

inpractice

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Data and Information Management

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Welcome

Starting out as President of our Institute, there's a temptation to behave like giant hogweed *Heracleum mantegazzianum*, a biennial, with just three years available to put on as much growth as possible with as many good ideas as giant hogweed seeds. However, reading Steph Wray's editorial in September's *In Practice*, I was put in mind more of a young English oak *Quercus robur*, clearly in a healthy condition and growing rapidly. Anyway, although impressive, *H. mantegazzianum* is dodgy to say the least.

A vote of thanks for Steph and her excellent 'arboriculture' and for leading us through this exciting and important time for CIEEM and our profession. I inherit a fine specimen and a priority must be to consolidate on our achievements whilst maintaining the momentum of a profession in the ascendancy. For me, this necessitates:

- Growing our membership with a priority to achieve a better balance between ecologists and environmental managers, between consultancies and statutory agencies and our non-governmental organisations, responding to the needs of the smaller and the larger consultancies, and different disciplines such as marine and freshwater.
- Furthering our engagement with universities, encouraging students to become members (CIEEM's life sap), responding to the opportunities in apprenticeships and developing clear career pathways.
- Building on greater Welsh, Scottish and Irish representation within CIEEM and continuing to strengthen support for country-based activities (e.g. training, workshops and conferences), with increased membership underpinning evidence to governments to help shape policy and legislation.
- Building on CIEEM's impressive training programme, so essential in underpinning high standards in our work, and progressing towards protecting our professions as ecologists and environmental managers with those key skills requiring evidence of quality and competence.

Steph described the CIEEM oak as being on a solid financial footing, if not luxurious. As a relatively young professional institute, we do need to continue to grow our finances, and not just to ensure that we implement our operational plan. Looking at the annual accounts for some other associations and societies of which I'm a member, their reserves do look like a luxury and make me envious. The reality is that they are critical and we must build up sufficient stores should we need to cope with an unexpected hard winter.

CIEEM's role in providing advice to the government of the day on our areas of expertise has delivered acorns aplenty over the last few years, not least due to the impetus provided by Brexit. We need to continue this across not just broader geographies but in other areas of change including the use of technologies in our work, managing benefits against risks, the need to extend our excellence in biodiversity assessment and management to a broader ecological approach including ecological function.

As CIEEM's Honorary Secretary, I have had the pleasure of working with CIEEM's Secretariat Team so ably led by Sally, and with our Governing Board. Their professional, able and competent approach is impressive as is their willingness, when needed, to go the extra mile, all of which leads me to believe that they will be able put up with me as President for three years and be prepared to curtail any giant hogweed moments! I'm certainly looking forward to working with them and our members.

Max Wade CEcol CEnv FCIEEM
CIEEM President

Information

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CIEEM Conferences 2019

CIEEM Ireland Conference

*Wading into Water:
The assessment and management
of our aquatic environment*

28 Feb 2019, Athlone

For the 2019 Irish conference, CIEEM aims to create a space where ecologists can discuss and learn about how we work in the water environment. This event will take a high-level look at policy with updates on WFD implementation, flood defence and an overall catchment approach. But there will also be a practical aspect, looking at the role of the ecologist when undertaking potential impact assessments on water quality, assimilative capacity studies and method statements, as well as exploring the collection of appropriate data to underpin and ensure robust assessments. The day will close with an open conversation on how ecologists and engineers need to work together in the water environment.

Bookings will open shortly.

CIEEM Spring Conference 2019

Biodiversity Net Gain: A Transformative Approach to Halting Biodiversity Loss, or a Wolf in Sheep's Clothing?

Spring 2019, location TBC

The call for papers for this conference is now open. Please contact KrystieHamilton@cieem.net for more information.

CIEEM Autumn Conference 2019

Planning and Ecology

Autumn 2019, Wales TBC

More information on this conference will be added to the website and circulated to members in due course.

CIEEM Employment & Salary Survey 2017-2018

This survey found that employment levels and prospects are generally good, but working hours are long and many employed members contribute un-remunerated time to their employer. Self-employed members work, on average, slightly longer hours but enjoy the flexibility and independence of their role.

Salaries are, in general, below those of related professions and significantly below the average for a professional working in the science and technology sector. For Full members, whether employed or self-employed, average salaries are higher outside of the UK than within.

Despite the challenges of long, anti-social hours and disappointing pay, job satisfaction levels are good and most respondents would recommend the profession to those looking for an interesting, varied and worthwhile career.

Find the full report on the CIEEM website.

Staff Changes

In October we welcomed Jade Hemsley as our new Professional Development Administrator. Jade has recently graduated from the University of Reading with a degree in ecology.

In Practice Themes

If you would like to contribute an article to a forthcoming edition of *In Practice* please note the submission deadlines below; early submission is appreciated.

Edition	Theme	Submission deadline
March 2019	Planning, Licensing and Ecology	n/a
June 2019	Biodiversity and Environmental Net Gain	25 February 2019
September 2019	Blue and Green Infrastructure	27 May 2019
December 2019	Future of Land Management	26 August 2019
March 2020	International Approaches	25 November 2019

If you would like to contribute to one of these issues please contact the Editor, GillKerby@cieem.net. Contributions are welcomed from both members and non-members.

Guidelines for Ecological Impact Assessment in the UK and Ireland (2018)

These updated guidelines combine the *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition* (2016) and the *Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal* (2010), with the aim of promoting good practice by ecologists, encourage a scientifically rigorous and transparent approach, and create a common framework for EIA.

Find the full guidelines on the CIEEM website.

Commercial Impacts of Brexit on the Sector

This report outlines the results of a survey, sent to both members and the wider environmental community, to determine how the Brexit vote has affected ecologists and environmental managers commercially.

The survey also looked at the measures that are being considered or have been put in place to mitigate any negative commercial impacts.

We hope to use the results of this survey in our discussions with policy-makers to highlight the important challenges and changes the sector will face post-Brexit.

Find the report on the CIEEM website.

Agriculture Bill introduced to Parliament

A landmark new Agriculture Bill has been introduced to Parliament by Secretary of State for the Environment, Michael Gove. The Bill describes how farmers and land managers will in future be paid for 'public goods', such as better air and water quality, higher animal welfare standards, access to the countryside and measures to reduce flooding. This will replace the current system of Direct Payments, which pays farmers based on the total amount of land farmed. The Bill was published alongside a policy statement which outlines England's agricultural policy for the next decade.

<https://www.gov.uk/government/news/landmark-agriculture-bill-to-deliver-a-green-brex>

Funding from EU programmes guaranteed until the end of 2020

The Treasury has announced that any funding secured by businesses, universities and local organisations through EU programmes, from now until the end of 2020, will be guaranteed by the UK government even in a no deal scenario. In addition, the Treasury will also guarantee funding for UK organisations which successfully bid directly to the European Commission through projects like Horizon 2020.

<https://www.gov.uk/government/news/funding-from-eu-programmes-guaranteed-until-the-end-of-2020>

IUCN publish guidance on valuing ecosystem services in protected areas

The new guidance by IUCN experts helps identify appropriate tools for ecosystem service assessment, with particular focus on protected areas (e.g. natural World Heritage sites) and Key Biodiversity Areas (KBAs).

<https://ieep.eu/news/guidance-on-measuring-modelling-and-valuing-ecosystem-services>

Natural Resources Wales highlights priorities for biodiversity protection

In a report titled 'Vital Nature', Natural Resources Wales (NRW) set out their priorities for protecting and restoring Wales' biodiversity. It outlines NRW's goals and a series of high-level actions and commitments up to 2022. Goals laid out in the report include: improving links between protected sites, increasing peoples' awareness and connectivity to nature, and ensuring biodiversity central to all of NRW's work.

<https://naturalresources.wales/about-us/news-and-events/news/nrw-sets-out-a-fresh-approach-to-wildlife-in-wales/?lang=en>

Bird Survey and Assessment Guidance in preparation

Bird survey and assessment guidance for ecological consultants and decision-makers working in planning and built development is in preparation. A steering group consisting of consultants and representatives from CIEEM, Natural England, RSPB and the BTO is developing the guidance to provide consistency of approach and effort to bird survey and assessment within the industry. The intention is that the guidance will be located on a web-platform and will be ready for issue in early 2019. Initially the guidance will cover survey scoping and breeding bird survey techniques. Subsequent revisions will add guidance on additional survey and assessment techniques, along with topics such as surveyor competency. There is also a strong commitment to the guidance being based on current scientific evidence and where gaps in evidence are apparent they will be highlighted, and practitioners and researchers encouraged to produce the evidence to fill these gaps and where appropriate to adjust the guidance.

Irish Minister announces funding for local Environmental Initiatives

The Minister for Communications, Climate Action and Environment, Denis Naughten, has announced a total of 880 projects will receive funding from the 2018 Local Agenda 21 Environmental Partnership Fund. €460,000 was provided by the Department, along with matched funding by local authorities and other sources, leading to a total of €1.5m. Chosen projects are those that will support national environmental policies such as those on Waste, Biodiversity, Climate Change, Air, Water and Sustainable Development.

<https://www.dccae.gov.ie/en-ie/news-and-media/press-releases/Pages/Minister-Denis-Naughten-announces-funding-for-local-Environmental-Initiatives-.aspx>

Ocean wilderness areas mapped

Marine scientists in Australia have mapped regions of 'wilderness' across the world's oceans for the first time. These are regions which are minimally impacted by human activities such as fishing, pollution and shipping. Just 13.2% (~55 million square km) of the world's ocean classifies as marine wilderness and very few coastal areas are undisturbed.

<https://www.bbc.co.uk/news/science-environment-44970671>

Consultation for practitioner-led research

The O'Connell Lab have announced a consultation to determine ecological research needs, aimed at UK-based ecology and conservation practitioners. The consultation recognises that a large proportion of the outputs of ecological research is not being used by practitioners due to a lack of relevance to their everyday work. The consultation uses CIEEM's Competency Framework for practitioners to suggest research areas relevant to them. Suggestions will then be collated into a research agenda. For more information and to take part in the consultation, please visit this link: <https://www.mark4ecology.com/wpcs>.

Developing the Use of Mobile GIS for Ecological Surveys

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Arcadis Design and Consultancy

Keywords: data collection, data management, digital strategy, ecology field survey, mobile GIS, training

Geographic Information Systems (GIS) have become central to ecological survey and reporting, underpinning decision-making and management by environmental practitioners across the board. The technology allows ecologists to digitally collect, store, manage, analyse and visualise geographic information related to projects, resulting in delivery efficiencies and added value and insight for clients.

This article describes how the use of mobile GIS by consultant ecologists has developed over the last five years and shares the lessons learned from three large-scale projects with complex survey requirements.

The GIS approach to data capture

The evolution of our GIS approach to data capture for field surveys progressed from desktop, through server to web-based solutions, as both the technology and client requirements developed. Mobile GIS data capture started with Personal Digital Assistants (PDAs) using dedicated desktop and mobile software packages, which required a large degree of configuration. This progressed to a server-based approach where data were hosted on a GIS Server, served up to maps and survey applications hosted online and accessed by surveyors in the field using data collection apps on Tablets (Figure 1). The current method of data capture is web-based rather than server-based, allowing improvements in content management, data storage,



Figure 1. Harvest mouse survey using an iPad on the Lower Thames Crossing project. Photo credit Arcadis.

performance and user access to information. Box 1 explains the software and hardware terms in more detail.

Desktop approach using Personal Digital Assistants

Case Study 1: Great Crested Newt Evidence Enhancement Project

From 2013 to 2014, PDAs (Trimble Juno SB) were used on Natural England's Great Crested Newt Evidence Enhancement Project to collect and collate information on great crested newt distribution, population size and habitat availability, and to provide information to develop a predictive model of distribution.

The challenge of this project was to collect appropriate field survey data over a wide

area in a short survey window and to supply the data to Natural England in a GIS format. The 2013 programme included newt surveys at over 3,000 ponds from seven pilot areas across England, collection of 600 water samples for analysis of pollutants and nutrients, and calculation of Habitat Suitability Indices for each pond surveyed. Up to 25 surveyors were in the field at any one time at different locations in England over a five-week survey period. In 2014, pond water samples were collected for great crested newt environmental DNA (eDNA) analysis from a subset of 700 of the same ponds from three of the pilot areas.

It was clear that a technology-based approach to data collection was needed,

Box 1. Key terms

A **Geographic Information System**

(GIS) is a system that uses computer software to record spatial or geographic data (e.g. latitude and longitude) relating to a feature, together with other information, in order to map, analyse, visualise and assess patterns and relationships in the data.

Mobile Devices include **Personal Digital Assistants** (PDAs) and **Tablets**. PDAs, such as the Trimble Juno SB, were simple, hand-held mobile devices, which ran on the Windows **Mobile Operating System**. PDAs evolved into **Tablets**, which are just small portable computers that accept input directly on to their screens; both devices have built-in cameras and GIS capability.

A Mobile Operating System is the system software that manages mobile hardware (PDAs and Tablets) and software resources, and provides common services for computer programs. Examples include Windows Mobile, Android and iOS (for Apple devices).

Structured Query Language (SQL) is a standard computer language for relational database management and data manipulation.

partly because the tight timescale for data return to Natural England did not allow for a more traditional paper-based collection and transcription approach. Efficiency in the field was maximised as follows:

- Pre-loading onto the PDAs the locations of survey ponds making it easy for surveyors to find and correctly identify them.
- Using picklists and drop-down menus so that habitat data could be entered in a uniform way by different surveyors.
- Using the PDAs to geo-reference water samples and pond photographs to the correct pond.
- Collecting Health and Safety data accurately and consistently for subsequent surveys.
- Calculating pond Habitat Suitability Indices automatically from the habitat

data, using scripted data quality routines in Structured Query Language (SQL).

- Monitoring quality-control and giving feedback on data collection to individual surveyors once the data had been downloaded.

Post-survey processing was also streamlined by linking field photographs directly to the GIS features that were surveyed. In addition, GIS data could be easily imported into desktop GIS software and used for analysis, mapping and reporting.

However, this technology-based approach was not without issues.

- Typically, the data received back from GIS surveys had to be manually transferred on and off the PDAs, and version control of data was time-consuming.
- The hands-on nature of the data management meant that GIS specialists were required to support field survey teams. This included initial training on the use of PDAs in the field, uploading and downloading data, and keeping the project information organised and secure.
- There was no live link between data capture in the field and data review in the office. The data were inaccessible until surveyors returned to the office, the data had been manually downloaded on to the company network and GIS specialists had processed the data into a legible format. Not only did this disconnected approach cause delays, it also presented a risk in terms of project resilience because data were not backed up on the field devices. The use of Secure Digital Memory (SDM) cards as an additional storage medium mitigated this risk to a certain extent but the potential for the device or memory card to be lost or damaged remained a risk.
- Finally, and importantly, the operating systems and software required to manage these devices rapidly became outdated.

A move to a server-based approach for GIS data collection helped to address these issues.

Server-based approach

Case Study 2: North West Coast Connections

Between 2015 and 2017, ecological support was provided to National Grid

on their North West Coast Connections Nationally Significant Infrastructure Project. Specifically, this related to a new electricity transmission connection from the proposed Moorside Nuclear Power Station near Sellafield to the existing grid network. Baseline ecological information was collected to inform project design, the Environmental Impact Assessment (EIA) and Habitat Regulations Assessment (HRA) for the Development Consent Order (DCO). The study area stretched over a 140-km corridor between Harker near Carlisle and Heysham in Lancashire.

The main challenges were to avoid ecologically sensitive areas [12 Special Areas of Conservation (SACs) Special Protection Areas (SPAs) or Ramsar sites, and 29 Sites of Special Scientific Interest (SSSIs)]; minimise the potential for adverse effects on species of conservation concern; and identify constraints at an early stage in order to inform project Options Appraisals and design reviews. A full suite of seasonally restricted, ecology baseline surveys across a very extensive study area was required within a tight timeframe. This involved managing up to 40 field ecologists concurrently surveying a remote landscape on over 16,000 land parcels that were owned by over 6,000 different landowners along the 140-km route.

A server-based approach for GIS data collection provided several advantages including greater resilience, improved scalability and greater efficiency.

- Data collected in the field could be synchronised to the server at any time when connected to a wireless or phone network (via SIM cards within the Tablets). This mitigated against data loss and meant that data were directly imported into the project database, improving version control and reducing the likelihood that data would be accidentally mis-managed. Furthermore, data could be dynamically uploaded to field surveyors to provide valuable contextual information. For example, land access data and associated maps were continually updated as information became available and could be issued directly to field surveyors along the 140-km route, reducing the likelihood of surveyor trespass. The location of surveyors could be tracked from their

Feature Article: Developing the Use of Mobile GIS for Ecological Surveys (contd)

mobile devices, improving the ability to respond swiftly to any Health and Safety emergencies. This was especially important in rugged and remote terrain.

- The server-based system was more scalable because the technology supported multiple concurrent users of the database. Adding to the number of field surveyors did not increase the amount of data management time required and duplication of survey effort was avoided because areas surveyed were automatically updated live in the field.
- Data were returned from survey sites in real or near-real time, releasing it for further use on the project and increasing efficiency. In addition, the GIS server software and database did all of the 'heavy lifting' in terms of managing version control, so reducing the amount of time required for manual data management.

Unsurprisingly, this server-based approach was not without its problems. Projects need to be adaptable to changes in technology change over their lifetime, and there were challenges associated with hardware and software upgrades, data volume and quality.

- Field testing during the North West Coast Connections project showed that the best synchronisation performance was achieved using the Apple iOS version of the field collection application on iPads. Although the hardware was not rugged, a water-resistant case proved perfectly satisfactory to protect the iPads from the weather.
- Over the course of the project (2015-2017) the initial operating system and mobile software versions became increasingly out of date. This meant that it was difficult to take advantage of upgrades and fixes, which would have improved project productivity, without causing disruption to delivery and incurring additional unplanned costs. It is therefore important to plan hardware and software procurement separately as part of longer-term business planning.
- The new editing tools and software applications allowed surveyors to collect more geospatial data than anticipated but data returning from the field were not always geospatially accurate or



Field survey using a mobile device (iPad) on the North West Coast Connections project. Photo credit Arcadis.



Water vole surveys using an iPad on the Lower Thames Crossing project. Photo credit Arcadis.

'clean'. This required significant time investment from office-based GIS specialists to edit and refine the data.

The next stage was to develop a web-based approach to address these issues.

Web-based approach

Case Study 3: Lower Thames Crossing

Highways England's Lower Thames Crossing is a proposed new tunnel under the River Thames, to reduce congestion at the Dartford crossing. Baseline ecological surveys over the 31-km route corridor for this proposed Nationally Significant Infrastructure Project started in 2017 and will inform the Development Consent Order (DCO).

The scale of the project means there are potential impacts on internationally and nationally designated sites (four SACs, SPAs/potential SPAs or Ramsar sites, and seven SSSIs); local wildlife sites of national importance for their invertebrate assemblage; and legally protected species and habitats within and adjacent to the

scheme. Work is also being carried out to an accelerated programme, which has required rapid deployment of a large, multidisciplinary ecology survey team (up to 30 surveyors in the field at any one time) and the need for rapid access to the survey data to facilitate early design and development of landscape and ecological mitigation measures in tandem.

The GIS data collection required a web-based GIS content management system which provides the following benefits:

- Easy adoption of complex data-collection workflows by multiple survey teams across various types of survey using many different apps.
- Reduced data management time and input by GIS professionals.
- A content management system able to support the long-term data management and resilience that is essential on projects with a long duration and multiple staff changes.
- Cloud-based data storage to accommodate large data volumes.

- Improved user interface to promote a culture of GIS self-service across the project.
- Easy sharing of data back to the rest of the project team.

Future steps

No mobile GIS strategy can afford to stand still, and advances in survey technology and hardware, such as the use of drones to collect data, will require further innovation. New ways to present data to clients, including the use of story maps, web map viewers and dashboards will become more common and are under development. It is particularly important that all ecology survey data is collected in Darwin Core format (see <https://www.gbif.org/darwin-core>), which is an internationally recognised standard for biodiversity data used by, and compatible with, the National Biodiversity Network (NBN, see page 41, this issue).

The emphasis of GIS support is changing from data management to solution-design support, process automation, analytics and overall project compliance to client standards. At the same time, the role of the ecologist is evolving to meet the growing requirement for digital skills in analytics and data management. The result is an overall growth in digital capability and a shift in the accepted baseline for ecology surveys.

Conclusions

All three case studies described in this article share features in common: they were large-scale, complex and time-limited, requiring the co-ordination of large survey teams working on multiple land parcels, and necessitating rapid access to, and analysis of, the field survey data. In each case, mobile GIS strategies were essential not only for productivity and efficiency but also to standardise data collection. This was achieved through intuitively designed forms, automatic data analyses, geo-referenced data sampling, and the ability to provide quality-control and feedback on data collection. By exploiting the latest technology, project resilience was improved along with scalability and data

Acknowledgements

Arcadis is grateful to Natural England, National Grid and Highways England for financial support during the course of the three case studies reported in this article. The Great Crested Newt Evidence Enhancement Project was carried out in collaboration with Biocensus and CGO Ecology Ltd. The Lower Thames Crossing is a joint venture between Arcadis, CH2M and COWI. The authors are grateful to Nick Henson for reviewing this paper prior to submission, for the patience and tolerance of all field surveyors trialling mobile GIS technologies, and for the hard work of the GIS support team.

storage. Other benefits included the ability to dynamically upload data and visualise geographic information. More recently, field surveyors have been able to take greater ownership of the whole process of data collection using a mobile GIS strategy based on a common software framework.

On the downside, mobile GIS can lead to new and unexpected problems (such as an increased risk of surveyors developing Repetitive Strain Injuries, alleviated via carrying straps and harnesses), and mobile technology does not always work: Tablets may fail, batteries become depleted, equipment might be lost or stolen, and servers may go down. A robust back-up strategy is essential to manage such risks.

To be successful, mobile GIS requires investment not only in software and hardware but also – and perhaps more importantly – in people. This includes GIS support staff to set up mobile GIS devices and platforms, and also to provide training for survey planners and field surveyors, along with data analysts to help make best use of the data collected. Planning, both at a specific-project level and at an organisational level, is essential as part of a digital data collection strategy. Issues such as future licensing, security, data volumes, performance, training and application requirements are equally important. Mobile GIS is integral to the work of ecology professionals and environmental consultants but keeping abreast of new developments is as much of a challenge as optimising its use in the field.

About the Authors



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R Coding as a Tool to Streamline Manipulation and Analysis of Ecological Data Sets

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Keywords: data analysis, data management,
data quality, information processing,
R environment, survey

The use of mobile data application software (apps) for ecological survey improves quality and consistency of field-collected data, but these advances can be undermined if subsequent data handling and analysis is not similarly streamlined. Here we describe how bespoke data analysis code written using the R statistical scripting language can minimise data processing time, reduce data manipulation errors and rapidly generate easily interpretable and replicable outputs.

Introduction

Code is widely used by researchers to analyse ecological data sets (Mislán *et al.* 2016), yet, in our experience, the use of code is much less common amongst ecological practitioners outside of academia. Instead, practitioners often rely on the use of spreadsheet software (such as Microsoft Excel) to calculate summary statistics and outputs. Multiple small tables and graphs are often created within raw data files, which can lead to confusion as to what has been done. The scope for error is greater, for example where the same data exist in multiple formats (subsets, pivot tables, etc.) which subsequently need to be amended or updated, or when formulae are copied and pasted without due care. Coding is a more efficient and reliable method of analysing



large datasets, with the added advantage that code can be generalised or adapted to allow re-analysis of data following subsequent sampling or for analysis of similar datasets collected elsewhere. This renders it ideally suited to the needs of ecological consultants. The R statistical scripting language and environment (R Core Team 2017) is one of the most widely used among ecologists globally.

Advantages of R coding

One of the most compelling reasons to use code rather than spreadsheets for data analysis is that the code contains

a precise record of all steps taken. This allows quick and easy quality assurance. Specific errors can be fixed and then code can be re-run, usually in seconds, saving time and ensuring that any changes in the data, or data manipulation process, are incorporated across the entire analysis. Analyses carried out in R can readily be updated when additional data are available, or reproduced across multiple sites when data are collected using the same survey methodology. This offers huge time savings and also ensures that analyses are standardised across projects and years. R code provides transparency of approach

and can be provided to clients or other stakeholders for scrutiny, allowing them to reproduce outputs if required.

Most commonly used R functions are extremely sensitive to anomalies in data and therefore represent a powerful tool for error checking. However, this also renders it highly sensitive to data format and typos, and it is helpful if databases are set up to facilitate data analysis using R. The rise in the use of mobile app technology is of great value here as it allows for more control during data collection in the field, for example by allowing provision of dropdown menus for data input to ensure consistency of recording, as well as resulting in automatically generated, standardised output datasets which can be optimised with analysis using R in mind.

The R language was specifically developed for data analysis and incorporates a vast range of libraries and functions written to

facilitate data manipulation, analysis and presentation. A range of additional tools are also available to maximise the ease-of-use and flexibility of the language (see Box 1).

Tables, graphs and figures can be generated and exported from R in a range of formats, and these can be inserted directly into reports. The layout of graphs is completely and readily customisable allowing compliance with company standards, from incorporation of company colours and themes to the addition of logos (Figure 1).

It is also possible to generate user-friendly documentation and reports including code, outputs and explanatory text using R Markdown (Allaire *et al.* 2018) and to build user-friendly interfaces based on R code using the R package Shiny (Chang *et al.* 2018). These allow non-expert colleagues or clients to apply the code to their own data sets.

Box 1. Top tips for using R

- Using R involves a steep learning curve but don't get disheartened and keep at it – it will soon get easier and become a source of satisfaction rather than frustration!
- RStudio allows you to visualise and execute code and view data, outputs, documentation and objects loaded into R's memory, all on a single screen. In addition, it includes helpful functionality to support code development such as highlighting incomplete lines of code and suggesting possible syntax options.
- Work through some online tutorials to get started.
- If something doesn't work, don't panic! Many bugs in code are the result of typos – ensure that names of column headings, factor levels and libraries are spelled correctly and remember that R is sensitive to case. Try running each component part of a line of code individually to ensure that it is doing what you think it should.
- Play around with functions to understand how they work. There is usually example code in the documentation and loadable training datasets within the relevant library. The latter can help you ensure that the structure of your own dataset is appropriate for the function.
- R cannot interpret formatting such as highlighting or colours to denote categories so use a new column to capture these data instead.
- Use hashes (#) to annotate your code. Text preceded by a hash will not be run by R and can be used to provide extra information to explain what each line of code is doing.
- Google is your friend! If you are stuck, the chances are someone else has had a similar problem, so do some searching. If you're still stuck, post your question on a forum and you will most likely receive several helpful suggestions from the R community.
- Keep practising! As with any language, regular practise is required to keep it fresh.

