

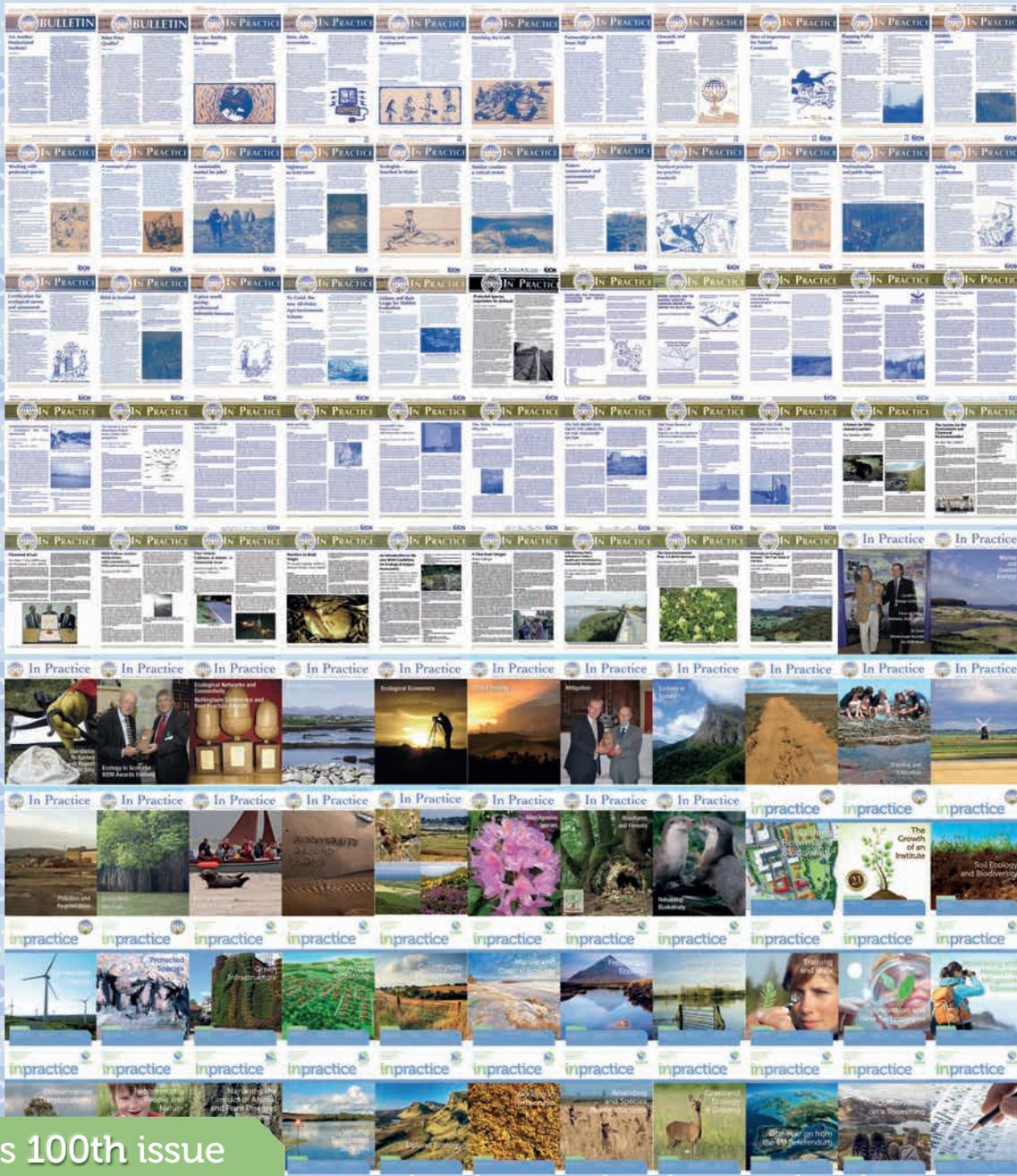
issue
100

Bulletin of the Chartered
Institute of Ecology
and Environmental
Management



inpractice

Issue 100 | June 2018



In this 100th issue

Big Issues: Human Population Growth and Climate Change – Beyond Carrying Capacity?

Big Issues: The Hidden Tragedy of the Earth's Freshwater Ecosystems

Big Ideas: Creating a Mess – The Knepp Rewilding Project

Welcome to the 100th issue

Let me take you back to October 1991 and the first issue of *In Practice*. The average house price was £70,987 and a pint was £1.40. Leeds United were on track to becoming the last champions of the First Division and Bryan Adams had been at the top of the charts for nearly 16 weeks. There was no Google, so it would have been hard to find out any of this. In fact the internet only had a million users. Nostalgic trivia aside, it is worth reflecting, in this our 100th issue, on what *In Practice* was talking about in 1991 and how it compares with where we are now.

The 1st edition contains a summary of the Environment Protection Act 1990, detailing its key provisions. It concludes that its effectiveness will depend on resourcing and the extent to which it conflicts with economic considerations. Environmental legislation has advanced significantly since then, particularly with the introduction of the European nature directives. These have helped build a robust and defensible network of protected sites and have become a constant in most of our careers. However, whilst there have been assurances, there are as yet no guarantees that they will be fully transposed into UK law post-Brexit and allowed to operate as effectively. To secure both we will need to address the same potential conflict with even fewer resources.

The 1st edition also contains a summary of the new Countryside Management Scheme. This opened in 1991 and was the first time that farmers and landowners were eligible from across the UK. It and its successors have been important drivers of habitat restoration and species recovery but overall declines in biodiversity in the wider countryside continue apace, so much more needs to be done. A green Brexit could help by diverting more agricultural subsidies into the delivery of public goods, including biodiversity. Landscape-scale conservation, catchment management and rewilding (see page 14) will also be key. The latter in the right locations can be genuinely transformative as Isabella Tree's article on page 29 eloquently describes.

So what will it be like to be a CIEEM professional picking up the 200th edition of *In Practice*? Brexit will have played out and the 25-Year Environmental Plan reached the end of its timeline. If between them they deliver on some of their key commitments, a very different legislative and policy landscape could emerge. What demands will this place on us? For example, are we ready for environmental net gain? Can we be effective brokers for land managers seeking to attract agricultural subsidies for public goods?

How we deliver our work is also likely to change. The 1st edition includes an article entitled 'GIS for environmental professionals'. It discusses the role GIS was starting, and could continue, to play in manipulating and presenting ecological data. What will be our 'go to' survey tools and techniques in the future? A number of articles in this edition explore emerging technologies and new/refined methodologies for posterity to judge. I hope *In Practice* will continue to provide a forum where we challenge each other respectfully to do better, be clearer about our shared outcomes and honest about successes and failures.

Ultimately though I think our role should remain the same: to provide an authoritative, evidence-based analysis of how the decisions we make as a society affect our natural environment and develop practical solutions that will help deliver a sustainable and prosperous future for both.

Here's to another 100 editions of *In Practice*!

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Information

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Front cover montage:
The first 100 editions

Big Issues



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Life in the Big City – Increasing Urbanisation and the Disconnect From Nature

Claire Wansbury



PG 12

The Hidden Tragedy of the Earth's Freshwater Ecosystems

Steve Ormerod



PG 14

Landscape Conservation

Keith J. Kirby

Big Ideas



PG 29

Creating a Mess – The Knepp Rewilding Project

Isabella Tree



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'District Licensing' for Great Crested Newts – Delivering a Big Idea

Tom Tew, Jeremy Biggs and Tony Gent



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From on High: Creating a Phase 1 Habitat Map Using Aerial Imagery

Iona Pearson, Hannah Thomas and Rose-Ellen Minchew

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CIEEM Conferences 2018		
Date	Title	Location
12 July 2018	Summer Conference 2018 Fit for the Future: Developing an ecologically resilient protected sites strategy	Natural History Museum, London
20-21 November 2018	Autumn Conference 2018 Habitat Re-creation and Ecological Restoration	Glasgow

Visit the CIEEM website to book your place at the Summer Conference and to find out more information.

Future *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
101 – September 2018	Environment and Pollution	n/a
102 – December 2018	Data and Information Management	27 August 2018

Articles could address, but are not limited to, the following:

- **Data and Information Management** – including big data, sharing, storage, management and analysis, etc. in relation to the natural environment

For further information please visit the website (www.cieem.net/in-practice) or contact the Editor (gillkerby@cieem.net).

Changes to Chartered Environmentalist Application Process

Currently, Chartered Environmentalist (CEnv) applicants initially submit an application form to check eligibility. If eligible, the applicant is then invited to submit a report within six weeks.

To streamline this process, eligible applicants will now be asked to submit the report at the same time as the application form.

Detailed guidance on how to assess eligibility along with application deadlines, is available on the CIEEM website at: www.cieem.net/chartered-environmentalist

For queries, please contact the Registration Officer, Michael Hornby, at: registrationofficer@cieem.net

In Practice is Going Open Access

In an effort to share the valuable information that is published in *In Practice*, as part of the grey literature, we will be making past editions of *In Practice* freely available as PDF downloads.

We recognise that members continue to see *In Practice* as a significant membership benefit and so will only be making editions older than two years available publicly. We believe that this is the right balance between maintaining the benefit for members and making that same benefit available more widely for the benefit of the sector and the impact that it has on protecting and enhancing the natural environment.

Look out for an announcement in the coming months!

Bat Mitigation Research Report

CIEEM has published a new report on bat mitigation effectiveness, which provides evidence for planners, developers and ecological practitioners on the efficacy of bat roost mitigation and compensation to help them ensure that mitigation approaches are evidence-based and beneficial for bats. Download the document from the CIEEM website (www.cieem.net/bat-mitigation-strategies-research-project). The next step for this project is to produce more substantial guidance on bat mitigation, which we hope to be able to publish in 2019.

Staff Changes

There have been some considerable changes to the staff makeup in the past few months.

In February, and after seven years of dedicated service to CIEEM, we sadly said goodbye to Richard Watts who had been our Administrative Officer since 2011.

In March we wished Lexie Munro well in her future endeavours. Lexie had been CIEEM's Professional Development Co-ordinator (Training) since 2014 and has done a huge amount to expand and improve the Professional Development Programme.

We wish them both all the very best as they take on new challenges in new sectors.



Siân Kear

In March we welcomed Siân Kear as Professional Development Officer and Samina Aziz as Professional Development Assistant.



Samina Aziz

They have taken over the continued delivery and development of the Professional Development Programme.



Helen Sielaff

As the new Administrative Officer, we were pleased to have Helen Sielaff join the team in April.

They have all settled in well with the team and we look forward to them helping CIEEM to continue to move from strength to strength.

IUCN publish guidelines on business and KBAs

New guidelines on business and Key Biodiversity Areas (KBAs) have been developed to support businesses in managing risk to biodiversity. The guidelines can also be integrated into responsible sourcing policies.

<https://portals.iucn.org/library/node/47660>

EU passes ban on neonicotinoid pesticides

EU governments have passed a near-total ban on the use of neonicotinoid pesticides on outdoor crops due to their impact on pollinators. Member States endorsed the European Commission's proposals to completely ban the outdoor uses of three active substances – clothianidin, imidacloprid, and thiamethoxam.

<http://greennews.ie/eu-backes-near-total-ban-on-neonics/>

NGOs stress need for cross-border environmental solution

An environmental coalition, Green 10, has called on Michel Barnier to stress the need for a solution to the border issue post-Brexit that maintains full alignment of environmental rules on the island of Ireland.

<http://greennews.ie/brexit-ngo-coalition-barnier-cross-border-environment/>

Michael Gove questioned on 25-Year Environment Plan

The Environmental Audit Committee has questioned the Secretary of State for the Environment, Food and Rural Affairs on oversight, governance, milestones and implementation.

The session built on what the Committee heard from the nature and environment organisations, including CIEEM, at the previous hearing.

<https://www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/news-parliament-2017/25-year-plan-evidence-17-19/>

Commons Library publishes report on badger culling

This report details the history of the badger cull in England, and links to devolved activities as well.

<http://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN06837>

ECJ ruling creates uncertainty for ecology

The recent People Over Wind and Sweetman ruling has potentially significant implications in the UK and Ireland, in that it appears to reverse the judgement in the "Dilly Lane" case (R on the application of Hart DC v Secretary of State for Communities and Local Government [2008]), which concluded that mitigation or compensation measures that were part of the project could be taken into account at the screening stage of the Habitats Regulations Assessment (HRA).

<https://www.cieem.net/news/475/cieem-comment-on-recent-ecj-ruling>

Report claims green Brexit unlikely

A new report by Friends of the Earth says that environmental standards are at risk from Brexit, from wildlife and habitats to water and air quality.

https://cdn.friendsoftheearth.uk/sites/default/files/downloads/Environment%20and%20Brexit%2C%20Burns%20Et%20al%2C%20March%202018%20web_0.pdf

Major IPBES reports on biodiversity and ecosystem services launched

A UN-backed IPBES meeting has considered five landmark reports aiming to inform better decisions by governments, businesses and individuals on biodiversity, and issues of land degradation and restoration. The reports comprise four regional assessments of biodiversity in Africa; the Americas; Asia and the Pacific; and Europe and Central Asia; as well as an assessment of land degradation and restoration, both regionally and globally.

<https://news.un.org/en/story/2018/03/1005112>

UK government confirms ban on ivory sales

Environment Secretary Michael Gove has announced that a ban on ivory sales in the UK will be introduced as plans are published to protect elephants.

<https://www.gov.uk/government/news/government-confirms-uk-ban-on-ivory-sales>

UK government publishes EU frameworks analysis

The UK government has published a list that breaks down the areas of EU law that intersect with devolved competence in Scotland, Wales and Northern Ireland.

<https://www.gov.uk/government/publications/frameworks-analysis>

EEA on environmental big data

Earth observation data obtained through the European Union's Copernicus programme presents new challenges and opportunities to improve our environmental knowledge. Combining up-to-date Copernicus data with our existing knowledge base, the European Environment Agency (EEA) aims to empower policy-makers and citizens across Europe in taking measures to address local, national and global challenges.

<https://www.eea.europa.eu/articles/europes-environment-the-power-of-data>

NERC Act Committee publishes inquiry report

CIEEM has welcomed the House of Lords Select Committee's report. We particularly welcome their recommendations regarding the need for a new and powerful environmental watchdog, restoring both the independence and funding of Natural England, devoting appropriate funding to the Nature Recovery Network, delivering biodiversity net gain, and strengthening the 'biodiversity duty' on public bodies.

<https://www.cieem.net/news/470/cieem-welcomes-select-committee-report-on-nerc-act>



Chartered
Institute of
Ecology and
Environmental
Management

Summer Conference 2018

Fit for the future: Developing an ecologically resilient protected sites network

12 July 2018, Natural History Museum, London

This year marks the 40th anniversary of the development of a strategic network of nature reserves. CIEEM's Summer Conference celebrates the achievements of this crucial cornerstone of UK nature conservation strategy but also looks forward.

Brexit provides an opportunity to re-think our strategy around the creation of an ecologically coherent network of designated sites on land and at sea. Drawing on research evidence we will explore whether there are alternative approaches that can account for the impacts of climate change and reflect our current understanding of ecological resilience, scale and the importance of connectivity.

Find out more and book your place at:

www.cieem.net/summer-conference-2018

www.cieem.net

#CIEEMconf

The Big Issues

Gill Kerby
Editor, *In Practice*



This 100th edition of *In Practice* is an appropriate point to take stock and consider some of the most important environmental issues before us today. In June 2012, as part of initiatives to mark the 21st Anniversary of CIEEM, we published '21 Questions for the Future – as chosen by the Fellows of the Institute' (<https://www.cieem.net/back-issues>); in this edition of *In Practice* we go a step further and publish expert reviews of priority environmental concerns.

As before, we asked each of CIEEM's Fellows to identify the 'big issues' for the future of the natural environment, focusing in particular on those that will have direct impact on the ecology and environmental management sector. The responses were wide and varied – and we could have devoted the entire edition to these issues – but there was also a fair amount of agreement on the major concerns. A small team sifted through the suggestions and identified nine broad topics that encompassed most of the concerns raised. We then commissioned the succinct review articles published in this special feature:

1. *Human Population Growth and Climate Change – Beyond Carrying Capacity?*
2. *Increasing Urbanisation and the Disconnect from Nature*
3. *The Hidden Tragedy of the Earth's Freshwater Ecosystems*
4. *Landscape Conservation*
5. *Restoration of Biodiversity (including the future of agriculture)*
6. *Environmental Degradation?*
7. *Getting the Message Across*
8. *Where Does Power Lie? And Can We – the Environment Sector – Get Better at Accessing It?*
9. *Using the Evidence*
10. *Reaching the Bar*

We asked authors to provide some background to the issue, summarise the main areas of concern, outline the potential implications and impacts on the natural environment and then to focus specifically on the future of the ecology and environmental management sector. The articles end by looking at ways through which CIEEM and its members can help to deliver solutions.

Inevitably, with limited space, some important issues have not made it into the final overviews (e.g. ecosystem processes and functioning, soil conservation) whilst other concerns such as human population growth, climate change, and the need for cross-sector cooperation and interdisciplinary communication are highlighted more than once. To some extent, the articles reflect the personal perspective of the author but, coming from CIEEM's Fellows, they are all written with the membership in mind. We hope you find them interesting, instructive and thought provoking.

Acknowledgements

Thanks to the CIEEM Fellows, *In Practice* Editorial Board, John Box and Jason Reeves for input to this special feature, commissioned to mark the 100th edition of *In Practice*.

Contact

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Human Population Growth and Climate Change – Beyond Carrying Capacity?

David Tyldesley FCIEEM

The problem

It is impossible to define a single meaningful 'carrying capacity' for global human population, or even for a continent or country; by which I mean the population before which environmental degradation occurs. It depends on how and where people live and how they organise themselves; different environmental assets will be affected in different ways. But there can be little doubt that we are beyond the carrying capacity of the earth now, in terms of some key resources. These subjects are well known for variations in predictions, accusations of alarmism, denial and conspiracy, poor application of science and statistics, and 'fake news'. But let me demonstrate the context of my concerns with some 'facts' gleaned from responsible sources.

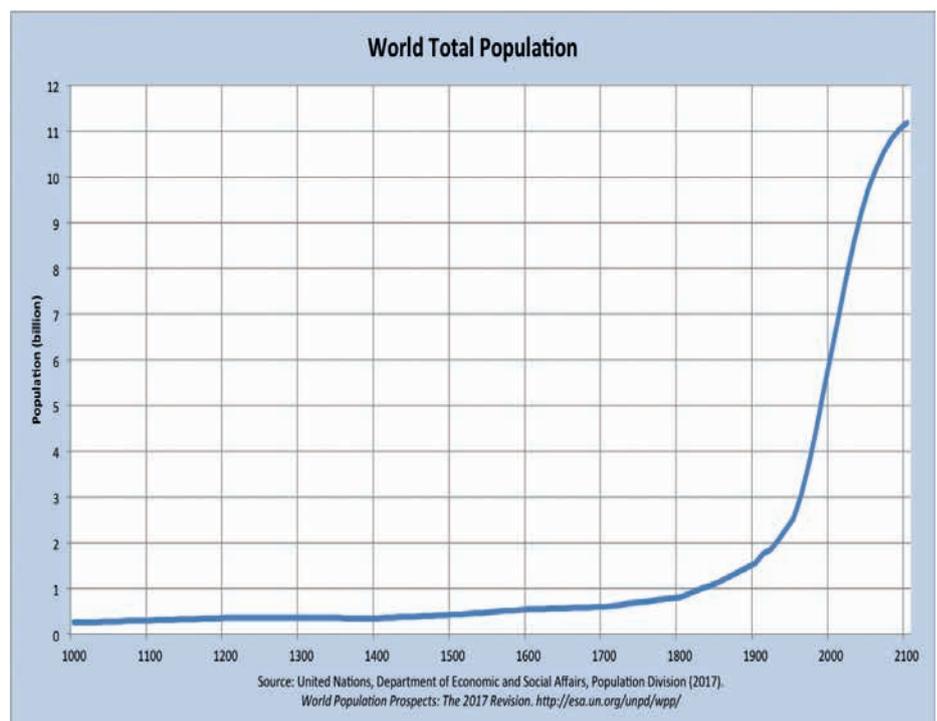
- There are now more than 7,500,000,000 (7.5bn) people on Earth. It took until the early 1800s for the world population to reach one billion. Now we add a billion every 12-15 years. World population has tripled in my lifetime¹.
- Using relatively conservative assumptions, the UN estimates a population of nearly 9.8bn by 2050, 30% higher than it is today¹.
- By 2050:
 - unless things change, 9.8bn people will be likely to need:
 - three earths to support them if they were all to live equally²
 - 70% more food³
 - 71% more resources each⁴;
 - at least half the world's population could live in water-stressed regions⁵; yet
 - a billion people could be at risk of catastrophic coastal or fluvial flooding⁶.

- By 2040, global demand for energy will increase by 30%⁷.
- By 2030, the global 'middle class', consuming at a high level, is expected to have risen from 3.2bn people in 2016 to about 5bn⁸.
- The current population of the UK is 65.6 million, 31% higher than in 1950. It is projected to be more than 75m by 2050. Net migration increased the population by more than 250,000 people per year on average from 2004 to 2015.⁹
- In 1950, the UK's population density was 207 people per square kilometre; today it is 271 ppkm² and by 2050 it is expected to be 300. In Greater London it is 5,590 ppkm².^{1,9}

Implications and impacts

There is, of course, continuous interaction between human population growth and climate change. Nature will have to adapt to both simultaneously. The speed of change will limit the 'success' of adaptation. There is convincing evidence that population growth and inequality have been major contributors to world ill-health, poverty and famine, pollution, climate change and environmental degradation, including depletion of biodiversity, reductions in species' abundance and habitat loss.

Although far from universal, there is a determination amongst many individuals, organisations and even some governments, to more effectively address



these world problems. The UK and Ireland are amongst world leaders in compassion and science-based environmental management. There is wide global support for the conservation of biodiversity. But, even if the world population remained the same for the next 30 years, it would be difficult to deal with these issues. In the face of a rising population density, coupled with religious, ethnic and territorial tensions and an increasing proportion of the population consuming more essential resources per capita, it is hard to see how things can improve.

I think it is likely that more people will want to move to what I will refer to as 'favourable climate areas' in wealthier countries, including particularly the UK. By 'favourable climate areas', I mean those areas lacking extremes of temperature; with the lowest risk of storms, floods or fires and the greatest capacity to grow or acquire food, generate energy and dispose of waste. Increasing population, affluence and consumerism will place even greater strains on our natural environment as more and more people unintentionally damage UK terrestrial and marine ecosystems.

The effects of global population growth exacerbating, and exacerbated by, the effects of climate change, are serious. The potential consequences of mass migration, food insecurity, water deprivation, pollution and energy starvation should not be underestimated. In extremis, they could cause civil unrest and conceivably, in an increasingly unstable world, wars over territory, food, water and energy. Need and greed will lead to further mismanagement of the natural environment for short-term gain, leading to accelerating effects such as desertification or deforestation, and ultimately and inexorably to further loss of biodiversity coupled with an increase (perhaps locally intolerable increases) in those species (other than man) which thrive in an imbalanced and exhausted, unnatural world incapable of adapting quickly enough to climate change.

Impacts on our profession

Although 2050 sounds a long way away, many of you reading this Journal will still be in practice then. Hopefully we will continue to try to protect and enhance biodiversity in the UK, but it will be an ever more difficult challenge, increasingly

influenced by political and social change. In society's choices to come, we cannot assume that people in an over-stressed population in Britain will prefer sustainable natural ecosystems to personal well-being and material satisfaction, even if they understand the effects on themselves.

We must develop our skills and knowledge about the natural environment and how it should work for people's survival as well as for nature, in new ways. Whilst project working at a 'landscape scale' now, in future we will need to work with nature on an even bigger canvas. World change is likely to generate demand for new types of ecologists and environmental managers. Some will need to diversify, at home and abroad, into the application of science to influence governments and organisations dealing with the environmental impacts of climate change and human population growth. Others will need to be educated and trained, with other disciplines, to learn how to more effectively use nature to mend or manipulate malfunctioning natural processes and degraded ecosystems, not just for nature's sake, but increasingly for human survival.

What can CIEEM do?

Despite these concerns I am a naturally optimistic person! Some problems will be helped through existing avenues addressed by Fellow authors in this Journal. But, unless my horizon scanning is thought to be flawed, I think that the Institute should urge academic and other research institutions, third sector bodies and international organisations to equip the world with a new breed of highly motivated and skilled environmental managers. By using ecological principles and practice, applied at the macro-scale, they would be contributing to the protection, restoration and improved functioning of large-scale ecosystems needed to prevent the worst outcomes of human population growth and climate change. In short, they will be increasing the world's carrying capacity, however that may be defined – perhaps the most important work imaginable.

Notes

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About the Author

David Tyldesley FCIEEM, FRTPI, FRSA is an active, founder member of CIEEM, retired from consultancy practice as an environmental planner and now a part-time author.

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Life in the Big City – Increasing Urbanisation and the Disconnect From Nature

Claire Wansbury CEcol CEnv FCIEEM

We live in an age of increasingly rapid urbanisation. According to United Nations figures, about 70% of the world's population is expected to live in urban areas by 2050 – already over half of us do so. However, over 60% of the land projected to be urban by 2030 has not even been built on (United Nations 2014).

Urban living can reduce the links between people and nature. Reduced connections with nature affect people. In the UK, this has been recognised as an issue for over a century. For example, one of the aims in the establishment of the National Trust in 1895 was ensuring access to open space for under-privileged urban residents, in the face of increasing urbanisation.

Evidence shows that an increasingly urban population suffers in both physical and mental health, and reconnecting with nature can help (Natural England 2017). Disconnection with nature can also result in impacts on the natural environment within and outside the cities, as people, including voters, lack understanding of its importance to them. Even looking at the excellent impetus of *Blue Planet II* inspiring action about plastic waste, discussions can focus on wildlife disconnected from the daily life of many people: lovely to watch on television but somewhere else, not recognised as being around all of us even in the most urbanised areas.

Ecosystem services – nature's benefits for people

In the UK, we are beginning to recognise the value of the ecosystem services we gain from nature. Atkins' valuation of London Wildlife Trust's Camley Street Natural Park shows that in its highly urban context this well-designed and well-used site of less than 1 ha contributes the equivalent of £2.8 million of services to the local economy and society annually (Atkins



Figure 1. Camley Street Natural Park. © London Wildlife Trust.

2015). On the international stage, there are areas where urbanisation is affecting the provision of ecosystem services with a direct impact not just on quality of life but on human survival. For example, earlier this year it was announced that Cape Town was heading towards day zero, the day when water supplies officially run out.

Many issues of urbanisation need solving at a large scale. However, no city is a single uniform area. Some of the most important large-scale solutions can only be achieved by getting things right over and over again at a much smaller scale.

Ecologists and designers are challenging the disconnect and finding solutions.

In some areas of the country water companies such as Dwr Cymru (Welsh Water), Scottish, Anglian and Thames have experimented with urban storm water management, adding to the biodiversity of urban green spaces and creating new ones while slowing the flow of water, giving immediate flood protection improvements for local people. Beyond these immediate benefits, such measures should help counter the effects of extreme weather events, likely to increase through climate change. In central London, the Wild West End partnership project aims "to encourage birds, bees and bats ... and create greater connections with nature for



Figure 2a. Stormwater management in South Wales – dry conditions.
© Jeremy Jones.



Figure 2b. Stormwater management in South Wales – wet conditions.
© Dwr Cymru Welsh Water.

residents, visitors and workers to enjoy”, recognising that such actions can be good for wildlife, people and business. (www.wildwestend.london).

Local connections with nature

One area of UK policy that can lead to very different issues in urban and rural contexts is biodiversity net gain. This concept has been growing gradually, supported in some areas by local policy, and it now appears in Defra’s 25-Year Environment Plan (Defra 2018). Among the issues for urban areas, if we think purely in terms of biodiversity, there may be perceived benefit in ‘exporting’ credits with losses in urban areas offset by gains achieved more cheaply in the wider countryside, but urban human communities will be poorer with this approach. In theory, this should be avoided through good stakeholder engagement, but the risk still must be recognised and managed.

Connecting people with nature benefits biodiversity by maintaining the public’s enthusiasm for wildlife and wild places, and the resultant value and importance placed on its protection. People also benefit directly, through ecosystem services like improved health and sense of place. As ecologists, we have a duty to promote that engagement. As part of this we need to recognise that we can be prone to using jargon without explaining it, a theme expanded on in *Getting the Message Across* (see page 20). Underpinning all our planning and actions to encourage reconnection, we should always bear in mind that facts and figures are not enough to engage people. Individuals’ personal experience is a vital part of the picture, whether that is through watching the latest

David Attenborough series on television, listening to a blackbird’s song, taking the kids for a muddy woodland walk, or any combination of these.

