ORNIS SVECICA 19: 32–40, 2009 https://doi.org/10.34080/os.v19.22666

Breeding Skylarks *Alauda arvensis* on organic set-asides – effects of time of cutting, vegetation structure and landscape composition

Effekter av putsningstidpunkt, vegetationsstruktur och landskapssammansättning på sånglärkor som häckar på ekologiska trädor

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Abstract

We assessed the quality of organic set-asides as habitat for breeding Skylarks. We evaluated (i) density in relation to vegetation structure and landscape composition, (ii) reproductive success on set-asides cut at normal time (1 June) and with delayed cutting (15 June), and (iii) nest predation and destruction by using artificial nests. Skylark density was negatively associated with vegetation height and cover, and it was three times higher on fields without forest than with more than 50% forest in the surrounding landscape. Of the artificial nests, 56% were destroyed by cutting that also increased predation on surviving nests. Delayed cutting resulted in higher reproductive success; mean number of fledged broods per territory increased from 0.42 to 0.52. The negative effects of early cutting seemed to be largest on fields with sparse vegetation. Based on fledging dates we suggest that 20 June is a reasonable date for first cutting in south-central Sweden. Reproductive success on organic set-asides could probably be further improved if less dense vegetation (or unsown patches or strips) is combined with a delayed cutting.

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Received 28 Febrary 2008, Accepted 20 August 2008, Editor: R. Sandberg

Introduction

Modernisation of farming in Western Europe has dramatically reduced biodiversity in farmland landscapes. Many agricultural bird species have declined severely in numbers (Tucker & Heath 1994, Fuller et al. 1995, Siriwardena et al. 1998), also in Sweden (Robertson & Berg 1992, Wretenberg et al. 2006). During recent decades different measures, such as increased area of set-asides, restoration of semi-natural grasslands, introduction of alternative crops, e.g., short rotation coppices (*Salix*) and organic farming, have decreased the rate of impoverishment of Swedish farmland landscapes (Statistics Sweden 1975–2005). In the European Union the area used for organic farming increased from 0.76 million ha in 1993 to 3.3 million ha in 1997 (European Union 2002). In Sweden 174,000 ha (6.7%) of the farmland area in 2004 was organic (Statistics Sweden 2005). In general, organic farming has been assumed to be positive for biodiversity, although species differ in the extent to which they are affected by organic farming (Bengtsson et al. 2005, Hole et al. 2005). There seem to be large positive effects of organic farming in intensively managed farmland landscapes, while there are no or small effects in mosaic landscapes with many habitats (Weibull et al. 2000, Bengtsson et al. 2005).

One difference between organic farming and conventional farming is the more frequent cultivation, cutting and mechanical weeding in organic farming. Frequency and timing of cutting of for instance organic set-asides (usually stubble undersown with clover *Trifolium* and grasses *Poaceae* used for green manuring) is important for e.g. ground-nesting birds such as Eurasian Skylarks *Alauda arvensis* (Donald 2004). Most organic farmers in south-central Sweden cut their organic set-asides a first time in late May and early June to increase the growth of the sown clover and grass as well as to control weeds such as creeping thistle *Cirsium arvense*. The cut vegetation is left on the field as green manuring. Furthermore, a second cut is made within 3–7 weeks after the first cut depending on conditions. Earlier studies suggest that set-asides are preferred breeding habitats compared with cereal crops (Berg & Pärt 1994, van Buskirk & Willi 2004). In general, rotational set-asides seem to be preferred compared with permanent set-asides, which have taller and denser vegetation (Henderson et al. 2000), but studies of rotational organic set-asides are lacking (Berg & Kvarnbäck 2005).

The aim of the present study was to evaluate the quality of organic set-asides as habitat for the ground-nesting Skylark, a widespread species that could be expected to be affected by management of organic set-asides. Habitat quality was evaluated by (i) analyzing factors (vegetation structure and landscape composition) related to Skylark density, (ii) comparisons of reproductive success (no. of fledged clutches per territory) on set-asides cut at normal time (1 June) and set-asides with cutting delayed two weeks (15 June), and (iii) evaluation of patterns of nest predation and nest destruction at cutting using artificial nests. We hypothesised that densities of skylarks should be high on organic set-aside, but that early cutting should strongly affect nest survival of artificial nests and number of fledged broods.

