FRAMEWORK AGREEMENT SCHEDULE 4

ORDER FORM/
WORK PACKAGE ORDER

FROM

Authority	Secretary of State for Environment, Food and Rural Affairs
Address	Defra Group Commercial 3rd Floor, Mallard House 1-2 Peasholme Green York YO1 7PX
Contact Ref:	Phone: [redacted] Email: [redacted]
Order Number	Ref: ecm_58847
Order Date	23 September 2020

TO

Contractor	UK Centre for Ecology & Hydrology
For attention of:	Name: [redacted] Phone: [redacted] E-mail: [redacted]
Address	Maclean Building Crowmarsh Gifford Wallingford Berkshire OX10 8BB

1. SERVICES REQUIREMENTS

(1.1) Services required:

The Authority is the UK Government Department responsible for the environment, food and farming and rural affairs. The Authority's priorities are to secure a healthy natural environment; a sustainable, low-carbon economy; a thriving farming sector and a sustainable, healthy and secure food supply. Further information on the Authority can be found at: Natural England

Modelling landscape scale species responses to Agri-environment schemes

Summary of Project Aims

The aim of this project is to investigate the feasibility of spatially modelling landscape scale species responses to Agri-Environment Schemes (AES) density in unsurveyed National Character Areas (NCAs). Building on data collected as part of a landscape scale species monitoring project (LM0465), this project should explore the role of additional datasets (e.g. national citizen

science surveys and environmental predictor variables), alternative statistical methods, as well as potential validation techniques.

Rationale

The Defra/Natural England Agri-environment Evidence Programme has funded a project looking at the impact of agri-environment schemes (AES) on mobile species at a landscape scale (LM0465). This 'landscape scale species' project has used gradients of AES density to assess responses of birds, bats, moths, and pollinating invertebrates and butterflies, with intensive field surveys covering 9 x 1km squares in 6 NCAs. Field surveys have collected significant amounts of field data so far, with a final baseline year of surveying planned to commence in spring 2021 (subject to confirmation). Preliminary analysis has detected different species' responses to different levels of AES uptake in the chosen NCAs, however the applicability and extrapolation of these responses across wider geographical areas is still uncertain.

Extrapolation issues include the role of NCA characteristics in the species response, as well as the applicability of AES density gradients in other areas; the experimental design of LM0465 was chosen to maximise the likelihood of detecting an effect of AES by using the NCA to control for variation in habitat composition across the country. The ability to separate AES gradient effects from landscape composition effects is based on the assumption that within an NCA, landscapes are relatively homogenous. This assumption is also based on all NCAs being different, and therefore there is no information of the NCA effect on species responses in unsurveyed NCAs, beyond using the average response of surveyed NCAs.

A pilot study carried out in the landscape scale species project identified four NCAs which were as closely related as possible to the four lowland NCAs surveyed, based on variables such as climate, altitude, NCA size, habitat coverage, species pool size and land class. The response models developed from surveying were then applied to the unsurveyed NCAs for bird diversity, bird richness, butterfly abundance, hoverfly abundance and the abundance of mid-tongue length bumblebees. The resulting predictions showed the difference in response from a zero AES scenario, and were presented alongside the uncertainty of the model output. All response variable predictions showed a high level of uncertainty, for example uncertainty of bird species richness ranged from approximately 120 to 200 species per km^2, whilst for butterfly abundance uncertainty ranged from approximately 950 to 1600 species per km^2. The pilot results reflect the low ability of the landscape scale species data to predict beyond the surveyed squares, highlighting the importance of the caveats described earlier.

The potential for reducing uncertainty in predicting response variables from the landscape scale species data is limited, however further exploration could be undertaken to determine whether the use of additional complementary datasets could hold potential in modelling landscape scale species responses beyond the surveyed squares. Possible datasets that use complementary survey methods and are more suitable for extrapolation to wider landscapes include the Breeding Bird Survey (BBS) and Wider Countryside Butterfly Survey (WCBS), however these datasets have their own limitations in the context of this research, and there is no guarantee that a viable extrapolation modelling approach could be developed. For example, the BBS and WCBS survey designs do not maximise contrast in AES uptake and surveys are carried out less frequently therefore may not be intensive enough to identify species responses to AES.