Future aspirations

The Defra 25-Year Environment Plan includes a commitment to *‘making sure that there are high quality, accessible, natural spaces close to where people live and work, particularly in urban areas, and encouraging more people to spend time in them to benefit their health and wellbeing.’*

This is a worthy aspiration, but how will it be achieved? What can CIEEM members do? For all of us, engaging with and understanding the issues around natural capital – which encompasses far more than just biodiversity – and the ecosystem services it provides, will help us contribute more to this essential topic. Speaking particularly to ecological consultants, my advice is also to take what for some may be a big, firm step outside your comfort zone: make contact with those undertaking social elements of environmental impact assessment, and with landscape architects and masterplanners. Ecologists have a lot of knowledge to share with urban realm designers (Natural England 2010) but we also have a lot to learn from them. So, if you want to help make a real difference, read up a bit on ecosystem services and then take a masterplanner out for coffee.

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The Hidden Tragedy of the Earth's Freshwater Ecosystems

Steve Ormerod FCIEEM

Biologically, freshwater ecosystems are among the Earth's most diverse. Although lakes, rivers and wetlands cover less than 1% of the Earth's surface, they support over 10% of all known species (Strayer and Dudgeon 2010). Among vertebrates, this proportion rises to over 33% because of the large richness in fresh waters of fishes, amphibians and birds which use inland waters or their margins during their life cycle. These numbers reflect the role of fresh waters in the origin of life and the physical heterogeneity into which species have since radiated. Yet for most people – including professional ecologists – much of this biological wealth is hidden beneath the water surface.

And therein lies tragedy.

For, in addition to being hotspots for biological diversity, fresh waters are also hotspots for human use: water is arguably the most fundamental resource on which we all depend. Across the Earth, over 50% of accessible fresh water is appropriated by people – dominantly for agriculture which accounts for over 90% of our global water footprint (Hoekstra and Merkonen 2012). Dams impound around 10,000 km³ of water – over five times the volume contained in the Earth's rivers (Dudgeon *et al.* 2006). Water quality is impaired globally, too, from rivers polluted by intentional waste disposal or incidentally by run-off from agriculture and other land uses. Around 1500 km³ of wastewater are released annually into the Earth's rivers, almost equivalent to total river volume (UN data). Nitrogen fluxes in many rivers now exceed pre-industrial background by at least 2-20 times. Across the European Union, around 60% of surface water bodies fail to reach 'Good Ecological Status' (European Environment Agency).

Intrinsic diversity, exploitation and impairment

It is the juxtaposition of biological diversity and human exploitation that has given rise



Ecydonurus sp. Photo credit Steve Ormerod.

to rates of species extinction in rivers, lakes and wetlands that are more rapid than any other ecosystem. The WWF Living Planet Index (WWF 2016) shows freshwater animals declining by more than 80% over the last 40 years – twice the rates for land (38%) and sea (36%) – and these trends are accelerating. Although it is challenging to appraise trends in less well monitored groups, such as invertebrates, the Living Planet Index accounts for taxonomic and biogeographical bias. The International Union for Conservation of Nature's (IUCN) Red List corroborates the widely threatened status among freshwater vertebrates, while data for better known invertebrates such as odonates, crustaceans and molluscs show parallel trends.

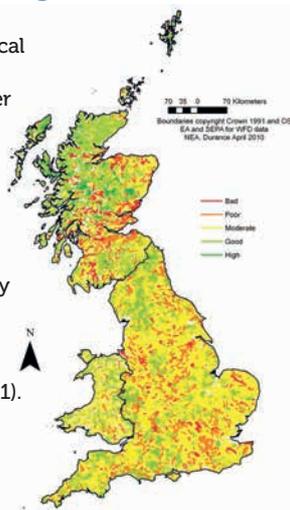


Southern Hawker *Aeshna cyanea*.
Photo credit Steve Ormerod.

If these statistics are not already alarming, growing use of the Earth's water is inevitable: if unchecked by disaster, human populations will expand globally by around 80 million per year for the next 30-40 years at rates that are largest in Asia and fastest in Africa (UN data). Without rapid – and probably unattainable – growth in water resource infrastructure to support storage, abstraction and irrigation, over four billion people will have insufficient water for food production. A billion will live in cities with perennial water scarcity, and three billion people will lack basic sanitation. More abstraction means less water for the dilution of pollutants, further impairment and increasing impacts on freshwater ecosystems. And all this arises in a World of increasing climatic uncertainty in which freshwater ecosystems are among the most sensitive to changing temperature, precipitation and associated stressors (Durance and Ormerod 2007). There is unfolding tragedy, then, not just for the conservation of freshwater organisms, but for freshwater ecosystems and for billions of people who depend upon them for basic life support.

How does the UK fare in this global challenge?

Figure 1. Ecological status classes of UK running water bodies recorded under the Water Framework Directive. Compiled from data supplied by the UK regulatory agencies for the National Ecosystem Assessment (2011).



There have been clear successes in the management of freshwater environments across all four UK countries. In the 1980s, the UK's urban rivers reached the end of decades of gross pollution from failing wastewater treatment and industrial discharge. The EU Urban Wastewater Treatment Directive (91/271/EEC), aided incidentally by industrial decline, brought major sanitary improvements to city rivers along with the celebrated return of salmonids and a significant increase in the richness of clean-water invertebrates (Vaughan and Ormerod 2012). Yet, there is another story. Over two thirds of UK rivers fail to reach Good Ecological Status against the requirements of the EU Water Framework Directive (WFD 2000/60/EC) – greater already than the European average and possibly even increasing (Figure 1). Admittedly, there are uncertainties around the class boundaries and in the use of the 'one-out all-out' principle where the lowest scoring metric is used to appraise status. Nevertheless, there are clear and potentially growing problems with diffuse pollution, particularly fine sediments, nutrients, and some pesticides from intensifying agriculture. In urban areas, too, problems with Combined Sewer Overflows continue alongside a legacy of extensive morphological alteration: over 50% of the UK's total river length of 389,000 km has been physically modified (Maltby and Ormerod 2011). New challenges are also emerging, for example from climate change, invasive non-native species, micro-plastics, pharmaceutical products from agriculture and human use,

and personal care products. The unequal distribution of rainfall (mostly in the north and west) and growing water demand (mostly in the south and east) across the UK is also likely to create a range of water resource headaches in the future – not least abstraction or water transfer to maintain lowland agricultural production. The simplest summary of the overall ecological trajectory of British rivers is that urban conditions are improving, but still impaired, while many rural rivers are now degrading. This is reflected, for example, in the declining populations of key quality indicators such as dippers, grey wagtails (Balmer *et al.* 2013) and salmonid fishes, or the systematic decline of larger, long-lived invertebrates affected by land-use intensification (Larsen and Ormerod 2010).



Dipper *Cinclus cinclus*.
Photo credit Charles Tyler.

CIEEM and the search for solutions

The risk, then, is that the UK is contributing to the global decline of freshwater organisms and impairment of temperate freshwater ecosystems. CIEEM members should be alert to the issues, and those members in the water industry, regulatory sector or aquatic consultancies can take action by bolstering the evidence, disseminating knowledge or advocating solutions. And solutions do exist – for example in defending the monitoring and assessment of the freshwater environment; expanding our reserve network to represent freshwater ecosystems and their catchments; regulating the water environment with rigour; developing and funding catchment management schemes that protect and restore freshwater ecosystems; developing markets for ecosystem services that properly value fresh waters against the costs of inappropriate resource exploitation; acting to build the protection of rivers, ponds and lakes into climate change adaptation.

And an arguably bigger duty for our Institute and its members is to engage just as fully with the problems of fresh waters as many of us do with terrestrial ecosystems. These critical resources are at a tipping point that we should make more visible to our governments, our communities and to the wider World.

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Landscape Conservation

Keith J. Kirby FCIEEM

Living Landscapes, Nature Improvement Areas, Ecological Focus Areas – most *In Practice* readers will have come across such ‘landscape-scale’ initiatives, but where have they come from and where might they go?

A long time ago...

The 1949 Acts that established post-war conservation separated, institutionally and culturally, nature conservation (largely site-focussed) from wider landscape conservation. For the next 30 years, the Nature Conservancy / Nature Conservancy Council and the Wildlife Trusts concentrated on SSSIs and reserves. Meanwhile the surrounding countryside was changed by farming, forestry and development. The conservation sector (less than a tenth of its current size) found it hard to assess the scale of these changes. Aerial photographs were scarce and often years out-of-date; there were no satellite images. Phase 1 habitat maps were constructed by field walking and scanning areas beyond the footpaths with binoculars. *Nature Conservation in Great Britain* (Nature Conservancy Council 1984) summarised what was known about post-war changes in habitats and species. The evidence was sometimes sparse, but the SSSI series alone was clearly insufficient to achieve conservation aims. Campaigns to stop the ploughing-up of Exmoor and the Halvergate Marshes attracted public support, as did concerns over subsidies for farming under the Common Agricultural Policy and tax support for forestry in Scotland (Figure 1). The way opened for what became agri-environment measures, taking conservation into the wider countryside.

The rise of landscape ecology and its application

During the 1980s landscape ecology developed as a discrete body of ideas and research (e.g. Forman and Godron 1986). Papers about metapopulations, fragmentation, isolation, habitat networks and least-cost movement paths between sites proliferated. Applying these ideas



Photo credit Keith Kirby.

to practical conservation proved more difficult; evidence that species respond as in the models, or that the distribution of patches matters more than just the general habitat extent, is often limited (Bailey 2007), but the general principles are sound (Lawton *et al.* 2010).

Management recommendations, however, still often mimic those for protected sites, rather than starting from the landscape view. At site level bigger patches generally equal ‘better’ conservation; but to enrich the whole landscape scattered small patches might be better. At site level we



Figure 1. Old style afforestation in Sutherland. Photo credit Keith Kirby.

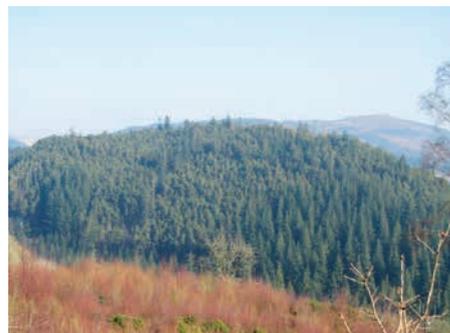


Figure 2. Future landscapes – new native woodland at Carrifran, scrubby fields on the Knepp Estate, mixed habitats at Coed y Brenin. Photo credit Keith Kirby.

focus on habitat specialist species, but across a landscape the priority might simply be to make ‘common’ species common again. At site level we worry about maintaining nativeness, local genetic integrity and past natural processes, but these are less important when restoring wildlife to heavily-modified, urban and agricultural landscapes, subject to climate change. We have yet to develop a coherent philosophy for landscape-scale conservation to cope with what Rotherham (2017) calls recombinant ecology.

Where do we go from here?

Let’s try to make the conservation sector and its employees redundant! Industrial, agricultural and forest production should be reshaped such that species thrive through economic activity without specialist intervention, just as hay-meadow flowers, or coppice-loving butterflies once did in the past. However, we are a very long way from this nirvana, so what do we do in the meantime?

Maintaining existing high-quality habitats, centred on protected sites, remains a priority. These are the sources from which species can spread again into the wider landscape. However, these sites will themselves be affected by climate change, disease impacts and nutrient inputs in ways that even the best management cannot prevent.

We need to create/restore/improve new species-rich patches through the countryside. These do not need to be, and it could be counter-productive if they were, slavish copies of current long-established habitats derived from former farming practices. We are not going back to nineteenth-century peasant economies. We need compositions and distributions

of species-rich patches that fit current and future socio-economic conditions (Figure 2). We need to include novel approaches such as rewilding (Lorimer *et al.* 2015), being trialled at the Knepp Estate (see page 29), or at Alladale; a more pro-active attitude to species translocations, as with pine martens to mid-Wales, and re-introductions (e.g. beavers in Scotland). We need flexibility in identifying cost-effective ways to get wildlife back: where to concentrate on a small number of high quality sites, where an equivalent or greater gain could be achieved more cheaply by accepting more ‘less good’ sites. For example, if we were to push for entirely native woodland in the proposed Northern Forest, we might get (say) 1000 ha established; by encouraging mixed and coniferous woodland as well, we might get only 500 ha of native woodland but 10,000 ha in total.

A role for CIEEM members?

Priorities for food and fibre production, water regulation and carbon sequestration will largely shape future landscapes, but we must help in their design.

- How much land should be ‘rewilded’ and where; how far down the rewilding path should we go?
- Which habitats and species can be maintained using present management practices under changed future conditions; which do we need to find alternative spaces for; are there some we should be prepared to lose?
- Where should we concentrate resources on protected sites; where on wider, more extensive but lower-quality, patches?
- More effort will be needed on assessing species distributions and processes at the landscape-scale with less concern for changes at the individual site level.

There is not one right answer across the whole country. We must develop scenarios, with the public and other land-users, around what sort of wildlife we want and can reasonably expect in the countryside in 2050. Overall, we must become better at seeing where economic and social factors are taking land use, and shape that flow in ways that can better incorporate wildlife.

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Restoration of Biodiversity

David Hill CEnv FCIEEM

Biodiversity loss in the UK is catastrophic, especially over the past 60 years. As ecologists, we must set and challenge policy; facilitate quantitative valuation approaches; develop solutions; and implement habitat creation, enhancement and management based more on functionality than species. This article explores what is needed to restore biodiversity in view of a new policy landscape, what the opportunities and risks for the profession will be, and how we need new financial models to pay for it in our predominantly farmed landscape.

The problem – biodiversity loss

The losses to biodiversity are documented in State of Nature 2016 reports (Hayhow *et al.* 2016a,b,c,d) produced by a consortium of conservation NGOs for England, Wales, Scotland and Northern Ireland separately (see Table 1 <https://www.cieem.net/back-issues/>). The two principal causes of terrestrial biodiversity loss are: a) the industrialisation and intensification of farming, particularly since WW2, and b) built development and transport infrastructure. Most remaining biodiversity in England is now confined to just 30% of the land not dominated by arable farming, improved grassland or built development. Much of this article therefore focuses on restoration across the farmed landscape given its disproportionate spatial impacts on biodiversity. Whilst there is some evidence that rates of decline have started to slow, low population levels often make reliable assessments difficult.

Biodiversity restoration to date has tended to focus on the removal of non-native species; reintroductions and translocations; specific habitat management; and combatting wildlife crime and unsustainable harvesting. Although there have been successes with these approaches, there needs to be a transformational change in the way we farm and the way we undertake development if we are to make a serious impact on restoring biodiversity in the UK.



Government policy

The devolved administrations in the UK each have their own environmental policies. The Welsh Natural Resources Policy promotes the maintenance and enhancement of farmland biodiversity, and aims to increase the resilience of the natural environment by restoring degraded habitats and creating new habitats (Welsh Government 2017). In Scotland, the aim is to meet the Aichi target of restoring 15% of degraded ecosystems by 2020, and to improve the management of natural assets by ensuring that the benefits which nature provides are better understood and appreciated (Scottish Government 2015). Scotland will use a Natural Capital Asset Index (NCAI) as a means of assessing natural capital in relation to the sustainability of the Scottish economy. Northern Ireland's policies appear less detailed and more general, although there is reference to ecological restoration of specific priority habitats (Department of the Environment 2015).

In England, the Government's 25-Year Plan for the Environment (Defra 2018) is a step in the right direction. For example, it highlights both the need to improve the environmental performance of farming and for all development to deliver net gain in biodiversity (CIEEM 2016). The

The following Tables are available as online Supplementary Material at <https://www.cieem.net/back-issues/>

Table 1. A brief summary of some of the documented losses to biodiversity.

Table 2. A review of the three key sectors where changes are required to deliver effective restoration of biodiversity, noting what needs to happen in policy terms, possible solutions that could be put in place and the potential scale of the market.

Table 3. Examples of opportunities and risks for the ecological profession from the commitments made in the 25-Year Environment Plan (Defra 2018).

Plan acknowledges that biodiversity is a natural capital asset whose continued depletion will lead to substantial economic consequences for society.

Solutions to restoration

Biodiversity restoration at a scale sufficient to reverse the catastrophic declines (Lawton *et al.* 2010) needs significant resourcing, and substantially more than is currently provided. I calculate from annual reports that the largest 17 conservation-orientated NGOs have an annual collective income of £854m, of which around £210-240m is spent directly on biodiversity in England alone (2012/13). In addition, the Government spends about £400m, largely on agri-environment schemes. To date, this spend has not reversed biodiversity decline overall; new financial models are needed, particularly for the farming and development sectors. Options include i) conversion of Pillar 1 CAP funds (about £3.2bn per annum) into environmental land management contracts, ii) habitat offsetting, and iii) corporate natural capital accounting. See Table 2 for more details (<https://www.cieem.net/back-issues/>).

Implications for the profession

Effective biodiversity restoration is reliant upon skilled ecologists and environmental

professionals. As the 25-Year Plan for the Environment (Defra 2018) is implemented alongside other environmental policies, members of CIEEM will be well placed to help reverse biodiversity loss through:

- Restoration ecology skills including practical experience of different techniques, planning, long-term monitoring and adaptive management.
- Proposing better large-scale solutions rather than within-site (development site) mitigation approaches that are unlikely to provide long-term net gain enhancements.
- Working to embed no net loss (NNL) and net gain (NG) fully in the planning process so that both planners and developer clients step up to their responsibilities.
- Promoting the natural capital approach at local and landscape scales, making biodiversity economically visible and valued. Involvement in the design of natural capital measurement systems (metrics).
- Contributions to policy developments in natural capital accounting; rolling out to development scenarios and corporate natural capital disclosure projects.
- Development of novel financing models for natural capital and biodiversity assets and the creation of standards to regulate funding flows.
- Contribution to the implementation of new environmental land management contracts for farmers – design of schemes, habitat creation, habitat management planning, cost-effective biodiversity assessment monitoring and reporting. Ecologists could be proactive in offering a service to farmers and landowners to win bids created by central government tendering processes.

Opportunities and risks associated with the various initiatives in the Plan are itemised in Table 3 (<https://www.cieem.net/back-issues/>).

Conclusion

Much of the biodiversity resource in the UK is threatened, largely by intensive agriculture and development impacts. Although there have been restoration successes in the past, often at the single-species level, funding needs to increase alongside policy changes to have an impact. The Government's 25-Year Environment Plan is a first class vision that

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could deliver a transformational change in both the appearance of the countryside and in the biodiversity it supports. Based on the principles of natural capital protection, enhancement and effective management, the Plan offers a unique opportunity to realise our ambitions for nature. Whilst we all understand the ethical, moral and intrinsic value of the natural environment, the Plan sets out how a healthy society and economy are underpinned by biodiversity and why it is so important to fully restore and better manage the natural environment in the future. New financial models and structures are needed to leverage sufficient funding to facilitate this transformational

change. The opportunities for ecologists to drive this forward and provide services to deliver actions on the ground should be substantial, notwithstanding the risks along the way.

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Environmental Degradation?

Kathy Dale CECOL FCIEEM

When I was invited to write an article on environmental degradation, the first question I asked myself was, is the environment degrading or is this just the general perception? In a survey (European Communities 1999)¹, the universal view of respondents was that their local area was fine, their country was OK but the world was in a terrible state! From my research of key environmental statistics and trends data I found that the answer is yes, the environment is degrading, but not all elements of the environment and not everywhere. There are uncertainties in the data and contradictory new research is published all the time, therefore the picture is quite complex.

Recent global history

Over the last 100 years, the global population quadrupled to 7bn and GDP increased about 20-fold. The resulting scale and intensity of pressures on the environment has altered nearly all of the earth's systems, leading to proposals that the planet has entered a new geological era: 'the anthropocene' (Zalasiewicz *et al.* 2015). Humans use the environment as both a source of raw materials and as a sink for wastes. At a global level, changes in the environment are driven by a number of interacting pressures, including demographic change, urbanisation, economic growth, transformation of renewable natural capital, levels of resource use, an increasing rate of technological change, levels of environmental pollutants, climate change and biodiversity loss (Natural Capital Committee 2015).

The picture in Europe

EU environmental policy was initiated in the early 1970s and there is now an EU 2050 vision of 'living well within the limits of the planet' (European Environment Agency 2015)². As a result of the implementation of these policies, in many parts of Europe the local environment is arguably in as good a state today as it has been since the start of industrialisation, due to reduced pollution, nature protection and better waste management. However, European natural capital is still being

degraded by socio-economic activities such as agriculture, fisheries, transport, industry, tourism and urban sprawl (see Table 1).

It can be seen from Table 1 that there have been marked improvements in the quality of drinking water and bathing water in recent decades and some hazardous pollutants have been reduced. Fossil fuel use has declined, as have emissions of some pollutants from transport and industry.

Despite improvements, air pollution continues to cause serious health impacts, particularly in urban areas, but these have reduced since the 1950s. The infamous smogs in England at that time precipitated vociferous public concern, which resulted in the UK Government introducing its first Clean Air Act in 1956.

The EU's total resource use has declined by 19% since 2007 (European Environment

Table 1. An indicative summary of environmental trends.

	5-10 year trends	20+ years outlook	Progress to policy targets
Protecting, conserving and enhancing natural capital			
Terrestrial and freshwater biodiversity			•
Land use and soil functions			No target
Ecological status of freshwater bodies			X
Water quality and nutrient loading			•
Air pollution and its ecosystem impacts			•
Marine and coastal biodiversity			X
Climate change impacts on ecosystems			No target
Resource efficiency and the low-carbon economy			
Material resource efficiency and material use			No target
Waste management			•
Greenhouse gas emissions and climate change mitigation			X / X
Energy consumption and fossil fuel use			X
Transport demand and related environmental impacts			•
Industrial pollution to air, soil and water			•
Water use and water quantity stress			X
Safeguarding from environmental risks to health			
Water pollution and related environmental health risks			X / •
Air pollution and related environmental health risks			•
Noise pollution (especially in urban areas)		N/A	•
Urban systems and grey infrastructure			No target
Climate change and related environmental health risks			No target
Chemicals and related environmental health risks			• / X

Indicative assessment of trends and outlook		Indicative assessment of progress to policy target	
	Deteriorating trends dominate	X	Largely not on track to achieving key policy targets
	Trends show mixed picture	•	Partially on track to achieving key policy targets
	Improving trends dominate	X	Largely on track to achieving key policy targets

Source: European Environment Agency (2015). *SOER 2015 – The European Environment – State and Outlook 2015*. European Environment Agency, Copenhagen.²

Note: The indicative assessments presented here are based on key indicators (as available and used in SOER thematic briefings), as well as expert judgement.

Agency 2015²), less waste is being generated and recycling rates have improved in nearly every country. However, globalisation of supply chains means that many impacts of Europe's production and consumption occur in other parts of the world. European greenhouse gas emissions have decreased by 19% since 1990 despite a 45% increase in economic output, but Europe is not on track to meet its 2050 target of 80–95% reductions. A high proportion of protected species (60%) and habitat types (77%) are considered to be in unfavourable conservation status, and Europe is not on track to meet its overall target of halting biodiversity loss by 2020. The reasons for this are cited as loss, fragmentation and degradation of habitats through urban sprawl, agricultural intensification, land abandonment, and intensively managed forests; overexploitation of fisheries; the accelerated establishment and spread of invasive alien species; and the increasing impacts from climate change exacerbating other threats.

The marine environment

As well as multiple other pressures, our seas have become a sink for increasing amounts of litter, such as plastics. Research at Plymouth University (Thompson *et al.* 2009) has shown that microplastic particles have accumulated in the oceans since the 1960s and are now widespread. Their impacts include physical problems for wildlife resulting from ingestion or entanglement, leaching of chemicals, and the potential for transfer to wildlife and humans. It has been estimated that of the 275 million tons of plastic generated in 2010 by 192 coastal countries, 4.8–12.7 million tons entered the oceans; this is expected to increase tenfold by 2025 (Jambeck *et al.* 2015).

Scotland's freshwater environment as a case study

The environment is a devolved matter in Scotland and is considered to be a key aspect of the country's success and wellbeing. Scotland's environment is generally in a good condition but there remain areas where environmental quality is poor (The Scottish Government 2017). The aquatic environment is subject to a number of pressures, including drainage of wetlands, abstraction for hydro-power,

industry and households, and channel modification for flood defence and development. These uses have altered river flows and led to the loss of connectivity between rivers and their floodplains. However, peatland restoration, natural flood management and the concept of payments for ecosystem services can deliver many benefits and have already reversed some of these losses. In addition, one of our iconic species, the otter has largely recovered from historical lows with around 80% of sites showing signs of otters in 2011–12 (Scottish Natural Heritage 2015). It is now generally considered that otters are ubiquitous in Scotland and they can be found in a range of places including in towns and cities; an indicator of environmental improvements.

A brighter future?

The environment industry sector, which produces goods and services that reduce environmental degradation and maintain natural resources, such as reduced pollution, nature protection and better waste management, grew by more than 50% between 2000 and 2011. It has been one of the few economic sectors to have flourished in terms of revenues, trade and jobs since the 2008 financial crisis (European Environment Agency 2015).

CIEEM members have key roles to play in the ecology and environmental management sector, helping to deliver some of the positive changes outlined above through awareness raising, improving the knowledge base, integration of policy, innovation, guidance and good practice, stakeholder engagement, mitigation, adaptation and resilience strategies, restoration and enhancement, across all our professional disciplines. Key to this delivery will be taking precautionary and preventive action, based on early warnings from science.

Notes

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2. European Environment Agency (2015). *SOER 2015 — The European Environment — State and Outlook 2015*. European Environment Agency, Copenhagen. The 2050 vision is set out in the EU's 7th Environment Action Programme (EU 2013).

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Getting the Message Across

Stephanie Wray CECOL CENV FCIEEM

CIEEM President, Dr Stephanie Wray, has long held the view that some of the greatest threats to the environment are apathy and cognitive dissonance. In this article she explores some considerations in getting our messages across to as wide an audience as possible.



The Living Planet Index measures biodiversity abundance of over 3700 species and illustrates that, on average, populations declined by 58% between 1970 and 2012 (WWF 2016). In the UK, as part of the State of Nature report, over 50 organisations and many hundreds of volunteers monitored 8000 species. They found that 15% of them, some 1200 species, were at risk of extinction in the UK. The UK is ranked 189th out of 218 countries monitored for their Biodiversity Intactness Index (RSPB 2016) with Ireland and the US ranked lower.

Now close *In Practice*, get a cup of coffee, come back in ten minutes and tell me what those figures were. Tricky, isn't it? We have clear and well-documented evidence to support the view that we are entering the earth's sixth mass extinction event. As professionals, we tend to reach for scientific evidence to support our arguments, but facts and figures aren't the only tool we need.

There has been a long history of apathy towards environmental protection from the general public and their political leaders. In the UK, this was demonstrated by the almost complete absence of environment as an issue raised throughout both the Brexit referendum and the last general election. I contend that a significant proportion of the population know that protection of the environment is important, but do not

feel that they can or need to act. Reaching into the apathy zone is key, so here are my thoughts on communicating environmental messages effectively.

1. **Know your audience.** You wouldn't give the same lecture to a group of university students as you would to a group of pre-schoolers. It is important to achieve the right tone, and balance between accurate science and accessibility when writing for a broader demographic. I tested the reading age of a quick sample of *In Practice* and it is aimed – quite appropriately – at those with a college education. If you look at a national newspaper, you will find that the reading ages range from around 9 (*The Sun*) to around 15 (*The Guardian*). We need to use plain English and distinguish clearly between those occasions when we are talking to other professionals and when we seek wider understanding of our work.

There are also times when we are not addressing a wide audience but may want to target particular groups within society to ensure our message reaches people of different ages, genders, ethnicities, and socio-economic backgrounds. A short article like this cannot cover how to approach all hard-to-reach groups, but one important difference to consider is the age-related preferences for receiving information.

For example, Millennials, the generation who don't remember a time before the internet, in general prefer to gain information visually, in short bursts, so video is a powerful medium for getting messages across. The channels by which that video is provided also need consideration. Different age groups vary in their use of social media platforms; tell me whether you prefer Facebook, Instagram, or Snapchat, and I will guess your age. Caring about causes, and concerned about the state of the environment, Millennials represent huge power for positive change and we, as a profession, have a responsibility to provide them with reliable evidence.

2. **It's the way you tell 'em.** The tone and attitude of a message is just as important as what you say. Nobody is receptive to a message that implies they are a terrible human being who is single-handedly destroying the planet. But a balanced, conciliatory message about what a great contribution they could make by changing a few things, might be better received. Think about veganism. Logically it makes sense: it can be better for animals, better for our health, and better for the planet. The only thing on the other side of the balance is how tasty bacon is and, frankly, that's a bit weak. But veganism can be portrayed as some sort of extreme 'holier than thou' lifestyle choice. Until Veganuary came along; a social-media driven, friendly, accessible campaign that didn't preach, and said "Just try it. It's not about being perfect." This year, over 150,000 people worldwide took part. In the same way, encouraging environmental messages about what can be achieved will gain more traction.
3. **Mind your language.** Any professional specialism will generate jargon, and ecology is no exception. But terms like biodiversity loss, ecosystem services and natural capital, whilst helpful to an audience of scientists, do not resonate with the general public. Words like 'nature' are far better understood. Recent studies have found that despite arguably being a greater crisis, the loss

Table 1. Communication strategies for different audience types.

