PASTORAL PRACTICES AND BIRD COMMUNITIES IN GRAN PARADISO NATIONAL PARK: MANAGEMENT IMPLICATIONS IN THE ALPS

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Abstract - Alpine meadows are examples of semi-natural habitats largely created and maintained through grazing of domestic livestock. Deterioration of these habitats is widespread in the Alps, due mainly to depopulation of high elevation rural areas and reduction of stocking levels followed by a continue intensification of agricultural practices in valley bottoms. In order to determine the best management practices in terms of bird diversity maintenance and bird species conservation, we examined the effects of pastoral abandonment on the breeding avifauna of Gran Paradiso National Park (nort-western Italian Alps). We tested for differences in mean species diversity and overall bird abundance per sampling area among four levels of increasing grazing impact, and examined the associations among 32 bird species and local habitat structure, landscape, grazing pressure and elevation. In general terms, the abandonment of pastures seems to determine a prompt increase of bird diversity and density per plot. However, while pastoral disuse leads to an overall increase in local avian diversity and density, most of woodland species that increase the diversity of abandoned habitats are quite ubiquitous and with a secure conservation status. conversely, several grassland species that here seem to be dependent upon grazing, have an unfavourable conservation status in Europe. It must be stressed that at landscape scale, grazing increases habitat diversity and, in turn, bird diversity. In conclusion, in order to preserve threatened bird species and to maintain a complex habitat mosaic and an high species diversity at large environmental scale, extensive grazing should be maintained in the Alps.

Keywords - bird communities, species diversity and density, domestic livestock, Gran Paradiso National Park

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1. Introduction

Agricultural and grassland habitats dominate Europe, covering about 50% of land surface (Tucker & Evans 1997). Development of farming technology after the second Word-War has resulted in radical and rapid changes of farming methods (Pain *et al* 1997). Farmland is paradoxically subject to dual contrasting threats: agricultural intensification and land abandonment. Massive agricultural intensification and specialization over the last 50 years have radically changed farmed lands across Europe, and much wildlife has suffered of this (Fuller *et al* 1995, Benton *et al.* 2002, 2003). In general terms, land abandonment is a side-effect of agricultural intensification, which makes low-intensity farming systems economically unviable and, therefore, unnecessary. As several bird species are specialists of agriculture and grasslands, the loss of these habitats can have profound effects on the avifauna. Nearly 70% of farmiand bird species have an unfavourable conservation status in Europe (Tucker & Evans 1997).

Alpine meadows are examples of semi-natural habitats largely created and maintained through grazing of domestic livestock. Deterioration of these habitats is widespread in the Alps, due mainly to depopulation of high elevation rural areas and reduction of stocking levels followed by a continue intensification of agricultural practices in valley bottoms.

In order to determine the best management practices in terms of bird diversity maintenance and bird species conservation, we examined the effects of pastoral abandonment on the breeding avifauna of Gran Paradiso National Park (Italy). To so, we re-analyzed data previously published by Laiolo *et al.* (2004).

2. Methods

Field work was carried out in pastures and abandoned pastures of Gran Paradiso National Park (north-western Italian Alps), in June-July 2001 and June-July 2002. The altitudinal range of the study area ranged from 1000 to 2800 m a.s.l.. We used a standardised 'area count' method (Bibby *et al.* 2000), surveying birds in circular plots of 50 m of radius. Counts lasted 15 minutes: during the first 5 minutes of the recording period the observer stood still as in standard point count, while in the latter time the observer moved and stopped at suitable vantage points recording all birds seen or heard

within the plot. Each census plot was visited twice (first visit in June, second in July of the same year); the largest values from the two censuses were used as a measure of bird species abundance per plot. At each plot, the following measurements were taken: vegetation height (40 random measurements per plot), heterogeneity of vegetation height (CV= height standard deviation (height) x 100), percent shrub cover, percent tree cover, percent boulder/stone cover. The last three estimates were by eye. Grazing impact was defined as: (0) abandoned pasture, (1) moderate grazing by free-ranging livestock, (2) high stocking levels, with cattle kept in fenced pastures, (3) haymaking associated with grazing. The above classification corresponds to a sequence of increasing grazing pressure. At the landscape scale, two variables were considered: the amount of contiguous grasslands around each census plot and the distance between each plot and the nearest woodland. These variables were extracted from the Gran Paradiso map database (derived from aerial photographs 1:10 000), with ArcView 3.1 (ESRI, CA).

Differences in mean species diversity (Shannon index: $H'=-\Sigma p_i$ x ln pi, where p_i is the relative frequency of species i) and overall bird abundance per plot among the four levels of grazing impact were tested by means of one-way ANOVAs on log-transformed data.

