SIXTH FRAMEWORK PROGRAMME
PRIORITY 8.1
Scientific Support to Policies (SSP)

Deliverable 2.2 Report on meta-analysis of selected Natura 2000 sites

Project acronym: **COCONUT**

Project full title: **Understanding effects of land use changes on ecosystems to halt loss of biodiversity due to habitat destruction, fragmentation and degradation**

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Comment:

Understanding effects of land use changes on ecosystems to halt loss of biodiversity
due to habitat destruction, fragmentation and degradation

Deliverable 2.2:
Report on meta-analysis of selected Natura 2000 sites

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COCONUT: WorkPackage 2
Deliverable D.2.2

1. Introduction and Context

Traditionally protected area management has focused on within site management in order to ensure protection of the biota. However, evidence from ecological theory and practice suggests that the structure and quality of the surrounding matrix is as important as the protected area itself (Forman 1995). Modifications of the surrounding matrix may include changes in the spatial configuration of the surrounding habitats and changes in the quality of the habitats themselves. Landscape configuration can be the most apparent change around protected sites. However, changes in habitat quality are equally important at a smaller scale for species persistence. Habitat Quality can be defined as the ability of the environment to provide conditions appropriate for individual and population persistence (McDermid et al. 2005). Maintaining habitat quality therefore is a critical component of nature conservation policy. For that reason generic habitat quality indices are commonly employed and habitat quality has been used as a surrogate for rapid species monitoring especially where resources, for expensive species-level survey and monitoring, are limited (Lucque and Vainikainen 2008). Habitats are recognisable entities that can be identified, mapped and managed. They are susceptible to intervention in a form that is recognisable to land managers, conservation officers etc. It is becoming clear that although the Natura 2000 designation is an important step towards biodiversity protection in Europe a static designation is no longer adequate and that we need a more dynamic approach to conservation to ensure that the conservation targets are achieved (Commission of the EC 2008). Preliminary results of the COCONUT project highlight that there is a need to monitor activities beyond the Natura 2000 boundaries since understanding the spatial pattern of habitat patches and the character of the intervening matrix is of utmost importance for the ecological structure and function of protected areas (Forman 1995).

2. COCONUT: WorkPackage 2 Background

COCONUT's Work package 2 aims to analyse current and historic species distribution data, coupled with matched landscape data, for a selected set of Natura 2000 sites and adjacent landscapes. Specific objectives were to:

- Compile a meta-database of Natura 2000 sites to assess the availability of suitable data for the current and historic distributions of key taxa, and matched current and historic land use data.
- Assess landscape composition and configuration changes in and around Natura 2000 sites
- Assess the meta-database to identify the most appropriate set of sites for which high quality data can be mined and then try to secure the selected datasets.
- Model changes in patterns of species distributions in and around a subset of Natura 2000 sites.
- Identify taxa, sites, habitats and bio-geographic regions where the extent of loss has been greatest.

This document reports on the progress made by the University of Reading leader of WorkPackage 2 to address changes in land use and habitat quality and their effects on biodiversity in and around Natura 2000 sites.

Methodology

Two approaches were taken to analyse landscape changes:

(i) A suite of landscape metrics was used to quantify changes in landscape pattern (composition and configuration);

(ii) A simple "quality model" was developed to assess changes in habitat and overall landscape quality.

Datasets

Due to the lack of resources for land cover analysis.(see probs with GISAT) the selection and analysis of the sites was limited to those Natura 2000 where historical and present landcover data were available through the BIOPRESS project (Gerrard et al. 2006). BIOPRESS is an EU project that has produced a standardised measure of historical land cover changes established from time-series of aerial photographs (1950-1990-2000). The data used were mainly 2km x 15km transects for seven countries across Europe, since that was the higher resolution data available (Fig.1). Although in some cases window data were also used. Windows are 30 x 30 km in size but the resolution is much lower.

