CIEEM in practice
Issue 119 | March 2023
Bulletin of the Chartered Institute of Ecology and Environmental Management

Conservation Translocations and the Risk from Disease

Beavering Away: The Reintroduction of Beavers in England

Wallasea Island: Showing Why and How to Rewild the Coast

Rewilding, Habitat Restoration and Species Reintroductions

Editorial

Welcome

I am writing this Editorial on the day the Government published its Environmental Improvement Plan 2023 (HM Government 2023) with its targets for habitat restoration in England, including to *"Create and restore at least 500,000 hectares of new wildlife habitats, starting with 70 new wildlife projects including 25 new or expanded National Nature Reserves and 19 further Nature Recovery Projects"*. This is welcome news, but the critical element here is *how* these targets will be delivered, and by whom.

We have been here before with ambitious targets for the restoration of the natural environment and one advantage of a long career in the sector is the ability to look back and reflect on past successes and failures to guide future progress. One of the biggest problems has been the disconnect between nature conservation and agricultural policy and practice, often resulting in conflict and the continuing decline of nature. Similar issues relate to forestry, and the lack of integrated management of fisheries and the marine environment. We have also worked on too small a scale and government resistance to strategic planning has led to too many development projects simply being in the wrong place.

It is tempting to dwell on the negatives, but there is now much room for optimism. We have the Lawton Principles (more, bigger, better, joined-up) now accepted by all four UK Governments. The original document (Lawton *et al*. 2010), is well worth reading again. There are signs that environment and agricultural policies are going to be better aligned, with, in England, the prospect of the new Environmental Land Management scheme being a delivery tool for at least some nature recovery. Progress on this is also being made in Scotland and Wales. Climate change, environmental concern and the COVID-19 pandemic have increased the connection of people with nature, and this will continue to drive political support and policy change.

I have always been interested in contextual issues relating to ecological restoration and what we are trying to achieve. I was reminded of this through reading *Rebirding: Rewilding Britain and its Birds* by Benedict Macdonald (2019), who, at the beginning of the book, reviews the impact of human activity on the UK landscape and its biodiversity from the end of the last Ice Age to the present day. It makes sobering reading on the riches we had and what we have lost. The book then raises serious questions about what we should restore and reintroduce, and that planning for climate change adds to the complexity of our decision-making.

The articles in this edition of *In Practice* cover the kind of programmes and projects required to deliver nature recovery. The restoration of Scottish peatlands, the creation of coastal ecosystems at Wallasea Island and the reintroduction of beavers are all projects working to increase and diversify UK habitats. It is hard not to see a case for a widespread reintroduction of beavers to England, Wales and Scotland, given their ecosystem engineering skills and their ability to deliver new habitats at little cost. This is also a live issue in Ireland where the beaver is not native (Irish Wildlife Trust 2020). The interrelationship of habitat and species conservation is considered with papers on northern pool frog and freshwater pearl mussel reintroduction. Two papers cover species conservation translocations, important to both the protection and enhancement of biodiversity, but with the proviso that biosecurity concerns must be addressed. The paper on habitat creation on landfill in north west Wales reminds us that we must make the most of opportunities to create habitats where and whenever we can.

The success of rewilding, habitat creation/restoration, species reintroductions and nature recovery more generally is going to depend on the ecological and environmental management expertise of CIEEM members. Is the profession large enough? Does it have sufficient expertise to provide the scientific and practical support that these programmes of work will need? Do decision-makers understand that ecologists and environmental managers

are essential to deliver cost-effective projects? These are issues on which CIEEM must take the lead in working with UK Governments, local authorities and other actors to argue for resources to provide the professional support which is needed.

There has never been a time when practical ecologists and environmental managers have been more in demand. We must embrace this opportunity to show what our profession can offer to help society deliver a more nature-rich world.

Dr David Parker CEcol CEnv FCIEEM
Past President, CIEEM

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Conferences Dates For Your Calendar!

The Role of Soils in Nature Recovery

FINAL FEW PLACES
BOOK NOW

Spring Conference — 21 March, London

Creating and managing soils and other substrates to support habitat creation and restoration is essential to drive nature recovery. New legislative and policy mechanisms, such as environmental land management schemes and biodiversity net gain are predicated on being able to effectively create places where nature can flourish. Getting soils and substrates right is therefore essential if those mechanisms are to succeed. Come along to this conference to learn effective soil and substrate creation and management techniques for a range of habitats and environmental outcomes.

Aiming for a Nature Positive Ireland

BOOK NOW

Irish Conference — 25 April, Athlone

Nature Positive is a global movement that advocates for having more nature at the end of the decade than at the start. This conference will explore what this looks like in the context of the island of Ireland. What will success look like? What are we already doing to move towards this goal? What needs to change if we are going to be successful? The conference will bring ecologists and environmental managers together to understand the challenges that we face in delivering Nature Positive for Ireland and how we can overcome them.

CIEEM

In this issue

In Practice

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Cover photo: Wild Eurasian beaver (*Castor fiber*).

CIEEM News

Recent webinars

We continue to run a full and varied series of webinars for members and the sector. Readers may be interested in the recent webinars that are available on the CIEEM Resource Hub, listed below.

- The People's Assembly for Nature
- Use of Drones in Ecological Surveying
- Could you be our next Mentor?
- A Focus on Ecologist MSc Degree Level Apprenticeships

Past webinars are available in the CIEEM Resource Hub (https://cieem.net/i-am/resources-hub/). Also look out for future webinars in the Events and training listing on the website (https://events.cieem.net/Events/Event-Listing.aspx).

Recent blog posts

Recent blog posts on the CIEEM website (https://cieem.net/news/) include:

- Digital Innovation is the Step Change Needed for Organisations to Understand the Value of Natural Capital – by Michael Aquilina
- The Kunming-Montreal Agreement is signed – by Stephanie Wray CEcol CEnv FCIEEM
- Water Companies in Wales: Everything You Wanted to Know About PR24 But Were Afraid to Ask – by Mandy Marsh
- Pass marks all around – by Jim Jeffrey
- Salt marshes may be super, but still need a helping hand – by Eve Leegwater MCIEEM and Dr Ben Green
- To tree or not to tree? Using data tools to maximise benefits from woodland creation – by Dr Matthew Brown, Laura Homfray and Anna Bright MCIEEM
- What's stopping the widescale use of nature-based solutions in our towns and cities? – by Rebekah Strong

If you would like to contribute your own blog, please contact SophieLowe@cieem.net.

Staff changes

In November 2022, we welcomed **Douglas Lewns** as Policy Officer.

And in February 2023, **Dr Mark Nason** MCIEEM joined us as Head of Professional Practice. You can read more about Mark on page 63.

Competency Standards

Two new Competency Standards have been published on the CIEEM website as part of the Raising Standards Project (https://cieem.net/i-am/current-projects/raising-standards/) – one for Badger Survey, Mitigation and Management and one for Aquatic Freshwater Macroinvertebrates Survey, Assessment and Management. These Competency Standards describe the knowledge and skills expected of practitioners involved in these activities at different levels of competence aligned to CIEEM's Competency Framework. There are also two draft standards published for consultation – Dormouse Survey, Mitigation and Management and Otter Survey, Mitigation and Management – available on the same webpage.

Nature-focused Jobs

As part of our work to raise the profile and accessibility of nature-focused careers CIEEM continues to actively engage in strategic initiatives across the UK and Ireland. Through our CEO, Sally Hayns, CIEEM is one of four Defra-nominated organisations on the UK Government's Green Jobs Delivery Group and Sally also chairs Defra's Nature Skills Working Group. CIEEM is also working with land-based sector skills agency Lantra and research consultancy Resources for Change to undertake research into the current and future opportunities for non-degree entry nature-focused roles in the ecology and environmental management sector.

In Practice digital editions

If you would like to reduce your and CIEEM's carbon footprint and receive only digital editions in the future, please let us know by contacting enquiries@cieem.net.

CIEEM Conferences 2023

Date	Title	Location
21 March 23	CIEEM 2023 Spring Conference: The Role of Soils in Nature Recovery	London
25 April 23	CIEEM 2023 Irish Conference: Aiming for a Nature Positive Ireland	Athlone

Find out more: https://cieem.net/events

In Practice Themes and Deadlines

Edition	Theme	Article submission deadline
June 23	Invertebrates	n/a
September 23	Diversity, Accessibility & Capacity in the Sector	19 May 23
December 23	Non-themed (submissions welcome on any topic)	18 Aug 23

If you would like to contribute to one of these issues, please contact the Editor at nikprowse@cieem.net. Contributions are welcomed from both members and non-members. Further information and guidance for authors can also be found at: https://cieem.net/in-practice/

Did You See?

