Relationships between field boundaries, farming systems and landscape: consequences on biodiversity pattern in agrarian landscapes.

Claudine Thenail, Didier Le Cœur & Jacques Baudry

INRA-SAD Armorique
65, rue de Saint-Brieuc
35 042 Rennes cedex
FRANCE

Abstract:

Field boundaries are important habitats for animal and plant species and sources of biodiversity in agrarian landscapes. We address the question of the driving factors of the diversity of the field boundary vegetation of three *bocage* areas in Brittany (France), differing by their density of hedgerows (decreasing from Site A to Site B then C). At the level of the field boundary and adjacent fields, the boundary vegetation (presence of trees, species diversity) is related to the boundary management, the adjacent field land cover, land use and associated farm characteristics. At the landscape level, the field boundary vegetation differs significantly from one study site to another. The dominant agriculture in the region is based on dairy production, with grassland, maize and cereals. However, the three study sites differ regarding the farm characteristics, and the structure of farm territories: there is an increase in production level, technical means, cropping, and a decrease in the fragmentation of farm territories from Site A to C. Consequently, choices made in farms, on the nature and spatial organization of land use and boundary management, are also different. The aggregation of the pieces of farm territory at the scale of each study site provides significantly different land use mosaics, and field boundaries networks. Our results show that the landscape context, in which the field boundaries are embedded, significantly influences the species composition of these boundaries. Farming activities collectively contribute to this landscape context. However, this is a complex factor, and the relative influence of the different mechanisms involved is still to be sought.

Key words: biodiversity, field boundary, farming system, farm territory, hedgerow, land cover, landscape, land use, plants.

Introduction

Biodiversity is now a top issue on the agenda of policy makers. At the planet scale, species are disappearing at an unprecedented rate, over geological times (Lubchenco et al., 1991). Under the Rio convention on biodiversity, Governments are responsible for species conservation, and must, therefore, design and implement policies to achieve such a goal. Evidences from regional and landscape scale studies increasingly demonstrate that policies of biodiversity conservation, solely based upon sets of reserves, are inefficient to protect species in the long run (Forman, 1987). Furthermore in Europe, agricultural landscapes are largely predominant, so that the notion of "natural area" has a few senses, and possible reserve areas are limited in space. The development of ecological networks or corridors at national or continental scales results from such clues (Cook & van Lier, 1994): these linear protected areas are designed to be embedded into farmland. Farmland itself is becoming a target for maintaining biodiversity, as soon as ecological concerns are not anymore restricted to "patrimonial" species (Green, 1981). The conservation or enhancement of the biodiversity in such farmed areas, implies an appropriate management of the dynamic of farmland (Gilg, 1998). This supposes to gain knowledge on the diversity of relationships between farms, farming activities and biodiversity (Burel & Baudry, 1995).

Research studies in landscape ecology (Forman, 1995) have shown that plants or animals "perceive" the mosaic of landscape elements (open fields, grassland, wetland, woodland, ponds, hedgerows etc.) as habitats patches (places to live) and possibilities to move from one place to another (corridors giving the possibilities to disperse) (Burel & Baudry, 1999). Different species require different habitats (single or combined landscape elements), may be a set of different habitats for different life stages (larval, adult) of different size (large, small). Therefore the inner diversity and structure of a landscape mosaic is a crucial point in the maintenance of biodiversity (Burel & Baudry, 1995).
Among the landscape elements earlier listed, the key elements pinpointed by ecologists are often located between fields, like channels or hedgerows, or more generally, *e.g*., for ponds or woodlots, outside the farmed "productive space" the agronomists traditionally focus on (Boatman, 1994; Deffontaines, 1993; Way & Greig-Smith, 1987). Nevertheless, elements such as field boundaries - herbaceous strips or hedgerows - are the subject of management practices (Watt & Buckley, 1994), and constitute a frame that may be more or less constraining for the development of farms and farming activities (Duvernoy et al., 1994; Sautter, 1993). Thus a complex set of relationships could be expected between the dynamics of field boundaries, and the dynamics of farms and farming activities, influencing the biodiversity of field boundaries, and more generally, of the agrarian landscape. We developed from this argumentation a research project dealing with the relationships between agriculture, field boundaries and biodiversity in bocage landscapes (hedgerows network landscapes), in Brittany (France) (Baudry et al., 1993). The aim of this paper is to present some of the results of this project, about the understanding of the diversity of the field boundaries and their contribution to the agrarian landscape mosaic. We jointly posed in this project, the question of combining a farming system approach (Gras et al., 1989; Person & Ison, 1997) with one in landscape ecology.