Methods

Study sites

A total of 31 organic set-aside fields (18 fields in 2004 and 13 new fields in 2005, mean±sd area =10.8±3.9 ha) situated within 50 km of Uppsala (approximate location 59°56'N, 17°38'E) were included in the study. Fields situated in open landscapes were selected since Skylarks avoid areas close to forest edges (Piha et al. 2003, Donald 2004). The set-asides were divided into two groups: 16 fields cut at normal time (30 May – 2 June) and 15 fields with a delayed cutting (14–16 June). Of these fields 30 were located pair-wise in the landscape (9 pairs of fields in 2004 and 6 pairs in 2005), with one field with normal cutting time and one field with delayed cutting time in each pair (situated on the same or neighbouring farms, within 1 km from each other). Data from17 arable fields in a comparative study (Kvarnbäck et al. 2005) are included in some analyses.

Bird censuses and estimates of reproductive success

The selected fields were searched for Skylarks with territory mapping (Bibby et al. 1992). Each field was visited 6–7 times between 25 April and 24 May. Territories were searched for signs of successful reproduction on 6–7 occasions between 25 May and 26 July. Parts of adjacent fields (<50 m) were also included to avoid biases due to movements of broods from bordering fields into the investigated fields. Only territories with a majority of the observations within the field were included in density estimates, which were based on the area of the set-aside field (i.e. adjacent areas were not included). The censuser walked through the fields along transects with 10–15 m intervals and all observed young were recorded on a map during each visit and assigned to the territory within which the observation was done. We consider problems with assigning broods to wrong territories (due to movements of broods) as relatively small due to distances between broods (many pairs failed). These data were combined into an estimate of reproductive success, i.e. the number of fledged broods per territory was averaged at the field level.

Habitat mapping

In addition to time of cutting, estimates of landscape composition and vegetation height and cover were included in the analyses. Landscape composition was estimated by measuring the proportion of forest within 300 m of the field edges on maps (1:20,000), since Skylarks have been shown to avoid forested landscapes and areas close to forest edges (e.g. Fuller et al. 1997, Piha et al. 2003). Similarly, Skylarks avoid tall and dense vegetation, although the preferred vegetation height differs between crops (e.g. Wilson et al. 1997, Chamberlain et al. 1999, Donald et al. 2001). Therefore, vegetation height was estimated (±1 cm) on each field with a folding ruler (ca. 15 May, during nesting, when the vegetation had started to grow) at 5–8 random points, which has been shown to give similar results as other measurement techniques for estimating vegetation height (Nordahl 2001). Vegetation cover (ca. 15 June, at peak of fledging when the vegetation was well-developed) was also estimated (in 10% intervals within 5–8 random 1×1 m plots on each field), since Skylarks might tolerate tall and dense vegetation on fields with patches of short and sparse vegetation (Schon 1999).

Artificial nest experiments

In 2004, artificial nests were used to study effects of cutting and predation on Skylark nests on 19 organic set-asides (including one field not censused for Skylarks). Artificial nests were laid out in three 11-day periods (length of Skylark incubation period, Jenny (1990)) starting between (1) 3–6 May, (2) 20–28 May and (3) 8–10 June. Effects of nest predation were studied in all three periods, while effects of cutting were studied in period 2–3. During period 1 and 2, nests were visited after 5 and 10 days to document effects of cutting and nest predation. During period 3 nests were visited after 10 days (cutting was done in the middle of the period).

Each artificial nest consisted of three eggs: one fresh egg from Japanese Quail *Coturnix japonica* to attract predators and two artificial eggs made of plasticine. The quail egg was larger (33.5±0.3 × 26.1±0.6 mm, 12.4±0.2 g, n=20) than Skylark eggs (23.7 × 16.9 mm, 3.3 g), see Glutz & Bauer (1985), which might have influenced predation rates (Roper 1992) and the effects of cutting on the eggs. However, the plasticine eggs resembled Skylark eggs in size (21.6±0.07 × 16.2±0.06 mm, n=20), shape, colour (painted with clay dissolved in water) and weight (3.35–3.40 g). Imprints in a plasticine egg anchored to the ground with a metal wire attached to a metal nail (150 mm) was used to identify nest predators.