Modelling of bird and butterfly abundance using citizen science data, such as BBS, has had mixed success in the literature, not necessarily linked to the fact these are volunteer surveys, but the inherent variability of environmental datasets and the subsequent challenges of modelling such data. Sullivan et al. (2017) modelled bird and butterfly abundance at BBS and Butterfly Monitoring Scheme (UKBMS) sites as a function of environmental variables using generalised linear mixed models. The environmental variables used in the models included land cover, linear features and altitude, with observation, site and 50km region accounted for as random effects. Generally, the models had relatively low explanatory power, possibly due to models not including other factors affecting abundance e.g. habitat structure, though the inclusion of linear features did improve model performance, particularly within agricultural landscapes. A similar modelling approach focused on butterfly abundance by Oliver (2014), which specifically included AES option area or count in models, found multispecies modelling performed best when based on a subset of ‘butterfly-friendly’ AES options, rather than including all AES options. Both local and landscape spatial scales were tested, mirroring the LM0465 design, with higher butterfly densities associated with higher counts of AES options, at the 3km scale using WCBS data, however such relationships were not detected at the 1km scale. The lack of relationship between butterfly density and AES at UKBMS sites, might reflect the likelihood of these sites being higher quality, and therefore reduced additionality of AES implementation.

The detection of relationships between mobile taxa abundance or density and AES management (or similar) using the BBS, UKBMS and WCBS datasets indicates there may be potential for these datasets to complement the relationships identified in the landscape scale species project. Common factors amongst the models used include taking into account broad spatial patterns to account for spatial autocorrelation, such as 100km or 50km grids, which could be analogous to the use of NCAs in the landscape scale species project. The

differences in observation processes may preclude simply pooling national datasets with those collected in LM0465. Integrated/joint modelling approaches will be explored under this contract.

Project Aim:

The aim of this project is to investigate the feasibility of spatially modelling landscape scale species responses to AES density in unsurveyed NCAs.

Objectives:

i. Acquire data for environmental covariates and relevant structured citizen science schemes and scope the coverage of AES intervention gradient at 1km squares surveyed in these citizen science schemes.
ii. Explore whether it is possible to explain variation in taxa responses between NCAs, through the inclusion of additional environmental covariates.
iii. Test the similarity of relationships with AES gradients between LM0465 and structured citizen science scheme data, showing whether the latter can provide validation for predictions from the former. Investigate whether differences in survey protocols between datasets are important, to enable a direct comparison of AES effects.
iv. Fit integrated models to LM0465 and citizen science scheme data using a joint likelihood approach. Evaluate whether the integrated models reduce uncertainty in predictions of response variables and assess changes in the detectable level of response from data integration. Explore whether model predictions of biodiversity responses can be calculated to inform the AES uptake required for effects that are relevant to policy targets.

In addition, CEH will run a training day to introduce the methodologies used and explain the results to the Natural England (NE) agri-environment evidence team, and a webinar for wider NE / Defra staff

Task 1: To explore the research questions using the approaches described below.

The aim of this project is to reduce the uncertainty in predicting mobile species response to AES density for unsurveyed NCAs. The mobile species responses used in the pilot modelling in LM0465 should be used; bird density, bird richness, butterfly abundance, hoverfly abundance and abundance of mid-tongue length bumblebees, however the unsurveyed NCAs may change if the incorporation of other datasets limits the areas which can be used.

The approach and methods to investigate the research questions is to be determined by the contractor in discussion with the project steering group. A

detailed project plan should be submitted within a month of project initiation, with appropriate milestones.