UK

Great Britain-wide strategy for plant health and biosecurity

Defra, in partnership with the Forestry Commission and the Scottish and Welsh Governments, has published the new Plant Biosecurity Strategy 2023–2028 for Great Britain. This document lays out the critical value of UK plants to our economy, society and environment, and estimates that plants annually add £15.7 billion to the economy. The plan sets out a 5 year vision for plant health, consisting of an action plan to secure national biosecurity and protect native species by reducing and managing risks from pests and pathogens.

https://cieem.net/new-great-britain-wide-strategy-sets-out-five-year-vision-for-plant-health-and-biosecurity/

Wales

Wales to meet 100% of electricity needs with renewable sources by 2035| Cymru i ddiwallu 100% o anghenion trydan gyda ffynonellau adnewyddadwy erbyn 2035

The climate change minister for Wales, Julie James MS, has announced that Wales aims to meet 100% of its electricity needs from renewable sources by 2035. Wales is already making good progress on its previous targets set in 2017, generating 55% of its current electricity needs from renewable sources. The minister stressed that improving infrastructure and supply chains were key to hitting this new target, and revealed £1 million in funding to further explore the potential of offshore wind in Wales. The minister said that "*the climate crisis shows that we cannot afford to rest on our laurels. Providing new targets compels us to stride towards Net Zero as quickly as we realistically can*".

https://www.gov.wales/wales-aims-meet-100-its-electricity-needs-renewable-sources-2035

Northern Ireland

Northern Ireland publishes Greenhouse Gas projections

The Department of Agriculture, Environment and Rural Affairs (DAERA) has published its greenhouse gas projection statistics for Northern Ireland. These statistics are updated annually, and project emissions in Northern Ireland from 2021 to 2031. The latest inventory estimates that there was a 24% reduction in CO_2 emissions in 2020 compared to 1990 and that by 2031 this number will have risen to a 34% reduction in greenhouse gas emissions.

https://www.daera-ni.gov.uk/news/northern-ireland-greenhouse-gas-projection-statistics-released

Republic of Ireland

Minister for the Environment, Climate and Communications announces €27 million for community climate action

Eamon Ryan, the Republic of Ireland's Minister for the Environment, Climate and Communications has announced €24 million in funding for Local Authorities to support communities in lowering their carbon output and scaling up climate action. Alongside this €3 million will be made available to support cross-border initiatives, as well as a drive for all-island community action. This funding comes as part of the Community Climate Action Programme, which was created to support projects and initiatives that facilitate climate action through education and capacity building within local communities.

https://www.gov.ie/en/press-release/-minister-ryan-announces-27-million-for-community-climate-action/

England

New Environmental Improvement Plan for England

Defra has published a new Environment Improvement Plan (EIP) as the first revision to the 25-Year Environment Plan published 5 years ago. This plan aims to provide a comprehensive delivery plan for the Government's approach to halting and then reversing the decline in nature. The Government has said in its press statement that it will create and restore at least 500,000 hectares of new wildlife habitats, deliver a clean and plentiful supply of water for people and nature, transform the management of our countryside, and boost green jobs. This plan hopes to underpin the ambitions of COP15 domestically, with progress measured against interim targets.

https://cieem.net/defra-publishes-second-environmental-improvement-plan-eip23/

Scotland

98 new Scottish Heritage sites identified to safeguard trees from climate change

A new report published by NatureScot and written in partnership with the UK Centre for Ecology & Hydrology has taken a significant step towards preserving the highly threatened genetic diversity of Scotland's native trees by identifying 98 new sites for gene conservation. The purpose of this is to ensure trees are able to maintain their genetic diversity, increasing their potential to adapt as climatic conditions change. Currently, there are five such gene conservation units in Scotland, representing four species of tree: Scots pine, silver birch, sessile oak and rowan. The newly proposed 98 areas will provide protection to seven more species of tree, preserving Scotland's diverse array of trees in their environment.

https://www.nature.scot/almost-100-new-scottish-sites-identified-safeguard-trees-climate-change

Feature

Species Conservation Translocation: Perspectives from Natural England

Large blue butterfly (*Phengaris arion*)

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Keywords: code and guidance for England, conservation translocation, IUCN guidelines, species reintroduction

In the context of the new legally binding targets of the Environment Act, which agreed to halt the decline in species by 2030, we are striving to facilitate and implement species recovery, including utilising conservation translocation as a powerful species conservation tool. Many translocation projects that Natural England has been involved with have progressed to show signs of creating sustainable populations, the key measure of success.

Through illustrated case studies, this article describes three reintroduction and conservation translocation projects Natural England has either led on or contributed to.

Introduction

Our levels of consumption of the Earth's resources have exceeded nature's capacity to regenerate. We have seen more than 500 species vanish from England with 25% of mammals threatened with extinction (Mathews and Harrower 2020). Natural England has a long track record, dating back to the 1980s, of working with partners to successfully reintroduce species such as red kites (*Milvus milvus*) and large blue butterfly (*Phengaris arion*).

When part of a wider programme of habitat improvement or creation, reintroductions can provide the catalyst for public support and engagement. Conservation translocations are an excellent tool when well-planned and diligently implemented and have been used and studied worldwide. They may also become a key option to ensure our ecosystems are more resilient to climate change. Yet there are significant risks associated with conservation translocations and this article highlights ways to reduce those risks to what our ecosystems and society are prepared to live with.

In May 2021, Defra published the *Reintroductions and other conservation translocations: code and guidance for England* (Defra 2021). The code is designed to encourage consistency across the UK in relation to conservation translocations and as such aligns with the Scottish code (National Species Reintroduction Forum 2014). It should be read alongside the IUCN conservation translocation guidelines (IUCN SSC 2013) and will help determine whether a specific conservation translocation is appropriate in England.

What is a conservation translocation?

Species reintroduction often refers to bringing back species lost from the wild in England. The IUCN guidelines define conservation translocation as "the intentional movement and release of living organisms where the primary objective is a conservation benefit". There are four types of conservation translocation (Defra 2021):

1. reinforcement: the translocation of an organism into an existing population of the same species
2. reintroduction: the translocation of an organism to areas from which it has been lost
3. assisted colonisation: the translocation of an organism to benefit its conservation status where the current or future conditions are likely to be more suitable than those in the current natural or dispersal range
4. ecological replacement: the translocation of an organism to perform a specific ecological function that has been lost through extinction of another organism.

The following three case studies share an insight into each project's development and the plight of the species. They highlight how engagement and collaboration with stakeholders is key to success.

Case study 1: wart-biter cricket

In the early 1990s the wart-biter cricket (*Decticus verrucivorus*; Figure 1) was thought to be present at three sites in the UK. One was a tiny population on a chalk ballast track across heathland in Dorset. The other two were both in East Sussex within 2 km of each other. In good years, the main East Sussex site held a strong population of approximately 1500 individuals, while the other held very low numbers estimated at between 20 and 40 individuals. This left the wart-biter in a precarious state with just one site holding strong numbers. A single calamitous event could spell extinction in the UK. Wart-biter populations rely on a varied sward length on chalk grasslands with small patches of bare ground. They have declined in the UK due to undergrazing and scrub growth, as well as overgrazing. Appropriate habitat management is typically light grazing in winter, and absence of sheep grazing in summer.

In 1991 the wart-biter was included in the first suite of species supported by the Species Recovery Programme (SRP) established by English Nature (now Natural England). In partnership with Buglife and the Zoological Society of London (ZSL), the SRP funded the translocation of wart-biters to three sites: a rediscovered location in Kent and two in East Sussex. This amounted to reinforcement at an existing site plus an introduction at a new location. The translocations encouraged appropriate management for wart-biters at each site and the SRP provided annual monitoring and advice. Appropriate management was also encouraged at a site in Wiltshire where wart-biter crickets were thought to be extinct but were rediscovered after several years of sympathetic management. By 2002, populations of wart-biter were present at five sites, of which the two main

Figure 1. Wart-biter cricket (*Decticus verrucivorus*). Photo credit: James Phillips.

translocation sites and the original stronghold in East Sussex were doing well. The UK population was stronger and had grown to over 1000 individuals recorded across three counties.

Back in the 1990s, another site, owned by South-East Water, was identified in East Sussex for possible reintroduction but needed sympathetic management for wart-biter. By 2014, site conditions were deemed suitable. A translocation programme was undertaken between 2015 and 2018, moving 237 adults from the main source population in East Sussex to the new site. The ZSL checked the health of each individual before release and, by 2021, the new population was estimated to have reached 450–600 adults.

All known wart-biter populations are monitored annually, by direct observation or listening for males stridulating (producing a sound from the rubbing of two body parts). This provides management advice to site managers and helps to inform agri-environment schemes. Climate change presents challenges for the crickets; for example, when drought results in little grass growth. If sites are then grazed over winter, the sward length may be too short and uniform to support wart-biter the following summer. However, climate change could also lead to opportunities, as more north-facing slopes may become warm enough for wart-biters, indicating that large landscape projects could be of benefit, if management is steered carefully.

Case study 2: hazel dormouse

Since 1992, Natural England, in partnership with the People's Trust for Endangered Species, have co-funded the National Dormouse Monitoring Programme (NDMP) and the dormouse reintroduction programme. The reintroduction programme was another of the first SRP projects and has sought to restore hazel dormouse (*Muscardinus avellanarius*; Figure 2) to counties of England from which they had been lost and where natural re-colonisation was unlikely.

The dormouse was once widespread throughout much of England and Wales and is associated with mature broad-leaved woodland. They can, however, be found in a range of mixed woodland habitats, coniferous woodland, scrub and hedgerow. In 1885, dormice were present in 49 English counties but have experienced a long-term population decline and have been lost from 17 counties (Wembridge *et al*. 2016). Throughout, the 20th century numbers have fallen due to three main factors (Wembridge *et al*. 2016, 2019).

Figure 2. Hazel dormouse (*Muscardinus avellanarius*). Photo credit: Michel Viard.

1. Habitat loss and fragmentation.
2. Changes in woodland management practices.
3. Climate change.

National monitoring through the NDMP has shown that the population has fallen by 51% since 2000, decreasing on average by 3.8% per year (Wembridge *et al*. 2019).

Since the original release in 1993, over 1000 dormice have been released to 24 sites across 13 counties, as shown in Figure 3. Prior to release, the dormice undergo health screening at the ZSL (also see Common *et al*. in this issue, pages 19–23) and Paignton Zoo. Long-term post-release health surveillance is also in place for the dormouse reintroduction sites. Both the reintroduction programme and monitoring of sites involve a huge amount of volunteer effort. In 2021, there were 1781 visits to 369 sites, where 107,567 dormouse boxes were checked for occupancy.

