

VARIABILITY OF SUITABLE HABITATS FOR WADERS: DOES GRAZING MANAGEMENT HELP?

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ABSTRACT

Due to the growing interest in sustaining biodiversity in agricultural landscape, it is now relevant to assess whether livestock management can contribute to habitat conservation. In a French coastal marsh of around 5000ha, the impact of livestock systems on wader habitats was studied. In this marsh, grasslands are mainly grazed by cattle and mowed for hay, and landscape is highly heterogeneous despite nearly constant topography. The suitability of the marsh as habitat for five wader species was assessed using Ecological Niche Factor Analysis. Our results indicate that (1) breeding birds are sensitive to agricultural practices, especially grazing, which can be used as a tool to shape suitable habitat for their reproduction; (2) the different species respond differently to human activities, which imply that spatial or temporal heterogeneity in agricultural practices is necessary to conserve the whole community.

INTRODUCTION

During the last few decades, the activities of some 5.7 billions human beings have dramatically impacted biological diversity (Meffe et al. 1997). Among these activities, agricultural intensification and specialisation have often been cited (e.g. Benton et al. 2003; Donald et al. 2001; Potter 1997). These factors have been particularly detrimental for wetlands, which are among the most threatened ecosystems in the world (O'Connell and Yallop 2002, Williams 1990). Drainage, grassland conversion to arable and perturbation of water levels are responsible for the decline of many species, especially waterbirds (e.g. Duncan et al. 1999).

In contrast, some natural ecosystems suffer more from land abandonment than from intensification (Potter 1997; Tucker 1997). Land abandonment leads to closure of farmland habitats by scrub encroachment, which causes the loss of species dwelling in open areas. Some agricultural practices, like extensive grazing or mowing, have been reported to counteract this phenomenon (Léger et al. 2002, Tichit et al 2002) and to enhance biodiversity (Wettstein and Schmid 1999). These practices can thus be viewed as efficient tools to optimize the management of farmland ecosystems for both viewpoints of livestock rearing and birds conservation (Milsom et al. 2000).

The Marais Poitevin (96,000 ha), located on the French Atlantic coast, is the second largest wetland in France. Like many other wetland areas, it has been deeply affected by agriculture intensification: it underwent a 50 % decline of wet grasslands between 1970 and 1995, mainly due to conversion to arable crops (Duncan et al. 1999). Because of its geographical location, it is an important site of migration and wintering for waterbirds and it hosts many protected species listed by the Bonn and Berne Conventions and by the European Birds and Habitat directives (79/409/EEC and 92/43/EEC) (Duncan et al. 1999). The marsh Ouest-du-Lay (5,000 ha) is the largest remaining wetland fragment of the Marais Poitevin. In this marsh, the main activity corresponds to unimproved permanent pasture (Crine 2003). It harbours some of the largest French population of lapwing (*Vanellus vanellus*), redshank (*Tringa tetanus*) and black-tailed godwit (*Limosa limosa*) (Deucenink, 2001). These characteristics make of it a crucial area for waterbirds conservation, particularly in the context of Natura 2000.

In this study, we investigate the impact of agricultural practices on the wader community present at Ouest-du-Lay and we discuss how our results can aid the management and the conservation of this community.

METHODS

The data - Birds data were provided by the Ligue de Protection des Oiseaux (LPO), who conducted surveys of bird abundance across Ouest du Lay every ten days in the springs of 1995 and 1996

(Caupenne, 1996). Here, we focus on five ‘species’ for which the data were most abundant: lapwing (*Vanellus vanellus*), curlew (*Numenius arquata*), redshank (*Tringa totanus*), black-tailed godwit (*Limosa limosa*) and a “species” constituted of the “other migratory species.” We also make a distinction between nesting and migratory birds. Lapwings are both breeders and migratory; redshanks are breeders; black-tailed godwit and curlew are only migratory.

