

Review of “Long-term vegetation monitoring in Great Britain - the Countryside Survey 1978-2007 and beyond” by Claire M. Wood, Simon M. Smart, Robert G. H. Bunce, Lisa R. Norton, Lindsay C. Maskell, David C. Howard, W. Andrew Scott, and Peter A. Henrys.

General comments

The Countryside Survey of Great Britain is a unique long-term monitoring dataset looking at changes in vegetation over a 29 year period. Very few countries have set up such long-term monitoring programs of vegetation over such a wide scale and therefore tend to rely on remote sensing to conduct time series analysis. This manuscript is a summary of the Countryside Survey - covering much of the information that is apparently already available in many separate publications. Knowledge of these publications seems to be important to follow everything in the current manuscript - I needed to read a few of the background papers. It may be a prequel summary prior to repeating surveys of many of the plots.

The original sampling design was set up using random stratification. I understand that the initial stratification was done using a TWINSpan on environmental variables such as altitude, climate etc. (using either a binary classification or ranks). Normally, TWINSpan would have been used to derive groups (based on divisive clustering) from data on species composition and abundance (or presence/absence) and this is how I have personally used TWINSpan (from 1981 to about 1992). For patterns in environmental variables I would have used principal component analysis and looked for cluster groups (as was done by Owen et al. in “Cluster analyses: a case study for the UK West Midlands 2”).

Perhaps the authors could mention that TWINSpan has been criticized (e.g., for the fact that it assumes a strong gradient in samples along the first axis, that the cut-levels are somewhat arbitrary, some samples which are extremely similar may end up being placed in different end groups (Legendre and Legendre 1998 page 49; Belbin and McDonald 1993 also compared TWINSpan to UPGMA and ALOC). As I am sure the authors are aware, TWINSpan is not used much today, and has now been replaced by a suite of other multivariate techniques. Canonical analysis of principal coordinates carries out discriminant analysis to test the efficacy of the classification (I believe that discriminant analysis was used in some of the earlier papers by the authors, e.g. Bunce et al. 1996).

I realize that the authors were constrained by what was available at the origin of the survey but I wonder if they should say that the original stratification produced by TWINSpan has been compared with other, more modern, multivariate techniques (I think this has been done). Today Geographic Information Systems using remotely sensed data would be used to set up a sampling design, classify land cover types, develop digital elevation models and evaluate representativeness of vegetation plots using various tools. Current techniques that could also be used for this type of analysis would be classification and regression trees and other machine learning models that can be easily interfaced with GIS.

Regardless of the original sampling design the data present a unique opportunity for modelling changes in plant species composition and abundance and have been used for many purposes and have the potential to be used for many more. It seems to be an ideal dataset for modelling using

machine learning species distribution models (SDMs - one of the high performance platforms such as random forests, boosted regression trees or Maxent) but it is not apparent if this has been carried out (?). These could run as ensemble models and the model results compared. In addition more fully exploring spatial patterns could be done using generalized dissimilarity modelling. Comparing patterns from the ground-truthed plots with remotely sensed data (NDVI) would be very interesting. There is some mention of the great potential to use these data for predictive modelling to predict changes in the distribution and abundance of plant species in the UK with climate change (line 52).

One question relates to the amount of time spent sampling as this can influence estimates of species richness: some work (e.g., Zhang et al. 2014 in Alberta) recommended that sampling time is taken into account as this can have an important effect on results.

The word 'habitat' is used incorrectly throughout the manuscript and should be replaced by vegetation type or some other phrase (habitat is species-specific and refers to "*the resources and conditions present in an area that produce occupancy - including survival and reproduction - by a given organism. Habitat is organism-specific; it relates the presence of a species, population, or individual (animal or plant) to an area's physical and biological characteristics. Habitat implies more than vegetation or vegetation structure; it is the sum of the specific resources that are needed by organisms.*" (Hall et al. 1997). I have also used 'habitat' incorrectly in many of my papers but currently have a review paper on this topic with a journal.

Specific comments:

Line 37 (Abstract) - 'habitat' diversity. As noted above, this is not really the correct use of the term 'habitat' which is species-specific and should be called 'vegetation' diversity or 'land cover' diversity.

Line 41: This sentence starts with a number (256) - perhaps the sentence structure could be changed?

Line 45: 'where practically possible' - I'm not sure what this means? Are there examples where original plots have disappeared? (human development, erosion etc.). Also by the mid to late 1990s handheld GPS were becoming sufficiently accurate to relocate plots.

Line 46: This sentence is a bit repetitive since it is already stated that surveys began in 1978.

Line 53: I tried to access the links that were included for the data and two of the doi's don't work. Countryside Survey 1978 vegetation plot data (<https://doi.org/10.5285/67bbfabd-d981-554ced-b7e7-225205de9c96>),

And Countryside Survey 2007 vegetation plot data (<https://doi.org/10.5285/57f97915-8ff1-473b-8c77-2564cbd747bc>)

Please correct these links.