There were cases where a site's boundaries extended beyond BIOPRESS windows and/or transects (**Fig.1**) therefore reliable processing was not possible and were omitted from the selection. As a result there were in total 100 sites which were finally employed using the following criteria a) high variation of land cover types, b) land cover information for all time periods (50s, 90s, 00s) for both transects and windows, c) more than 75% of the Natura 2000 site covered by landcover data

For example in the UK although BIOPRESS focussed on 8 sites only 4 of these sites fulfilled the criteria and were retained for the analysis as described herein.

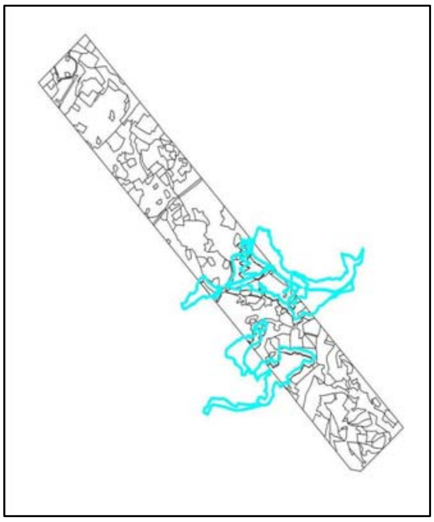

Fig 1: Mismatch between land cover data availability and N2K site boundaries

Fragmentation

Changes were evaluated within the site and outside at a range of 1km buffer zone. A parsimonious set of landscape metrics (McGarigal et al. 2002) was employed to explore changes in composition and configuration of the site including Mean Number of Patch, Mean Patch Size, Mean Edge Density, Mean Nearest Neighbour and others. These metrics were calculated using with Patch Analyst within ArcGIS.

Habitat Quality

We evaluated habitat quality changes in and around N2K sites. For the areas around N2K sites we employed two spatial scales a) the area defined by 1km buffer around the site b) the area of the whole BIOPRESS transect where a site was contained. For these spatial scales we calculated a **Quality Index** (QI) for every time slice (1950-1990-2000) using land cover data from BIOPRESS transects and windows. This index was calculated as follows:

$$QI = \Sigma (Qi \times Pi),$$

where Q is the quality score and P is the proportion of CORINE land cover class i.

Habitat quality scores (Qi) was based on the opinion from a minimum of 10 experts for each taxonomic group (birds, plants, bees and butterflies) and each bio geographical region (i.e. Mediterranean, Scandinavia, Central Europe). A separate analysis using the same method was applied in the UK sites. The survey was based on a questionnaire where land cover classes were rated on a scale from 0-5 (where 0 was the lowest value and 5 the highest) (see Appendix). Quality is defined here as a broad measure of the overall value of the land cover type for general biodiversity for every taxonomic group; it is not related only to rare species. Judgment was made on the basis of which land cover types could potentially support the greatest diversity of plants, birds, bees and butterflies.

Responses for every land cover category in and around for the selected European Natura 2000 sites were averaged, and mapped into the GIS in order to get a picture of changes in habitat quality over time. The last operation was to create the maps of land use changes and quality for every site and its buffer.

Scenarios

Using the future scenarios developed in ALARM (ref needed) i.e. GRAS, BAMBU and SEDG, landuse maps for 2030 were created for the UK sites only.

- GRAS scenario: Growth Applied Strategy Scenario. A future world orientated towards economic growth
- BAMBU scenario: Business as might be usual scenario. A continuation into the future of currently known (and near future) socio-economic) and policy strategies.
- SEDG scenario: Sustainable European Development Goal scenario. A normative scenario focused on the achievement of sustainable development

From these scenarios we produced future habitat quality maps by using the same approach as described above.