Approach (a) Can the variation in responses between NCAs be explained using a wider range of predictor variables (e.g. landscape characteristics, elevation, slope)? This approach should consider alternative predictor variables in both LM0465 data and other datasets (e.g. BBS, WCBS). The use of additional data may help to understand what is driving the differences between NCAs, which if incorporated into the models could reduce uncertainty in unsurveyed NCA predictions. Principal Component Analysis may be a useful tool to identify appropriate predictor variables, examples of which may include; densities of habitats which might provide alternative foraging, refuge, or nesting (nearby grassland, woodland, urban, etc. from Land Cover Map or Mastermap), soil measures (type, drainage, wetness, etc.), elevation, aspect, distances from roads/water bodies etc. One potential issue of this approach found in the landscape scale species monitoring project is that analysis adding in landscape characteristics frequently found models would not converge, and it was only possible to test 2-3 habitat variables per response variable. This approach might have limited success given the difficulties found already in getting models to converge. Landscape variables which have been previously associated with the effectiveness of AES-like management have been compiled for different mobile taxa groups as part of the scoping study for LM0465 (Staley et al., 2016: LM0457 – Table 5a & 5b). Consideration of multi-scale approaches may also be useful in this investigation, i.e. model at coarse scale using x variables, then use that as an input to fine scale with y variables.

Approach (b) Are similar relationships found with response variables (e.g. butterfly richness) using the calculated AES gradient scores with national datasets (e.g. WCBS, BBS)? This approach will assess whether the species response relationships detected with the LM0465 data are also evident in the BBS and WCBS datasets, for the surveyed NCAs. If the same responses are identified, there is confidence that the surveyed NCAs are representative and the LM0465 results can be extrapolated beyond the surveyed NCAs using national datasets. There could be a range of reasons why the same responses might not be detected; for example the landscape scale species monitoring project undertook more intensive surveying than the BBS or WCBS monitoring and so there might simply not be enough data for the same relationships to be revealed, or the relationships might be driven by data collected at a slightly different time point (highlighting the importance of interannual variability). There is merit in testing this approach, however the results from the pilot suggest that there will still be high uncertainty in extrapolating to unsurveyed NCAs.

Approach (c) Can datasets can be combined to produce estimates of AES effects representative of the whole country e.g. combining LM0465 data with WCBS? The use of multiple datasets in models may allow the benefits of

different datasets to be maximised i.e. the power to detect AES effects from LM0465 with the national coverage of other surveys. Being able to account for the biases in individual datasets could theoretically reduce uncertainty in modelling, but as yet approaches such as joint modelling or integrated distribution modelling, are still an emerging and challenging area of ecological analysis and therefore there is no guarantee of successful application in the context of this research. Joint modelling enables the abundance of multiple taxa (or species) to be modelled, accounting for correlation between taxa as well as response to predictor variables (Warton et al., 2015).

Approach (d) Can a combination of the approaches above be used to improve predictions of landscape scale species response to AES density? The approaches a-c will give an insight into whether the confidence in predicting species responses to AES density can be improved for unsurveyed NCAs, through including more data, predictor variables or more sophisticated modelling techniques. It should be explored whether a combination of these approaches reduces uncertainty to produce meaningful predictions in unsurveyed NCAs.

Task 2: One day face to face training with NE Agri-environment evidence team.

The aim of this training is for NE staff to develop their understanding of modelling approaches and their applicability to AES outcomes. The session should explain the methods of the modelling undertaken in this project, interpretation of the results and include discussion on potential future work which could follow-on from this project.

The format of the session will be decided with the NE project officer, and will be informed by the progress of modelling made during the course of the project; a mixture of presentation, group discussion and hands on elements would be beneficial. A face to face training session is preferable at a NE office (at a location which is easily accessible by all attendees), however this will be decided at a later date in line with coronavirus advice at the time. The cost for this training session, including travel, should be costed separately in the tender.

The training session should be aimed at an informed non-specialist audience (i.e. detailed agri-environment knowledge and some existing statistical knowledge), with approximately 6-10 participants.

References

Isaac, N.J., Jarzyna, M.A., Keil, P., Dambly, L.I., Boersch-Supan, P.H., Browning, E., Freeman, S.N., Golding, N., Guillera-Arroita, G., Henrys, P.A. and Jarvis, S. (2020). Data integration for large-scale models of species distributions. *Trends in Ecology & Evolution*, *35*(1), pp.56-67.

