# 20 EFFECTS OF LOCAL HABITAT AND LANDSCAPE STRUCTURE ON BIRD COMMUNITIES OF THE OAK FORESTS IN NORTHERN ITALY

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## INTRODUCTION

Habitat loss is regarded as the greatest threat facing forest plant and animal communities worldwide (Ehrlich, 1988). In Europe, forest fragmentation has been severe mostly in lowland temperate or boreal forests, which experienced a long history of man-made disturbances. In this study, we address the effects of forest fragmentation on the avifauna of downy oak woods on the northern border of Mediterranean Region. We analyse the effects of vegetation structure, forest patch area and shape on the composition and diversity of breeding and overwintering bird communities, in order to highlight habitat and landscape crucial factors for the avifauna in small forest patches in a farmland matrix.

## STUDY AREA AND METHODS

Fieldwork was carried out in May-June and December 2003 in the Bormida Valley, northwestern Italy (Fig. 1). This area is characterised by a hilly topography, with several forest fragments scattered in a prevailing farmed landscape. Forest patches are dominated by downy oak (*Quercus pubescens*) or sweet chestnut (*Castanea sativa*) (Fig.2). We focused on 7 downy oak forest patches ranging from 1 to 48 ha. Birds were surveyed with the standard point-count method (Blondel *et al.*, 1970; Blondel, 1975). This technique involves a count of all birds seen or heard inside a 50 m radius circular plot; each point was sampled for 10 minutes between sunrise and 4 hr later. Each census plot was visited twice in spring and twice in winter, and the largest values from the two surveys per season were used as a measure of bird species abundance per plot. Overall, 49-point counts were carried out, and the number of points per forest patch was proportional to patch size. At the centre of each census station, we also measured diameter of four canopy trees at average 1 m height (DBH) and canopy density (DENS: the distance among the four closest trees was paced in metres and the inverse of distance gave the measure of density). From these measurements we derived the variability in tree diameter (CVDBH) and the variability in tree density (CVDENS), *i.e.* the coefficient of variation of tree diameter and density (SD/mean percent). A

Geographic Information System (ArcView 3.1 for Windows) and FRAGSTATS software (McGarigal & Marks, 1995) was used to measure the landscape parameters illustrated in Table 1 at patch level. Non-parametric Spearman correlation test was used to determine correlations between variables. The bird community structure in each forest patch was expressed in terms of total species number, and in terms of mean bird density, species richness, and Shannon diversity per sample plot (0.78 ha).

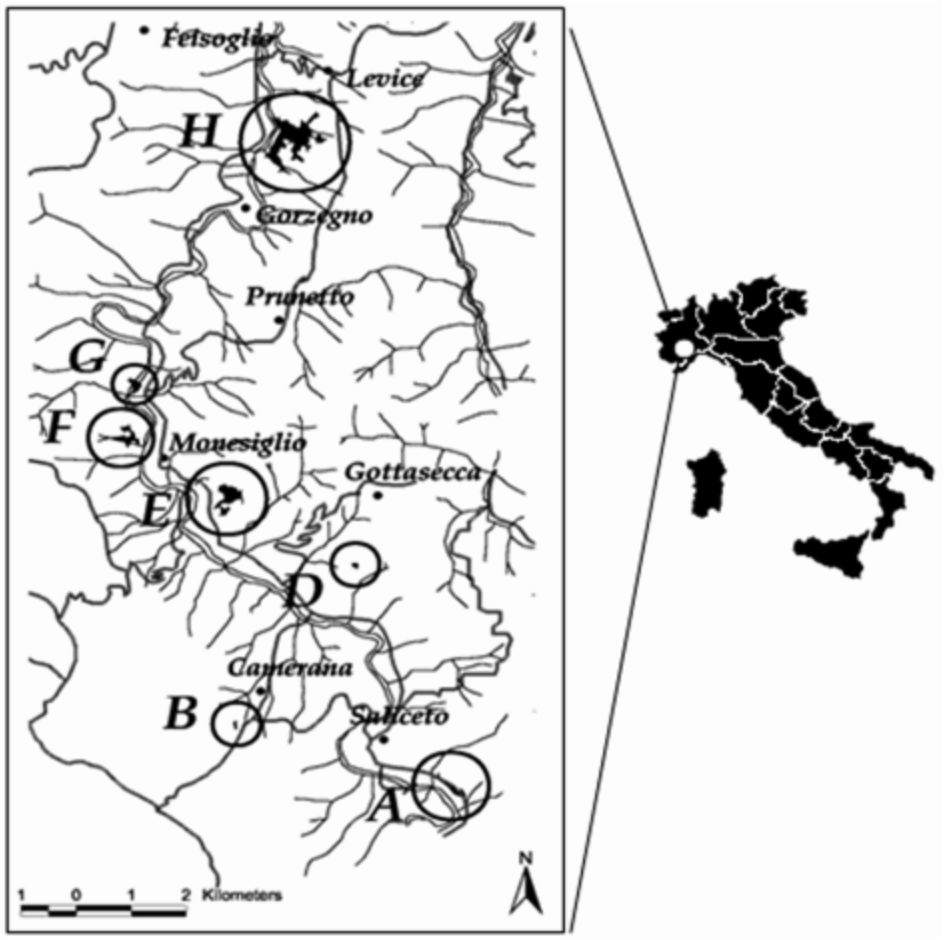


**Figure 1**: Valle Bormida and selected wood patches.

**Table 1**: Spatial metrics computed for the seven patches (if no specified, refers for all metrics to McGarigal & Marks, 1995).