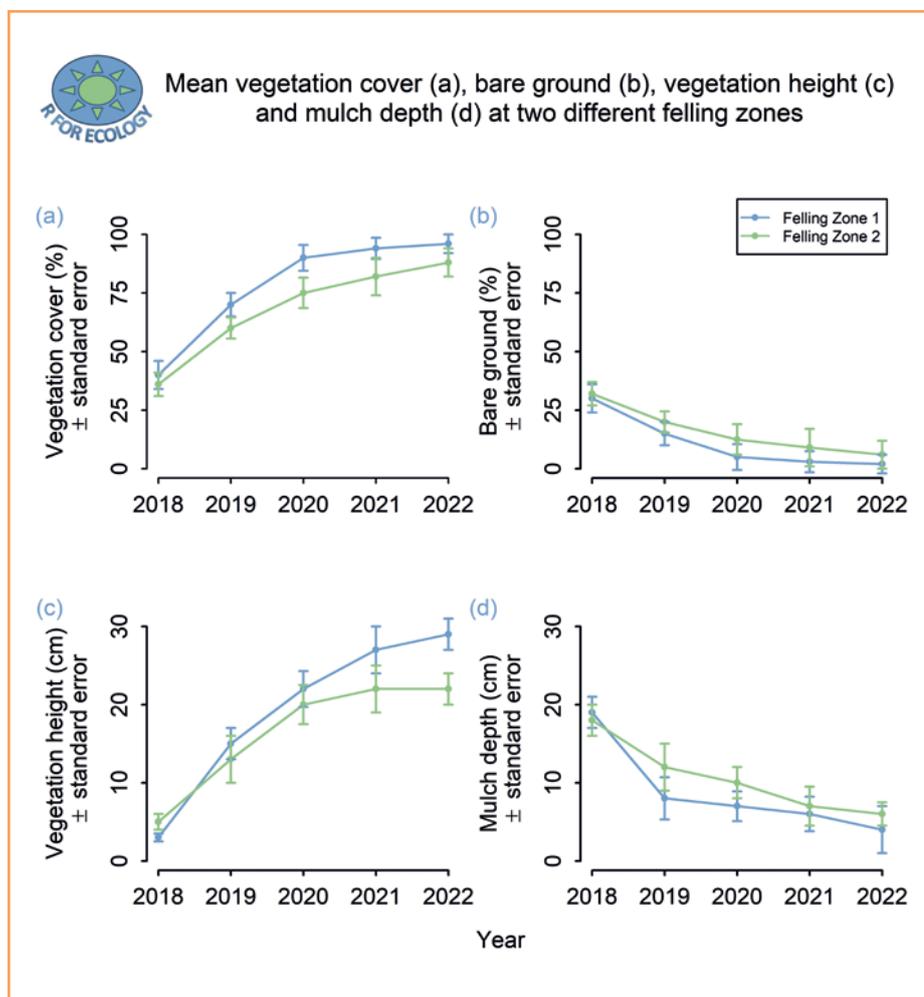


Figure 1. This simple figure, based on fictional data and incorporating a logo and the CIEEM colours, was produced entirely within R.

Feature Article: R Coding as a Tool to Streamline Manipulation and Analysis of Ecological Data Sets (contd)

Using R

Analysing data using R involves writing code that contains instructions for all the processes required to get from the raw data to the desired outputs. Many practitioners are daunted by the idea of writing code, but the underlying process is the same as for any other analysis methodology. It can be thought of as simply writing down the steps required to analyse the data in a logical order (for example, open the data, check for errors, remove any data not required for the current analysis, calculate summary statistics, generate plots). It is then just a case of becoming familiar with the way the language is structured and the libraries and functions available to implement these steps and, most importantly, where to look to get help!

The best way to learn is to have a go and keep at it. There are a growing number of courses available to help ecology practitioners to learn to use R and its extensions, including through CIEEM. There is also a wealth of free knowledge online including comprehensive documentation, online forums and a vast range of tutorials. In addition, software packages such as RStudio (RStudio Team 2016) provide user-friendly interfaces including several tools to facilitate code development (see Box 1).

With the drive towards further automation, it will increasingly be necessary for science professionals to be competent at coding. The increase in accuracy and efficiency that data analysis coding brings makes it well worth the time and effort involved to learn.

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Erratum

Jones, J. (2018). Intensive Poultry Units: Their Potential Impact on Lichens and Lower Plants in Mid Wales. *In Practice – Bulletin of the Chartered Institute of Ecology and Environmental Management*, **101**: 17-21.

On page 19 of the above article, the second paragraph of the section on **Regulatory control** should give a critical level of $3 \mu\text{g}/\text{m}^3$ for everything other than lower plants, not $31 \mu\text{g}/\text{m}^3$ as printed. The correct text for the paragraph is: 'Thresholds' are percentage amounts of the level of atmospheric ammonia above which there will be damage to a habitat or species – known as the critical level. There are two critical levels – one for lower plants (lichens, bryophytes, mosses, etc.) ($1 \mu\text{g}/\text{m}^3$) and one for everything else ($3 \mu\text{g}/\text{m}^3$). The lower plant critical level is the lower of the two and so, by definition, the critical level takes account of the fact that lichens are more sensitive than other species possibly being impacted.



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The Irish Vegetation Classification – An Overview of Concepts, Structure and Tools

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Keywords: distribution maps, ecological
databases, fuzzy analysis, quadrat data,
synoptic tables, vegetation communities

A new classification of the vegetation of Ireland is being developed utilising multivariate analysis and a large resource of existing quantitative plot data. In this article we introduce the concepts underlying the new system, the structure of the classification and the outputs and tools which are being made freely available to practitioners.

Classifying, mapping and describing habitats and vegetation is a bread-and-butter task for many people involved in ecological research or environmental management. It is thus perhaps surprising that Ireland lacked a standard scheme for this purpose until 2000 when *A Guide to Habitats in Ireland* (Fossitt 2000) was published by The Heritage Council. It was soon widely adopted by those working in the public and private sectors, being often referred to simply as 'Fossitt'. It provides descriptions of natural, semi-natural and artificial habitats and is analogous to the Phase I habitat classification used in the UK. The accounts of terrestrial and freshwater habitats in this scheme draw in part on the numerous academic phytosociological studies conducted in Ireland over several decades, following the Braun-Blanquet approach widely used in continental Europe (see White and Doyle 1982). This approach conceives plant communities based on floristic composition



Figure 1. RH1A *Asplenium trichomanes* – *Ctenidium molluscum* crevice community, Gorteendarragh, Arroo Mountain, Leitrim. Photo credit NPWS.

and uses subjectively chosen diagnostic species to both differentiate between communities and to organise them into a hierarchical classification (Maarel 1975). Notwithstanding the success of the Fossitt classification, there is still a need in Ireland for a scheme that will permit a more detailed level of recording, such as when monitoring change in vegetation or conducting surveys of protected habitats or

sites (Phase II surveys in UK parlance). This requirement is reflected in the National Biodiversity Action Plan. Numerous theses and national surveys have produced detailed, separate classifications of specific habitats, but they vary considerably in methodology and the specificity of the categories. Although the British National Vegetation Classification (NVC) has been employed for some purposes in Northern

Ireland, it is not directly applicable to Irish vegetation due to significant differences in habitats and flora.

The Irish Vegetation Classification (IVC) seeks to meet this requirement by producing a single, unified framework which describes in detail all aspects of Irish natural and semi-natural vegetation. The project was commissioned by the National Biodiversity Data Centre (NBDC) in 2015 with funding from the National Parks and Wildlife Service (NPWS) and is being conducted by BEC Consultants. So far, grasslands, woodlands, saltmarsh, heath, bog and rocky habitats have been tackled (Figures 1-3). Initial development is due to be completed around 2020. The project has a number of underlying principles which guide development; these are outlined below.

Vegetation classification

<p>Irish Vegetation Classification</p> 	<p>As the name states, the IVC is a vegetation classification whose basic categories (the communities) are defined purely</p>
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on floristic composition, with data on environmental parameters (e.g. substrate, altitude or inundation frequency) and management (e.g. mowing or fertilisation) being used only to ecologically interpret the categories *post hoc*, rather than helping to define the categories in the first place, as would be the case in a habitat classification such as the Fossitt or Phase I schemes.

Vegetation continuum

Species respond individually to changes along environmental gradients, creating continuous variations in species composition. Vegetation classifications are thus inherently artificial frameworks, but we need them so that we can divide this continuum into practicable units for tasks such as mapping and management. The IVC system incorporates the concept of transitional vegetation by using a statistical method called 'fuzzy analysis' to calculate for vegetation samples a degree of membership or best fit to each of the various possible communities, rather than samples belonging to only one community and not at all to others.



Figure 2. SM3B *Plantago maritima* – *Puccinellia maritima* saltmarsh, Ballyvoreen, Cork Harbour, Cork. Photo credit Marcin Penk.



Figure 3. GL3E *Festuca rubra* – *Rhinanthus minor* grassland, Cloongee, Mayo. Photo credit NPWS.

Feature Article: The Irish Vegetation Classification – An Overview of Concepts, Structure and Tools (contd)

Statistically based

The classification is based on multivariate analysis of existing quantitative vegetation data from Ireland, mostly manually extracted from the National Vegetation Database (NVD) (see Box 1). Not all of the records used are relevant in the strict sense (i.e. subjectively placed quadrats for the purposes of phytosociology), so we refer to them by the more general term of 'plots'. These data have been collected by generations of ecologists, using different vegetation cover scales and for various purposes; inevitably, there are issues with suitability and consistency. Most data have not been recorded using percentage cover and need to be converted to mid-range values. Data from unusually large or small plots, plots seemingly lacking in bryophyte records, and plots where 5% or more of cover is recorded only at the genus level are excluded. Furthermore, it has been necessary to make numerous amendments and some compromises to overcome nomenclatural and taxonomic issues (e.g. combining records of *Agrostis canina* and *Agrostis vinealis*). In selecting an analytical approach from the wide selection available, we were influenced by a recent body of work on defining and managing dynamic vegetation classifications (see for example Wisser and De Cáceres 2013) and decided to use a version of fuzzy analysis called noise clustering which also identifies any outlier data that are poorly described by the current classification. Analysis has been conducted within the R statistical environment (R Core Team 2017).

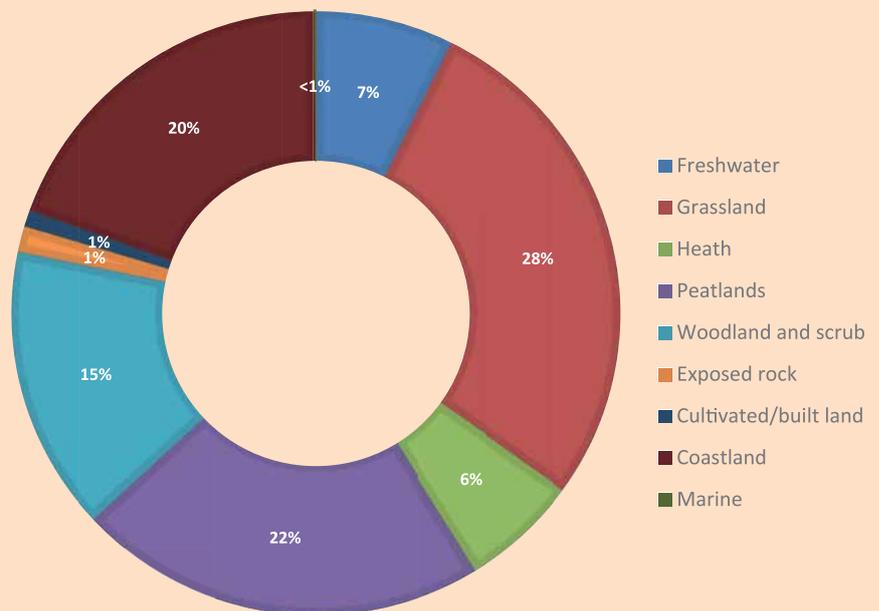
User-friendly

The IVC is designed to be accessible for a range of potential users, including field surveyors, environmental managers, planners, scientific officers, policy-makers, researchers and students. To this end, we have steered away from using the less intuitive phytosociological conventions to name our categories or to structure the classification.

The first main resource that the IVC provides is a series of 'community synopsis' documents, one for each community, and similar to the association descriptions produced by the United States National Vegetation Classification. Each synopsis contains a concise description of the

Box 1. National Vegetation Database

The National Vegetation Database (NVD) was established in January 2007 by the National Biodiversity Data Centre (NBDC) in conjunction with the National Parks and Wildlife Service. Ireland has a rich history in the collection of vegetation data, and it was recognised that this information is a valuable resource that should be digitally captured in a centralised national database. A national vegetation audit was conducted initially to identify sources of vegetation data, followed by a five-year phase of historical data capture to collate Irish vegetation plot data in the NVD. By May 2012, there were approximately 30,000 plots in the NVD. New data are being added as they become available.



Breakdown of all plots in the NVD (May 2012) by level one Fossitt habitat categories.

The software package Turboveg (Hennekens and Schaminée 2001) is used to store the NVD. This specialist vegetation data management program provides a standardised format for the exchange of data between researchers and is widely used in Europe. An Irish plant checklist, 'Ireland2008', was specially constructed by the National Botanic Gardens for use within the NVD. It includes vascular plants, bryophytes, lichens and charophytes, and incorporates all known synonyms that have been used in Ireland. Plot data can now be submitted to the NBDC in Turboveg file format and, indeed, projects such as the National Survey of Upland Habitats have made use of mobile device versions of Turboveg to record data in this format in the field. The NVD is part of the European Vegetation Archive and has been utilised by more than fifteen European initiatives to date.

vegetation, plus notes on its ecology, conservation, management, threats and similar communities, (cf. Averis *et al.* 2004). Extended descriptions (cf. Rodwell 1991) have been omitted so that users are able to quickly grasp the essence of each vegetation type. Distribution maps at the hectad level are included (Figure 4) showing when the most recent records

were made (cf. Blockeel *et al.* 2014), whilst also indicating the number of records within each hectad. Synoptic tables display median Domin values in addition to the range (cf. Stevens *et al.* 2010). Mean cover-weighted values for Ellenberg's indicator values are provided. Finally, affinities with the categories of Fossitt, EU Habitats Directive Annex I habitats,

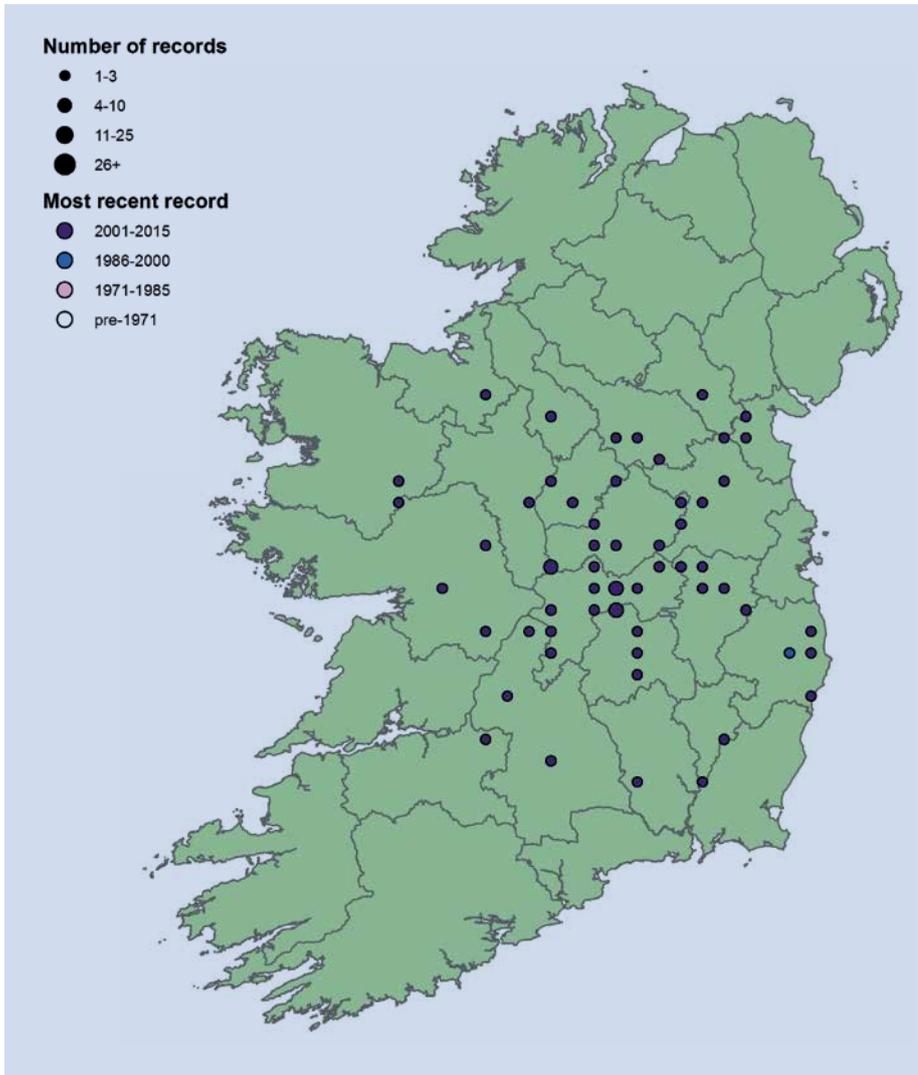


Figure 4. Hectad distribution map for WL4F *Betula pubescens* – *Pteridium aquilinum* woodland, which has established widely in the midlands on degraded raised bogs.

Level of hierarchy	Basis of differentiation	Example
Division	Dominant growth form and broad diagnostic species	Grassland
Group	Major environmental gradients	GL3 <i>Cynosurus cristatus</i> – <i>Plantago lanceolata</i> group
Community	Overall floral composition	GL3A <i>Briza media</i> – <i>Thymus polytrichus</i> grassland
Sub-community	Specific indicator species or subtle differences in floral composition	GL3Ai <i>Briza media</i> – <i>Thymus polytrichus</i> grassland <i>Sesleria caerulea</i> – <i>Tortella tortuosa</i> sub-community

Table 1. Hierarchy used in the Irish Vegetation Classification with examples.

phytosociological alliances, EUNIS habitats and the NVC are given. For example, an estimated 92% of plots defining GL3A *Briza media* – *Thymus polytrichus* grassland had been described as Annex I calcareous grassland (habitat code 6210) and 97.6% as Fossitt habitat GS1 Dry calcareous and neutral grassland.

Using the Irish Vegetation Classification in practice

Categories within the IVC are organised into a hierarchy (Table 1). Different levels within this can be used depending upon the scale and focus of a particular project. For larger surveys, scoping exercises and studies covering a wide range of habitats, the group level may be appropriate. For habitat-specific surveys, perhaps involving vegetation monitoring and assessment, the community level will provide the greater differentiation required. Sub-communities can be recorded where particular precision is needed. For example, within the heaths division, four groups are currently defined. The HE1 *Dryas octopetala* – *Sesleria caerulea* group comprises a single community representing the limestone heath found in karst areas of Galway and Clare. The HE2 *Erica cinerea* – *Calluna vulgaris* group contains five communities of dry or damp acidic heath, often dominated by *Calluna* and occurring at lower altitudes. The HE3 *Vaccinium myrtillus* – *Racomitrium lanuginosum* group comprises six communities of heath and heathy bog found in the montane zone. Lastly, the HE4 *Molinia caerulea* – *Polygala serpyllifolia* group contains five communities of wet heath and bog in which *Molinia* is usually abundant or dominant. See examples in Figure 5.

In the field, workers should find that compiling a quick list of the main plant species and referring to the descriptions, species tables and maps in the community synopses will often be sufficient to identify the best IVC category for any given area of vegetation. When working in unfamiliar habitats or areas of transitional or intermediate vegetation, some further guidance may be helpful. Furthermore, inter-observer variation in assigning vegetation to categories within a classification can be significant even when professional ecologists are using well-described categories (Cherrill 2013)

Feature Article: The Irish Vegetation Classification – An Overview of Concepts, Structure and Tools (contd)



Figure 5. Communities from each of the heath groups within the IVC. Clockwise from top-left: HE1A *Dryas octopetala* – *Sesleria caerulea* heath; HE2A *Ulex gallii* – *Erica cinerea* heath; HE3D *Calluna vulgaris* – *Racomitrium lanuginosum* heath; HE4C *Molinia caerulea* – *Schoenus nigricans* bog/heath. Photo credit NPWS except top-left, Orla Daly.

with potential consequences for decision-making based on such data (Cherrill 2016). To this end, the second main resource the IVC provides is a software application called ERICA (Engine for Relevés to Irish Communities Assignment) to help users to consistently identify the communities to which their data fit best. It is thus similar in purpose to TABLEFIT and MATCH used in the UK. ERICA uses the same noise clustering method that defines the classification.



To use ERICA, fieldworkers have the option of two approaches. For each area of vegetation for which they need guidance, they can simply compile a list of the vascular plants and bryophytes. Or they can

record the percentage cover of these plants in a plot or series of plots; 2 × 2 m plots are recommended for many habitats such as grassland, bogs and heaths. Plots may take longer to record but will yield more informative results. Species nomenclature needs to match that used by the IVC and a checklist is provided. Both species lists and plot data are uploaded to the ERICA application as simple spreadsheets (.csv files) with samples in rows and species in columns so multiple vegetation samples can be analysed at the same time. Formatting is explained in the manual and example data are provided. The analysis compares the uploaded samples with a reference dataset, currently comprising over 16,000 individual plots. For each sample, ERICA calculates the degree of membership to each IVC community as a percentage, highlighting the best match (Figure 6). Transitional samples and outliers are identified and summary data on species

richness are given. Supplementary analyses provide a range of additional information: Simpson's index of diversity, Simpson's measure of evenness, mean values for Ellenberg's indicator values and measures of taxonomic diversity and species rarity. All results can be downloaded as a .csv file. ERICA is currently available as a web application, accessed through the NBDC website. A mobile phone version that can inform decision-making in the field is being trialled. Uploading data to ERICA does not automatically submit them to the NVD, although we do encourage users to submit their final datasets, if possible using Turboveg or the NBDC's standardised spreadsheet template.

Updateable

Any classification is naturally limited by the data upon which it is based. As classifications are used and new data are collected, it is inevitable that gaps,

either geographical or compositional, will become apparent and that revisions or additions to the scheme will become desirable (e.g. JNCC 2011). The IVC is a dynamic system that will be relatively straightforward to update or expand after initial development ends. The statistical approach facilitates this, allowing us to build the IVC progressively. Furthermore, the use of individual documents for the community synopses means that these can be more easily updated. Since all outputs from the project are web-based, they are free to access and use and we can also provide a large number of photographs to illustrate the vegetation.

Conclusions

Whilst acknowledging that all models are idealised, we hope that this one will be useful. There is still a substantial amount of work to be done: data from several habitats including fens, flushes, swamps and sand-dunes have yet to be incorporated into the classification, and some further optimisation will certainly be required. The cross-walk with phytosociological syntaxa will be strengthened by using the EuroVegChecklist Expert System to objectively identify classes. Note also that, currently, no data are included from Northern Ireland although it is hoped that

this will be possible in the future to provide all-Ireland distributions in vegetation and assist cross-border initiatives. The IVC is already being used by national monitoring programmes (e.g. Annex I saltmarsh assessments) and some Irish universities. We hope that the project will stimulate further recording of appropriate plot data that can be used in future revisions, and will provide assistance to everyone working with vegetation in Ireland.

For further details on the IVC, to download the community synopses and to access ERICA, please visit: <http://www.biodiversityireland.ie/projects/ivc>

Code	Community	Group	Division	Max	Type	Link
plot32	GL4A Agrostis capillaris - Trifolium repens	Nardus stricta - Galium saxatile	Grasslands	70.5	Assigned	web
plot6	GL3A Briza media - Thymus polytrichus	Cynosurus cristatus - Plantago lanceolat...	Grasslands	71.4	Assigned	web
plot37	GL3D Cynosurus cristatus - Trifolium pratense	Cynosurus cristatus - Plantago lanceolat...	Grasslands	71.6	Assigned	web
plot24	GL3D Cynosurus cristatus - Trifolium pratense	Cynosurus cristatus - Plantago lanceolat...	Grasslands	71.6	Assigned	web
plot49	GL1C Molinia caerulea - Succisa pratensis	Juncus acutiflorus - Molinia caerulea	Grasslands	74.4	Assigned	web
plot11	GL3A Briza media - Thymus polytrichus	Cynosurus cristatus - Plantago lanceolat...	Grasslands	76.0	Assigned	web
plot31	GL3D Cynosurus cristatus - Trifolium pratense	Cynosurus cristatus - Plantago lanceolat...	Grasslands	77.5	Assigned	web
plot44	GL1E Juncus acutiflorus - Rhytidadelphus squ...	Juncus acutiflorus - Molinia caerulea	Grasslands	78.5	Assigned	web
plot21	GL3D Cynosurus cristatus - Trifolium pratense	Cynosurus cristatus - Plantago lanceolat...	Grasslands	79.6	Assigned	web
plot36	GL3A Briza media - Thymus polytrichus	Cynosurus cristatus - Plantago lanceolat...	Grasslands	79.9	Assigned	web

Figure 6. Example of main output from the ERICA application. For each sample plot, the maximum degree of community membership is shown together with the relevant community, community code, group and division. Each green 'web' button links to the online PDF of the relevant community synopsis.

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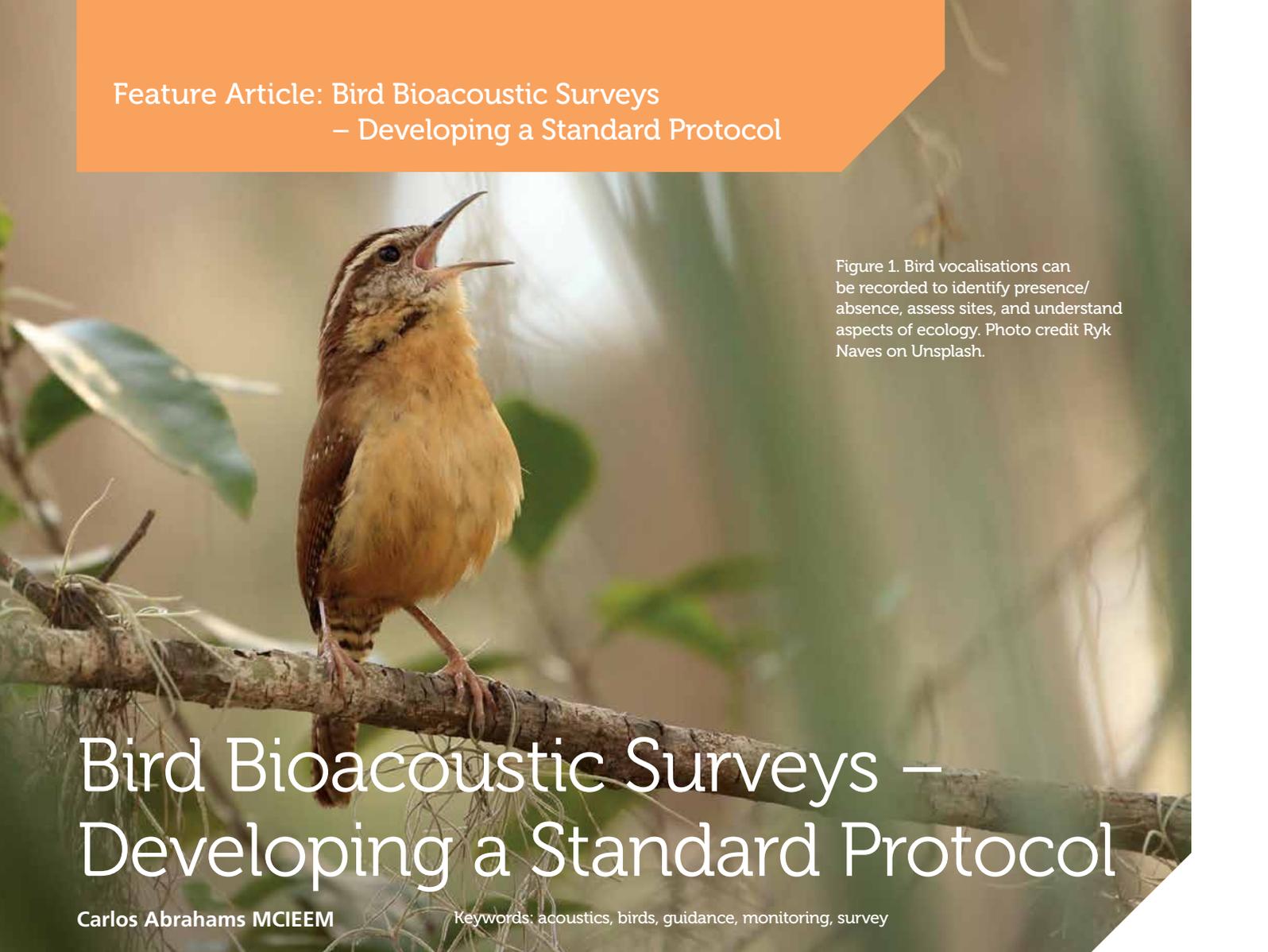


Figure 1. Bird vocalisations can be recorded to identify presence/absence, assess sites, and understand aspects of ecology. Photo credit Ryk Naves on Unsplash.