The dormouse reintroduction programme has been partially successful in recovering the species locally and to parts of its former range, with a current focus on the range edge (Chanin 2014). However, nationally, the dormouse population continues to decline and is listed as Vulnerable on the IUCN-compliant red list for terrestrial British mammals (Mathews and Harrower 2020).

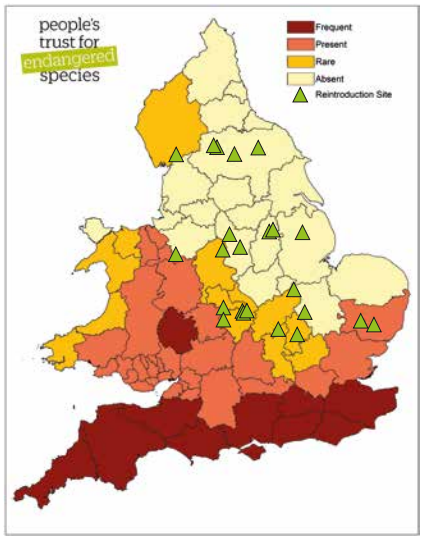

Figure 3. Dormouse reintroduction strategy, showing current dormouse distribution in England and Wales. All reintroduction sites between 1993 and 2022 are shown; some are considered to have been unsuccessful. Source: People's Trust for Endangered Species.

The long-term reintroduction and monitoring programme has provided essential information to inform effective decision-making for the national conservation of the species. The work is also contributing to the preparation and publication of a species conservation strategy for dormice, in development by Natural England and partners, using new provisions in the Environment Act 2021.

Case study 3: Eurasian curlew

Eurasian curlew (*Numenius arquata*) has suffered a significant decline over the past 40 years. In 2019, Natural England and the Wildfowl and Wetland Trust (WWT) worked together on a trial project to explore the potential of a head-starting project to help the falling population of Eurasian curlew in the English lowlands. Head-starting is a conservation technique of artificially rearing species and releasing them into the wild. The project arose from the need to keep airfields clear of risk from collision with birds. Airfields, due to their open grassland structure, provide an appropriate habitat to build nests (Figure 4), and so curlew nests and their eggs are subject to destruction, under licence, to maintain flight safety. Rescuing the eggs prior to destruction and head-starting them has been an innovative way to boost the population at this scale. The principal areas involved were military airfields in the east of England.

Eurasian curlew (*Numenius arquata*)

In spring 2019, 55 viable eggs were transported to Slimbridge where 50 eggs were successfully hatched and the birds released. Graham Irving received a Breaking the Mould Defra award for his contribution to boosting curlew productivity. Following this trial, a Natural England-funded head-starting project was set up, to run for approximately 5 years using the (doomed) eggs from airfields as the donor source for the project.

By May 2021, Natural England staff had put a full-scale project together. An incubation and rearing facility in north Norfolk, at Pensthorpe Natural Park, agreed to take on the egg and chick management work for the Norfolk Curlew Recovery Project and two large estates on the Norfolk coast of the Wash, Sandringham and Ken Hill, agreed to be release sites.

Figure 4. Curlew nest at the edge of a runway. Photo credit: Graham Irving.

Due to COVID restrictions in 2020 no eggs were collected, but a total of 147 eggs were collected in 2021 (with Pensthorpe receiving 106 and WWT 41), which resulted in a total of 79 birds being released in Norfolk. During spring 2022 a total of 96 eggs were collected (with Pensthorpe receiving 57 and WWT 39), with 37 birds being released in Norfolk.

The project is a great example of partnership working. As well as Natural England, Pensthorpe and WWT, partners include Royal Air Force, Ministry of Defence, Defence Infrastructure Organisation, British Trust for Ornithology and several bird control contractor bodies whose involvement are pivotal in finding the eggs for the project.

Natural England and project partners are monitoring the dispersal of the released birds by different methods including leg flags, short-term radio tracking and long-term tracking via satellite tagging. This will inform the level of dispersal from the release sites each year. The surprises from this year's releases are a bird travelling to southern Ireland and a bird traveling to the French coast, east of Jersey.

A short film, *A Curlew Calls* (Smith 2021), is available online describing the curlew's plight and this project further.

Aspirations for species recovery and conservation translocations

Natural England is committed to support, deliver and champion species conservation translocations where the benefits to the environment, the economy and people are clear. This includes the range of translocations as defined by the IUCN from reinforcing populations in England to reintroducing species that have been lost. Natural England is also keen to explore whether conservation translocation could be a useful tool to help species be more resilient to climate change (Brodie *et al*. 2021). Beavers, for example, have the potential to be keystone species in our river valleys but projects will need to be carefully planned to maximise the benefits (also see Howe and Dalton in this issue, pages 13–18).

Although Natural England has a keen interest in species conservation translocations, none of the projects to date were undertaken solely by Natural England. As illustrated above, projects are collaborative, and our partners and stakeholders are key to their success. We need their passion, dedication and expertise to bring proposals to life. We will guide, accompany and support them along the way with our various roles. Natural England is a regulator as well as an expert body in nature conservation. Licensing permits activities to take place that would otherwise be unlawful, but it is also works proactively to support species reintroduction projects and contributes to their success.

Conservation translocation is a great species conservation tool, but it is not always the miracle solution, and in many cases habitat restoration and management will be sufficient to encourage species back to where they belong, as shown by the dormouse case study. Conservation translocation should be looked at holistically and embedded in other initiatives currently being developed, such as the publication of species conservation strategies, and should also be a pivotal element of the Nature Recovery Network (NRN), a national network of wildlife-rich places and a major commitment in the Government's 25 year Environment Plan (Defra 2018). Natural England hopes to make the future bright for species recovery and conservation translocation projects, as we see the first pilot projects utilising funding through Landscape Recovery and Environmental Land Management schemes.

Key points

We strongly believe that we have the necessary tools, expertise and ambition in England to conduct many more successful conservation translocation projects in the years to come and contribute to halting species decline. There are a few key steps, however, that remain critical when considering translocating species in the English landscape:

- align with the principles of the *Reintroductions and other conservation translocations* (Defra 2021) and IUCN guidelines
- engage early with Natural England and other statutory bodies
- engage early with stakeholders likely to be affected (positively or negatively) by the project.

Natural England is also excited to provide the Secretariat to the newly formed England Species Reintroduction Taskforce where we anticipate seeing experts' discussion and proactive, evidence-based output contributing to the future of species conservation translocation in England.

About the Authors

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Beavering Away: The Reintroduction of Beavers in England

Figure 1. Beaver and kit on the River Otter, Devon. Photo credit: David White.

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Keywords: ecological restoration, Eurasian beaver, reintroduction

There is widespread interest in restoring beavers to the English landscape and wild free-living populations are now present across southern England. Reintroducing beavers can help regain lost natural ecosystem function, thereby contributing to broader ambitions to restore as much biodiversity as possible through the re-establishment of more naturally functioning habitat mosaics. Natural England is working to put the steps in place to ensure England will have a healthy population of beavers that will thrive and maximise conservation gain.

Introduction

Eurasian beavers (*Castor fiber*) are semi-aquatic rodents and a formerly native species in England. They were once widespread across Europe and northern Asia, but probably disappeared from Great Britain between the 12th and 16th centuries primarily due to being hunted for fur and castoreum. Cessation of hunting, protection of relict populations and multiple reintroduction and translocation projects in mainland Europe have resulted in beaver populations re-establishing across vast swathes of their former range (Rosell and Campbell-Palmer 2022).

Interest in bringing back beavers to Great Britain has grown since the 1990s, resulting in an official trial reintroduction in Knapdale Forest in Scotland (Box 1). As wild releases were not authorised in England, enthusiasts

of reintroduction kept beavers in large fenced enclosures in naturalistic habitat settings. In the period since the early 2000s, beavers have been released into outdoor fenced enclosures at over 30 sites (Heydon *et al.* 2021, Natural England Wildlife Licensing Service personal communication). However, escapes, mainly from unlicensed enclosures, as well as unauthorised releases, have resulted in populations of wild free-living beavers in seven separate locations in southern England (Figure 2). This uncoordinated approach to beaver reintroductions has resulted in disjointed populations across England. Only one of these populations (on the River Otter, Devon) has been formally sanctioned following a 5-year reintroduction trial (Brazier *et al.* 2020, Howe and Crutchley 2020).

Figure 2. Locations of known populations of wild free-living beavers in England.

The decision to allow beavers to remain on the River Otter prompted the Government to consider the future of beavers in England (see Box 1), resulting in a public consultation being launched in 2021. This was supported by a substantial body of evidence provided by Natural England (e.g. Howe 2020).

Results of the consultation were published in September 2022 (Defra 2022). At the time of writing, we are waiting for the Government to announce its views on future reintroductions. It is anticipated that this will follow additional work that Defra is undertaking with Natural England.

Why bring back beavers?

There are various reasons for reintroducing beavers. There is a requirement under the Habitats Directive to study the desirability of reintroducing species in Annex IV (in which the beaver is included). Defra's 25 year plan (Defra 2018) raises the prospect of reintroducing the beaver to England for its positive effects on ecosystem functions.

Conservation action for the species also needs to be considered (principle one of *Reintroductions and other conservation translocations*; Defra 2021). As the beaver is assessed as Least Concern globally, reintroduction into Great Britain is not necessary for the security of the global population. However, any further reintroductions would help expand the range to part of its former distribution. Reintroduction is the only way this species can recolonise Britain.

There are also wider benefits. Beavers are widely regarded as ecosystem engineers because they can greatly modify the physical environment around them by damming and impounding water and creating networks of ponds and lakes. They can re-establish lost natural ecosystem processes, which is seen to contribute to mitigating the climatic and biodiversity crises (Howe 2020).