| ACRONYM | PARAMETER | UNIT | RANGE |
|---|---|---|---|
| Area | Total Area | $m^2$ | >0 |
| Perimeter | Total Perimeter | m | >0 |
| Gyrate | Patch extent | m | >0 |
| Para | Perimeter / Area ratio | None | >0 |
| Shape | Perimeter / Area ratio compared | None | >1 |

| | | | |
|---|---|---|---|
| Frac | Fractal dimension (O'Neill *et al.*, 1998) | None | 1≤FRAC ≤2 |
| Circle | Patch elongation | None | 0≤CIRCLE ≤1 |
| Contig | Patch connectedness (La Gro, 1991) | None | 0≤CONTIG ≤1 |
| Ncore | Number of Core Areas | None | ≥0 |
| Cai | % of the patch area that is comprised of core area | % | 0≤CAI ≤1 |

## RESULTS

Twenty-four species were observed in the study stands (Table 2). In Spring 21 species were observed, 14 in winter. In spring the total number of species per sample plot was positively correlated with forest size and fragmentation, forest age and patch shape complexity. Mean bird species richness, density and Shannon diversity per sample plot were positively correlated with forest age and complexity. At the species level, chiffchaff densities per plot peaked in old stands characterized by a complex shape, whereas blue tit and chaffinch preferred large forest patches. On the contrary, long tailed tit was more abundant in small patches, and greenfinch favoured stands with sparse tree. In winter, forest age and size resulted positively correlated with mean bird density and species richness. At the species level, marsh tit and wren peaked in old stands while the abundance of blackbird is positively correlated with forest size and fragmentation. Species-area curve for both seasons is illustrated in Fig. 2.

**Table 2**: Species list (alphabetical order).

| | | | |
|---|---|---|---|
| *Aegithalos caudatus* | Long-tailed Tit | *Parus palustris* | Marsh Tit |
| *Carduelis carduelis* | Goldfinch | *Phoenicurus phoenicurus* | Redstart |
| *Carduelis chloris* | Greenfinch | *Phylloscopus bonelli* | Bonelli's Warbler |
| *Colomba palumbus* | Wood Pigeon | *Phylloscopus collybita* | Chiffchaff |
| *Cuculus canorus* | Cuckoo | *Picus viridis* | Green Woodpecker |
| *Dedrocopos major* | Great spotted Woodpecker | *Oriolus canorus* | Golden oriole |
| *Erithacus rubecula* | Robin | *Sitta europea* | Nuthatch |
| *Fringilla coelebs* | Chaffinch | *Streptopelia decaocto* | Collared Dove |
| *Garrulus glandarius* | Jay | *Sylvia atricapilla* | Blackcap |
| *Oriolus oriolus* | Golden Oriole | *Troglodytes troglodytes* | Wren |
| *Parus caeruleus* | Blue Tit | *Turdus iliacus* | Redwing |
| *Parus major* | Great Tit | *Turdus merula* | Blackbird |

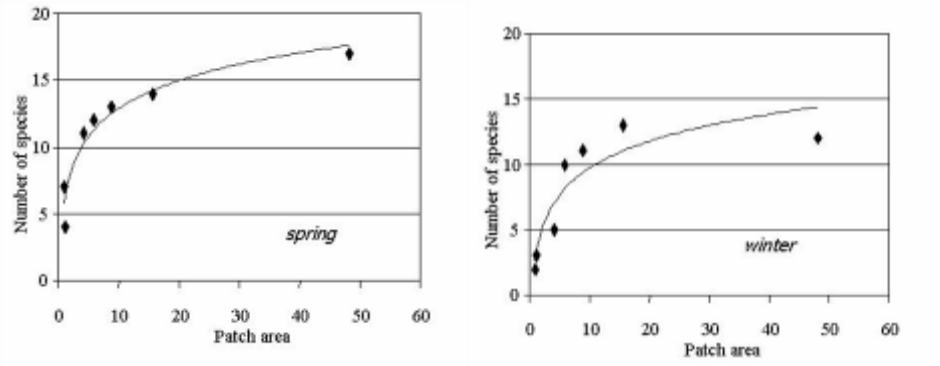


**Figure 2**: Species area-curve in spring (above) and winter (below).

## DISCUSSION AND CONCLUSIONS

In the study area, a significant species-area correlation was found in spring, thus confirming the role of patch size in maintaining a rich bird community on the whole (Forman, 1995). The number of species and density of birds per plot increased with forest age, emphasising the positive role of mature trees in forest ecosystems (Moss, 1978; Helle & Mönkkönen, 1990). At the species level, contrasting results were obtained, suggesting that single bird species were differentially affected by forest fragmentation: two species preferred to dwell in the largest forests (blue tit and chaffinch), whereas one favoured small ones (long-tailed tit). In winter the correlation species-area appears weaker than in spring probably according to trophic needs. Blue tit is the most abundant species. As observed for spring abundance of marsh tit, it is positively correlated with forest age and size and blackbird prefers fragmented patches.

In the breeding period, the mean density of the blackcap (*Sylvia atricapilla*) and chiffchaff (*Phylloscopus collybita*) per point-count stations increased in forest patches with complex edges, whereas the blue tit (*Parus caeruleus*) was more abundant in large forest patches. In winter, the wren (*Troglodytes troglodytes*), marsh tit (*Parus palustris*) and blackbird (*Turdus merula*) were more abundant in large patches, and the former two species also selected mature stands.

The results of this study suggest that forest fragmentation in small patches is likely to be detrimental to the bird community on the whole. Mature, large forest patches with complex edges seem to favour several species throughout the year.

According to our analysis it seems that the presence of marsh tit can be regarded as a good indicator of a healthy wood ecosystem (mature and non-fragmented stands). We can conclude that the conservation of wood primary structure is strongly recommended to maintain healthy populations of species of stable wood ecosystems.

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