Five artificial nests were placed out on each field and the proportion of destroyed nests on each field was used as dependent variable in analyses. Nests were placed at least 30 m from field edges, 60 m from trees or shrubs and at least 25 m from other artificial nests. The nests consisted of small depressions (3–4 cm) with a diameter of 8–10 cm, which is similar to real Skylark nests (Glutz & Bauer 1985). Nests were not put out if corvids *Corvidae* were seen in the vicinity. Nests were marked with plastic sticks (5–10 cm), visible within 3 m from the nests. Nests were classified as depredated if eggs were missing, obviously destroyed by predators or if the plasticine eggs had imprints. Depredated eggs with imprints from teeth or beaks were collected. Nest predators were classified as corvids, other birds, fox *Vulpes vulpes*, badger *Meles meles*, mice (Murinae) or voles (Microtinae) or unknown. Nests run over by machines or completely covered by grass were classified as destroyed.

Analyses

Effects of vegetation height, vegetation cover and landscape composition on densities of Skylarks on 31 organic set-asides was analysed with covariance analysis (including cutting time as covariate). Reproductive success of Skylarks on organic set-asides with cutting at normal time and with delayed cutting was compared with paired t-test, since the two field types were located pair-wise in the landscape. Similarly, comparisons of artificial nests on organic set-asides with different cutting time was analysed with t-test, and relationships between predation rates and vegetation was analysed with linear regression.

Results

Skylark densities – effects of field type and landscape composition

Skylark density was negatively associated with forest cover (proportion forest within 300 m of the field edges) at the landscape scale (Figure 1). An analysis (ANCOVA, df=3, F=19.9, p<0.001) of Skylark densities on the 31 organic set-asides showed that Skylark density was negatively associated with forest cover (t=−9.1, p<0.001) and field vegetation cover (t=−4.0, p<0.001), and positively associated with the interaction between field vegetation cover and height (t=3.4, p<0.01). Thus, Skylarks preferred organic set-asides in open landscapes with, for this field type, sparse vegetation.

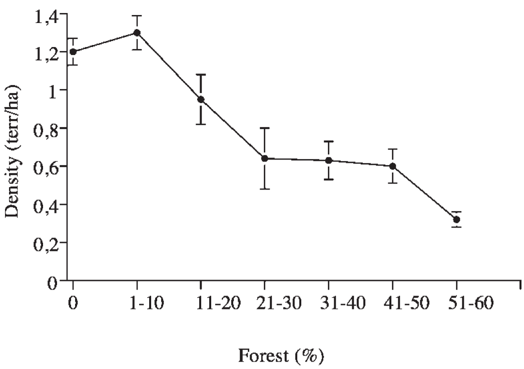

Figure 1. Mean (±SE) field density of Skylark territories (per ha) in relation to proportion of forest (grouped in 10% intervals) at the landscape scale (within 300 m) in the surroundings of the 48 fields (31 organic set asides and 17 arable fields, from Kvarnbäck et al. 2006). n-values in the different forest cover categories were as follows: 0–10%forest cover = 20 fields, 11–20% = 9, 21–30% = 6, 31–40% = 9, 41–50% = 2 and 51–60% forest cover = 2 fields.

Täthet (medel±se) av sånglärka (revir/ha) i relation till andel skog (i 10% intervall) i omgivande landskap (inom 300m) för 49 fält (31 ekologiska gröngödslingsträdor och 17 odlade åkrar, från Kvarnbäck et al. (2006). N-värden: 0–10% skog = 20 fält, 11–20% = 9, 21–30% = 6, 31–40% = 9, 41–50% = 2 and 51–60% skog = 2 fält.