Findings

Fragmentation: Although landscape composition has not changed significantly among the 3 time slices (1950, 1990 2000) landscape configuration shows some notable changes particularly with respect to increased number of patches and decreased mean patch size and increase Mean Nearest Neighbour (Fig 2). This is the case particularly around the site and it more obvious for 1990-2000 which indicates fragmentation taking place (Fig 2)

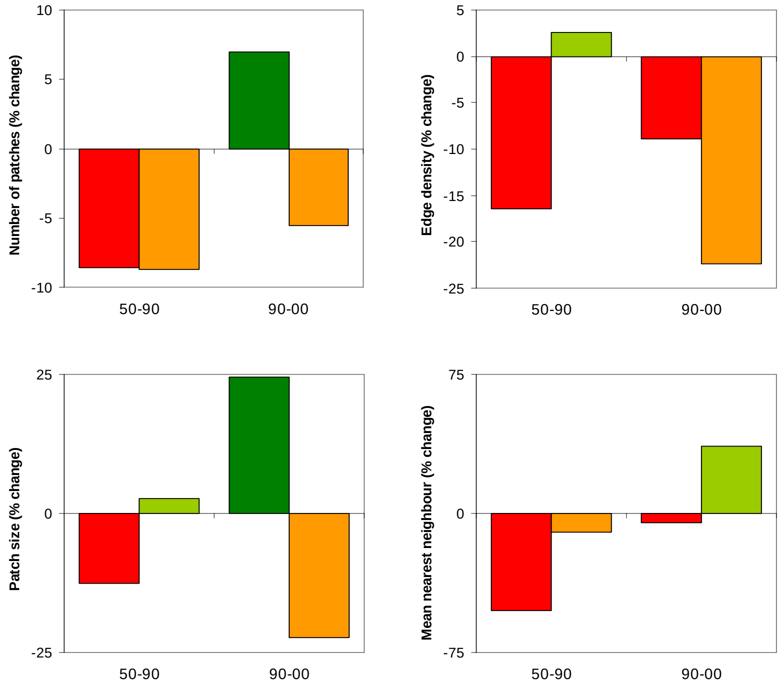

Fig 2. Main changes in landscape configuration and composition around UK N2K sites

Quality in UK sites: Quality index remains stable for the majority of the areas within Natura 2000 sites and for the majority of the groups examined (Fig. 3). This patterns is also consistent if the whole transect is analysed. However, results for the area immediate outside the UK N2K sites indicate a sharp decline of quality for all the taxonomic groups in the 1990s.

Quality in Mediterranean sites: 1990 is the year where generally speaking things deteriorate also demonstrated from Mediterranean sites as exemplified by Italy. What is perhaps striking for Italy is that there is a very strong signal of habitat quality deterioration for bees (& butterflies) around the Natura 2000 sites (Fig.4)

Quality in Central European sites: Generally an increase in quality in the 1990s for all group taxa examined within N2K sites. However, there is a significant decrease in quality in 1990s for the sites examined for all the major taxa.

