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Protected areas and landscape conservation in the Lombardy plain (northern Italy): an appraisal

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Abstract

Between the 1980s and 1990s, conservation policy in Lombardy (NW Italy) was enhanced with the establishment of the Protected Areas System, which encompassed a wide area of nature reserves and regional parks. The main aim of the Protected Areas System was to preserve cultural, natural and traditional human activity over large areas affected by very rapid development processes.

Currently, the Protected Areas System covers about 26% of Lombardy, and human activity within the protected areas is managed and controlled by a consistent body of rules and laws, operating in an eco-sustainable framework. The actual effect of these rules and regulations on landscape and biodiversity conservation is, however, poorly understood.

The aims of this study are: (1) to describe the development of the Protected Areas System and its features in southern Lombardy between 1980 and 1994; (2) to confirm that avian species richness is higher in the Protected Areas System than in the related buffer zones; (3) to describe the role of the regulations and laws in establishing the Protected Areas System.

The study was carried out in four regional parks of southern Lombardy, and in the related buffer areas, considered as controls. Five variables (natural habitat surface, field size, grassland availability, urban areas, and avian species richness) were compared within and outside the protected areas.

Results are summarized as follows: during the study period, the surface covered by natural habitats decreased significantly in control (63.6%) than in protected areas (33.2%), the average field area increased 34.2% in control areas and 15.3% in protected areas, urbanized areas increased 52.3% in control areas and 15.1% in protected areas, while no significant difference was observed in grassland availability. Avian species richness was significantly higher in protected than in control areas.

Results showed that despite a general reduction of the environmental value in the wider environment from the 1980s to the early 1990s, the network of protected areas effectively protected some landscape features, and successfully contributed in restraining the expansion of urban areas. Moreover, it confirmed that avian species richness is higher in the Protected Areas System than in control areas.

Data on restraining urban development was of the utmost importance, since the Lombardy Protected Areas System included wide areas of primary urban value. These data can be partially explained by the dominant role of the Park Development Plan on

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the Urban Development Plan, adopted by the local municipality, and proposes the application of the precautionary principle in the simplification process, which is currently affecting the rules and laws governing protected areas in Italy.

Keywords: Landscape conservation; Protected areas; Northern Italy

1. Introduction

The protection of landscape features and biodiversity rests on the creation of networks of protected areas (parks and reserves), as well as on the environmental conditions of the outer unprotected areas (Roberts, 1988; Shafer, 1999; Woinarski et al., 1992). The establishment of a system of protected areas is widely recognized as being critical to nature and landscape conservation (WRI/IUCN/UNEP, 1992; Andelman and Willig, 2003; Shafer, 1997; Waldhardt, 2003). The importance of the outer unprotected 'buffer' areas is, however, often neglected. In conservation, buffer areas are important for three main reasons: (1) the environmental quality of buffer areas is critical to maintain ecosystem functioning of protected areas, allowing animal and plant dispersal and gene flow (Bridle et al., 2004; Ishibashi and Saitoh, 2004); (2) to prevent a *siege* approach (*sensu* Primack, 1995), where human activities outside protected areas can be totally deregulated; and (3) to establish "control" areas useful for monitoring changes in landscape features compared to protected areas.

In the floodplains of Western Europe, several parks and nature reserves are facing heavy pressure due to increased urban development and modern farming practices (Treu et al., 2000), which, in turn, negatively affect the quality of the residual natural habitats. During the early 1980s, a network of regional parks was implemented in Lombardy (northern Italy) (hereafter called Protected Areas System), focusing on the protection of the "historic countryside" (Cooper, 2000) rather than biological diversity. Indeed, regional legislation was more directed towards regulating deep-impact activities (such as urban expansion and intensive farming) than on direct protection of biodiversity inside these protected areas. This holistic approach to nature conservation, where planning of human economic activities (including farming) are given priority over the protection of natural habitats, appears to be effective for the protection of both landscape and biodiversity (Canova, 2004). In fact, within the next few decades, terrestrial ecosystems are expected to be affected mainly by changes in land-use (Robson, 1997; Sala et al., 2000; Waldhardt, 2003).

Within this context, local efforts and funding have been devoted more to strengthen the administration of the Protected Areas System, rather than to studying its real effect on the conservation of biodiversity and landscape features (Blasi, 2001; Lasen, 2001). Therefore, verifying the actual contribution of the Protected Areas System to nature conservation is important in selecting future political choices, since several protected areas, especially in the southern sector of Lombardy, include sites of primary industrial, agricultural and urban value (Treu et al., 2000; Mariotti and Margiocco, 2002).

The aim of the present study is to describe the changes in landscape features within and outside the Protected Areas System in southern Lombardy between 1980 and 1994, and to analyse the contribution of protected areas in preserving an important component of biodiversity (i.e., avian species richness) (Bani et al., 2002). Finally, the efficacy of the Lombardy Protected Areas System for the conservation of landscape features and biodiversity is discussed.