Audience type	Strategy
Hostile	Open with humour; seek win-wins; evidence all assertions; focus on any areas of agreement.
Neutral	Spell out benefit; present just 3 clear, evidenced points; use stories and personal insights.
Uninterested (informed but don't care)	Grab attention with a big headline or fact and show how it affects them directly; use expert testimony.
Uninformed (lacks information)	Establish your credibility, experience or qualifications; keep it simple – just a few key messages with straightforward evidence, don't confuse with complex supporting evaluations.
Supportive	Use success stories to recharge enthusiasm; help them anticipate and refute possible counter-arguments; give clear actions.
Mixed	Identify who most needs to be convinced / has most influence and target them; appeal to different sub-groups (without promising everything to everyone).

of biodiversity is mentioned in English newspapers only once for every eight mentions of climate change (Keim 2018). The authors suggest using emotive, but easily-understood language, like “burning the library of life”.

4. **Keep it Simple, Stupid.** We have seen a recent surge in interest in the problem of plastics in the ocean, driven in part by the ‘Attenborough effect’. I recently did a survey of attitudes to nature in 18 to 25-year olds who did not have particular environmental expertise. Of 100 young people, all were aware that plastic pollution was a problem. However, over 75% believed this was a problem entirely related to people throwing plastic into the ocean, or littering on beaches. That is, they thought it was a problem caused by other people – the sort of unaware people who throw trash in the sea. They hadn't seen the issues around their own use of plastics, blowing away from landfill, or taken by sea for recycling or disposal in the developing world. The key in driving environmental action is to make it personal, explain how your audience can make a difference and don't be afraid to explain the links you thought were obvious. There is, however, a very fine balance between creating the ‘burning platform’ (Kotter 1996) that inspires action, and delivering messages that are ‘doom and gloom’ which can turn people off, thinking it's too late or there is nothing they can do.

5. **Read the room.** Being persuasive requires us to target our approach depending on the audience. Are they hostile or supportive? Uninterested or just uninformed? Are they already supportive, but don't know what they can do? Table 1 gives strategies for different audience types.

Conclusion

Human brains are very bad at prioritising long-term good over short-term desire. In evolutionary terms that makes sense; but in our more complex society we need to take strategic approaches for the long term, and our hindbrains don't help. I'll stop smoking tomorrow. I'll take that low-cost flight today, and worry about climate change tomorrow. There are significant parallels with health education. The battle to tackle smoking has been long, and has involved both carrot and stick: attractive alternatives; punitive taxation; and social isolation through bans. We need to make environmental responsibility the social norm and make activities which degrade the environment both socially unacceptable and financially unattractive. Government is being tough on single-use plastics, but does it need to be? The public mood has changed and retailers are competing to shed their links to plastic litter faster. That is the engagement we need on wider biodiversity issues.

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Because the consequences of environmental degradation aren't evident immediately, society can think it has time to deal with it later. If the engines were to fail on that cheeky low-cost flight, you wouldn't just fall right out of the sky. The plane would glide and the pilot would have maybe 20 minutes to find a safe space to land. For those 20 minutes you, as a passenger, would be in grave danger but might not be aware of it at all; not plummeting, just silently gliding. We need to get across the image of nature on that glide path. The engines have failed, and we are in that finite window in which we need to reach safety, or suffer catastrophic consequences. As environmental professionals, I believe it is our ethical duty to raise awareness and offer evidence-based advice on how to land.

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Stephanie Wray is President of CIEEM and an environmental consultant with Biocensus and Tyler Grange. In what she laughingly calls her spare time, she writes, and is passionate about communicating environmental issues.

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Where Does Power Lie? And Can We – the Environment Sector – Get Better at Accessing It?

Robin Buxton CEnv FCIEEM



Fourteen million Brits (and 80 million Chinese) watched *Blue Planet II*. Surely such popular interest demands political action? *Blue Planet II* highlighted plastic pollution in the oceans, a key environmental concern. Tackling marine plastic is a strong commitment in the UK government's 25-Year Environment Plan, published shortly after *BPII* was broadcast (Defra 2018). More usually, translating armchair interest in nature into financial and political commitment to the environment, meets stiff resistance at many levels in UK society, with only 4% of UK philanthropy going to green causes¹. What was different about this particular story in this particular television series? My aim here is to shed

some light on the political and societal indifference to environmental issues, and ask whether we, as environmentalists, are part of the problem?

Lessons from the 25-Year Environment Plan

The 25-Year Environment Plan took a long time to produce and nearly stalled (Defra 2018). It was going to be combined with a 25-Year Plan for Agriculture but the two sectors need to satisfy different political constituencies and so logic gave way to political expediency (Clark 2014). Even though the process was contested (including within Defra), the Plan was eventually published. George Monbiot's

response² to the published version – “...in some ways the best government document I've ever read...” – suggests the first draft was written with passion, intelligence, ambition and sincerity. What has happened since? What we see, as with all government statements, is what is left after all departments – Treasury, Home Office, Foreign Office, Ministry of Housing, Communities & Local Government, Department for Business, Innovation and Skills, etc. – have removed anything they could possibly object to. It is the product of time-pressured people, hypersensitive to personal, departmental, lobby, media and party risks, applying the red pen³. The lesson here is that power to obstruct is much more

dispersed than power to enable and if we want to influence people with power, we need to reassure and win over blockers as much as we encourage promoters.

Understanding the dynamics and pecking-order of Parliament is a first step to engagement with those in power. Every minister in every department of the UK government has signed up to the statements of intent in the 25-Year Environment Plan. This is a triumph. Now we need to help the policy makers feel good about it so that they see engagement with environmental issues as potentially career enhancing, advantageous to their party, their department, their political capital, their share of votes at the next election; as something they can be proud to tell people they are embracing.

Different approaches, different tactics

All sectors have differences. It is the stuff of politics, and every sector you look at closely has its fundamentalists, liberals, mavericks, and red line, fight-to-the-last firebrands who see negotiators as traitors to the pure cause. The most common reason given for not engaging with green interests is that environmentalists cannot agree amongst ourselves. We need to address that criticism and find a way to manage its causes. Fundamentalists, whether an individual Swampy tied to a tree, or institutions determined never to surrender an inch of green belt or a single newt, are important, but so are those who gain concessions from others by negotiation. As a sector, we have real internal challenges in becoming more coherent while valuing diversity; more focused on achievable goals and being open to engaging with other interests to achieve progress through give and take. This is never more important than when interacting with those in positions of power and influence, especially those holding political sway.

What was your reaction to reading that? "Pah! Sell out?", "He's one of them, mainstream, not one of us?" Look back to the mid-20th century and the beginning of government engagement in nature conservation in the UK and you will see a situation that is unrecognisable today. The Nature Conservancy was empowered to lead nature conservation for the nation. Its senior officers had real influence on policy and the power to implement it (Moore 1980). There were battles, particularly

with farming interests – the battle of West Sedgemoor is a totemic example, with farmers burning an effigy of the Nature Conservancy Council's chairman⁴. And NCC won – so now we have common cranes breeding in as near natural wetland as we have in England. Ironically, as the whole environmental sector has grown, and statutory protections increased, the freedom of statutory agencies to lead and champion nature has been stripped away. There are many reasons, but I fear that one of them is the image of an environmentalist as a single-minded extremist with no interest in all of the other legitimate and vitally important issues that preoccupy the mainstream of society.

As its resources and membership have grown, CIEEM has developed increasingly effective engagement with the UK Parliament, the devolved administrations, the Department of Environment, Food and Rural Affairs (Defra) and the Statutory Nature Conservation Bodies. Our influence in the Republic of Ireland is growing too. It fields persuasive experts to respond to policy consultations and to present views, concerns and recommendations at informal discussions and formal enquiries. It highlights that contact with nature is not just nice to have, but has substantial benefits for ordinary people's physical and mental health and productivity at work. Economies pick up as environmental challenges are addressed. Local group action for nature and quality green spaces foster community development. Are these things enough to elevate the environment to stand alongside jobs, education, health, national security, civil order and the economy as crucial considerations of mainstream society? My contention in this article is that they are not enough, and that increasingly strident, single-minded environmentalism is more a barrier to, than a facilitator of, mainstream engagement. To raise environmental sustainability into the political mainstream I believe we need to collaborate with all legitimate interests. If we really want to be influential we must take society with us and to do that we must engage with all the key issues, including development and economic growth. We need to build alliances and develop relationships with key sectors and individuals, especially political leaders.

Notes

1. Under 4% of UK philanthropy goes to green causes <https://www.greenfund.org/what-influences-wealthy-donors-to-give-to-different-causes/>
2. www.theguardian.com/commentisfree/2018/jan/11/theresa-may-plastic-plan-economy-consume
3. Michael Dobbs (1990). House of Cards trilogy television series.
4. www.telegraph.co.uk/news/obituaries/1338879/Sir-Ralph-Verney-Bt.html

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Dr Robin Buxton MBE held key positions with CIEEM and the Earth Trust before his recent retirement. Alongside charitable activities, Robin is enjoying reviving his roots as a naturalist.

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Using the Evidence

Rob Marrs CEcol FCIEEM

The phrase 'evidence-based' is used routinely almost everywhere and our profession is no exception. However, when I hear it I revert to my Scottish "*We're all doomed*" scepticism because it is used too often as a contrivance to make something appear better than it is rather than being a guarantee of up-to-date evidence. Our profession, above all, should pride itself on using only the best evidence to guide management actions. If we do not, we are akin to soothsayers throwing some bones to derive some supposed wisdom.

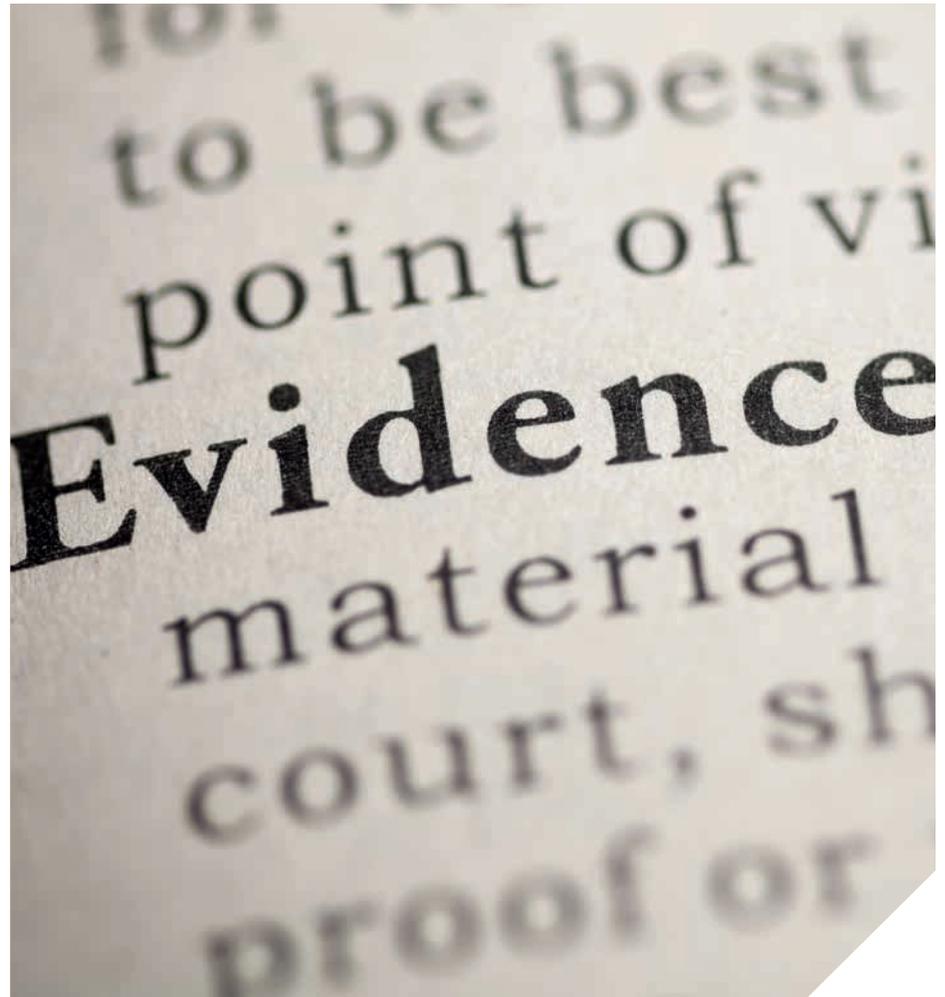
For me there are four issues for us as professionals:

1. the realisation that evidence is needed;
2. the ability to get up-to-date evidence;
3. being able to understand the information obtained; and
4. linking to social science to help resolve conflicts.

Realisation that you need to obtain the evidence

As a profession, we are collecting evidence all the time but how many of us do serious research at the planning stage of a project to ensure the information we collect and use is of the highest quality? As well as identifying partners with complementary expertise, we should critically appraise our own skills. This is where Continuing Professional Development is crucial. Conferences and training courses have a major role here but there are many other ways of updating and extending our skill set. If cost is an issue, be imaginative to find a way to update your skill set, use the internet or, even better, volunteer alongside experts.

Taxonomic identification skills are particularly important in our profession. There has been a massive decline over the last 50 years but many courses are available, ranging from local Wildlife Trust one-day courses to specialised, much longer, accredited identification courses (e.g. the joint initiative between Manchester Metropolitan University and the Field Studies Council to provide training at Masters Level). Courses run



by CIEEM, Plantlife, BSBI and others also provide vehicles for any member of our profession to upskill where their taxonomic skills are weak.

It is beholden on us all to ensure the evidence we collect is accurate, appropriate, comprehensive and of the highest standard in order to guide effective environmental management.

Knowledge acquisition

One of the biggest complaints by environmental practitioners is: "*I can't get hold of the up-to-date evidence I need*". I'm sorry, but I just don't buy this excuse. Over the last 20 years there has been a complete revolution in the way scientific information is published.

Almost all scientific journals maintain searchable, web-based platforms, and most provide access to back issues. Everyone can read at least the titles and abstracts of almost everything that is published, and much material is free to access; if not, the full version will be available for a modest fee (and yes, the fees are modest). Every year more and more journals adopt an open-access policy as we move towards free availability of all published material (see the Directory of Open Access Journals at www.doaj.org). In the meantime, there is always the fall-back option of emailing the author to ask for a PDF – most authors are very willing to help people in this way – or check your local libraries.

So, really, there is no excuse for not being able to access up-to-date information but how do we find it in the first place? Many rely on 'Professor Google' to search the scientific literature but *Google Scholar* is better. There are many freely-available search engines (see <https://onlinephdprogram.org/academic-research/> for a comprehensive list), some of which provide access to published papers as pdfs. Another easy way to keep up-to-date with key publications is to set up Table of Contents alerts direct to your Inbox. Publishers want you to find and use what they publish and compete to make it as easy as possible for you to find what you are looking for. Take a day to set up some automatic feeds and then make a habit of scanning what comes in.

Understanding the information collected

Never has the need for decision-making that is informed by science and evidence been more necessary but it is not simple. Environmental decision-making often involves a need for information from many different disciplines and the evidence from each one might be conflicting. The hydrologists say "Yes", the geologists say "No", and the ecologists say "Maybe, depends on which taxonomic group you are looking at".

Moreover, science, and especially statistical analysis, has become more complex over the last 50 years and it is sometimes difficult for non-specialists to discern the truth from confusion. Here, there is a need for what is effectively a translation system, where specialists assist in helping the non-specialist get to the nub of the issue. As I see it, there are three ways that collated evidence can be derived, these are:

a. Someone else does the collation for you. This is beyond a simple *Google* search and includes reviews by NGOs or other scientists. Reviews in the peer-reviewed literature are usually balanced but others may be less so – choose your source carefully and judge the information accordingly.

b. Somebody provides a summary of the evidence but allows you to come to your own conclusions. A great example of this is *Conservation Evidence* which is a free online, searchable, information resource database. It publishes research, monitoring results and case studies on the effects of

conservation interventions in its open-access journal; provides summaries of papers published in the wider literature including methods of habitat or species management; draws together synopses of major issues; and publishes an over-arching, free-to-download book *What Works in Conservation* providing expert assessment of the effectiveness of interventions based on the synopses. The user accesses the *ConservationEvidence.com* search engine and gets all the available information on their area of interest, often in summary form. It is then up to the user to read the available information to inform decision-making.

c. Somebody produces an unbiased assessment of an important question in environmental science.

No-one can be completely unbiased but you can try and minimise it. This is where the concept of Systematic Review, originally developed by Archibald Cochrane for the medical sciences, will be transformative. The approach has been developed by the Collaboration for Environmental Evidence (CEE), a worldwide partnership with six autonomous centres to date including the Centre for Evidence-based Conservation at Bangor, and partners at Harper Adams and Exeter universities in the UK. These centres carry out Systematic Reviews and Systematic Maps using the approved CEE methodology. Here, a single environmental question is reviewed using a repeatable search methodology which attempts to minimise bias by identifying all the papers that attempt to answer the question. These are subject to a meta-analysis to produce a more robust answer to the question than the individual studies. Importantly, the search protocol and methods are scrutinised by stakeholders and are openly available. The Systematic Reviews/Maps are available in the CEE library and often in the open-access journal *Environmental Evidence*. They aim to become the industry standard over the next 10 years to inform decision-making.

The future

In my view, we must as a profession move towards an evidence-based approach free of bias. However, in our subject area

many practitioners are also motivated by strong feelings based on personal interests or their own ethical agenda. Where this occurs, it is sometimes difficult to stand back and take a measured view. I hope that the development of tools to produce unbiased assessments become the norm to try and remove inherent biases from decision-making. It is also inevitable that future environmental practice will require us to interact with a much greater range of professionals, in particular with social scientists and economists. Good examples include the RELU and BESS programs where inter-disciplinarity has been championed (<http://relu.data-archive.ac.uk/>; <https://nerc.ukri.org/research/funded/programmes/bess/>). Although conflicts will continue, hopefully, the principles to solve such conflict situations identified by Redpath *et al.* (2015) will be used, extended and improved. Compromise will sometimes be necessary but let's accept this and enjoy the camaraderie that ensues from working with other disciplines.

Resources

- BESS. <http://www.nerc-bess.net/>.
See also <https://ecosystemsknowledge.net/bess>
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Reaching the Bar

Will Woodrow CEcol MCIEEM and Jenny Neff CEcol CEnv FCIEEM

As CIEEM members, much – if not all – of our professional work is aimed at dealing with often complex environmental pressures and recommending ways to minimise impact and maximise benefit. The quality of our work, across the membership, is a big part of how seriously the ecological and environmental profession, and ecological and environmental protection, is taken.

“I learned long ago, never to wrestle with a pig. You get dirty, and besides, the pig likes it.” George Bernard Shaw

Recent work by CIEEM and others has resulted in a significant increase in guidance and information on what is expected in the quality of ecologists' work. There has been a good deal of attention on *raising the bar*. However, it has to be acknowledged that there is a real challenge in helping all in actually *reaching* the bar that has been set.

The Irish experience

In Ireland, factors such as a chronic historic lack of funding for and enforcement of environmental obligations, along with a lack of training opportunities, has meant that individuals or companies have been left to set where they want to be rather than all being lifted by a rising tide. This has resulted in a situation where we share our profession with those who are truly driven to excel in their field as well as, unfortunately, those who are happy to provide the minimum requirement – and in some cases well below.

Low standards can be exacerbated by the ongoing expectations of clients who require an individual ecologist to undertake work/surveys across a wide range of species and habitats, which few have the ability to do well. We, as practitioners, must all know our individual limits. As members of CIEEM we are obliged to abide by a Code



of Professional Conduct which includes *'maintaining our professional knowledge and skills'* and *'only undertaking work that we have the competence to do to the expected standard and seek appropriate advice, training and assistance if we are involved in topics beyond our competence'*. Sadly, some members in Ireland - including some with many years' experience – continue to work outside their core area(s) of expertise, resulting in low standards bringing the profession into disrepute and letting down clients in the process.

We have noticed a certain buzz around practitioners recently who have highlighted the hunger for raising the standard through training and other ways but have also occasionally voiced concern over the difficulties in keeping high standards when there is noticeably substandard work also being produced and accepted.

So, what to do? Certainly, rather than wading in and waving our Code of

“Education is not the filling of a pail, but the lighting of a fire.” W.B. Yeats

Professional Conduct at every opportunity (though there is a place for that) perhaps there is a need to figure out what the issues are that have led to this variation in standards and draw up a strategic approach to dealing with it.

Improving skills

Although there is a real need for training in Ireland, the take up of offered training courses is often surprisingly low. Lack of sufficient interest has meant that some courses have had to be cancelled. Yet other courses and events hit a nerve and are completely oversubscribed, which highlights that there is a real appetite for training but there is something missing in either what is offered or how it is being offered. Certainly, there are limited useful training opportunities for many of the more experienced professionals, and those courses that are offered may be led by fellow Irish professionals. Given the relatively small pool of people, who are likely to be competing with each other regularly for contracts, it is easy to see why some people might shy away from such events.

Another stumbling block for the delivery of a broad range of training events is that

the fees available for trainers are often limited and not attractive to the senior professionals who we should be looking to in order to lead the field.

“A cynic is a man who knows the price of everything but the value of nothing.”

Oscar Wilde

Mentoring or shadowing can be particularly useful for practitioners who are getting to grips with new areas. However, it is difficult to achieve in a country where many practitioners are self-employed/sole traders or work in companies in small ecology teams. Properly done, it requires structure and takes time, something that many of us are short of. There may be an argument for CIEEM to provide help or guidance on this, but there is also a need for members to respond where feasible and appropriate (such as in spending time on the phone to help tease out a complex issue), and conversely, to use resources wisely and to avoid taking unreasonable advantage of those prepared to share their skills.

Driving up standards

There is no doubt that submitting low tenders doesn't help to keep standards high. We need to raise the profile of our profession so that proper fees are an accepted norm – and where low tenders should be met by clients with raised eyebrows rather than delight! There is a still a sense in some people/organisations that ecology is not a real profession, unlike engineering or architecture for example, where we know they are real professions because of how much they charge. This perception needs to change and we, as professionals, need to help change it.

There have been some welcome moves by local authorities recently, with their requirements almost mirroring CIEEM best practice, by requiring the names of authors together with details of their qualifications relevant to the work to be submitted in reports. This recognition of the importance of qualifications and skills is something that CIEEM should highlight to other authorities, through the Heritage/Biodiversity Officers (in Ireland) and through other networks.

The reality is that, without proper fees being charged, practitioners will always be on the back foot in finding time and money for training, mentoring and strategy, and that does not bode well for a profession trying to raise standards.

Overcoming challenges in Ireland to reach the bar

The lack of importance that has been given to the environment in Ireland and the shortage of associated statutory funding has left ecological practitioners without some of the basic building blocks that are needed to do our job. For example, there have been a number of landmark caselaw decisions relating to the Appropriate Assessment (AA) process under Article 6 of the Habitats Directive and yet Natura 2000 site Management Plans are still absent for many sites around the country and, crucially, the guidance on AA is out of date. It is hoped that such issues will be expedited following the current staffing recruitment at the technical professional level in National Parks and Wildlife Service (NPWS).

“A Government that robs Peter to pay Paul, can always depend on the support of Paul.”

George Bernard Shaw

In recent years, CIEEM has worked to raise the professional profile in Ireland, meeting with Ministers and statutory bodies, and consulting with statutory agencies in relation to CIEEM professional guidance from an Irish perspective. The Irish policy group has fed into many consultations in the last few years, as a result of which CIEEM is now represented on various working groups at national level as its relevance becomes recognised and acknowledged. It is a hard slog and requires tenacity. With a relatively small pool of people to carry out this work, it is vital to focus on what the priorities are and where to put the effort in.

So it seems it is a case of 'lots done, lots more to do' in order to reach the bar. We need better approaches for improving our skills and removing the obstacles that stop us from doing our job, as well as steps to improve the way we are perceived and

“Even if the hopes you started out with are dashed, hope has to be maintained.”

Seamus Heaney

the value of our profession. All of this will require continued and targeted lobbying of statutory agencies, as well as finding creative ways of working with industry. Importantly and maybe hardest of all, as an organisation and as individuals, we need to work to spot opportunities, provide support and call 'foul' when we are concerned about the profession being dragged down.

“Do not wait to strike till the iron is hot; but make it hot by striking.” W.B. Yeats

There is no doubt that in 'post-crash' Ireland, the economy is really starting to move again, the number of adverts recruiting ecologists is noticeable and reassuringly there is an increasing requirement for CIEEM membership. This is definitely the time to ensure that a rising-tide mentality develops through support and targeted action for ecologists and environmental managers in Ireland – helping all to reach the bar.

Whilst this article has been written from the Irish perspective and much of the content relates specifically to Ireland, the authors are fully aware that aspects, such as fee levels, client expectations and the need for professional integrity, etc., equally apply across the CIEEM membership.

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CIEEM Featured Training

Survey, Ecology and Identification

Grass and Sedge Identification – Neutral and Calcareous Grasslands

Salisbury, 13 June

This one-day course will give participants the confidence to identify a wide range of grasses and sedges commonly encountered in lowland grassland habitats (including waste ground and road verges) using a combination of non-flowering and flowering features. The training delivers 6 hours of CPD with fieldwork in the beautiful Salisbury countryside.

Bat Handling and Identification

Canterbury, 9 June & 7 July

This exciting course will provide an introduction to British bat ecology, followed by species identification (in the hand), sexing and health & safety precautions. A practical handling session will enable participants to handle permanent captive bats, including opening wings, sexing and looking for identification features.

Hazel Dormouse: Handling and Survey Methods

Canterbury, 27 July

A basic introduction to dormouse ecology is followed by more detailed information about dormouse survey and handling techniques including nut searches, nest identification, and the use of nest boxes and nest tubes for survey and monitoring. Relevant legislation and how to complete NDMP recording forms will also be covered. Artefacts such as nests will be available for close examination, followed by a practical session in small groups to identify nuts nibbled by a range of small mammals.

Mitigation and Management

Water Vole Live Trapping, Handling, Practical Care and Re-establishment

Lifton, 3-4 July

This advanced two-day course will familiarise experienced practitioners with the practical elements of water vole trapping and considerations for maintaining water voles in captivity. Delegates will have the opportunity to handle water voles of different ages and sexes, consider the requirements pertinent to the effective re-establishment of water vole populations and techniques to assist with successful restoration.

Wetland Habitat Identification, Evaluation and Management

Swansea, 9 July

This one-day course uses Crymlyn Bog National Nature Reserve, a wetland site of international importance, as the field site to explore some of the key issues in wetland identification, assessment and conservation. Field and classroom sessions are planned to build understanding of the structural and ecological types of wetland, the collection and interpretation of vegetation data as well as some of the factors affecting wetland quality and how these may be managed.

Badger Impacts and Mitigation

Lincoln, 19 July

This classroom-based training offers seven structured sessions to include planning for survey and reporting, impacts (including sett loss, disturbance and impacts on foraging habitat) and the design and implementation of mitigation measures. The trainer will also advise on the principles of licensing, when and how to apply for a licence.

Delegates will have opportunities to analyse examples of badger projects and explore a case study of a development project to address the identification of impacts and formulation of mitigation measures.

