Seasonal shift of foraging habitat among farmland breeding Eurasian Curlews \textit{Numenius arquata}

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\textit{Abstract.} The importance of landscape heterogeneity for farmland birds is widely recognized, but the underlying processes remain unclear. Here I investigate the distribution of foraging and non-foraging Eurasian Curlews over agricultural treatment classes during the breeding season. The results show that Eurasian Curlews used grassland for foraging early in the breeding season but shifted to cereal fields later. Contrastingly, the distribution of non-foraging Eurasian Curlews over treatment classes rarely deviated from random. I conclude that relative foraging habitat quality changed among the investigated agricultural treatment classes and that landscapes containing more than one treatment class have higher overall quality for Curlews. Preserving or creating landscapes with a mix of different kinds of commercially managed fields is a relatively cheap and easily accepted farmland bird conservation measure.

Key words: Landscape heterogeneity; spatio-temporal distribution; habitat quality; conservation; waders; soil penetrability

INTRODUCTION

When conservation programs fail to halt the decline of farmland biodiversity, another look in the “toolbox” is required (Whittingham 2007, Kleijn et al. 2011). Landscape heterogeneity is increasingly recognized as an important factor in maintaining farmland biodiversity (Benton et al. 2003, Herzon & O’Hara 2007). Due to its multiple dimensions and scales, the concept of landscape heterogeneity is complex, and the links between heterogeneity components and biodiversity are only partially understood (Tschamkite et al. 2005, Fahrig et al. 2011). Nevertheless, various heterogeneity-based farmland bird conservation measures have already earned their merits (Wilson et al. 2005, Schekkerman et al. 2008), but these measures reduce crops and increase costs, and thus rely on financial compensation to farmers.

The model species of this study is the Eurasian Curlew \textit{Numenius arquata} (hereafter “Curlew”), a conspicuous and common farmland bird in northern Sweden (Svensson et al. 1999). In boreal agricultural landscapes, Curlews nest and forage on farmed fields and set-asides (Berg 1992, Valkama et al. 1998), but avoid the surrounding forest habitat. Foraging Curlews take their prey from the soil surface or by probing (Cramp & Simmons 1983), and during probing, they regularly bury their entire bill into the soil (Zwarts & Esselink 1989). In studies in Sweden (Berg 1993) and Finland (Currie and Valkama 1998), soil-living invertebrates were the main food source for farmland breeding Curlews.

Under the constraints of reproductive effort, adult Curlews are likely to optimize foraging efficiency during the breeding season, and thus can be expected to shift between habitat patches in response to temporal changes in relative foraging habitat quality. In this study I test whether the distribution of Curlews over agricultural treatment classes changed during the breeding season and whether foraging and non-foraging Curlews displayed different temporal responses.

MATERIAL AND METHODS

The study was performed in the vicinity of the city of Umeå (63°49’N, 20°16’E), Västerbotten county in northern Sweden during spring and early summer 2007. In this area, farmland is well-drained, open and readily accessible by roads. Dairy and pork are the main farm products, and ley (sown perennial grasses) and barley for fodder are the main crops. Due to harsh winter conditions, farming does not start before mid-May and only spring sown cereals are grown (Figure 1).

The agricultural fields for this study were selected in a two step process. First, a set of 12 road sections was chosen randomly from the many roads crossing farmland within the study area. The distance between these road sections was > 0.5 km. Second, all fields along these road sections were selected under the condition that (a) they were fully visible (= no hidden
For each period, I created 95% confidence intervals of the expected numbers of foraging and non-foraging Curlews separately for each treatment class, based on random binomial probability distribution in relation to area (Figure 2). Observed numbers were compared with the corresponding confidence limits.

RESULTS

The sample size of observed Curlews was 257 (78, 79 and 100 during Period I-III respectively), of which 123 (48%) were foraging. Total numbers and proportion of foraging birds did not differ significantly between periods ($\chi^2$ for given probabilities = 3.6, $P = 0.17$ and 4.6, $P = 0.10$ respectively). The control program revealed that two birds (0.8%) had been overlooked during initial scanning. The proportion of treatment classes among controlled fields did not differ from the full set of studied fields ($\chi^2$ for given probabilities = 2.4, $P = 0.48$).

I used R version 2.13.1 (R Development Core Team 2011) with the lattice package version 0.18-3 (Sarkar 2008) for statistical analyses ($\chi^2$ for given probabilities, Pearson’s $\chi^2$ and Fisher’s exact tests) and plotting.

The proportions of males differed neither between periods ($\chi^2$ for given probabilities = 1.13, $P = 0.57$, male/female ratio = 1.0, 1.3 and 1.5 for $N =$ 49, 66 and 65 during Period I-III respectively) nor, for foraging birds, between leys and cereal fields (Fisher’s exact $P = 1.0$ for all periods, $N_{\text{males}} = 47$ and $N_{\text{females}} = 47$).
Pastures and set-asides together covered less than 9% of total area and hosted less than 6% of the observed Curlews. Neither non-randomness nor temporal patterns were apparent (Figure 2), but the observed numbers were too small for statistical testing.

Over the three periods, the observed numbers on leys were 44, 28 and 8 for foraging birds and 25, 36 and 33 for non-foraging birds. On cereal fields the corresponding numbers were 1, 2 and 39, and 4, 5 and 17. Compared with random distribution over available area of leys and cereal, only foraging Curlews showed consistently significant ($P < 0.05$) deviations from the expected numbers; biased towards leys during Period I and II and towards cereal fields during Period III (Figure 2).

A temporal change in relative abundances on leys and cereal fields occurred among foraging and non-foraging Curlews, but was more pronounced for the former ($\chi^2 = 80.0, P < 0.0001$) than the latter behavioural class ($\chi^2 = 7.7, P = 0.02$). The ley-cereal balance did not change between Period I and II (Fisher’s exact odds ratio (FEOR) = 3.1, $P = 0.56$ for foraging and FEOR = 0.9, $P = 1$ for non-foraging), but did so between Period II and III (FEOR = 62.5, $P < 0.0001$ for foraging and FEOR = 3.7, $P = 0.03$ for non-foraging).

**DISCUSSION**

The observed shift in the distribution of foraging Curlews over treatment classes implies that relative foraging habitat quality of leys and cereal fields changed over the breeding season, and that mosaic landscapes with ley and cereal may represent greater overall habitat quality for Curlews than landscapes with just one of these treatment classes. Even non-foraging Curlews changed their preference for leys and cereal fields over the breeding season, but this change was only moderately significant, and in addition, non-foragers’ distribution over treatment classes were spatially (near) random during all periods.

The shift of habitat choice of the foraging Curlews seems to be an adjustment of individual birds to changing foraging conditions. Alternatively, the initial population was replaced with Curlews with different preferences. To avoid population turnover, I conducted the study between the migration periods (Figure 1), and indeed a stable Curlew population was suggested by similarity over Periods I-III of (a) total numbers, (b) proportions of foraging birds and (c) proportion of males.

An important driver of the foraging habitat shift
Sammendrag. Sesongmessig forandring i habitat hos storspove som hekker i jordbrukslandskap. Det er generelt akseptert at et sammensatt landskap er gunstig for fugler. Å opprettholde eller skape en tilgjengelighet på arealer med mer enn én dyrkningsform er viktig for storspov. Å oppretholde eller skape en blanding av ulike typer dyrket mark kan vise seg å være et relativt billig og lett akseptabelt forvaltningsmiddel for fugler i jordbrukslandskap.

REFERENCES


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