Oliver, T. (2014). Assessing the importance of spatial location of agri environment options within the landscape to butterflies. Correlative analysis of datasets to assess the degree of success in the delivery of ES objectives. NECR157. publications.naturalengland.org.uk/file/5157448927150080

Staley, J.T., Siriwardena, G.M., Smart, S.M., O'Connor, R.S., Henderson, I.G., Jarvis, S.K., Jones, N., Freeman, S.N., Redhead, J.W., Carvell, C., Hallam, C., Jitlal, M. (2016). A study to develop the scope for monitoring landscape-scale biodiversity impacts of agri-environment schemes in England, final report to Natural England, project ECM 42922/LM0457

Sullivan, M.J., Pearce-Higgins, J.W., Newson, S.E., Scholefield, P., Brereton, T. and Oliver, T.H., 2017. A national-scale model of linear features improves predictions of farmland biodiversity. *Journal of applied ecology*, *54*(6), pp.1776-1784.

Warton, D. I., Blanchet, F. G., O'Hara, R. B., Ovaskainen, O., Taskinen, S., Walker, S. C., & Hui, F. K. (2015). So many variables: joint modeling in community ecology. *Trends in Ecology & Evolution*, 30(12), 766-779.

Outputs

Specific outputs for this project are listed below, to be delivered within the 2020/21 financial year.

- Monthly update reviewing project progress.
- An interim project report, the format of which will be agreed with the Project Steering Group (PSG). This is to allow the project steering group to provide input during the project.
- A comprehensive final written report, externally peer-reviewed, covering all objectives and tasks of the project. The final report should be available to the steering group for comments 19th February2021, with a final version due 15th March 2021.
- Well documented and annotated code which is capable of reproducing any analysis using open and freely available data. Any non-code analysis or data processing to be fully documented.
- Steering group meeting to present/discuss the final report.
- A '2-page summary' report, summarising the aims, outcomes and implications of the project, for use by policy colleagues, and other non-specialists. The summary should use a template which will be provided by the NE project officer.

- The contractor will present a webinar to NE staff and interested parties, reporting the results and findings of the project.
- Training session with selected NE staff– face to face preferred. The aim of this will be to develop understanding of modelling approaches and their applicability specifically to AES outcomes amongst key NE staff.

Reporting and Milestones

In order to assist the NE project manager to observe the progress we request that you include sufficient milestones within the project that will demonstrate the progress of the research. Compulsory milestones are as follows:

1. 30th September 2020: Project plan to be submitted following the inception meeting.
2. 18th December 2020: Interim report
3. 19th February 2021: Draft final report. This should include full analysis, conclusions and discussion on the data analysed against the requirements.
4. 15th March 2021 (TBC): Training session with NE staff.
5. 15th March 2021: Final report with accompanying 2-page summary will be provided to NE (please note, payment will not be released until the report has been reviewed and deemed satisfactory by the project manager).
6. 31 March 2021 (TBC): Present a webinar outlining the main results of this project suitable for key staff at NE and the wider Defra group. The webinar will also be recorded for NE's skills port to deliver wider dissemination within NE and Defra. This is expected to be in the format of a PowerPoint presentation and conference call.

This project will be paid by milestones, however not all milestones need to be associated with payment. It may be appropriate to include additional milestones that are not related to payment to be used to indicate progress within the project. The frequency of milestone payments should be determined by the contractor, however, we request that they are appropriate and not at a frequency greater than every month.

The format of the final report will be agreed between the project manager and project leader. Natural England and Defra require the opportunity to comment on the draft final report (approx. 4 weeks). The successful contractor will be responsible for ensuring both the quality of the work as well as the presentation of the material (e.g. proof reading, ensuring clear English). The appointed contractor is also to be aware that Natural England requests acknowledgement in the publication of its funded research. All reports should be provided in MS Word and PDF format.

Bidders should be aware that Natural England and Defra intend to publish final reports. The contractor will be responsible for arranging peer-review of the final report (see below).

Natural England is happy to encourage widespread publication, and welcomes the use of appropriate trade press, peer-reviewed journals and sector-specific journals. The contractor is also to be aware that Natural England requests that all publication (including oral presentations) of its funded research is notified to the project manager at least two weeks before publication.