Land cover, land use and biophysical data (25 variables in total) were provided by the Institut National de la Recherche Agronomique, INRA (Domaine de Saint Laurent de la Prée). These data are based on agro-ecological surveys realised in 1994 and 1996.

The analysis - We used a very recent statistical method called Ecological Niche Factor Analysis (ENFA; see Hirzel et al. 2002 for thorough details.) The approach, combining Geographical Information Systems (GIS) and multivariate analyses, is basically dedicated to identify ecological preferences of a given species. Input data are maps of “ecogeographical” variables providing information about environmental characteristics (micro-topography, percentage of surface floods, distance to meadows, to shooting hide etc.) and about agricultural usages (mowed parcels, grazed parcels, cultivated parcels, etc.) in both the whole studied area and the area occupied by the focal species. Output variables are an index of *marginality* and an index of *specialisation*. Marginality, defined as the ecological distance between the species optimum and the mean habitat within the reference area, measures the extent to which the focal species preferences depart from the global environmental conditions. Specialisation is defined as the ratio of the ecological variance in the mean habitat to that observed for the focal species. It measures the tolerance of the species to changes in its environment. Besides providing information on the species ecology *per se*, these two indexes are used to draw *habitat suitability maps*, displaying the more suitable sites for the focal species in the reference area. The big advantage of ENFA is that it only relies on presence data (not presence-absence data), which render it very robust to potentially false absences (e.g. species present, but not detected in a given site).

RESULTS

The five species are not similar in terms of niche dimensions (table 1). Lapwing (both breeding and migratory), redshank and curlew exhibit the lowest marginality and specialisation scores. This means that these species easily find suitable conditions in the Ouest-du-Lay marsh, and that they are relatively not sensitive to variations around these conditions. In contrast, black-tailed godwit is found rather marginal and specialised. Its habitat preferences are distant from the mean conditions offered by the marsh, and it is not very tolerant to variations around these conditions (marginality $\gg 0$; specialisation $\gg 1$). As a consequence, the suitable area for this species at Ouest-du-Lay is narrower (fig. 1).

Table 1: Marginality and specialisation scores for the five most abundant species at Ouest-du-Lay marsh. Non marginal species will have a score close to 0; non specialised species will have a score close to 1.

<i>Species</i>	<i>Marginality</i>	<i>Specialisation</i>
<i>Breeding Lapwing</i>	0.661	1.831
<i>Migratory lapwing</i>	0.702	2.103
<i>Curlew</i>	0.695	2.170
<i>Redshank</i>	0.614	2.732
<i>Black-tailed godwit</i>	0.874	4.401
<i>Other migratory species</i>	0.802	2.641

ENFA also makes it possible to identify the few ecogeographical variables that have the largest influence on marginality and specialisation indices. In our analysis these variables are “surface floods”, “shooting hides”, “dredged ditches”, “distance from water”, “grazed pasture” and “permanent pasture”. They can be split into two groups, the first four ones characterising the “wetness” of the occupied parcels, the last two ones rather describing land use in the parcels. Our results indicate that the species are not equally sensitive to these two sets of variables. On the one hand, migratory lapwing and black-

tailed godwit are more responsive to wetness. On the other hand, Lapwing, curlew and redshank are more sensitive to land use, especially grazing.