However, beaver reintroductions may also come with drawbacks and challenges. In Scotland beavers established from unauthorised releases far outnumber those from the official trial (Box 1). Unofficial releases can cause concerns such as sourcing and genetic make-up, health status and risk assessment, risk of introducing invasive non-native species, lack of engagement with stakeholders and associated negative impacts from beaver activities (burrowing, feeding and damming)

Box 1. How did we get here?

In Scotland an official trial reintroduction of beavers took place in Knapdale Forest, Mid Argyll between 2009 and 2014 (the Scottish Beaver Trial). There are more wild beavers in Scotland through unauthorised releases in the Tay and Earn catchments (Tayside) in Perthshire from around 2006. The largest beaver population in Scotland now occurs on Tayside with 251 active family groups (Campbell-Palmer *et al.* 2021). Beavers in Scotland were given legal protection as a European Protected Species in 2019.

In England in 2013, a population of breeding beavers became public knowledge on the River Otter in east Devon. As the release was not authorised and the origin of the beavers unknown, there was considered to be a risk of disease, primarily *Echinococcus multilocularis*, or the fox tapeworm, a notifiable disease which Great Britain is currently free of. The origin and numbers, and whether the beavers were Eurasian or North American, were unknown. Defra's response was to call for removal, before a successful campaign to retain the beavers on the river. Health and genetic screening confirmed the species present were Eurasian beavers and found no diseases of concern. Ministers agreed to permit a formal 'beaver reintroduction trial' and a 5-year licence was issued by Natural England in 2015 enabling the first authorised trial of a beaver reintroduction in England (Brazier *et al.* 2020).

In August 2020, following the conclusion and assessment of trial results (Howe and Crutchley 2020), free-living beavers were permitted to remain permanently and continue to expand their range naturally, resulting in the first legally sanctioned reintroduction of an extinct native mammal to England.

In August–November 2021 the Government held a consultation on the approach to further beaver reintroduction and management in England.

In July 2022 beavers gained legal protection in England, fulfilling objectives under the Bern Convention. The legislation came into force on 1 October 2022.

In September 2022 the Government published their summary of response to the consultation and next steps, alongside Natural England's advice on management and derogations.

Figure 3. Series of beaver dams within a beaver enclosure site in England. Photo credit: Claire Howe.

(Campbell-Palmer *et al.* 2023). Authorised releases can combat some of these concerns but bringing back a species that can dramatically change its own environment into highly modified and densely populated habitats can result in land (and people) management issues. Natural England has published a management hierarchy and is engaging widely to support people living alongside and/or managing beavers (Natural England 2022).

Current status of beavers in England

The current best estimate of the wild-living English beaver population is around 70 territories and as many as 420 individual beavers (Campbell-Palmer *et al.* 2019, Devon Wildlife Trust personal communication, East Kent Beaver Advisory group personal communication, Harrington *et al.* in press). Given the unplanned and recent return of wild-living beavers this demonstrates their capacity to thrive in England's highly modified landscapes, but what should we expect in the future? Natural England's Defining Favourable Conservation Status (FCS) project describes the situation in which a habitat or species is thriving throughout its natural range and is expected to continue to thrive in the future (Hanna 2021). As part of the project Natural England has published a definition of FCS for beavers in England. The current population is approximately 1% of what is considered to represent a fully re-established and favourable beaver population in England (5200 beaver family groups), while current known distribution covers approximately 3% of the predicted favourable range for this species in England (5000 km^2 of suitable habitat) (Morris and Mousley 2021). However, it is likely that the social acceptance threshold for beavers, the changes people will tolerate, is likely to be met before FCS is achieved (Auster *et al.* 2019).

Understanding the status of existing populations in England

Restoring the beaver as a widespread native wild mammal in England is ecologically feasible. This has been demonstrated by previous work and the establishment of current wild populations (Gurnell *et al.* 2009). However, several important considerations in international guidelines for conservation reintroductions have yet to be met. It is important that these are addressed as we move towards further reintroduction

"Beavers are ecosystem engineers and can greatly modify their physical environment. They can re-establish lost natural ecosystem processes, mitigating the climatic and biodiversity crises."

and establishment of the beaver as a native species in England (IUCN SSC 2013, Defra 2021). The reintroduction code for England (Defra 2021) sets out a series of principles which should be applied to any conservation reintroduction. As populations of beavers in England are already present in several locations, retrospective consideration of the key principles is required to establish how the populations are faring. We are working to learn more about the existing unauthorised populations (Table 1).

Beaver management groups have been established, but they vary depending on the organisations willing to participate. As a result, the aims of the groups differ but typically include:

- support and education for communities to co-exist with beavers
- maximising the ecological and socio-economic benefits beavers can deliver
- enabling targeted mitigation work where conflicts occur.

Table 1. Projects underway by Natural England to establish the status of existing populations in England.

Work area	Purpose	Key outputs
Surveys of wild free-living populations	Surveys to find distribution and population size and to flag likely ecological benefits or potential management conflicts.	Survey reports of the populations indicating territory extents and an estimate of the likely number of individuals.
Health and genetic screening of wild free-living populations	Understanding the health and status of populations in the context of their uncertain origin. This will promote our knowledge of beaver health and genetic status.	Assessment of the health status of beavers in existing populations. Confirmation that founding beavers are not North American beavers (*Castor canadensis*) and an assessment of any concerns with genetic health.

In 2023, Natural England will establish a National Beaver Forum. The forum will connect parties monitoring and managing existing wild populations and ensure consistency between management groups. It will promote collaboration and a collective evidence-based view on the management of beavers in England, and help overcome challenges associated with beaver reintroduction.

Figure 4. Beaver dam across a stream, River Otter, Devon. Photo credit: Laura Dalton.

Supporting future reintroduction and establishment of beaver populations

The reintroduction of a species capable of profoundly altering habitats also raises some questions about what we will see and experience. The review of the evidence on the interactions of beavers with the natural and human environment in relation to England (Howe 2020) was produced to advise the government on the consultation. In this document evidence gaps and future priority research needs were flagged. Research and monitoring are needed on a prioritised and long-term basis to understand the interactions between beavers and species, habitats and socio-economic factors. Table 2 highlights some of the work Natural England is leading on to address these questions.

Future hopes for beavers in England

Natural England is determined to ensure we have viable and healthy populations of beavers in England which will thrive, maximise conservation gain and ecosystem benefits and minimise potential conflicts.

The reintroduction of the beaver, as a formerly native species, promotes opportunities to renaturalise habitats and species assemblages and is a nature-based solution to tackle the decline of the natural environment in England. This is in line with building more ecological resilience into the way nature is conserved, restoring the multiple natural capital benefits that flow from naturally functioning ecosystems, and adapting to climate change. However, it is recognised that

> **“If managed appropriately the quantifiable benefits of beaver reintroduction in relation to natural capital and societal benefits can be much greater than the financial costs.”**

Table 2. Projects to support future reintroduction and establishment of beaver populations.

Work area	Purpose	Key outputs
Genetic diversity analysis of beavers in England	To investigate underlying genetic diversity in beavers in England, both free-living wild populations and in enclosures, to inform best practice for future reintroductions and management of existing populations.	Genetics report published on genetic diversity analysis of wild and captive beavers in England (Ritchie-Parker *et al*. 2021). Creation of a studbook for beavers in Britain to inform movements to maximise genetic health. Continued assessment of genetic diversity from analysis of beavers moved from Scotland and from wild populations in England.
Disease risk assessment and management (also see Common *et a*l. in this issue, pages 19–23)	To ensure healthy source populations of beavers and minimise risks from disease related to the conservation translocation of beavers.	Disease risk assessments for beaver reintroductions (Donald *et al*. 2021, Common *et al*. in press). Guidelines for disease risk management and post-release health surveillance for beaver releases, reintroductions and translocations.
Facilitating recording of beaver signs and populations	Development of a citizen science project for gathering records and reports of beavers and beaver signs in England. The app would also include all mammal species.	Enhancing functionality of the Mammal Societies Mammal Mapper app to enable beaver surveys to be recorded.
Research and evidence gathering	Identifying further areas of research into beaver ecology, management, monitoring and interactions with other species.	Creation of a beaver research group to bring together those studying beavers in Britain. Using eDNA to monitor biodiversity benefits from beavers (PhD study). Research into beaver interactions in reed bed systems (PhD study).
Mapping and modelling work	To understand the suitability of areas for occupation by beavers and the dispersal potential of populations throughout the landscape.	Development of beaver impact assessment toolkit for use on MAGIC maps. Development of a beaver dispersal model to investigate and map beaver dispersal from a source population.

reintroducing beavers into England can generate a range of costs and benefits for people and the economy, which will vary between locations. If managed appropriately the quantifiable benefits of beaver reintroduction in relation to natural capital and societal benefits can be much greater than the financial costs incurred.

Natural England will continue to work closely with Defra and the Environment Agency, develop guidance and engage with partners and stakeholders to prepare for further sanctioned wild releases in England.

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Conservation Translocations and the Risk from Disease

Hazel dormouse (*Muscardinus avellanarius*)

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The success of conservation translocations can be substantially affected by disease, either directly or indirectly. In this article we talk about the importance of considering the risk from disease in any conservation translocation and highlight some of the work we are doing to evaluate and mitigate disease in translocated animals in England.

Introduction

Conservation translocations (reinforcement, reintroduction, assisted colonisation and ecological replacement) are the intentional movement of living organisms from a source site and release at a destination

site, where a conservation benefit is the primary objective (IUCN SSC 2013). Conservation translocations have become an incredibly useful tool, widely used across the world, for saving threatened species and restoring habitats and ecosystems. However, conservation translocations are not free of risks and the threat from disease is one of these.

