Factors influencing biodiversity within organic and conventional systems of arable farming – methodologies and preliminary results

Lisa R Norton
Centre for Ecology and Hydrology, Windermere Rd, Grange over Sands, Cumbria, LA11 6JU, UK

ABSTRACT

This paper describes the approaches and preliminary results of a study that is designed to provide a large amount of data at a range of scales in order to investigate the potential factors influencing biodiversity on arable farmland on comparable organic and conventional farms. In particular, the study examines the role of non-crop habitats within the different farming systems and how the extent and management of non-crop habitats differs between them. A detailed description of the methodologies being employed to establish differences in non-crop habitat, plant, invertebrate and bird diversity is given. The study remains in its early stages as a result of the impact of Foot and Mouth disease on the fieldwork schedule during 2001. The process of setting up the study revealed that the numbers of farmers growing cereals organically are low as a proportion of the organic sector as a whole, despite recent large increases in numbers of farmers converting to organic production. Preliminary results from the first year of fieldwork on plants reveal significant differences between organic and conventional farms in terms of the numbers of weed species on fields and non-significant differences in numbers of species found on non-crop habitats.

Keywords: comparative organic and conventional farming, biodiversity

INTRODUCTION

One of the claims put forward by the proponents of organic agriculture is that as a farming system it supports greater biodiversity than comparable conventional systems. Whilst there have been a number of studies carried out to investigate such claims, the majority have been on a relatively small scale and have been unable to reveal more than general trends associated with organic farming practice. With increasing consumer interest in buying organic foodstuffs, both for their perceived health and environmental benefits, and increasing pressure on MAFF to take notice of organic farming, MAFF sought to commission independent scientific research, which would investigate the factors influencing biodiversity on comparable organically and non-organically managed farms.

As a result of this the British Trust for Ornithology (BTO), the Centre for Ecology and Hydrology (CEH) and Oxford University were awarded funding from MAFF to carry out a research proposal which aims to identify which features, if any, of both organic and non-organic farming are beneficial for wildlife and to compare both systems of farming in terms of their overall impact on biodiversity. Each of the

research partners are primarily concentrating on certain aspects of biodiversity, with the BTO looking at impacts on birds, CEH- plants and Oxford University- invertebrates and bats. This paper reports on the methods being adopted across the consortium but concentrates in detail on both the methods and preliminary results of the work being carried out by CEH on plants.

In order to keep the number of potential variables down to a minimum, the study is confined to farms where cereal crops and wheat in particular are grown. The design of the study attempts to ensure that a representative sample of organic cereal growing farms within England, i.e. a sample that covers the true extent of organic cereal farming within England, is investigated. In addition an attempt is being made to include farms in the sample in proportion to the occurrence of all cereal growing organic farms across England within particular land classes, using the ITE land classification (Bunce *et al*. 1996)[1]. The study aims to identify target numbers of organic farms with particular cereals, i.e. 30 farms growing spring cereals and 60 growing winter wheat, all of which are to be surveyed over the period 2000-2003. Each organic farm will be paired with a comparable conventional farm, i.e. within the same ITE land class and with a comparable area of woodland, and within a 10km radius.

One of the key aspects of the study is an investigation of the relative importance of non-crop habitat to biodiversity on farmland and it therefore investigates any differences between paired organic and conventional farms in terms of the extent, nature and management of these habitats, both by field recording and information from farmers. As the study is a survey rather than an experimental study, differences in terms of actual field management can only be looked at on a broad scale using information supplied by farmers about crop management. It was thought that longevity of organic management of particular fields may play a significant role in influencing biodiversity and hence the sample of fields included in the study is stratified according to duration under organic management with (as far as possible) half of the sample less than 5 years organic and the other half greater than 8 years organic.

METHODS

Site selection

Organic farmers were recruited for the study through the two major organic registration bodies (The Soil Association and Organic Farmers and Growers) in late 1999 and early 2000. A letter to all farmers who listed cereals as produce, asking for farm details and interest in taking part in the study, elicited a good response and a database of all suitable farms (in terms of appropriate cropping regimes, organic longevity and farm size – minimum 30Ha) was compiled. However, for the part of the study looking at spring cereals, there were only 30 farms with organic spring cereal production available from the compiled database. Presumably, they therefore comprised the majority of farmers growing spring cereals organically in England in 2000. Site selection was also carried out for the

1 The CEH land classification was developed as a means of classifying the British landscape (in 1km squares) into a number of land classes using a large range of physical characteristics

winter wheat sample for both 2000/01 and 2001/02 in late 2000 and again revealed low numbers of organic cereal producers. Although it was possible to find a total of 30 farmers growing winter wheat in the category 'greater than 8 years organic', there were only 20 farms in the category 'less than 5 years organic'. New producer lists supplied by the SA and OF&G have revealed that a number of new farmers have converted to organic cereals since 1999/2000 which should enable the target sample size of winter wheat growers to be achieved over this year and next.