What is the accuracy of plot locations?

Line 76 (similarly line 79, 86 etc.): Again this is not the correct use of the term ‘habitat’ which is species-specific and should be called ‘vegetation’ categories or ‘land cover’ categories.

Line 98: It would be better to start this sentence with ‘One’ rather than a number (but not sure of the journal formatting advice on this).

Line 107: The authors indicate that ISA was carried out on “Altitude, climate, geology, human geography and location variables”. ISA is a technique (later evolved into TWINSpan) usually used for species composition and abundance data (see above) - I would have suggested another analysis method such as PCA, cluster analysis or perhaps, classification and regression trees (but the latter were not available until about 1984).

I wondered if the authors mean also that they carried out ISA on the plant species data (e.g., abundance by species) and then analyzed the relationship with the variables listed (e.g., mean altitude per plant species TWINSpan group etc.).

Line 120: I understand that the survey locations of the 1km squares are not being disclosed. The other reviewer has suggested that these data should be made available and open access. However, many of the survey squares occur on private land and presumably the only reason the authors were allowed access for monitoring was if they agreed that locations would not be disclosed. If they allowed these data to become publicly available then this would not only jeopardize future monitoring by the authors themselves but it would also prevent any future collaboration with current landowners or their descendants.

There is also a possibility that if the exact locations are disclosed then this could influence future land use decisions that could impact the specific sites and render them of no use for future monitoring. So in this situation the issue of the data being open access is equivocal.

Line 127: Is the statistically robust method here referring to ISA (later TWINSpan)?

Line 128: I’m not sure about the sentence referring to ‘scaling up’ from the sample sites to the population.

Line 146: Autocorrelation

The authors state “Initially, vegetation and soil data were recorded from five dispersed random (‘X’) plots in each 1 km square, which were located using a restricted randomization procedure designed to reduce auto-correlation.

Sites within a 1 km square are always going to have some degree of spatial autocorrelation and I don’t know if this can be controlled for using a randomization procedure. (Perhaps future modelling of plots would need to take spatial autocorrelation into account, or at least test how much variation is explained by spatial location versus measured biophysical features versus temporal variation).

Line 169-171: Could these species not be identified later by taking small samples for expert identification or herbarium comparison? (as long as they are not endangered or threatened?).

Line 187: The authors may need to explain the 'phytosociological requirement of homogeneity' for general readers.

Line 197: "The design is to ensure that the whole plot is covered, as tests had shown that a major difference between observers was their search routine." What were these tests?

Line 204: word missing 'in order *to* allow'

Line 211: "In arable fields where full access is not possible, species records are made from plots taken from an estimated 14m square, starting three metres into the crop in order to avoid any edge effect."

Is 3 metres really a sufficient distance to avoid edge effects here? I would think it would depend on the nature of the edge vegetation (e.g. tall hedgerows and trees could cast shadows over great distances into a crop field).

Line 212: "in order to causing minimum disturbance to the crop." Please correct sentence structure.

Line 254: Later the authors state "The purpose of establishing the plots was to record the arable weed population at the edge of cultivated fields and any subsequent changes".

Presumably these plots were designed to look at edges of fields so are quite distinct from the arable field plots above?

Line 358-360: No bias was found between QA and CS teams using DCA which is an unconstrained ordination. Presumably this was done using visual interpretation (no distinct grouping of QA and CS surveyed plots in the ordination). There are multivariate techniques available that could test this difference statistically (e.g., in *n*MDS ANOSIM, or using the test for the homogeneity of multivariate dispersions in PERMANOVA +).

Line 362:

Is it a good idea to include bryophytes and lichens in the surveys if these cannot always be identified to species and if experienced bryologists and lichenologists are not deployed in field surveys? The authors mention that some differences in species richness could be attributed to this.

The decline in 'quality' of recordings in 2007 was possibly attributable to the fact that bryophytes were not identified with the same degree of accuracy as in previous years. But surely whether or not the decline in quality was due to differences in bryophyte identification could be assessed by including or excluding bryophytes from statistical comparisons?

Line 372: “and strategic sampling at the landscape level was then tested successfully in regional surveys in Cumbria and Shetland (Bunce and Smith)” What does ‘tested successfully’ mean?

Line 401: It would also be possible to examine the performance of different model platforms by dividing data into two groups: 1) a training dataset used to create the initial model and 2) an independent test dataset which was used to test model quality (Fielding & Bell, 1997) and to ensure accuracy and repeatability.

Line 432: The scientific genus for hawthorn is *Crataegus* (not *Cratageous*).

Line 441: I’m not sure how useful simple results of changes in species richness are - given spatial effects including environmental gradients.

Line 513: link does not work

Line 519: link does not work

Line 524: link does not work.

Line 529: Page does not exist...

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Please note that I have previously corresponded with one of the authors (L. Norton).