Bird Bioacoustic Surveys – Developing a Standard Protocol

Carlos Abrahams MCIEEM

Keywords: acoustics, birds, guidance, monitoring, survey

Bioacoustic surveys can be used to capture useful and robust data on bird vocalisations to inform studies on avian distribution and ecology. However, currently there are no recognised standard methods for their use in the UK. This article sets out a draft protocol for testing and adoption, and invites feedback from CIEEM members to further develop good practice.

Introduction

Animals produce sound. Birds, amphibians, fish, invertebrates and mammals sing, squeak, click, snap, crackle, pop, rattle and hum. As ecologists, we can use these signals to detect animals in the dark or at remote locations, identify what species are present, and work out what they are doing (Figure 1). Ornithologists have always used this capacity to tell the difference between species yet, unlike bat workers, do not routinely make recordings of birds in the field as part of standard survey practice. We're missing a trick.

Birds create species-specific sounds that can be readily recorded using automated or manually-controlled recording systems.

Such devices allow acoustic surveys to be undertaken for extended periods of time, with data being saved for later analysis using machine techniques and/or human assessors. This bioacoustics approach is familiar to any bat surveyor, as detectors are absolutely vital to pick up ultrasound calls to which human ears aren't attuned. However, birds can normally be seen and heard in the field without the use of specialised equipment. So, why use a bioacoustics approach for bird survey and monitoring?

The benefits of using automated recording, especially alongside traditional surveys, are well documented in scientific research (see Box 1). In particular, the ability to produce a standardised, long-duration, permanent

dataset, which can be repeatedly analysed, and subject to quality assurance checks, is a major advantage over standard field surveys (Darras *et al.* 2018). There are some disadvantages – principally the lack of visual cues that would be used by a human surveyor in the field, and the fact that the static bioacoustic approach does not lend itself to preparing the territory maps often used in bird assessments (see Box 2). However, depending on the aims of the survey, bioacoustics methods have many advantages. For example, Zwart *et al.* (2015) found that acoustic recorders offered a 217% increase in nightjar *Caprimulgus europaeus* detection over human surveyors, (with 19 detections in 22 survey periods compared to 6 detections by humans). With these recognised benefits, the use of automated recorders in scientific research has increased significantly over the last ten years (Figure 2).

Human vs. machine

The bioacoustics approach, using static recorders, is equivalent to point-count bird

surveys. Several studies have compared point-count data to automated acoustic recording in a variety of habitats such as rainforest (Leach *et al.* 2016), tropical savanna (Alquezar and Machado 2015), temperate woodlands (Holmes *et al.* 2014, Furnas and Callas 2015), and temperate meadows (Tegeler *et al.* 2012). These have shown that the results are comparable in terms of species-richness and bird assemblage composition when used for equivalent lengths of time. However, automated recording can easily provide larger amounts of data than human surveyors, often with less survey effort (Holmes *et al.* 2014). For example, Tegeler *et al.* (2012) gained >1,100 additional hours of data using automated recorders, and recorded more species with a quarter of the personnel effort. Using both methods together often provides the best overall results as their respective strengths and weaknesses are complementary (Klingbeil and Willig 2015, Shonfield and Bayne 2017).

Developing a draft survey protocol

Although there are myriad survey methods for bird assemblages, taxon groups and single species (Gilbert *et al.* 1998), few organisations have yet developed guidance on the use of bioacoustics methods (Darras *et al.* 2018). The World Wide Fund for Nature has recently published an introductory guide (Browning *et al.* 2017), with more detailed methods produced for tropical bird assemblages (Lacher 2008), Canadian forest birds (Saskatchewan Ministry of Environment 2014) and Australasian bittern *Botaurus poiciloptilus* (O'Donnell and Williams 2015).

To start the development of UK guidance, the first national workshop on bird bioacoustics was held in June 2017, attended by more than 40 delegates from academia, consultancies and conservation bodies. Participants were asked to grade the relative pros and cons of the approach (see Boxes 1 and 2), and a draft survey protocol was developed from the contributions (Box 3). Further input on this prototype is sought from CIEEM members, but it is considered to be a sound basis for gathering bioacoustics data for ecological assessments and site management in the UK.

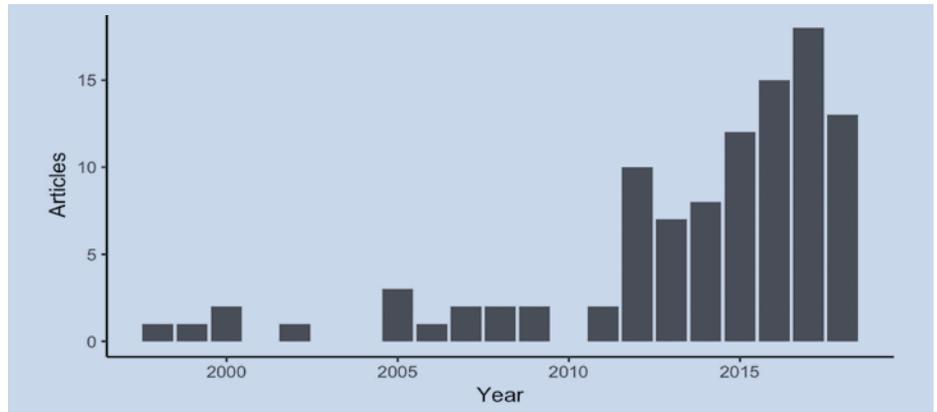


Figure 2. Number of original research articles that used recording units for avian bioacoustic studies. Search conducted on Web of Science database in September 2018 using the following search term: (bird* OR avian) (automated OR autonomous OR *acoustic) (recorder OR aru OR ard).

Box 1.

Advantages of bioacoustics	Grade 10=major; 1=minor
Long-duration data capture	7.3
Ability to repeatedly listen to and re-analyse data	7.1
Permanent raw data record	6.9
Greater standardisation in data collection	6.3
Quality assurance opportunities, with ID verification	6.0
Reduced subjectivity and observer bias	5.7
Less disturbance to surveyed birds	4.5
Opportunities to share raw data	4.3
Less reliance on availability of expert surveyors	3.5
H&S – avoids night-time work, reduces visits to remote areas	3.4

Box 2.

Disadvantages of bioacoustics	Grade 10=major; 1=minor
Capital cost of equipment	7.1
Need for improvements in automated classification systems	6.7
Lack of expertise/skills in bioacoustics	6.0
Reduced ability to cover a wide spatial area compared to transects	5.9
Data storage requirements	5.5
Potential for loss of data if units fail	5.1
Availability of hardware/software	4.8
Comparability with established methods	4.8
No visual recording of birds	4.8
The method is not yet widely proven/accepted	4.3

Survey considerations

1. Survey effort and timing

The recording and data volume requirements of any survey will vary depending on the project objectives and the species concerned (Bayne *et al.* 2017). The seasonal programme and daily timing of recording need to be

considered, to maximise the long-term data capture benefits of automated recorders, whilst avoiding an overwhelming data mountain (Klingbeil and Willig 2015).

Bird detection probability normally varies with time of the day, so recording times distributed throughout the day will sample the entire community most effectively

Feature Article: Bird Bioacoustic Surveys

– Developing a Standard Protocol (contd)

(La and Nudds 2016). Scientific studies have found that a stratified 'on-off' time sampling programme (e.g. recording 1 minute in every 10), can capture comparable data to continuous recording, with consequent benefits in terms of battery life, data storage and processing time (La and Nudds 2016, Bayne *et al.* 2017). This is especially the case when recording is focused on the main dawn and evening chorus times. With prices reducing and availability of data storage increasing, continuous recording, that can be sub-sampled later in the processing stage, is also a realistic option for fieldwork.

2. Recorder placement

For coverage of a site, the aim should be to sample across the range of the habitats and species of interest, with recorders placed to limit overlap of detection radii

so that counts are independent (O'Donnell and Williams 2015). The effective radius of most recorders is in the region of 50 m, so a minimum separation distance of at least 100 m should be used (Yip *et al.* 2017). As a recommended standard, a larger 250 m spacing between recorder locations would provide 16 sampling locations/km². This is dense enough to provide a good level of survey data, and is also likely to be relevant to the territory sizes of bird species of interest within ecological assessments. However, alternative separation distances between 100-500 m could also be used, depending on survey requirements.

When placing recorders in the field, omnidirectional microphones should be used, located horizontally 1-2 m from the ground (or higher if security is an issue), and in a mounting position that does not block the field of sound or increase the

levels of background noise from wind and water (Klingbeil and Willig 2015, La and Nudds, 2016)

3. Recording equipment

There are many options in terms of recording equipment, but the best current approach uses off-the-shelf, single recorder units, which incorporate a microphone, circuitry, power source and recording media in a single unit. Examples of this are the Wildlife Acoustics Song Meters, Cornell Labs Swift or AudioMoth. These are both scaleable and easily available to a range of users.

Recorder model, microphone type, and settings should be standardised across a study and carefully recorded in metadata. Microphone management, calibration and checking is very important before and after field deployments, as degradation in microphone quality over time can significantly affect results.

4. Audio settings

For good quality audio data, a non-compressed digital file format (i.e. .WAV rather than MP3) should be used. If possible, recordings should be in stereo using a sample rate of 48 kHz and 24-bit depth (although 44.1 kHz and 16-bit depth is acceptable). These settings will cover the entire audible range, producing detailed data on frequency and amplitude to produce clear spectrograms and analysis information. If, however, the study is focussed on particular target species, with lower frequency calls, then a lower sample rate can be used to save on storage and battery life.

5. Metadata recording

With each survey deployment, appropriate metadata including location, dates/times, weather, habitat and equipment identifiers should be recorded. This can be done using paper/tablet, or by speaking into microphones while they are recording, so the metadata becomes part of the recorded data itself. This background data is clearly needed to accurately organise and archive recordings, and can be used for any detailed analysis of how environmental characteristics determine the bird acoustic assemblage. It is also important to make acoustic data as comparable as possible across different surveys, allowing use in larger-scale monitoring projects and contributions to databases.

Box 3. Draft Bird Bioacoustics Survey Protocol

1. Survey effort and timing

Surveys should include a minimum of two deployments, in April to mid-May, and mid-May to end of June, with a four-week gap between deployments. Recording should cover a five-hour period from two hours before sunrise until three hours after, with a one minute sample taken every ten minutes. Each deployment should cover a minimum of three days recording. The same methods should be used for evening recording, e.g. for dusk chorus, owls and nightjars, but using a three-hour sampling period, from one hour before sunset, until two hours after.

2. Recorder placement

Use a regular grid-based or stratified random sampling system across the survey area, with a minimum distance between sampling locations of 250 m. Recorders should be located 1-2 m from the ground, on tripods, narrow poles or trees <0.2 m diameter, avoiding branches/leaves around the unit as far as possible.

3. Recording equipment

Commercially available, off-the-shelf, single recorder units should be used to provide consistency in data collected between different studies. The recorder should be a programmable, automated unit, using omnidirectional acoustic microphones, with a flat response across the range of audible frequencies. Recorder

and microphones should be individually numbered, checked and calibrated on a regular basis (at least once per year).

4. Audio settings

Recordings should be made as non-compressed .WAV files, ideally with a sample rate of 48 kHz and 24-bit depth. Lower sample rates may be used when surveying for lower-frequency, bird species (e.g. bittern) to save on storage and battery life. Before deployment, ensure that hardware and software settings are recorded and standardised across all units.

5. Metadata recording

At the start of each deployment, record the date/time, surveyor name, sampling location and recorder/microphone identifiers. Photographs of location and set-up should be taken. Weather conditions during the survey period should also be recorded.

6. Data analysis methods

Identify the presence/absence of each species in one minute audio samples and calculate the proportion of samples in which each species is recorded. Provide a summary of species observations per day or sampling event. If using any automated recogniser or clustering process, then the error rates should be checked and reported so that the quality of the recogniser can be properly assessed.

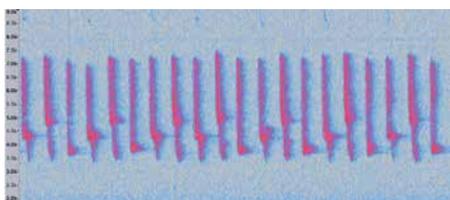


Figure 3. Bioacoustic software can be used to manage, view and analyse recordings, allowing identification of species present in the dataset, such as this chiffchaff *Phylloscopus collybita*. Image credit Carlos Abrahams

6. Data analysis methods

The analysis of data gained from acoustic recorders is perhaps the most difficult area in which to make standardised recommendations. A range of software is available to manipulate, view and analyse acoustic recordings (e.g. Kaleidoscope, Raven, Audacity, Luscinia and packages in R), some of which allow the clustering or automated recognition of bird calls (Figure 3). However, much scientific research has simply relied upon ornithologists listening to audio files and viewing spectrograms. At present, a human-supervised semi-automated process probably offers the best balance between accuracy of call classification and time required for analysis. Whichever method is used, the data analysis protocol should be fully described, and identification error rates calculated, providing metrics such as precision and recall if a recogniser has been used (Knight *et al.* 2017). The simple and robust metric of call activity, as set out in Box 3, will provide a species list for each sampling location, together with the relative vocal activity levels for each species. This presents a basic assessment of the data and will allow comparability between different studies. (Bayne *et al.* 2017).

Conclusion

Although there are still challenges to the widespread adoption of bird bioacoustics in the UK, the approach and technology is well proven around the globe in a wide variety of ecosystems and with a range of species and communities. Fully automated software to allow the recognition of all bird calls has not yet been developed, but this should not stop the use of the methods that are currently available. The draft protocol in Box 3 is targeted at the collection of species assemblage data for a particular site, such as for a breeding or wintering bird survey,

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but it could equally be used to focus on particular target species. Such single-species (or small group) approaches are extremely valuable, and acoustic surveys have already been conducted for conservation priorities like nightjar, corncrake *Crex crex*, bittern *Botaurus stellaris*, owls and capercaillie *Tetrao urogallus* (Abrahams and Denny 2018).

There is a good scientific basis to bird bioacoustics, great benefits to its use and a useful set of methods to follow. By sharing experience and building the practical evidence, the technique can be taken up effectively by the profession. Please help to test and refine the approach by using the draft protocol and offering feedback to Carlos Abrahams at c.abrahams@bakerconsultants.co.uk

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Optimising Camera Trap Data Quality at Mammal Resting Places

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A thorough understanding of how camera traps function is essential for ensuring correct set-up and quality of data. We illustrate the challenges through a case study of camera trapping an otter *Lutra lutra* resting and breeding place. Appropriate survey design, such as using multiple cameras, decreasing the distance between camera and otter holt entrance, and camera trapping for sufficient duration, is likely to reduce the propensity for false negatives and increase our ability to correctly identify and protect mammal resting places.

Introduction

Data quality is important for best practice. It should be optimised pre-survey, via a careful sampling design and well-designed data entry protocols, and via post-survey quality control. This relies upon knowledge of how the tools we use function in order to identify any bias or limitations to the data collected. It is crucial to ensuring that the data we collect actually represents the real world. This includes camera traps, a popular remote-sensing technology used within our industry.

Based on recent research, we discuss the broader issue of data quality when using camera traps for ecological survey, and the specific use of camera trapping to



Image from video of otter visiting a resting site. Copyright CC-BY-4.0.

identify mammal 'resting/breeding places', protected by the Habitat Regulations. These regulations protect such sites from damage and prohibit disturbance to animals when they are occupying such sites.

We focus particularly on false negatives and how these relate to camera trap function and survey design. Finally, we provide recommendations for ecologists to improve camera trap data quality.

False positives and false negatives in the context of mammal resting places

An immediate hurdle to data quality when identifying resting or breeding places is that these terms are not strictly defined and apply to species with widely different behaviour. Guidance from the EU (European Commission 2017) describes breeding places as '*areas needed to mate and... give birth*'. Resting places are described as '*areas essential to sustain*

an animal or group... when they are not active...' and '*required for: resting, sleeping or recuperation... hiding, protection or refuge*'. The guidance also states that '*resting places that are used regularly, either within or between years, must be protected even when not occupied*'. However, these descriptions still leave room for ambiguity. How can we know if our data reflect the real world if the real world is not well defined?

For protected species that use a structure in which to rest or breed (holts, dens, setts), it's ostensibly simple: we locate a potential site (perhaps based on field signs), deploy a camera trap facing its entrance(s), and confirm/refute use based on recordings. In certain circumstances this can give a clear result: a lactating female regularly rests and collects bedding or an animal enters then exits some time later. In this scenario we can clearly confirm a structure as a breeding or resting place, a true positive (Table 1a).

	The structure is a resting place	The structure is not a resting place
Identified as a resting place	(a) TRUE POSITIVE BENEFIT: Legislative compliance and biodiversity protection	(b) FALSE POSITIVE COST: Erosion of duty to provide accurate information
Not identified as a resting place	(c) FALSE NEGATIVE COST: Erosion of duty of legislative compliance and biodiversity protection	(d) TRUE NEGATIVE BENEFIT: Legislative compliance

Table 1. Possible outcomes when identifying structures as 'resting places' for mammals. There are costs to both false negatives and false positives.

Inevitably, grey areas exist. What if the target species is only seen outside the structure, or just entering – is this a 'resting place' that deserves protection or could it be a false positive (Table 1b)? Does it matter if we misidentify breeding/resting places? We will be more likely to protect real sites overall, but false positives may present a more insidious harm to our profession. The data that ecologists use for advice and decision-making must be of the best quality and have the highest integrity. We must be seen to be balanced and to avoid restricting economic activity based on scant evidence and loose application of legislation (see CIEEM Code of Professional Conduct point 4). By contrast, false negatives (Table 1c) are clearly harmful. Failure to identify a site that should be protected risks un-mitigated disturbance to the target species, and failure of compliance.

Evidence-based guidelines can help to minimise false positives and false negatives in ecological surveys but such guidance is lacking for camera trapping surveys. Specifically, there is currently an acute danger of poor data when ecologists use camera traps for identifying mammal resting and breeding places. Data quality could be improved by a more thorough understanding of camera trap function, a clear integration of such knowledge (alongside species ecology) into survey design, an adaptive approach to set-up, and robust processes of data capture from the camera trap footage.

Camera trap function and sources of false negatives

False negatives are possible at the scale of the whole survey, i.e. whether a structure is

correctly identified as a breeding or resting site (Table 1), but they will be made more likely if there is a high proportion of false negatives within the data itself, i.e. an animal passes through the 'detection zone' of a camera trap, but the camera trap fails to capture it. The majority of camera traps use 'passive infrared' (PIR) sensors. An accessible guide to understanding how these function can be found in Welbourne *et al.* (2016).

The surface of every object emits infrared (IR) 'heat' radiation, including animals and their environment. A camera trap's Fresnel



Concealed camera-traps monitoring an otter holt. Copyright CC-BY-4.0.



Set up to elevate cameras from water levels during spates. Copyright CC-BY-4.0.

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lens focuses infrared onto two elements in the PIR sensor. When an animal passes through the detection zone, this usually leads to a change in infrared received by the elements in the PIR sensor, warming one element more than the other and creating a signal which can trigger the camera. However, in some circumstances, an animal may emit a similar amount of infrared to the background (e.g. cold-blooded reptiles, mammals in a warm environment, mammals whose surface is particularly cold) and can generate false negatives by not triggering the sensor. This has been observed in semi-aquatic mammals such as otters, whose body surface temperature may be similar to the background when exiting water (Kuhn and Meyer 2009) and therefore may not trigger a PIR camera (Lerone *et al.* 2015).

The 'detection zone' of the PIR sensor should not be considered to be a fixed zone with a discrete boundary. At a given distance, detection may be higher if the animal is closer to the centre-line (Rowcliffe *et al.* 2011), while an animal is less likely to trigger the PIR sensor the further it is away (Howe *et al.* 2017). This distance effect can vary widely between species, and may depend on context (wet/dry, background temperature, vegetation density) and within species. Distance and angle are therefore variables which affect the probability of a false negative.

Camera traps are so called because they 'capture' images of animals. Capture relies on more than just the camera being triggered. The signal from the PIR sensor has to activate recording via control circuits, which takes time. This delay (often called 'trigger speed' or 'latency') can also generate false negatives. The locations of a passing animal at triggering and subsequently at the initiation of recording may differ; the latter may be outside of the camera's field-of-view! Camera trap users will know that footage frequently records no animals ('false triggers'). These could be true negatives (e.g. waving vegetation or sunlight), but may also be false negatives. Ongoing research using CCTV will help to determine which factors influence false-negatives.

There are trade-offs when selecting between still images or videos. Stills have faster trigger speeds reducing false

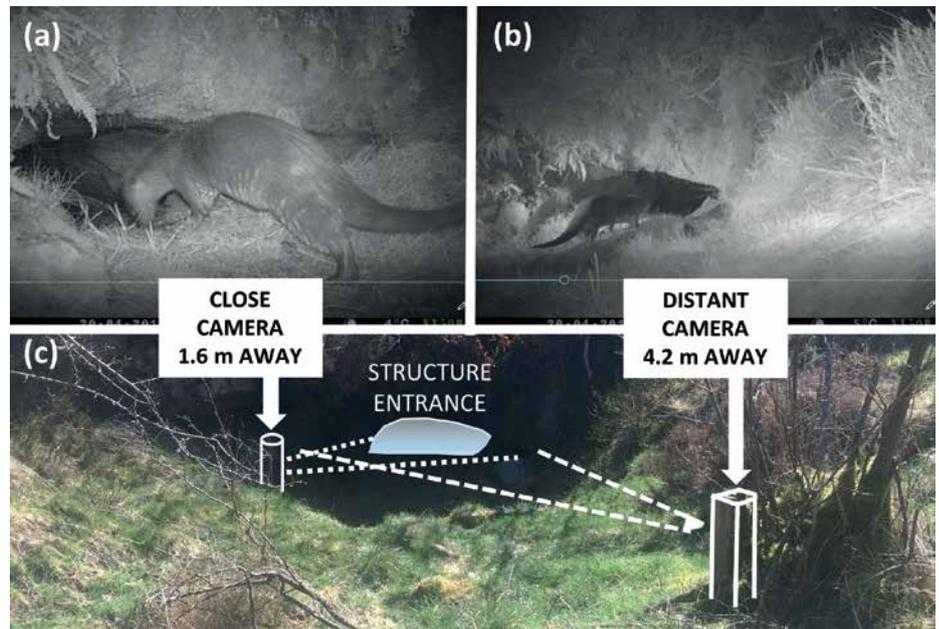


Figure 1. Camera trapping set-up of a structure in southern Scotland used by otters as a breeding and resting place, showing (a) image from the close and (b) from the distant camera traps, and (c) their locations relative to the structure entrance. Copyright CC-BY-4.0.

negatives for fast-moving animals. The advertised trigger speed for a camera will usually represent stills, not video. However, videos can yield more data on behaviour/activity, and give multiple angles, aiding individual identification or sexing. However, videos use more memory and power (if either are exhausted, the camera trap will stop functioning), and require longer processing time. These considerations become important when monitoring a busy site, or if non-target species or false triggers are frequent.

A case study from an otter breeding and resting site

Knowledge of how camera traps function is important because every potential resting site is different necessitating an adaptive approach. With the aim of generating some general principles and minimum standards, we are carrying out camera trap studies on Eurasian otters which have unpredictable denning habits making it challenging to identify resting/breeding places.

We discuss a six-year study of a structure in southern Scotland used for resting and also breeding (Findlay *et al.* 2017). The site was monitored continuously using two camera traps at different distances ('close' and 'distant') from the structure entrance (Figure 1). The initial client brief was to

determine if the structure was a natal or breeding holt, but it also presented an opportunity to assess our camera trapping set-up. One of our objectives was to optimise camera set-up for data quality while recognising constraints on time and resources. Given a known breeding and resting place, could we have monitored the site less intensely (e.g. fewer cameras, shorter study duration, shorter video clips, setting a 'duty time' to reduce



Bushnell Trophy Aggressor camera trap. Copyright CC-BY-4.0.

Box 1. Summary of key practical findings from a long-term camera trap study of a confirmed Eurasian otter breeding and resting place (Findlay *et al.* 2017). Camera trap positions are shown in Figure 1.

One or two cameras?

While the close camera detected a third more presences of otters, the distant camera still recorded 11% of presences that the close camera missed. We recommend using ≥ 2 cameras at different angles and distances to an entrance. If only a single camera is feasible, a closer distance is likely to reduce false negatives. We found no evidence that the camera traps (min. 1.6 m from entrance) or maintenance visits disrupted activity patterns, although there may have been habituation to these visits over time.

Duration of study?

There was a winter bias in breeding. Monitoring during May to October only would not have identified a breeding place (false negative), therefore multi-seasonal monitoring is recommended. When the structure was not being used for breeding, 5% of rests would have needed ≥ 29 days monitoring to detect. This does not account for possible habituation time at the start of monitoring. Camera trapping over 1-2 months would have been necessary to significantly reduce the probability of a false negative for resting when the female did not have young cubs.

'Duty time' of cameras?

Cameras were set to run 24 h/day, but this required viewing of much extraneous footage. 89% of all otter footage occurred between 1 h pre-sunset and 1 h post-sunrise (100% during natal periods). Setting a 'duty time' on the camera (i.e. a daily cycle of active and inactive periods), or ignoring some diurnal footage could have saved significant resources whilst minimally impacting on breeding/resting site identification.

Clip duration

Cameras were set to record 30 s videos, resulting in significant post-processing time. The most useful data (presence, sex, count, behaviour) was skewed towards the beginning of clips. In a presence-only study, very short videos, or still images, would have sufficed. Where sexing otters (e.g. to determine breeding), we could have reduced clip duration to c. 20 s (33% reduction) while only reducing the number of successful sex determinations by 5%. This could be a worthwhile trade-off given the commensurate reduction in battery-drain, memory-use and data analysis time.

non-target and false triggers; see Box 1), whilst still reaching the same true positive identification as a breeding and resting site? The key findings are summarised in Box 1.