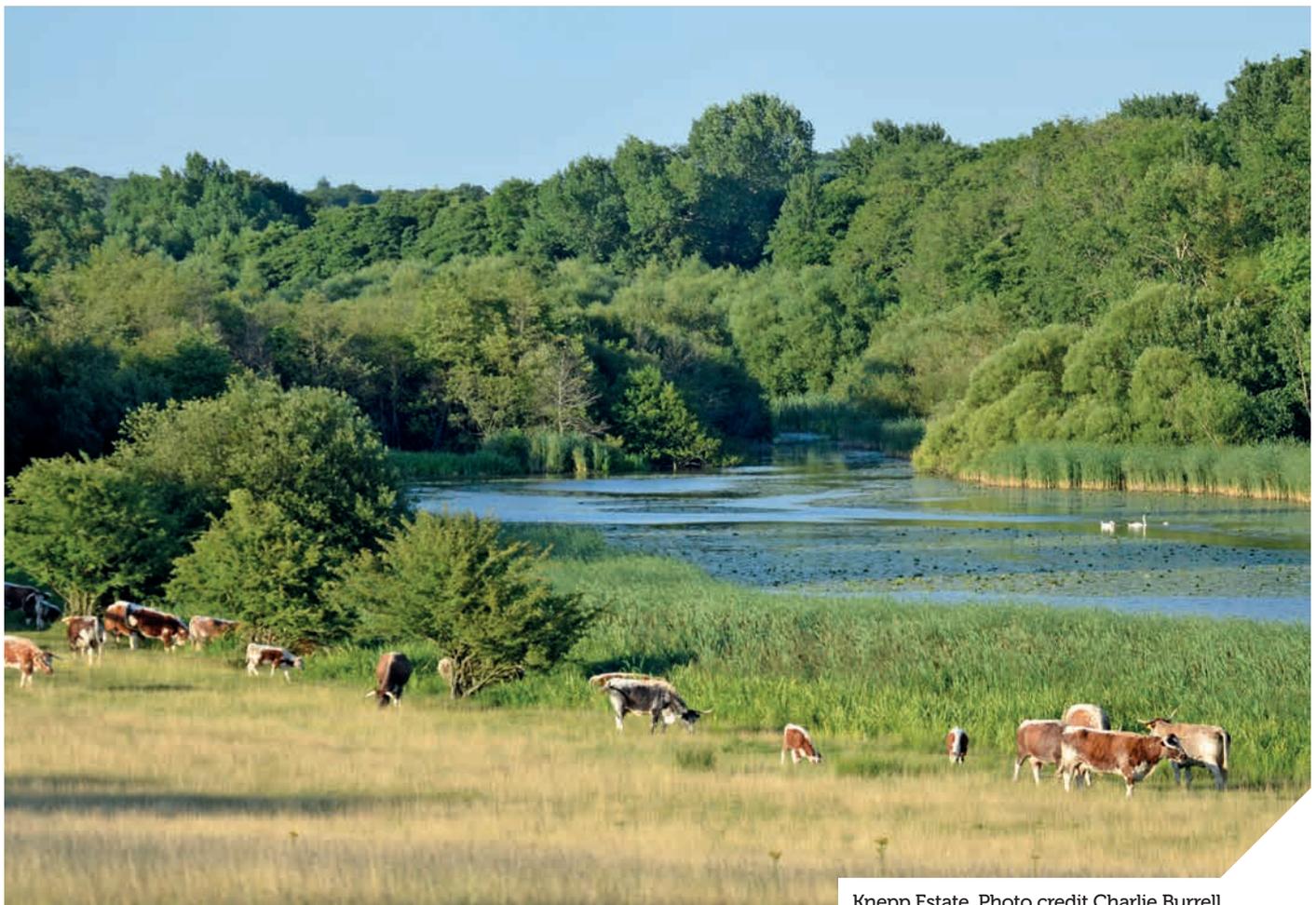
Book Early for Discounted Course Fees on all our Training Events

<http://events.cieem.net/Events>

Creating a Mess – The Knepp Rewilding Project

Isabella Tree

Keywords: ecosystem services, naturalistic grazing, process-led, rewilding, scrubland, soil restoration



Knepp Estate. Photo credit Charlie Burrell.

Established in 2001, the Knepp rewilding project in West Sussex has produced astonishing results in terms of recovering habitats and biodiversity. But its potential as a provider of vital ecosystem services – including soil restoration – is greater still and could revolutionise land management in the UK.

Standing on the southern edge of our 3,500-acre rewilding project on a June day, on the brow of one of Knepp Estate's few elevations, one would be forgiven for imagining oneself gazing on African savannah. This does not look like West

Sussex – or anywhere else in England, come to that. The rough, hummocky grassland, a riot of anthills, is punctuated by fists of thorny scrub. Hedgerows have billowed out into swathes of unruly brush. Weaving between them, a filigree of dusty

trails signals the wanderings of large herds of ungulates. The air is thick with birdsong, many of them African in origin – swallows, house martins, swifts, lesser whitethroats, chiffchaffs, willow warblers, reed warblers, garden warblers, Cetti's warblers. You can hear cuckoos, often several at once and, at night, competitive clusters of nightingales send thrilling, unsettling arias into the darkness, interrupted by the occasional nightjar. This is perhaps the only place in the UK where numbers of turtle doves are actually rising.

Big Ideas: Creating a Mess – The Knepp Rewilding Project (contd)

There is a wildness here, an untrammelled exuberance, pulsing with life, that is so unfamiliar, so essentially un-British, that visitors naturally seek comparisons with foreign parts – the scrublands of the Serengeti in East Africa, or the Deccan in India, perhaps. ‘*You expect to turn a corner and see a herd of buffalo or a leopard up a tree*’, they say. It feels as though anything could happen here, and sometimes it does. The number of visitations from extremely rare species is rising – last year, a Montagu’s harrier and a black stork flew over, checking us out, a black tern settled on the lake, peregrine falcons nested in a Scots pine for the second time and, in the summer, a red-backed shrike struck up his territory on a hawthorn, catching emperor dragonflies on the wing and impaling them; in February this year, a pair of great white egrets paced the winter water-meadows and, in March, a black redstart appeared in the park. It is almost impossible to remember the time, only fifteen years or so ago, when this landscape was arable – fields of maize, barley, wheat, as far as the eye could see, a virtual desert in terms of biodiversity.

The whys and wherefores

We took the decision to come out of in-hand farming in 2000. For decades, the farm – mixed arable and dairy – had run at a loss but in the 1990s, as the industrialisation of farming and modern technologies widened the gap between farms like ours and massive farms on better land, those losses became unsustainable. Categorised as grade 4, or grade 3 at best, our land has never lent itself to modern intensive production. We are hampered by poor drainage, small, hedged fields and our heavy soil – 300 metres of Low Weald clay over a bedrock of limestone. It is like concrete in summer and in winter, unfathomable porridge, preventing any access to the land by heavy machinery after the first rains of autumn.

The idea to rewild came off the back of the restoration of the 19th century Repton Park around the house. Ploughed up in WW2 as part of Britain’s ‘Dig for Victory’ campaign, the land had been in constant production ever since. In 2001, however, we received funding from the Country Stewardship Scheme to restore the park, providing breathing space for, among other things,

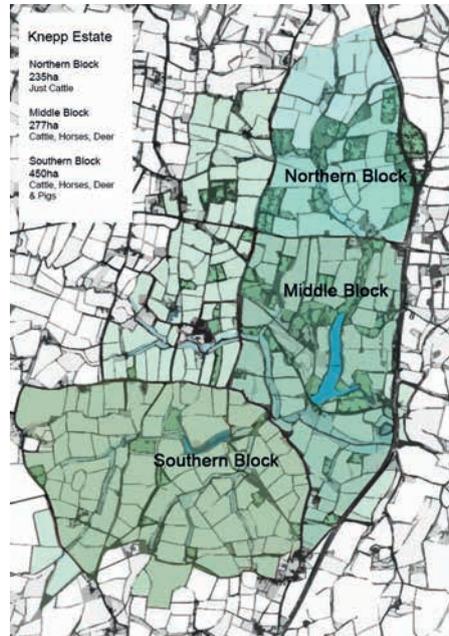


Figure 1. Map of Knepp Estate. Key indicates suites of herbivores in each block.

veteran oaks suffering from agri-chemical assault. Returning these 140 hectares to permanent pasture, re-seeding with native Low Weald flowers and grasses, and introducing fallow deer as grazers, was a revelation. The following summer we walked knee-deep through oxeye daisies, bird’s-foot trefoil, ragged robin, knapweed, red clover, ladies’ bedstraw, crested dog’s tail and sweet vernal grass, kicking up clouds of butterflies, our ears thrumming

with the sound of bumble bees, hoverflies and grasshoppers – something we hadn’t even known we’d been missing. The land itself seemed to be breathing a sigh of relief. For us, it was the psychological breakthrough that allowed us to look at the Estate with fresh eyes, to dare to break with our farming tradition. It showed us the potential of working *with* the land, rather than constantly battling against it.

Our park restoration coincided with the publication, in 2000, of the groundbreaking book *Grazing Ecology and Forest History* by the visionary Dutch ecologist Frans Vera (Vera 2000), and a visit to his naturalistic grazing project, the Oostvaardersplassen in Holland, expanded our horizons exponentially. We realised we had the potential to do something much wilder and more exciting than a conventional park restoration in other areas of the Estate. By introducing a suite of other herbivores – Exmoor ponies, Tamworth pigs and old English longhorn cattle – in addition to red deer and fallow deer, and allowing them free-rein to trample, rootle, wallow, puddle, ring-bark, graze, browse and dung where they liked, we could kick-start dynamic natural processes on our land; we could use them to prevent the succession of species-poor closed canopy woods on our ex-arable fields, creating something much more interesting and diverse instead. In effect,



Longhorns in the Southern Block – cows are naturally browsers as well as grazers and a breed like old English longhorns relish being outside all year round and need no supplementary feeding. Photo credit Charlie Burrell.



Common whitethroat.
Photo credit Charlie Burrell.

they would be acting as proxies of the tarpan, wild boar and aurochs – some of the big-hitting megafauna that once roamed our countryside disturbing the soil and battling with vegetation succession, transferring seeds and nutrients across the landscape, driving habitat complexity.

The Middle and Northern Blocks (700 acres/283 hectares and 530 acres/215 hectares respectively – see Figure 1) had been part of a fallow deer emparkment in Norman times and this allowed us to attract further funding from Countryside Stewardship in 2003 to roll out the park restoration, enabling us to reseed both these areas with a mix of native grasses, take up internal fencing and gates, ring-fence the boundaries and release free-roaming animals to graze and disturb (Box 1).

But there was no such funding forthcoming for the Southern Block – an area of 1,100 acres (450 hectares – see Figure 1). At a loss as to what to do, and with contract farming actually costing us money, we had no alternative but to step back and leave the land to its own devices. We had begun taking the lowest yielding fields out of production in 2001, and continued in increments over the following five years. Unable to pay for a boundary



Turtle dove. Photo credit Charlie Burrell.

Box 1. Free-roaming animals at Knepp

The project is divided by roads into three areas (see Figure 1). Each Block entered the rewilding project under different management, in a different year(s) and with a different suite of grazing animals. Consequently the habitat looks very different in each and provides a useful demonstration of grazing management options.

The Middle Block (700 acres/283 hectares) kicked off the rewilding project in 2000 with the Countryside Stewardship restoration of Repton Park around the house. Because of its cultural designation the area is retained as traditional parkland, tightly grazed with clear browse-lines on the trees and shrubs. It is currently grazed by 290 fallow deer, 42 red deer, 81 longhorn cattle and 6 Exmoor ponies.

The Northern Block (530 acres/215 hectares) also originally received Countryside Stewardship funding as a park restoration, but harking back to the time when Knepp was a Norman deer park. Consequently, we can be less restricted (messier!) here than in Repton Park. Because this whole area was either pasture already or re-seeded with grass, vegetation is, however, taking a long time to get away. Thorny scrub is only just beginning to break out of the hedgerows and colonise the thick, thatchy sward. We have therefore introduced only longhorn cattle here – 108 of them – in order to give vegetation a chance to establish. Once it does, we will introduce ponies, pigs and deer. Hopefully it will eventually have the vegetation complexity and dynamism of the Southern Block.

The Southern Block (1,100 acres/450 hectares) supports 385 fallow deer, 48 red deer, 94 longhorn cattle, 10 Exmoor ponies and 7 Tamworth pigs. This area remained unfenced until 2008, with the fields left as they were after their last harvest and not seeded with grass. This allowed a spectacular vegetation pulse to happen over 4-6 years. The Southern Block is now the wildest and woolliest part of the project, with a more equal

battle between vegetation succession and animal disturbance creating really exciting new habitats. And because there is so much browsing available here, the area can sustain a larger number of herbivores, including pigs, and still supply plenty of habitat for nightingales, turtle doves and other species.

Density of animals: The numbers of herbivores in the project is really a question of judgement and rule of thumb. Too few and areas will turn into species-poor, closed canopy woodland. Too many and the land will revert to relatively uninteresting open grassland. We introduced red deer into the project only when we judged the vegetation was robust enough to withstand this additional heavy-hitting browser.

Wild range meat: Culling the herds produces 75 tonnes (live weight) of organic pasture-fed beef, venison and pork per year, bringing in around £120,000. Because the animals live outside all year round, with no supplementary feeding or routine medication like antibiotics, inputs are low and profits are high. Able to 'self-medicate' on herbs and shrubs within the project, the animals are healthy and robust, and rarely require veterinary attention. They are managed by a single stockman, who brings in occasional help.

Crucially, because the animals are entirely 'pasture-fed' their meat is high in omega 3 fatty acids, vitamins A and E, selenium and betacarotene (powerful anti-oxidants), and conjugated linoleic acid (CLA) – one of the most powerful anticarcinogens in nature.



Exmoor pony. Photo credit Charlie Burrell.

Big Ideas: Creating a Mess – The Knepp Rewilding Project (contd)



Roaring red stag with turf on its antlers – like our other herbivores, these great beasts create disturbance within the project, helping counter vegetation succession and creating opportunities for other species. Photo credit Bill Brooks.

fence and with, therefore, no immediate prospect of introducing herbivores here, we decided to avoid the cost of re-seeding with a native grass mix as we had in the Middle and Northern Blocks. We simply left the fields as they were after the last harvest of maize, wheat, barley or whatever crop they happened to be growing. It was an uneasy and discomforting hiatus – it felt like we were literally turning our backs on the land, pressing pause on our naturalistic grazing experiment – but, ironically, it was rocket-fuel for rewilding.

Scrub – a forgotten resource

Our haphazard process of letting the land go, combined with no re-seeding of grass and a delay in introducing the heavy-hitting herbivores generated opportunities for wildlife that were far more exciting than anything we were doing elsewhere. It wasn't until 2009 that we received Higher Level Stewardship funding for the whole project, enabling us – at last – to introduce grazing animals into the Southern Block

in 2010 (Box 1). By then, unhindered by the kind of impenetrable grassy sward established in the Middle and Northern Blocks, thorny scrub had begun to take off, providing a nursery for jay-planted oak saplings and the spontaneous germination of crab apples and wild service, as well as protective cover for invertebrates, birds and small mammals, and a cornucopia of berries for over-wintering birds. Eruptions of sallow (hybrid willow) germinating in the damp, open soil, has given rise to the largest colony of purple emperor butterflies in the UK. By the time free-roaming animals were introduced there was plenty of browsing as well as grazing available to them, providing them with a richer food supply. The ensuing battle between animal disturbance and vegetation succession has increased habitat complexity even further. This is now by far the wildest area of the rewilding project and source of most of our headline wildlife successes (Box 2) – the part that looks like Africa.

It is also the area that has, understandably, proved most challenging for our neighbours. For many, the natural landscape of Southern England is a patchwork of neatly hedged fields and ditches, small copses and bare, rolling Downland. It is an idyll that has become lodged in our subconscious, invested with nostalgia, an image considered to be balanced and harmonious. Scrubland does not feature anywhere in this idealised country. Demonised by farmers, landowners and gardeners alike, it is considered 'wasteland' – messy, worthless, a waste of space, a sign of neglect or mismanagement.

But it was not always so, as Knepp's own field names suggest. Benton's Gorse, Stub Mead, Faggot Stack Plat, Bramble Field, Broom Field, Cooper Reeds, Broomers Corner and numerous Furze-fields ('furze' is an old Sussex name for gorse) point to a time when scrub was valued for myriad uses – blackthorn for walking-sticks and sloes; dog rose for rose hips; gorse for animal fodder and fuel for kilns and ovens; juniper for smoking meats and making pencils, its berries for distilling oil and flavouring game and gin; bramble for berries and dye; alder for gunpowder; hawthorn for tool handles; hazel for hurdles and charcoal; willow for basketry, cricket bats and medicine; broom – of course – made excellent brooms.



Nightingales at Knepp love our exploding hedgerows and emerging thorny scrub, which provides protection from predators and an abundance of insects. Photo credit David Plummer.



Wild Knepp – the complex, biodiverse scrubland of the Southern Block, a habitat almost entirely eradicated from Britain’s modern landscape. Photo credit Charlie Burrell.

Time was – and not so long ago – when scrub was cherished. But almost all the purposes for which it was once used are now satisfied by plastic and mass-produced alternatives. Chainsaws and mechanised diggers have enabled us to eradicate it wherever it dares to appear. One of the richest habitats for nature is now deemed ‘unnatural’. Even conservationists, bent on keeping areas designated for nature in stasis for the preservation of targeted species, often find the morphing, unpredictable, impenetrable character of scrubland hard to countenance. Fortunes are spent every year on its eradication, with scrub-bashing a staple activity of conservation volunteers.

An optimistic future

The accidental reappearance of scrub at Knepp, and the astonishing resurgence of wildlife it has encouraged, in such a short space of time, shows extraordinary potential – and not just for the recovery of rare and declining species. The implications underlying the project are enormous. Knepp shows how rewilding the land leads to other forms of provision vital for the public good – ecosystem services like carbon sequestration, flood mitigation, water storage, air purification, ethical meat production, human health and recreation. It even demonstrates an alternative, low-cost, natural way of re-establishing woodland – without the need for carbon-intensive polypropylene cylinders, tanalised wooden stakes and high-maintenance planting by human hand.

But perhaps most important of all and, inevitably, connected to all the above, it addresses one of the most pressing concerns facing farming today – soil degradation. Centuries of relentlessly ploughing without regard for soil structure, of applying chemicals to the land and destroying soil biota, have led to catastrophic levels of soil erosion. According to the National Farmers’ Union, we have fewer than a hundred harvests left in the country before we have no topsoil left in which to plant crops. At Knepp, the appearance of fruiting fungi such as *Boletus mendax* (a mycorrhizal mushroom associated with old oaks), and milkcaps and fly agaric in our willow scrub, as well as common spotted, southern marsh and early purple orchids (plants that depend

Box 2. Biodiversity in the Knepp Rewilding Project

In all, 2,630 species have been recorded at Knepp since rewilding began, of which 75 are nationally notable or rare.

Headline species: Knepp’s most surprising successes are nightingales (34 nightingale territories recorded in 2012 compared to nine in the 1999 national nightingale survey); turtle doves (from none at all in the days of farming to 16 singing males recorded in 2017); and purple emperor butterflies (with a UK record-breaking 126 individuals counted on a single day in 2015). Observations of the butterflies’ feeding and breeding behaviour in the scrubland habitat is changing scientific views about this species’ preferences – information of great value to future conservation efforts. In addition, Knepp now hosts all five main UK species of owls – tawny, barn, long-eared owl, short-eared owl and little owl – and 13 out of the UK’s 17 breeding species of bats, including foraging barbastelle bats and a maternity roost of the extremely rare Bechstein’s bat.

Invertebrates: Of the 1,611 invertebrates found at Knepp, 34 of these are butterflies, 480 moths, 454 Coleoptera (many of them dung beetles whose populations have exploded thanks to an organic system of livestock ranching), 72 spiders, 56 molluscs, 79 hymenoptera and 19 species of



Purple emperor butterfly. Photo credit Charlie Burrell.

earthworm (an astonishing recovery considering the poor state of Knepp’s soils under intensive agriculture).

Vascular plants: 558 vascular plants have been recorded, including the rare adder’s tongue fern, several species of water-starwort, the scarce marsh speedwell, water-violet, greater butterfly orchid and lesser water-parsnip – a species in decline in Sussex.

Bryophytes & Fungi: 119 bryophyte species have been identified, including several rarities, suggesting that Knepp may prove to be one of the richest sites for this group in Sussex. Several extremely rare saproxylic fungi have been recorded, including *Phellinus robustus*, *Polyporus quercinus*, *Ganoderma resinaceum* and *Buglossoporus quercinus*.

For more information on species at Knepp see <https://knepp.co.uk/yearly-surveys/>

Big Ideas: Creating a Mess – The Knepp Rewilding Project (contd)



Grazed hawthorn scrub. Photo credit Charlie Burrell.

on subterranean mycorrhizal fungi) in our former arable fields, is a clear indication that our soils are reviving. In 2013, a study by Imperial College London found an exponential rise in the abundance and variety of all three categories of earthworm – epigeic, endogeic and anecic – compared with neighbouring farmland with the same soils and under the same conventional agriculture as previously at Knepp. In total, we have now found 19 species of earthworm – a diversity that, according to soil scientists, is extraordinarily high.



Charlie Burrell, owner and instigator of the Knepp Wildland project, with a purple emperor butterfly – one of our unexpected successes, previously considered a 'woodland species' but which we now know proliferates in a complex habitat of sallow scrub.

So Knepp points the way to a low-cost system of soil restoration – a model that could be rolled out across marginal land likely to fall out of agriculture in the post-Brexit shake-up of farming subsidies, and that may prove vital even for Grade 1 agricultural land. Scale, of course, is key in order to allow process-led systems to function but already we are seeing 'farm clusters' – groups of small farms – clubbing together to achieve landscape-scale restoration together. Moreover, 'rewilding' may not mean dedicating land to a minimal-intervention system in perpetuity. The idea of 'pop-up Knepps' – first suggested by a former senior advisor for Natural England – could be a strategy for the future. Parcels of land could be devoted to rewilding for, say, 25-year periods, creating a rotational system of wildlife-rich scrub and restoring the soil, allowing farmers to return one patch to agricultural land again (hopefully to a more sustainable form of agriculture) and rewild another – thus allowing species continued availability of habitat. It could be a way of providing the webbing, running through our farmland, connecting existing conservation sites, to bring about Prof. Sir John Lawton's vision of 'more, bigger, better and joined up' nature in Britain (Lawton *et al.* 2010).

Knepp shows how rewilding could, if we wish, bring about incalculable public benefits. But if we are to embrace it we need to re-educate our sensibilities.

Knepp is a signal reminder of our need to embrace messy, exuberant scrubland once again, to allow it space in the landscape – and in our hearts.

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About the Authors



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'District Licensing' for Great Crested Newts – Delivering a Big Idea

Keywords: development, District Licensing, great crested newts, planning

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New European Protected Species policies enable a more flexible approach when considering developmental impacts on great crested newts. Following a trial scheme in 2016 in a single Planning Authority (Woking), Natural England has now issued a District Licence to seven contiguous Local Planning Authorities in the South Midlands. A trilateral partnership has been formed between private companies, NGOs and Planning Authorities to secure the Licence and deliver the new scheme. The South Midlands scheme is significantly different from the Woking model and has several features designed to deliver improved landscape-scale conservation for great crested newts, facilitate better compliance with planning policy and save developers time and money.

Introduction

When a group of conservationists wrote *Making Space for Nature* (Lawton *et al.* 2010) nearly a decade ago, we were acutely aware of the funding implications of those landscape-scale aspirations. Funding for nature conservation has worsened since then, so it is imperative



Great crested newt *Triturus cristatus*. Photo credit Andy Buxton.

that what money does come into nature conservation is spent effectively. Furthermore and separately, speculation around Brexit encompasses several de-regulation scenarios, all of which become more likely as long as existing systems are deemed by society to be failing.

The current system of licensing for great crested newts *Triturus cristatus* has long been unpopular with developers and it is frequently lambasted by the popular press as a waste of money. These criticisms largely revolve around the effort required

to protect individual newts, which underpins the conventional mitigation approach. While individual case studies can demonstrate long-term persistence following mitigation (e.g. McNeill 2010), practitioners typically report difficulties in securing ongoing habitat management and in safeguarding habitats from post-construction impacts. Recently, there has also been a more open appraisal of the system's failings from both the regulators and the environmental sector. The monitoring of long-term outcomes

has been poor, but what evidence there is, indicates low levels of success (Lewis *et al.* 2016), leading to calls from conservationists for systemic change (Watson 2013, Beebee 2015, Germano *et al.* 2015).

Defra's new policies for European Protected Species (Natural England 2016) set out a new framework for great crested newts, which provides a more flexible set of options for developers. There is less emphasis on survey and the legal protection of individual animals, and more on outcomes that safeguard the population – these policies have generally been welcomed.

In setting-up and trialling a 'District Licensing' scheme in Woking, Natural England moved the framework on another step. Using the principles of the new policies to create a District-wide framework for great crested newt conservation, in 2016 they awarded Woking District Council an organisational Licence for great crested newts, thus enabling the Local Planning Authority (LPA) to authorise developers under the Licence. The Woking pilot demonstrated how two of the largest problems with the existing system could be removed. Firstly, an up-front district-wide survey allowed Licensing decisions to be made without the need (for each developer) to commission hundreds of reactive site surveys. Secondly, the Licensing decision and planning decision could be made by the same body, so that a developer need not go to two separate public bodies, at separate times with separate processes and standards, to seek their planning consent.

Natural England followed up Woking by facilitating three further national pilots to test District Licensing, each of which increased the scale from a single District to a County. A pilot in Kent was led by Natural England and a second in Warwickshire was led by Warwickshire County Council. The third, in the South Midlands, was a three-way partnership between the private sector (NatureSpace and NatureMetrics), the NGOs (Amphibian and Reptile Conservation Trust and Freshwater Habitats Trust) and the LPAs, and not only operates at a much larger scale, but is designed to be actively responsive to the level of development. The South Midlands scheme was awarded a District Licence by Natural England in

February 2018. The rest of this article describes how the South Midlands scheme was designed and instigated.

Delivering fourfold net gain through compensation

The principle behind the South Midlands scheme is that the impacts of individual developments on newts and their habitats, after appropriate avoidance and mitigation, are compensated for by the delivery of a region-wide conservation strategy for great crested newts that is funded through charges paid by developers. It is the first example of a 'landscape-scale' conservation project delivered through groups of adjacent LPAs working together to result in a financially and environmentally

sustainable long-term strategy. The conservation strategy is underpinned by a 4:1 ratio (a figure chosen by Natural England and stipulated as a condition in the District Licence) – the creation of four 'high-quality' newt ponds, plus surrounding terrestrial habitat, for every one 'occupied pond' lost to development. The scheme is required (again through conditions set out in the District Licence) to deliver a net gain for great crested newts at both the regional level and individual District Level. We believe the scheme will deliver much more effective outcomes for newt conservation, and do so at the same time as saving both planners and developers time and money. How will it achieve this win-win?

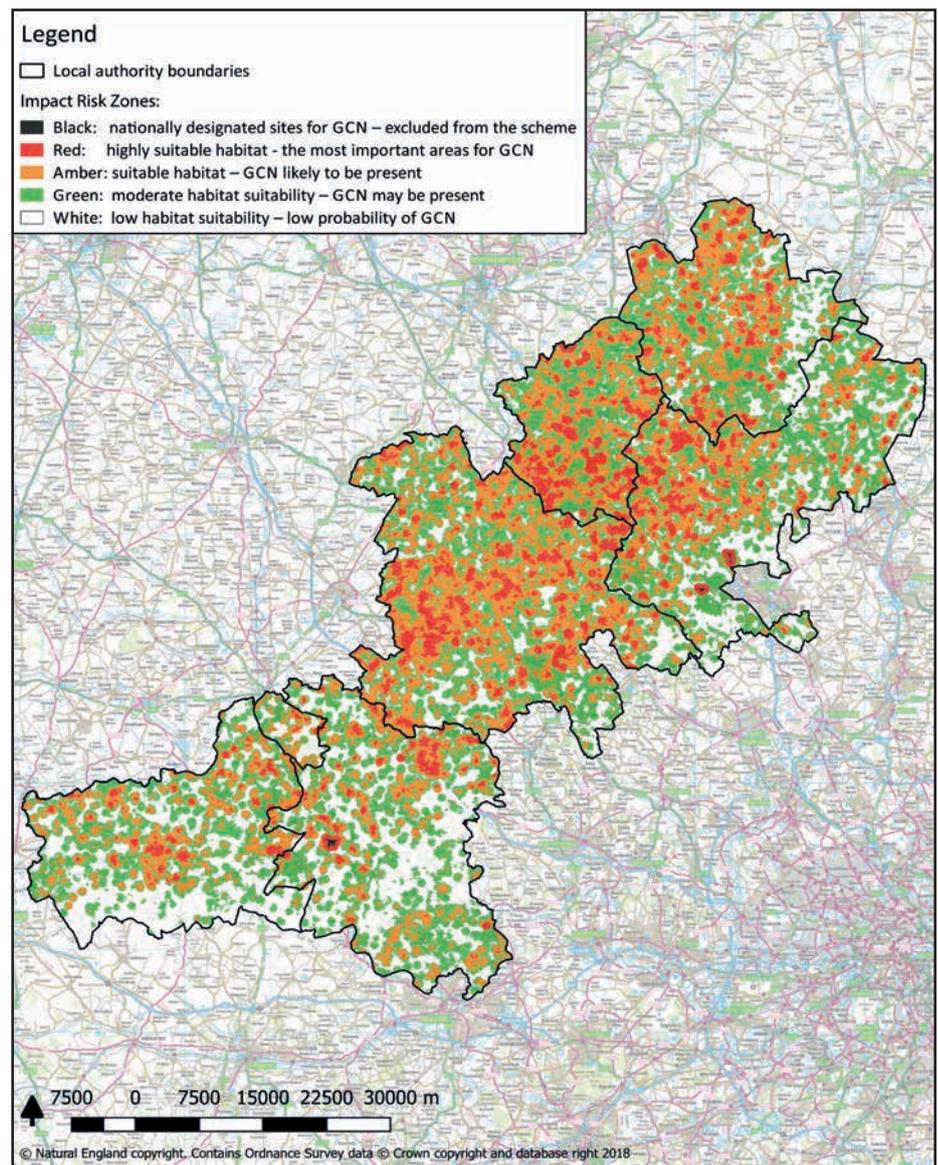


Figure 1. Map of South Midlands District showing Impact Risk Zones for great crested newts (GCN).



Newt pond under construction. Photo credit Pascale Nicolet



Newly created newt pond with associated terrestrial habitat. Photo credit Pascale Nicolet

Designing and setting the scheme up

A significant investment of time and resources was needed to set the scheme up because it required:

- brokering partnerships with Local Planning Authorities
- surveying and modelling the newt distribution and habitats across the region
- defining conservation objectives and a conservation plan (that refer to local and regional Favourable Conservation Status)
- ensuring compliance with European Protected Species legislation and the new licensing policies
- ensuring that the technical, legal and administrative processes are simple for developers and planners
- establishing a delivery mechanism for creating, managing and monitoring large networks of newt habitats in perpetuity.