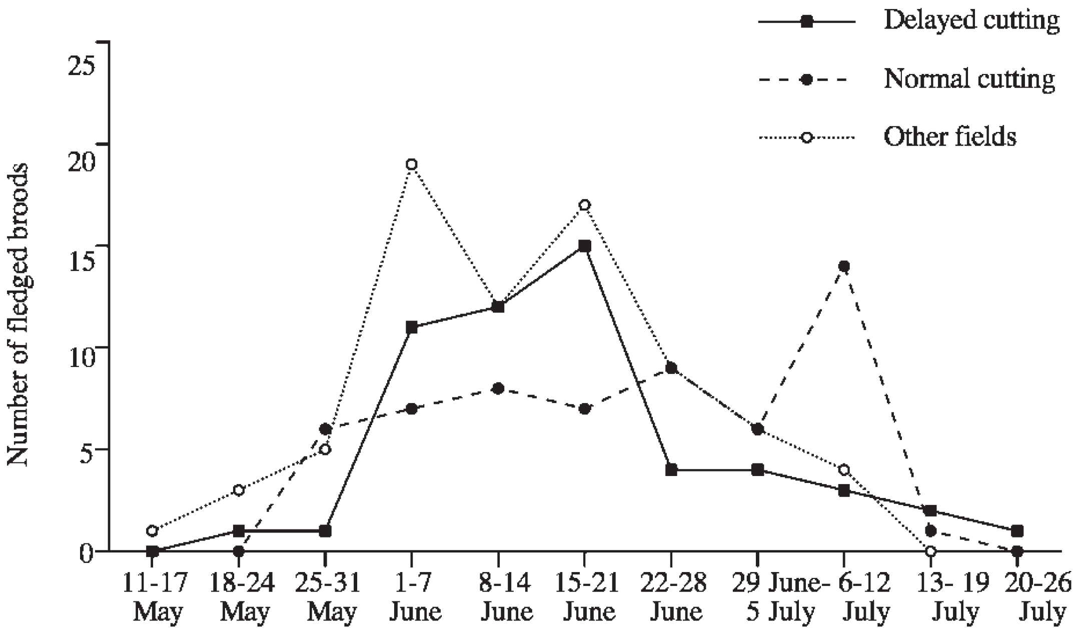

Figure 2. Number of broods fledged per week on organic set-asides cut at normal time, fields with delayed cutting and on other uncut arable field types (from Kvarnbäck et al. 2006).
Antal flygga kullar per vecka på ekologiska trädor slåttrade vid normal tidpunkt, trädor med senarelagd slåtter och på odlade åkrar (från Kvarnbäck et al. 2006).

Reproductive success of Skylarks

A pair-wise comparison (paired t-test, df=14, t=-2.14, p=0.05) of production of fledged clutches per Skylark territory on 30 organic set-asides showed a significantly higher reproductive success on fields cut late (mean±SE=0.52±0.09) compared with fields cut at normal time (mean±SE=0.42±0.08). However, reproductive success differed considerably between years. In 2004, the fields cut at normal time produced 0.26 fledged broods per territory and the late cut fields 0.39 broods per territory; in 2005, 0.66 and 0.73 broods per territory, respectively.

For fields with sparse vegetation cover, effects of cutting on reproductive success were associated with vegetation cover. The effect of cutting (differences between normal cutting time and delayed cutting) decreased with vegetation cover in the interval 70–90% vegetation cover (Linear regression, F=21.6, df=1, p<0.001), suggesting that cutting was negative on fields with not too dense vegetation. However, for fields with above 90% vegetation cover, time of cutting was not related to reproductive success, and a regression including all fields was not significant (F=1.97, p=0.18). There was no effect of Skylark density on reproductive success (Linear regression, F=0.53, df=1, p=0.47), i.e. no density dependent effects on reproductive success could be detected.

Broods fledged between 16 May and 26 July, with a peak during the three first weeks of June, which is during the normal period for cutting of organic set-asides (Figure 2). In 2005 the number of fledged broods peaked in the second week of July on organic set-asides cut at normal time, but this late peak was not present in 2004. This may be because in 2005 the interval between successive cuts was longer than in 2004 (4–7 weeks compared with 3–4 weeks respectively) and possibly because weather was warmer and less wet.

Artificial nest experiment

During periods 2 and 3, when fields were cut more than half of the nests (mean 56%) were run over by machines or covered by grass in windrows. No eggs were removed from nests by the mowing equipment (mostly rotary mowers). The proportion of nests destroyed did not differ between normal (mean±SE=0.51±0.08) and delayed (mean±SE=0.61±0.06) cutting time (t-test, p>0.3). The mean daily predation rate during the whole period was 3.3±0.4% (n=19 fields). Nest predation rates were significantly higher on fields with low vegetation cover (p=0.004) and vegetation volume, estimated as height×cover (p=0.04, Linear regression, F=5.7, R^2=0.64, p=0.041).