International best practice guidance has been produced by the International Union for the Conservation of Nature (IUCN; IUCN SSC 2013) and subsequently the Scottish and UK governments have developed specific codes and guidance (Defra 2021, National Species Reintroduction Forum 2014). A common theme across these guidelines is the need to consider diseases and parasites in any conservation translocation. Disease outbreaks may arise from conservation translocations, posing a threat not only to the translocated animals, but also to sympatric free-living wild animals including other individuals of the same species if still present at the destination (recipient population) and free-living wild animals of other species, threatening the ecosystem and biodiversity as a whole. Not only are free-living wild animals at risk: disease outbreaks are possible in people or domestic animals, including livestock, at the destination, and such outbreaks could have major economic consequences.

Risk from pathogens

From a conservation perspective it is imperative to ensure that populations of other wild animal species at the destination, whether of current conservation importance or not, are not endangered by the efforts to conserve another. One driver of disease outbreaks is non-native parasite incursion and there is a need for better prediction of how and when these parasites will impact on wild animal populations. The catastrophic effects of such situations have been widely documented on a global scale for the amphibian pathogen *Batrachochytrium dendrobatidis*, or chytrid fungus as it is more widely known, which has led to population declines in more than 500 amphibian species and 90 presumed extinctions (Fisher and Garner 2020). Closer to home, the incursion of squirrelpox virus through the introduction of North American grey squirrels (*Sciurus carolinensis*) into Great Britain more than 100 years ago has led to dramatic losses of the highly susceptible native red squirrels (*Sciurus vulgaris*; Sainsbury *et al*. 2008, Rushton *et al*. 2006). Both examples of non-native parasite incursion occurred as a consequence of wild animal translocations, conducted by humans, although not for conservation purposes. In addition to the potential risks associated with parasites moved and/or co-introduced with translocated animals, novel parasites may also be present at the destination. These would represent a risk to the translocated animals, which may be immunologically naïve to them and unable to properly fight an infection.

Box 1. The Disease Risk Analysis process

A brief overview and definitions of relevant terms used in this article (as defined in Sainsbury and Carraro 2022):

- Disease Risk Analysis (DRA) is a formal assessment of the risks from disease, in this case of a conservation translocation, through identifying the probability of occurrence and the magnitude of any negative consequences with a view to reducing the risks from disease by altering translocation protocols. DRA is the overarching term.
- A hazard is defined as a biological, chemical or physical agent, or a condition of an animal, with the potential to cause disease.

An early step in a DRA is identify potential hazards, both infectious (parasites) and non-infectious (e.g. toxins), that could pose a risk to the conservation translocation. This is done through a comprehensive literature review and by liaising with experts to improve knowledge on both the parasites that may be harboured by the species that is the focus of the conservation project and those that might be found at the release site. Once a list of potential hazards has been created, the risk of disease arising from them is estimated through a disease risk assessment, which is a component of the DRA. Briefly, we assess the likelihood of the hazard being released at the destination site, the likelihood that the recipient population and/or other species at the destination may become exposed to the released hazard, and the potential magnitude of any consequences (biological, environmental, economic) deriving from the release, establishment and dissemination of the hazard at the destination site.

Where supported by the results of the disease risk assessment, a DRM protocol is developed. This is a reasoned explanation of mitigation measures that can reduce the risk from a given hazard.

After animals have been released, the DRAHS team carries out PRHS to monitor the health and detect disease in the translocated and recipient populations. This involves health examinations and screening of live animals at the release site as well as post-mortem examinations of any animal found dead. The information gathered is fed back to improve the DRA.

Should you find a dead beaver, please contact enquires@naturalengland.org.uk

The DRAHS team

The Disease Risk Analysis and Health Surveillance (DRAHS) team at the Institute of Zoology, Zoological Society of London (ZSL), works to analyse and reduce the risks from disease in conservation translocations. The team undertakes Disease Risk Analysis (DRA), develops Disease Risk Management (DRM) protocols, examines the health of animals prior to their release and undertakes post-release health surveillance (PRHS) through, for example, post-mortem examinations. A brief overview of the process, including definitions of terms used in this article, is given in Box 1. Principally, the team works alongside Natural England as part of a longstanding partnership for their Species Recovery Programme for native species at different stages of conservation interventions.

Three case studies are presented here to highlight the role played by the DRAHS team in native species recovery and possible future applications.

Case study 1: Eurasian beaver

The Eurasian beaver (*Castor fiber*) is thought to have become extinct in Britain between the 12th and 16th centuries (Raye 2015). As many as seven wild free-living populations are known to currently exist in England due to authorised and unauthorised releases, but there may be further undiscovered populations. A Government-led consultation was launched in 2021 seeking views on further reintroductions of this species in England and its management (see Howe and Dalton in this issue, pages 13–18). To inform this consultation, the DRAHS team undertook a DRA (Donald *et al*. 2021) to identify and assess potential hazards to the reintroduction of beavers from several different sources into England, and this was updated in 2022 (Common *et al.* in press). Mitigation measures were identified and recommended for these hazards to reduce risk to an acceptable level and to safeguard the health of beavers, other wild animals and humans at the release site. These measures are being translated into DRM guidelines which detail practical steps for beaver practitioners to follow (Campbell-Palmer *et al.* in preparation).

A disease surveillance scheme was set up by Natural England and DRAHS in 2021 to further our understanding on the health status of free-living beaver populations, as the source and health status of these beavers are largely unknown. Dead beavers found by members of the public, for example on roads or washed up on riverbanks or beaches, were submitted to the DRAHS team who conducted detailed systematic post-mortem examinations, including thorough sampling and diagnostic tests to diagnose diseases and investigate possible causes. In particular, hazards identified in the DRA as possible risks to the beavers, native populations of rodents, native populations of other mammals, livestock, humans in contact with beavers and the general human population in England were assessed. Moreover, the disease surveillance aims to identify novel parasites of beavers which might have been unknown at the time of their introduction and require consideration for future translocations.

Figure 1. Wildlife vet Sophie Common performs a post-mortem examination of a Eurasian beaver. Photo credit: Zoological Society of London.

So far, 12 beavers have been examined. All were from the south of England, with the highest number (seven) found in Kent. No parasites of concern have been identified, but five suspected deaths by road traffic collision have been detected, highlighting the need for appropriate release site consideration and management strategies in the future. Three beavers were discovered on beaches, and they may have died in a river and been washed downstream or attempted to disperse downstream and become overcome by currents and saline water.

It is important to note that there are biases associated with such scanning disease surveillance; beavers that die in areas close to human activity may be more likely to be detected and reported than those that die away from humans. It is necessary to interpret data with this in mind. Targeted health screening of live individuals from some wild free-living populations will also be undertaken in 2023 to further our understanding of their health status.

“A disease surveillance scheme was set up in 2021 to further our understanding of free-living beaver populations, as the source and health status of these beavers are largely unknown.”

Case study 2: hazel dormouse

The hazel dormouse (*Muscardinus avellanarius*) was once widespread across England and Wales. Unfortunately, the loss of woodland and hedgerows, as well as changes to traditional countryside management practices and climate change, have contributed to population declines and dormice are now listed as Vulnerable on the IUCN-compliant red list for terrestrial British mammals (Mathews and Harrower 2020).

Through a collaborative project, led by the People’s Trust for Endangered Species (PTES) and Natural England (see Ashworth *et al*. in this issue, pages 8–12), the DRAHS team plays a key role

Figure 2. Georgina Gerard assists with health checks of hazel dormice under general anaesthetic at London Zoo. Photo credit: Zoological Society of London.

in reintroducing captive-bred dormice into the wild to help overcome the decline of the species. Hazel dormice have been bred in captivity for release since 1993 by the Common Dormouse Captive Breeders Group (CDCBG). The CDCBG includes private individuals and zoological collections interested in conserving hazel dormice. Natural England and PTES collaborated to release the first dormice in 1993 (Bemment 2021) and to date over 1000 dormice have been released in 13 English counties. The DRAHS team has developed a DRM protocol for the project and carries out PRHS of the released dormice.

The health of dormice chosen for each year's reintroduction is assessed under quarantine conditions for about 10 weeks at ZSL and Paignton Zoo. During quarantine, they are weighed weekly, receive a detailed health examination and are microchipped to aid identification once in the wild. The veterinary health examinations help us to understand the health status of individuals prior to release and mitigate against the introduction of non-native parasites which might cause disease and impact free-living populations.

After the reintroduction, dormouse nest boxes in the various reintroduction sites are checked monthly through the National Dormouse Monitoring Programme (NDMP). Any sick dormouse is reported to DRAHS and dead individuals undergo post-mortem examination. PRHS is continuing for all reintroduced populations. DRAHS has a comprehensive database of pathological diagnoses from free-living dormice and a substantial archive of frozen and fixed materials from pathological examination for retrospective studies. The results from post-release monitoring and any subsequent post-mortem examinations not only inform the dormouse reintroduction programme but also provide an insight into threats to these small populations in the face of changing conditions (including climate change and habitat destruction).

Figure 3. A hazel dormouse being weighed during the quarantine period at ZSL. Photo credit: Zoological Society of London.

Case study 3: extrapolating DRA to rewilding scenarios

The techniques developed by DRAHS to assess and combat the risks from disease in conservation translocations can be extrapolated to do the same for rewilding where movements of wild

"The results from post-release monitoring and any subsequent post-mortem examinations inform the dormouse reintroduction programme and provide insight into threats to these small populations in the face of changing conditions."

animals are involved. The same principles can be used to identify hazards, assess the threat they pose and set out DRM measures. For example, a preliminary DRA has recently been conducted by DRAHS for the introduction of European bison (*Bison bonasus*) to Blean Forest in Kent (Vaughan 2021). This DRA identified the parasite *Ashworthius sidemi* as a hazard: it is present in populations of bison in continental Europe but not in captive or native ungulates in the UK as far as we are aware and, as a non-native parasite, might be associated with disease in native or captive ungulates in the UK. It is therefore important to consider health examinations of bison originating from the continent, including possibly screening for *A. sidemi*, prior to introduction to the UK, and release into the wild, and to undertake PRHS.