Reconciling data from multiple cameras and images

If multi-camera set-ups are more effective (Box 1), how do we reconcile these into one coherent dataset for interpretation? We developed the 'events-list' approach, an 'event' being a unit of continuous otter activity which combines the maximum data from both cameras. For example, an event could be a male otter arriving at the holt and sprainting before leaving. The close camera may record a male arriving and sprainting, but not leaving, while the distant camera may not provide data on sex or record arrival and sprainting, but may record the animal leaving. Using one or other of the recordings would provide incomplete data, but the combined data informs a complete event and reduces false negatives. A chronological list of events could then be compiled. Although two camera traps improved the number of events recorded, false negatives were still possible if both camera traps failed to record.

The 'events-list' was essential to establishing how the structure was used (Findlay *et al.* 2017). There is no published advice on how long a 'rest' has to be and we had no prior knowledge of how long otters might remain in the structure. By examining paired entry-exit 'events', we found a striking bimodal distribution for this site (Figure 2).

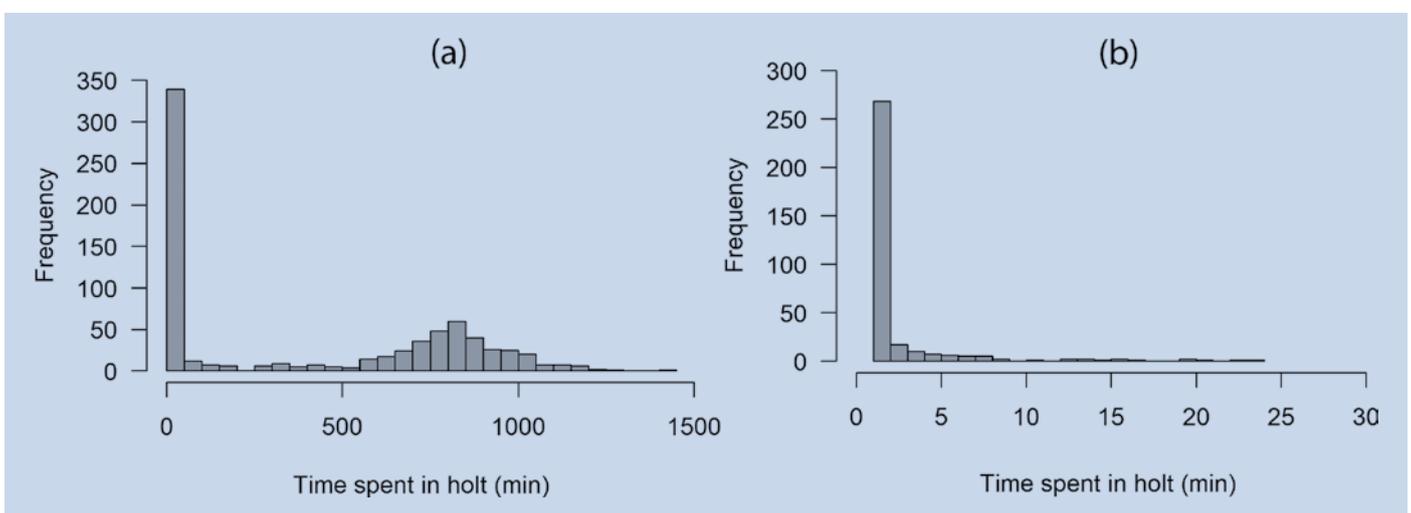


Figure 2. Frequency distributions of time spent by an otter in a holt in southern Scotland: (a) bimodal distribution of time spent in holt (n = 797), and (b) detail of the distribution in the first 30 min only (n = 425). Copyright CC-BY-4.0.

Feature Article: Optimising Camera Trap Data Quality at Mammal Resting Places (contd)

Most paired entry-exits were either < 1 min (Figure 2b) or clustered around 800 min (c. 13 hours; Figure 2a), the latter primarily representing rests through daylight. Some shorter rests did occur, and are known to be more frequent at other structures. This second peak at c.13 hours provides strong evidence that the site is used for resting. Sites not used for resting exhibit only the first peak of < 1 min as otters frequently visit structures used for resting and also those not used for resting.

Conclusions and advice for practitioners

There is considerable variation between camera trap models, and the technology is improving all the time. There are other aspects of camera trap function that impact data quality but are not discussed here (e.g. illumination type), and we would encourage attendance at CIEEM camera trap training courses. Detailed and species-specific, evidence-based guidelines are needed for ecologists using camera traps for breeding/resting place identification but some best-practice principles are emerging from recent research. Each survey site will differ and there is no one-size-fits-all sampling design, but initial recommendations include:

1. Ecologists should become familiar with their camera trap model(s). Test the trigger speed (which can differ from that advertised) for stills and videos, and trial the equipment in a dark, quiet room to ensure no red-glow or noise from the camera.
2. Cameras closer to a structure's entrance are more likely to detect animals, and multi-camera set-ups are likely to improve data quality. Where feasible, cameras should present different angles and distances to the entrance, with overlapping fields-of-view.
3. Camera trapping duration should be as long as feasible, ideally a couple of months to incorporate habituation time; trapping for just four months carries a significant risk of missing breeding activity. When resources are limited, an adaptive approach can increase efficiency (shorter clips, setting duty time, see Box 1). If breeding or resting is not confirmed, surveys should be repeated in each season.

Data quality in camera trapping resting places can only be fully optimised through a combination of evidence-based survey protocols and improved knowledge of how different species use structures to 'rest'. However, these two elements are not mutually exclusive, as improved camera trapping techniques will shed greater light on the way in which these structures are used.

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Green-Lighting Green Infrastructure: A Data-Driven Approach for Promoting Green Infrastructure in London

Abby Crisostomo, Katherine Drayson MCIEEM and Peter Massini MCIEEM
Greater London Authority

Keywords: evidence-based policy, GIS, green infrastructure, machine learning, remote sensing



Figure 1. Green (and blue) cover map for London. Photo credit Greater London Authority.

This article outlines the methods used by the Greater London Authority to better understand London's green infrastructure network, as well as to better target future green infrastructure interventions

and investment. It is intended to illustrate the considerable merits, and the methodological challenges, of a data-driven approach towards urban green

infrastructure. It will be useful for all those with an interest in green infrastructure policy, as well as project development and management.

Introduction

Evidence-based policy-making and project-shaping is the holy grail for policy developers and project managers. But how do we present the issues we want to address in ways that are easily understood by decision-makers, as well as informed by data that are cost-effective to collect, analyse and update?

Box 1. The London Environment Strategy

For the first time, the London Environment Strategy brings together and integrates policies and proposals on key aspects of London's environment, from air quality to noise. The vision is for London to be the world's greenest global city. The strategy helps direct, support and catalyse improvements to the city that will benefit not only Londoners, but also the city's wildlife, habitats and landscapes.

Box 2. Defining green infrastructure and natural capital

London's **green infrastructure** is the network of parks, green spaces, gardens, woodlands, rivers and wetlands (as well as features such as street trees and green roofs) that is planned, designed and managed to:

- promote healthier living
- lessen the impacts of climate change
- improve air quality and water quality
- encourage walking and cycling
- store carbon
- improve biodiversity and ecological resilience.

London's **natural capital** is the set of environmental resources (green space, air, water, wildlife) that provides services, such as flood protection or cleaner air, that benefit the wellbeing of Londoners and the city's economy. Like other forms of capital, such as human capital and goods and services, natural capital is a valuable asset that must be managed sustainably to maintain and improve these service benefits.

We faced that difficulty when trying to identify where investment in new and/or enhanced green infrastructure was most needed in London, particularly for the London Environment Strategy (Mayor of London 2018 – see Box 1). Green infrastructure can help to address many of the challenges of an urban environment but deciding where best to invest is extremely complex.

As Urban Greening officers within the Environment Team at the Greater London Authority, the integrated approach of the London Environment Strategy was a logical extension of our work. We had already shifted our policy framework (Drayson and Massini 2016) from one that focused primarily on the protection of green space and the conservation of biodiversity, to a green infrastructure and natural capital approach (see Box 2). This provides a more compelling rationale for protecting and enhancing London's natural environment as the city continues to develop and densify (driven by city and national policy).

However, despite having access to a wealth of reports and case-studies that make the case for green infrastructure, we struggled to:

- identify where London's existing green infrastructure resource is (and is not) located
- identify the specific local environmental and social challenges that green infrastructure could help to address (i.e. the business case for investment)
- understand which types of green infrastructure interventions might be most appropriate across different parts of the city.

High quality spatial data was desperately needed so we set out to develop a set of new resources and tools for our own use, our stakeholders and partners, and the public. The aim is to ensure more, better quality green infrastructure across the city, which is purposefully planned, designed and delivered to address some of London's key challenges.

The three key project outputs are high resolution maps of 1) green cover and 2) tree canopy cover across London, and 3) a Green Infrastructure Focus Map.

Imagery choice

The basis for any new spatial dataset is the underlying data used to develop it. Over the past few years, there has been an explosion in the number and types of spatial remote sensing datasets available, from satellite and aerial imagery to LiDAR (Light Detection and Ranging) data. Many are free to download.

The imagery used for this work was 10-cm pixel resolution colour infrared (CIR) aerial imagery of the whole Greater London area, provided by the GeoInformation Group and collected across several days in September 2016. The resulting 32 GB file proved extremely difficult to process and analyse so the data were re-processed to a lower resolution (25-cm pixels) without losing a significant amount of detail. The map was then split into 467 more manageable 2 x 2 km image tiles.

Imagery analysis

Normalised Difference Vegetation Index (NDVI) is a well-established method for identifying vegetation through near-infrared imagery. It calculates the difference between near-infrared light (which vegetation reflects) and red light (which vegetation absorbs) and is essentially a measurement of chlorophyll in the vegetation. Green cover and canopy cover were assessed using two different approaches, both based on NDVI.

Green (and blue) cover

To be consistent with the London Environment Strategy's definition of green infrastructure, we define green cover as the total area covered by vegetation and water across London. It includes:

- publicly accessible and publicly managed vegetated land (i.e. green space)
- non-accessible green and blue spaces
- privately owned vegetated land (such as farmland, private gardens, green roofs, street trees and rain gardens).

Using GIS software, we first assessed the NDVI outputs of the imagery. This was necessary because every set of imagery is different based on the time of year (seasonality of vegetation cycles), time of day (angle of the sun and shadows), annual climate conditions and other factors, so it is not possible to use a standardised NDVI threshold.



Figure 2. Excerpt of the green (and blue cover) output for central London. Photo credit Greater London Authority.

We used random point sampling to identify the NDVI values for fields, grass, scrub, trees, bare grass, bare ground, buildings (metal and non-metal), shadow (green and non-green), water and man-made surfaces. From this, we established an NDVI threshold of 0.05, over which everything would be considered 'green'.

However, we knew that the NDVI analysis would underestimate the actual green cover, both because of the amount of shadow on some areas, and because the time of year (September) meant that many normally green areas (often grassland) were showing as bare. Therefore, we

supplemented the NDVI analysis with land use map data of known green areas.

Although OS MasterMap® Greenspace (Ordnance Survey 2018a) could not be used to identify green land parcels because of incomplete coverage within the Greater London boundary, and inconsistent inclusion of man-made areas, OS MasterMap® (Ordnance Survey 2018b) was used to identify water bodies. Instead, GeoInformation Group's UKMap product was used to identify green land cover. This was then combined with the NDVI analysis to produce a unified dataset that filled in areas showing up as bare.

Once again, random point sampling was used to assess the accuracy of the methodology. The final outputs are a rasterised (pixel-based image) data layer and a vectorised (polygon-based) shapefile showing the extent of green cover across London (Figures 1,2). This spatial output allows us to analyse the data for any geography and against any other spatial data layer. This is an improvement on previous methodologies that either combined a broad range of spatial datasets of varying quality and completeness, or involved random point sampling methodologies that provide a probabilistic estimate of green cover for the city, but cannot show where it is located.

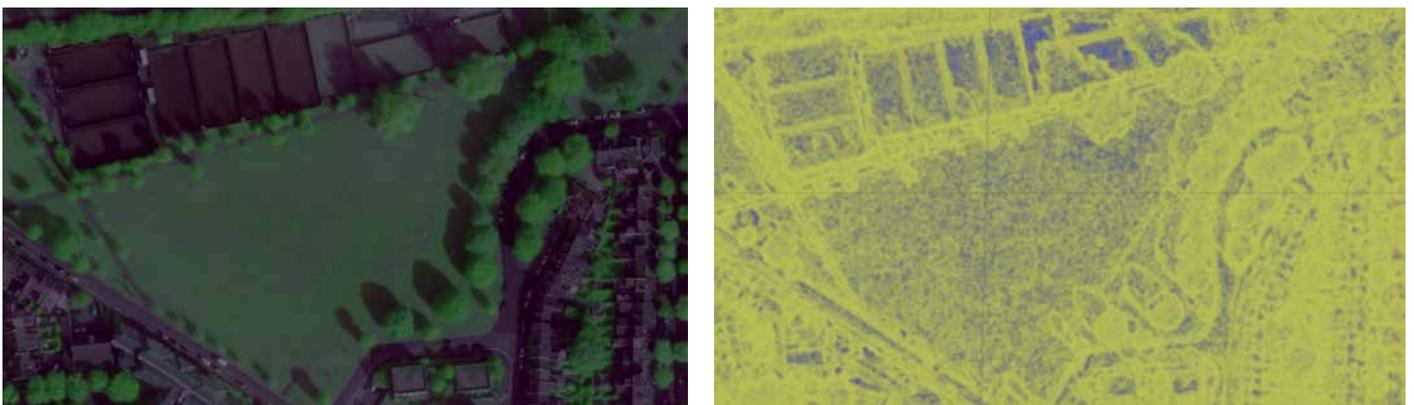


Figure 3. Colour infrared (CIR) aerial imagery (left) compared to the Enhanced Vegetation Index entropy-based feature classification representing texture (right). Photo credit GeoInformation Group and Breadboard Labs.

The way in which this dataset will be used in London over the coming years is outlined below (see 'Using the spatial outputs').

Tree canopy cover

Tree canopy cover cannot be estimated by simply using NDVI. Although trees are generally 'greener' and so have higher NDVI values than other vegetation, this is not always the case. For example, well maintained parks, golf courses, agricultural fields and vegetation in shadow can also display a high NDVI value. While well-established methodology does exist, e.g. i-Tree Canopy (i-Tree Cooperative 2018), more sophisticated machine learning and advanced data processing techniques were required.

Accordingly, we partnered with Breadboard Labs, a start-up company focused on building tools to connect people with environmental data (e.g. Curio tree app, Hickey and Nugent 2018). Google Earth Engine™ analytics platform (Earth Engine, <https://earthengine.google.com>) (Gorelick *et al.* 2017) was used to analyse the 2016 aerial imagery. Breadboard Labs developed a model (called the Curio canopy model) using scripts in Earth Engine that could predict which of the nearly 30 billion 25-cm pixels across London was a tree canopy pixel, based on analysis of the imagery using machine learning.

Machine learning techniques rely on a description of the data they are trying to model in order to identify patterns that can be used to classify pixels. The attributes that make up that description are called 'features'. As part of the machine learning analysis, more than 30 features were allocated to each pixel, including:

- vegetation index features – including NDVI value, two-band Enhanced Vegetation Index and Transformed Difference Vegetation Index
- texture-based features – using Earth Engine to identify what the human eye sees as texture in an image (Figure 3)
- neighbourhood- and smoothing-based features – these take into account the features of pixels surrounding each pixel and uses that to smooth outliers.

Once pixels were assigned features, the model was trained. This was done by humans assigning whether a set of randomly selected pixels in the imagery



Figure 4. Section of tree canopy cover map. Photo credit Breadboard Labs.

were either 'tree' or 'not tree' (or 'unsure' to prevent arbitrary labelling). Around 24,500 points were labelled, providing a large amount of information from which the model could be both trained and tested for accuracy.

Using the Random Forest classifier algorithm available within Earth Engine and the information from the 30 or so pixel features from the training data, the Curio canopy model was able to assign a 'tree' or 'not tree' probability for all pixels in the Greater London area. Additional tools within Earth Engine were used to provide clean, rasterised and vectorised outputs (Figure 4).

The model's accuracy was evaluated in a number of different ways and iteratively refined by adding or subtracting different features from the model. The model outputs were also compared to recent i-Tree Canopy studies for the boroughs of Ealing and Camden.

While the random point sampling method used to check the accuracy of the Curio canopy model is similar to the well-established i-Tree Canopy methodology, the machine learning model goes a step further by providing a spatial output of where trees are located. In addition, the approach was less time-consuming: the i-Tree methodology recommends surveying 500-1,000 points per area and so surveying

each ward in London would require 315,000-630,000 sample points (it took roughly 6 person-days to label just the 24,500 points of our training dataset).

Using the spatial outputs

Monitoring change over time

The main objective of this project was to establish, for the first time, a green cover baseline from which to monitor the impact of policies set out in the London Environment Strategy and the new London Plan. It was important to be able to carry out London-wide comparisons that could be replicated (at least every five years) whilst also being relatively future-proof and cost-effective.

Our method is robust, practical and replicable but there are still limitations. The cost of the high resolution aerial imagery remains expensive and will probably be purchased no more frequently than every five years. Additionally, although the imagery could be assessed using the same method, the imagery itself would be different (time of year, time of day, etc.), with a different spread of NDVI values from which to calculate the best threshold. Nonetheless, this approach still provides a much better, more visual and more replicable way to assess green cover and canopy cover than has previously been available.

Feature Article: Green-Lighting Green Infrastructure: A Data-Driven Approach for Promoting Green Infrastructure in London (contd)

We investigated the possibility of using free satellite imagery to track changes across the whole city annually. Unfortunately, the coarseness of this imagery (10-m pixel resolution) and the issue of cloud cover meant it was not effective for this purpose. Nevertheless, comparing imagery over a two-year period did allow us to identify site-specific changes to NDVI values, suggesting that satellite imagery has potential at a more local scale to identify changes in green cover over time.

Analysing across other geographies and data

The green cover and tree canopy cover maps open up numerous data analysis possibilities. At the most basic level, the spatial datasets can be analysed at different geographies, allowing us to compare, for example, outer versus inner London, different wards or post codes. They can also be analysed against other datasets. For example, green cover can be analysed against building footprints to identify existing green roofs; and both can be overlain with demographic and social data to identify correlations with various indices of deprivation.

Particularly important for London, the green cover dataset can be overlain with a map of London's Areas of Deficiency in Public Open Space (based on standards set out in the London Plan). Since Areas of Deficiency can in fact be very green (for example, due to extensive private gardens), this will allow us to better target initiatives towards either greening of the public realm or improving accessibility to existing green spaces, depending on the local context.

We also hope that the datasets can be used to target investment in green infrastructure. This will help to target scarce resources most effectively and also ensure that when opportunities arise for addressing economic and environmental issues (such as through urban regeneration), green infrastructure is considered as a potential solution. We have undertaken an additional project building on these data outputs to make the data even more usable in this policy context.

Green Infrastructure Focus Map

Our recently developed Green Infrastructure Focus Map is an interactive webmap that brings together datasets covering a number

of environmental and social issues that we know green infrastructure can help solve. (available at <https://maps.london.gov.uk/green-infrastructure/>). The Focus Map therefore shows which parts of London have the most 'need' on these issues, and which issues for any given area are the most important. This will help us, together with our partners and stakeholders, to focus our investments and improve green infrastructure design to address specific issues for an area.

Whilst the Focus Map is mainly concerned with 'need' for green infrastructure, the green cover and canopy cover datasets can be viewed on the map to help identify where the need might best be addressed by either new green infrastructure, or by changing the design or management of existing green infrastructure.

Conclusions

We are optimistic that the green cover and canopy cover datasets, as well as the Green Infrastructure Focus Map, will encourage more dialogue and better collaboration

between land-managers, land-use planners, developers and others making changes to the use of land. In turn, this will ensure that London is planned, designed and managed to optimise the use of green infrastructure, and maximise the benefits of a greener city.

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Cofnod: Creating Data Systems for Consultant Ecologists

Roy Tapping MCIEEM

North Wales Environmental Information Service

Keywords: data request, data search, Local
Environmental Records Centre, professional ecologist

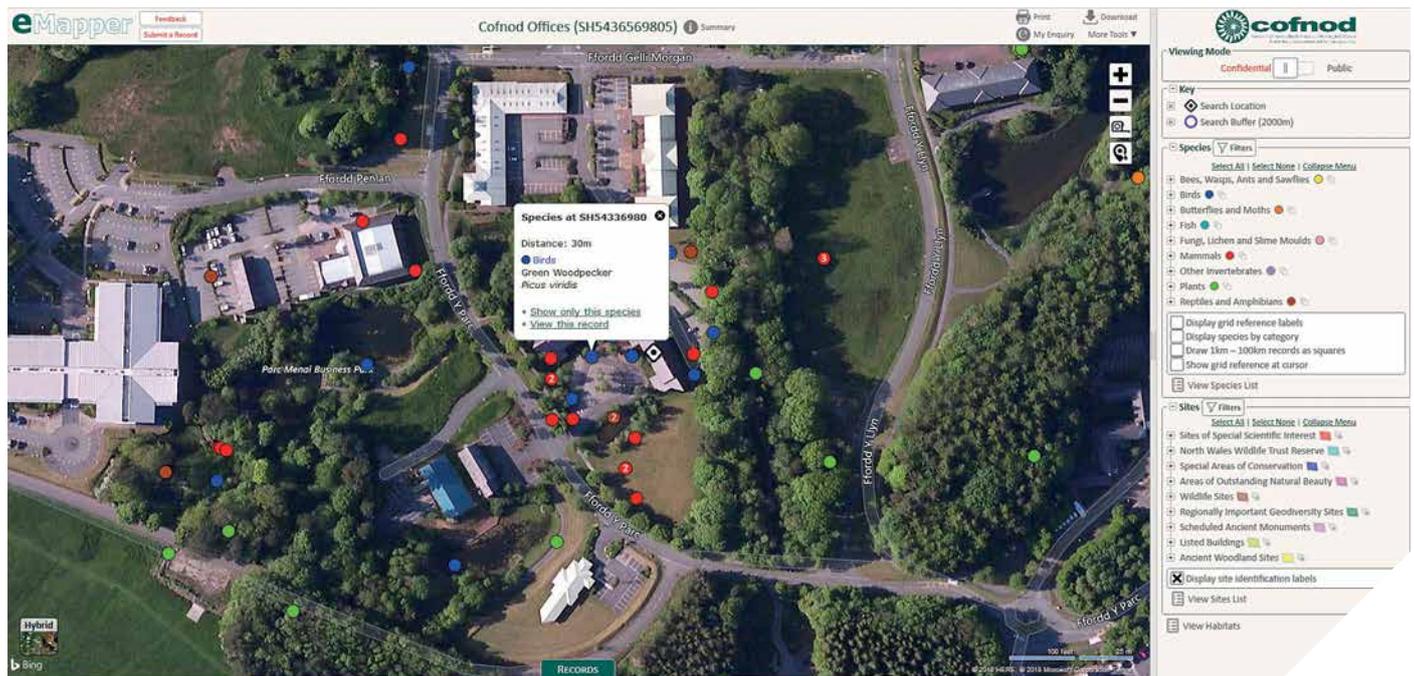


Figure 1. A typical eMapper output showing species and sites on an online map.

Consultant ecologists need rapid, straightforward access to environmental data held by Local Environmental Records Centres. Recent developments at Cofnod have transformed the way data are stored, managed and provided. This article describes our new tool called eMapper, which allows users to interact with ecological data through an online map, offering greater flexibility and making data interpretation more efficient. For clients using eMapper, turn-around times for data

requests have been drastically reduced and reports can be downloaded in a wide range of formats to allow scrutiny offline. These improvements have revolutionised our data retrieval service, providing ecology and environmental professionals with a rapid, efficient and cost-effective way of acquiring the data they need.

The back story

Based in North Wales, Cofnod is one of over 60 Local Environmental Records Centres (LERCs) in the UK. Established in 2005, we were part of a 5-year

programme to establish LERCs covering Wales. Although LERCs have similar remits, the scale of operation and business model can vary, contributing to some differences in the products and level of service, which can occasionally cause difficulties for clients. An accreditation scheme introduced in 2012 by the Association of Local Environmental Records Centres seeks to address this by improving levels of service and increasing standardisation. Cofnod hopes to receive accreditation before long, joining a range of LERCs across the country attaining this standard.

Data request service

Along with other LERCs, Cofnod offers a data request service for a range of customers including consultant ecologists. First introduced in 2007, this service has seen a gradual increase in use, with over

320 requests from consultants last year compared to just 80 in 2008. Nevertheless, we continue to find it difficult to predict the numbers and types of requests each year and although our capacity to deal with requests has increased, the service continues to feel under-used. A recent study in London suggested that over 18% of all planning applications required a LERC data search, yet less than 1% requested data from GiGL (Greenspace Information for Greater London CC), the LERC covering Greater London (Greater London Authority 2016). This pattern is replicated in North Wales, where we estimate that less than 2% of all planning applications requested a data search from us last year. So why are the percentages so low when consultant ecologists know the services we provide and have probably used them previously? Maybe they were unhappy with the level of service they received, or perhaps they don't think they need the data. Most likely, their clients are unwilling to pay for the cost of data searches. To encourage greater use of the environmental records we hold, we continue to improve the data retrieval service we provide to consultants. For example, we recently agreed to provide unlimited data requests for an annual fee from one of the larger local consultancies. This has seen a dramatic increase in the number of data requests they make, as they

no longer need to justify data search cost to their clients. This not only demonstrates that our service was previously under-used but also, crucially, that the data we provide are now being used more consistently, which is our ultimate aim.

Delivering a better service

Since 2015, we have made fundamental technical changes to the way we store, maintain and manipulate data, moving to a single integrated system with improved functionality. Previously, although we had largely automated the process of combining and querying the data, the production of outputs took several defined and often lengthy steps. For example, creating an easy-to-interpret map to scale was often time consuming, especially where there were hotspots of data or large search areas. The product, which was essentially a formatted table of species with associated maps, was sometimes criticised for being too static and difficult to use, especially with large bodies of data.