The question of the diversity of the field boundaries is here addressed regarding the diversity of structures, *i.e*., hedgerows versus shrub and/or herbaceous boundaries, and the diversity of the herbaceous plant species. The diversity of structures can be related to a diversity of local microclimatic conditions susceptible to influence the composition of the species assemblages (Hegarty et al., 1994; Mountford et al., 1994). In addition, variables describing the structure are easier to collect than exhaustive lists of plant species.
We propose a hierarchical approach for analyzing this diversity of field boundaries and its driving factors (Fig.1). *At the level of the field boundary and adjacent fields* (Fig.1.a), we hypothesize that the characteristics of the vegetation of the field boundary are linked to the management of the boundary, but also to the management of the adjacent fields (arrows A1, A2). Their narrowness suggests that their vegetation may be at least influenced by the management practices implemented on adjacent fields (Le Coeur et al., 1997). Research studies about the farm territory management show that groups of fields connected or not, can be managed together, so that these groups form "functional islet" (Josien et al., 1994; Maxime et al., 1995). We suggest that a field boundary may be part of the organized management system of the field or set of fields it is connected to, in a farm (Fig.1.b,c; arrow B1). *At the level of the farm*, we hypothesize that the diversity of field boundaries is linked to the characteristics of the family-farm system (Gras et al., 1989), as well as to the characteristics of the farm territory (Fig.1.c; arrows B1, B2). Not only the physical but also the

structural characteristics of the farm territories have been shown to be driving factors of the land use composition and spatial organization in farms (Morlon et Benoît, 1990; Deffontaines et al., 1995). Field boundaries maybe part of this organization, being both inherited features, and products of farming. One of the specificity of agrarian landscapes is the organization of the land use mosaic, as related to the inner farm factors of organization, and to the spatial pattern of constraints at the landscape level (Baudry, 1993; Bonnemaire et al., 1995; Stomph et al., 1994). This leads us to a last hypothesis that, *at the landscape level* (Fig.1.d), the density of the hedgerows network and its species composition, may be linked to the composition and spatial organization of farms and land use (arrows C1, C2).

Place and methods of study

The research project was carried out in Brittany, France. The agricultural landscape of this region is a representative example of a cultural *bocage* landscape[1], which exhibits since the Second World War dramatic structural changes (notably field enlargement and hedgerows removal). These changes have accompanied a rapid modernization and intensification of the agriculture (Dalton & Canevet, 1999). However, the hedgerows density remains very heterogeneous today, with a succession in space of dense networks, and more open ones, through out the region (Morant et al., 1995). This heterogeneity can also be observed at micro-regional scales: the scale of a county, several municipalities, or a large watershed for instance. In a micro–region of the south of the Mont Saint Michel bay (Northern Brittany), such a gradient of bocage density can be observed, while the agriculture is very homogeneous, with a predominance of dairy production systems, based on maize, cereals, rotational and permanent grassland.

We chose, in this micro-region, three study sites of 500-800 ha each (Baudry et al., in press). The sites are close to each other (3-5 Km) but differ by the density of hedgerows (decrease of density from Site A to Site B then C). The comparison of the three sites allowed analyzing a diversity of situations both in term of field boundaries, and in term of overall composition and spatial structure of the boundaries network at the landscape level. All the landscape elements of each site (fields, field boundaries, rivers etc.) were registered in a Geographical Information System (GIS), and described in associated databases, from which we run the analyses (Morvan & Thenail, 1995). We intended to interview all the farmers using at least one field in one of the study site, in order to cover by this information, a major part of each site. A total of 69 farmers accepted to be interviewed; they are conventional farmers, and most of them are full time farmers. They use about 2000 fields, the half of them being situated in the study sites.

I. Description of the diversity of boundaries

A linear feature, such as a hedgerow is often delimited in ecological studies, independently of any adjacent landscape element (Bunce & Hallam, 1993; Hooper, 1987). To make possible the analysis of the relationships between boundaries and fields' utilization, we chose to limit the boundaries in length, according to the limit of the adjacent fields that follow each other in space (Baudry & Thenail, 1999). Each boundary is thus associated to an agricultural unit of management (Fig.1.b).
The *structure of the vegetation,* as well as *the tree and shrub species* were described for the totality of the field boundaries of the three sites (over 3000 boundaries). A first typology was made, separating the hedgerows (with trees) from the other boundaries. The presence of hedgerows surrounding fields were also expressed by a variable called "woody perimeter" which is the proportion of the field perimeter covered by hedgerows (Fig.1.b).
The *plant species composition of the herb layer* was described for a subset of about one hundred boundaries per site. The herb layer is defined as the vegetation between 0 and 1 m high. While most of the trees and shrub species are planted (at least favored), this ground vegetation is spontaneous and much richer, thus more likely to depict variations in environmental factors. For this later survey, we considered the two sides (*i.e.*, the two field margins; Fig.1.a) of a boundary independently, as we hypothesized that species composition depends on the use and management of adjacent field (Baudry et al., 1998).