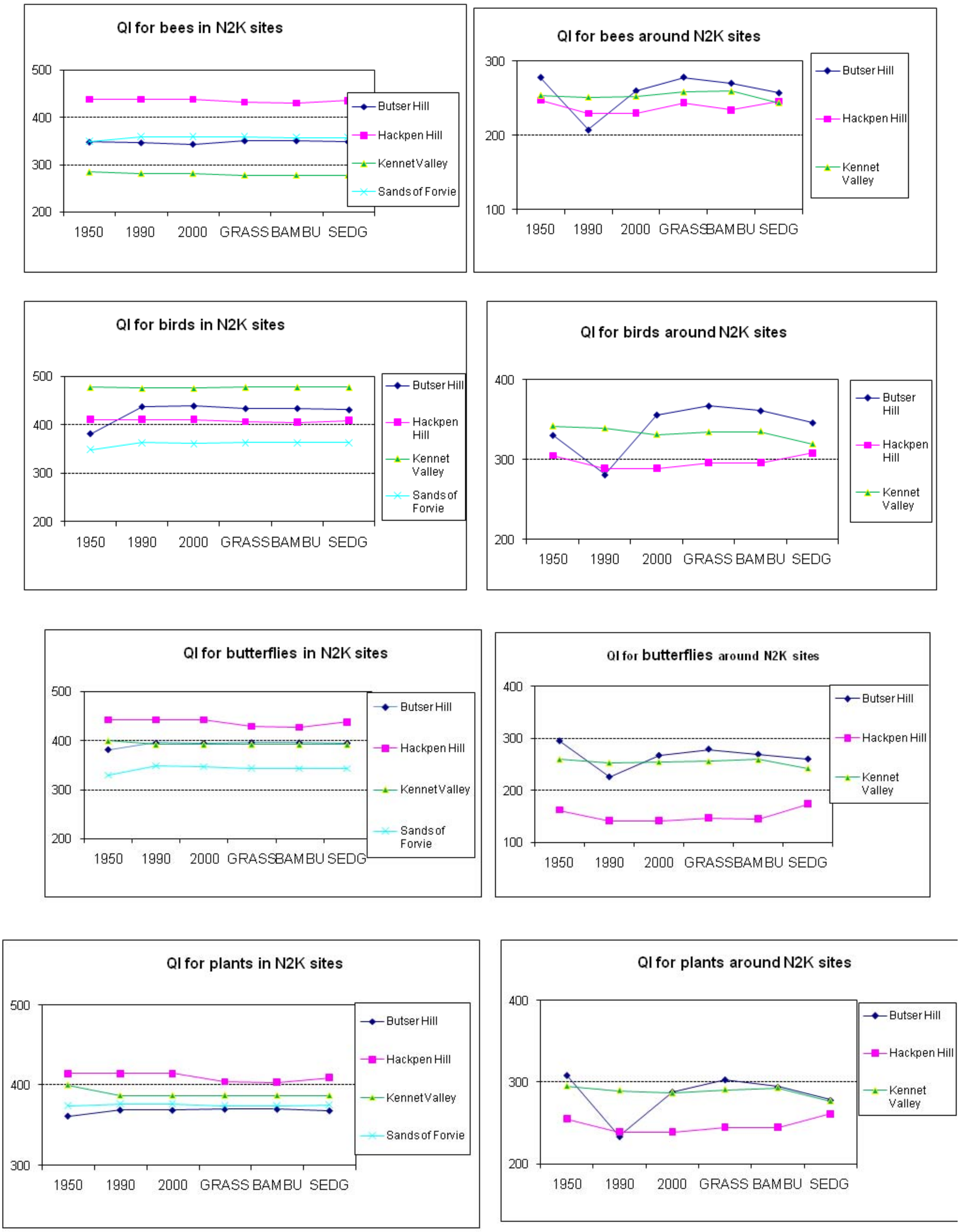

Fig. 3 Quality Index (QI) for the UK Natura 2000 sites and taxonomic groups examined, including major time periods and ALARM scenario projections

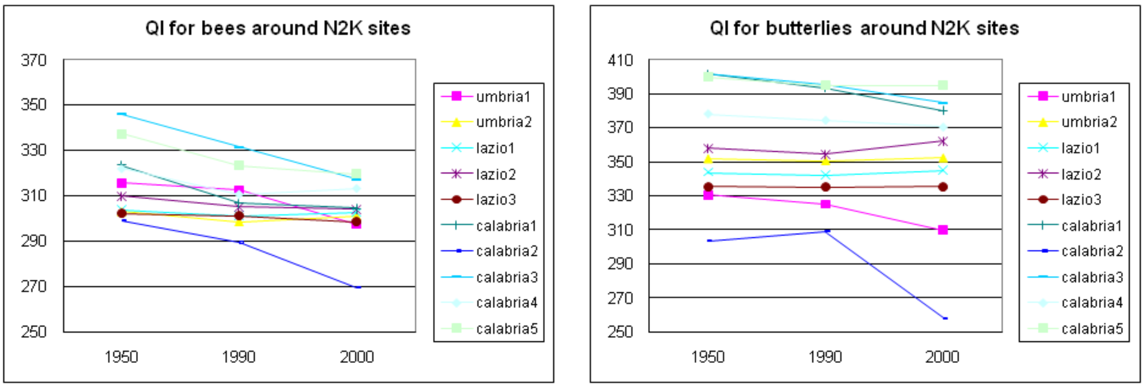

Fig. 4 Quality Index (QI) for 10 Italian Natura 2000 sites and two taxonomic groups examined

Quality in Scandinavian sites: Although in habitat quality around N2K sites for birds and plants do not show significant differences it seems that bees and butterflies are the groups of taxa affected the most since for the majority of the sites examined habitat quality has deteriorated in the 1990s (Fig. 5).