All of which had to be done in a transparent, auditable and secure fashion.

A partnership was established to deliver the scheme, with NatureSpace Partnership strongly supported, in both time and expertise, by the Planning Authorities, NatureMetrics Ltd, the Amphibian and Reptile Conservation Trust, and the Freshwater Habitats Trust. Even with this collaborative approach, the South Midlands GCN Licence cost £1m to set up.

Over a third of this cost was dedicated to providing up-front habitat creation. Gain must precede loss and under the District Licence the Planning Authorities cannot authorise any actions that impact

occupied ponds until new ponds have been created. To achieve this, and through social investment funding from the Esmée Fairbairn Foundation, the scheme invested £400k in the up-front creation of newt habitat at sites across the South Midlands region.

Another major set-up cost was the initial survey and modelling that went into producing a region-wide map of newt habitat. A team from the Freshwater Habitats Trust surveyed over 600 ponds in May 2017 and took eDNA samples from all that held water at the time of survey. The eDNA data were combined with a wide suite of environmental variables and great crested newt records to produce the 'Impact Risk Map' shown in Figure 1, modelled by the Durrell Institute of Conservation and Ecology using an ensemble modelling approach.

There are four zones on the map, ranging from the red zone (where development is highly likely to impact on newts) to the white zone (where development is unlikely to impact on newts). The red zone comprises 10%, and the amber zone 30% of the total area. This map triggers different levels of impact assessment according to location, sets the charging strategy, and indicates in advance to developers who wish to enter the scheme where they are likely to pay most (red) and least (white).

Operating the scheme for developers

This scheme is voluntary and developers remain free to pursue the existing licensing mechanisms for great crested newts. However, for those who wish to use it,

the District Licence offers developers a completely new option for meeting their obligations arising from great crested newts. In traditional approaches, as most readers will know, developers employ professional ecologists to undertake surveys of ponds that might be affected by their development. In parts of the country where there are few ponds this is not such a problem, but in the South Midlands 70% of the land is within 500 m of a pond and so many developments require surveys to be done. There is a narrow window for survey and thus developments can be held up for many months waiting for survey; even where no newts are found this process creates expensive delays and it is the costs of delay, rather than the costs of survey, which are the most significant for developers. If newts are found then mitigation licences may be needed, and that means applying to Natural England in a process that can take many more months. The required mitigation or compensation processes can be difficult, time consuming and costly (the average cost of a major mitigation scheme under a Natural England licence in 2015 was £250k). It is an expensive, uncertain, complex and lengthy business for developers and the outcomes for great crested newts are frequently poor (op. cit.).

Under the South Midlands District Licence, the developer pays a standard fee of between £500 and £10,000, depending on the size of the development and the zone it is located in (Figure 1). For the standard £1k payment in the white or green zones, a certificate is issued (within 10 working days) to the developer to

Big Ideas: 'District Licensing' for Great Crested Newts – Delivering a Big Idea (contd)

show entry to the scheme, which is submitted with the planning application; thereafter the developer is authorised by the Planning Authority to work under the District Licence. That's it – no delays, no surveys, no uncertainties, no mitigation, no long-term obligations and full legal compliance. While it may be unlikely that there will be newts on these 'low risk' sites, should any subsequently be found there will be no need to stop work because the development is covered by the District Licence. Thus, in the white and green 'low newt probability' areas, the scheme operates as a cost-effective insurance policy for developers, providing legal certainty and peace of mind in a region in which, as one of the national hotspots for the species, there is always a chance that great crested newts could turn up.

Developers in the amber and red zones who wish to enter the scheme have a two-stage payment process. The first-stage charge, of £5k or £10k, is made pre-application whilst the second-stage payment, calculated according to the likely impact of the development, using a great crested newt metric (written by NatureSpace for the South Midlands scheme and approved by Natural England), is made post-permission. The great crested newt metric is a key element of this scheme and is the mechanism by which the mitigation hierarchy, and a range of possible planning conditions, are embedded in the decision-making. Possible planning conditions include on-site mitigation, restrictions on timing of works or site stripping and these, together with additional best practice guidelines, reduce the impact of development on resident animals (Figure 2).

While population surveys are not required, the metric assesses net impacts based on a range of environmental data (such as pond Habitat Suitability Index scores) supplied by the applicant, considers impacts on range, population, habitat and prospects (the four parameters of Favourable Conservation Status), and gives positive consideration to avoidance and on-site mitigation measures. The provision of accurate ecological information by developers could significantly lower the impact score and reduce compensation costs, and represents a significant on-going role in this process for ecological consultants.

Within 10 days of the first-stage payment, NatureSpace provide the developer with a report which sets out the calculations of the metric and quantifies the second-stage payment. This could range from zero (if there is no impact from the development) to £90k for very significant impacts (e.g. major developments directly affecting ponds in the red zone). The second-stage payment, and any recommended mitigation planning conditions, then become requirements of any subsequent planning permission (if permission is applied for and given), to be discharged prior to commencement of any development. In this way, the developer knows quickly and with complete certainty, without the need for any survey, and *before* they apply for permission, how much it will cost to meet their legal obligations for great crested newts at that site.

Operating the scheme for newts

In the South Midlands scheme the developer's charges are converted into permanently managed great crested newt habitats. The 'conservation delivery' part of the scheme is delivered by conservation experts through a non-profit, asset-locked Community Benefit Society. The South Midlands Newt Conservation Partnership (SMNCP) has been specifically established for the delivery of this scheme and will be managed in close association with the Amphibian and Reptile Conservation Trust and the Freshwater Habitats Trust. Income to the scheme funds:

- the creation and management of great crested newt ponds and habitats across the region
- the creation of a great crested newt 'endowment fund', again run by the SMNCP, that will pay for the in-perpetuity management of all the habitat created
- a long-term, three-tier monitoring programme that surveys all the ponds created, all the development sites, and the conservation status of ponds and great crested newts across the region
- the operational costs of both the SMNCP and NatureSpace
- any extra resources needed by the LPAs (in the South Midlands the scheme funds the full costs of 'newt officers' working in each Authority).



Newt exclusion fencing at development site. Photo credit Simply Ecology Ltd.

A key feature of the scheme, prescribed by the Licence, is that a set percentage of income is directly (and immediately) channelled to the habitat creation programmes. So, as developer uptake of the scheme rises (or falls), so income rises (or falls) and so habitat creation rises (or falls). The more popular the scheme, the more habitat is created to compensate for the greater developmental impacts. The adaptability of the South Midlands scheme to cope with varying developmental pressure is a key feature not seen in the other pilots – where Natural England issued the Licence based on a set level of assumed developmental impact and a set level of compensatory habitat provision.

The habitat creation scheme provides for much more than just pond digging; funding typically allows for the provision of around 0.5 ha of terrestrial habitat and 500 m of 'connecting' habitat such as hedgerows for each new pond. Under the District Licence, ponds must reach a HSI score of greater than 0.7 and be larger than 600 m², to be counted as a 'compensation pond', so the scheme is designed to ensure the creation of high-quality ponds, in the right places, within the right habitat, and at the right times.

Meeting the CIEEM challenge

In February 2018, CIEEM released their position statement on great crested newt District Licensing. CIEEM welcomed the ambition to deliver 'net gain' for great crested newts and strongly supported the more strategic approach. However, the CIEEM position statement also raised a number of significant concerns to District Licensing – all of which, we believe, are

answered *only* by the South Midlands model. In summary, our scheme:

- defines, and therefore sets a context for, local and regional Favourable Conservation Status
- clearly sets out a strategy (and funding) for long-term monitoring of both the scheme's delivery and the conservation status of the species in the landscape
- fully funds professional ecological expertise in each participating Local Authority
- sets appropriate levels of developer financial contribution so that the scheme, and the long-term monitoring and in perpetuity management of sites are funded
- sets out a spatial conservation strategy for the species that is delivered by a fully funded, not for profit Community Benefit Society
- incorporates quantitative assessments of spatial connectivity into both impact and gain metrics.

Forward look and overview

Natural England continues to promote a range of delivery models and expects District Licensing to roll out across the whole of England in the next two years. We hope the South Midlands model will be an attractive one to Local Planning Authorities, especially those where both high densities of great crested newts *and* high development pressure means that adaptable and economically self-supporting schemes are needed. Conversely, where there are few ponds or indeed little development, this form of District Licensing may not be appropriate. Great crested newts remain protected by law, but new policies and new approaches to implementation are seeking to both increase the effectiveness of their conservation *and* reduce the burden on developers and planners. Where Planning Authorities choose to set up a District Licensing scheme, a variety of delivery models are open to them. The South Midlands region has trialled a model whereby the work of designing, managing, funding and delivering a landscape-scale conservation scheme is done by a private sector and NGO partnership for the LPAs. This has been done entirely without public sector funding.

Securing the District Licence in the South Midlands required a significant input of time, expertise and other resources; it has developed a new approach to acquiring a licence, and designing and implementing a high-quality scheme that:

- deploys the new European Protected Species policies to focus on conserving populations of great crested newts
- operates beyond a single administrative District, at a landscape scale (3700 km²), providing common standards for developers across seven Local Planning Authorities
- reduces both risks and costs for developers, both large and small, providing certainty without delay through a voluntary system

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- offers a quantum improvement in conservation of great crested newts through a strategic and regional (rather than reactive and local) approach
- is adaptive and able to react to any level of uptake, always delivering a 4:1 (high-quality) pond creation ratio ahead of the developmental impact on the great crested newt population
- delivers terrestrial habitat and landscape connectivity as well as ponds
- provides in perpetuity funding to ensure continuing habitat management
- funds completely the LPAs' costs of engagement with the scheme
- is delivered by a trilateral partnership between the private, public and not for profit sectors.

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Creating a National Conservation Network

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Keywords: connectivity, linear, partnership, resourcing, volunteer

Sustrans, with the support of the Esmée Fairbairn Foundation, has been repurposing the verges of 400 km of cycle paths across the UK since 2013. The aim is to develop a linear network of wildlife habitats which are embedded in and managed by local communities. The project has increased the amount and quality of habitat under conservation management, improved the knowledge and training of our estates teams, improved local residents' attitudes towards conservation and their knowledge of wildlife on their local cycle route, and developed a set of guiding principles to help shape similar networks.

Connecting landscapes

Providing habitat connectivity to allow species to disperse, respond to changing environmental conditions, exchange genes and move around safely has long been a goal of landscape-scale conservation. *Making Space for Nature* (Lawton *et al.* 2010) sets out what has become known colloquially as the Lawton principles, which are aimed at tackling the narrow focus of some previous conservation projects. It was followed in June 2011 by the Government's Natural Environment White Paper, which focussed on a landscape-scale approach to conservation (Defra 2011) and, more recently, the 25-Year Environment Plan published in January

2018, which includes the promise of action to complement and connect wildlife sites through a 'Nature Recovery Network' (Defra 2018).

Alongside the drive to improve the connectivity between nature reserves and other important habitats, there has also been a wider recognition of the value,

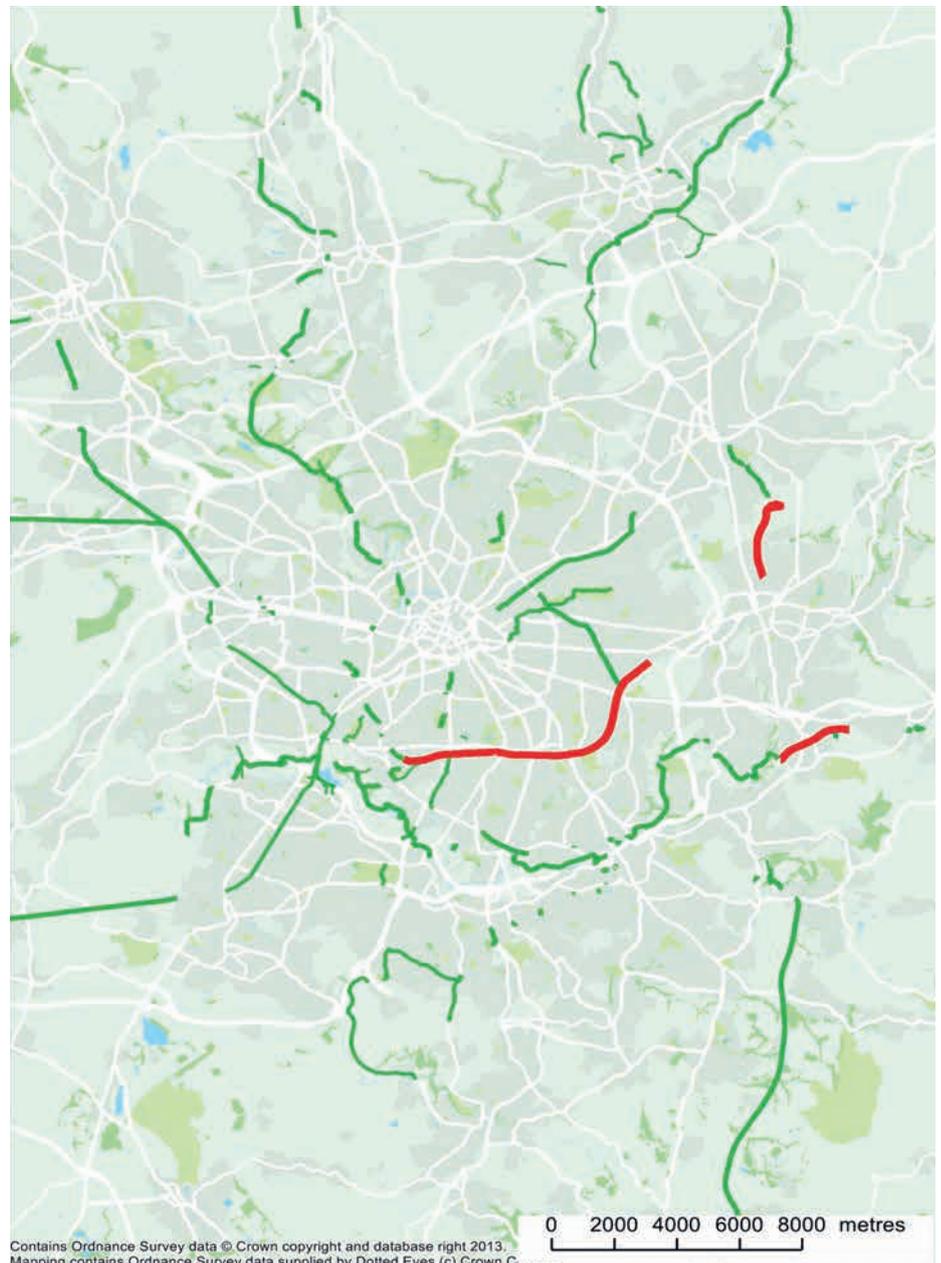


Figure 1. The off-road sections of the National Cycle Network around Manchester shown in green with project routes highlighted in red. Photo credit Ian Barker.

both for people and for conservation in general, of encouraging greater public access to nature. In particular, the mental health benefits of spending time outside in a semi-natural environment are acknowledged in Natural England's review of nature-based interventions (Bragg and Atkins 2016), and by the National Lottery, which dedicated over £30 million to public access projects between 2008 and 2014. The Wildlife Trusts also recognise this benefit in their annual reviews of the health and wellbeing impacts on their volunteers (see Rogerson *et al.* 2017).

However, many projects lack both sufficient resources and suitable areas of land for connecting habitats. In an ideal world, every nature reserve, SSSI, ancient woodland and wildlife site would include complementary habitat corridors managed specifically for conservation. Although challenges exist, there are a number of major landowners who own infrastructure that could be used to help create this network, notably alongside existing transport routes. Self-evidently, the whole purpose of travel routes is to connect places, and the soft estate associated with railways, roads, canals and rivers has great scope to be managed as national wildlife corridors. Together with cycle ways, these linear areas of land offer great potential to provide important linking habitats or stepping stones.

Improving existing networks – Sustrans case study

Sustrans, with the support of the Esmée Fairbairn Foundation, has been running conservation projects along sections of the National Cycle Network since 2013, called 'Greener Greenways'. This initiative is helping to manage the verges of off-road cycle paths to create more species-rich linear habitats (Figure 1). The aim is to:

- improve connectivity across landscapes by enhancing green corridors and by creating or restoring diverse habitats
- increase the amount of land managed for nature conservation by improving both training and understanding amongst maintenance staff and contractors
- engage with local communities and volunteers to increase people's exposure to nature and to teach them more about conservation.



Figure 2. Local volunteers scything a wildflower grassland on the Fallowfield Loop in Manchester. Photo credit Ian Barker.

During a pilot project, 25 locations totalling 280 km of path were selected and assessed. Route management plans were drawn up by the project ecologist with the aim of enhancing habitats and other notable features such as bridges and disused railway stations. Volunteer groups were coordinated and managed by Sustrans staff according to the route management plans. Careful monitoring allowed us to compare different delivery models and to assess the value of surveying as well as practical conservation tasks.

Guiding principles for a national conservation network

Since 2016, the Greener Greenways project has expanded to cover most of England (apart from London), Scotland and Wales, currently accounting for over 600 km of cycleway (approximately 8.5% of the National Cycle Networks off-road routes). The following principles derived from the project are now standard practice within the organisation:

1. **Think long term.** It can be very easy to focus too intently on firefighting specific issues but having longer-term plans is essential, both for annual maintenance planning and long-term habitat management goals. These plans also need to be flexible and achievable with the resources available. Sustrans generally plans 80% of our maintenance work 6-12 months in advance and the specific goals for each route are refreshed every five years or so.

2. **Start small.** Sustrans volunteers often work without a professional ecologist on site, so producing clear guidance and developing specific small-scale projects is a great way of introducing conservation principles and empowering people to take on larger plans and objectives (Figure 2).
3. **Share resources.** Some of our greatest successes have come from partnership working. Finding local experts and enthusiastic amateur naturalists has allowed us to do more than we ever could on our own. We are now working with over 100 groups and organisations to deliver a wide variety of different projects (Box 1).
4. **Communicate widely.** Many of our volunteers come from communities and areas where nature conservation is not a priority. The use of a wide variety of communication tools, from on-site posters to social media campaigns, has allowed us to convince people that nature is accessible, easy and fun. Once they're hooked, most people want to know more of the details and we can start to train new naturalists.

Project outcomes

Over the four years the project has been running our volunteers have carried out over 500 wildlife surveys including taking part in Butterfly Conservation's 'Big Butterfly Count' (www.bigbutterflycount.org.uk) and the RSPB's 'Big Garden Birdwatch' (www.rspb.org.uk/get-involved/activities/birdwatch).

Box 1. Butterfly Conservation's Small Blue Butterfly Project – Warwickshire

The small blue butterfly *Cupido minimus* is one of the rarest butterflies in the West Midlands Region with only three colonies surviving in 2008. It has vanished from Shropshire, Staffordshire, Herefordshire, Worcestershire and the West Midlands County. Although it just survives in Warwickshire, it has declined by 87% since the 1960s.

Butterfly Conservation has worked in partnership with Sustrans to restore and improve calcareous grasslands on the Lias Line greenway, which now supports 22% of the small blue butterfly colonies in Warwickshire. In addition, the number of butterfly species recorded on the route has increased from 17 in 2012 to 21 in 2016.



Lias Line information board. © Sustrans 2013.

We have also completed over 1000 practical work days, ranging from hedge laying to planting wildflowers in community gardens. We estimate that this has created or improved 50 ha of path verge. In addition, species-specific projects have been carried out on a number of routes with predominantly positive results (Box 1).

Expanding the conservation network

Much of the National Cycle Network is owned and managed by local councils, charities or individuals. The next stage of the Greener Greenways project is to partner with these landowners, share the lessons learned from the project, incorporate more areas into the project and work towards a more diverse conservation network nationwide. In addition, organisations such as the Canal and Rivers Trust, Highways Authorities, drainage boards and the Environment Agency are responsible for long distances of potentially biodiverse habitats that could be used for wildlife conservation projects and improved to allow more people access to nature and the outdoors. The Linear Infrastructure Network (LINet@naturalengland.org.uk), led by Natural England, provides a hub for sharing best practice and encouraging organisations to manage linear infrastructure to maximise environmental performance.

There are many other initiatives where organisations are working to enhance the biodiversity value of linear infrastructure.

Landscape-scale conservation such as the Wildlife Trusts' Living Landscapes programme (www.wildlifetrusts.org/living-landscape) include a variety of projects around boundary and linear features. Other projects include Buglife's successful B-Lines project (www.buglife.org.uk/b-lines-hub), the River of Flowers' work to create and connect flowering habitat in cities (www.riverofflowers.org),

About Sustrans

- Sustrans is the charity making it easier for people to walk and cycle.
- We connect people and places, create liveable neighbourhoods, transform the school run and deliver a happier, healthier commute.
- Sustrans works in partnership, bringing people together to find the right solutions. We make the case for walking and cycling by using robust evidence and showing what can be done.
- We are grounded in communities and believe that grassroots support combined with political leadership drives success.
- For more information on the Greener Greenways project, to download our management guide, or to request a free meeting to discuss a linear infrastructure management project visit www.sustrans.org.uk/our-services/projects/greener-greenways.

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Kew Gardens' Grow Wild project (www.growwilduk.com) and the variety of Green Infrastructure projects promoted by the Town and Country Planning Association's Green Infrastructure Partnership (www.gip-uk.org.uk), which aim to increase the amount and connectivity of species-rich habitat in more urban settings.

About the Author



David Watson has been the lead ecologist managing the Greener Greenways project since 2016. He moved to conservation and volunteer work after 10 years' working in ecological consultancy. He now specialises in teaching habitat management skills, designing accessible species survey programmes and shopping for hand tools.

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Introducing the UK Habitat Classification – Updating Our Approach to Habitat Survey, Monitoring and Assessment

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Keywords: ecosystem services, GIS, mapping, metrics, natural capital, UKHab

The UK Habitat Classification is a new, free-to-use, unified and comprehensive approach to classifying habitats that is fully compatible with existing classifications. It is designed to provide digital outputs suitable for habitat metrics, impact assessment and better data integration and sharing between organisations.

Introduction

In March 2015, we argued the case for a new, unified and comprehensive system for classifying UK habitats, reflecting recent developments in technology, policy, data management and information exchange (Edmonds *et al.* 2015). Since then, a steering group of professional ecologists has developed and refined the UK Habitat Classification (UKHab), with a combination of field trials and expert consultations. It has been published online this year with supporting information and guidance (Box 1), which has been designed so that botanical surveyors competent in the use of other UK classification systems can start using it immediately.

A suite of training courses and materials will be available throughout the 2018 field season, to ensure that whatever your current level of expertise, learning how

to use UKHab will be straightforward. We encourage you to download the documents and get out into the field to test them out (<http://ecountability.co.uk/ukhabworkinggroup-ukhab>).

Rationale for a new classification

Three years ago, we suggested that a new comprehensive habitat classification system was warranted to address systemic problems with current systems and methods. JNCC Phase 1 Habitat Surveys

have been the standard, map-based classification used by ecologists for over 30 years and are still widely used (JNCC 2010). While having the advantage of being simple and intuitive, the classification was developed in the age of paper maps and devised for county-scale surveys. It results in frequent mis-classifications (Cherrill and McClean 1999, Cherrill 2014); does not translate easily into Priority Habitat Types or Habitats Directive Annex 1 types; does not have scope to incorporate assessments of condition, origin or management regime;

Box 1. The UK Habitat Classification Document Set

Workbook (xls) comprising:

The UK Habitat Classification (Professional Edition)
Complete Primary habitats in hierarchical view
Complete Secondary code list

The UK Habitat Classification (Basic Edition)
Selected, regularly found Primary habitats in hierarchical view
Selected list of most commonly required Secondary codes

List view of all habitats

Cross tabulations with JNCC Phase 1 Audit, National Vegetation Classification (NVC), Farm Environment Plan (FEP) codes and European Nature Information System (EUNIS)

Habitat Definitions (pdf)

User Manual (pdf) comprising:

The UK Habitat Classification Overview
Mapping Manual
The UK Habitat Classification Key
Suggested Mapping Symbology

and does not perform well in electronic mapping systems because of its architecture. All these issues limit its effectiveness.

Use of different classification systems has made it challenging to share data and interrogate historic datasets. Local Environmental Records Centres (LERCs), government agencies, consultancies and NGOs know that useful information on the UK's habitats remains largely inaccessible because of the prohibitive costs and limitations of translation. A widely adopted, comprehensive classification system would benefit ecologists in all sectors and dramatically improve opportunities to track changes in habitat extent and condition over time. For example:

- Business users of consultancy services would benefit from a streamlined habitat reporting system that lends itself to digital management and output
- LERCs would benefit by being able to integrate habitat data from a wide range of sources
- NGOs would benefit through improved systems to survey and monitor the sites they manage
- Government agencies would benefit through streamlining survey requirements and use of a wider range of local and national habitat data for monitoring and reporting.

A major benefit of widespread adoption of a single system is the potential to combine new field data with existing regional and national habitat datasets managed by LERCs, Centre for Ecology and Hydrology (CEH), National Parks, local authorities and agencies, allowing landscape-level assessment.

Key features of UKHab

UKHab has been designed to build on existing classifications. It is a fully translatable, hierarchical system that integrates with all major classifications in use in the UK and Europe. The direct and unequivocal interpretation of baseline habitat survey data into Priority Habitat Types and Annex 1 habitat types, fundamental to ecological impact assessment, is a major benefit.

The system includes translation tables that allow legacy datasets to be translated into UKHab and for integration of habitat data collected using other systems. For example, UKHab is designed to integrate with large-scale GIS-based habitat datasets, such as CEH Land Cover Map, giving a significant advantage for scoping large-scale surveys and for sharing data regionally, nationally and internationally.

The architecture and most habitat names used in UKHab should be readily recognisable to all ecologists working in

this field. The primary hierarchy of UKHab consists of five nested 'Levels' (See Box 2 and Figure 1). There is also an extensive list of secondary codes that can be linked to each primary habitat. This combination of primary habitats and secondary codes allows habitat mosaics, habitat management, origins and other environmental and species features to be added directly to each coded primary habitat, removing the need for complex target notes, and increasing consistency and spatial accuracy.

UKHab also includes a mapping protocol and GIS symbology to ensure consistent data collection and presentation of final maps.

UKHab Habitat Key

A useful feature for new users will be the UKHab Habitat Key for terrestrial habitats, based on a field key extensively field-tested and used across the UK for Countryside Survey (Carey *et al.* 2008). The colour-coded key includes references to National Vegetation Classification (NVC) vegetation types associated with particular habitat types, supporting botanical surveyors who use NVC for survey and monitoring vegetation. UKHab does not aim to replace NVC for detailed vegetation monitoring, but has been designed to complement and allow integration between detailed vegetation sampling and broader habitat surveys. The key also includes direct translation to the

Major ecosystem (level 1)	Ecosystem type (level 2)	Level 2 code	Level 3 habitats; Broad Habitats	Level 3 code	Level 4 Habitats including Priority Habitats (bold)	Level 4 code	Level 5 Habitats including Annex 1 Habitats (bold)	Level 5 code
Terrestrial	Woodland and forest	w	Broadleaved mixed and yew woodland	w1	Upland oakwood	w1a	Western acidic oak woodland (H91A0)	w1a5
					Upland mixed ashwoods	w1b	Lime-maple woodlands of rocky slopes (H9180)	w1b5
							Other upland mixed ashwoods	w1b6
					Lowland beech and yew woodland	w1c	Beech forests on acid soils (H9120)	w1c5
							Beech forests on neutral to rich soils (H9130)	w1c6
							Yew-dominated woodland (H91J0)	w1c7
					Wet woodland	w1d	Natural box scrub (H5110)	w1c8
							Alder woodland on floodplains (H91E0)	w1d5
					Bog woodland (H91D0)	w1d6		
					Upland birchwoods	w1e		
			Lowland mixed deciduous woodland	w1f	Dry oak-dominated woodland (H9190)	w1f5		
					Oak-hornbeam forests (H9160)	w1f6		
					Other Lowland mixed deciduous woodland	w1f7		
			Other woodland; broadleaved	w1g	Line of trees	w1g6		
					Other broadleaved woodland types	w1g7		
			Other woodland; mixed	w1h	Other woodland; mixed; mainly broadleaved	w1h5		
Other woodland; mixed; mainly conifer	w1h6							
Coniferous woodland	w2	Native pine woodlands	w2a5					
		Other Scot's Pine woodland	w2b					
		Other coniferous woodland	w2c					

Figure 1. The UK Habitat Classification Primary Hierarchy (Professional Edition) for woodland habitats.

Scottish interpretation of EUNIS adopted by Scottish Natural Heritage (Strachan 2017). We believe that use of the key will increase consistency of habitat recording.

Habitat metrics

UKHab is designed for use in GIS. It does not allow overlapping habitat codes and has a strict protocol for recording fully georeferenced points, lines and areas. This makes it more suitable for the application of habitat metrics than existing systems and ensures that all important landscape features are accounted for.