At the species level, we examined the associations among 32 bird species (those contributing with at least 10 individuals to the data set) and local habitat structure, landscape, grazing pressure and elevation using canonical correspondence analysis (CCA, ter Braak 1986). This is a multivariate technique that ordinates plots using both a primary matrix of species abundances and a secondary matrix of environmental variation (ter Braak 1986). We performed CCA in PC-ORD (McCune and Mefford 1999), logarithmically transforming data to give similar weights to all species and variables. To assess the significance in the CCA axes, we used the Monte Carlo simulation to test the hypothesis that there was no correlation between the primary (bird) and secondary (habitat, elevation, landscape and grazing) matrices: *P* values were based on the proportion of 1000 Monte Carlo simulations with eigenvalue greater than the observed eigenvalue.

Tab. 1 - List of the bird species recorded in the 350 plots of Gran Paradiso National Park.

Order	Family	Species: Common name	Scientific name
Galliformes	Tetraonidae	Ptarmigan	Lagopus mutus
Galliformes	Tetraonidae	Black grouse	Tetrao tetrix
Galliformes	Phasianidae	Rock partridge	Alectoris graeca
Cuculiformes	Cuculidae	Cuckoo	Cuculus canorus
Piciformes	Picidae	Great spotted woodpecker	Picoides major
Piciformes	Picidae	Green woodpecker	Picus viridis
Passeriformes	Alaudidae	Skylark	Alauda arvensis
Passeriformes	Motacillidae	Tree pipit	Anthus trivialis
Passeriformes	Motacillidae	Water pipit	Anthus spinoletta
Passeriformes	Motacillidae	Grey wagtail	Motacilla cinerea
Passeriformes	Motacillidae	White wagtail	Motacilla alba
Passeriformes	Cinclidae	Dipper	Cinclus cinclus
Passeriformes	Trogloodytidae	Wren	Troglodytes troglodytes
Passeriformes	Prunellidae	Dunnock	Prunella modularis
Passeriformes	Prunellidae	Alpine accentor	Prunella collaris
Passeriformes	Turdidae	Robin	Erithacus rubecula
Passeriformes	Turdidae	Black redstart	Phoenicurus ochruros
Passeriformes	Turdidae	Whinchat	Saxicola rubetra
Passeriformes	Turdidae	Rock Thrush	Monticola saxatilis

Order	Family	Species: Common name	Scientific name
Passeriformes	Turdidae	Wheatear	Oenanthe oenanthe
Passeriformes	Turdidae	Ring ouzel	Turdus torquatus
Passeriformes	Turdidae	Blackbird	Turdus merula
Passeriformes	Turdidae	Song thrush	Turdus philomelos
Passeriformes	Turdidae	Fieldfare	Turdus pilaris
Passeriformes	Turdidae	Mistle thrush	Turdus viscivorus
Passeriformes	Sylvidae	Lesser whitethroat	Sylvia curruca
Passeriformes	Sylvidae	Whitethroat	Sylvia communis
Passeriformes	Sylvidae	Garden Warbler	Sylvia borin
Passeriformes	Sylvidae	Blackcap	Sylvia atricapilla
Passeriformes	Sylvidae	Bonelli's warbler	Phylloscopus bonelli
Passeriformes	Sylvidae	Chiffchaff	Phylloscopus collybita
Passeriformes	Sylvidae	Goldcrest	Regulus regulus
Passeriformes	Aegithalidae	Long-tailed tit	Aegithalos caudatus
Passeriformes	Paridae	Coal tit	Parus ater
Passeriformes	Paridae	Willow tit	Parus montanus
Passeriformes	Paridae	Marsh tit	Parus palustris
Passeriformes	Paridae	Crested tit	Parus cristatus
Passeriformes	Paridae	Blue tit	Parus caeruleus
Passeriformes	Paridae	Great tit	Parus major
Passeriformes	Certhidae	Treecreeper	Certhia familiaris
Passeriformes	Thicodromatidae	Wallcreeper	Tichodroma muraria
Passeriformes	Laniidae	Red-backed shrike	Lanius collurio
Passeriformes	Corvidae	Jay	Garrulus glandarius
Passeriformes	Corvidae	Nutcracker	Nucifraga caryocatactes
Passeriformes	Corvidae	Alpine chough	Pyrrhocorax graculus
Passeriformes	Corvidae	Red-billed chough	Pyrrhocorax pyrrhocorax
Passeriformes	Corvidae	Carrion crow	Corvus corone corone
Passeriformes	Corvidae	Raven	Corvus corax
Passeriformes	Passeridae	Snowfinch	Montifringilla nivalis
Passeriformes	Passeridae	Italian sparrow	Passer italiae
Passeriformes	Fringillidae	Chaffinch	Fringilla coelebs
Passeriformes	Fringillidae	Serin	Serinus serinus
Passeriformes	Fringillidae	Citril finch	Serinus citrinella
Passeriformes	Fringillidae	Goldfinch	Carduelis carduelis
Passeriformes	Fringillidae	Linnet	Carduelis cannabina
Passeriformes	Fringillidae	Redpoll	Carduelis flammea
Passeriformes	Fringillidae	Bullfinch	Pyrrhula pyrrhula
Passeriformes	Fringillidae	Crossbill	Loxia curvirostra
Passeriformes	Emberizidae	Rock bunting	Emberiza cia