Discussion

Conservation translocations are an important conservation tool, but disease can represent a potential threat. Whenever an animal is moved, any parasites it harbours are moved with it, resulting in disturbance to the host–parasite relationships with potential repercussion on different levels. Disease outbreaks may be precipitated in translocated animals and/or other species at the destination, including humans and domestic animals. It is therefore important that thorough DRA, combined with carefully designed mitigation measures, is completed before any translocation. Along with those presented here, the DRAHS team has been working on many other projects to conserve priority native species across a broad taxonomic range, from the hen harrier (*Circus cyaneus*) to the pool frog (*Pelophylax lessonae*) and the chequered skipper butterfly (*Carterocephalus palaemon*). The team has also been involved in several overseas conservation projects, including of the sihek, or Guam kingfisher (*Todiramphus cinnamominus*), and the golden coin turtle (*Cuora trifasciata*).

For further information on the DRAHS project and submission information for other species visit www.zsl.org/science/research/drahs or contact drahs@zsl.org

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Reintroduction of the Northern Pool Frog and Disease Risks in Amphibian Translocations

Figure 1. Reintroduction of the northern pool frog to England has been carefully planned, carried out and monitored by a partnership of organisations and individuals over a long time. Photo credit: John Baker.

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Keywords: amphibian, disease, *Pelophylax lessonae*, reintroduction, translocation

Following its extinction in England, the northern pool frog, a globally rare form of *Pelophylax lessonae*, has been reintroduced by translocation from Sweden. This article focuses on a second translocation to bring the species back to Thompson Common. Head-starting was used to generate founding stock and four releases of late-stage tadpoles have established a second population; further monitoring will be required to confirm long-term viability. Rewilding has stimulated interest in amphibian reintroductions, but enthusiasm for rearing amphibians in captivity for release can be misguided. It is strongly recommended that amphibian releases follow published guidance which includes remedying the causes of extinction and considering the risks entailed in reintroduction. For amphibians, habitat loss is the major driver of extinction and this should be addressed in conjunction with, or even instead of, reintroduction. Disease is a significant risk for amphibian reintroductions, and this can be exacerbated when there is a captive element to a conservation intervention.

Introduction

The history of the northern pool frog, which is a distinct form of the pool frog (*Pelophylax lessonae*) in England has not been straightforward. Originally pool frogs were regarded as a form of the edible frog (*Pelophylax esculentus*). Discoveries of 'edible frogs' in the mid-1800s at two locations in East Anglia were regarded as introductions from continental Europe. Notably, there were documented importations of edible frogs from Belgium and France which were released at several locations in Norfolk immediately prior to early observations from the field. Hence anthropogenic introduction seemed the most likely source of any 'edible frogs' found in East Anglia.

More recent evaluation of what we now know to be pool frog populations has determined native status (Beebee *et al*. 2005). Several lines of research, including examination of sub-fossil remains, preserved specimens and recordings of calls came to a unanimous and surprising conclusion. Some of the 'edible frog' populations in East Anglia were in fact pool frog, which was not only native, but part of a clade from the north western edge of a larger species range spanning Europe and into western Russia. These pool frogs are a genetically distinct group. They look and behave differently to other pool frogs and globally they are rare, being limited to a few isolated populations in Scandinavia, Estonia and England (Zeisset and Hoogesteger 2018). They are referred to as northern pool frogs to recognise this distinct form.

The research that went into recognition of native status came just too late to benefit English northern pool frogs, which declined to extinction in the mid-1990s, but it did pave the way to reintroduce the species.

Translocation from Sweden

The reintroduction was carefully planned and carried out by the Amphibian and Reptile Conservation Trust (then the Herpetological Conservation Trust), Natural England and partners, following best practice guidance at the time. The rationale, planning and feasibility were documented in a reintroduction strategy (Buckley and Foster 2005). This identified the underlying driver of extinction as habitat loss, due to the historic drainage of the fenland region, with changes in habitat management acting locally. Potential receptor sites were reviewed and the most suitable of these was prepared to receive the translocation. The receptor site contains a high density of ponds in a relatively open landscape. Northern pool frogs were translocated from Sweden, with the necessary permissions, because the donor populations were sufficiently robust to provide founder stock.

Over 4 years, 2005–2008, approximately 90 adults and other life stages were imported from Sweden and released at the receptor site in Norfolk. The reintroduction was partially successful (Foster *et al*. 2018). The frogs established a self-sustaining population that is present to this day. The established population, however, remains small, at most comprising 50 or 60 adults. This has created an unforeseen situation. To ensure long-term survival and to recover the species to desired levels it is important to establish northern pool frogs at more sites and in greater numbers. Due to their specific habitat requirements the frogs were regarded as unlikely to spread to new sites though natural dispersal yet there are insufficient numbers of frogs in the new population to repeat the wild-to-wild translocation process.

Head-starting

Head-starting has been trialled and adopted as an alternative means of translocation. Head-starting is the process of rearing young animals under protected conditions in captivity, for subsequent release back into the wild. For northern pool frog recovery this means taking spawn from the wild and rearing tadpoles under captive conditions, where they are protected during life stages in which, in the wild, most individuals would be lost to predation. Tadpoles approaching metamorphosis are released, providing large numbers of founders with minimal impact on the donor population. Release of some head-started tadpoles at the donor site can also compensate for the spawn taken.

Figure 2. Native northern pool frogs were present until as recently as the 1990s at Thompson Common, which contains large numbers of naturally formed ponds. Photo credit: John Baker.

Secondary reintroduction

The next location selected for a reintroduction was Thompson Common, a Norfolk Wildlife Trust reserve which is one of the best pond sites in England, supporting many pingos (ponds formed naturally by periglacial activity during the last glaciation). Significantly, Thompson Common was the last known site at which native northern pool frogs occurred; a population persisted there until the 1990s (Figure 2).

Critical steps in species reintroduction include the identification and redress of extinction factors. Formerly, northern pool frogs were found in relatively open areas of the Common in warm ponds sufficiently permanent to allow the tadpoles to complete development over the summer. Population decline appears in part to be have been caused by a reduction in grazing, the subsequent overgrowth of ponds and succession to secondary woodland. A further issue was a lowered water table, as northern pool frogs require permanent ponds for breeding. Site management carried out by Norfolk Wildlife Trust has included removal of secondary woodland and reinstatement of grazing by cattle and konik ponies. Sluices have been installed to hold more water on site.

Head-started tadpoles were released in 2015 and 2016 but suspended in 2017 when instead a trial translocation of spawn (374 eggs) was undertaken, directly from the primary site. Head-starting resumed in 2019 and 2021. Although northern pool frogs do not reach sexual maturity until they are 2 years old, males were first heard calling in 2016. Breeding occurred the following year and has taken place annually since then. The population at Thompson Common remained small for the first few years, perhaps because the founders were introduced as youngsters rather than sexually mature individuals. Nevertheless, the establishing population showed consistent signs of increase. Peak counts have been used as an index of population size in lieu of population estimates which have proved difficult when the population has been small. In spring 2022 the peak counts of adult frogs leapt from fewer than 30 to more than 60 and the frogs spread to several new ponds. The monitoring data that year indicated a turning point. Rather than a small, establishing population, the frogs had become firmly established. Head-starting had restored the northern pool frog to its last known former home in England.

“The monitoring data in 2022 indicated a turning point. Rather than a small, establishing population, the frogs became firmly established. Head-starting restored the northern pool frog to its last known former home in England.”

A long-term project

Since spring 2022 the country has been subject to a summer of drought and record high temperatures. The impact of these weather extremes on northern pool frogs is unknown but unlikely to be positive. Several breeding ponds dried before tadpoles could complete development, which normally occurs in August, and the counts of young froglets leaving the water were disappointingly low given the numbers of breeding adults. Even where ponds did not dry completely, lowering water levels left young froglets emerging onto bare mud rather than into fringing vegetation cover, presumably increasing predation risk. The arid terrestrial environment was also likely to have made life difficult for frogs once they had left the water. Monitoring data showed a drop in numbers of frogs after the hot summer of 2018 raising fears of a similar decline to follow 2022.

Large populations are better able to survive environmental and demographic fluctuations. So although a future drop in numbers of northern pool frogs may be disappointing and feel like a step backwards, it highlights two important aspects of reintroductions. Specific to this case is the urgent need to establish the species in greater numbers and at more sites. Hopefully the frogs established a sufficiently robust population at Thompson Common just in time to ride out the extreme weather conditions of 2022. A broader point is that reintroductions can take a long time and long-term monitoring is needed to determine their outcomes.

Herpetofauna rewilding

Interest in rewilding has generated discussions of further amphibian reintroductions to include species long extinct from Britain but present in continental Europe, such as the agile frog (*Rana dalmatina*) and the moor frog (*Rana arvalis*). These are exciting and stimulating ideas but they have been embraced by some in a way that overestimates the value of breeding herpetofauna for conservation releases and which underestimates risks. We understand the passion for these animals and share the enthusiasm of ‘herpetofauna rewilders’. Nevertheless, the herpetofauna rewilding narrative, as promoted by some, includes a misconception. Biodiversity is not in decline because we are not breeding and releasing enough animals. The bigger, trickier-to-address and perhaps less headline-grabbing factors are habitat loss, degradation and fragmentation. As described for the northern pool frog above, one of the key steps in species reintroduction is addressing extinction causes. If habitat is restored and managed favourably then in almost all cases it will become colonised, naturally, by our widespread amphibian species at least. Rare species, beyond natural colonisation distance, as is the case with northern pool frog, may require reintroduction, but in most cases habitat restoration is the priority rather than translocation or captive-rearing programmes.