[1] Hedgerows network landscape.

II. Selected factors at the field/boundary and farm level

1) Factors tested on the vegetation structure of the field boundary: farm type, land cover type, land use type, and field characteristics

Farms were characterized by a set of socioeconomic (*e.g.*, age, economic size[2]), production, and technical variables (Thenail, 1996). These variables were selected to describe structural features of the farm, but also to give some features of its technical functioning, such as the milking equipment and techniques used by the farmer, or the source of equipment and labor force implemented for the main field activities (*e.g.*, maize ensiling). This is the choice we made to represent the family-farm system. A Multiple Correspondence Analysis on these variables, followed by a Cluster Analysis (Gower, 1987) led to the identification of 7 farm types, among which a majority of dairy farm types. We selected for the present paper the four dairy farm types DF1 to DF4. From DF1 to DF4, the milk quotas are increasing (from about 20-50,000 to 200-500,000 l.), as well as the economic size (from 12-40 units, to more than 40 units) and the technical means for the dairy production (increase in the frequency of milking parlors, of milk recording and artificial insemination for heifers). There is also an increase in the diversity of production from DF1 (very specialized dairy farms) to DF4 (dairy farms including cash crops and bull calves production). Finally the cooperative organization of farmers for the main field works is dominant in type DF4, while it decreases unto DF1, the farms calling more on agricultural contractor or using the only workforce from the farm.

We collected information on land cover (woodland, grassland, cropland, built up areas etc.) by field survey, and on land use by farmers interview. The land cover gives only a partial expression of the farming activities that are implemented on fields. We defined land use as the combination of three components, expressed on a time span of 8 theoretical years corresponding to the longer crop succession identified in the studied areas (Thenail & Baudry, 1996). These components are: the crop succession, the main kind of livestock feedlot and of harvested grass fodder when the field is used for grassland. A classification of land use types was made as for farm types. For the purpose of this paper, we focused on two contrasted land use types. The type LU1 corresponds to a long duration sown grassland (*i.e.*, a sown grassland kept for 5 to 8 years, followed by one year of maize or a directly of a new grassland), used as a pasture for heifers or beef cattle, and providing hay. The type LU2 is a crop succession of maize, wheat and/or other cereals.
We considered the following field characteristics: hydromorphy, size and shape of the field, its accessibility and distance to the farmstead. We also took into account the fact that the field may be isolated in the farm territory (*i.e.*, with no adjacent fields from the same farm), or on the contrary embedded into a "field cluster", *i.e.*, an isolated continuous land islet divided into several contiguous fields. In this paper, we selected two contrasted types of fields: 1) small fields with a woody perimeter of more than 80%, embedded into a land islet of several fields, 2) large isolated fields with a woody perimeter of less than 20% (Fig.2).

2) Factors tested on the herbaceous plant species composition: margin structure, margin management, land cover, crop succession, farm type

A variation partitioning by partial Canonical Correspondence Analysis or CCA (Ter Braak, 1990) was used to assess the relative weight of a set of chosen variables, in the total explained variation of the plant species composition (Fig.3). At the level of the margin, we selected the margin structure, as the cover and height of the tree and shrub layer may modify the microclimatic parameters. We also selected the margin management. We indeed observed a great diversity of farming practices, like herbicide spraying, livestock grazing, mowing, even alternatively on the same margin (Baudry et al., 1998). Besides, the trees are still pollarded for firewood every 8-15 years, and this operation is likely to disturb the lower layers of the hedgerow.
At the level of the field, we selected the land cover, the crop succession, and the farm types (as earlier defined). The farm type may influence the flora composition, with the choice of margin management practices, but also indirectly, with the choice of land use: for instance herbicides or fertilizers spread on the field, livestock on a grassland (grazing, trampling) may affect the margin vegetation. We hypothesize in this frame, that the crop succession (variable of land use) may be a better explanatory factor than the land cover.