Predation rates on fields decreased during the period they were uncut. However, predation rates on cut fields did not differ between the two time periods with cutting (Figure 3) suggesting that cutting increased predation rates. Of the 285 nests, 111 (39%) were depredated, and of the depredated nests, corvids were identified as predators in 35 cases (31.5% of the depredated nests), mice and voles in 14 cases (12.6%) possibly an effect of absence of incubating adults, unknown birds in 9 cases (8.1%), badger or fox in 4 cases (3.6%), whereas the predator was unknown in 49 cases (44.1%).

The number of broods per territory was negatively correlated with the proportion of failed artificial nests on the nine organic set-asides cut at normal time in 2004 (Multiple regression, F=5.99, R^2=0.78, p=0.04). However, on the fields with delayed cutting in 2004, success of Skylarks did not correlate with artificial nests (p>0.2). The taller and denser vegetation during the period for delayed cutting might have caused abandonment of territories, and differences in nest site selection and predation rates between real and artificial nests.

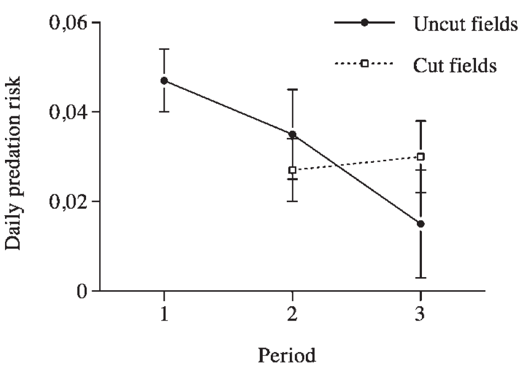

Figure 3. Mean ± SE daily nest predation risk for artificial nests on cut and uncut organic set-asides during period 1–3.
Daglig predationsrisk (medel±se) för konstgjorda sånglärkebon på under period 1-3 slåttrade och inte slåttrade ekologiska trädor.

Discussion

Skylark densities

This study showed that Skylark density was high on organic set-asides. The density was similar to that on stubble fields and organic autumn-sown cereals and higher than on spring-sown cereals and permanent set-asides and leys (Kvarnbäck et al. 2006). Most other species were rare on organic set-asides. The second most common species was Meadow Pipit *Anthus pratensis* (0.05 territories/ha). Moreover, the Common Quail *Coturnix coturnix* (0.02 territories/ha) was observed on five organic set-asides, but this species did not occur on any other field type (Kvarnbäck et al. 2006).

Several other studies have found higher Skylark densities on set-asides than on cereal crops (Berg & Pärt 1994, Poulsen et al. 1998, Chamberlain et al. 2000, Donald et al. 2001, Henderson et al. 2000, Toepfer & Stubbe 2001, Eraud & Boutin 2002). In our study Skylark density was negatively related to vegetation height and vegetation cover. The clover on many of the organic set-asides became dense and covered the ground by the first weeks of June, probably making it difficult for Skylarks to find open spots for feeding. Skylarks abandoned a few fields in mid June, possibly because of too dense vegetation. This abandonment may be because Skylarks prefer intermediate vegetation heights (15–60 cm). Preferred vegetation heights differ between studies and field types (Wilson et al. 1997, Chamberlain et al. 1999, Donald et al. 2001, Toepfer & Stubbe 2001, Eraud & Boutin 2002), which in turn probably depends on differences in vegetation cover and vegetation development. Thus, Skylarks can breed in fields with high vegetation with gaps. Studies of vegetation microstructure have shown that Skylarks prefer parts of cereal crop fields with poor growth (Schon 1999).

Skylark density was also strongly affected by landscape structure (Figure 1). Other studies have shown that Skylarks prefer open landscapes and avoid forest edge zones (Fuller et al. 1997, Wilson et al. 1997, Petersen 1998, Chamberlain & Gregory 1999, Piha et al. 2003). It is probable that landscape factors are more important in mosaic and forest-dominated landscapes, such as in northern Europe, than in farmland-dominated landscapes in central Europe. A study of Swedish farmland landscapes (Berg 2002) showed that the amount of forest was the factor that affected bird community composition most, since many species avoid fields close to forest edges and several other species prefer edge habitats. A probable cause for avoidance of edge habitats is increased nest predation risk close to edges (Møller 1989, Andrén 1995).