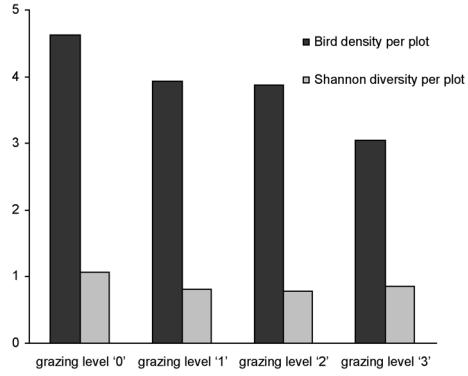

Fig. 1 – Mean bird diversity and density per plot (0.78 ha) under different grazing levels. For acronyms of grazing levels see methods.

3. Results

In 350 independent plots, we recorded the occurrence of 59 species (Table 1). Overall, 165 plots occurred in areas with grazing impact 0, 114 in areas with grazing impact 1, 52 in areas with grazing impact 2 and 19 in areas with grazing impact 3. Plots were located at a minimum distance of 200 m. Mean diversity and bird density per plot peaked in abandoned pastures (diversity: $F_{3, 346} = 5.4$, , $P < 0.01$; density: $F_{3, 346} = 4.0$, $P < 0.01$). A trend of decreasing bird density per plot associated to an increasing trend of grazing impact was recorded (Fig.1). LSD planned comparison post-hoc tests reveals that differences were significant between abandoned pastures and all the grazed fields.

CCA was used to ordinate matrices of bird community (32 species) and local habitat, landscape and grazing descriptors. The first two ordination axes of CCA had significant canonical eigenvalues, as revealed by the Monte Carlo tests (both axes: $P = 0.01$). The first CCA axis expressed a gradient from forested (left) to open and high altitude habitats (right). The second axis represented a gradient from low (top) to high grazing levels (bottom). Woodland and shrubbery species such as tits, robin, and warblers were associated with high percentages of shrub and tree cover and preferred spots with tall vegetation, whereas at increasing elevation, grassland area and distance from woodland, typical alpine birds were found: snowfinch, alpine accentor, choughs, wheatear and rock pipit. Wagtails, skylark, linnet, red-backed shrike, tree pipit, whinchat and fieldfare seemed to prefer grazed fields (Fig. 2).

4. Discussion

This study shows that undergrazing or complete elimination of domestic grazing can have consequences for the avifauna. In general terms, the abandonment of pastures seems to determine a prompt increase of bird diversity and density per plot. At the species level, different bird assemblages occur in the successional stages of grassland closure following pastoral disuse. High altitude grasslands are dominated by the typical alpine birds (snowfinch, alpine accentor, wheatear, rock pipit, rock thrush, alpine and red-billed chough); at intermediate elevations the community of grasslands is dominated by birds dwelling in open habitats (wagtails, skylark, whinchat, black redstart) and ecotones (carrion crow, linnet, fieldfare, mistle thrush, ring ouzel, tree pipit). When scrub and tree encroachment is no more arrested by grazing, assemblages typical of shrubbery and woodland are found: tits, robin, chiffchaff, nutcracker, wren, lesser whitethroat, garden warbler, dunnock and blackcap. By considering the present data and those published by Laiolo *et al.* (2004), it appears that the peak of bird diversity in abandoned pastures is mainly determined by the invasion of woodland and shrub species, that follow tree and shrub encroachment. Laiolo *et al.* (2004) found out that woodland and shrub specialists make up a disproportionate share of the species inhabiting abandoned pastures, at least in the montane belt. The results obtained with canonical correspondence analysis show that species typical of the alpine belt (choughs, wheatear, water pipit, etc.) are not influenced by grazing, whereas open habitat birds that inhabit lower elevation (skylark, linnet, whinchat, wagtails), and ecotone species (hooded crow, some thrushes), are positively influenced by grazing.