[2] *Cf.* E.U. definition (EEC, 1985).

III. Selected factors at the landscape level

The density of the hedgerows decreases from Site A, to Site C. Thus the overall composition of the field boundaries, in term of vegetation structure, differs from one site to another. Regarding the *structure of the field boundaries*, we analyzed the relationship between the density and spatial organization of these hedgerows, and the composition and spatial organization of the farms and land use types in each site (Fig.4). We also analyzed the difference between study sites, in term *of tree and shrub species composition*.
Regarding the *plant species composition of the margins*, we added as potential explanatory factor in the test earlier presented (CCA) a variable indicating to what study site A, B or C, the field margin belongs to. This variable allows testing if the "landscape context" of the margin, also has an influence on the diversity of plant species of its ground layer.

Results

I. Factors linked to the boundaries' diversity, at fine scales

1) Factors linked to the structural diversity of the boundary vegetation

As a first approach, we analyze the relationship between the presence of a line of trees on the field boundaries (*i.e.*, the presence of hedgerows) and the nature of the types of land cover both sides.
Three groups of field boundaries can be identified, with an increasing percentage of hedgerows from: Group 1) boundaries adjacent to a tarred road or lane what ever is on the other side (61 to 69 % of these boundaries are hedgerows), Group 2) boundaries with agricultural land both sides (65 to 81 % hedgerows), Group 3) boundaries adjacent to a dirt lane, whatever is on the other side (87 to 95 % hedgerows). This first result indicates that road enlargement participates a lot to hedgerow removal, outside of farmers' action. They also present a range of situations according to the adjacent land cover, which is larger than within Group 1 or 3. Further analyzing the land cover adjacent to the field boundaries within the agricultural land, we observe differences between boundaries with permanent grassland at least on one side (79 to 81 % of hedgerows), and boundaries with a crop both sides (65 % of hedgerows). As land cover partially express the implemented land use, these results suggest a differentiation of field boundaries (herbaceous field boundaries *versus* hedgerows) within the agricultural land, according to the farming activities implemented both side, and thus, also, according to the associated farm types.

As a second step, we analyze the relationships between the land use implemented on fields and the characteristics of these fields (Fig.2). The structure of the boundaries surrounding the field is represented by the "woody perimeter"(*Cf.* Fig.1.b). The type of land use LU1 corresponds to the long duration sown grassland used as a pasture for heifers or beef cattle, and providing hay. This type of land use is significantly allocated to a small field (about 0.5 ha) with a woody perimeter of more than 80%, and embedded into a land islet of several small fields. Conversely, the type of land use LU2, which is a crop succession of maize, wheat and/or other cereals, is significantly allocated to large isolated fields (2 to more than 4 ha), with a woody perimeter of less than 20%.
We also observe that these specific associations between land use, and fields with a given set of characteristics, are not randomly distributed among the farm types present in our study areas. We observe that LU1 is mainly found in the dairy farm type DF1 (less intensified farms of medium level of production), while LU2 is mainly found in the farm types type DF3 and DF4 (more intensified farms of high level of production).

2) Factors linked to the diversity of the ground layer vegetation of field boundaries

Results of a Canonical Correspondence Analysis, expressed as average inertia per variable, for each set of variables, are given for the example of field margins situated along streams. These stream banks have ecological functions regarding both terrestrial and aquatic environment (Le Cœur et al., unpublished data). The plant species composition has been described for 200 stream banks. The relative weight of the chosen variables in the total explained variation of the plant species composition of the stream banks is given in Figure 3. The margin structure appears to have no significant weight. We find then, in the direction of an increase of the inertia per variable: the margin management, the adjacent land cover, the farm type, then finally, the crop succession.

II. Factors linked to the boundaries' diversity, at the landscape level

1) The density of hedgerows at the landscape level: relationships with the land use mosaic and the farm types composition

The density of hedgerows decreases from the site A to the site B then C. Parallel to this, we observe a difference in the farm types' composition (Fig.4.a,b). Farms of type DF1 and DF2 (less intensive farms with medium production) are in higher proportion in Site A, while types DF3 and DF4 are in higher proportion in Site C. There is jointly a relationship between the composition of farm types in each site, and the structure of the farm territories (Thenail, 1996). Indeed, the farm territories in Site A are very fragmented, with a lot of fields of less than 0.5 to 1 ha, scattered on a space up to 1-2 km from the farmstead. The farm territories in Site B are intermediate. In Site C, the farm territories are formed by larger land islets including one or several fields, partly close to the farmstead.