Non-organic farmers (the term 'conventional' is applied to this group, although it is recognised that a broad range of farming practices is covered by it) growing the relevant crops (either spring cereals or winter wheat) within a radius of 10km of each organic farm have been found and recruited using a variety of means including, letters to farms identified from maps, HGCA farmer databases and other sources.

Surveys of taxa

The study aims to integrate research on birds, invertebrates, bats and plants at different levels. Work on birds concentrates on wintering birds and surveys on all farms included in the study (as far as possible) will cover both the field of wheat or spring cereal being surveyed intensively for invertebrates and plants (target field) and a section of the farm surrounding that field. Similarly bats will be recorded along a 3km transect concentrated as far as possible around the target field using specialist recording equipment. Plants and invertebrates are being looked at in detail on the target field alone. Pitfall traps (18 per field) set at intervals into the crop (9) and in the uncropped field margin (9) are being set twice in both the early and late summer to record invertebrates present on the field. The location of the margin traps is designed to coincide with the area surveyed by plant surveyors. Detailed methods on plant surveys are given below.

Plant surveys

Surveys will be carried out in both winter and early summer on winter wheat fields and were carried out in early summer only on spring cereal fields in 2000. The aim of the winter surveys is predominantly to get a picture of weed composition and in particular bird food availability through the winter on the paired farms. The summer sample attempts to record maximum species richness and density on the fields.

Plots surveyed include A-plots (arable margin plots) and B-plots (boundary plots) which form part of the CS2000 methodology (Haines-Young *et al.* 2000). A-plots consist of a 100m x 1m strip around the edge of a field going from the boundary into the field, B-plots consist of a 1m x 10m section of the field boundary. Within A-plots the presence of all plant species are recorded, whilst in B plots all species are recorded together with a measure of their % cover. In addition to the Countryside Survey type plots, detailed quadrat data are recorded in 0.5 x 0.5m^2 quadrats along 12 transects running into the field at regular intervals around the field boundary at distances not less than 30m from field corners. The transects are each 32m in length and quadrat data recording species presence and

cover/number (dependent on the timing of survey) is recorded at 2,4,8,16 and 32m into the field along each transect.

Surveys of non-crop habitats

In addition to the survey of a range of taxa across the farms, non-crop habitats are being looked at a range of scales. Plant surveys include a detailed investigation of a boundary plot (see above), which is supplemented by more basic measurements of boundary type and, where appropriate, dominant species composition, hedge height and width along an adjacent and more extensive plot determined and recorded by the invertebrate recorders. Bird surveyors are recording non-crop features within the area that they are surveying for birds, including, hedgerows, copses, ponds, areas of scrub, field boundary measurements, buildings and other features which may affect biodiversity on a farm. Large-scale measures of landscape features are also being investigated using the CEH land cover map of the UK. This can be used to investigate the landscape context of individual farms at a range of radii from the farm (for example between 1 and 10km) and to measure the potential impact of landscape features at this scale on biodiversity at the farm scale.

Surveys of farmers/farm managers

The individual(s) running the farm may have a very significant influence on biodiversity, both in terms of the way in which they manage both cropped and non-cropped land as well as their general attitude towards biodiversity. In order to try to take account of this a questionnaire was put together with advice from Elm Farm Research Centre and the Royal Agricultural College asking farmers for extensive information on current and past management practices both at field and farm levels on cropped and non-cropped habitats, with specific reference to potential impacts on biodiversity.

RESULTS

The study is currently in its early stages due to the onset of Foot and Mouth disease early in 2001, although the poor weather in Autumn 2000 was already threatening the feasibility of working on winter wheat crops for harvest in Summer 2001. As a result, although some plant data were collected in the autumn/winter on the first year winter wheat sample, they are incomplete and have not been analysed.

Results presented here are from the survey of spring cereal crops carried out on 30 paired farms in 2000 and can represent only an indication of the potential trends which may or may not be confirmed from an analysis of the entire dataset at the conclusion of the project. The results presented here concentrate on a preliminary analysis of species numbers found at sites on the different plot types.