Peer Reviews

A comprehensive, externally peer-reviewed final written report suitable for publication as a Defra science report, covering all objectives and tasks of the project. The contractor will be responsible for arranging peer-review of the final report by 2 appropriate reviewers, to be agreed with the PSG.

For carrying out the peer review Natural England will provide:

1. A form for peer reviewers to complete to guide them through key questions.
2. A declaration for reviewers to sign regarding the use of confidential information and any conflicts of interest.

There should be a minimum of two peer reviewers and they must be independent of organisations working on the project. A cost for peer review should be itemised in the tender. This should take into account staff time to organise the peer review, staff time to edit report in light of the reviews (subject to steering group agreement) and cover costs for reviewers if required.

Project management & Timetable

Duration: 03 September 2020- 31 March 2021.

- The successful contractor should appoint a project leader. The project leader will be responsible for the management and delivery of the project and will act as the liaison point with the Natural England project manager.
- Natural England will establish a project steering group (PSG) to oversee the contract including representatives form NE and Defra and other relevant partners. A project initiation call between the contractor and the NE project manager will be required within one week of the start of the contract, and a project inception meeting between the contractor and the PSG will be required within two weeks of the start of the contract (usually at a Defra/NE office, to be agreed based on the location of the contractor and PSG members, however this may be a teleconference depending on coronavirus guidance).

- The PSG will meet will meet up to three further times throughout the course of the project, by teleconference or face-to-face, as appropriate to discuss findings. The project officer/successful contractor (as appropriate) will be responsible for setting up these meetings.
- Secretariat and production of minutes from meetings is the responsibility of the successful contractor, who will share meeting minutes with the project team, NE and the steering group, where applicable.
- The successful contractor will send a short (no more than 1 page of A4) progress update to the NE project manager once a month. The form of these updates will be agreed in the inception meeting.
- The project is expected to start on 03 September 2020 and finish no later than 31st March 2021. Bidders are reminded that cost is one of the factors that will be considered when assessing bids.
- Research contracts are let on a firm price basis (excluding VAT). This is an all-inclusive price for the contract and, so long as the scope of the contract remains the same, it is not subject to any review, amendment or alteration.

Property rights, publication and confidentiality

Where possible, and subject to third party rights and licensing restrictions, all data resulting from this project, project documents, code and other materials will be the property of Natural England. Where possible and subject to third party rights and licensing restrictions any code, models and data collected will be made openly and publicly available.

To the extent that Natural England reasonably requires access to data used within this project, such shall, subject to third party rights and licensing restrictions, be licensed to Natural England by the Contractor or the relevant third-party owner.

All data used within this project must be licensed by Natural England and all data licensing must be agreed with Natural England by contacting data.services@naturalengland.org.uk prior to data being obtained and analysis commenced. Potential datasets are listed below.

Natural England and Defra intend to publish the final project report as a Defra science report. The published report will be made available on the Natural England and Defra Science websites. It is likely to be shared directly with partners as part of regular liaison over agri-environment policy and delivery.

Natural England encourages widespread publication, and welcomes the use of appropriate trade press, peer-reviewed journals and sector-specific journals, but it is a requirement that all plans to communicate outcomes, including publications and oral presentations, from funded research are agreed with the

project manager (who will ensure Natural England and Defra QA requirements are met) before publication or presentation.

The Contractor(s) will be responsible for ensuring the quality of the work, the presentation of the final report and any other material to be published.

Dataset name	Data Supplier	Has NE received a licence to use the source data	Licence Terms
National Character Areas	NE		OGL
Countryside Stewardship Scheme 2016 Management Options (England)	NE		OGL
Environmental Stewardship Scheme Options (England)	NE		OGL
LM0465 - Landscape scale species monitoring	NE/CEH/BTO		Data held by project team**
BTO Breeding Bird Survey	BTO		Data held by BTO**
UK Butterfly Monitoring Schemes incl. WCBS*	UKBMS Partnership		OGL, data managed by UKCEH

*These structured invertebrate schemes will be scoped, may not be included in modelling if coverage is too low or survey methods differ too much.