A robust and repeatable habitat classification for baseline surveys and monitoring is essential for ecological impact assessment and projects seeking to demonstrate 'Biodiversity Net Gain', increasingly considered as a policy objective or benchmark for new development (CIRIA-CIEEM-IEMA 2016). UKHab allows losses and gains to be compared consistently so that outcomes for habitat extent and condition can be tracked at different geographic scales, for example nationally or within a local plan area. Natural England is currently reviewing the use of UKHab as the basis for a revised metric framework. In our view, UKHab provides a robust framework for impact assessment, offset design and auditing biodiversity offsets over time by allowing broad calculations of loss and gain to be supported by more detailed assessment of condition and management incorporating secondary codes. UKHab is also being reviewed in the context of mapping ecosystems as a basis for quantifying ecosystem services (see Box 3).

Comprehensive and adaptable

Responding to practitioners' requests, UKHab was developed to be adaptable to various survey objectives. The full classification, the UK Habitat Classification Professional Edition, comprises 213 primary habitats and 296 secondary codes. An abridged version, the UK Habitat Classification Basic Edition, with 88 primary habitats and 47 secondary codes, omits habitats that are either small, rare or have a very restricted geographic range, while retaining all Priority Habitat types and major habitat divisions.

Box 2. Primary Habitats Hierarchy Structure

UK Habitat Classification – Professional Edition

Level 1: the major ecosystem category, currently covering terrestrial, freshwater and coastal ecosystems.

Level 2: 9 ecosystem types, based upon the Mapping and Assessment of Ecosystems and their Services (MAES) typology and corresponding with major habitat types within the EUNIS classification.

Level 3: 20 broad habitat types, corresponding directly with UK Biodiversity Action Plan Broad Habitats and closely to EUNIS.

Level 4: 80 habitats, including 47 UK Biodiversity Action Plan Priority Habitats.

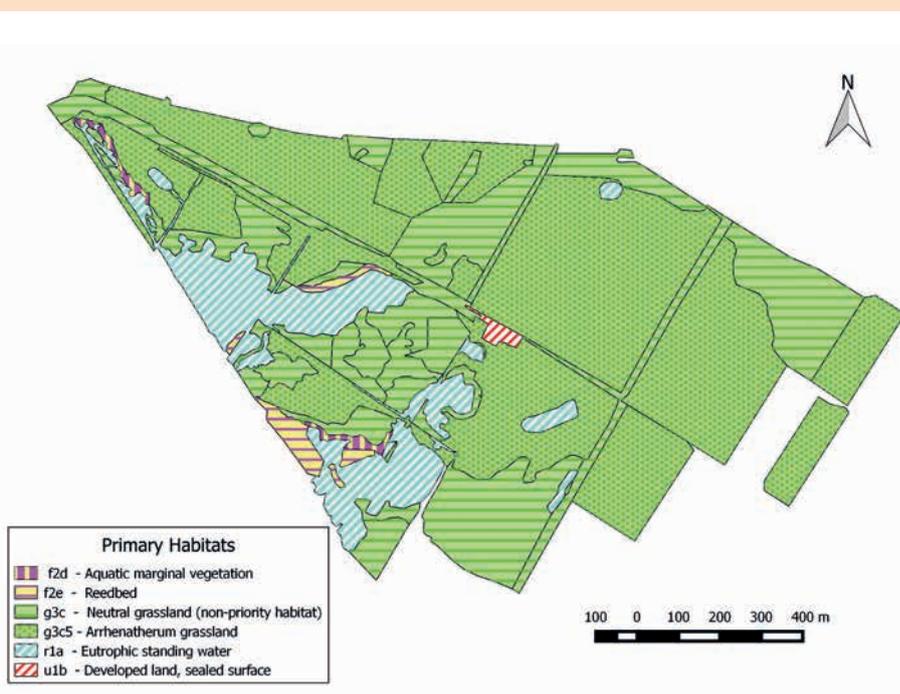
Level 5: 104 habitats, including 69 Habitats Directive Annex 1 habitats and divisions of common habitat types, e.g. neutral grassland, missing in previous classifications.

UK Habitat Classification – Basic Edition

Levels 1-3: as described in the Professional Edition.

Level 4: 47 habitats, principally UK Biodiversity Action Plan Priority Habitats.

Level 5: 12 habitats, including widespread divisions absent from Level 4.



UKHab Map for part of Wicken Fen, Cambridgeshire

Case Study: Wicken Fen. In 2017 UKHab (Professional Edition) was used to map sections of Wicken Fen for the National Trust. The land, arable until recently, is now managed as a variety of habitats including wetland. The habitat map can be used for planning future management and as a baseline to show change. Note, only selected Primary habitats are shown here; adjacent areas of the same Primary habitat represent varying secondary codes. This example illustrates some of the advantages of UKHab over previous classifications, e.g. more refined habitat definitions and direct associations of environmental and management secondary codes that cover the whole polygon.

A Green Infrastructure section of secondary codes enables consistent mapping of city greenspaces; this can be used as a stand-alone system or alongside the main habitat classification.

An important aspect of the system's flexibility is the ability to work within different levels of the hierarchy. For example, a large-scale project may use remote-sensed datasets to determine broad habitat types (Level 3), with follow-up walkover surveys recording to UKHab Basic Edition. Where more detailed surveys are required the full Professional Edition can be used.

Tried and tested

UKHab has been developed collaboratively, relying on input from a wide range of specialists and field trial volunteers. User feedback has led to the development of a mapping symbology; a more detailed breakdown of neutral grasslands and non-priority habitat types; the use of more intuitive coding letters for the major ecosystem types; and highlighted the importance



Cressbrook Dale SSSI, Derbyshire Dales. Grazed dry grasslands and scrub on chalk or limestone with scattered scrub. UKHab Code: g2a5 10 54 89. Inland rock outcrop – s1a.

Box 3. Comments from users of UKHab

"CIEEM welcomes innovation in ecological practice, and encourages practitioners to explore new ways of improving accuracy, efficiency and effectiveness of fieldwork. The UK Habitat Classification Scheme potentially represents an exciting development in habitat classification and assessment. The Professional Standards Committee (PSC) congratulates the author team in developing the tool, and is interested to see how it is now applied by practitioners 'in the field'."

CIEEM Professional Standards Committee, April 2018

"A new habitat mapping protocol that represents mixed communities more clearly and which is easy to read, interpret and analyse clearly and conveniently, is to be welcomed. The new system could also be used for landscape-scale opportunity mapping to identify habitats, linkages and buffering for display, community involvement and funding appeals."

Penny Anderson CEcol FCIEEM (rtd), Director, Penny Anderson Associates

"We reviewed UKHab for a new eco-metric approach to assessing natural capital, which is being developed for Natural England. Our core matrix of scores included 38 rural habitats and 29 urban habitats and green infrastructure features, based mainly on UKHab primary and secondary codes. The translation tables developed by UKHab will be really useful to extend this matrix to other systems such as Phase 1."

Alison Smith, Senior Research Associate, Environmental Change Institute, University of Oxford

"Local Environmental Records Centres often find it challenging to collate and map green infrastructure data in a standard way. We are confident that widespread adoption of the Green Infrastructure approach will enable robust comparison of greenspace between areas and effective application of greenspace data within ecosystem service assessments."

Mandy Rudd, CEO, Greenspace Information for Greater London CIC.

"I reviewed UKHab during its development and was particularly interested that it is comprehensive, fully GIS-compatible and enables cross-tabulation between habitat and vegetation classifications already in use. For example, within Natura 2000 sites information about the distribution of Annex 1 habitat is often only available in the form of Phase 1 or NVC surveys, translation can be messy and also involves the loss of data recorded as target notes. I hope ecologists will try out UKHab, safe in the knowledge it is fully compatible with previous systems."

Dr Sophie Lake, Senior Ecologist at Footprint Ecology and co-author of Britain's Habitats: A Guide to the Wildlife Habitats of Britain and Ireland. Sophie is a member of the UKHab Implementation Panel.

"UKHab provides a useful system that we can use on our properties, mapping what habitat is present now, and then we can re-visit the patches to see how it has developed. We can also target species surveys and monitoring on different selected habitat types."

Stuart Warrington, Regional Wildlife Adviser, National Trust

of translation tables from currently used classifications. In addition, more than 300 detailed comments on habitat definitions and hierarchical relationships between categories have informed revisions for the final published version.

As a result of testing and consultation on the draft classification, a number of organisations from a range of sectors are already looking to adopt UKHab for a wide range of uses (see Box 3).

Conclusion

The new UK Habitat Classification represents a step-change in habitat recording in the UK, for the first time allowing full integration between Broad and Priority Habitat Types and Annex 1 Habitats and, importantly, allowing translation to and between all commonly used existing systems. The classification is flexible enough for use in a wide range of survey types from walkover surveys for small scale development to regional- and national-scale habitat mapping in both analogue and digital systems. Widespread

adoption will enable all of us, as ecologists, to provide robust and comparable measures of how our countryside is changing over time and how it differs across space at a range of scales. We encourage ecologists working in all sectors to download the document set, participate in training, and try out the new system for themselves. We welcome constructive feedback from ecologists and hope that over time a community of practice will develop to support the continued development of UKHab.

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From on High: Creating a Phase 1 Habitat Map Using Aerial Imagery

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Keywords: classification, data consistency, GIS, land use change, remote data capture, repeatability

This article discusses the use of aerial imagery to assess large study areas and to classify land cover to produce Phase 1 Habitat maps. It negates the need for large teams and removes the logistical difficulties encountered when undertaking field survey work. The technology can improve the way that ecological field data are collected, analysed and stored, as well as providing greater opportunity to influence infrastructure design by collecting data far earlier in a project programme.

Introduction

When development projects require ecological assessment, gathering Phase 1 Habitat survey data is often the starting point for baseline data collection after the desk study. Although it is carried out using a standard methodology (JNCC 2010), surveyor bias is a recognised problem (Cherrill and McClean 1999, Stevens *et al.* 2004) and on large infrastructure projects the resources and land access requirements can prove problematic and costly.

At large scales (20-30 km²), aerial imagery analysis can create accurate habitat maps quickly and easily. Combining this with sample ground-truth surveys allows high-quality habitat classification. A key advantage of this technique is the repeatability of the survey, achieved by using pre-programmed flight paths drawn up during survey planning, and the ability to analyse the raw data multiple times to assess anomalies and provide consistency. This represents a major step forward in habitat assessment and management.

Advantages of the technique

The published, traditional methodology for collecting Phase 1 Habitat data involves surveyors walking the land requiring survey. There are almost always limitations of time, budget, land access and staff resource to complete these surveys, which can be particularly constraining on projects with large study areas.

Aerial imagery, generated via fixed-wing or drone platforms, offers the ability to collect habitat data quickly and accurately when surveying extensive study areas. Subsequent analysis then categorises the habitats recorded in accordance with the Phase 1 Habitat classification (JNCC 2010).

The technique is well established within the geospatial industry and the use of imagery to map habitats has been developed and utilised in research contexts. For example,

satellite imagery was used to create a land cover map of Wales as part of the first United Kingdom (UK) Land Cover Map (Fuller *et al.* 1994) and, more recently, to update the Phase 1 Habitat Survey of Wales (Lucas *et al.* 2011). The latter project utilised object-orientated rule-based classification of satellite data and mapped semi-natural and agricultural land, enabling a progressive update of the Phase 1 survey.

The Phase 1 survey handbook (JNCC 2010) highlights the value of both aerial and satellite imagery in habitat mapping and monitoring land use change, as well as comparing the usefulness of the data collected through different survey techniques. Nevertheless, its application within a commercial context is relatively new, and its specific use in relation to Phase 1 mapping for infrastructure projects is an innovative approach to addressing existing habitat and conservation challenges. This paper discusses the methodologies and practicalities of this approach, with specific focus on development assessments.

(See Box 1 for a Glossary of Terms and Abbreviations).

Methodology

Aerial imagery collection

Depending upon the size of the survey area, aerial imagery can be collected via a fixed-wing aircraft or a drone – this part

Box 1. Glossary of Terms and Abbreviations

- FCIR: False Colour Infrared Reflectography
- GSD: Ground Sample Distance
- ISO: Iterative Self Organising – the ISO Cluster Unsupervised Classification tool identifies and classifies similar RGB clusters in an image
- LiDAR: Light Detection and Ranging – a remote sensing method used to examine the surface of the Earth
- nDSM: Normalised Digital Surface Model – calculated from the height of features and the height of the ground
- NDVI: Normalised Difference Vegetation Index – indicates healthiness (greenness) of vegetation using the Near Infrared and Red channels of the imagery
- Raster: generally, a rectangular grid of pixels, each with an XY coordinate and attributes – aerial image attributes are red, green and blue values
- RGBI: Red Green Blue Intensity
- TWI: Topographical Wetness Index – calculated using elevation data
- Vector: points, lines or polygons defined by pairs of XY coordinates

of the work is generally undertaken by a specialist sub-contractor. The benefits of using fixed-wing aircraft are few land access requirements, the ability to fly in poor weather conditions and ease of flight license. Using a drone can be more cost efficient for smaller sites but requires a higher level of flight license and more land access to allow the pilot to plan the flight set-up, maintain visual contact with the drone and replace batteries. The data quality is dependent on the resolution and type of data collected, rather than the vehicle used to collect it.

For Phase 1 Habitat classification we have found that simultaneously captured LiDAR and Four Band (RGBI) Aerial Photography provides the most appropriate data for analysis. Before capturing the imagery, it is necessary to set out the ground control points for the flight path; these allow the aerial image to be tied to the existing mapping data at the correct location, scale and orientation. The number of ground control points can vary, and is linked to the resolution requirements for the project. For example, on two recent projects we employed 45 control points for image capture (2.5 cm resolution) over 43 km² and ten points for image capture (8.0 cm resolution) over 39 km² respectively.

In our experience, the minimum level and resolution of the information required to provide accurate habitat classification is:

- 4 pulses per m² (0.5 m post spacing) LiDAR.
- 8.0 cm GSD resolution RGB and FCIR aerial photography.

Each part of the imagery is then used to refine the analysis and allow more accurate categorisation into Phase 1 Habitat types. The analysis uses a combination of point cloud surface classification, feature height and a rule-based unsupervised classification on a segmented raster to build up a better picture of the survey area.

A simplified example of how parts of the imagery collected are used within the analysis is as follows:

- LiDAR data provide information on the height of vegetation and can be used to differentiate between bare ground, grassland, scrub and woodland.
- RGB and FCIR data are used to create a Normalized Difference Vegetation Index (NDVI), a classification essentially representing the greenness of vegetation.

Sample data collection (ground-truthing)

Before carrying out any analysis work, we recommend that a cross section of habitats from the study area is surveyed using the traditional Phase 1 Habitat survey method (JNCC 2010). These initial survey data provide the criteria on which to base the analysis of the imagery and allow a more accurate classification of habitats.

The availability of land access is likely to dictate the areas and habitats that can be surveyed. The focus will vary depending on the local conditions but, as a general guide, the effort should be on mapping habitats within protected sites and providing a cross-section of the habitats dominating the survey area. This is particularly important if there are 'more interesting' habitats within an agricultural landscape.

Analysis

The technique we use within our project work is object-orientated classification (in ArcGIS Pro). This technique segments the image by grouping similar pixels together into vector objects (Figure 1); in simple terms the technique digitises the image and then classifies the resulting object (in this case assigning a Phase 1 Habitat class).

Although the segmentation of the image is generally straightforward, the analysis of the information generated by the imagery (classification) is crucial to accurate assignment of Phase 1 Habitat classes. The vector objects can be classified based on geometry, area, colour, shape, and texture. Standard guidance or methodology to classify land cover features has not yet been developed. However, the following guidelines are regularly used to classify land cover (GIS Geography n.d.) and illustrate how different parts of the imagery are used to provide information about the habitat type present.

- Trees have varying heights (high nDSM standard deviation) and high near-infrared reflectance (high NDVI).
- Buildings are often rectangular (high rectangular fit), are tall (high nDSM) and have high slopes.
- Grass is short (low nDSM), is flat (low nDSM standard deviation) and has moderate near-infrared reflectance (moderate NDVI).
- Roads reflect a lot of light (high RGB), are flat (low nDSM), and have a low or negative NDVI.
- Water is flat (low nDSM), accumulates into depressions (high TWI), has a low temperature (thermal infrared) and high near-infrared absorption (negative NDVI).

Alexander *et al.* (2018) found that tree or vegetation height is an important attribute in terms of habitat classification and that the LiDAR data are key, because they

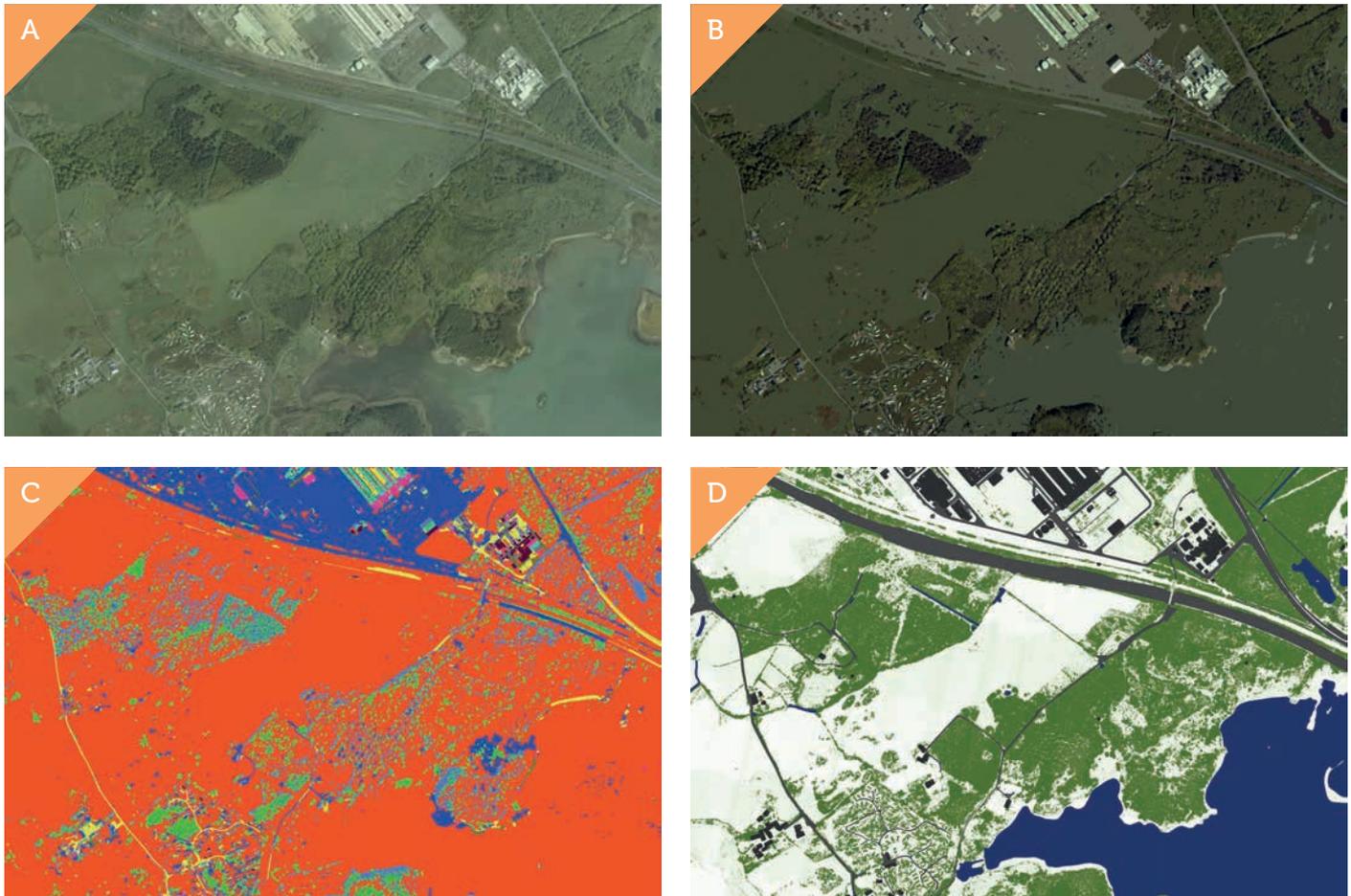


Figure 1. A series of images illustrating the segmentation and classification process used to create a Phase 1 Habitat map from aerial images.

- A. Original image
- B. Segmented image – adjacent pixels with similar RGB values grouped together
- C. Vegetation highlighted via classification (green colours)
- D. Vegetation classification combined with LiDAR data to identify trees (dark green)

provide X, Y and Z values of each point, even from ground below forest canopy. The addition of existing topography and known locational information taken from Ordnance Survey Master Map (OSMM) gives an accurate overview of both man-made and natural habitat types. Combining these approaches with rules based on ecological knowledge creates an expert, collaborative rules system. It is important to note that these aspects of the analysis cannot be carried out in isolation and that the collaborative system is essential.

In our experience, relatively accurate Phase 1 Habitat maps can be created by a two-step process which comprises: a) using an unsupervised ISO cluster tool to merge similar parts of the segmented raster together, followed by b) use of the NDVI, point cloud and OSMM to assign the Phase 1 Habitat classes. The NDVI (Figure 2)

is used to categorise the density/intensity of vegetation (≥ 0.3); bare soil/rock (≥ 0 and ≤ 0.1); and hard-standing (< 0), and has proved to be sufficient to classify agricultural areas reasonably accurately, differentiating improved and semi-improved grassland. The areas of woodland and scrub are classified using a point cloud classification of vegetation (Bands 3 and 4) with a height value > 25 cm (Figure 3). The final part of the analysis uses information provided by OSMM to classify all areas of buildings, roads and water.

Discussion

The application of this survey and analysis technique has both advantages and disadvantages – some more obvious than others (see Box 2). In our experience, the size of the project is important in deciding whether to employ this technique, as the economies of scale influence the

advantages. This type of survey technique requires specialist equipment, software and skill sets, which are likely to be more readily affordable on larger projects when comparing the cost with deploying field survey teams to collect Phase 1 Habitat data.

One of the major advantages comes with being able to collect a consistent data set. Phase 1 Habitat survey data collection is subjective and even the most experienced surveyors will assign habitat types slightly differently despite the guidelines provided by the Phase 1 methodology. Various studies have discussed this issue (Cherrill and McClean 1999, Stevens *et al.* 2004) and it is an accepted limitation of the survey technique. The aerial imagery provides a permanent record of the survey area which can be viewed and reviewed to address any queries over the baseline. The technique is also repeatable, so data from different years or seasons can be



Figure 2. Visual result of displaying NDVI; brighter green is associated with agricultural grassland in this example.

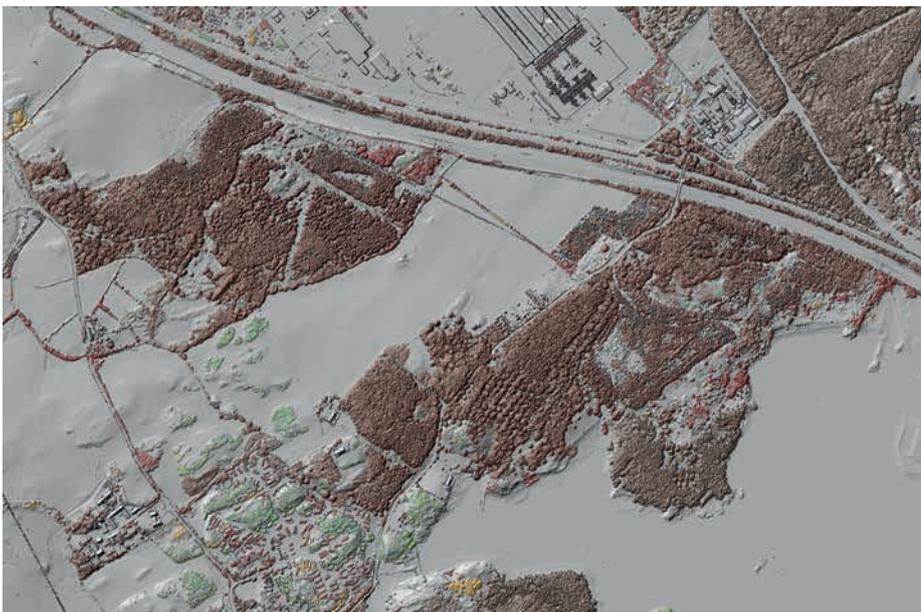


Figure 3. Image illustrating areas where vegetation height >25 cm; darker colouration shows areas of taller vegetation, e.g. deciduous trees.

consistently collected if required to inform the baseline conditions. The habitat classification itself is an automated process, which therefore ensures consistency based on the rules applied. Whilst there may be occasions when natural habitats are misclassified or small habitat changes missed, the majority of the analysis will be accurate and the consistency is likely to be greater than that achievable by a field survey team.

Although some field visits are advised to improve the habitat classification, the problems often associated with ecology field work on large projects, such as land access permissions and the health and safety of field teams, are much reduced by employing this survey technique. It can be used early in the project programme to inform optioneering and scoping, and in particular to better define (type and location) Phase 2 survey requirements in conjunction with the desk-based records.

There are also some disadvantages, and the scale, sensitivity and potential effect of the project may determine whether or not these outweigh the advantages. The most obvious disadvantage arises from being unable to complete target notes, which often provide important additional information about a survey area, including evidence of protected species. The aerial imagery will be able to capture data with a resolution as low as 2.5 cm, although the rules which classify the habitats may not be able to perform to the same resolution, with the outcome that habitat mosaics may not be readily identifiable or some of the more cryptic habitat types could be missed. For example, it may not be possible to differentiate acid, neutral or calcareous grassland or valley, basin, and flood plain mire. However, this can be significantly improved with ground-truthing work in advance of the analysis.

We found that initial analysis provided approximately 95% correct classification of the land parcels in the projects where we have employed this technique, which was further improved by subsequent ground-truthing visits. For larger project areas, or areas where habitat types were likely to be more complex, we would look to perform sample data collection prior to image analysis to develop the rule base and provide higher classification accuracy.

Box 2. Pros and cons of creating a Phase 1 Habitat map using aerial imagery

Advantages	Disadvantages
<ul style="list-style-type: none"> • Consistent data set • Repeatable and efficient • Reduced land access requirements • Reduced Health and Safety risks • Project programming advantages • Cost savings on large projects 	<ul style="list-style-type: none"> • Target notes not possible without site visit • Habitat mosaics may not be readily identifiable • Expensive for small projects

Big Ideas: From on High: Creating a Phase 1 Habitat Map Using Aerial Imagery (contd)

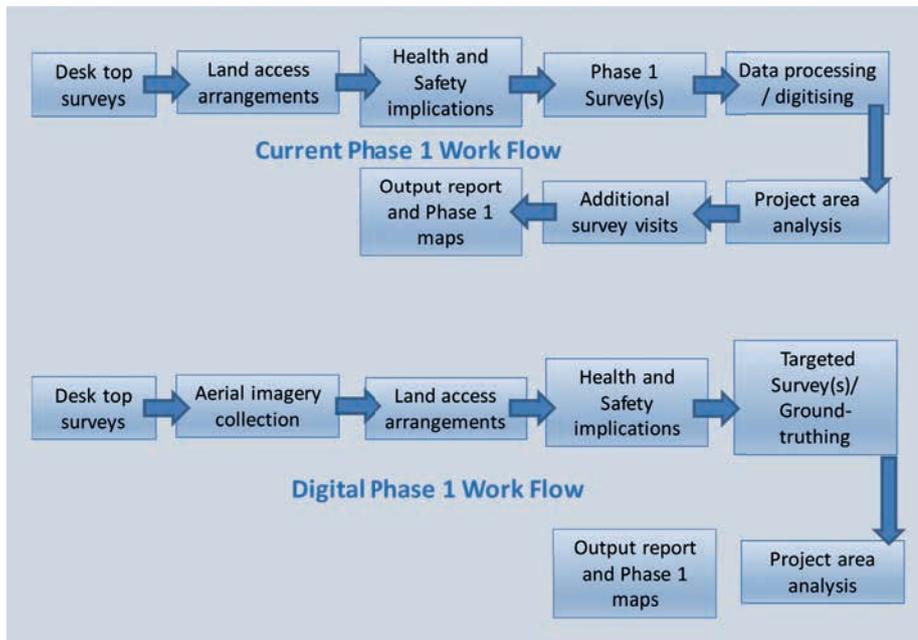


Figure 4. Comparison of the workflows using traditional and digital techniques for Phase 1 Habitat surveys

Our experience to date is that, for projects with survey areas in excess of 20-30 km², the advantages of the technique far outweigh the disadvantages. We have successfully implemented this technique to carry out Phase 1 Habitat survey for entire study areas early in the baseline data collection period, as well as to verify Phase 1 data that had been collected during previous years. In the latter case, being able to show that the habitats present had changed very little in the intervening period allowed us to provide reassurance to stakeholders that the validity of our baseline was unaffected by the age of the data.