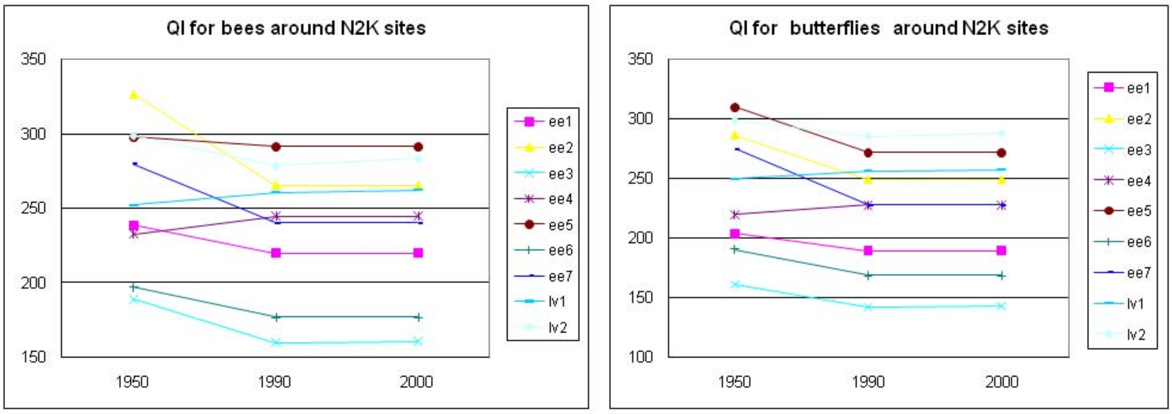

Fig. 5 Quality Index (QI) for 10 Scandinavian Natura 2000 sites and two taxonomic groups examined

Scenarios

In most of the UK sites examined BAMBU and SEDG scenarios suggest an improvement of quality in the immediate vicinity i.e. 1km buffer around the N2K sites. However, if the whole transect is taken into account a deterioration of quality is apparent for all three scenarios (Fig 6).

ALARM scenarios do not place emphasis on biodiversity. For example and although SEDG may be "environmentally-friendly" in terms of carbon emissions it has the greatest expansion of bioenergy crops. This explains any low scores in the results. In the same manner GRASS has the greatest abandonment which leads in positive/higher score.