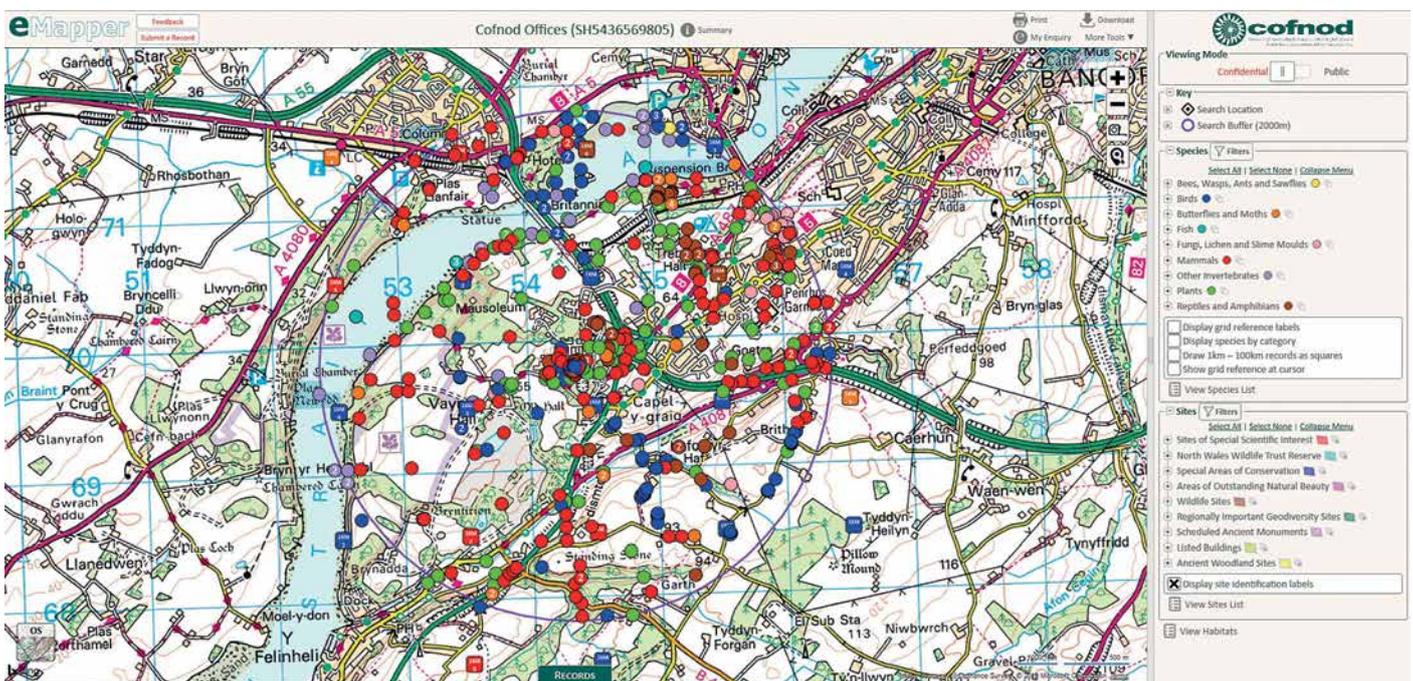
By contrast, the new system allows users to:

- interact with the data online, making the information easier and quicker to interpret
- download reports in a wide range of data formats
- access data shortly after making a request.

Creating an online mapping approach: eMapper

Development of an interactive mapping interface was key to improving user experience. We created a program called eMapper that allows our data to be manipulated and interrogated using online mapping tools. For the first time, eMapper allows users to interact with the species, site and habitat data across the search area, allowing them to quickly visualise how species and habitats could potentially be impacted by a proposed development (Figure 1).

The eMapper system provides all relevant data, rather than just selected species or groups. Hence users are sometimes presented with more data than they specify but the on-board filters allow them to quickly focus on the important features, making use of the data much more comprehensive and versatile. For example, for large complex sites, it is easy to zoom into areas and display certain data, such as all species recorded within the last 10 years or all species with a protected status (Figure 2). Furthermore, users can create their own custom maps by changing the way the data are displayed and using a variety of base maps. We felt this was important for customers without GIS capability. In addition, we provide a range of download formats



A close up eMapper view showing clusters of species records.

	Steps	Who	How
5 minutes	Define search requirements	Consultant Ecologist	Cofnod website
	Retrieve an instant quote		
	Register or login		
	Submit data request		
10 minutes	Process data request	Cofnod	Cofnod internal systems
	Run data search		
	Send search results		
	Send invoice		
	Receive search results	Consultant Ecologist	Email containing eMapper weblink
	Open results in eMapper		Web browser and online mapping
	Pay invoice within 28 days		

Table 1. Cofnod's data request process. Note that times are approximate.

including Excel or ESRI Shape for users who wish to analyse the data further.

Speeding up the service

The eMapper interface allows us to offer a significantly improved level of service and a consistently high response time. Customers still submit a data request via the Cofnod website but in most instances they receive results within minutes of submitting their request (Table 1). This has largely been achieved by streamlining the data request process to utilise a series of standard, predefined products (built on experience of what the majority of our customers require) together with online mapping tools to better specify the data search location. The system automatically provides an exact price for the work when customers make the data request, depending on the product selected. This allows users to vary parameters in advance in line with resource constraints – an important development in its own right. Once the data request parameters have been verified by a Cofnod staff member, a weblink is emailed. This provides online access to the data requested via the eMapper software. Turn-around times are usually between 10 minutes and two hours.

The way forward

Since its launch, feedback about eMapper and the service we provide has been overwhelmingly positive:

“the eMapper tool is by far the best service/method of data delivery I’ve seen from any LERC”

“I have to say that your website and e-mapper service is one of the easiest user interfaces I have come across”.

Other LERCs are starting to adopt eMapper, with Leicestershire and Rutland Environmental Records Centre being the first to integrate it within their products. eMapper is also used in the Wales Biodiversity and Reporting Database, Aderyn, which is currently used in Wales to service national contracts and provide outputs for consultants in Mid Wales.

Capturing data from professional ecologists

In their Code of Professional Conduct, CIEEM states:

‘members wherever possible, should make scientific data collected during the course of their professional duties available to others such as records centres.’

Over the past few years we’ve tried a variety of methods to capture data from consultant ecologists but although the pace of exchange has increased, mainly through collaborations with smaller, local consultants, more could be achieved. The time saved through eMapper has allowed us to focus more on sourcing high quality data, thereby creating a better product as well as offering an improved service. Currently, with the permission of local planning authorities and consultants, we are digitising important species information held on planning files. We have also

developed a system to archive ecological reports and store vital metadata. This important contextual information helps create a direct link between the species records and a copy of the original report. Our aim is to develop a simple system for consultant ecologists to directly upload ecological reports or data. We hope this will encourage more people to share their data with us, allowing it to be more widely used in our reporting process.

Making things easier

Although many of the systems we’ve developed at Cofnod are designed to allow us to source and manage local environmental records more efficiently, we are wholly committed to pushing forward with systems that improve the user experience for those who need to access our database. We look forward to further development, working with the community of consultant ecologists and environmental professionals to make the data we hold ever more useful to their work.

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About the Author



Roy Tapping is the Manager of Cofnod and a Member of CIEEM. Before establishing Cofnod, some 13 years ago, Roy worked for the Countryside Council for Wales, English

Nature and the Institute of Terrestrial Ecology, both in technical and ecological roles. Cofnod continues to provide Roy with a unique opportunity to blend his knowledge of ecology with a passion for environmental data. Alongside a small, highly skilled team, he has coordinated the development of a Local Environmental Records Centre with particular strengths in system development and implementation.

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Predatory Journals: A Growing Threat to Scientific Integrity?

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Keywords: academic publishing, Beall's list, fraud, peer-review

Predatory journals mimic mainstream academic publications but are characterised by the deliberate misrepresentation of the extent to which they abide by the accepted standards of peer-review. They threaten the credibility of academic publishing and can mislead the public about current scientific thought. Students and practitioners researching unfamiliar topics must also be vigilant. This article reviews the fraudulent behaviours exhibited by predatory journals, their potential impacts, and how they can be identified and combatted.

The peer-review model

Peer-review of manuscripts submitted to journals, based on feedback from authoritative colleagues working in the same field as the authors, is a mainstay of the academic publishing world. Peer-review has been criticised for bias and subjectivity, but it remains key in ensuring that published papers are reliable and trusted. Ecology and environmental management are based on a scientific understanding of the world. Members of CIEEM should therefore recognise how recent developments in open access publishing have opened the door to online predatory publishers.

The changing nature of academic publishing

The publishing world has changed dramatically since the invention of the world wide web (Beall 2017). Gone are



the days when academic papers were accessible only as paper copies on library shelves or posted to individual subscribers. The number of journals has mushroomed with the greatest growth being in those published online. Open access publication is also becoming more common. This has been hailed by some as a democratisation of research; with the results of scientific endeavour (often publicly funded) being available free of cost to a wider audience. The move to open access publication has, however, led to a redistribution of the costs of publication from subscribers to authors. Many open access journals charge authors fees from a few hundred to several thousand Euros depending on the length of the article, use of colour, and prestige of the journal. Whilst online publication does not carry the traditional costs of printing and postage, there remain justifiable costs associated with the peer-review process, editorial services and maintenance of the website, although it should be noted that as with subscription-based journals, reviewers remain unpaid. Online academic

journals are important sources of income for many publishers, including not-for-profit scientific societies.

Recognising predatory journals

The growth in online open access publication has, unfortunately, created an opportunity for unscrupulous publishers, who forego the established rules of peer-review, and charge authors to publish their work online with minimal input from reviewers or the editor. Predatory publishers deliberately seek to convince authors and readers that they offer a credible peer-review process through cynical and fraudulent misrepresentation. Predatory journals frequently mimic peer-reviewed journals by having similar names, while cutting costs on the very processes which give academic journals credibility in the eyes of the public and scientists alike. Hundreds of predatory journals now exist online, alongside established journals with hard-won reputations for academic excellence, and high editorial and production standards.

How then can we identify predatory journals? Jeffrey Beall, an American librarian, ran an online blog with a 'blacklist' of predatory journals and publishers from 2012 to 2017 (archived at <https://beallist.weebly.com/>). This work now continues at a website called 'Stop Predatory Journals' (SPJ) (<https://predatoryjournals.com>). The list can be consulted freely and identifies warning signs that a journal is predatory, including the following:

1. Charging for publication and falsely claiming to apply peer-review
2. Targeting potential authors through email spamming in attempts to get them to publish or serve on editorial boards (which then serve no useful purpose)
3. Listing scholars as members of editorial boards without their permission, not allowing such 'editors' to resign, and inventing fake scholars as editors
4. Quick acceptance of low-quality papers, including pseudo-science
5. Copying the design and content of websites of legitimate journals; sometimes combined with fraudulent or improper use of ISSNs
6. Giving false information about the location of the publishing operation
7. Fake, non-existent, or mis-represented impact factors (as a fraudulent measure of how often the journal has been cited).

The risks posed by predators

Predatory journals dilute the quality of academic literature with papers that have not been subject to adequate peer-review. They dupe and potentially mislead readers. Readers most at risk are those unfamiliar with a topic, such as students and those needing to research a new topic against a tight deadline. Many of the most prestigious academic and professional journals are hidden from scrutiny behind a subscription pay-wall. This increases the chance that the unwary will inadvertently resort to accessing less credible sources. In an unfortunate twist of fate, and an example of unintended consequences, the open access movement which criticises subscription journals as being elitist and undemocratic, has created the environment in which predatory journals are able to thrive. These predators hide in

plain sight and undermine the benefits of open access.

Predatory journals prey on unwary scholars who unwittingly submit their manuscripts to what amounts to a fake academic journal. Authors at risk are particularly those in developing countries, those early in their careers who are inexperienced and desperate to publish, and those working as enthusiastic amateurs or industry professionals who lack experience of academic publishing and peer-review. The consequences for an author can be serious. Potentially valuable work may lose credibility through poor editorial input, loss of the opportunity to gain advice from knowledgeable peers via the review process, and simply through association with a predatory journal. Authors may also be subject to criticism for failing to show adequate judgement in choice of outlet for their work and risk having their work unread and their career prospects damaged.

Anti-predator defence strategies

Predatory journals can be difficult to identify with websites that appear very professional. How then can we protect the integrity of the scientific process, ourselves and our profession? Given that predatory journals specialise in deception, detecting signs of their activity may require some background research. Consulting the blacklists of suspected predatory journals, publishers and dubious impact factors (also available on the SPJ website) is a helpful first step for both readers and potential authors. The website Think, Check, Submit (www.thinkchecksubmit.org) is also a useful resource, and includes advice, and links to so-called whitelists of reputable journals that do employ peer-review (see Figure 1). Familiarity with a subject area and its journals is, however, indispensable because neither blacklists nor whitelists may be fully up to date. Consulting knowledgeable colleagues can be invaluable in highlighting journals that may be less than reliable. But for those without timely access to subject experts, and without personal knowledge of the specialist literature, other strategies are recommended.

Potential authors should be wary of unsolicited invitations to publish their work in unfamiliar journals. As research-active academics, we receive numerous invitations from the 'Editorial Staff' of predatory



Figure 1. The Think, Check, Submit Toolbox available at www.thinkchecksubmit.org

journals suggesting that we might like to publish in their journal. It is usually obvious that the letter is computer-generated spam. Poor grammar, and lack of congruence between our research area and the journal title, are often further warning signs that this is not a 'real' journal.

Intending authors may find that researching the journal's editorial board independently from the information given on the journal's website will confirm suspicions. Does the information on the journal's website accord with that on an editor's personal web profile at their place of employment (typically a university or research institute)? If in doubt, you should consider contacting the editor directly, at their place of employment, before submitting a manuscript to the journal's website.

Browsing the content of journals can be revealing for potential authors and readers alike. Some predatory journals are conspicuous in that they provide an outlet for pseudo-science. Beall (2016) gives examples of journals publishing papers claiming that asbestos poses no threat to health, untested drugs are effective, nuclear power plants carry hitherto unknown risks, and climate change does not have anthropogenic causes. Superficially credible papers published in these same journals are unlikely to have been subject to peer-review. It is

also helpful to check whether the journal publishes papers that do not appear to match either the title or the stated scope. For example, whilst browsing an unfamiliar entomological journal we were surprised to find that it included a paper on the post-operative survival rates of cancer patients in a developing country. No credible academic journal specialising in entomology would publish a paper on this topic and we subsequently found that the journal is listed as a predator. Sadly, there are multiple potential victims in this story. First, some of the entomological papers in this journal looked credible but we now feel reluctant to read them. Second, the medical study may have some validity, but it is unlikely to be read by the medical community.

Common sense suggests that there must be a gradient in predatory behaviour, and the value of papers published, by predatory journals. In a response to issues raised by Beall (2017), one of his colleagues makes the insightful point that assessing the validity of information sources has always been an important aspect of scientific literacy (Swauger 2017). Some good papers may be published in predatory journals by authors who have been fooled into believing they offer peer-review publication. In that sense, while predatory journals lie towards one end of a gradient of sources of varying credibility, other factors must be borne in mind when considering individual papers. We have some sympathy for this nuanced viewpoint, but one of the defining issues in the debate about predatory journals must surely be the extent to which the publishers are engaging in outright dishonesty, i.e. they claim to conduct rigorous peer-review when they do not, and often use fake or stolen information on their websites. The boycotting of otherwise 'good' papers, inadvertently published in predatory journals, might therefore be necessary collateral damage in the fight for scientific integrity.

While it is important not to exaggerate the issue, readers clearly need to take extra care when considering citing or relying on work published in a journal that exhibits predatory characteristics. If these papers enter the scientific mainstream (e.g. through citation in papers published in more credible journals) there can be an erosion of credibility in the eyes of the public and politicians. Beall (2016) warns that papers published in some predatory journals appear in searches conducted through the trusted Google Scholar database used by students. Unfortunately, there is no simple answer to this problem. Swauger (2017) correctly recognises that teaching and practicing information literacy is essential but has always been difficult.

Conclusion

The growth of open access online publication has tremendous benefits but also has inadvertently opened the door to unscrupulous publishers, intent on profit, yet with no regard for scientific integrity. The situation is unlikely to change anytime soon, but knowing the risks reduces the potential damage. Ultimately, we all share a responsibility for the integrity of the scientific publishing underpinning our profession. If readers stumble across a suspected predatory journal they can report it online at the 'Stop Predatory Journals' website (<https://predatoryjournals.com>), whereupon it will be investigated and may be added to the list.

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Think, Check, Submit:
Choose the right journal for your research.
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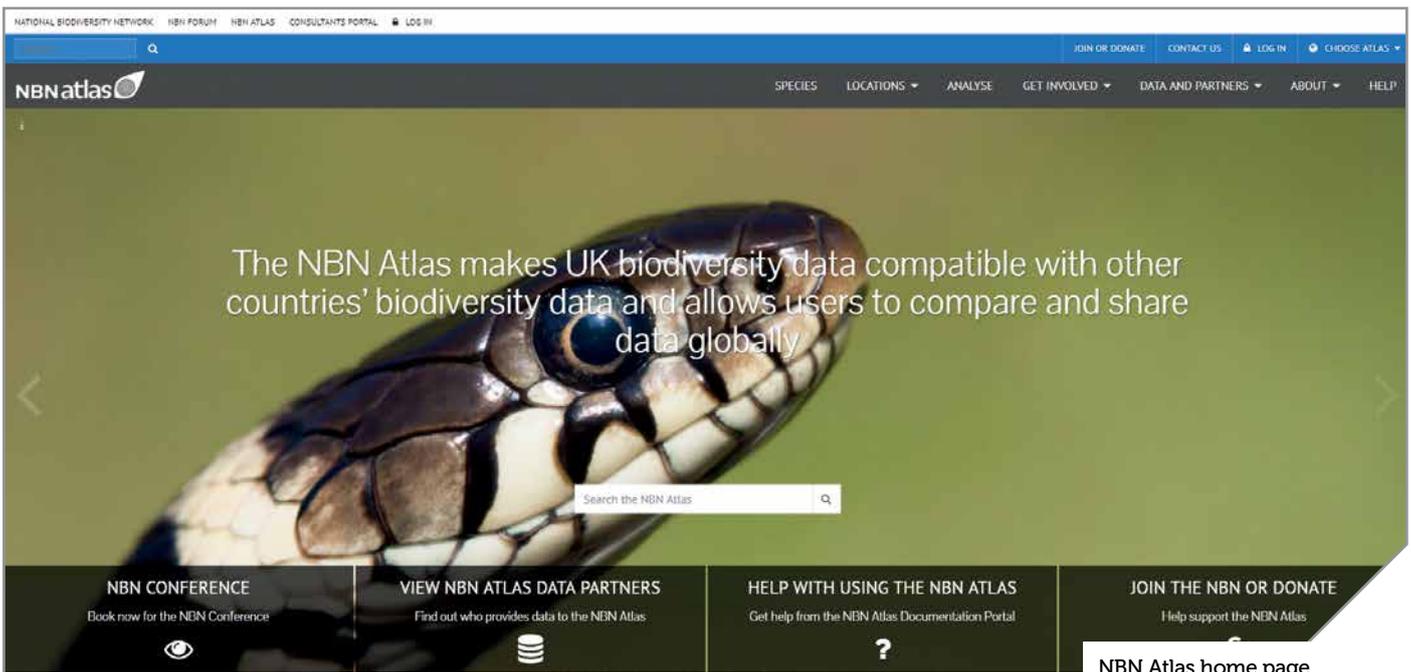
and insect conservation. He is Professor of Entomology in the Department of Crop & Environment Sciences at Harper Adams University where he runs the only general Entomology degree in the UK. He believes passionately in outreach and blogs at *Don't Forget the Roundabouts* and can be found on Twitter as *@Entoprof*.

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Accessible UK Wildlife Data For All – the NBN Atlas

Keywords: Darwin Core, data, licensing, map, species records, verification

Jo Judge, Mandy Henshall and Sophia Ratcliffe
National Biodiversity Network (NBN) Trust



NBN Atlas home page

The National Biodiversity Network has been championing the sharing of UK biodiversity data since 2000. It aims to improve the availability of high resolution and high quality data to provide an evidence base for environmental decision-making. It does this through the NBN Atlas, a free online platform to engage and inform people about the natural history of the UK.

The NBN is a partnership between many of the UK's largest conservation organisations, wildlife charities, government agencies, local authorities, local and national recording schemes, Local Environmental Records Centres, ecological consultancies

and academia. Many of these contribute records to the NBN Atlas.

The NBN Atlas

Launched in April 2017 as a replacement for the NBN Gateway, the NBN Atlas is helping to improve biodiversity knowledge. It is the largest UK-wide aggregation of multiple sources of information about species and habitats, and provides the ability to interrogate and map these data in a single location, opening up new and exciting research possibilities. It is a vital data discovery tool for environmental managers and currently holds almost 220 million records across 43,000 species, which are available for use in accordance with specific licence conditions (see Box 1). The many, divergent data providers and data users necessitate a platform where the availability and quality of the records are clear and understandable.

Box 1. NBN Atlas key facts

- 500,000 records can be downloaded from the NBN Atlas in a single download
- Search areas can be pre-defined or drawn individually
- Each record has an identification verification status
- Each record has an associated licence and strict licensing conditions apply
- Records can be filtered by different attributes, including the licence, the identification verification status and resolution.
- Records are stored following Darwin Core data standards.

Records are stored in the NBN Atlas following the Darwin Core standard, an internationally accepted format for sharing biodiversity data. This not only aids sharing of records with other organisations, such as the Global Biodiversity Information Facility (GBIF – <http://www.gbif.org>), but also ensures efficient and effective filtering of standardised records, based on the requirements of the individual user.

Every record held on the NBN Atlas has a licence, which indicates the conditions under which the record may be used; an identification verification status, indicating whether the record has been verified; and a location with accompanying resolution, allowing the user to determine the accuracy of that information. It is possible to filter occurrence records by any, or all, of these attributes, making the search facility customisable to user needs.

Data licensing

This can be a complex part of data sharing. Data on the NBN Atlas are either 'Open' or 'Shared' depending on the associated licence. Fifty-two percent of the datasets and 12% of the records are on open licences.

Open licences are used to make data freely available to access, use and share, including for commercial use. They include:

1. Open Government Licence (OGL)
2. Creative Commons licence with attribution (CC-BY)
3. Creative Commons No rights reserved licence (CC0).

More details on the conditions of use of the Open licences can be found on the NBN Atlas Help Portal (see <https://docs.nbnatlas.org/data-licenses/>).

There are two types of **Shared licence**:

1. Creative Commons with attribution non-commercial (CC-BY-NC)

Most biodiversity data in the UK is collected by volunteers. Organisations that record and compile data also undertake data management and verification tasks to prepare their records for dissemination. This work, and support for volunteer recorders, is largely unfunded. By using a CC-BY-NC licence these data can be made freely available for not-for-profit uses, while ensuring those who obtain commercial gain from using the data contribute towards its collection and management

through purchasing data services. For commercial purposes, data available on the NBN Atlas with a CC-BY-NC licence should be used as discovery datasets to find out who holds the information you need.

Commercial use is defined as '*one primarily intended for or directed towards commercial advantage or monetary compensation*' and therefore probably includes most data used by ecological consultants and environmental managers. Data do not have to be downloaded for the licence conditions to apply; viewing the data and summarising information is still a breach of licence conditions.

If you wish to use data on a CC-BY-NC licence commercially, you must obtain prior permission from the data provider. Data provider contact details are associated with each dataset and included in the download file, so it's easy to get in touch with them. Data providers may charge for their services and whilst prices vary between providers, most are between £100 and £500 per data search area. If you do not obtain their permission, you may be liable for a fixed charge notice of £500 per data provider for breach of licence conditions (i.e. if you use data from three data providers the fixed charge notice will be £1500).

The NBN Trust does not actively police breach of licences, but download reports are regularly sent to data providers for them to inspect and take any necessary action. More information can be found at <https://docs.nbnatlas.org/data-licenses/breach-licence-conditions/>

2. Restricted Re-use Licence

This licence type is only associated with sensitive species data, where records on an agreed sensitive species list are available publicly at a low resolution under one of the licences above. High resolution data can be requested from the data provider. The restricted re-use licence they issue permits the licensee to hold the sensitive data to carry out a specific activity that is of demonstrable environmental benefit.

Record identification verification

Record verification is carried out by recognised experts for each taxon. This is often the National Scheme or Society and the data verification status of each record is supplied by the data provider

when they submit data to the NBN Atlas. Identifications are either Accepted or Unconfirmed and can be amended on subsequent uploads. Accepted and Unconfirmed records are displayed on the NBN Atlas in different colours on the occurrence record maps and it is possible to filter and search records by identification verification status.

Developing the NBN Atlas in future

Much has been achieved over the first year of the NBN Atlas (see Box 2) and more developments are planned. These include improvements to the occurrence record search, record page and species descriptions, as well as providing the ability to request enhanced access to sensitive species data and to save search criteria for re-use.

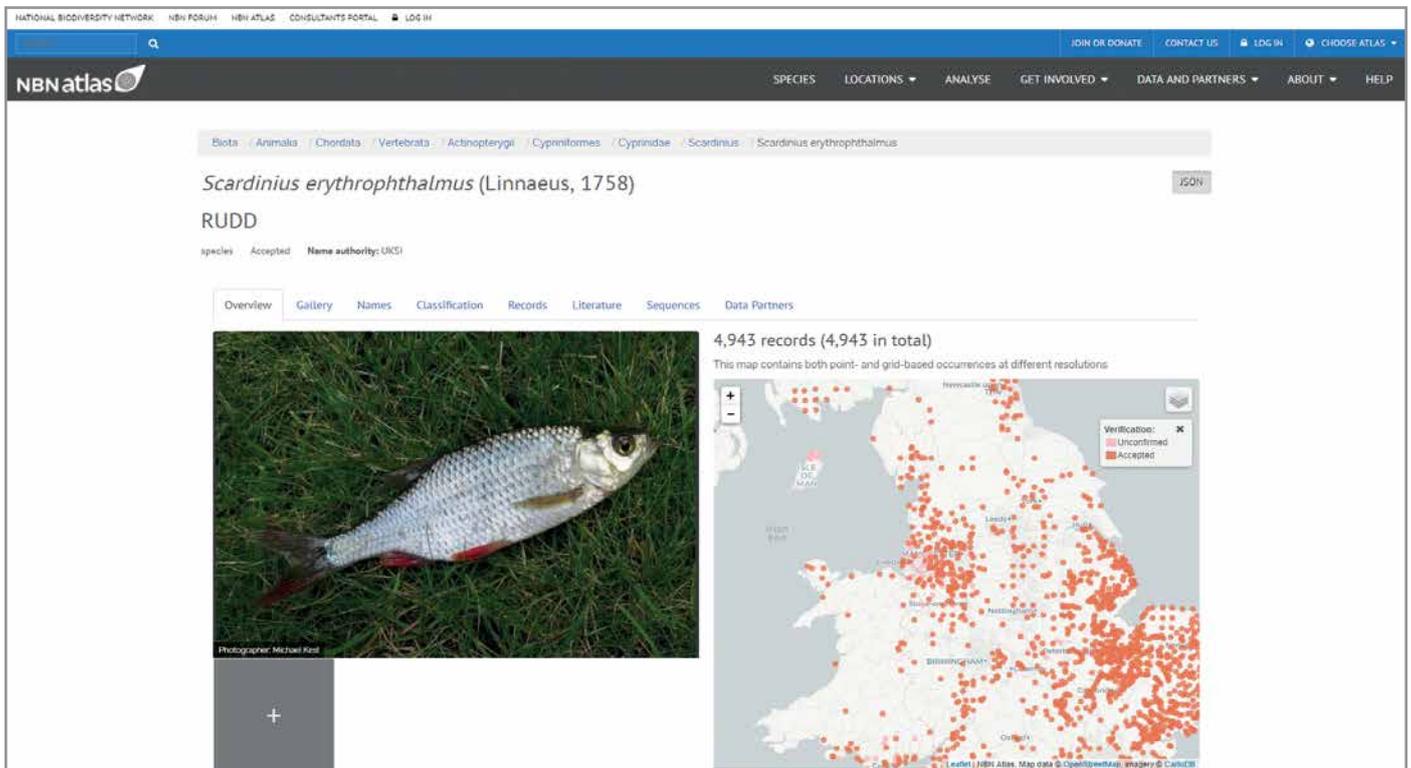
Over the coming months, the NBN Trust will be exploring options to facilitate greater data sharing via the NBN Atlas, including the ability to make data available at a higher resolution for approved users and better signposting where higher resolution records are available from data providers. We will also be investigating ways to integrate the NBN Consultant's Portal into the NBN Atlas and providing multi-regional and national data services in collaboration with our providers.