With large infrastructure projects, the information required for this technique – for example topography, OSMM, aerial photography and LiDAR – is often already purchased for other design or topic assessment requirements. With fewer steps than conventional survey (Figure 4) and the potential for rapid checks and resurvey, the costs of producing a Phase 1 Habitat map are likely to be lower than physical survey and the financial risk to the client will be better controlled.

In a recent review of two infrastructure projects where we used this technique, we found that using aerial imagery classification reduced survey time in the field, minimised time spent arranging land access, removed the need for additional

survey visits where access had been refused, and resulted in significantly lower health and safety risks associated with working in the field. In combination, these benefits, particularly for ecological input on large infrastructure projects, result in time and cost savings as well as a reduction in the risks associated with timely project delivery.

About the Authors



Iona Pearson has worked in consultancy for almost 20 years on a variety of large infrastructure projects. She has led much of the work in Jacobs to make ecological data collection and display more innovative, and pioneered the use of GIS and electronic data capture on a number of projects early in her career.

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Do We Need More Evidence-Based Survey Guidance?

Keywords: evidence-based, good practice, guidance, monitoring, survey

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Darryn J. Nash CEcol MCIEEM

As ecologists and environmental managers, we rely on good quality baseline information. However, the survey methods we currently employ are often unsupported by scientific testing and are not proven to provide high quality outputs. As a community of practitioners, we should seek to change this, taking on board new research and technological developments – and building more evidence explicitly into our survey guidance.

Introduction

As ecologists and environmental managers, the data we gather through survey and monitoring programmes is vitally important in all aspects of our work. It allows us to predict impacts with some level of confidence, track and anticipate trends in biodiversity, and assess whether our management interventions are working – or not. To generate good quality data though, we need good quality survey methods, which are developed, reviewed and updated in line with existing evidence, new scientific findings and technological developments (Figure 1).

To an extent, we already have reasonable survey methods, which have provided much useful information in national monitoring programmes or in site-based assessments. We are lucky in the UK to have a well-developed history of voluntary and professional work in the conservation sector, and long established standards for surveying flora and fauna. However, if we consider the age of some extant survey guidance (such as the *Great Crested Newt*

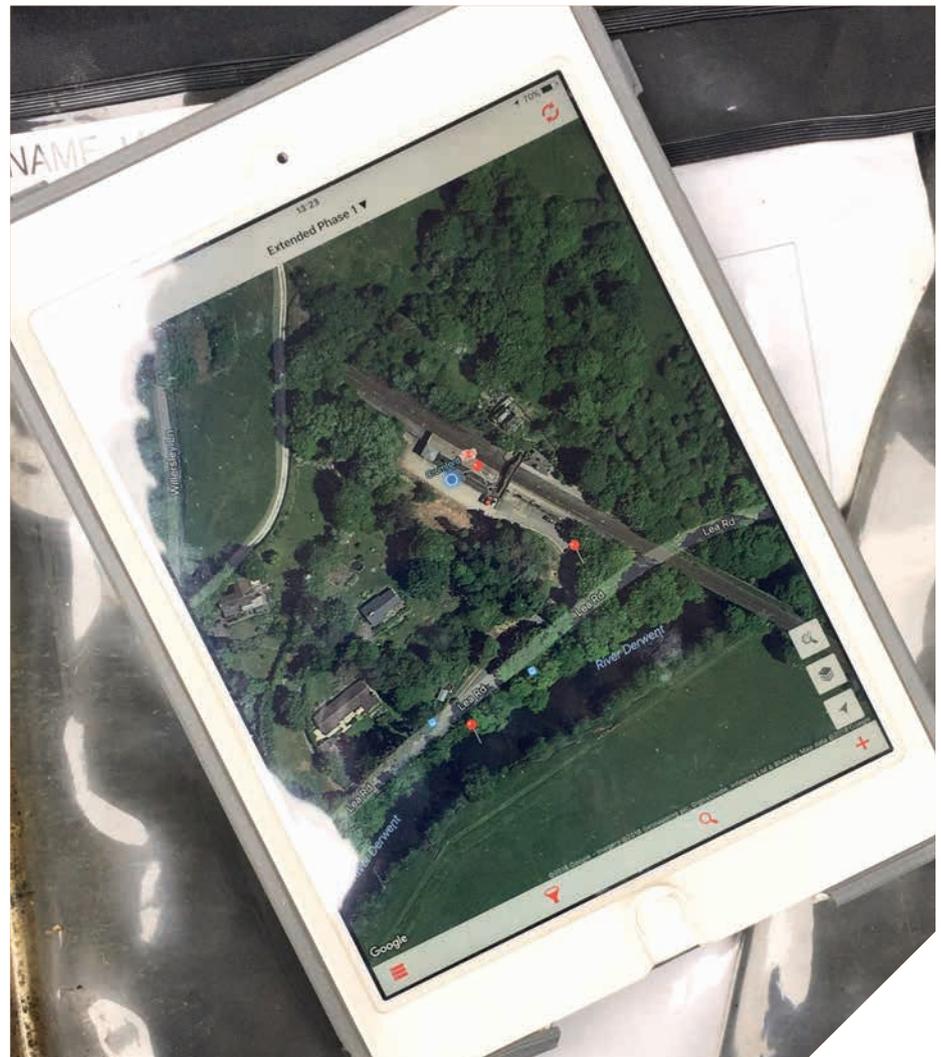


Figure 1. GPS-enabled tablets allow accurate field recording, with forms that can be customised to different types of survey or sites, to allow standardised data collection. Photo credit Carlos Abrahams.

Mitigation Guidelines, English Nature 2001), against the pace of research and technological change, the need for ongoing updates becomes clear.

We all have a responsibility to ensure that our survey methods are fit for purpose. Both BS:42020 (BSI 2013) and the CIEEM *Code of Professional Conduct* require that methods used to undertake surveys should follow published good practice guidelines

where they exist. However, if published guidance is out of date and/or better techniques have been developed, then we should take new innovative approaches where these could provide a better outcome. To make this type of judgment call we should be basing our decisions on *evidence* of what actually works best for our particular needs. However, in the first instance, how much of our established



Figure 3. The use of bioacoustics is common practice for bat surveyors, but could be used effectively by ecologists studying other groups of species. Here an acoustic recorder is deployed to record capercaillie *Tetrao urogallus* in north-east Scotland. Photo credit Carlos Abrahams.



Figure 4. The use of artificial cover objects (ACO) has long been the mainstay of reptile surveys. In the absence of rigorous scientific testing, there are still disagreements over the number, material and colour of ACOs that should be used. Photo credit Carlos Abrahams.

1983). This method is useful for providing detailed information on the distribution of bird territories, but is time-consuming, and difficult to apply and interpret. As there is no set number of site visits for this method when used by consultants, the number of surveys carried out within EclA studies is often determined by the consultant's qualitative assessment of the site or their own established practice. The appropriate level of survey effort required to accurately assess the composition and species-richness of a bird assemblage in a particular location has not been determined in many cases (Calladine *et al.* 2009). In addition, territory mapping may not even be the best option for EclA purposes: point counts, line transects or bioacoustic recording might provide equal or better quality data, and probably with less survey effort (Figure 3) (Abrahams and Denny 2018; Gregory *et al.* 2004).

Reptiles: Our current reptile survey guidance consists principally of Froglife's (1999) *'Advice Sheet 10: Reptile Surveys'*. There was an attempt to update this with Natural England's (2011) *Mitigation Guidelines (TIN102)*, which were rapidly withdrawn, and the more recent survey protocols from Sewell *et al.* (2013), which incorporated seasonal variations in detectability by species. This latter document was perhaps the first major advance in our approach to reptile survey in the past two decades, but remains

unknown to many practising ecologists. The lack of scientific support for established methods and the need for improved approaches was recently highlighted in a review of reptile monitoring programmes (Nash 2018), which showed that new evidence is available to support the revision of survey protocols (Figure 4).

Using Evidence

We need to use science more to tell us the answers to two important questions: (i) which survey methods are best – or at least 'good', and (ii) how much survey effort is needed to generate a sound understanding of a study area? If we want to develop robust and accurate ecological baselines for Environmental Impact Assessments (and other purposes), then we should make sure that our methods are up to the job. It may be that the methods we currently employ are just fine, and incorporating referenced research into our existing guidance would allow us to demonstrate this. If so, we have no need for concern. However, if the methods we use have no demonstrable scientific basis then we need to recognise this as an industry and develop new protocols over time to promote the best practicable methods for data collection, clearly based on evidence. After all, this is the absolute bedrock of our day-to-day work, on which we base assessments, make recommendations and stake our

reputations. How can we not take a more evidence-based approach to survey? Creating survey guidance is a hard and thankless task. Building the content, gaining agreement from a range of professionals with their own views and experiences, and then getting organisations to approve the finished article will never be easy. Griffiths *et al.* (2015) note that *'The uptake of new methods by professional practice will..... be strongly influenced by cost, practicality and the explicit requirements of regulatory authorities'*. However, there is always room for developments in practice where these are supported by good argument and good evidence, so each of us as individuals – and as a community of practitioners – are free to pave new ways where they are needed. One could (correctly) argue that professional judgment should be applied by all ecologists when designing their surveys, and we should all be prepared and able to go beyond standard survey guidance. However, we don't always have time to keep up to date with technical developments in all the fields in which we might work. Accessing information on methodological advances can be difficult in itself, especially for those who aren't fortunate enough to have access to the scientific literature. To help develop a better scientific context for our published guidance, there are a number of ways forward. Firstly, any new guidance that is produced should explicitly state the evidence on which it is based,

and provide appropriate references. Or, if it is only based on best-guess rules-of-thumb, this should be stated clearly. Secondly, consultants, consultees and regulators should all take a more flexible approach to survey methods, and concentrate more on the quality (and meaning) of outputs rather than whether standard protocol has been slavishly followed. Most importantly though, we would make a call for a 'Survey Evidence' initiative for ecologists, along similar lines to Conservation Evidence (www.conservationevidence.com). This would gather, assess and disseminate research findings to allow optimal survey and monitoring recommendations to be developed. This could be done within an organisational setting, or perhaps better, in a crowd-sourced, Wikipedia-style, online forum to which anyone interested could contribute. Such an approach would allow new research findings to be added regularly, allowing constant ongoing development of scientifically supported survey methods and technological innovations – and rapid communication of these across the sector, instead of waiting for irregular approval by a formal authority. It would be independent, authoritative and available to all, demonstrating good practice for our work and enabling us to make better, informed decisions on how we gather data. It would require us to examine our established, and often outdated, methods. In the end, it would raise the questions we should all be asking ourselves. Is our good practice guidance actually proven to be good enough? And if not, how can we all make it better?

Acknowledgements

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CIEEM's Policy Activities Update

Jason Reeves MCIEEM

Policy and Communications Manager, CIEEM

We have continued our Brexit engagement activities¹ in Westminster with a meeting with Scottish National Party MPs John McNally and Angus MacNeil and their researchers in March. At the meeting we discussed issues relating specifically to Scotland and the natural environment and how possible common frameworks and a single UK scrutiny body could work.



CIEEM President Stephanie Wray, CIEEM Fellow Alastair Driver and I have had the opportunity to meet with Sir John Randall, Theresa May's environment advisor at 10 Downing Street. In a wide-ranging discussion, we raised a variety of concerns and were reassured that Downing Street has the environment high on the agenda. It was hugely encouraging to hear how enthusiastic Sir John is about the environment and his own wildlife passions.

Later in April we organised a Parliamentary breakfast, kindly hosted on our behalf by former Environment Minister Richard Benyon MP, on the topic of the environment and land management post-Brexit. The roundtable discussion was attended by four other MPs (Colin Clark, David Drew, Anna McMorrin, Rebecca Pow) along with four senior CIEEM members and a representative



each from the National Farmers Union (NFU) and the Country Land and Business Association (CLA).



CIEEM's Strategic Policy Panel² had its latest meeting on 24 April. The meeting covered our current policy activities and future plans. In particular, the Panel discussed finalising our paper on a framework of principles for Brexit, future Parliamentary events, and our engagement at the European level.

Regarding our European engagement, we must unfortunately report that it has been decided that the European Network of Environment Professionals (ENEP) will cease its operations this year. There are ongoing discussions about what the former members of ENEP could do to maintain a network of some kind. Whatever happens, CIEEM will maintain engagement at the European level.

Much of CIEEM's Brexit activity has been guided by a communications consultant. Our initial contract concluded in March and we have signed a new 6-month contract with the consultants, although with a reduced service as we no longer need as much direct support.

There have recently been some high profile consultations that we have responded to³, including the National Planning Policy Framework (NPPF), the Health and

Harmony consultation on the future of farming in England, and the Wales Planning Policy consultation. At the time of writing the consultation on the environmental scrutiny body for England had just been released as the Environmental Principles and Governance Bill.

CIEEM's new country policy working groups⁴ – for England, Ireland, Scotland and Wales – have now all had their initial meetings. It has been agreed that their core activities will be to facilitate responses to consultations and inquiries, horizon-scanning, and helping to grow our influence with decision-makers.

During my visit to Scotland for the Scotland Policy Working Group's meeting I also took the opportunity to meet with representatives from Scottish Government and Scottish Environment Link to discuss Brexit and the natural environment in Scotland. In addition, we have had specific discussions with the British Ecological Society regarding how we can work together on policy activities in Scotland and Wales.

From June we will be joined in the Policy and Communications team by a Policy and Communications Intern. The 9-month internship will help to delivery our expanding policy and advocacy activities and ambitions.

In the immediate future we will be working on, amongst other activities, getting the country policy working groups into their stride and new parliamentary events.

CIEEM is grateful to the following organisations, which have invested in our Brexit engagement activities:



Notes

1. www.cieem.net/eu-referendum
2. www.cieem.net/strategic-policy-panel
3. www.cieem.net/past-consultation-responses
4. www.cieem.net/country-policy-groups

Ecology and the Donald Rumsfeld Question

Allison Potts MCIEEM

Member of CIEEM's Professional Standards Committee

What does Donald Rumsfeld have to do with ecology, I hear you ask?!

Well, how many of us can accurately separate our ecological known knowns, from the known unknowns? Let alone the known unknowns from the unknown unknowns?

It is enough to even untangle the question, but to answer it requires regular and concerted effort – and here Donald summarised it by saying there are things “we do not know we don't know”.

“There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. There are things we don't know we don't know.”

Donald Rumsfeld, former US Secretary of Defence, 2002

This is a serious point for ecologists: How can we as individual practitioners be confident we are making the best possible ecological decisions if we aren't well informed on the latest developments and weight of evidence in our field (i.e. make sure we know the 'knowns'), as well as the limitations of available knowledge (i.e. make sure we are aware of the 'known unknowns')? And as individuals, could we do more to contribute to the existing knowledge base (i.e. reduce the number of 'unknown unknowns')?

As members of CIEEM, we have obligations under the *Code of Professional Conduct* to maintain our knowledge and skills, having regard to relevant guidance and standards, and working within our competence. But do we invest enough

of our professional development time in ensuring that we understand the applications of the latest research? And if you wished to do more of this in future, would you know where to start?

Luckily, there is now an increasing number of really practical sources of information which can help us double check our thinking on specific questions, or more generally:

Good Guidance

As some of you may have already spotted, CIEEM has recently published webpages listing sources of good guidance for a variety of habitats and speciesⁱ. This is available to members only and is intended to be updated regularly, replacing the *Sources of Survey Methods* and signposting the key references on survey, mitigation, management and monitoring. This is a basic but very useful check to ensure that you are relying on what is considered to be good guidance. If you are aware of a key text that hasn't been included, there is a link on the page to enable you to put this forward for review, so we can all help to keep each other up to date!

This is the latest in a series of CIEEM guidance documents designed to outline good practice. Other publications, all available on the CIEEM websiteⁱⁱ, include:

- Guidelines on Ecological Report Writing
- Guidelines on Preliminary Ecological Appraisal (2nd Edition)
- Guidelines on Ecological Impact Assessment
- Guidelines for Accessing and Using Biodiversity Data

Professional Development and Resources

CIEEM runs a comprehensive programme of training opportunities throughout the

yearⁱⁱⁱ. Some of these are based around practical field skills, where participants have the opportunity to learn from leading experts. Other courses explore and explain core CIEEM guidance documents in more detail, often with input from the authors themselves.

In addition, CIEEM runs a series of themed conferences throughout the year. These are a great opportunity to build your networks, as well as learn something new and refresh and/or challenge your understanding of particular aspects of ecology.

And of course, there's *In Practice!* A great way to stay in touch with developments and explore the opportunities that your Institute provides to keep you abreast of changing evidence.

Conservation Evidence

This free online resource^{iv} provides links to primary literature and handy, digestible synopses. It is specifically designed to help practitioners find the information they need to make the most effective decision for conservation. The *What Works in Conservation* summaries of evidence can be particularly useful both for general professional development and when searching for evidence on specific topics.

Monitoring and sharing what works and what doesn't!

Anyone who attended the 2017 Autumn conference will remember the fascinating talk given by Mike Oxford, entitled 'A Black Box Approach to Delivering Effective Mitigation'. In it, Mike argued that ecologists need to think more like the aviation industry, ensuring that we use our monitoring information and sharing what we learn when things go wrong. He suggested that we need to change the culture of ecology by learning from our mistakes, safely challenging each other, by recognising that failure needn't be seen

as shameful or stigmatising, but rather an exciting opportunity for enlightenment.

Given how many previously 'standard' mitigation techniques have recently been shown to be largely ineffective (e.g. bat and dormouse bridges), what conservation outcomes might we risk if we do not rise to this challenge and share both our data and our mistakes openly?

So back to Donald, and why his question is relevant to ecologists: because it is now so much easier to refresh our knowledge than was previously the case!

If both individually, and as a profession, we can begin to decrease our known unknowns (i.e. we learn from the evidence that is out there), then we can better understand the unknown unknowns (i.e. identify the knowledge gaps). It's important to acknowledge those knowledge gaps and, in these situations in particular, the evidence and experience we have employed in making our judgements, together with the degree of uncertainty. And if we share our experiences of failure, we can accelerate this learning process, whilst at the same time delivering better ecological outcomes. CIEEM's Professional

Standards Committee is interested to know whether you feel an online forum for sharing experiences of failure would be helpful and well used? Would you welcome a forum for logging or sharing evidence gaps? You can give us your views on these questions by emailing us at enquiries@cieem.net or by joining the conversation on CIEEM's LinkedIn group^{vi}.

There is research^{vi} available to suggest that ecologists are complacent when it comes to seeking evidence. It undermines our ability to secure the most effective policy outcomes and to deliver successful mitigation. The reasons for this complacency vary from practitioners feeling they already have sufficient knowledge, to believing evidence isn't relevant or is too difficult to access.

If as a profession we wish to build our credibility to a point where we can reverse the decline of biodiversity alongside the ever ambitious sustainable growth agenda, we must each hold ourselves to account and do more to explore, expand and evolve our knowledge on a continual basis.

Notes

- i. http://events.cieem.net/Portal/Guidance/Good_Practice_Guidance.aspx
- ii. <https://www.cieem.net/technical-guidance-series-tgs->
- iii. <http://events.cieem.net/Events/Event-Listing.aspx>
- iv. <https://www.conservationevidence.com/>
- v. <https://www.linkedin.com/groups/4306428>
- vi. <http://www.nature.com/articles/s41559-017-0244-1>

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Allison Potts is a manager in Natural England's Dorset, Hampshire and Isle of Wight Team and a member of CIEEM's Professional Standards Committee. Allison has previously worked in local government policy and for several Wildlife Trusts and her interests are in securing sustainable development, including net gain, through the planning and licensing systems. At the time of publication, Allison is on maternity leave.

Celebrating 100 Editions:

A Short History of the CIEEM Bulletin

Jason Reeves MCIEEM

Policy and Communications Manager and *In Practice* Editor 2007-2013

In Practice, the Institute's membership bulletin, has been in circulation since the Institute's founding in 1991. It has seen many changes since the original incarnation (see front cover of this edition).

That first edition was printed in monochrome blue text with gold and cream accents. This continued until 2004 when the font colour was changed to black. There has been an ongoing development of the style and appearance of the publication, including the first full colour edition in 2004. There were then major redesigns in 2006 and 2012.

There is an interesting story to be told in the expansion of the pages over time. The very first edition had just 16 pages and there is a period during 1993-1994 when three consecutive editions were each a mere 8 pages long. There were a few problematic years for the publication in the late 1990s but since then it has grown steadily over time to the point now where it is published at a consistent 72 pages. There was, however, a time when the page extent simply reflected whatever had been submitted.

In Practice is now seen as a prestigious publication and a credible reference source in the grey literature. In contrast to when we had to beg and plead, we now have to decline submissions to each edition. This is due in no small part to the ongoing development and improvements made to *In Practice* and the growing influence and recognition of the Institute overall.

Before the Institute had any permanent staff of its own, NatureBureau administered all of the Institute's affairs. This included production of the magazine, mainly done by Sue Everett. Jim Thompson started as the Institute's Executive Director (and first

member of staff) in 1996 and also took over as Editor. I took over the editing role from Jim in 2007.

To coincide with the 2006 redesign, themes were introduced, the first being 'Focus on Wales'. These have continued ever since and provide focus for potential authors, helping greatly in attracting a more consistent number of submissions for each edition.

An Editorial Board, made up of members who volunteer their time, and representing a broad spread of skills and expertise (and geographic location), was established in 2011. The Board's role is not peer-review in the academic sense, but rather to give a membership perspective on what would be valuable to readers and highlight potential improvements in articles.

Gill Kerby became Editor in 2014, adding her considerable expertise to the publication process. Using her past experience of editing the *Journal of Applied Ecology*, Gill has continued to drive improvements in the publication with the help of the Editorial Board to create the publication of the quality that you now have in your hands.

The core content of *In Practice* has remained relatively consistent. Articles continue to reflect the work that members undertake professionally and those issues that affect the sector. This has included articles on practical fieldwork, case studies, technological advances, changes in practice methods, and new policy and legislation.

We have had some important support for the magazine. The British Ecological Society (BES) contributed financially to the Institute in return for us publishing short summaries of their journal papers. It was a mutually beneficial relationship, the BES got academic research out to practitioners and the Institute got additional funding that was much needed in the early days. We continue to publish 'In the Journals' and work closely with the BES – although



the days of them 'paying' us to do so have long since passed.

There has also been content that has come and gone. There are no doubt readers who will remember Basil O'Saurus with some fondness. He was our very own sharp witted Professor of Tauroscatology, who from 2003 to 2012 mused on the state of the sector.

To reflect the importance of *In Practice*, it has had its own annual CIEEM Award since 2015. This is presented to the author(s) of the article that the judges consider to be valuable to the reader, set in useful context, provokes further thinking and is clearly written.

So what does the future hold for *In Practice*? We will of course continue to make incremental improvements to the publication, but we will also be undertaking a full review in the near future. So expect a new and improved version soon! If you have any thoughts on how you would like to see *In Practice* improved, or on future themes, please send your comments to enquiries@cieem.net.

Benefits of Being Chartered – What You Told Us

Following the article in the last edition of *In Practice* which summarised the outcomes of CIEEM's most recent employment and salary survey (see issue 99, p50), the Registration Officer has looked more closely at the responses to questions specific to Chartered Ecologist Registrants. Initial findings look to be very positive indeed and the responses overall have been fed into the ongoing issue, being addressed with the support of the Registration Authority, of how we best raise the profile of what in relative terms is still a very new Register.

Key headlines:

- Of the almost 70% of Registrants who responded to the survey, an overwhelming majority (87.5%) stated their primary motivation for becoming Chartered was to demonstrate their own standard of competence and further their career. Less than 25% of respondents stated a requirement from their employer or an increased salary as a driver for applying. Encouragingly, 88% of respondents stated that their key drivers for becoming Chartered had been either fully or partially met.
 - Although almost half of respondents had yet to see a difference in terms of their salary or the type of work undertaken since becoming Chartered, more than 75% agreed that Chartered status leads to greater professional recognition from colleagues and others they work with. In addition, 75% of respondents also agreed that having Chartered status positively impacted on the status of the profession.
- It was excellent also to receive comments about what becoming Chartered means to you:

"I believe that there is a need for ecologists to have the same professional standing as other professions and with that comes a need to set the bar high."

"Chartered status is part of the expectation of being a full and rounded professional. For me, it's about credibility."

As part of our strategic activity for the next three years we will be focussing not only on raising the profile of Chartered members generally, but also on identifying opportunities to develop the roles that members with Chartered status can fulfil for CIEEM. The comments received through the survey have already provided some interesting ways in which we might meet these aims, so thank you for taking the time to respond.



Paul Robert Gregory

CEcol CEnv MCIEEM

Ecologist (Director), Ecology Services

Tell us a bit about yourself.

I have over 22 years' experience working within the ecological environment and in conservation projects. During this time I have been involved with projects which have covered both terrestrial and marine environments including a diverse range of fauna and flora. My professional experience commenced in 1996, working seasonally as Scientific Officer in West Wales. I have published research on marine mammals and instigated the monitoring programme for the bottlenose dolphin population in Cardigan Bay. I have worked on a wide portfolio of ecological projects and surveyed a diverse range of habitats. These have included saltmarsh, grassland, heathland, woodland and benthic marine habitats. I have published various scientific

papers and reports, and produced various articles for magazines, periodicals and the regional press. I have also undertaken various TV and radio interviews in relation to wildlife conservation and the environment. I am an accomplished wildlife and underwater photographer.

Why did you join CIEEM?

I joined CIEEM as I believe that the Institution can guide or 'bench mark' industry standards and can collectively influence policy in relation to the natural environment.

Why did you apply for Chartered status?

I applied for Chartered status as I feel that the title gives our profession the recognition it deserves.

How did you find the Chartership process?

I found the process rigorous and strict, but fair. Achieving the status meant a great deal to me.

How has achieving Chartered status impacted on the types of work you undertake?

Achieving Chartered Status hasn't really impacted on the types of work I undertake, but I have noticed that we are viewed or 'respected' more by our counterparts within the engineering/construction industry.

Would you recommend applying for Chartership to your peers and colleagues?

I would definitely recommend applying for CEcol to peers and colleagues. However, I would suggest that you feel you are ready and you can confidently address the necessary criteria.

What is the best thing about your job?

The best thing about my job is meeting and working with some fantastic people and amazing wildlife.

If you are interested in submitting your own profile please contact the Registration Officer, Michael Hornby, at RegistrationOfficer@cieem.net.

Student Hub: Plans for Summer? Build Your Practical Ecology Skills

Putting theory in to practice can be a challenge whilst you are studying, as can identifying what skills you will need once you graduate and start looking for employment. Using a mixture of available resources from CIEEM and making the most of the long summer days to build your practical ecology skills, puts you on the path to becoming a well-rounded ecologist or environmental manager.

Practical Experience with Organisations

If you are looking for practical experience, consider joining one or more of your local wildlife groups for their walks and talks. These groups include:

- Wildlife Trusts
- Mammal Society
- Bat Conservation Trust
- Natural History Societies
- RSPB
- The Conservation Volunteers

CIEEM Section Events – The Chartered Institute's Geographic Sections cover the whole of the UK and Ireland and organise talks, workshops, seminars, field trips and social events. They also provide numerous opportunities for members to network, share knowledge and skills as well as providing peer-to-peer member support. If you are studying in one place but living in another, it's a great opportunity to attend different events which are often very low cost or free.

"I volunteered with the Wiltshire Wildlife Trust on a placement year from Harper Adams University. I volunteered at least 3 days, often 5 days every week from July 2017 to August 2018. It was a fantastic experience! I had the opportunity to work with the reserve management team, the biological record centre and many of the teams working with different groups

of people with limited access to the countryside. I gained skills and experience in land management including tool use and DIY. I learnt basic GIS and the delicate workings of biological records and I was privileged to work with a group of excellent, enthusiastic and dedicated nature lovers."

Andrew Barrett, CIEEM student member



CIEEM's Toolkit

Technical Guidance Series

CIEEM has developed various publications available to download from the website (www.cieem.net). In particular, CIEEM published a Competencies for Species Surveys (CSS), which covers the UK and Ireland and sets the criteria for the knowledge, skills and experience required by ecologists undertaking a range of species survey work in a professional capacity.

How do you know what you need to improve upon? Using the Competency Framework

Take a closer look at CIEEM's Competency Framework which enables you to identify the skills (both technical and transferable) required for Graduate, Associate and Full membership as well as roles within the profession. It's widely used by employers to help with the recruitment and development of staff. You can see what skills, knowledge and abilities are required for entry level (basic) competencies, enabling you to better plan your career progression.

Use the framework to your own advantage by mapping your own suitability and effectiveness for roles and build a portfolio to show how you are gaining the skills. Work out what skills you are already strong at, or not, and start building up some evidence and examples by getting some practical experience. Not only will you gain skills required for CIEEM membership but also skills you'll need to demonstrate on a CV and any future job applications. So familiarise yourself with it!