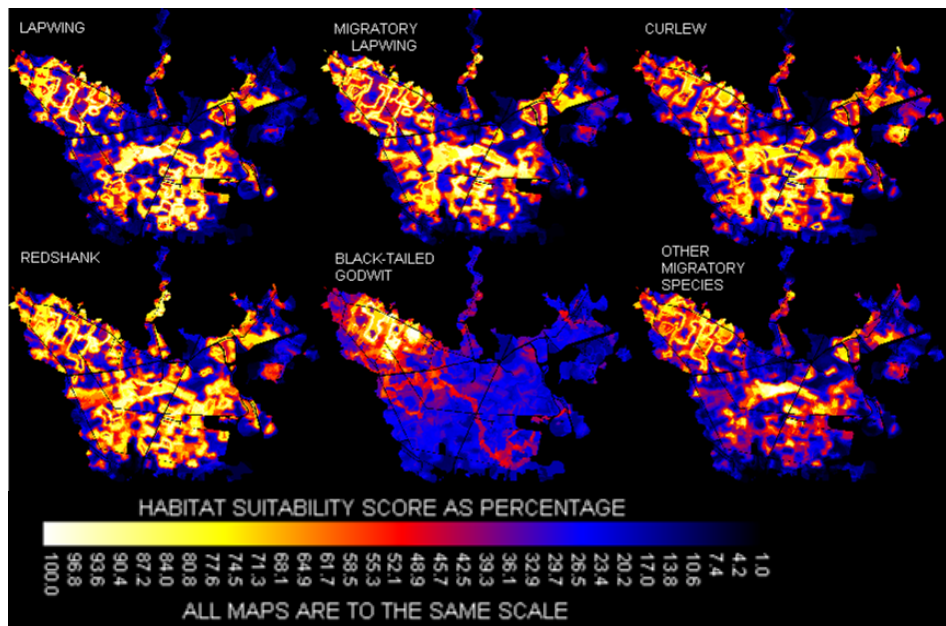


Figure 1: Habitat suitability maps for the five most abundant species at Ouest-du-Lay marsh. Clear colours indicate high suitability. Dark colours indicate low suitability.

DISCUSSION

The study of marginality shows that environmental conditions at Ouest-du-Lay match relatively well the habitat preferences of lapwing, redshank and curlew. Conversely, black-tailed godwit is found marginal. This species also appears to be specialised, which explains why its suitable sites are very localised (north-west of the marsh, fig. 1). These features make it highly sensitive to modifications of agricultural practices in the marsh. We found that one of the factors determining black-tailed godwit habitat suitability is a lower than average proximity to pasture that is mowed before being grazed. This result is in accordance with Kruk et al.(1996), who show that a tall sward in spring provides suitable habitat for this species and that a major limiting factor of their nesting success is the recent earlier mowing of such swards due to agricultural intensification. If the current practices were to be changed at Ouest-du-Lay, black-tailed godwit might disappear from the wader community. In a lesser extent, these conclusions may hold true for some “other migratory species” (fig. 1). These results show how managing grasslands for a single specific species is likely to conflict with other species. This is particularly true for lapwing and black-tailed godwit: increasing habitat suitability for the first species could be reached by replacing mowed pastures by grazed ones, which would negatively impact black tailed godwit’s habitat suitability (Tichit et al 2004).

Habitat preferences do not build on the same ecogeographical variables for all species. Two groups of birds come out, with respect to two different sets of variables: the first group, more attracted by “wetness”, is made of migratory species: migratory lapwing and black-tailed godwit. The second group, more attracted by “usages” instead, is made of lapwing, redshank, two species that nest at Ouest-du-Lay, and curlew. This dichotomy in ecological preferences stands upon different constraints affecting the two groups. Migratory birds only look for wet areas where they will find small aquatic invertebrates that compose their diet. The degree of wetness of the parcels is thus essential to them. Humidity is also sought by the species that breed in the marsh, but agricultural land uses (and particularly grazing) are even more important to them: this factor shapes the sward state (height, heterogeneity, distribution of tussocks) (Tichit et al, 2003), which is a key factor for their breeding success of these ground-nesting species (see also Milsom et al. 2000).

Interestingly, the six habitat suitability maps (fig. 1) do not coincide exactly, which means that even the non marginal species do not have exactly the same ecological preferences. This highlights the importance of maintaining a certain amount of heterogeneity in the marsh, in order to preserve every species in the community, a remark that is in total agreement with several recent papers dealing with

the conservation of biodiversity in wetlands (Benton et al. 2003; Donald et al. 2001; Milsom et al. 2002; Milsom et al. 2000; Wettstein and Schmid 1999).

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