There has been some criticism of the ‘conservation establishment’ by those who advocate for a more radical, less regulated approach to translocations (e.g. Barkham 2020). The argument seems essentially to be that research and regulation get in the way of taking urgent action. These advocates have a point: biodiversity declines continue in spite of conservation efforts. But it seems to us unfair to then conclude that the conservation establishment has little to offer and it is unhelpful to regard rewilding as an alternative to managed conservation interventions rather than being complementary. The preparation, procedure and regulation of species reintroductions can be

Figure 3. Disease transmission is a significant risk in amphibian translocations. Health screening has been integral to the reintroduction of the northern pool frog. Photo credit: Jim Foster.

frustrating. The regulated procedure could certainly be more efficient. But it is there for a reason, as species reintroductions are not without risk. These include the potential impacts on resident wildlife through competition, trophic effects or genetic effects. In addition to biological risks, translocations can compromise other species recovery efforts or create legal issues for landowners.

Amphibian disease risks

For amphibian translocations disease is a significant risk (Figure 3). Amphibian disease, specifically chytridiomycosis, is a key driver behind amphibian declines globally. It is caused by a microscopic fungus (chytrid) that lives in amphibian skin and it has been spread around the world by human movement of amphibians. The latter has even resulted in the release of chytrid fungus into the wild as part of an amphibian conservation reintroduction (Walker *et al*. 2008). Biosecurity considerations are integral to species reintroduction and crucial to those for amphibians. The northern pool frog reintroduction included screening animals before and after translocation from Sweden and then every year since.

Captive elements of conservation translocations can pose a particular risk when facilities involved house a variety of species from different locations around the world, such as may be the case in a zoo or private collection. These cosmopolitan collections create the opportunity for pathogens to jump between species that would otherwise have no contact. Amphibians intended for reintroduction have to be completely isolated from other stock, creating considerable financial and logistical costs in a zoo setting, for example. Alternatively, reintroduction stock should be housed in a dedicated unit, away from other species, as has been the case in head-starting northern pool frogs. See Common *et al*. in this issue for more on translocations and disease risk (pages 19–23).

The chytridiomycosis that has wreaked havoc on amphibians around the world has been spread by a specific fungus, *Batrachochytrium dendrobatidis*. Its global spread has brought it to Britain. It was first detected here in non-native North American bullfrogs (*Lithobates catesbeianus*), illegally released into the wild. It is now widespread throughout Britain. Fortunately our native amphibians seem to be able to survive the ill effects of this particular disease. But there is another chytrid species waiting in the wings. *Batrachochytrium salamandrivorans* has relatively recently been discovered in continental Europe where it has been associated with the release of non-native amphibians. The Netherlands has lost almost all of its native fire salamanders (*Salamandra salamandra*) to this fungus (Spitzen-van der Sluijs *et al*. 2013) and emerging evidence suggests that it has reduced great crested newt (*Triturus cristatus*) populations in Germany (Lötters *et al*. 2020). In response to the threat, the USA has banned the importation of any

“The chytridiomycosis spread by *Batrachochytrium dendrobatidis* has arrived in Britain. Our native amphibians seem to be able to survive its ill effects but another chytrid species, *B. salamandrivorans*, has been discovered in continental Europe where it has been associated with the release of non-native amphibians.”

salamander species. *B. salamandrivorans* is also here in Britain, in captive amphibians (Fitzpatrick *et al*. 2018). Release of captive amphibians into the wild, or even keeping non-native amphibians in garden ponds or outdoor enclosures, runs the risk of spreading this invisible pathogen to the wild, with potentially catastrophic consequences. Good practice in disease risk assessment and management is therefore crucial for any amphibian reintroduction programme, and the pool frog reintroduction project has attempted to progress good practice in this area (Sainsbury *et al*. 2017).

Conclusions

The Amphibian and Reptile Conservation Trust's view is that reintroductions have a significant role in species conservation and we welcome their inclusion in the Government's 25 year plan (HM Government 2018). We also look forward to the conclusion of the inquiry on reintroductions by the Environment, Food and Rural Affairs Committee. Species reintroductions are not, however, without risk, so they need careful planning and implementation. Guidance is available: see IUCN SSC (2013), Defra (2021) and Linhoff *et al*. (2021). Reintroductions can be a long-term commitment, requiring long-term funding and monitoring. Even with careful planning, project management should be adaptive and be able to respond to changes and requirements that may be picked up through project monitoring and review.

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Habitat Restoration of Historic Local Authority Landfills in Ynys Môn (Anglesey) and Gwynedd

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Keywords: Anglesey, Atlantic dune woodland, fens, Gwynedd, peatland restoration, Wild Landfill

Four capped landfill sites in north west Wales, two in Gwynedd and two in Ynys Môn (Anglesey) have been given over to habitat restoration projects. Each site is uniquely different: what they have in common is that they have no subsequent use except as low-quality grazing, providing an opportunity for them to be restored as wildlife habitat. Ecological baseline surveys guide the direction of the restoration as the natural capital of the existing sites is revealed.

Introduction

Following a successful first for the Wales multi-agency Sustainable Management of Natural Resources (SMNR) demonstration project at Penhesgyn Landfill on the isle of Ynys Môn (the Welsh name for Anglesey), where Welsh Government grant-in-aid funding was utilised to create a multi-benefit mosaic habitat, a further successful application was made for Challenge funding to expand the project to three other landfills in north west Wales (Figure 1). Uniquely, adopting the template of wildflower meadow creation on the surface of the closed landfills allows maintenance of the landfill gas-extraction infrastructure and maintains the structural integrity of capping works. The project has created 40 ha of donor wildflower meadow above millions of tonnes of capped waste.

Ancillary connected improved low-grade council-owned land surrounding the landfills was included on all four sites and over 45,000 native woodland trees have been planted. Hedgerow expansion and connectivity at scale, multiple wetland and water body creation and improvement to riparian habitat, including a peat-rich fen, have formed ecologically rich connected habitats which are a template for the restoration of contaminated land.

All fencing and barriers to animal movement have been removed and an outreach education project has been established with the aim of reaching all schools in Ynys Môn and Gwynedd to increase knowledge and awareness of biodiversity loss and local solutions at scale.

Figure 1. Map of north Wales with locations of the landfill sites.

Restoring nature in the post-industrial landscape

The legacy of industrial activity and waste disposal is one of biodiversity loss and pollution of the natural environment. The activity has degraded land and soils, eliminated habitats and species, permanently polluted large areas of land and reduced the amenity of local places.

Wild Landfill is a Natural Resources Wales (NRW)-led, Welsh Government-funded, multi-agency project aimed at reversal of this trend, utilising degraded, non-contested land to deliver multiple environmental benefits, incorporating

many aspects of the SMNR principle and the ecosystems approach in its brief to deliver multiple biodiversity adaptation and climate benefits. Climate change and the biodiversity crisis are global issues for current and future generations. Wild Landfill aims to provide local solutions to these global issues, empowering the people of Wales to better understand the problems and help to make a tangible difference.

A capped landfill is contaminated and not fit for development purposes. It cannot be planted with trees, or used for anything except low-quality agricultural grazing. What if we could take landfill sites full of rubbish and turn them into oases for wildlife, carbon sinks and wildflower meadows, creating new ponds, wetlands and new forests? Well, that is exactly what the Wild Landfill project is doing. We have taken four landfill sites in Gwynedd and Ynys Môn, each of which contain millions of tonnes of waste, and turned them into ecological hot spots, enhancing biodiversity, creating havens for wildlife and increasing carbon storage in the trees and soils in and around the sites. We have created a connected, fence-free habitat within a lowland, primarily pastoral agricultural landscape.

Wild Landfill aims to reduce the impact of industrial sites on the environment and climate, turning areas of historical environmental degradation into diverse, ecologically rich habitats for wildlife recovery and carbon storage, improving land for pollinators which are vital for food production and creating multiple new water bodies, helping to reverse the decline in freshwater ponds. The UK has lost 90% of its ponds and 97% of its wildflower meadows over the past 100 years. Wild Landfill is helping reverse this trend and has created a series of new wetlands and ponds to create living diverse aquatic habitats to further increase biodiversity.

“Wild Landfill aims to provide local solutions to global issues, empowering the people of Wales to better understand the problems and help to make a tangible difference.”

The project was initiated by Tony Roberts of NRW through the Welsh Government Challenge Fund and Gwynedd and Ynys Môn County Councils, with collaborations across a spectrum of partnerships and stakeholders.

The sites will be an educational resource for the public, educators, environmentalists, politicians, policy-makers and all other interested parties. They will act as a template for the development of a network of thriving, biodiverse sites across Wales that are rich in wildlife and create a multitude of nature-based solutions in response to the climate and nature emergencies. Through a dedicated online resource and a schools outreach programme that incorporates a website, animated and documentary-style films, and useful simple environmental information, Wild Landfill is engaging, educating and invoking action across multiple stakeholder groups in Wales.

Establishing a baseline

To draft a management plan for the future, it is necessary to establish an inventory of what is already present: an ecological baseline. This was a substantial operation across four sites, because as much of the flora and fauna as possible needed to be sampled. There was a limited budget for this work, and as the sites are situated in different counties the funding was drawn from different financial sources, requiring considerable input from multiple partners. Private sector contractors who were appointed actively participated in the design and delivered additional work *pro bono* to ensure maximum environmental benefit was achieved within budget and on time.