2. Study areas and methods

The study area included the southern sector of the following Regional Parks: Ticino (90,640 ha), South Adda (24,400 ha), South Milano (48,000 ha) and Serio (7480 ha), and a buffer belt distributed along the SE boundary of the protected areas (Fig. 1). Regional parks are located in the mid-lowland of Lombardy; three parks are located along the main course of Po, Adda and Serio rivers and are classified as "river parks", while the South Milano park mark the south boundary of Milan (Table 1).

Fig. 1. Details of the study area (grey: protected areas; dotted: control areas).

The total protected area included in the study was 98,000 ha, corresponding to about 54% of the regional parks located in the southern Lombardy plain. The extension of the unprotected buffer belt (hereafter "control areas") was 80,000 ha.

Analysis was carried out on the basis of a grid of 1-km^2 sample units, consistent with the UTM system (980 in protected areas and 800 in control areas). Each sample unit was progressively numbered and a sample of 120 separate units was randomly chosen for protected and control areas. Therefore, the total unit samples analysed were 240, corresponding to 24,000 ha of total surface (12,000 ha included in protected areas and 12,000 ha in control areas).

Changes in landscape features within and outside the Protected Areas System were analysed by comparing aerial photos and maps (CTR 1:10,000) taken in 1980 and 1994. In each sampling plot, the total surface covered by natural habitat (woods and woodlots, reed beds, oxbows), the field areas (i.e., average surface of cultivated patches), the area covered by grassland, and the area covered by urban or built-up areas were measured using the Arcview 3.1 package. Grassland (i.e., meadows and flooded meadows, locally known as "marcite") were not recognizable on aerial photos; therefore this variable was measured only in the South Adda Park and the related control areas, on the basis of archive information collected by the author between 1980 and 1994.

Avian species richness (i.e., the number of breeding species/plot) in sample units were gathered from Brichetti and Fasola (1992); following Bani et al. (2002) avian specie richness was considered as a qualitative, partial index of local biodiversity importance.

2.1. Statistical analysis

All habitat variables are expressed as hectares/square kilometer ± standard error of mean (S.E.). Analysis of variance was used to assess the mean differences between periods; data were log-transformed to approach the normal distribution, and homogeneity of variances was tested using Cochran's test. Statistical Package for Social Science (SPSS 10.1) was adopted for analyses.

3. Results

3.1. Natural habitats

From 1980 to 1994, the area covered by natural habitats decreased, though not significantly, in all

Table 1
Details of the protected areas (see also, Fig. 1)

Protected area	Province	Description
South Milano	Milano	South Milano park is a wide semicircular belt located along the southern perimeter of the province of Milan The environmental features of the area are those characteristic of the Milanese irrigated plain, with an intensive agriculture that goes back to the first drainage systems of the Middle Ages The prevailing environmental matrix is constituted by a typical rural habitat, by a network of channels, hedgerows and a few natural habitat fragments South Milano park's most relevant features are architectural elements, such as the Abbeys of Chiaravalle, Mirasole and Viboldone, and the rural centres of the ancient farms
South Adda	Lodi, Cremona	The park extends from the middle course of the river Adda to the mouth in the Po river. Wide agricultural extensions and a few natural habitats (willow woodland and oxbow) are included in the park A few animal communities are remarkable from a naturalistic point of view, such as a huge heronry in the Zerbaglia reserve. The Park is managed by 37 local authorities, including 35 towns and two provinces (Lodi, Cremona)
Serio	Bergamo, Cremona	The park includes areas along the river Serio from the middle course to the mouth in the Adda river. Wide agricultural extensions, a few natural habitats, and historical elements such as the Castello di Malpaga, are included in the Serio park The Park is managed by 28 local authorities among which includes 26 towns and two provinces (Cremona, Bergamo)
Ticino	Pavia	Ticino rises in Switzerland. Its main source lies at the head of val Bedretto and San Gottardo. After a wild route, the river runs through the plain of Magadino, where it flows into the Lago Maggiore. From the lake, the river runs for about 110 km in the Padana Plain, flowing into the Po river near the town of Pavia The Regional park includes wooded areas and oxbows, and is the most important greenbelt connecting the ecological region of the Alps to the cultivated Padana Plain. Cultivated and industrial areas are included in the regional park, as well as towns, such as Pavia and Vigevano. The Park is managed by 49 local authorities, and includes 46 towns and three provinces (Milano, Pavia, Varese)