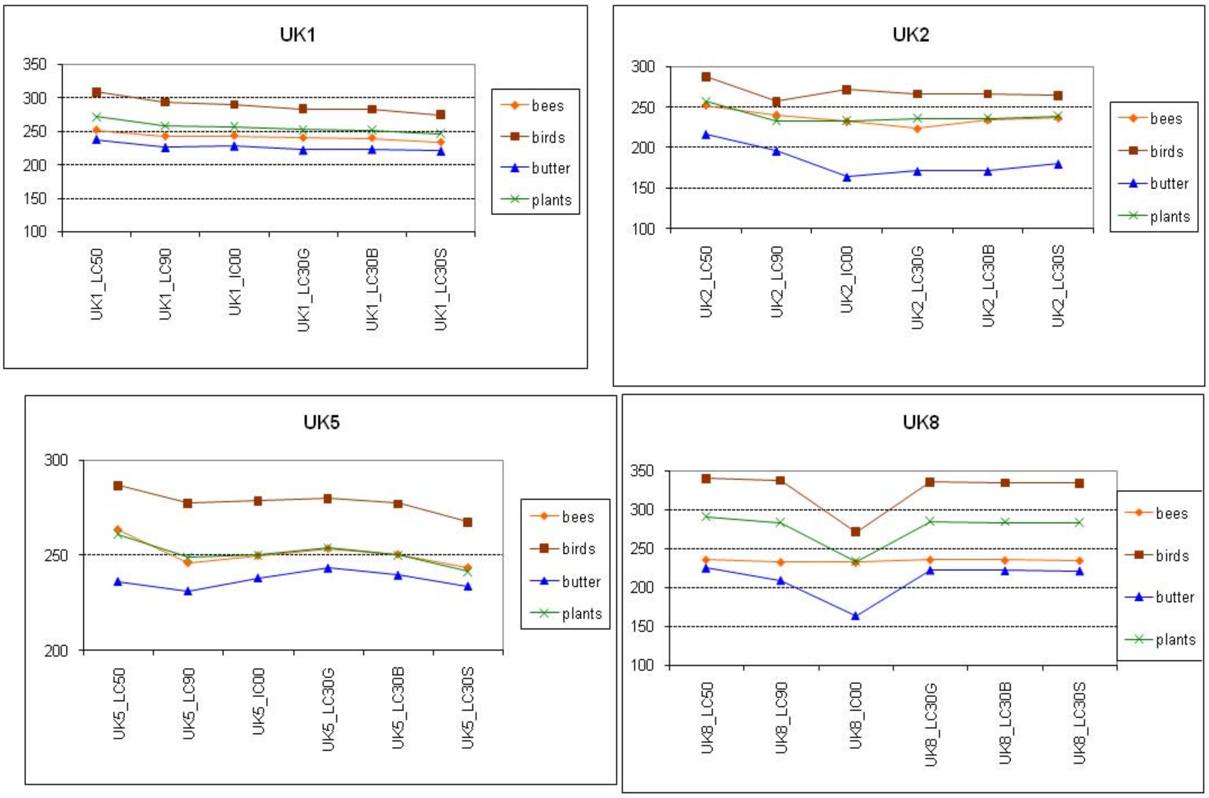

Fig. 5 Quality Index (QI) around the four N2K sites examined (whole transect level), for all taxonomic groups, including major time periods and ALARM scenario projections (LC30G: GRASS, LC30B: BAMBU, LC30S: SEDG)

Conclusion

Changes in landscape configuration seem to be more important in the sites examined rather than composition with more alarming the 1990s time snapshot. However, what is more profound is the loss of habitat quality for most of the taxonomic groups around the sites during the time period examined. This is particularly alarming for conservation efforts in the area. For most of the sites examined evidence suggest that at the European level s habitat quality inside Natura 2000 sites has generally remained constant between 1950 and 2000. However, habitat quality for areas immediately outside Natura 2000 sites has deteriorated in many sites between 1950 and 1990 for the majority of the groups of organisms examined (birds, plants, butterflies and bees). Changes are less obvious for the period 1990 to 2000. Using contrasting land use scenarios to predict changes in the future and in turn changes in habitat quality a clear pattern emerges where “development” rate is inversely related to habitat quality.

This is particularly alarming for conservation efforts in the area. Obviously biogeographical differences and management differences/priorities between sites make generalisation difficult. Changes within sites might reflect changes in management practices while changes around a given site the pressures from external factors including CAP reform, national policies etc.

Nevertheless the results highlight there is a need to monitor activities beyond the N2K boundaries since understanding the spatial pattern of habitat patches and the character of the intervening matrix is of utmost importance for the ecological structure and function of protected areas.