We would welcome input and suggestions from ecological consultants on these planned developments.

Box 2. Some NBN Atlas statistics

(at August 2018)

- Over 219 million species (occurrence) records covering almost 43,000 species
- Over 800 datasets from 130 data partners
- The oldest record with a full date is for *Bembidion (Philochthus) aeneum* dated 1645-11-30 (from the dataset Carabidae records for Britain to 2014)
- The most recent record is for *Scardinius erythrophthalmus* dated 2018-06-27 (from Freshwater Fish Recording Scheme datasets)



NBN Atlas showing unconfirmed and accepted verification for *Scardinius erythrophthalmus*

NBN Atlas – try it out

With almost 220 million species records, the NBN Atlas is an invaluable resource for anyone involved in ecological management. In contrast to the NBN Gateway, where none of the data could be used commercially without written permission from the data provider, the NBN Atlas provides some data for use without any restriction. It also allows you to see which organisations hold relevant information and provides the contact details for requesting permission to use the data. Ultimately, we all want the data to be used, whilst at the same time protecting the rights of our data partners, without whom the NBN Atlas would not exist. We therefore encourage you to register and see what the NBN Atlas can do for you.

Further information

National Biodiversity Network Trust, NBN – <https://nbn.org.uk>

NBN Atlas - <https://nbnatlas.org.uk/>

If you would like further information or advice on the NBN Atlas, please contact support@nbn.org.uk

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Legal Update: There's No Such Thing As A Mitigation Measure

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The judgment in Case C-323/17 *People Over Wind & anor. v. Coillte* has forced many to revisit their practice when screening for Appropriate Assessment (AA).

Background

Generally, CIEEM members in Ireland have followed the relevant guidance in respect of AA (EC 2001; NPWS 2009 and 2010) and would not take mitigation measures into account at the screening stage. The European Commission guidance made clear that screening “should be carried out in the absence of any consideration of mitigation measures that form part of a project or plan and are designed to avoid or reduce the impact of a project or plan on a [Natura 2000 site]”.

Notwithstanding this, courts in the UK and Ireland had accepted that “avoidance or mitigation measures can, as a matter of law, be considered at the screening stage”. That was the statement made by Sullivan J. in *R. (Hart District Council) v. Secretary of State* [2008] EWHC 1204 (Admin) and it was applied in several Irish cases. For example:

1. “[T]ried and tested” surface water management and “best practice construction management techniques” were relied upon to avoid an AA of pylon foundation work (*Ratheniska &c. v. An Bord Pleanála* [2015] IEHC 18 and *Rossmore Properties v. An Bord Pleanála* [2014] IEHC 557).

2. The mitigation relied on to avoid construction phase disruption and wind turbine risk to whooper swans comprised: timing restriction of site-works, limitation of habitat loss to certain areas, limitation of hazard warning lights to certain months, placing all cables underground and five years’ monitoring (*Carroll v. An Bord Pleanála* [2016] IEHC 90).
3. When dealing with sewage sludge and effluent risk to water, the fact that a composting plant had been designed “to ensure no liquids or solids from the enclosed composting process are able to escape from the site to the surrounding area” was relied on (*Harten v. An Bord Pleanála* [2018] IEHC 40).

In each case, the developer's ecological consultant had acknowledged the potential for significant effects, but satisfied themselves, the competent authority and the court that mitigation measures would remove that prospect.

Court of Justice (CJEU) Judgment in *People Over Wind*

This approach is no longer defensible. The CJEU, in Case C-323/17 *People Over Wind & anor. v. Coillte*, has ruled that “it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on [a Natura 2000 site]”: a decision that CIEEM ecologists generally agree with.

The case concerned a proposed underground 38 kV grid connection along a 15 km route between the permitted Cullenagh wind farm and the national grid. The screening determination concluded that there was no potential for significant effects on the European site for two reasons: the separation distance and the “protective measures that have been built into the works design of the project”. In particular, the ecologist's report suggested that “[i]n the absence of protective measures, there is potential for the release of suspended solids into waterbodies along the proposed route”, which it was conceded would harm the Nore freshwater pearl mussel *Margaritifera durrovensis*, plant growth, lamprey and salmonid spawning habitat, other invertebrates, birds, fish and mammals.

The “protective measures” comprised: no in-stream work, no encroachment onto semi-natural habitat, careful use of directional drilling, silt traps, check dams and bunds etc. In addition, the proposed works were located 12 km upstream of the relevant Natura 2000 site.

Against this background, the Irish High Court asked the Court of Justice whether, or in what circumstances, mitigation measures can be considered when carrying out screening for AA.

In its judgement of 12 April 2018, the CJEU:

- Highlighted that the Habitats Directive does not contain any reference to mitigation measures. There is no such thing: article 6 refers only to conservation, preventive and compensatory measures.

- Explained that the measures which the Irish court described as mitigation, and which the developer described as protective, should be understood as denoting measures that are intended to avoid or reduce the harmful effects of the envisaged project on the site concerned.
- Decided that a full and precise analysis of those measures must be carried out not at the screening stage, but specifically at the stage of the AA. Taking account of such measures at the screening stage would, in the Court's view, be liable to compromise the practical effect of the Habitats Directive.

Residual uncertainty

That is far from the end of the matter because the judgment leaves scope for argument about whether a measure is intended to avoid or reduce harmful effects on a Natura 2000 site.

We know the uncertainty is unwelcome.

Already, we have seen the English High Court apply the judgment, but conclude that the location of works and the time of year when those works are carried out must remain relevant at screening stage: *R. (Langton) v. Secretary of State* [2018] EWHC 2190 (Admin).

That makes sense, certainly for location. It is impossible to understand how the fact that “the proposed works are located a significant distance upstream” should be irrelevant to screening. A critical issue is what pathways there are that connect the development with the European site and its qualifying interests.

The time of year is a little more complex. Unless the “best scientific knowledge” is agreed about the appropriate working window, it would make sense to carry out the “full and precise analysis” of AA.

What about the selection of a method of work, construction management techniques and best practices that are selected regardless of the risk to a Natura 2000 site? There remains scope for argument that these are part of the nature and extent of a project that has not been introduced to avoid or reduce harmful effects on a Natura 2000 site.

Other recent CJEU judgments

There are two other references to the CJEU from the Irish courts that merit brief mention.

Grace & anor. v. An Bord Pleanála

A measure compensating for the negative effects of a project cannot be taken into account in a stage two AA: Case C-164/17 *Grace v. An Bord Pleanála*. In that case, the development of a wind farm would have meant that some part of a Natura 2000 site was no longer available to provide suitable foraging habitat for the protected fauna, hen harrier *Circus cyaneus*. The developer had proposed a management plan to ensure that, as regards this foraging habitat, at any given time the area is not reduced and indeed may be enhanced. That did not impress the Court of Justice, which concluded the management plan was a compensatory measure relevant only to article 6(4) of the Habitats Directive.

The judgment appears to preclude habitat and species management plans as ‘mitigation’ for impacts on designated sites within the AA. The CJEU did not agree that the management of lands to offset the loss and potential loss (displacement) was acceptable as a protective (mitigation) measure. They clearly saw this as a compensatory measure.

An example of a recent Natura Impact Statement (NIS) was in relation to the loss (as a result of the erection of farm buildings on a large dairy farm) of improved agricultural grassland within a Special Protection Area (SPA) that is used as winter feeding grounds by SPA qualifying species, which demonstrates the kind of problem caused by this judgment in relation to site management. Extensive survey and research led to the conclusion that the proposal was not likely to result in an adverse impact on the integrity of the SPA. However, complete certainty in such conclusions as required by Article 6 of the Habitats Directive are highly challenging, if not impossible. Such uncertainty could be avoided by additional measures to reduce disturbance on the area, for example, or to undertake management measures in such a way as to maximise the suitability of the area for the Qualifying Interest species through appropriate farming practices (where such measures are not already in place). A situation which would also result in better management of the area for the Qualifying Interest species. However, the ruling in *Grace* introduces doubt for

the acceptability of such measures. The wording of the ruling does not provide real clarity about its potential application in such a context, but suggests that management (which is a fundamental aspect of achieving the conservation status of such farmed areas) cannot be used to offset any uncertainties of whether loss of such areas could result in an impact on integrity of such SPAs.

Holohan v. An Bord Pleanála

Judgment is awaited on a reference where 11 questions have been asked in relation to the assessment of a road project that crosses a riverine Natura 2000 site: Case C-461/17 *Holohan v. An Bord Pleanála*. Advocate General Kokott has given her opinion, including, for example, helpful observations that AA does not have to address protected species not covered by the conservation objectives of a Natura 2000 site, it may not be necessary to name-check every qualifying interest where only certain protected habitat types and species are relevant, harm to habitats or species that are not protected might alter the conservation states of protected habitat types or species, ex-situ harm to species or habitats may affect the integrity of a Natura 2000 site. Judgment is expected before the end of the year.

Ecological practice

Most ecological practitioners have seen a marked change in the approach to AA screening following this judgement – some positive – but others negative, combined with a nervousness on the part of clients, planning authorities and some advising lawyers. Indeed, one local planning authority (LPA) in Ireland went so far as to email local ecological consultants highlighting the likely need to skip the screening stage altogether and provide a NIS for everything! This ‘one size fits all’ approach does not make scientific sense because the assessment depends upon so many variables, including: the nature of the development itself, the receiving environment, the nature of the qualifying interests and conservation objectives of the Natura 2000 site(s) which have potential to be impacted upon, either directly or indirectly; and critically what pathways are possible for potential impact in relation to these factors.

There are many situations where screening is absolutely the correct way to go.

The professional judgment of the ecological practitioner should be relied upon, assuming of course that appropriate expertise has been used (i.e. the right specialist for the job). The concern surrounding the recent CJEU judgments is that the role of the professional practitioner (ecologist) appears to have been taken over by the courts which is very worrying. Had prudent ecological advice been taken on board at the design and planning stages of developments, many of these issues would have been avoided. It is time for the profession to be heard in order for this approach to be rectified. This is where CIEEM's influence is essential.

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About the Authors



Brendan joined McCann FitzGerald in May 2018 to lead their planning and environment team. Before then, he worked with the firm representing An Bord Pleanála, the

Environmental Protection Agency and other public authorities, advising on every significant development in recent years.



Jenny is Director and Principal Consultant at EACS – Ecological Advisory and Consultancy Services and has extensive experience of, and a special interest in, the implementation of

Article 6 of the Habitats Directive and the AA process. She has been an expert witness on many occasions in oral hearings; and in legal proceedings including in relation to several judicial review proceedings in the Irish High Court in relation to Article 6.

Jenny has just completed two terms in office as CIEEM's Vice President for Ireland, and is currently Chair of CIEEM's Ireland Policy Working Group.

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Ecology in BREEAM, CEEQUAL and HQM – Updating and Expanding the Approach

Max Wade CECOL CENV FCIEEM
CIEEM President and Technical Director,
Ecology – UK & Ireland, AECOM

Yetunde Abdul
BREEAM Scheme Development Manager,
BRE Global

Alan Yates – BREEAM, CEEQUAL and HQM Technical Director, BRE – says: *“The design, construction and management of the built environment inevitably has a profound impact on biodiversity and local ecosystems. The benefits of achieving ecologically sound outcomes can be broad in terms of society and economics as well as environmentally. Ecology has formed a key part of the BREEAM family of schemes from its early days playing a major part in promoting ecological protection and enhancement. But ecological practice and regulatory systems evolve over time and I am very grateful to the many ecologists and other stakeholders who have helped us to update our requirements and processes ensuring that these are meaningful, practical and supportive.”*

The BREEAM family of assessment schemes has been driving improved sustainability in the built environment for the last 28 years. Developed by BRE, BREEAM is the world’s most widely used environmental assessment method for master-planning, design, construction, operation and refurbishment in the buildings and infrastructure sectors.

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Ecology has been one of BREEAM’s key assessment categories since 1993, encouraging project teams to identify and protect ecologically valuable features, enhance habitats and mitigate unavoidable impacts – and to improve the long-term biodiversity management practices of assessed sites and associated areas.

Time for a change

BREEAM’s approach to ecology assessment had not significantly changed since 1998. Feedback from clients, ecologists and BREEAM assessors has increasingly flagged up the limitations of BREEAM’s previous approach to ecology – and the need to bring this in line with current best practice and address changes in related policy issues.

Alan Yates says: *“Stakeholder engagement and feedback from users over the years had indicated the need for a change. Working closely with relevant stakeholders has been an integral part of the BREEAM family’s development and growth as it approaches the end of its third decade.”*

The BREEAM team at BRE has worked closely with a wide range of stakeholders to review its approach to ecology. These included the UK Green Building Council, professional bodies such as CIEEM and the Landscape Institute, together with a range of consultants, developers, designers, constructors, landscape contractors, managers and policy-makers.

Max Wade – CIEEM’s technical representative on BREEAM’s Ecology Advisory Group – observes that *“in the 25*

years since ecology became part of the BREEAM process we have learnt a great deal and gained invaluable experience on which to base our recommendations” and that *“the fresh approach now being taken by BREEAM is a chance to apply and build on all that knowledge, and to broaden the impact of ecology in BREEAM working with other specialists”*.

A fresh approach

Consultation and engagement are key to development of the ecology section. BRE, therefore, set up advisory groups covering strategic approach, technical aspects and practical application. These included a range of ecologists, landscape architects, contractors, facilities managers, contractors and policy specialists. Members of these groups have been invaluable in feeding into the development of BREEAM’s overarching Strategic Ecology Framework (SEF) published in 2016. This sets out the strategy for assessing ecology in the BREEAM family of schemes. The SEF is now in the process of being implemented into the certification schemes.

Information about the SEF is available at: www.breeam.com/discover/resources/strategy/

As a result, the methodologies and criteria used across the UK schemes are being updated to align with what ecologists currently do and the future direction of policy and practice. Some of the ‘fresh’ additions moving forward are highlighted below.

Method for calculating the change in ecological value

Following a review of BREEAM’s plant species-based methodology for calculating

ecological value, recent advances in understanding, measurement, calculation and data quality and after input/advice from a range of sources including ecologists, BREEAM has adopted a new methodology aligned closely to the 'Defra metric'. This builds on the work of Defra and Natural England, focusing on the calculation of Biodiversity Units. This approach supports current and up and coming Government policy on environmental protection and enhancing biodiversity.

Alan Yates says: "BREEAM has always tried to avoid duplication of systems or process. With the 'Defra metric' being increasingly adopted by public and private sector bodies, BREEAM's alignment with this method makes perfect sense."

Promoting collaboration and information sharing to support a successful outcome

A key point of feedback from BREEAM's Strategic Ecology Framework Advisory Group (set up to advise on the implementation of SEF into BREEAM, CEEQUAL and HQM) was the importance of collaborative working throughout the lifecycle to realise ecological benefits. An example of this was the relationship between landscape architects and ecologists.

The Advisory Group recognised the crucial role many non-ecologist stakeholders, including landscape architects, play in achieving beneficial outcomes that support both ecology, well-being and value.

Max says: "Most of the projects we work on involve landscaping of some sort. This can range from the large-scale planting of trees, shrubs, ornamental beds and grassed areas, to green roofs and small, inner city features – but almost all represent potential ecology gain."

Maintaining rigour while encouraging application of BREEAM

To take full advantage of this ecologists need to talk to the landscape architects – who are key to visualising a project's outcome and the expectations of the client – from day one. It is important that ecologists understand their landscaping plans and they understand the ecologist's role, so that the project's landscaping and habitat management can be successfully

combined. The ecologist's contribution is in assessing ecological value and potential, identifying what should be conserved and improved. To this the landscape architect brings their practical implementation skills – working together is a plus all round!

Alternative ecology routes – an issue raised in feedback from BREEAM users – concerned the need for input from a professional ecologist on every project. With some projects, perhaps small urban developments or refurbishments for example, the ecology-related risks and opportunities issues may be very limited. To address this, a new route to ecology assessment – Route 1 – has been introduced for those projects in which professional expertise is not required. Route 2, for all other projects, will continue to need professional input and remains an option in all cases.

In Route 1 assessments, a designated team member with ecological knowledge will be responsible for ecology issues, supported by detailed BREEAM guidance developed for this purpose, and input from local experts.

Guidance Notes 34 and 36 (www.breeam.com/discover/resources/technical/) provide more information about these routes.

Ecology and its wider sustainability benefits

Recognising the wider benefits of ecology in the built environment was a key issue for the advisory groups. In line with BREEAM's overarching holistic focus, going forward schemes will include criteria which encourage alignment and integration with wider sustainability activities in the project or existing development.

Ecology benefits can relate to areas including heritage and local character, noise mitigation, air quality measures, flood risk management, climate change mitigation, green infrastructure, and community and end user involvement.

It is this ability to create a link between ecological solutions and wider benefits that has the potential to maximise the value of BREEAM's ecology criteria moving forward.

David West, Associate Ecologist at WYG, joined BREEAM's Strategic Ecology Framework Advisory Group to help improve the assessment methodology. He says: "I think the changes made to

the schemes bring more consistency to the assessment process and will make it easier to highlight where high-performing BREEAM projects have gone 'above and beyond'. I also hope that it will promote greater collaboration between disciplines, communication and early engagement to improve the likelihood of successful ecological outcomes."

Max says: "Having been largely nature conservation and biodiversity driven in the past, BREEAM is now better able to make use of ecologically sensitive solutions to enhance many other aspects of a project site. This also brings opportunities for ecologists and landscape professionals to work with other specialists such as – drainage engineers, air quality and human health and well-being experts."

To date the new approach has been incorporated within the BREEAM UK Non-Domestic New Construction 2018 and Home Quality Mark (HQM ONE) schemes launched over the course of 2018. A range of resources are available on the BREEAM website (www.breeam.com/engage/research-and-development/) to support ecologists in carrying out assessments under these schemes.

Alan Yates says: "We will be moving on to consider how to incorporate some of this thinking into our other schemes including the international ones."

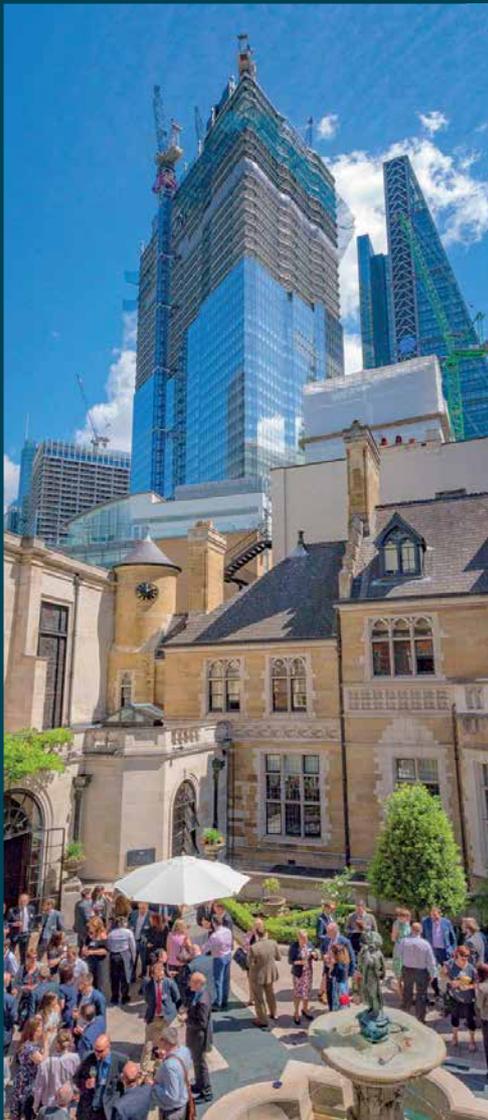
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Natural England Updates

Earned Recognition – A New Licensing System for Bats

Stephen Rudd
Natural England

Keywords: accreditation, bat licensing, competence framework, quality assurance, standards

Summary

Earned Recognition is a new approach to bat licensing based on the principle of accrediting professional bat ecologists. It is based on their skills and experience. Once accredited, users will benefit from a more streamlined licensing service and have greater authority to take pragmatic decisions in the interests of bats and development. This article provides an update on the earned recognition project and an insight into expectations for 2019. Earned recognition is part of a programme of reforms to Natural England's wildlife licensing service. Other changes include the new policies introduced in 2016, Strategic Licensing for Great Crested Newts, class licences, and improvements to the processing systems. All aim to make the licensing system more streamlined and better for wildlife.

Resourcing challenges

Natural England receives a growing numbers of bat licence applications every year. Under the present system, all licence applications require a series of up-front checks before a licence can be issued. Efficiency measures are put in place where practicable to improve service standards and manage resources. However, the potential for further efficiencies will always be limited if the assessment of licence applications against the legal tests is reliant solely upon detail presented in the licence application.

Experimenting with earned recognition

The concept of using earned recognition to speed up the licensing service while maintaining standards is not new. It was first applied to bat licensing through the Bat Low Impact Class Licence (BLICL) in 2015. BLICL has received good feedback from users but its accreditation method has been criticised as more focussed



Big-eared free-tailed bat *Otomops martiensseni*

on quantity of work than quality. Consequently some highly competent consultants have not been able to register to use this class licence. A suite of improvements to the low impact approach is now being implemented, which it is hoped will address outstanding issues and enable more professional ecologists to become registered.

A comprehensive new approach to earned recognition

A next step is being developed in partnership by Natural England, CIEEM and

the Bat Conservation Trust (BCT). Building on the success of BLICL, it introduces a complete accreditation system, extending the principle of 'streamlined process in return for accreditation', across the full range of impacts and purposes for bat mitigation and commercial survey licenses. The new system will be based on a competency framework created specifically for professional bat work, with similarities to the framework used for CIEEM membership but combining elements of BCT's Professional Training Standards.

Gaining accreditation will involve demonstrating the described competencies, at the appropriate level. In practice, the assessment process is likely to involve a range of methods, including online testing, log books and even professional competence interviews for the higher levels. Expert assessors will be recruited to ensure the assessment process is rigorous and fair and they in turn will be held to account and quality assured by a dedicated quality assurance panel.

This new system could eventually become the primary licensing route for bats, and would be designed to drive up standards and accountability. When fully established it would be expected to remove the need for manual assessment of the majority of licence applications. Instead they could potentially be granted on demand, through a self-service online system. Assessment by Natural England staff would then be reserved for the highest impact cases

only, freeing up resource to focus on post licence compliance.

This project was first presented to CIEEM members at the 2017 CIEEM Autumn Conference and an online consultation launched the same day gathered feedback from professional ecologists. It attracted 188 respondents, 71% of whom were 'very positive' or 'positive' about the proposal.

Project update

Written feedback gathered through the consultation was used in project development this year. A set of case-level risk categories has been drafted and a competency framework is currently being developed from the CIEEM Competency Framework and the BCT Professional Training Standards. A quality assurance and disciplinary process will be designed over the next few months, and the decision-making 'front end' and online platform will be scoped out by spring 2019. Subject

to the business case for establishing this new system, a pilot will be put in place to ensure the new system is properly tested in practice, and to enable a clear transition to be designed for all licencing stakeholders.

Communication is key

The partners are keen to ensure ongoing communication is maintained with CIEEM members and the wider ecology profession throughout the project. It is intended that a full public consultation will be carried out to gather feedback before any final decisions are made about implementation.

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Charges for Wildlife Licences

Keywords: bats, great crested newts, licence charges, licence reforms, protected species

Summary

To support a whole programme of improvements to the wildlife licensing service, Natural England will be introducing charges for some wildlife licences from April 2019, starting with mitigation licences.

Why introduce charges for wildlife licences?

The aim of introducing charges is to reduce delays by enabling investment in the licensing service in line with changes in demand. It will also change the service from one that is solely funded by the taxpayer, to being one where users pay – this is in line with Treasury guidance and with how other public bodies are funded. The investment in the service should also help secure better outcomes for protected species, for example as a result of more compliance checks.

Natural England consulted in the winter of 2017-2018 on the proposal to charge for wildlife licences. In response to concerns

raised by ecologists and others, we have made several changes. We have reduced the charge for survey licences, to reflect projected savings through moving to more use of the online system. Natural England has also committed to improving the service performance for mitigation licences; this will be achieved alongside the implementation of charges.

Natural England has retained and clarified the exemptions laid out in the consultation. There is no proposal to charge where the aim is the prevention of serious damage to property (such as crops or fisheries), the prevention of spread of disease, householder development projects, or conservation project delivery or conservation science. Licences that are primarily used for a voluntary purpose are not subject to charges.

When will the charges start?

We will implement charges for mitigation licences in a phased manner from 1 April 2019.

In order to be able to reduce the cost of survey licences, the online system for taking survey licence returns needs to be fully established. This will not be until winter 2019 at the earliest, so survey licences will remain free of charge until then.

Changes to improve the wildlife licensing system

The introduction of charges is one part of a package of reforms to the wildlife licence service that together will result in a better customer service and improvements for wildlife.

We are overhauling our processes so as to ensure that we can issue licences faster. We have already implemented some changes. These include identifying applications that we can process quickly because the risk to the species' favourable conservation status is low. To limit the impact of high caseloads in certain areas, we are now moving casework to staff in different teams around the country. We are planning a whole host of further improvements to speed up



Great crested newt



Badger



Dormouse

licence processing time. For example, for bats, we are:

- improving the application forms to ensure we get all the information we need to see how complex the licence is and how much it will cost if charges are appropriate;
- changing the Method Statement so it is much more specific in asking consultants to set out how their proposals match the needs of the species' and their suitability for a licence; and
- altering the Licence Annex so it covers more of the situations that arise regularly, making it quicker to produce and easier to use.

Other reforms include simplified class licences, earned recognition (discussed

elsewhere in this edition of *In Practice*) and Great Crested Newt District Level Licensing. District Level Licensing will increase great crested newt (GCN) populations on a landscape-scale and reduce delays for developers. A similar approach was trialled in Woking and an adapted version is being rolled out in Kent, Cheshire, and elsewhere across the country. The District Level Licensing approach starts by gathering data and then developing a licensing strategy for GCN at a landscape scale. New habitat for newts is built in advance of any development commencing, and is designed strategically to ensure the end result is 'more, bigger, better, joined-up' habitat. Due to this advance planning, developers are given much more assurance over project timelines. There are a variety of different ways that consultant ecologists can get involved with District Level Licensing, including conducting surveys, eDNA analysis, and providing data and expertise. Consultancies can also hold the licence. With this increase in suitable, connected habitat, and greater certainty for developers, District Level Licensing will be better for wildlife, business and people.

For more information on wildlife licences, please see www.gov.uk/guidance/wildlife-licences

Natural England seeks advisers for a Great Crested Newt Licensing Expert Panel

Natural England is seeking scientific and specialist advice from a range of experts with an interest in great crested newt (GCN) conservation, from ecologists and species specialists to leading thinkers in more broadly related areas such as population dynamics, dispersal and spatial distribution modelling.