The figures 4.c and 4.d present the maps of the spatial distribution of the land use based on rotational grassland in Site C (open bocage landscape) and Site A (dense bocage landscape). The effect of the structure of farm territories on the inner farm land use organization is perceptible at the scale of the study sites: the rotational grassland appear to be very scattered in Site A, while they are distributed in larger blocks in Site C. These "inner farms" factors of organization of the landscape mosaic interferes with "out farms" factors. The location of the settlements is one of these factors. In this region, settlements are scattered into hamlets of different size. In Site C, rotational grasslands appear to be clustered around a few settlements, as they each contain several farmsteads. In Site A, the hamlets are smaller and do not all contain a farmstead. The "inner farms" factors also interfere with a specific spatial distribution, in each site, of field and land islets types: small hydromorphic fields surrounded by hedgerows are mainly clustered along the river in the most open site, while they are more scattered in the dense bocage site A.

2) The plant species composition of field boundaries: relationships with their landscape context

In Table 1 are listed the trees and shrub species which are the most represented among the field boundaries of each of the three study sites (Le Coeur, 1996) . This evaluation is made on the 3000 hedgerows of the three study sites. In Site C, species as *Rubus idaeus*, *Cotoneaster*, *Sorbus*, *Aesculus*… are from recent plantation. Site B has also several introduced species or fruit trees as *Malus*, *Prunus cerasus*, *Juglans*, *Populus*, *and Syringa…* Site A has less characteristic species, but they are spontaneous local species: *Quercus*, *Corylus*, *and Cytisus scoparius*, *Euonymus*, *Prunus spinosa*…

Pooling the stream banks of the three study sites, we observe that the associated margin management, crop succession, land cover and farm types are determining factors of the diversity of their ground layer vegetation. A variable indicating to what study site the field boundary belongs to, is added in (CCA) as explanatory variable: it identifies the "landscape context" of the field boundary. The inertia found for this last factor " is of 0.13, so higher than the value found for the previous variables which inertia range from 0.04 to 0.11 (*Cf.* Fig.3.).

Discussion

The results show that, at the finest scales, the herbaceous plant species composition of the margins are under the influence of a combination of factors related both to the margin itself and to the adjacent elements. Moreover, the factors linked to the farming activities and the farm characteristics are predominant. (Le Coeur et al., 1997) found similar results for all field margins, except that boundary structure also presented an effect. The structure of the boundary, notably the presence of trees, is also related to the land use and land cover in the adjacent fields. This relationship is also perceptible, when taking the reverse viewpoint: the type of land use implemented on a field presents relationships with the proportion of hedgerows on its perimeter. In fact, the results jointly show that this criterion of “woody perimeter” cannot be considered independently from the other characteristics of the field (size, distance from the farmstead, hydromorphy etc.), to understand the type of land use implemented. The different types of fields, land islets, and associated land use are not found with the same proportion in the different farm types, emphasizing the linkage between the family-farm system and the land use organization of farm territory (Thenail & Baudry, 1994).

We chose the three sites A, B, and C differing by their density of hedgerows. Our results show that the plant species composition, and the spatial organization of the different types of boundaries, also differ from one site to another. These “ inner farms ” and “ outside farms ” factors of organization lead in this way to polarized, or, on the contrary scattered land use mosaic, and influence the determinism of these mosaics (Thenail, 1996). The analyses about plant species composition lead to the conclusion that the factor “landscape context” is indeed a complex factor, but which significantly influences the margin ground layer vegetation. It can be argued that this factor may integrate direct or indirect ecological factors that were not covered with the other variables. The difference in soil and land cover composition between the three study sites can be two of these factors. Indeed, Sites B and C are on shale bedrock, and present a higher proportion of crops than Site A which is on a granitic one, and presents a higher proportion of permanent grassland. However, these hypotheses have to be balanced with other factors linked to the *structure* of the landscape in each study site, like the grain size (the size distribution of the pieces of land surrounded by hedgerows) or the structure of the hedgerows network in itself. This factor “landscape context” finally integrates cultural conditions (what people like to plant), as well as a certain collective history, through land consolidation program, and the aggregation in space of individual activities.