**No license shall be granted to Defra / NE, data will be used internally by BTO or UKCEH.

(1.2) Commencement Date: 03 September 2020

(1.3) Completion Date: 31 March 2021

2. PERFORMANCE OF THE SERVICES [AND DELIVERABLES]

(2.1) Key Personnel of the Contractor to be involved in the Supply of the Services

[redacted] Project Leader
[redacted] Lead for statistical analyses/modelling
[redacted] Lead for spatial analyses/GIS
[redacted] Statistician, modelling advisory role
[redacted] Invertebrate citizen science data expert
[redacted] Spatial analysis and data support
[redacted] BTO lead

[redacted] Statistician/modeller
(2.2) Performance Standards
(2.3) Location(s) at which Services are to be provided: Maclean Building Crowmarsh Gifford Wallingford Berkshire OX10 8BB
(2.4) Standards:
(2.5) Contract Monitoring Arrangements For the avoidance of doubt the services required are being provided under Framework Agreement 22707

3. PRICE AND PAYMENTS
(3.1) Contract Price payable by the Authority excluding VAT, payment profile and method of payment (e.g. Government Procurement Card (GPC) or BACS)) £75,758.00 For full pricing schedule see Appendix 1 Payable by BACS
(3.2) Invoicing and Payment The Supplier shall issue electronic invoices in arrears following completion of appropriate milestones.

4. Invoicing Requirements

All invoices should be sent to the Natural England Project Officer.

BY APPROVING THIS ORDER FORM THE CONTRACTOR AGREES to enter a legally binding contract with the Authority to provide to the Authority and natural England the Services specified in this Order Form, incorporating the rights and obligations in the Call-Off Contract that are set out in the Framework Agreement entered into by the Contractor and Defra on 03 September 2020.

Electronic Signature

Acceptance of the award of this Contract will be made by electronic signature carried out in accordance with the 1999 EU Directive 99/93 (Community framework for electronic signatures) and the UK Electronic Communications Act 2000. Acceptance of the offer comprised in this Contract must be made within 7 days and the Agreement is formed on the date on which the Contractor communicates acceptance on the Customer's electronic contract management system ("Bravo"). No other form of acknowledgement will be accepted.

Appendix 1 – Pricing Schedule

No.	Item	Staff Grade	Day £ rate	No. of days	Financial year	Total price (ex. VAT) £
1	Task 1: Modelling approaches	UKCEH: [redacted] (Project manager, PM)	[redacted]	[redacted]	20/21	[redacted]
		UKCEH: [redacted] (Technical / specialist)	[redacted]	[redacted]	20/21	[redacted]
		UKCEH: [redacted] (Senior specialist / PM grade)	[redacted]	[redacted]	20/21	[redacted]
		UKCEH: [redacted] (Technical / specialist)	[redacted]	[redacted]	20/21	[redacted]
		UKCEH: [redacted] (Senior specialist / PM grade)	[redacted]	[redacted]	20/21	[redacted]
		UKCEH: [redacted] (Technical / project support)	[redacted]	[redacted]	20/21	[redacted]
2	Task 2: NE training workshop	UKCEH: [redacted] (Project manager, PM)	[redacted]	[redacted]	20/21	[redacted]
		UKCEH: [redacted] (Technical / specialist)	[redacted]	[redacted]	20/21	[redacted]
		UKCEH: [redacted] (Senior specialist / PM grade)	[redacted]	[redacted]	20/21	[redacted]
		UKCEH: [redacted] (Technical / specialist)	[redacted]	[redacted]	20/21	[redacted]
3	Peer review	External reviewers (Senior specialist equivalent)	[redacted]	[redacted]	20/21	[redacted]
4	Travel & Subsistence	Travel to training workshop, 3 UKCEH staff, 2 BTO staff			20/21	[redacted]
5	Other costs - BTO subcontract	BTO subcontract for work on Tasks 1 & 2 as specified in E01 and E02.*			20/21	[redacted]
6	**Total exc VAT**				20/21	75758.00