Reproductive success

Reproductive success was intermediate on organic set-asides, low on cereal crops (Kvarnbäck et al. 2006), and high on stubble fields (Kvarnbäck et al. 2006) in the studied area. Similarly, other studies (Wilson et al. 1997, Poulsen et al. 1998) found a higher reproductive success on set-asides than on intensively managed cereal crop fields. However, there is a considerable variation between areas in the reproductive success of Skylarks on cereal crops and set-asides. Donald et al. (2002) found a significantly higher nest survival on cereal crops than set-asides and grasslands, and a higher production of young on cereal crops than set-asides and grasslands. Possible causes to these differences between areas are differences in vegetation structure and nest camouflage, densities of nest predators, or specialisation on nest predation by predators (Donald et al. 2002).

The present study found that cutting significantly decreased reproductive success on organic set-asides. The artificial nest experiment suggests that more than half of the artificial nests (mean 56.5 %) were destroyed during the two cutting periods, and that cutting resulted in increased nest predation risks on surviving nests. In line with this, delayed cutting (15 June) resulted in significantly higher reproductive success than cutting at normal time. However, the mean number of fledged broods per territory only increased from 0.42 to 0.52. A further delay in cutting time would probably have slightly increased reproductive success. The number of fledged broods on uncut arable fields (Figure 2) decreased rapidly after 20 June, in a similar pattern as on the fields with delayed cutting, suggesting that other factors also influenced reproductive success. Comparable studies on organic set-asides are lacking, but earlier studies on leys have found that the reproductive success of Skylarks is strongly affected by mowing (Schläpfer 1988, Jenny 1990). Jenny (1990) found that 98% of the nests were destroyed due to mowing of leys. Leys are cut more frequently than organic set-asides (every 3–4 weeks compared with every 4–6 weeks), and their cutting height is probably lower. Poulsen & Sotherton (1992) found that nest survival was higher on set-asides with 12-cm cutting height than on fields with 5-cm cutting height.

Early cutting had the strongest negative effects on Skylarks breeding on organic fields with sparse vegetation cover, suggesting that vegetation cover influenced reproductive success on organic set-asides. Vegetation growth on the organic set-asides was fast. Vegetation height increased from 9 cm in early May to 45 cm in mid June (Kvarnbäck et al. 2006). Similarly, vegetation cover increased from 49% to 83% during the same period. Thus, less dense vegetation or unsown patches might be beneficial on organic set-asides, which is also indicated by the large number of late fledged broods (relayings after cutting) on organic set-asides cut at normal time. A potential problem on fields with dense vegetation is impaired conditions for foraging and decreased food availability despite high abundance of food (Oddeskaer et al. 1997). In experiments, gaps in the vegetation have been shown to increase Skylark density (Oddeskaer et al. 1997), and to give opportunities for several breeding attempts. Similarly, unsown patches in autumn-sown cereal crops improved reproductive success of Skylarks (Donald & Morris, 2005).

Conclusion and management recommendations

Skylark densities were strongly associated with landscape composition. Thus, different management regimes, such as cutting of organic set-asides, affect larger numbers of Skylarks in open landscapes than in mosaic landscapes. Delayed cutting improved reproductive success, but reproductive success was on average still lower than on stubble fields. An alternative to save nests would be to cut after the breeding season, but this would delay cutting until ca. 20 July, and many breeding attempts would probably fail anyway due to the dense and tall vegetation. Possibilities of increasing reproductive success would be better if less dense vegetation (or unsown patches) was combined with a delayed cutting. The date when cutting can be recommended can be seen as a trade-off between failures due to cutting and growing vegetation. We suggest 20 June as a reasonable compromise in south-central Sweden on fields with an average vegetation density and moderate weed problems.

Acknowledgements

We thank the Swedish Board of Agriculture for financing the studies. We also thank the bird censusers Sören Eriksson, Ulf Karlsson and Mats Wilhelm. Tomas Pärt and Bo Söderström commented on earlier versions of the manuscript.

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Sammanfattning

Moderniseringen av jordbruket i västra Europa har haft stora negativa effekter på biologisk mångfald. Många jordbruksfåglar har minskat kraftigt i antal (Tucker & Heath 1994, Fuller et al. 1995, Siriwardena et al. 1998), också i Sverige (Robertson & Berg 1992, Wretenberg et al. 2006). Åtgärder som ökad areal träda, restaurering av ängs- och betesmarker, odling av nya grödor (t.ex. Salix) har bidragit till att stoppa utarmningen av jordbrukslandskapet (Statistics Sweden 1975–2005).