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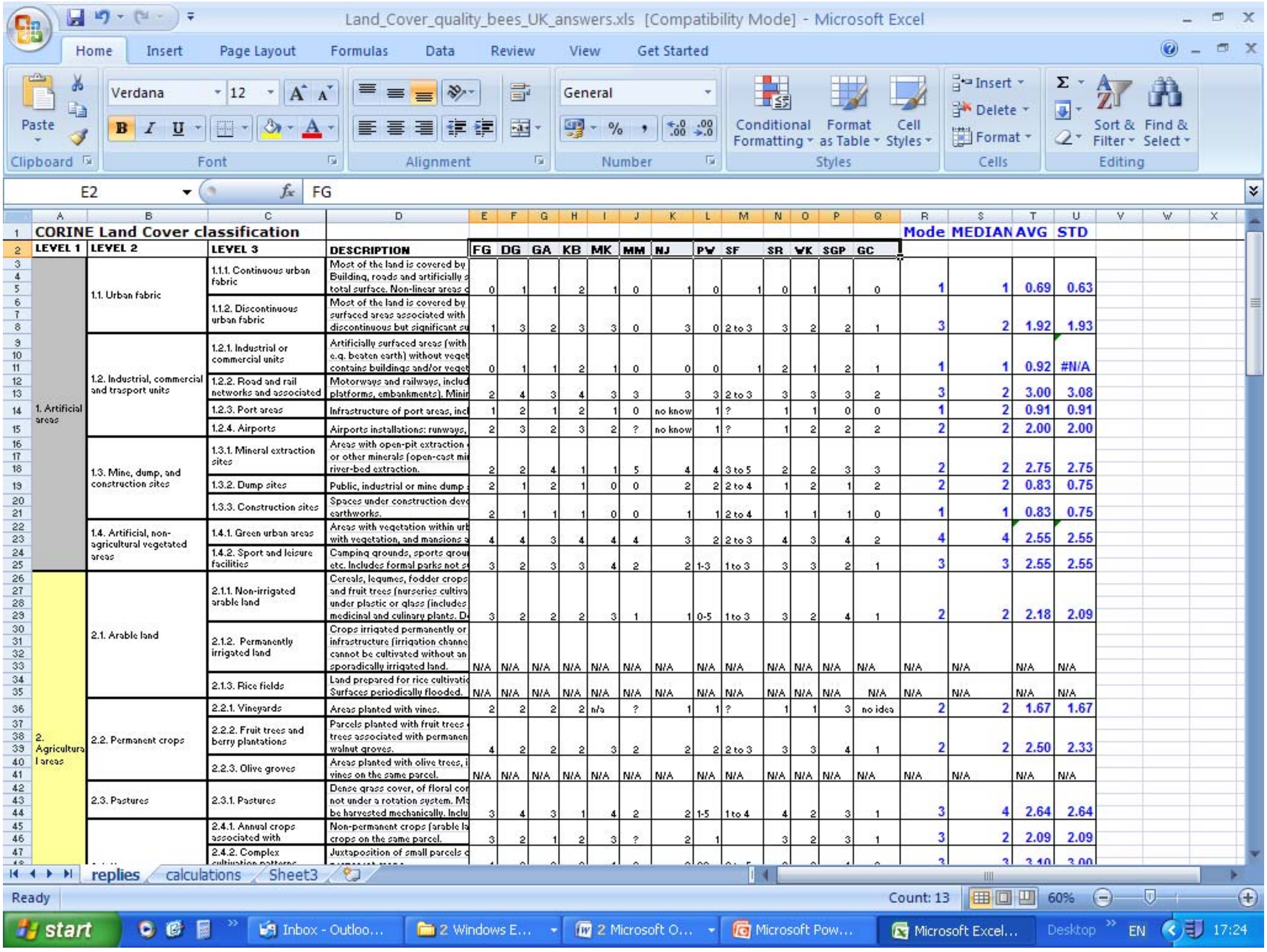
APPENDIX: Evaluation of Habitat Quality for bees in the UK context by a team of UK experts