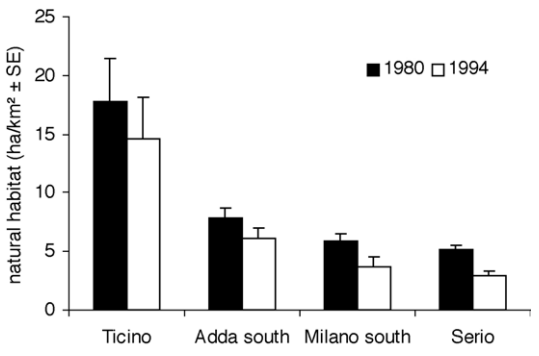

Fig. 2. Decrease of natural habitat in the protected areas (1980–1994). Results are given as the average area (in hectares) per square kilometers ± S.E.

protected areas ($F_{1,238} = 2.51$, $P = 0.11$; Fig. 2). The average area varied from 9.2 ± 1.0 ha/km^2 before 1980 to 6.9 ± 1.0 ha/km^2 in 1994. In the control areas, the average area/plot covered by natural habitat significantly decreased from 4.9 ± 0.3 ha/km^2 before 1980 to 1.8 ± 0.1 ha/km^2 in 1994 ($F_{1,238} = 93.3$, $P < 0.001$).

Natural habitat availability was lower in control than in protected areas, even before the establishment of the Protected Areas System; however, during the study period, its availability decreased more strongly in control (63.6%) than in protected areas (33.2%) (Table 2).

3.2. Fields

Field average area significantly increased during the study period, both in protected and in control ar-

Table 2
Standard statistics for four variables (in hectares/square kilometer ± S.E.) in protected and control areas (1980–1994)

Variable	Protected areas		Control areas	
	1980	1994	1980	1994
Natural habitat	9.2 (±1.0)	6.9 (±1.0)	4.9 (±0.3)	1.8 (±0.1)
Field area	1.8 (±0.1)	2.1 (±0.1)	2.0 (±0.1)	2.7 (±0.1)
Grassland area	13.9 (±1.3)	4.9 (±0.8)	15.9 (±0.8)	4.5 (±0.4)
Urbanized area	5.7 (±0.6)	6.6 (±0.6)	6.3 (±0.5)	9.5 (±1.6)

eas, with a corresponding decrease of ecotone, such as hedgerows and tree rows separating fields.

Field average area increased more in control areas ($\bar{X}_{80} = 2.0 \pm 0.1$; $\bar{X}_{94} = 2.7 \pm 0.1$; $F_{1,238} = 31.1$, $P = 0.002$) than in protected areas during the study period ($\bar{X}_{80} = 1.8 \pm 0.1$; $\bar{X}_{94} = 2.1 \pm 0.1$; $F_{1,238} = 9.52$, $P < 0.001$).

From 1980 to 1994, average field area increased 34.2% in control areas and 15.3% in protected areas (Table 2).

3.3. Grassland

In South Adda Park, grassland areas markedly decreased during the study period, both in the protected and in the control area (Table 2). The average area covered by stable cultivation dropped from 15.9 ha/km^2 before 1980 to 4.5 ha/km^2 in 1994 in the control area, and from 13.9 ha/km^2 to 4.9 ha/km^2 in protected areas.

A significant decrease was observed both in protected ($F_{1,58} = 36.2$, $P < 0.001$) and in control areas ($F_{1,58} = 178.5$, $P < 0.001$); in 1994, moreover, the availability of grasslands in protected areas did not significantly differ from control areas ($t = -0.40$, d.f. = 29, $P = 0.67$).

3.4. Urbanized and built-up areas

Urbanized and built-up areas increased significantly during the study period in control areas ($\bar{X}_{80} = 6.3 \pm 0.5$; $\bar{X}_{94} = 9.5 \pm 1.6$; $F_{1,238} = 3.76$, $P = 0.05$), while no significant differences were detected in protected areas ($\bar{X}_{80} = 5.7 \pm 0.6$; $\bar{X}_{94} = 6.6 \pm 0.6$; $F_{1,238} = 1.02$, $P = 0.31$).

Between 1980 and 1994, the average value of urbanized areas increased 52.3% in control areas and 15.1% in protected areas (Table 2).

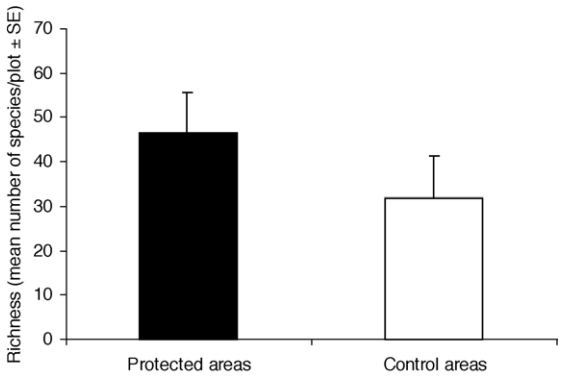

Fig. 3. Avian species richness in protected and control areas.