Simple paired T-tests show that there were highly significant differences between the paired organic and conventional farms in terms of the numbers of species found in the arable margin (A) plots (Paired t-test, df =29, t = 4.57, p< 0.0001, Fig 1) and the numbers of species found along the transects running into the target fields (Paired t-test, df=29, t=1.69, p<0.0001, Fig 2). However, the numbers of

species found in the non-crop habitat, i.e. the boundary (B) plots were only marginally significantly different between the two farm types (Paired t-test, *df* =29, t = 1.79, p< 0.04, Fig 3).

Fig 1. No. of species in A plot for organic and conventional farm pairs

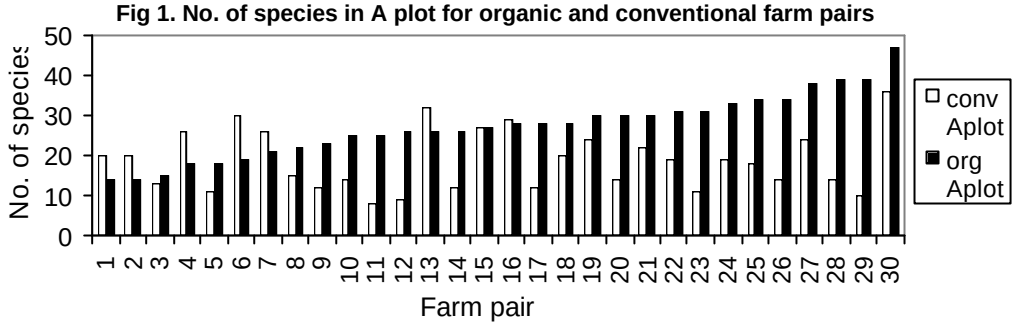


Fig. 2 Mean no. of species in transect quadrats for organic and conventional farm pairs

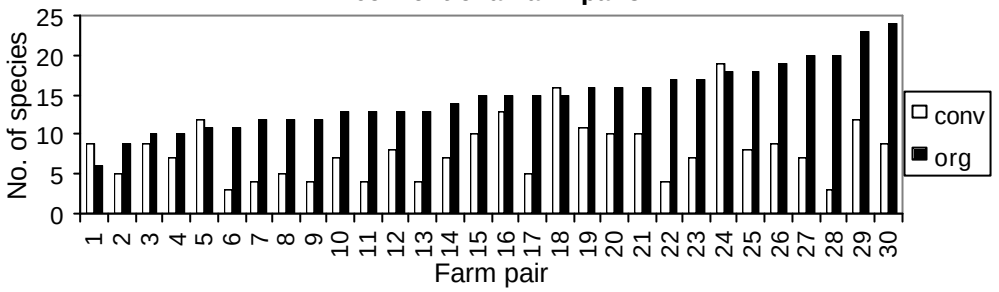
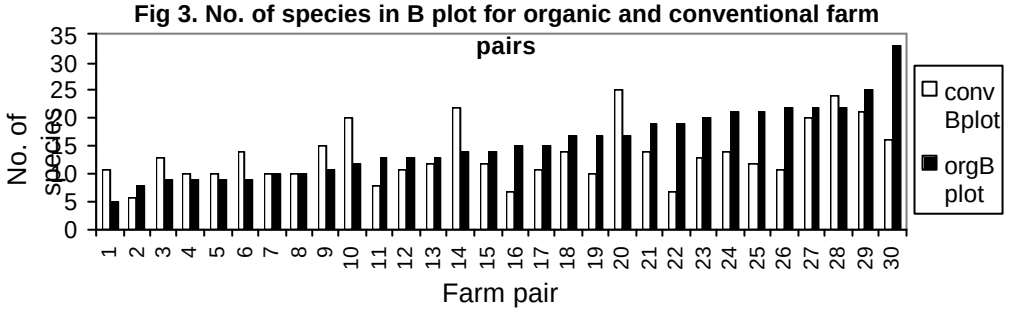


Fig 3. No. of species in B plot for organic and conventional farm pairs



DISCUSSION

These results are preliminary and may differ significantly in future years of the study, but give an indication of the range of variation in the numbers of species of plants, which may be found in the full data set. However, they do show that on spring cereals, organically managed fields contain a higher diversity of plant species than conventionally managed fields. Whether these species are of value, either in themselves (as relatively uncommon arable weeds) or as food sources for other valuable species needs to be investigated further (using the data on invertebrate and bird numbers). It appears from these results that the non-crop habitats that farms contain and manage may show less marked differences in terms of plant biodiversity between conventionally and organically managed farms.

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