Natural England is bringing together this new 'GCN Licensing Expert Panel'

to provide support and challenge, and to help to continuously improve their innovative licensing approaches for GCN.

The panel will provide specific ideas, advice and recommendations for the District Level Licensing programme, helping to develop GCN conservation partnerships, and informing, refining and reviewing Natural England's monitoring strategies to ensure that new licensing policies

deliver better conservation outcomes for GCN alongside improved outcomes for developers, householders, ecologists and other stakeholders.

If you would like to know more about the role, and feel that you may have the skills, expertise and experience to get involved, then please email james.taylor@naturalengland.org.uk to receive further information and details of how to apply.

Accredited Ecological Clerk of Works – An Update

The Accredited Ecological Clerk of Works (Accredited ECoW) project is an initiative to raise the profile of this important role during the construction phase of development projects and to raise standards of delivery. The project is essentially the development of a training and accreditation scheme for Ecological Clerks of Works (ECoWs) that makes use of the CIEEM Competency Framework and the National Occupational Standards approach used by the construction industry.

Clients, contractors and experienced ECoWs have been working collaboratively to agree the required competencies and set standards. The project has been split into two phases: Phase One covers development of the concept, and Phase Two covers implementation.

The project currently has an Advisory Group and a Steering Group. The Advisory Group includes representatives from the Civil Engineering Contractors Association (CECA), Construction Industry Training Board (CITB) and Association of Environmental and Ecological Clerks of Works (AEECoW) as well as consultants, developers and contractors. The Steering Group includes funders such as High Speed 2 (HS2) and the Scottish Environment Protection Agency (SEPA) as well as CECA, CITB and consultant representatives.

Progress to date

Phase One was completed towards the end of last year with the identification of two distinct ECoW roles (depending on level of responsibility) and outline competency profiles for each, using



CIEEM's Competency Framework to inform role specifications. We have also looked at how the accreditation could work as a qualification standard. In parallel, CITB funded CECA to commission some stakeholder research into the need for accreditation.

The stakeholder research report showed clear evidence of a demand for ECoWs with 75% of relevant respondents expecting their demand to stay the same or increase in the future. The majority of existing ECoWs who responded to the survey stated that the ECoW role is part of their broader job role, typically for seven days per month.

Clients and contractors reported that the following skills were most needed from ECoWs:

- experience of construction methods;
- a good understanding of how construction and civil engineering projects are undertaken;
- the ability to anticipate challenges in construction where biodiversity protection is an issue;
- preparing and/or inputting into designs in collaboration with other professionals; and
- good communication skills.

In general, ECoW respondents' perception of their skills in the areas of communication, taking pragmatic decisions, being innovative and creative, and being a collaborative team player was higher than perceived by clients/contractors. Most ECoWs acknowledged that their lack of awareness of construction could be an issue and expressed a desire to be better consulted and involved by contractors.

There was an acceptance by the majority of all respondents that ECoWs need a higher profile/status on construction sites and that they could be more proactive in identifying/anticipating problems and proposing solutions.

Next steps

We will shortly be embarking on Phase Two of the project – the development of the standards, assessment plans and training support. We are also looking at how assessment of ECoW competence can relate to demonstrating competence for membership/chartership upgrades for our members. We have now created a project page on our new website and will keep it updated with progress.

Plant Identification Skills

Over the summer we asked our members about their level of confidence in their plant identification skills. Almost 900 of you responded, providing some very useful food for thought for the Training, Education and Careers Development Committee (TECDC).

The survey arose because TECDC was becoming concerned about an anecdotal lack of interest in developing increasing competence in plant identification – a skill that is fundamental to vegetation survey and habitat condition assessment. With the support of the Association of Local Government Ecologists (ALGE), local authority ecologists were also asked for their views on their confidence in the plant identification that they see in reports and documents that come their way from other ecologists and environmental managers.

From the members survey it was clear that the majority of respondents (75%) use their plant identification skills for Phase One or equivalent habitat survey, with a much smaller proportion (40%) undertaking NVC or detailed Phase Two assessments. Approximately 50% of respondents use them for specific plant species survey (including submission of records), populations assessments, habitat condition assessments and habitat management planning (including for agri-environment schemes).

The majority of respondents described their competence in vascular plant identification as intermediate (see Figure 1) which broadly aligns to Level 4 on the Botanical Society of Britain & Ireland (BSBI) Field Identification Skills Certificate (FISC) pyramid (see http://bsbi.org/wp-content/uploads/dlm_uploads/Botanical_Skills_Pyramid.pdf). Of the 27% of respondents who rated their skills as Basic, almost half were Graduate or Qualifying members. Confidence was less strong when considering lower plants however (see Figure 2), with 65% of



respondents citing only Basic competence and an additional 20% not able to identify any lower plant taxa.

Does this matter? The survey of ALGE members revealed that respondents were confident that the majority of ecological reports they saw had identified habitats correctly in less than 40% of cases, noting that whilst confidence is high for more commonly found/lower value habitats, for less common habitats the picture is more worrying. Just over 40% of ALGE respondents reported confidence that the majority of higher plants are identified correctly but this drops to less than 5% for lower plants. This is against a background of 95% of the same respondents feeling that plant identification skills are 'very important' or 'quite important' to sound decision-making during the planning process.

Figure 3 shows the sources of plant identification skills for respondents. Understandably most respondents cited several sources of learning. Self-study, whether 'on the job' or not, was by far the most common source, followed by learning from colleagues/peers and from formal courses.

TECDC was very interested in the level of confidence respondents feel regarding their plant identification skills in relation to the requirements of their role. As Figure 4 shows, the majority of respondents (80%) were 'reasonably confident' to 'very confident' that they had the necessary level of competence for their role requirements although many of the associated comments caveated this with 'it does depend on the habitat'.

Disappointingly, 40% of employed respondents said that their employer would

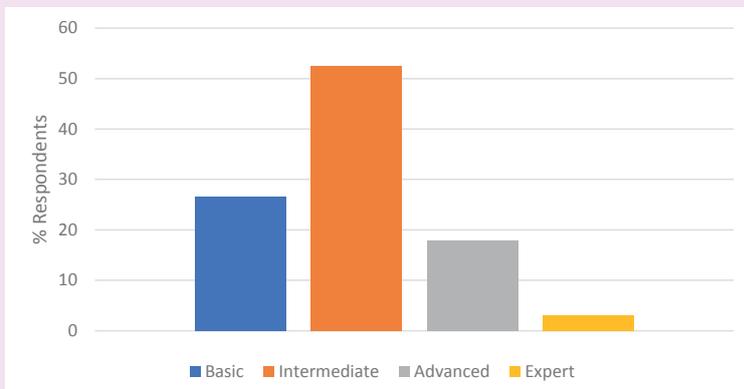


Figure 1. Vascular Plant Identification Skills

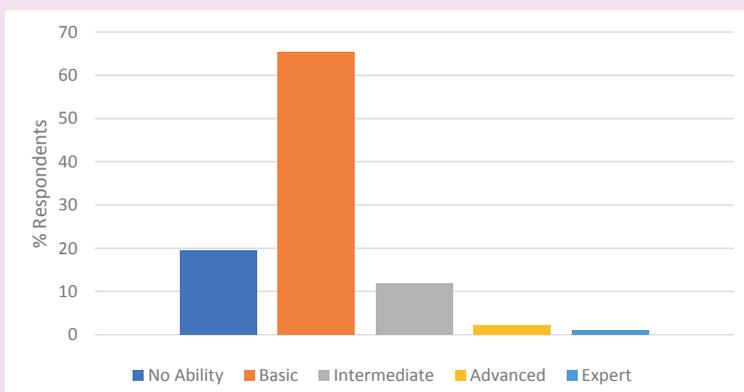


Figure 2. Lower Plant Identification Skills

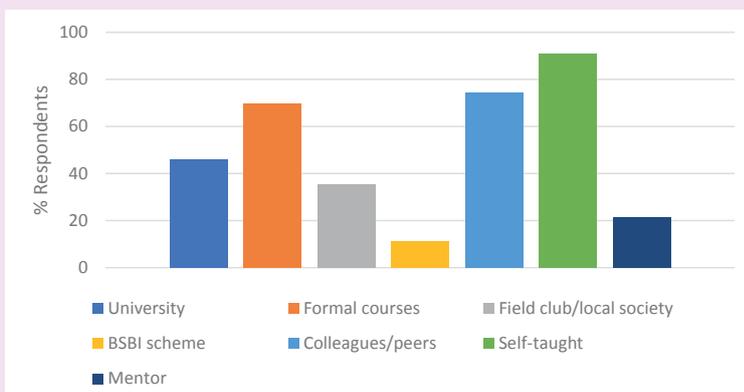


Figure 3. Sources of Plant Identification Skills



Figure 4. Confidence Relative to Role

not be encouraging or supporting them to improve their plant identification skills. Almost 75% of self-employed respondents had invested in improving their skills in recent years.

On a positive note, almost 90% of respondents said that they intend to improve their plant identification skills over the next two years with short training courses, self-study and learning from colleagues/peers being the most popular likely avenues.

What happens next?

TECDC is reviewing the information provided and will consider the implications for CIEEM's professional development programme. We are also talking to other plant identification training providers to see how we can collaborate in encouraging and supporting our members in this vital skill area including, for example, whether we can make more of the FISC plant identification skills pyramid as an indicator of competence.

New Scheme for Registered Practices

Early in 2019 we will be introducing a new scheme of Registered Practices. The idea arose out of market testing a potential new corporate supporter initiative which has been under discussion for a couple of years. Several consultees wanted a scheme that their organisation could belong to which recognised good practice standards. Consequently, the Governing Board has been overseeing the development of Registered Practices in recent months.

Why register your organisation?

CIEEM's Registered Practices will be champions of high professional standards and the delivery of the best outcomes for biodiversity whilst supporting a thriving economy. They will be ambassadors for our profession, helping to raise its profile and communicating its valuable contribution to society. They actively seek to share their knowledge and expertise and support others, both individuals and organisations, to do their bit for our natural world.

By registering your organisation, you are telling your stakeholders, clients and prospective clients that this is what you are committed to doing, giving confidence in your collective competence and ways of working. It is a benchmark of quality, which will be evidenced by your right to use a new CIEEM Registered Practices logo and to be promoted by CIEEM as a Registered Practice.



Will your organisation be eligible?

The scheme has been designed to be achievable for every organisation, from sole traders to large multidisciplinary organisations and companies. Registered Practices will need to meet the following criteria:

- Your company is committed to actively supporting CIEEM's Objects.
- At least 90% of your staff and associates undertaking relevant professional work for the company are professional grade members or member applicants of CIEEM at the appropriate grade.
- Your Practice includes at least one Full member of CIEEM (and for companies with at least 11 staff/associates, at least one Chartered Ecologist or Chartered Environmentalist member).
- Your Practice demonstrates a culture of promoting good practice in respect of use of technical guidance and other relevant professional guidance.

- Your Practice is committed to following good practice in employment practices (if relevant), equality, diversity and inclusion, and health and safety.
- Your Practice has a published Complaints Policy for clients or customers (or has agreed to use the CIEEM model Complaints Policy).

Registration fees will vary from £100 to £5,000 depending on the number of employees. The Scheme will not be complicated to join but you must make sure you can meet the eligibility criteria.

Registered Practices will have to conform with a *Code of Practice* (in addition to the individual members obligation to abide by the *Code of Professional Conduct*) and being in breach of the *Code of Practice* could mean removal from the Register.

When will the scheme be launched?

The Registered Practices Scheme will be launched early in 2019. Full details will be available on our website and we will alert members through our usual communications.

Membership Update

Stuart Parks

Membership Manager, CIEEM

2018 has been a very busy year of change for the Membership team at CIEEM. We have managed to achieve a lot in the last 12 months (in fact we are not always sure where the time has gone!) so we thought you might be interested to learn more about what we have been doing, as well as what we have got planned for 2019.

I am writing this on a sunny October day in the second week of the 2018-19 subscription year and the rest of the team is busily talking to lots of you about your subscription, changes in personal circumstances and ambitions to upgrade your membership. Paying your subscription fee promptly, and ideally online, makes a huge difference to the work of the Membership team at this time of year so a big thank you to you for doing so. We have spent much of the year getting to grips with our new CRM system and it has already changed many of the ways we have been working. For instance, the fact that we can generate your renewal information, add it to your secure online space and email you to let you know it is ready is a world away from the printing, envelope stuffing and posting of just four years ago. I am also pleased to say that we have achieved our ambition to become paperless when it comes to dealing with membership applications.

This investment in technology has also presented some challenges in that the team has been forced to not only build and get to grips with new ways of delivering the administrative processes they carry out daily, but also to review each of the processes themselves in order to make sure that potential efficiencies were realised. I am really happy to confirm that your Membership team – Sarah 'Saz' Hayward (Assistant Membership Officer), Michael

Hornby (Registration Officer) and Katie Allen (Membership Administrator), all expertly guided by Sarah Cox (Membership Officer) – embraced this wholesale revision of the way they work with confidence and emerged largely unscathed on the other side!

A positive outcome from this revision of our day-to-day processes is that we are now able to devote more time to developing the membership offer and our relationships with members and applicants. We have had the capacity to respond much more quickly to suggestions from some of you and this has led to changes to, for example, the abeyance process and eligibility criteria for members wishing to either retire or return to study. In addition, the team has been working in lots of new areas, including:

- developing a suite of more regular communications for members in their first year of membership to help them make better use of the benefits available to them;
- producing new application forms and guidance documents for both membership and upgrade applications;
- writing some *In Practice* articles dispelling common misconceptions about our processes and encouraging you to act as sponsors or mentors for potential new members;
- contributions to a more accessible version of the Competency Framework and a forthcoming online self-assessment tool;
- preparing a series of short webinars about making best use of the Competency Framework and how it supports membership and upgrade applications;
- drafting a whole new set of webpages about membership in preparation for the launch of CIEEM's new website; and
- building links with key contacts in sectors currently under-represented in our membership in order to better understand their needs.

The team's day-to-day activity of processing new applications for membership of course remains and the news there is also positive. Throughout 2018 we have received and processed more applications per month, every month, than in each of the last four years and, on average, 85% of those applying for competence-assessed membership grades have been successful. This welcome increase in assessment workload does come with its own issue in that at the heart of this assessment process lies volunteer members. With the support of the Membership Admissions Committee, we have taken steps to double the number of volunteer assessors with the twin aims of reducing pressure on the current system and speeding up the entire process. Hopefully those of you considering upgrading your membership in the coming months will be able to benefit from this additional investment in this key area.

Growth in the number of members attaining Chartered status continues at a steady pace. Those of you with Chartered Ecologist and/or Chartered Environmentalist status now make up 18% of the total membership (and you are now 32% of those eligible to apply at present). This is all good news, but there is still plenty of room for growth in this area. Michael Hornby, Registration Officer, has been working with colleagues and Member Network volunteers to arrange Chartership workshops and has recently held two successful ones. We are also trialling some drop-in 'surgeries' at CIEEM conferences so that those of you that are interested in finding out more about gaining Chartered status can come and chat in person. In addition, we have recently agreed a more structured process for matching applicants with mentors to assist with the application process. In the coming year Michael and I will also be working with the Registration Authority to agree and implement some further changes to the application and assessment processes for both Charterships

in order to make them more accessible and straightforward to undertake.

Finally, how can you help?

- i. Focus on you: take some time to consider your own development needs for 2019 – are you at the grade of membership that best reflects your skills and experience? Have a look at the Competency Framework and see if it might be appropriate for you to upgrade your membership. Now could be just the right time to start that process (and it really helps us if you do it at this time of year too!).
- ii. Spread the word: we know that the vast majority of you (in fact well over 90%) renew your subscription once you have gained membership, so we must be getting something right. Do you

work alongside someone who could also be a member? Do you manage team members whose development might benefit from additional support from CIEEM? Does one of your peers just need some gentle encouragement to get on with their application? We have made huge progress in making the application process as simple as possible and most people that apply succeed. Please do encourage people in your networks to make 2019 the year they join CIEEM.

- iii. Consider volunteering: if you are a Full or Fellow member and may be able to spare 3-4 hours per month to assess membership applications we would love to add you to our list of potential assessors.

- iv. Don't be a stranger: I am always particularly interested to receive ideas, comments and feedback about CIEEM's membership offer, our processes and ways in which we might improve what we do for you, most especially if you work in a sector that is currently under-represented within CIEEM, so please do drop me a line.

Many thanks for your continued support of CIEEM's work.

Contact Stuart at:
stuartparks@cieem.net



SPREAD YOUR WINGS

Every other day, a CIEEM member makes the leap and upgrades... Will today be the day you let your career soar?

Enjoy greater professional recognition.
Upgrade your membership and get the relevant post-nominals.
Access a broader range of benefits.
Help shape our future.

membership@cieem.net

Policy Activities Updates

Amber Connett

Policy and Communications Intern, CIEEM



CIEEM CEO Sally Hayns and Rebecca Pow MP

CIEEM has continued its active engagement in Westminster with a roundtable dinner hosted by Rebecca Pow MP, held on 16 October 2018. The purpose of the dinner was to discuss Biodiversity/ Environmental Net Gain.

CIEEM co-published (with CIRIA and IEMA) the first *UK Principles on Delivering Biodiversity Net Gain*¹ in 2016 and is currently producing the first industry guidance on how to deliver biodiversity net gain through development. Discussion at the roundtable event ranged from how net gain can be measured to the impact on development. The event was attended by: Rebecca Pow MP, Neil Parish MP, Alex Sobel MP, Dr Alan Whitehead MP, Jackie Clayton (Deputy Head of Land Use,

Natural Environment Directorate, Defra), Sam Richards (Director, Conservative Environment Network), Nigel Frankland (Strategic Estates Manager, University of Reading), Sally Hayns (CIEEM CEO) and Jason Reeves (CIEEM Policy and Communications Manager).

Continuing our work on biodiversity net gain, we have invited Secretary of State for the Environment Michael Gove and Parliamentary Under-Secretary Thérèse Coffey to attend sites, kindly suggested by our Policy Investors, which demonstrate the application of biodiversity net gain in development projects. The sites showcase the improvement in biodiversity following successful mitigation and restoration efforts. At the time of writing we have received responses from the offices of both Ministers expressing their interest in attending. We are now awaiting confirmation of dates.

Our CEO Sally Hayns and England Vice President Lisa Kerslake recently attended a meeting with Michael Gove, along with representatives from RSPB, ALGE and Bat Conservation Trust, to discuss environment-related proposals as part of the Red Tape Initiative. Sally has also attended a Defra workshop on biodiversity net gain this summer and was subsequently asked to meet with Defra officials to discuss specific areas of the future environmental net gain consultation.

We also continued our six-monthly liaison meetings with Natural England in November. These meetings serve as high-level strategic discussions.

Following the introduction of the new Agriculture Bill into Parliament, we produced a briefing for MPs. The briefing outlines that CIEEM supports the new Bill but calls for a shorter transition period, inclusion of biodiversity net gain approach

into future agri-environment funding and regulation and enforcement of good soil health, air and water quality and animal welfare. The Bill Committee has now been formed and we will be engaging with the MPs selected.

We have recently responded to consultations in the devolved nations, including the 'Developing an Environmental Strategy for Scotland' discussion paper released by Scottish Government, the Welsh Government consultation on land management titled 'Brexit and Our Land' and our Irish Policy Group has produced a response to the DAERA consultation on a 'Future Agricultural Policy Framework' for Northern Ireland². At the time of writing, we are waiting on the release of a Defra consultation on environmental net gain.

Our four Country Policy Groups have all had meetings this Autumn, during which they continued their work on horizon-scanning and began work on country-specific projects which we hope to publish later this year or early in 2019. The Strategic Policy Panel also met in September and discussed a variety of issues including: increasing CIEEM's engagement in Europe and the devolved nations, continued engagement with Westminster,

and current policy issues such as the Agriculture and Environment Bills.

The results of our survey: '*The Commercial Impacts of Brexit on the Ecology and Environmental Management Sector*', have been collated and a report is available on our website (<https://www.cieem.net/commercial-impacts-of-brexit-on-the-ecology-and-environmental-management-sector->). This report outlines the results of a survey which looked at how the Brexit vote has affected ecologists and environmental managers commercially. Measures that are being considered or have been put in place to mitigate any negative commercial impacts are also discussed. We hope to use the results of this survey in our discussions with relevant decision-makers, to highlight the effects that Brexit has had on the sector, and potential future implications.

In addition to our own policy work, we have continued our joint policy work. We recently signed up to the Institute of Fisheries Management (IFM) response to Defra's consultation, 'Sustainable fisheries for future generations', as part of the Environmental Policy Forum. In October we attended an Environmental Policy Forum meeting, where we discussed the future Environment Bill and environmental

Notes

1. https://www.cieem.net/data/files/Publications/Biodiversity_Net_Gain_Principles.pdf
2. <https://www.cieem.net/past-consultation-responses>

net gain. We also attended a Greener UK meeting in November.

CIEEM will continue its policy work in 2019 through responding to consultations such as the upcoming environmental net gain consultation. We will be looking into how we can replicate our Westminster parliamentary engagement activities in the devolved administrations and we are hoping to develop a new Parliamentary group in Westminster for nature engagement.

Contact Amber at:
AmberConnett@cieem.net

CIEEM is grateful to the following organisations for investing in our policy engagement activities:



Student Hub: Offseason Occupations:

From Armchair Ecologists to Whistle Punks (and everything in between)

With Christmas only a few weeks away, you're probably either cramming for exams, stuck in dissertation purgatory, or maybe, if you're one of the lucky ones (we're looking at you, first years!), simply looking forward to a few weeks of mince pies, eggnog noggling and not having to do your own laundry.

And yes, we know that pimping your CV is probably the last thing on your mind right now, but the winter months are the perfect opportunity to get involved in some volunteering. You'll up your experience, gain brownie points with local organisations/companies (who could be the golden ticket to your dream job in the future), as well as making your CV stand out from the crowd.

"43% of employers think that employees who undertake voluntary work and learn new skills have a better chance of promotion and earning a higher salary."
TimeBank Employer Attitude Survey

But don't just take our word for it...

Employer case study, Arup:

"When reviewing CVs for graduates or early career entrants we look for evidence that the candidate is actively pursuing additional training and CPD opportunities beyond those obtained from academic study. We look for signs the candidate has a genuine interest in ecology and an enthusiasm for knowledge. The first job is often the hardest to land (we've all been there!), so signs you are committed to CPD and ecological learning will make your CV stand out from the rest."

"Over two thirds of volunteers aged between 16-24 see volunteering as a way of enhancing their career prospects."
TimeBank Employer Attitude Survey

But where to begin...

- Getting involved in surveys and citizen science projects (e.g. www.ceh.ac.uk/citizen-science-apps) is a great place to start.
- Simply attending events, such as those hosted by your local Wildlife Trust or CIEEM Member Network, are a great way to show you're engaged and interested. Plus, many of them are free, and some come with biscuits!
- Sign up to a CIEEM event. We run everything from full-blown intensive courses to webinars, (some free, some not) all over the country and even offer free student places at our conferences. See <http://events.cieem.net/Events/Event-Listing.aspx>.
- Develop your ecological skills by volunteering at a local bird club, nature reserve, bat group or botanical society. Although the winter months are quieter, they're often still after help with things like scrub clearing, tree felling and coppicing.
- Join your local CIEEM Member network. They run events, talks, field trips, seminars, workshops and social events and are a great opportunity to network. Sometimes it really is who you know... And if you're studying in one place but living in another during the holidays, you can still go along since there's no commitment.

- And if you'd rather do something from the comfort of your sofa, there are loads of opportunities to be an armchair ecologist: Offer to write a piece for a community magazine or newsletter, or have a scroll through www.environmentjob.co.uk/volunteering to see if there's any research or admin that you could turn your hand to (possibly while still in your PJs).

"When recruiting, 80% of employers value volunteering on a CV."

Keeping track

Don't forget to keep a record of everything you've been involved in. It's amazing how many little details you forget while juggling university, volunteering and attempting to have a life. We can help with that. Our online CPD Tool (in the Members' Area of our website) helps you record any professional development whilst building on what you learn at university. So, if you've read some relevant literature, taken part in a webinar, or been to an event (no matter how small), jot it down and smugly pull it out when you're inevitably quizzed about your extra curriculars by a potential employer!

British Ecological Society



A-Level Summer School

Karen Devine

Head of External Affairs, BES

Building on our undergraduate summer schools, in 2018 the British Ecological Society with the support of CIEEM took 30 A-level students and five biology teachers to Margam Park in South Wales.

Our students were mostly from low income families. Most were the first generation in their families to consider higher education and most were of black, Asian or other minority ethnicities.



Photo credit Andrew Barratt

Saniya joined us from Newham Collegiate in London and summarises how the BES summer school changed her thinking: *“Doing this week has definitely shown me that I want to go into conservation, do more ecology and do fieldwork. I’ve got more to talk to my parents about. They’re very iffy on biology, there’s nothing to do with it and it’s a waste of time but now I feel like I can confidently go up to them and say this is what I want to do and why I want to do it and there’s loads of opportunities for me...”*

Kayla from Kings Warrington added: *“For someone who has always been in love with ecology, the BES summer school was an amazing experience. Upon arrival I was overwhelmed by the brilliant people around me. I had the chance not only to meet like-minded young people, but to be inspired by adults who had started out just like we did.”*

The days were brimming with activities. I was surprised at how many different careers ecology had to offer. We had lectures on a plethora of different topics, from marine ecology and animal behaviour to conservation and microbiomics. My favourite activities always took place after it went dark – groups of us learned how to track animals using UV lights and some neon powder. It is overwhelmingly unanimous that the bat detecting – led by Diana Clark, Laura Palmer and Anna Sutcliffe – was the best session of all. Our final night of the trip was spent wandering around a castle with our flashlights on the search for bats, and later watching them swoop down over the lake one after another.”

A huge thanks to CIEEM and Diana Clark, CIEEM Project Officer (Wales), for leading and organising a whole host of volunteers who were: Alex Ellis (Arcadis), Sean Hathaway (Swansea Council), Nia Howells (Cardiff Museum), Kailey O’Brien (Arcadis), Laura Palmer (Neath Port Talbot Council), Julie Player (Arcadis), Ellen Quinton (Arcadis), Sarah Simons (Arcadis) and Anna Sutcliffe (Biodiversity Solutions).



Member Network News

CIEEM has regional Geographic Sections across England and national Sections in Wales, Ireland and Scotland. Special Interest Groups (SIGs) provide a focus for activity in particular topic areas of ecology and environmental management.

Each is run by a volunteer committee, providing opportunities to network, share knowledge and learn more about the science and practice of our profession.

There are currently about 170 Member Network volunteers.

For further information about what they get up to and how you can get involved, please visit www.cieem.net/member-networks.

NORTH WEST ENGLAND

Nature Friendly Farming Network at Sizergh Estate

25 May 2018, Kendal

The North West Section Committee ran a joint event with the Nature Friendly Farming Network on the 25 May at the National Trust's Sizergh Estate near Kendal. The aim of the event was to explore and discuss sustainable economic and ecological grazing systems by learning from two innovative practitioners.