Theme	Surveying	
Competency	S1: Habitat/species survey design, planning and fieldwork	S2: Species identification, handling and evaluation
Basic Has some knowledge with an understanding of terminology and concepts. Has some experience of practical application. Would be able to carry out standard tasks to the required standard under the supervision.	Aware of the principles of ecological survey and relevant good practice guidelines. Can identify survey objections for 'standard' surveys and select the most appropriate survey technique(s). Understands how they are applied. Can use commonly applied fieldwork techniques consistently effectively whilst under supervision. Demonstrates and awareness of, and follows, biosecurity protocols.	Has a basic knowledge of taxonomy and classification and can identify some common species. Carries out standard species surveys under guidance using simple descriptive techniques. Is developing a knowledge of species surveying and species handling by working with/ showing others. Is aware of legal and biosecurity issues and standard biosecure protocols.

British Ecological Society



Richard English

Communications Manager, BES

Hello and welcome to the latest round up of BES news. As ever, we have plenty of initiatives and ways to get involved. We are always happy to chat through any potential collaborations, so please do get in touch.

Translated abstracts in our Journals

As part of our commitment to foster an inclusive community, we are excited that our journals have launched an initiative to allow authors to publish a translated abstract in their native language or language of the country of their research. This will appear alongside the English abstract article. Readers can then toggle between the English and translated abstract. We've already had some great feedback on this initiative from our authors and we have so far published translated abstracts in Dutch, Estonian, German, Hungarian, Spanish and te reo Māori! We look forward to publishing abstracts in many more languages over the months and years to come.

Biologging Feature

Journal of Animal Ecology is currently running an open call for submissions on biologging for a Special Feature to be published in 2019. With recent technological advances, biologging techniques enable the hidden lives of animals to be uncovered. The recent explosion of this field offers a unique opportunity to better understand the functional role and consequences of variation in animal movements on individual fitness, population dynamics, and community functioning. The understanding of the interplay of movement, behaviour and physiology

that biologging offers has applied relevance for a range of fields, including evolutionary ecology, wildlife conservation and behavioural ecology. You can submit an article for the Special Feature (research articles, reviews, synthesis or commentary articles are all welcome!) through the journal's online submission system by 20 September 2018.

Spotlights in *Journal of Applied Ecology*

In case you missed it, our *Journal of Applied Ecology* published a Spotlight on 'Decision Making Under Uncertainty'. The papers in this Spotlight consider the questions, methods and solutions behind decisions made by applied ecologists and conservation scientists that can decide the fate of species and ecosystems. You can read Senior Editor Michael Bode's article on the Applied Ecologist's Blog: jappliedecologyblog.wordpress.com

In issue 55:3, our *Journal of Applied Ecology* also published an article on fisheries management. It features a Spotlight on fisheries management and was published on 13 April. This selection of articles has been chosen by the Editors as examples of the latest high-quality research on a widely-debated and relevant topic. The articles cover a variety of management approaches and implications for fisheries, including size and spacing guidelines for marine protected areas, and species recovery following closure to towed mobile fishing gear. Find out more here: <http://bit.ly/AppliedSpotlights>.

People and Nature: our journal of relational thinking

We will soon be launching an exciting new journal: *People and Nature*. It will be a broad-scope open access journal, publishing work from across research areas and exploring relationships between

humans and nature. Our high-profile editorial board includes Editor-in-Chief Kevin Gaston (University of Exeter) and Lead Editors Kai Chan (University of British Columbia), Robert Fish (University of Kent) and Rosemary Hails (Centre for Ecology and Hydrology).

For pre-submission enquiries, expressions of interest in joining the editorial board or general questions get in touch with Emile, the Managing Editor, at emilie@britishecologicalsociety.org.

The Accessibility Network

In mid-2017, a PhD student member approached us to ask how they might raise the issue of disability and the impact of disabilities on developing careers. They identified a lack of access to successful senior researchers (with disabilities) and a fear of openly discussing some of the issues that disabled researchers face. So, we launched the Accessibility Network at our 2017 Annual Meeting in Ghent. The network is intended to provide an opportunity for people to come to together to share experiences and discuss what does or does not work in supporting disabled researchers. We will meet annually at our Annual Meeting alongside developing an annual programme of smaller events focussing on particular aspects of research. Most importantly we want **your** thoughts on how we can support disabled researchers and people who supervise or manage disabled colleagues. To join our network or write an article about your experiences, email Karen, our External Affairs Manager, at karen@britishecologicalsociety.org.

Contact

richard@britishecologicalsociety.org
 @BritishEcolSoc
www.britishecologicalsociety.org

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.



EAST OF ENGLAND

East of England Ecology Quiz 26 January 2018, Cambridge

Great fun was had by all at the East of England Section Ecology Quiz, held at the Sun Inn in Waterbeach. What better way to spend a Friday night than with like-minded ecologists?

All credit to quiz master James Simpson, especially for his wildlife-related music round. The top spot went to the Vice Convenor's team, the Huckle Bears, but the best team name by far was ... Myotis Redding!

Read more about the East of England Section at www.cieem.net/east-of-england

SOUTH EAST ENGLAND

The National Nathusius' Pipistrelle Project

19 August 2017, Cobham

Ross Baker, chairman of Surrey Bat Group, presented a talk to members on this ground-breaking Bat Conservation Trust project at Cobham Village Hall in Surrey. Participants in the Project have been catching, ringing and radio-tracking Nathusius' pipistrelles since 2014, providing new insights into the distribution of both breeding and migratory populations of this rare species in the UK. Surrey Bat Group has been studying Nathusius' at one site since 2012 and across the county since 2014 as part of the national project, identifying the River Thames as a probable major migration corridor for bats coming over from north-eastern Europe in the autumn.

Read more at www.cieem.net/south-east



SOUTH EAST ENGLAND

Identification of Trees in Winter 6 February 2018, Southampton

Fifteen hardy South East England Section members braved the freezing wind at Riverside Park in Southampton for a workshop on identifying deciduous trees in winter, led by John Poland, co-author of the *Vegetative Key to the British Flora*. The park features a range of both native and non-native trees and shrubs, of the kind frequently encountered by urban ecologists, thus providing a fantastic opportunity to get to grips with these species and cultivars, which can be challenging even in summer. John showed us how these can be identified to species using only features such as buds, bark and thorns or spines.

Read more at www.cieem.net/south-east

SOUTH WEST ENGLAND

Building with Nature in the South West

March 2018, Exeter, Truro and Bristol

The South West England Committee organised three fantastic events this March with Gemma Jerome of Gloucestershire Wildlife Trust to present their 'Building with Nature' initiative and provide an opportunity for some lively debate.

Read more about it at www.cieem.net/south-west

Nathusius' pipistrelle





SOUTH WEST ENGLAND

Nocturnal Landscapes: Environmental Growth at Night 15 March 2018, Redruth

Over 130 delegates, mainly ecologists and planners, attended this excellent conference, which was organised and sponsored by Spalding Associates (Environmental) Ltd (Truro) and Cornwall Council, in association with the CIEEM South West England Section Committee, Cornwall & Isles of Scilly Local Nature Partnership (LNP) and University of Exeter.

Along with many fascinating sessions on the impacts of changing light pollution on a variety of nocturnal species, the highlight was definitely the bird vs. bat karaoke performed by Prof. Mathews!

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

ACADEMIA SPECIAL INTEREST GROUP

Now that the Academic Special Interest Group has been relaunched we are keen to hear from anyone who is involved in teaching or with research interests. As degree apprenticeships come online it is particularly important that teaching and practice in our profession remain closely connected, supporting each other to further the interests of the profession.

Interested? Find out more and get in touch at www.cieem.net/academia.

SOUTH EAST ENGLAND

Student engagement at the University of Reading 7 March 2018

Craig Llewellyn and Clare Caudwell of the South East England Section Committee gave a presentation to students at the University of Reading aimed at those on the relevant MSc in ecology, conservation and environmental management. The presentation outlined what CIEEM represents, its aims, and what it does for its members, including examples of recent policy, consultation responses, publications, training and the range of events that the South East England Committee has carried out over the last year. The presentation also included the role that the organisation can play for the next generation of ecologists and environmental managers, and the resources available.



UK OVERSEAS TERRITORIES SPECIAL INTEREST GROUP

Webinar: What news about dolphins of the Falkland Islands?

7 February 2018

The first in a new series of quarterly webinars designed to reach members working out in the UK's Overseas Territories and others interested in these amazing biodiversity hotspots. This successful event was truly international, hosted



St Helena

EAST OF ENGLAND

Great crested newt alternative trapping methods workshop 27 March 2018, Nevendon

The East of England Committee held an event at Nevendon on 27 March 2018,



a site managed by Jon Cranfield of Herpetologic. The event looked at the work that Herpetologic has undertaken on site and methods for carrying out great crested newt (GCN) surveys including the use of daytime deep water bo traps. The bo traps have been shown to successfully detect GCN within in a couple of hours during the daytime, demonstrating an alternative technique to obtaining presence and absence data. The traps are also being used in comparison with bottle traps to assess capture rates.

Read more about this event at www.cieem.net/east-of-england.

from Winchester with speaker, Marina Costa of the South Atlantic Research Environmental Institute (SAERI), presenting from the Falklands and streamed live to a conference in St Helena, with other participants in the UK and beyond! Read more about the UK Overseas Territories Special Interest Group at www.cieem.net/member-networks.



London

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.



Falkland Islands

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 and Chartered members:

ADMISSIONS

Chartered Ecologist (CEcol)

John Brophy, Eamonn Delaney,
James Girgis, Delphine Pouget,
James Simpson

Full Members (MCIEEM)

Dr Emma Boston, Andrew Campuzano,
Dr Samantha Cartwright,
Alexander Cruickshank, James Davidson,
Yvonne Grieve, Peter Hague,
Brian Heppenstall, Dr Paul Howe,
Dr James Littlemore, Bernie O'Connor,
Catherine O'Reilly, Simon Roper,
Dr Elena San Martin, Dr Claire Tancell,
David Thorpe, Christopher Toop,
Gareth Ventress, Denise Yorke

Upgrades to Full Membership (MCIEEM)

Emma Bagguley, Calum Campbell,
Corey Cannon, Zoë Costas-Michael,
Andrea Coyne, James Hicks,
Robert Hutchinson, Kimberley Jennings,
Louisa Jones, Kate Kibble, James Meyer,
Faye Midmore, Lorraine Palmer,
Louis Pearson, Christopher Shaw,
Jenny Stephenson, Louise Woolley

Associate Members (ACIEEM)

Jay Allen, Dr Dawn Anderson,
Charlotte Clements, Robert Dalziel,
Alan Dunne, Nicola Hesketh-Roberts,
Mhairi Mackintosh, Ashley Martin,
Mark Middleton, Cecilia Montauban,
Gareth Price, Porscha Thompson,
Maria Walentek

Upgrades to Associate Membership (ACIEEM)

Georgia Alfreds, Catherine Bywood,
Alexandra Cole, Philippa Cope,
Emily Costello, Jenny Downie,
Deborah Fieldsend, Declan Ghee,
Rebecca Harmsworth, Andrew Heideman,
Courtenay Holden, Patrick Leatham,
Martin Ledger, David Lovett,
Rosemarie McDonald, Gregory Nightingale,
Vanessa Reeves, Hannah Rowding,
Carolyn Smith, Henry Smith, Lynn Spencer,
Katherine Thorne, David White,
Hannah Willis, Bethan Withey,
Lewis Wright

Graduate Members (Grad CIEEM)

Sarah Allman, Emma Archer,
Lydia Atkinson, Samuel Barker,
Diana Beecroft, Dayle Bickley,
Jade Brennan, Clare Cashion,
Cameron Chester, Athina Constantinou,
Calum Cooper, Livvy Cropper,
Charlotte Durigan, Catherine Finlayson,
Becca Grainger-Wood, Hanna Grimsdale,
Peter Hacker, Isobel Harding, Melissa Hill,
Hamish Jackson, Alex Johnston-Comerford,
Sonja Kaulbarsch, Samuel Knowles,
Lyndsey McBean, Thomas McClellan-West,
Scott McCollum, Jack Medley,
Ciaran Meehan, Carl Noyce,
Gwilym Pask-Hale, Kate Philpot,
Helen Pietkiewicz, Alice Power,
Richard Prew, Amy Reddick,
Verity Richardson, Timothy Rickard,
Hayley-Louise Snowdon, Alejandra Toledo,
Matthew Whittle, Bethany Wilson,
Samuel Wilson

Upgrades to Graduate Membership (Grad CIEEM)

Dr Salma Ahmed,
Monica Amaral de Paula Souza,
Hayley Barrett, Harry Ferguson,
Harriet Fuller, Lucy Grable,
Benjamin Griffin, Viktoria Hobbs,
John Salisbury, Martin Smith

Qualifying Members

Hayley Astbury, Dr Hazel Burridge,
Adam Cuffley, Megan Gee, Paul Harrison,
Alexia Michaelides, Sara Simmons,
Matthew Wood, Gemma Worswick,
Adam Dayman, Cara Donald,
Ashley James, Beth Mell, Emma Baker

Student Members

Al-Zanaka Ahmed, Claudia Allen,
Chardé Anderson, Rea Atkinson,
Rebekah Baker, Vanessa Barlow,
Henry Barrett, Ellie Bartle, John Beaumont,
Elizabeth Beck, Warren Beets, Jack Bell,
Tobias Betts, Oliver Bevan, Celia Brailsford,
Sophie Bray, Sarah Brignall,
Amanda Brockinton, Natalie Brykalski,
Jessica Busuttill, Anna Byatt,
Alexander Camilleri, Natasha Chinn,

Lindsey Clark, Rachel Clarke,
Dean Claxton, Ross Collins, Bradley Collins,
Amber Connett, Claire Cornhill,
Duncan Cowper, Lydia-Rose Cox,
Jack Cresswell, Thomas Cumberland,
Charlotte Dacre, Ella Dangerfield,
Frank Dawson, Elvin Delaney,
Stephen Devereaux, Emily Dimond,
Owen Dodgson, Sophie Elliott,
Katie Farmer, Chelsea Fletcher,
Sophie Forbes, James Fotios, Caitlin Fox,
Robert Fox, Bruce Gardiner, Steven Gilham,
Hayley Glanville, Lucy Goddard,
Kirsty Grant, Roisin Grimes, Emma Hawkes,
Nadira Hendarta, Veerle Herzberg,
Bo Hickey, Cara Daisy Hodge, Isaac Hogan,
Louise Hopkins, Lois Horton-Cleary,
Nia Howells, Bethany Hunt,
Rebecca Hunter, Natascha Imlay,
Rhodri Jones, Scott Kean, David Kelly,
Christopher Kilmartin, William King,
Victoria King-Cline, Lonneke Klein-Aarts,
Andrew Knight, Jenny Kuru, Alison Laing,
George Lee-Harris, Sophie Long,
Amy Lovegrove, Jennifer MacIsaac,
Ruth Main, Liam Maries, Andrew Marks,
George Massingham, Renée McAlister,
Rebecca McGowan-Griffin, Rachel McNally,
Adam McVeigh, Leanne Meldrum,
Nelson Mhlanga, Will Mills, Sarah Morgan,
Megan O'Brien, Chloe O'Dell,
William Oliver, James Oliver,
Wendy O'Neill, Tristan Orr-Berwick,
Anna-Emilia Pääkkönen, Mark Peti,
Verity Phillips, Annette Price,
Adèle Remazeilles, Samuel Rogerson,
Natalie Rolph, Louise Russell,
Charles Ryder, Megan Skinner,
James Smith, Tanya Smith, Edward Snell,
Nicolle Stevens, Jacob Stillyards,
Kathryn Stirling-Brown, Rebecca Stobbart,
Teresa Sullivan, Katie Sweet, Mirjana Tako,
Charlotte Tamkin, Philip Tennyson,
Penni Thomas, Lauren Turner,
Kate Twynham, Faith van Jaarsveld,
James Walker, Hannah Weald,
Georgina Westwood, Sarah White,
Freya Wiggin, Alexandra Wildman,
Alex Williams, Aleksandra Wisniewska,
Lisa Wood, Antony Woodgate,
Christopher Woodham



Agri-environmental Management in Europe: Sustainable Challenges and Solutions – From Policy Interventions to Practical Farm Management

Authors: Kathy Lewis, John Tzilivakis,
Douglas Warner, Andy Green

ISBN: 9781912178445

Price: £85.00

Available from: www.5mbooks.com

This comprehensive monograph provides a perspective on the current state of agri-environmental management in Europe from both a policy and practical perspective. Modern agriculture faces many challenges, including food security and the need for sustainable farming systems. These and other important issues form the framework of the book, which takes an integrated approach by not just examining these issues separately but examining the whole system in which these problems are manifested. At the end, technologies and solutions which are currently being developed and could be used in the future are discussed and the horizon scanned for future environmental challenges.



Bumblebees:

An Introduction

Authors: Nikki Gamman, Richard F.
Comont, S.C. Morgan and Gill Perkins

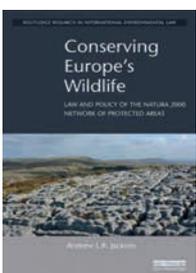
ISBN: 9780995773905

Price: £9.99

Available from: www.nhbs.com

A general introduction to bumblebees has not been available until now. This

Bumblebee Conservation Trust book fills that gap by introducing these charismatic species to a wider audience. Written by Trust staff, it covers bumblebee biology, their decline and conservation and what you can do to help them in your garden and beyond. It also has an identification guide to all UK bumblebee species, with over 250 colour photographs.



Conserving Europe's Wildlife: Law and Policy of the Natura 2000 Network of Protected Areas

Author: Andrew L.R. Jackson

ISBN: 9781138203655

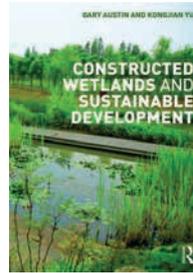
Price: £115.00

Available from:

<https://www.routledge.com/>

Based on original archival research and

interviews with key participants, this book records a detailed history of the origins and negotiation of Natura 2000 policy and law, with the history of EU environmental policy provided as a framework. Three phases in the history of EU environmental policy are identified and described, and the history of EU nature policy is placed within the context of these three phases. Informed by this history, the author presents a comprehensive summary and assessment of the law and policy that protects Natura 2000 sites at EU-level and reviews the nature conservation outcomes for the targeted species and habitats.



Constructed Wetlands and Sustainable Development

Authors: Gary Austin and Kongjian Yu

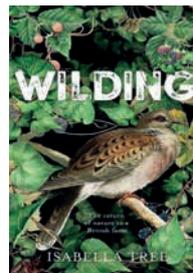
ISBN: 9781138908994

Price: £50.99

Available from: www.routledge.com

This book explains how, with careful planning and design, the functions and performance of constructed wetlands can

provide a huge range of benefits to humans and the environment. It documents the current designs and specifications for free water surface wetlands, horizontal and vertical subsurface flow wetlands, hybrid wetlands and bio retention basins; and explores how to plan, engineer, design and monitor these natural systems. Site- and municipal-scale strategies for flood management, storm-water treatment and green infrastructure are illustrated with case studies from the USA, Europe and China, which show how these principles have been put into practice.



Wilding:

The Return of Nature to an English Farm

Author: Isabella Tree

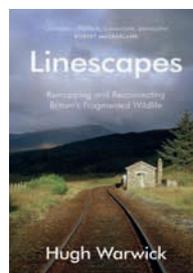
ISBN: 9781509805099

Price: £16.99

Available from: www.nhbs.com

Isabella Tree tells the story of the 'Knepp experiment' and what it reveals of the ways in which we might regain that wilder, richer

country. It shows how rewilding works across Europe; that it has multiple benefits for the land; that it can generate economic activity and employment; how it can benefit both nature and us – and that all of this can happen astonishingly quickly. Part memoir, part an account of the ecology of our countryside, *Wilding* is a story of hope. See Isabella's article on page 29 for a brief introduction to the Knepp Estate.



Linescapes:

**Remapping and Reconnecting
Britain's Fragmented Wildlife**

Author: Hugh Warwick

ISBN: 9780099597766

Price: £7.99

Available from: www.nhbs.com

It is rare to find a landscape untouched by our lines – the hedges, walls, ditches

and dykes built to enclose and separate; and the green lanes, roads, canals, railways and power lines, designed to connect. This vast network of lines has transformed our landscape. The author unravels the far-reaching ecological consequences of the lines we have drawn: as our lives and our land were being fenced in and threaded together, so wildlife habitats have been cut into ever smaller, and increasingly unviable, fragments. This publication proposes a challenge and gives ground for hope; for while nature does not tend to straight lines and discrete borders, our lines can and do contain a real potential for wildness and for wildlife.

Predicting the impacts of wind farms on seabirds: An individual based model

Warwick Evans, V., Atkinson P.W., Walkington, I. and Green, J.A.

Journal of Applied Ecology 2018; 55:503–515.
<https://doi.org/10.1111/1365-2664.12996>

The author's spatially explicit individual based models (IBM) highlight that it is vital to know the colony specific foraging grounds of seabirds that may be impacted, when identifying potential wind farm sites, in order to account for cumulative impacts from multiple sites. Avoiding areas highly used for foraging and commuting, and avoiding large scale developments should be effective in limiting gannet mortality as a result of collision, competition and energy expenditure. The author's IBM provides a robust approach which can be adapted for other seabird populations or to predict the impacts from other types of spatial change in the marine environment.

Open access: <https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.12996>

Landscape greening and local creation of wildflower strips and hedgerows promote multiple ecosystem services

Sutter, L., Albrecht, M. and Jeanneret, P.

Journal of Applied Ecology 2018; 55:612–620.
<https://doi.org/10.1111/1365-2664.12977>

Local establishment of perennial, species rich wildflower strips and hedgerows, combined with landscape scale greening measures in agricultural landscapes, can promote multiple ecosystem services (ES) in conventional production systems. Benefits may be maximised when local and landscape measures are combined. However, enhanced pollination and natural pest regulation seem to contribute relatively little to final crop yield compared to local agricultural management practices in the high input conventional production system studied. Further research is needed to better understand how to improve the effectiveness of ecological focus areas and other greening measures in promoting regulatory ES. Potential improvements include minimising trade offs while promoting synergies between ES provision, food production and biodiversity conservation.

Correspondence: louis.sutter@agroscope.admin.ch

The changing environment of conservation conflict: Geese and farming in Scotland

Mason, T.H.E., Keane, A., Redpath, S.M. and Bunnefeld, N.

Journal of Applied Ecology 2018; 55:651–662.
<https://doi.org/10.1111/1365-2664.12969>

This study demonstrates the primary role of habitat modification in the emergence of conflict between goose conservation and agriculture, alongside a secondary role of climate change. The research illustrates the value of exploring socio ecological history to understand the processes leading to conservation conflict. In doing so, the authors identify those elements that are more controllable, such as local habitat management, and less controllable, such as climate change, but which both need to be taken into account when managing conservation conflict.

Correspondence: tom.h.e.mason@gmail.com

Harbour seals avoid tidal turbine noise: Implications for collision risk

Hastie, G.D., Russell, D.J.F., Lepper, P., *et al.*

Journal of Applied Ecology 2018; 55:684–693.
<https://doi.org/10.1111/1365-2664.12981>

This study provides important information for policy-makers looking to assess the potential impacts of tidal turbines and advise on development of the tidal energy industry. Results showing that seals avoid tidal turbine sound suggest that a proportion of seals encountering tidal turbines will exhibit behavioural responses resulting in avoidance of physical injury; in practice, the empirical changes in usage can be used directly as avoidance rates when using collision risk models to predict the effects of tidal turbines on seals. There is now a clear need to measure how marine mammals behave in response to actual operating tidal turbines in the long term to learn whether marine mammals and tidal turbines can coexist safely at the scales currently envisaged for the industry.

Open access: <https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.12981>

Designed habitat heterogeneity on green roofs increases seedling survival but not plant species diversity

Walker, E.A. and Lundholm, J.T.

Journal of Applied Ecology 2018; 55:694–704.
<https://doi.org/10.1111/1365-2664.12970>

Redistribution of green roof substrate and the addition of logs and pebble piles altered microsite conditions and created habitat heterogeneity on a green roof. These design modifications represent a minimalist strategy to ameliorate growing conditions, improve seedling survival and decrease species loss on shallow substrate green roofs.

Correspondence: emily.walker@smu.ca

Shifts in North Sea forage fish productivity and potential fisheries yield

Clausen, L.W., Rindorf, A., van Deurs, M., Dickey Collas, M. and Hintzen, N.T.

Journal of Applied Ecology 2018; 55:1092–1101.
<https://doi.org/10.1111/1365-2664.13038>

The results of this study demonstrate that fisheries reference points for short lived planktivorous species are highly dynamic and respond rapidly to changes in system productivity. Furthermore, from an ecosystem based fisheries management perspective, a link between functional complementarity and productivity, indicates that ecosystem resilience may decline with productivity. Based on this, the authors advise that system productivity, perhaps monitored as forage fish growth, becomes an integral part of management reference points; in both single species and ecosystem contexts. However, to retain social license of biological advice when fish catch opportunities are reduced, it is crucial that shifts in productivity are thoroughly documented and made apparent to managers and stakeholders.

Correspondence: mvd@aqua.dtu.dk

Forthcoming Events 2018

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

Conferences

Date	Title	Location
12 July 2018	CIEEM Summer Conference 2018 – Fit for the Future: Developing an ecologically resilient designated sites strategy	London
20-21 November 2018	CIEEM Autumn Conference 2018 – Habitat Re-creation and Ecological Restoration	Glasgow

Training Courses

June 2018

5	Botany for Beginners	Bristol
7	Otter Survey Impacts and Mitigation	Dunblane
9	Bat Handling and Identification	Herne Bay, Canterbury
12	Otter Ecology and Surveys	Stafford
13	Otter Mitigation	Cannock, Staffordshire
13	Grass and Sedge Identification – Neutral and Calcareous Grasslands	Salisbury
14	Grass, Sedge and Rush Identification – Heathland, Acid Grassland and Bogs	Fordingbridge
16	NVC: What You Need to Know	Hereford
20	Beginners Guide to the NVC	Carlisle
25	Using Indicator Species for Habitat Assessment (Phase I and NVC) – Grasslands	Salisbury
26-27	Introduction to Phase 1 Habitat Survey	Richmond Park, Surrey

July 2018

3-4	Water Vole Live Trapping, Handling, Practical Care and Re-establishment	Lifton
4-6	Working with Crayfish	Settle
7	Bat Handling and Identification	Herne Bay, Canterbury
9	Wetland Habitat Identification, Evaluation and Management	Swansea
10	Water Vole Ecology and Surveys	Ilkeston, Derbyshire
11	Water Vole Mitigation	Ilkeston, Derbyshire
19	Badger Impacts and Mitigation	Lincoln
27	Hazel Dormouse: Handling and Survey Methods	Herne Bay, Canterbury

August 2018

2-3	Advanced Bat Survey Techniques	Wotton-Under-Edge, Gloucestershire
7	Identification of Invasive Alien Plants	Richmond

September 2018

3-4	An Introduction to the NVC	Birnam, Scotland
6	Phase 1 Survey and Interpretation	Cambridge
17-18	Ground Water Dependent Terrestrial Ecosystems	Birnam, Scotland
18	Water Vole Ecology and Surveys	Cirencester
19	Water Vole Mitigation	Cirencester
25	An Introduction to SUAVs for Ecological Practice	Preston
26	Barn Owl: Ecology, Surveying and Mitigation	Tamworth, Staffordshire
27	Peregrine Falcon: Ecology, Survey and Mitigation	Great Barr, Birmingham
27	Preliminary Ecological Appraisal: An Applied Approach	Cooksbridge, East Sussex

October 2018

3	Introduction to Bat Ecology and Bat Surveys	Wareham, Dorset
3	Eurasian Beaver Ecology and Survey Techniques	Birnam, Scotland
4	Eurasian Beaver Mitigation and Management	Birnam, Scotland
4	Bats: Impact Assessment of Development, Mitigation and Enhancements	Wareham, Dorset



**Undertaking training
has helped me
share my
expertise**

David Goddard is a Senior Ecologist at WYG, who has benefitted from career development opportunities and has been able to share his expertise through mentoring. David tells us more:

I returned to university as a mature student and graduated with a BSc in Environmental Conservation. Whilst I enjoyed studying, I chose to work as an ecological consultant during my final year. It was around this time that I co-authored a report for English Nature (now Natural England) specifying how to carry out the surveying and monitoring of Odonata on all SSSIs within England.

At WYG, I am responsible for delivering a wide variety of ecological projects and have developed a specific interest in ornithology, aquatic and terrestrial invertebrate surveys. I have been able to share my expertise with colleagues by delivering internal training on invertebrate surveys and providing project specific advice and support.

Sharing my expertise has improved the team's capabilities including how to assess sites for invertebrate potential and identify where further surveys and mitigation are required. I have subsequently led training courses for external organisations including Derbyshire and Nottinghamshire Wildlife Trusts, BTCV and National Trust.

I'm grateful for WYG's support, allowing me to broaden my abilities by attending and delivering courses that cover a wide range of invertebrate species groups such as aculeate hymenoptera (bees, ants and wasps), ground beetles, centipedes, millipedes and woodlice and site assessment using invertebrates.



If you're interested in ecology and have got what it takes to join WYG's ecology team, search and apply for roles at www.wygcareers.com or email your CV to ecology@wyg.com.



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