Även arealen ekologisk odling har ökat och i Sverige var andelen ekologisk odling 6,7% år 2004 (Statistics Sweden 2005). Generellt tycks effekten av ekologisk odling på biologisk mångfald vara positiv i intensivt brukade landskap, medan effekten är liten i heterogena landskap med många olika habitat (Weibull et al. 2000, Bengtsson et al. 2005). En skillnad mellan konventionell och ekologisk odling är att mekanisk ogräsbekämpning, kultivering, slåtter och andra "störningar" sker oftare ekologisk odling. Exempelvis kan tidpunkt och frekvens av slåtter på ekologiska trädor (insådda med klöver och gräs för gröngödsling) förväntas ha stor effekt på markhäckande fåglar som sånglärkan. De flesta ekologiska odlare i Mellansverige slår sina gröngödslingsträdor i slutet av maj och början av juni för att förhindra etablering av ogräs och öka tillväxten av de insådda grödorna. Målsättningen med denna studie var att undersöka betydelsen av gröngödslingsträdor som häckningsbiotop för sånglärka genom att (i) undersöka vilka faktorer som var relaterade till tätheten av sånglärka, (ii) jämföra reproduktionsframgång (flygga kullar per par) på gröngödslingsträdor med normal slåttertid (ca. 1 juni) och senarelagd slåtter (ca. 15 juni) och (iii) utvärdera vilka faktorer som påverkar boförluster på grund av slåtter och predation genom att använda konstgjorda sånglärkebon.

Metoder

Trettioen fält (18 fält 2004 och 13 nya fält 2005) inom 50 km avstånd från Uppsala ingick i undersökningen. Sexton av dessa slåttrades vid normal tidpunkt (1 juni) och 15 fält slåttrades senare än normalt (15 juni). Trettio av dessa fält var lokaliserad parvis (ett med normal slåttertid och ett med sen slåttertid) inom undersökningsområdet.

Fälten inventerades med avseende på sånglärkor med hjälp av revirkartering (Bibby et al. 1992) 6–7 gånger under perioden 25 april–24 maj. Reviren genomsöktes sedan efter flygga ungar vid 6–7 tillfällen och reproduktionsframgången uppskattades som antalet flygga kullar (minst en flygg unge) per revir. Förutom slåttertid så ingick landskapssammansättning (andel skog inom 300 m från fältkanten), vegetationshöjd (15 maj) och vegetationstäckning (10% intervall, 15 juni), eftersom landskapssammansättning och vegetationsstruktur tidigare visat sig ha stor effekt på förekomsten av sånglärka (Fuller et al. 1997, Piha et al. 2003, Wilson et al. 1997, Chamberlain et al. 1999, Donald et al. 2001).

2004 genomfördes ett experiment med konstgjorda sånglärkebon på 19 fält med ekologisk gröngödslingsträda. Konstgjorda sånglärkebon (två ägg av plasticin med samma storlek, 21,6±0.07 × 16,2±0.06 mm, och färg som sånglärkeägg och ett ägg av japansk vaktel *Coturnix japonica* lades ut i tre 11-dagars perioder med start 3–6 maj, 20–28 maj och 8–10 juni. Effekter av bopredation studerades under alla tre perioderna, medan effekter av slåtter studerades under period 2 och period 3. Fem bon (3–4 cm djupa, 8–10 cm breda) placerades ut på varje fält (minst 30 m från fältkant, 60 m från närmaste träd och 25 m från närmaste konstgjorda bo). Bon klassificerades som prederade när äggen var försvunna eller om plasticinäggen hade märken av predatorer (som identifierades när det var möjligt). Överkörda bon och bon helt täckta av avslagen vegetation klassificerades som förstörda på grund av slåtter.

Resultat

En analys av tätheten av sånglärka på gröngödslingsträdorna visade att tätheten var negativt korrelerad till andel skog inom 300 m (t=−9,1; p<0,001) och till vegetationens täckningsgrad (t=−4,0; p<0,001). Sånglärkorna föredrog gröngödslingsträdor i öppna landskap och fält med (för denna fälttyp) gles vegetation.