LEVEL 1	LEVEL 2	LEVEL 3	DESCRIPTION	FG	DG	GA	KB	MK	MM	NJ	PW	SF	SR	WK	SGP	GC	Mode	MEDIAN	AVG	STD
1. Artificial areas	1.1. Urban fabric	1.1.1. Continuous urban fabric	Most of the land is covered by Building, roads and artificially s total surface. Non-linear areas c	0	1	1	2	1	0	1	0	1	0	1	1	0	1	1	0.69	0.63
		1.1.2. Discontinuous urban fabric	Most of the land is covered by surfaced areas associated with discontinuous but significant su	1	3	2	3	3	0	3	0	2 to 3	3	2	2	1	3	2	1.92	1.93
	1.2. Industrial, commercial and trasport units	1.2.1. Industrial or commercial units	Artificially surfaced areas (with e.g. beaten earth) without veget contains buildings and/or veget	0	1	1	2	1	0	0	0	1	2	1	2	1	1	1	0.92	#N/A
		1.2.2. Road and rail networks and associated	Motorways and railways, includ platforms, embankments). Minir	2	4	3	4	3	3	3	3	2 to 3	3	3	3	2	3	2	3.00	3.08
		1.2.3. Port areas	Infrastructure of port areas, incl	1	2	1	2	1	0	no know	1	?	1	1	0	0	1	2	0.91	0.91
		1.2.4. Airports	Airports installations: runways,	2	3	2	3	2	?	no know	1	?	1	2	2	2	2	2	2.00	2.00
	1.3. Mine, dump, and construction sites	1.3.1. Mineral extraction sites	Areas with open-pit extraction or other minerals (open-cast mi river-bed extraction.	2	2	4	1	1	5	4	4	3 to 5	2	2	3	3	2	2	2.75	2.75
		1.3.2. Dump sites	Public, industrial or mine dump	2	1	2	1	0	0	2	2	2 to 4	1	2	1	2	2	2	0.83	0.75
		1.3.3. Construction sites	Spaces under construction deve earthworks.	2	1	1	1	0	0	1	1	2 to 4	1	1	1	0	1	1	0.83	0.75
	1.4. Artificial, non-agricultural vegetated areas	1.4.1. Green urban areas	Areas with vegetation within urb with vegetation, and mansions a	4	4	3	4	4	4	3	2	2 to 3	4	3	4	2	4	4	2.55	2.55
		1.4.2. Sport and leisure facilities	Camping grounds, sports grou etc. Includes formal parks not s	3	2	3	3	4	2	2	1-3	1 to 3	3	3	2	1	3	3	2.55	2.55
2. Agricultural areas	2.1. Arable land	2.1.1. Non-irrigated arable land	Cereals, legumes, fodder crops and fruit trees (nurseries cultiva under plastic or glass (includes medicinal and culinary plants. D	3	2	2	2	3	1	1	0-5	1 to 3	3	2	4	1	2	2	2.18	2.09
		2.1.2. Permanently irrigated land	Crops irrigated permanently or infrastructure (irrigation channe cannot be cultivated without an sporadically irrigated land.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		2.1.3. Rice fields	Land prepared for rice cultivatic Surfaces periodically flooded.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2.2. Permanent crops	2.2.1. Vineyards	Areas planted with vines.	2	2	2	2	n/a	?	1	1	?	1	1	3	no idea	2	2	1.67	1.67
		2.2.2. Fruit trees and berry plantations	Parcels planted with fruit trees trees associated with permanen walnut groves.	4	2	2	2	3	2	2	2	2 to 3	3	3	4	1	2	2	2.50	2.33
		2.2.3. Olive groves	Areas planted with olive trees, i vines on the same parcel.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2.3. Pastures	2.3.1. Pastures	Dense grass cover, of floral cor not under a rotation system. Ma be harvested mechanically. Inclu	3	4	3	1	4	2	2	1-5	1 to 4	4	2	3	1	3	4	2.64	2.64
		2.4.1. Annual crops associated with	Non-permanent crops (arable la crops on the same parcel.	3	2	1	2	3	?	2	1		3	2	3	1	3	2	2.09	2.09
		2.4.2. Complex cultivation patterns	Juxtaposition of small parcels c	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3	3	3.10	3.00