3.5. Avian species richness

Data on avian species richness, before and after the establishment of the Protected Areas System, were not available; therefore avian species richness, within and outside the Protected Areas System, was compared using original data published by Brichetti and Fasola (1992). Data showed that avian species richness, namely the number of breeding species/plot assessed in 1987, considered as a partial index of biodiversity, was significantly higher in protected areas than in control ones ($\bar{X}_{\text{protected}} = 46.4 \pm 9.1$; $\bar{X}_{\text{control}} = 31.9 \pm 9.4$; $F_{1,58} = 36.7$, $P = 0.001$) (Fig. 3).

4. Discussion

In the southern plains of Lombardy, the pattern of landscape alteration was examined inside the protected areas and the unprotected buffer zones, considered as controls areas. Five main variables (natural habitat surface, field size, stable cultivation availability, urban areas and avian species richness) were compared in

protected versus control areas to monitor the effectiveness of the conservation policy in Lombardy during the 1980s.

Data showed that a wide process of habitat change took place in the Lombardy plain from 1980 to 1994, confirming a pattern well known in developed countries (Myers, 1987; Primack, 1993; Hunter, 1996). As elsewhere, this process of habitat change involved both protected and unprotected areas, and is caused mainly by an increase of urban areas (Weber, 2003; UNPD, 1991), a qualitative and quantitative change in farming (Baldock, 1990; Tucker and Dixon, 1997; Potter, 1997), and a decrease of natural habitat (Gaston et al., 2003).

In the study area, however, the transformation process appeared to be slower in the Protected Areas System than in the control areas. Significant differences in habitat change were observed for: (1) the natural habitat surface, which decreased more in control (63.6%) than in protected areas (33.2%); (2) the average field area, which increased 34.2% in control areas and 15.3% in protected areas; and (3) the urban areas, which increased 52.3% in control areas and 15.1 in protected areas.

Hence, it is confirmed that more natural habitat, and typical rural habitat and less urbanized areas, are included in protected areas than control ones.

Grassland availability did not differ significantly between protected and control areas, thus suggesting that the Protected Areas System successfully preserved some physical agrocoenosis features (i.e., field size), but cannot prevent the alteration of agrocoenosis quality.

Data showed that avian species richness was significantly higher in protected areas than in control ones, confirming a greater naturalistic value of the Protected Areas System than the control areas.

The pattern described here confirms that the overall influence of the rules and laws governing the protection of nature in Lombardy (LR 86/83, Park Development Plan) was successful in the conservation of some environmental features.

The urban expansion appeared to be strongly restrained inside protected areas, owing probably to the effectiveness of the laws regulating urban development. Within protected areas, building activity is moderated by laws, also known as Piani Territoriali di Coordinamento or Park Development Plan, curbing or preventing unplanned urban expansion. This complex system of laws prevailed, and became superimposed on the local development plan adopted by small towns and cities. The prevailing rules of the Regional Parks imposed a homogeneous development on towns and on farmhouses located within parks, and this probably resulted in a reduction of the expansion of urbanized and built-up areas.

5. Conclusion

The preliminary data needs to be confirmed by checking for possible error sources, such as initial differences between protected and control areas, original differences in farming practices, differences in the organization of local farmland management, property, and so on. The approach followed in this paper, however, will be useful during in-depth analysis of the importance of buffer areas in conservation enhancement, the actual contribution of protected areas analysed in a semi-experimental context, and comparative studies, including other animal or plant taxa.

The present data cautiously suggest that the institution of the Lombardy Protected Areas System had a real effect on conservation of natural habitat and landscape features in the Lombardy countryside, despite a widespread process of habitat alteration, which also affected the Protected Areas System. Data support the statement that regional parks and nature reserves are an effective tool in preserving nature, even in the most industrialized and urbanized areas.

From the 1970s, planning authority has been slowly transferred from the State to regional and provincial control (Treu et al., 2000). During this period, the role of municipalities in local planning increased significantly and, among local authorities, only national and regional parks maintained a substantial role in landscape management. To entrust protected areas a substantial role in landscape management is an effective mechanism in protecting landscape and nature. Nevertheless, these positive effects must be enhanced by preserving and strengthening the prevailing laws governing nature conservation and urban planning within Regional Parks.

A more general outcome of this preliminary research is that the fragmentation of expertise between several local authorities could result in a weakened

environmental policy, and that Fitzsimmons's (1998) hypothesis, of a management of the ecosystem controlled by market forces, should be resolutely rejected or, at least, cautiously considered.

The application of the precautionary principle (O'Riordan and Cameron, 1994) in the simplification of law-making, currently under progress in Italy, appears, at least in the case of environment policy, to be highly desirable.

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