In conclusion, while pastoral disuse leads to an overall increase in avian diversity and density, most of woodland species that increase the diversity of abandoned habitats are quite ubiquitous and with a secure conservation status. Conversely, several grassland species that here seem to be dependent upon grazing have an unfavourable conservation status in Europe: skylark and red-backed shrike are 'SPEC 3' species, the whinchat, despite being a non-SPEC species, is becoming rare in western Europe, while the linnet is showing a negative population trend in Britain (Tucker & Heath 1994,

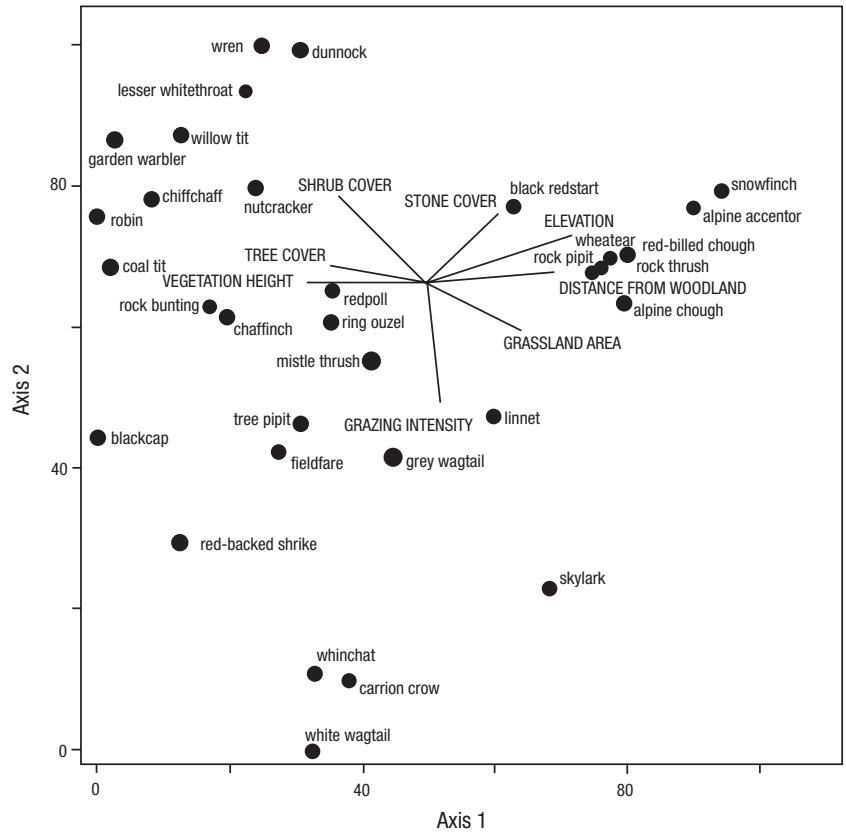

Fig. 2 – Biplot ordination diagram of axis one and axis two of CCA analysis showing the effects of elevation, local habitat variables, landscape variables, grazing intensity (vectors) on the bird community (points).

Chamberlain & Crick 1999, Henderson, Vickery & Fuller 2000).

5. Management implications

Grazing abandonment in Gran Paradiso Natural Park has significant effects on bird species diversity and community organisation. At the local (plot) scale, pastoral abandonment determines an increase of bird diversity through the invasion of shrub and woodland generalist bird species. Despite the negative effects of grazing on overall species richness and diversity at local scale, three different reasons suggest that pastoral practices should not be considered as detrimental to the alpine avifauna: 1) grazing maintains open fields and increases the availability of insect preys (dung beetles, flies), thus favouring certain open-habitat species that are declining throughout Europe (McCracken *et al.* 1995), 2) below the timberline, grazing increases habitat diversity and, in turn, bird diversity over broader scales (β diversity), 3) low-intensity livestock systems (associated with low inputs of agrochemicals and nutrients, relative abundance of semi-natural vegetation and stability of good management practices) can make an important contribution conservation by enhancing soil quality and increasing biodiversity (Vickery *et al.* 2001).

Ecological studies to determine optimum stocking levels should be encouraged, with parallel adjustment in pastureland management regulations and in incentives given to farmers, in order to facilitate sustainability, biodiversity and nature conservation (Zervas 1998). Eventually, the management of livestock should also take into account consequences for wild ungulates that inhabits the Park (Rupicapra rupicapra and Capra ibex).

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