Conclusion

Surveys in different European countries, of interstitial elements, such as hedgerows, ponds, ditches and other field margins, have shown a significant decrease of these elements in agrarian landscapes (Agger & Brandt, 1988; McAdam et al., 1994). The main reasons put forward to explain the hedgerows removal are the lost of economic functions, and the technical constraints of the small fields they were associated to. Our results suggest that not only these long term perspective, but also the dynamics linked to the farming activities have to be taken into consideration, to understand the dynamics of the field boundaries. We proposed from this research project, to consider the field boundaries as integral parts of the spatial units of management of farms (Baudry & Thenail, 1999). In this way can be analyzed the interference between these long run dynamics (land exchanges, land consolidation etc.), and these short run, cyclic dynamics of the farm functioning.

The farm territories in the region we studied are rather scattered. The phenomenon of fragmentation of farm territories in this region was traditionally linked to the redistribution of land among heirs, with the re-delimitation of small plots by hedgerow plantations. Nowadays, the increase of the size of farms in France like in many European countries, is done with the acquisition of pieces of land which maybe remote from the farmstead (Croix, 1997): this is actually a new factor of fragmentation of the farm territories. Deffontaines emphasizes the field as a setting for farming practices, a unit of management within a farm, but also a facet of a landscape, interacting with the surrounding land (Deffontaines, 1993). The fragmentation of the farm territories reinforces this view of farms producing “facets of landscape”, that maybe more complex like land islets (Thenail & Baudry, 1996). The field boundaries take part in these interactions between fields and their surrounding land, both as a structure and as a pool of plant species. The situation presented here illustrates at the same time, the specificity of the organization of the landscape mosaic in agrarian landscape, and the complexity of the “inner farm” and “outside farm” factors of this organization of the landscape mosaic (Deffontaines et al., 1995). Such features of organization have to be explored in a perspective of landscape management (Baudry et al., 1999).

It is worth underlining the high diversity of vegetation structure and plant species composition we found among the field boundaries. The hierarchical analysis we implemented demonstrates that a whole suite of factors drive the dynamics and patterns of this biodiversity in agricultural landscapes: the boundary structure and management, the adjacent land use, the structure of the land islet and farm territory, the farm type, and landscape context. The diversity of farm and land use types is highly significant, while the farms are all conventional. Further research should yield results on the mechanisms involved in the relationships we have observed. However, the results already show that it is possible and fruitful to develop methods for the evaluation of this biodiversity at the farm and landscape scales. In contrast to several studies (Paoletti & Pimentel, 1992), we do not aim at defining the " best " practice, but to decipher the role of farm diversity, landscape management, cropping systems on different groups of species. To seek only these best management practices at the field/ boundary scale can be counterproductive, as a diversity of situations create a diversity of environments. Besides, our results illustrate that not only farming practices in themselves, but also the design of the farm territories has to be considered, as it strongly influences the spatial organization of farming activities (Morlon & Benoît, 1990; Van der Ploeg, 1994). Providing farmers with degrees of freedom within their farm may increase the compliance with environmental policies and the combined effects of several farms in a landscape can provide a bonus.

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Figure 1. Architecture of the different levels of study.
Figure 2. Distribution of two types of fields and associated land use, among the four main dairy farm types of the study sites.
Figure 3. The species diversity of the ground layer vegetation of stream banks: hierarchy of determining factors (results of the CCA test).
Figure 4. Comparison of Site A (dense bocage landscape) and Site C (open bocage landscape): proportion in four dairy farm types (4.a,b), and spatial distribution of rotational grassland (4.c,d).

Table 1. Main tree and shrub species characteristics of each of the three study sites

Site A	Site B	Site C
Cytisus scoparius	*Alnus glutinosa*	*Ulmus minor*
Euonymus europaeus	*Fraxinus excelsior*	*Tilia cordata*
Quercus robur	*Malus domestica*	*Acer campestre*
Corylus avellana	*Prunus cerasus*	*Rubus idaeus*
Crataegus monogyna	*Salix fragilis*	*Betula pendula*
Fagus sylvatica	*Ulmus minor*	*Spartium junceum*
Prunus spinosa	*Populus x canadensis*	*Cotoneaster salicifolia*
Rubus fruticosus	*Sambucus nigra*	*Sorbus aucuparia*
Ulex europaeus	*Juglans regia*	*Fraxinus excelsior*
Mespilus germanica	*Prunus laurocerasus*	*Quercus rubra*
Rosa sp.	*Chamaecyparis lawsoniana*	*Aesculus hippocastanum*
Prunus avium	*Syringa vulgaris*	*Populus x canadensis*
	Taxus baccata	*Frangula alnus*
	Salix sp	
	Populus alba	
	Prunus domestica	
	Acer platanoides	
	Salix x rubens	
	Tilia x vulgaris	