En parvis jämförelse av antalet flygga kullar per revir på 30 ekologiska gröngödslingsträdor visade en signifikant bättre reproduktion (parat t-test, df=14, t=−2,14, p=0,05) på fält med fördröjd slåtter (mean±SE=0,52±0,09) än på fält med slåtter vid normal tidpunkt (mean±SE=0,42±0,08). Kullarna blev flygga mellan 16 maj och 26 juli, med en topp under de tre första veckorna av juni (Figur 2), även om det var stor skillnad de två åren.

Mer än hälften (medel 56%) av alla konstgjorda bon förstördes under slåtter. Andelen förstörda bon skiljde sig inte signifikant mellan normal och sen slåtter. Den dagliga predationsrisken uppskattades till 3,3±0,4% under hela perioden. Bopredationsrisken var signifikant högre på fält med låg vegetation (p=0,004) och vegetationsvolym (p=0,04, linjär regression, F=5,7; R2=0,64; P=0,041). Predationsrisken på oslåttrade fält minskade under perioden, men predationsrisken på slåttrade fält skiljde inte mellan perioder (Figur 3), vilket indikerar att slåtter också kan ha ökat bopredationsrisken på grund av lägre vegetation. Av 285 bon var 111 (39%) prederade. Kråkfåglar identifierades som predatorer i 35 fall (31.5%), grävlig eller räv i 4 fall (3,6%), medan predatorn var okänd i 49 fall (44,5%).

Diskussion

Undersökningen har visat att tätheten av sånglärka var relativt hög på de ekologiska gröngödslingsträdorna och jämförbar med tätheter på stubbåkrar (Kvarnbäck et al. 2006). De flesta andra arter var sällsynta på trädorna. Den näst vanligaste arten var ängspiplärka (0,05 revir/ha). Dessutom förekom vaktel (0,02 revir/ha) på fem gröngödslingsträdor, men inte på de andra fälttyperna (Kvarnbäck et al. 2006).

Tätheten av sånglärka var negativt korrelerad till vegetationshöjd och till vegetationens täckningsgrad. Sånglärkor föredrar vegetation av intermediär höjd (15–60 cm), men den prefererade höjden skiljer mellan undersökningar och fälttyper (Wilson et al. 1997, Chamberlain et al. 1999, Donald et al. 2001, Toepfer & Stubbe 2001, Eraud & Boutin 2002), Klövervegetationen på många trädor blev tät och täckte marken i första veckan av juni, vilket troligen gjorde det svårt för sånglärkorna att hitta öppna områden för födosök, och många sånglärkor övergav fälten i mitten av juni. Tätheten av sånglärka påverkades också starkt av det omgivande landskapets sammansättning (Figur 1), vilket även visats i andra studier (Fuller et al. 1997, Wilson et al. 1997, Petersen 1998, Chamberlain & Gregory 1999, Piha et al. 2003). En trolig orsak till att sånglärkan, och flera andra arter (Berg 2002) undviker skogskanter och skogsdominerade landskap är ökad bopredation nära skogskanter (Møller 1989, Andrén 1995).

Reproduktionsframgången var intermediär på gröngödslingsträdorna, låg i sädesåkrar (Kvarnbäck et al. 2006) och hög på stubbåkrar (Kvarnbäck et al. 2006) i samma område. Vissa andra studier har också funnit högre reproduktionsframgång på trädor än på intensivt skötta sädesåkrar (Wilson et al. 1997, Poulsen et al. 1998), men andra studier visar motsatt resultat (Donald et al. 2002). Orsaker till dessa skillnader är troligen skillnader i vegetationsstruktur, bokamouflage och predatorfaunan mellan olika undersökningar.

Denna undersökning har visat att slåtter minskade reproduktionsframgången på de ekologiska gröngödslingsträdorna. 52% av de artificiella bona förstördes under slåtter och senare slåtter resulterade i signifikant bättre reproduktionsframgång. Skillnaden i andelen flygga kullar mellan normal och sen slåtter var bara 0,1 kull/ revir och en förskjutning av slåttertidpunkten som är längre än 15 dagar skulle troligen ytterligare förbättra reproduktionsframgången. Vi föreslår 20 juni som en kompromiss mellan att skapa bra förhållanden för sånglärkan och att motverka etablering av ogräs och gynna produktionen av gröngödslingsmassa. Vidare skulle troligen en mindre tät vegetation, eller osådda mindre partier, på trädorna vara positiv för sånglärkan (Oddeskaer et al. 1997).