheep (two farms). Bobolinks were present on all study sites. Each farm contained an experimental and control plot, consisting of one large subdivided hayfield or two separate fields in close proximity. On control plots, we requested that participating farmers harvest the hay on a typical schedule at their own discretion. This regimen consisted of a first harvest in early to mid-June, then a second harvest after 35–40 days. Farmers volunteered to harvest experimental plots on one of two alternative management schedules: a late first harvest on or after 15 July, or a first harvest as early as possible and not later than 1 June, followed by 65 days before a second harvest. Across four farms in 2011 and six in 2012, there were four hayfields managed with an early harvest regimen (two different fields in each year; mean = 6.6 ha, range 2.0–13.5 ha), ten with typical management (four sites in 2011 and six in 2012; mean = 7.1 ha, range 4.3–13.5 ha), and six with late harvest management (two sites in 2011 and four in 2012; mean = 7.3 ha, range 3.0–13.5 ha). The same three farms participated in both years though there were changes to the management regimens and hayfields studied, and a total of seven different farms participated across both years.

3. Data collection

3.1. Point counts

Experimental and control plots had one to two point count stations each depending on plot size, at which five-minute, 50 m radius point counts were conducted between 30 min after dawn and 1000 h every 3–6 days from mid-May to 15 July 2012 (no point counts were conducted in 2011), for a total of 12–16 counts per station. We did not conduct counts during periods of precipitation, fog, or winds ≥25 km/h. We limited our point count area to a 50 m radius to ensure adequate detection and to suit field size and topography; low rolling hills on some sites would not allow larger radii due to visual obstruction. Some smaller fields could only support one point count station, as point count centers were spaced at least 150 m apart to avoid potential double counting. We counted all male, female, and fledgling bobolinks, and their observed reproductive activity was recorded (*sensu* Vickery, Hunter, & Wells, 1992; Nocera et al., 2007). Reproductive activity was classified for each point count station over the season by assigning an ordinal index rank, progressing from 0 when no bobolinks were settled on-site, 1 for male presence >3 weeks, 2 for female presence >3 weeks, 3 for evidence of pairing (such as females carrying nest materials), 4 for adults carrying food to presumed nestlings, and 5 for observed fledglings. This method is useful to examine differences in the overall reproductive activity achieved between management regimens, rather than to estimate the timing of phenological events (Betts, Simon, & Nocera, 2005). In 2011, field searches were conducted every 3–5 days on early managed fields after first harvest to detect bobolink (re) colonization and reproductive activity.

3.2. Bobolink banding and resighting

Between late May and early June of 2012 we captured male and female adult bobolinks with mist-nets on or near male territories