Grassland systems dominating the agricultural landscape in Great Britain

are largely economically unproductive, ecologically degraded, dominated by a single grass species, organic carbon poor and heavily reliant on inputs to maintain productivity. Attendees visited two sites that are being managed in a way that bucks this trend. Lane End Farm, an important area of species rich grassland which has been managed for conservation over the last 10 years, and Low Sizergh Farm, a family-run dairy farm and rural business that is applying the Holistic Management methodology including Holistic Planned Grazing.

Read more at: www.cieem.net/north-west

Attendees observing Holistic Grazing Management in practice on Low Sizergh Farm



Delegates joining in discussions around innovative grazing management

WALES

Marsh Fritillaries at Welshmoor Common SSSI

1 September 2018



Marsh Fritillaries at Welshmoor Common

Members of the Welsh Section gathered on Welshmoor Common, Gower, in early September, for an informal and informative couple of hours with Dr Deborah Sazer, a local marsh fritillary expert. The event started with a quick look at the food plant for this species (devil's-bit scabious) and ensured we were all up to speed with the differences between that and other similar plants. It was then off to look at several examples of larval webs, complete with some individuals outside the webs clearly on the march looking for their next meal! Some great discussion on habitat changes and appropriate management approaches ensued, and what sort of management in the future might benefit this species. Many thanks to Deborah for a fascinating session, and to Mark Hipkin at the National Trust for arranging land access.

SOUTH EAST ENGLAND

Bird Ringing and London Wetland Centre Tour

13 September 2018



South East Section members had an enjoyable day, with experienced ornithologist and licenced bird ringer Bill Haines and Chief Ecologist Richard Bullock at the London Wetland Centre. In total 58 birds were trapped consisting of 12 different species. The bird ringing involved taking information such as weight, sex, age, wing measurements, breeding condition amongst other data to monitor survival rates of birds and collect information about their movements. The information provides vital support for conservation efforts and identifies steps needed in reversing declines. The second half of the day involved a tour of the London Wetland Centre from Richard, who was able to discuss in depth, past and present habitat management, species diversity and the history of the centre.

Look out for upcoming events in your area and keep up to date with what's been going on at www.cieem.net/member-networks.

For information on vacancies in your Member Network committees visit www.cieem.net/cieem-committee-vacancies.

SOUTH WEST ENGLAND

Guided tour of Braunton Burrows dunes

14 July 2018, North Devon

Thirteen members enjoyed a comprehensive tour of this five square mile internationally important dune system with former NNR warden John Breeds and wife Mary, author of *Wildflowers of Braunton Burrows*.

Our circular walk began with a view across the Taw-Torridge estuary to 'unmanaged' retreat on Horsey Island. We then took in the shoreline around Crow Point where we saw developing saltmarsh, and active spur erosion. We ticked off classic strandline and fore-dune plants, such as sea stock *Matthiola sinuata* as well as several adult

Mediterranean gulls, before venturing into the fixed dunes and Pebble Slack. Here we encountered the rare water germander *Teucrium scordium*. Discussion centred on the results of the historic grazing trials with Soay/Portland sheep and beef cattle (plant diversity increased). Despite the evidence, the land agent of the day would not agree to long-term grazing, which led to the de-designation of the NNR in 1996.

Returning to the start, there was even something for the history buffs; the Normandy landing practice infrastructure at 'D Lane'. A thoroughly enjoyable, well-paced, wildlife-rich day led by two 'dune doyens'!

Read more at: www.cieem.net/south-west



A close examination of the pebble slacks



The group explore the strandline

New Members

The decision on admission is usually taken by the Membership Admissions Committee or Registration Authority under delegated authority from the Governing Board but may be taken by the Governing Board itself.

CIEEM is pleased to welcome the following individuals as new, upgraded and Chartered members:

ADMISSIONS

Chartered Environmentalist (CEnv)

Joanne Rathbone

Full Members (MCIEEM)

Beatrice Davis, Colin Heaslip,
Philippa McKee, Graham Roberts,
William Taylor, Mike Trewby

Upgrades to Full Membership (MCIEEM)

Aaron Davies, Alexandra Ellis, Jon Garner,
Russell Goodchild, Erin Grieve,
Dr Suvi Harris, Eleanor Hayter, Sarah Ive,
Kristy James, Sam Marles, Oliver Moore,
Sarah Price, Natalie Rutter,
Christopher Savage

Associate Members (ACIEEM)

Tilly Fitzwebster, Olatz Gartzia,
Alexandra Learmont, Julie Riley

Upgrades to Associate Membership (ACIEEM)

Sophie Carr, Arabella Catlow,
Owen Crawshaw, Laura Duggan,
Rachel Kennedy, Matthew Palmer,
Laura Spence, Jessica Tait, Daniel Wales,
Georgina Whittaker, Ben Wood

Graduate Members (Grad CIEEM)

Claudia Ardrey, Victoria Baker,
Luke Burgess, Emma Checkley, Anna Clark,
Anna Douglas, Roxanne Gardiner,
Robert Gavan, Thomas Gomersall,
Alexander Gould, Ross Harding,
Christina Hewitt, Dr Laura Hodgkinson,
Adam Jones, Benjamin Kelly,
Susannah Lowe, Bethany Phythian,
Caroline Ritchie, Abigail Sampson,
Luke Scott, Alexander Smith,
William Steele, Calum Wallace,
Luke Walters, Aaron White, Kerry White,
Laura White, Paul Wolstenholme,
Georgina Young

Upgrades to Graduate Membership (Grad CIEEM)

Dominic Allmark, Jamey Bergman,
Beth Caine, Sian Comlay, Lyana Radzif

Qualifying Members

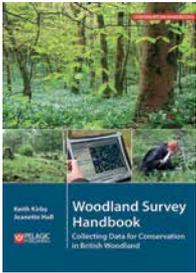
Shannen Allison, Sohinee Bhattacharya,
Sinead Clifford, Phillipa Dean,
Jane Harrison, Jonathan Nasir,
Cathal O'Brien, Annie Ottaway,
Laura Thompson

Student Members

Alison Affleck, Roger Ahern, Louise Ainslie,
Hollie Armstrong, Sarah Ashley,
Iman Ayesha, Sarah Barker,
Clemency Bathurst, Chelsea Birkett,
Rebecca Blackman, Coravida Brangman,
Hollie Branna, Thomas Bridge,
Laura Brooks, Amy Brown,
James Browning, Chelsea Brydon,
Claudia Caporusso, Laura Cappelli,
Katherine Carter, Olivia Cassidy,
Nicholas Chambers, Samuel Chapman,
Chloe Chappell, Donna Chatterton,
Sophie Christman, Emily Clarke,
Thomas Clarke, Daniel Connell,
Isabelle Costaz, Alex Cunningham,
Mollie Davies, Omais Dixon,
Kevin Donovan, Gareth Dowle,
Harriet Duffield, Laura Dunn,
Eloise Eggleston, Marcus Ellinor,
Emma-Jayne Evans, Jack Everist,
Laura Farrar, Paul Fenton,
Nicolle Fieldsend-Roxborough,
Daniel Fishburn, Sebastian Fisher,
Allison Flaherty, Oliver Ford,
Jaione Franco Sudupe, Kathryn Fraser,
Tara Fricke, Fiona Galbraith,
Devon Gilbert, Margaret Gill,
Katie Goldsbrough, George Goodby,
Vanessa Gouldsmith, Lisa Grayston,
Alexander Gregory, Jenna Grier,

Gemma Grossart, Ceri Haines, Jay Hands,
Chloe Hannabuss, Ben Harris,
Alex Harrison, Kathryn Henderson,
Gabriel Holmes, Chloe Howard,
Maja Hudej, Hannah Humphreys,
Ranbir Jabanda, Lauren Jackson,
Meena Jagait, Robert Jaques,
Rebeckah Jarvis, Dionne Jenkins,
Rebecca Jenkins, Holly Jenkinson,
Matthew John, Ceri Jones, Gareth Jones,
Megan Jones, Tristram Keats, Rory Kellett,
Hannah Klair, Dr Liz Lakin,
Anouska Laramy, Richard Llanos,
Veronika Lopatko, Richard Magala,
Naomi Mansell, Maggie Marlow,
Jake Matthews, Danielle McCallion,
Elaine McCarthy, Douglas McGarvey,
Rebecca Messenger, Sophie Mills,
Anoushka Nutting, Ben O'Neill,
Nicole Owston, Joseph Oxley,
Elsbeth Parks, Frank Pennie, Ryan Philpott,
Siobhan Pryke, Jodie Pullen,
Katherine Rennie, Zoe Richards,
Samuel Richardson, Aemelia Roe,
Katy Ross, Kimberley Russell,
Charlotte Scales, Melissa Schiele,
Ryan Scott, Valentine Seymour,
Luke Shaw, Amy Shepherd, Shivira Shukla,
Adam Spence, Sebastian Stroud,
Lucy Sumner, Kerri Symonds, Mollie Taylor,
Abby Thomas, Eleri Thomas,
Virginia Thomas, Amy Tose,
Leanne Tough, Sarah Tullie, William Tully,
Natasha Underwood, Blanca Vázquez,
Viivi Vepsäläinen, Olivier Vryens,
Ljiljana Vujakovic, Beatrice Walecki,
Oliver Warren, Eilidh Watson,
Udeshika Weerakkody Appuhamillage,
Chantae Wells, Jordan Whitcombe,
Benjamin Willers, Jessica Willis,
Courtney Wilson, Mohammed Yaseen,
Alexandra Zemanová

Recent Publications

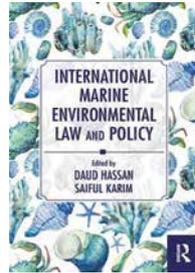


Woodland Survey Handbook: Collecting Data for Conservation in British Woodland

Author: Keith Kirby and Jeanette Hall
ISBN: 9781784271848
Price: £30.00

Available from: www.pelagicpublishing.com

This book explains ways to record the flora and fauna found in woodland and outlines the sources you can go to find out more about the history and management of an area. The methods discussed range from what can be found online, to what can be seen on a general walk round a wood, to the insights that can come from more detailed survey and monitoring approaches. Fast evolving techniques such as eDNA surveys and the use of LiDAR are touched on.

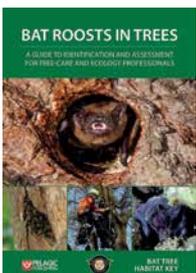


International Marine Environmental Law and Policy

Edited by: Daud Hassan and Saiful Karim
ISBN: 9781138651135
Price: £34.99

Available from: www.routledge.com

Several issues pose a threat to the marine environment and its well-being, among them marine environmental pollution and degradation of marine biodiversity. This book presents a thorough appraisal of the main issues, actors and institutions engaged in the legal aspects of marine environmental conservation. With contributions from an international range of authors, the book provides an account of the legal and policy framework underlying international marine environmental issues, and of the fundamental concepts and strategies that are important to the protection of the marine environment.



Bat Roosts in Trees: A Guide to Identification and Assessment for Tree-Care and Ecology Professionals

Author: Bat Tree Habitat Key
ISBN: 9781784271619
Price: £40.00

Available from: www.pelagicpublishing.com

This book is a guide to finding tree-roosts for all 14 tree-roosting bats in Britain. It is the result of the collaborative efforts of professional surveyors and amateur naturalists across Europe as part of the Bat Tree Habitat Key project. This is the first time legislation and planning policy have been reviewed and put to practical use to define an analysis framework with clearly identifiable thresholds for action. The framework allows the surveyor to compare their results at every stage, from the desk-study, through ground-truthing, survey and analysis.

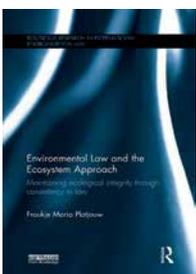


Practical Management of Invasive Non-Native Weeds in Britain and Ireland

Author: Mark Fennell, Laura Jones, Max Wade
ISBN: 9781853411656
Price: £34.99

Available from: www.nhbs.com

Practical Management of Invasive Non-Native Weeds in Britain and Ireland responds to the GB Non-Native Species Strategy and deals with over 40 species which have been selected from plants listed in Schedule 9 of the Wildlife & Countryside Act 1981 for the UK; invasive alien species of EU concern; and other noteworthy species of the urban environment. Each species account includes: a description on ecology and identification, a distribution map, immediate actions that can be taken once identified, pathways of spread, life history strategies aimed at assisting the determination of schedules for survey and treatment, prevention measures, waste-disposal requirements, revegetation post-management and continued monitoring. Key references to published data and links to appropriate websites are also included.

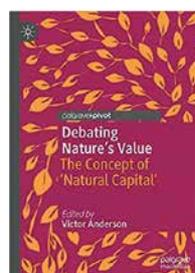


Environmental Law and the Ecosystem Approach: Maintaining ecological integrity through consistency in law

Author: Froukje Maria Platjouw
ISBN: 9781138363922
Price: £36.99

Available from: www.routledge.com

The ecosystem approach embodies a concept of the environment which emphasizes the integrated components of nature as complex adaptive systems. This book examines the relationship between the architecture and design of environmental law and the implementation of the ecosystem approach as a means to maintain ecological integrity. The main issue addressed is: in which manner and to what extent does fragmentation and administrative discretion in environmental law impede the implementation of an ecosystem approach?



Debating Nature's Value: The Concept of 'Natural Capital'

Edited by: Victor Anderson
ISBN: 9783319992433
Price: £49.99

Available from: www.springer.com

'Natural Capital' values the natural world and the resources it provides to us in terms of its monetary value. This book comprehensively discusses the issues raised by the concept of 'Natural Capital', with contributors presenting not only arguments for and against the widespread adoption of the idea, but also viewpoints arguing for nuanced, pragmatic and middle-ground positions.

Priority Threat Management for biodiversity conservation: a handbook

Josie Carwardine, Tara G. Martin, Jennifer Firn, Rocio Ponce Reyes, Sam Nicol, Andrew Reeson Hedley S. Grantham, Danial Stratford, Laura Kehoe, Ladine Chadès

Journal of Applied Ecology 2018; Online
<https://doi.org/10.1111/1365-2664.13268>

Threats to biodiversity and the integrity of ecological systems are escalating globally. Decision-makers have inadequate resources to manage all threats and lack information on the likely outcomes and cost-effectiveness of possible management strategies. Priority Threat Management is a decision-science approach that brings people together to define and prioritise strategies for managing threats to biodiversity across broad regions. It delivers a prospectus for investment in the biodiversity of a region that is transparent, repeatable, participatory and based on the best available information. This handbook provides guidance and resources for expanding the PTM approach to new locations, contexts and challenges.

Correspondence: Josie.Carwardine@csiro.au



Comparing convenience and probability sampling for urban ecology applications

Andrew Speak, Francisco J. Escobedo, Alessio Russo, Stefan Zerbe
Journal of Applied Ecology 2018; 55: 2296-2307
<https://doi.org/10.1111/1365-2664.13167>

Urban forest ecosystems deliver multiple ecosystem services. There is therefore a need to quantify community structure and composition, so benefits can be better understood in ecosystem service models. Efficient sampling methods are crucial in this process. Modern vegetation surveys increasingly use a stratified-random plot-based sampling to reduce the bias associated with convenience sampling. The urban landscape provides a unique case for comparing these two methodological approaches. These results suggest that convenience sampling may be a time and money saving alternative to random sampling as long as stratification by land-use type is incorporated into the design.

Correspondence: andyspeak33@gmail.com

Rewilding in the English uplands: Policy and practice

Christopher J. Sandom, Benedict Dempsey, David Bullock, Adrian Ely, Paul Jepson, Stefan Jimenez-Wisler, Adrian Newton, Nathalie Pettorelli, Rebecca A. Senior

Journal of Applied Ecology 2018; Online
<https://doi.org/10.1111/1365-2664.13276>

Rewilding is gaining momentum as a new approach to restore and conserve biodiversity and ecosystem services. Following concern that the term is imprecisely defined and with has limited empirical supporting evidence. This practitioner's perspective paper discusses the different approaches to rewilding in the English Uplands, the risks and opportunities these approaches present, barriers to implementation, and potential solutions to allow beneficial rewilding to be put into practice where it is wanted.



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Win-wins for biodiversity and ecosystem service conservation depend on the trophic levels of the species providing services

Hui Xiao, Laura Dee, Ladine Chadès, Nathalie Peyrard, Régis Sabbadin, Martin Stringer, Eve McDonald-Madden

Journal of Applied Ecology 2018; 55: 2160-2170
<https://doi.org/10.1111/1365-2664.13192>

Confronted by significant impacts to ecosystems world-wide, decision makers face the challenge of maintaining both biodiversity and the provision of ecosystem services (ES), the objectives of which, may not always be in concert, resulting in the need for trade-offs. This research provides the first optimisation model to examine trade-offs between a biodiversity- or ecosystem service-based approach. Results from considering species-services interactions in ecosystem network dynamics can provide managers with quantitative insights to identify opportunities for win-wins and or to avoid win-loss outcomes, by focusing on the trophic level of the species providing services.

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Nature, extent and ecological implications of night-time light from road vehicles

Kevin Gaston, Lauren Holt

Journal of Applied Ecology 2018; 55: 2296-2307
<https://doi.org/10.1111/1365-2664.13157>

Emissions from vehicle headlights need to be considered as a major, and growing, source of ecological impacts of artificial night-time lighting. Previous studies of these impacts have focused on those resulting from stationary sources of light emissions, particularly streetlights. However, mobile sources, especially road vehicle

headlights, contribute substantial additional emissions. This study looks at the nature of light from road vehicles and implications. It will be a significant challenge to minimise these impacts whilst balancing drivers' needs at night and avoiding risk and discomfort for other road users. Nonetheless, there is potential to identify solutions to these conflicts, both through the design of headlights and that of roads.

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When to monitor and when to act: Value of information theory for multiple management units and limited budgets

Joseph Bennett, Sean Maxwell, Amanda Martin, Iadine Chadès,
Lenore Fahrig, Benjamin Gilbert

Journal of Applied Ecology 2018; 55: 2102-2113

<https://doi.org/10.1111/1365-2664.13132>

The question of when to monitor and when to act is notoriously difficult to answer. This study sets out an expansion of Value of Information (VOI) theory which can reduce the risk in monitoring or acting decisions for many applied ecology problems. While the approach cannot account for the potential value of discovering previously unknown threats monitoring programmes, it provides quantitative guidance on whether to monitor before acting, and which monitoring or management actions are most likely to meet management objectives. This article provides a case study using simulated studies of single-species protection that must choose among potential habitat areas, and classification and management of multiple species threatened with extinction.

Open access: <https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.13132>

Regulation of body reserves in a hunted wader: Implications for cold-weather shooting restrictions

Carlos Sánchez-García,
Owen Williams, Andrew Hoodless

Journal of Applied Ecology 2018; 55: 2274-2284

<https://doi.org/10.1111/1365-2664.13128>

Severe winter weather can reduce avian energetic reserves. At such times, reducing disturbance, and therefore energy expenditure, through science-based policy is crucial to mitigating negative impacts on survival. This study uses data from shot and live birds over two winters to show that, in order to reduce the effects of cold weather on Eurasian woodcock (*S. rusticola*), shooting should be restricted before energy reserves are depleted. Current policies vary across Europe, but results suggest that restrictions should come into force sooner.

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Trade-offs and synergies between bird conservation and wildfire suppression in the face of global change

Adrián Regos, Virgilio Hermoso, Manuela D'Amen,
Antoine Guisan, Lluís Brotons

Journal of Applied Ecology 2018; 55: 2181-2192

<https://doi.org/10.1111/1365-2664.13182>

The combined effects of climate change and other factors, such as land-use change or fire disturbance, pose challenges for biodiversity conservation world-wide. This study predicted the future effectiveness of the Natura 2000 network at maintaining and representing suitable environmental conditions for a set of 79 bird species in a fire-prone area. The findings show: how the current Natura 2000 could still hold an important bird conservation value by 2050, how the relocation of some protected areas should be considered in order to increase bird conservation effectiveness; and how the integration of fire-vegetation dynamics, management policies and their objectives within conservation planning provide "win-win" solutions for bird conservation and fire prevention in fire-prone abandoned landscapes.

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Consequences of game bird management for non-game species in Europe

Karen Mustin, Beatriz Arroyo, Pedro Beja, Scott Newey,
Robert Justin Irvine, Julia Kestler, Steve M. Redpath

Journal of Applied Ecology 2018; 55: 2285-2295

<https://doi.org/10.1111/1365-2664.13131>

Photo credit David Kilbey



The management of game bird populations for shooting is widespread across Europe. Game bird management has the potential to benefit conservation, as management practices specifically targeted at reducing the factors limiting game populations may have positive effects on non-game species. However, such management may also have costs to species. This review shows that effects of such management practices vary between different non-target species. There is a need to understand these trade-offs, find effective strategies to limit the damaging aspects of game bird management and work to enhance the benefits for the conservation of biodiversity.

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Predation risk for reptiles is highest at remnant edges in agricultural landscapes



Nicole A. Hansen, Chloe F. Sato,
Damian R. Michael,
David B. Lindenmayer,
Don A. Driscoll

**Journal of Applied Ecology
2018; Online**

[https://doi.org/10.1111/
1365-2664.13269](https://doi.org/10.1111/1365-2664.13269)

Reptiles are at risk of predation by birds and mammals in both remnant patches and the farmland matrix. This study measures the predation risk in four farmland types, relative to patch edge and remnant vegetation. The results demonstrate that edge habitats are potentially riskier for lizards than the farmland. Vulnerability to predation may be increased by a lack of shelter within edge habitats which increases visibility of reptiles to predators. Therefore, to benefit reptiles, land managers could provide shelter (rocks, logs and grasses), particularly between remnants and linear plantings which could improve landscape connectivity.

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Forthcoming Events

For information on these events please see www.cieem.net.

Conferences

Date	Title	Location
28 Feb 2019	CIEEM Ireland Conference – Wading into Water: The assessment and management of our aquatic environment	Athlone
Spring 2019	CIEEM Spring Conference 2019 – Biodiversity Net Gain	TBC
Autumn 2019	CIEEM Autumn Conference 2019 – Planning and Ecology	Wales TBC

Training Courses

January 2019

9-10	Intermediate QGIS for Ecologists and Environmental Practitioners	Nottingham
22	Habitats Regulations Appraisal of Projects (England & Wales)	Manchester
23	Wind Farm Bird Collision Risk Modelling	Aberdeen
29-30	Developing Skills in Ecological Impact Assessment	Leeds

February 2019

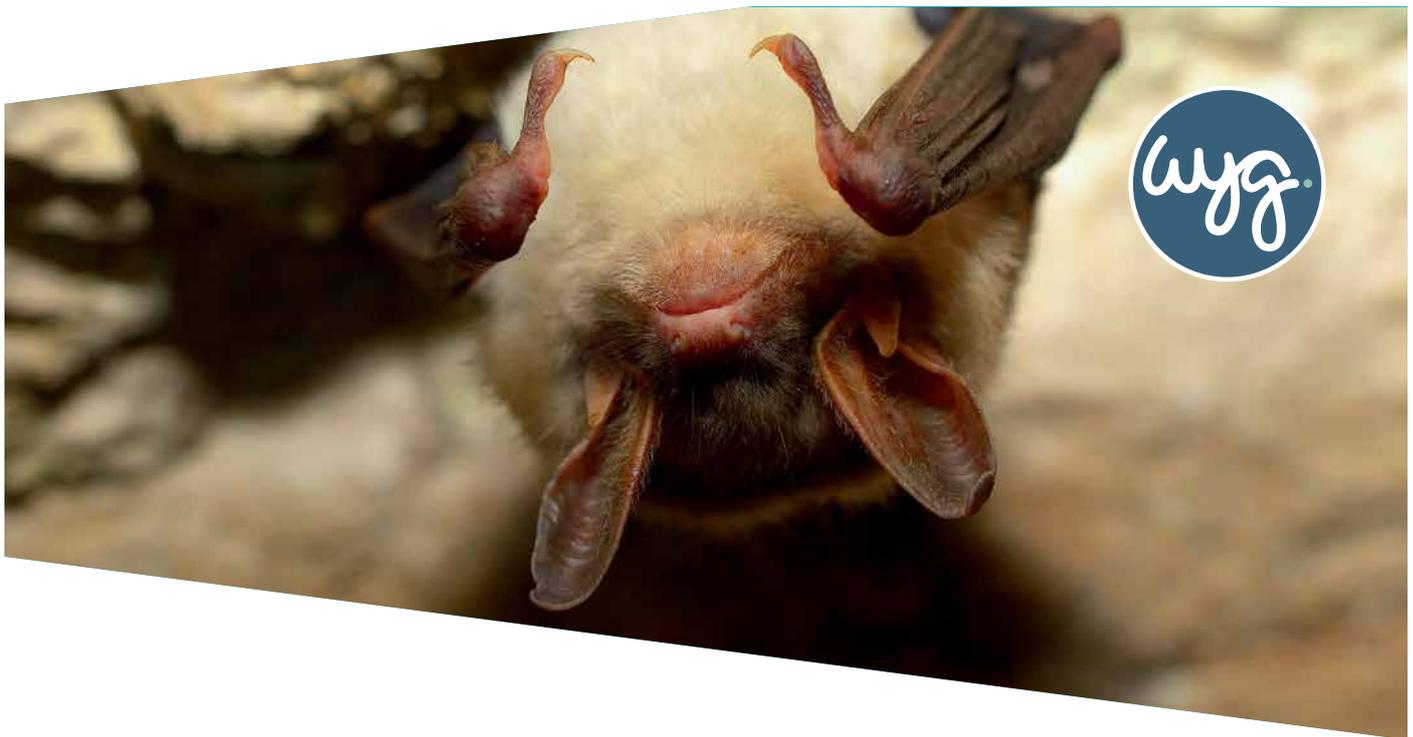
5-6	Developing Skills in Ecological Impact Assessment	Swindon
6	Ecological Clerk of Works	Manchester
6-7	QGIS for Ecologists and Environmental Practitioners (Ireland)	Athlone
7	BS42020 Biodiversity: Code of Practice for Planning and Development	Manchester
12	Effective Communication Skills	Bristol
13	Introduction to Protected Species Law and Policy	Birmingham
20	Introduction to Protected Species Law and Policy	Newport
21	Calculating and Using Biodiversity Units	London
26	Habitats Regulations Appraisal of Plans / Projects (Scotland)	Stirling
26	Introduction to Ecological Impact Assessment	Manchester
27	Ecological Report Writing	Manchester
27-28	Intermediate QGIS for Ecologists and Environmental Practitioners	Kingston
28	Ecological Clerk of Works	Swindon

March 2019

5	Advanced Ecological Impact Assessment	Nottingham
6-7	Train the Trainer for Ecologists	London
12	Report Writing for Ecological Impact Assessment	Swindon
12	Effective Workplace Mentoring	Bristol
14	Phase 1 for Development	Cambridge
14	Introduction to Ecological Impact Assessment (Scotland)	Glasgow
26-27	Developing Skills in Ecological Impact Assessment (Scotland)	Aberdeen
28	Ecological Clerk of Works (Ireland)	TBC, Ireland

April 2019

4	Introduction to Bat Ecology and Surveys	Wareham
5	Bats: Impact Assessment and Mitigation	Wareham
16	Using Bioacoustics for Field Survey	Derbyshire
23	Effective Communication for Women	Reading
24	Ancient Woodland Indicators	Bristol
25	Habitats Regulations Appraisal Projects (England & Wales)	Bristol



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