Funds enabled extended Phase 1 and breeding bird surveys across all the sites, and some limited invertebrate surveys on Ynys Môn, including moth trapping by volunteers. Volunteer days also enabled additional botanical surveys of sites on Ynys Môn by the local Flora Group, affiliated to the Botanical Society of Britain and Ireland (BSBI). Without the input of volunteers, the data collected would have fallen short of the requirements of a good baseline survey. However, too much reliance on volunteers can undermine the value placed on the work.

Professional consultants are guaranteed to do the work, governed by a code of conduct and underwritten by liability insurance. Consultants are also proficient at managing technical requirements such as licences and permits. Personal communication with Natural England while managing the Fenns and Whixall Moss NNR LIFE project suggests that around 15% volunteer input is a good balance.

Sites in Gwynedd 1: Ffridd Rasus

The baseline site surveys highlighted how different the sites were from one another. This site, near Harlech, would have been maritime acid grassland, grey dune and heath before the establishment of the landfill and surrounding commercial forestry. Imported soil and compaction has created large stands of willow (*Salix cinerea*) and buddleia (*Buddleia davidii*) scrub, and, peculiarly, dry reedbed on the high point of the landfill where imported clay topsoil from ditch clearance has been spread. It has breeding whitethroat (*Curruca communis*) and sedge warbler (*Acrocephalus schoenobaenus*) in the drainage ditches, and a remarkable display of viper's bugloss (*Echium vulgare*) in late summer, indicative of what it might become.

Among the project constraints there is a requirement for tree planting on all sites to meet the Welsh Senedd targets (Mosalski 2021), amounting to 42% of the 32 ha of landfill. Consultation with all stakeholders (including NRW, Snowdonia National Park, the local authority and the RSPB) concluded that encouraging development to Atlantic dune woodland (Tryfon 2016) would be desirable, and a tree mix appropriate to the habitat target was duly proposed, including native conifers (Sassoon *et al*. 2021) (Figure 2).

Sites in Gwynedd 2: Llwyn Isaf

The second Gwynedd site was 24 ha located next to a Site of Special Scientific Interest (SSSI), part of the Ynys Môn and Llŷn Fens Special Area of Conservation (SAC). This helpfully provided information on what to

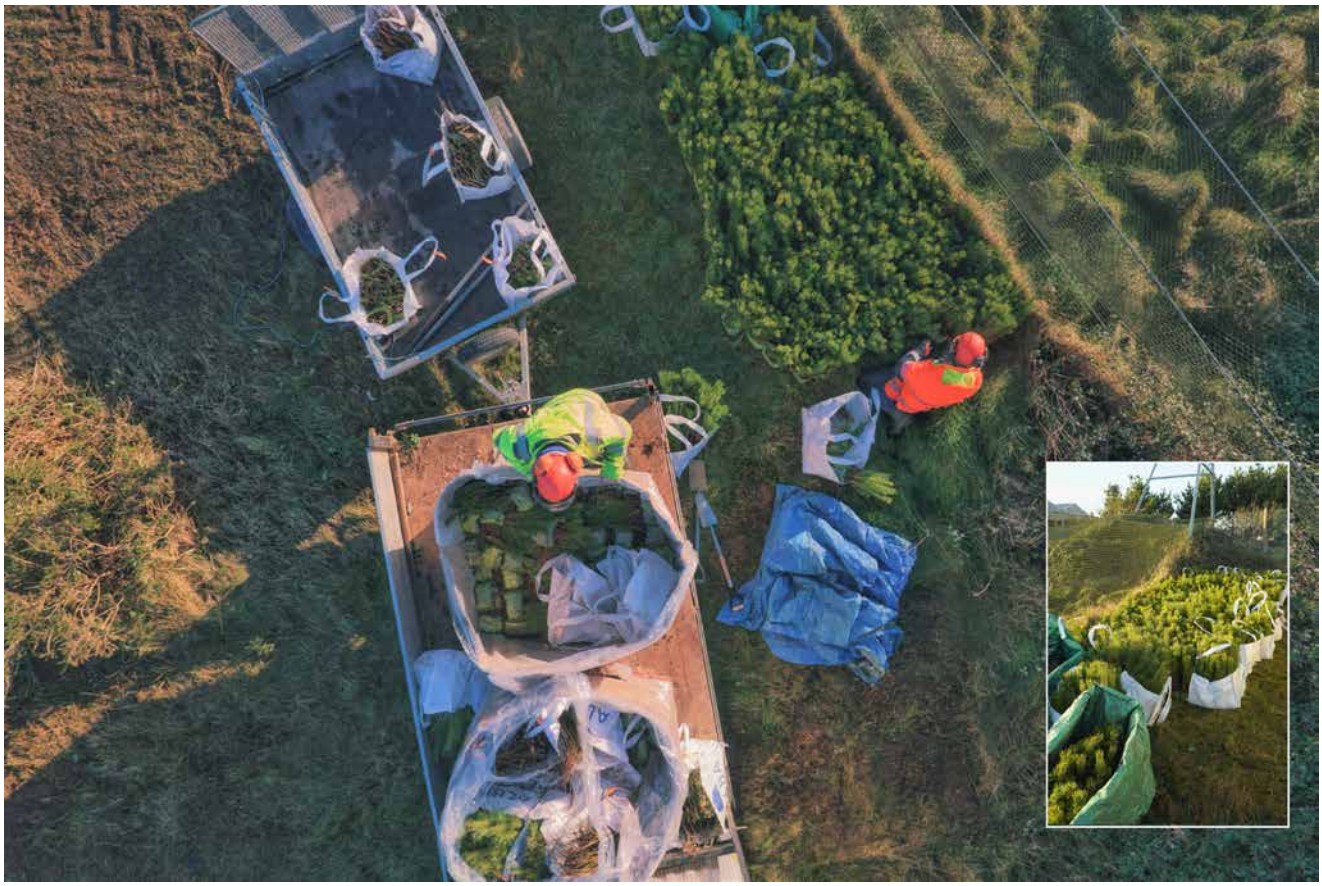

Figure 2. Scot's pine (*Pinus sylvestris*) loaded onto a flatbed, ready for planting. Photo credit: Jonas Stuart, Rocketland.

"Part of the Llwyn Isaf grassland has been managed successfully for butterflies, with populations of small heath and dingy skipper as well as the more typical grassland butterflies."

expect, both from the SAC and supporting SSSI designations. In addition, because protected sites are generally better recorded, good data was received from the Biodiversity Records Centre for North Wales (Cofnod). Part of the grassland has been managed for butterflies, and with some success, for it has populations of small heath (*Coenonympha pamphilus*) and dingy skipper (*Erynnis tages*; Figure 3) as well as the more typical grassland butterflies.

Tree planting will occupy 2.5 ha of the Llwyn Isaf site not occupied by capped landfill. The covered landfill will be allowed to develop as species-rich grassland, subject to the same management regime that has

Figure 3. Dingy skipper (*Erynnis tages*) is already present at two of the sites in Gwynedd and Ynys Môn. Photo credit: Richard Birch.

Figure 4. Ponds at Llwyn Isaf. Photo credit: Jonas Stuart, Rocketland.

encouraged the butterflies that are already there. Several new water bodies have also been established by enhancing the site watershed soakaways (Figure 4), which will provide further permanent climate-resilient aquatic habitat at the site.

Sites in Ynys Môn 1: Clegir Mawr

In addition to the Welsh Senedd's commitment to tree planting, restoring and preserving fen is a recognised strategy for sequestering carbon. Both the Ynys Môn sites are former fens. The 12.5 ha site at Clegir Mawr, closed in the 1960s, is now so well recorded botanically that it is the subject of an experimental reintroduction project with the involvement of BSc Honours students from the University of Wales in Bangor, in conjunction with the university's Botanic Garden at Treborth. Using the botanical species list as a guide, and a wider knowledge of plants typical of the Ynys Môn fens, it is possible to imagine what species might have been present had they not been lost or failed to colonise. These include species proposed as key performance indicators (KPIs) to facilitate a quantitative experimental increase in biodiversity.

The initial project involved a widespread Ynys Môn species absent from the site, even though the habitat appears suitable. Forty plants of marsh helleborine (*Epipactis palustris*), grown from locally sourced stock at Treborth Botanic Garden, from original material collected from a sand dune restoration project 16 km away, were planted in two plots in September 2022 (Figure 5) and their establishment will be measured by students in future years. The existing grassland at Clegir Mawr is already sufficiently diverse that seed mixes – proposed for the capped landfill at some of the sites – are unnecessary and management is confined to grazing and scrub clearance. However, piecemeal additions planted as part of student projects fulfil another aim of the scheme, that of community involvement and education. Good colonies of marsh helleborine and, in future, vervain (*Verbena officinalis*) and yellow bartsia (*Parentucellia viscosa*) will be considered as part of larger projects, and will add to the species diversity,

"Restoring and preserving fen is a recognised strategy for sequestering carbon. Both Ynys Môn sites are former fens. Clegir Mawr is now so well recorded botanically that it is part of a reintroduction project with involvement of University of Wales in Bangor BSc(Hons) students."

which already includes great crested newt (*Triturus cristatus*), common lizard (*Zootoca vivipara*) and slow worm (*Anguis fragilis*).

Purists might consider this proactive approach as 'gardening', but it is no more so than sowing wildflower seed or planting trees. Corridors through which species can reach the site naturally are rare. Natural colonisation may take years, and one thing we can do to counter the dearth of biodiversity is to provide experimental re-introduction where it is appropriate.

Sites in Ynys Môn 2: Penhesgyn

The second Ynys Môn site was capped only recently and highlights how plants get moved from place to place by

Figure 5. (a) Flowering-sized plants of marsh helleborine (*Epipactis palustris*). (b) Marking out and preparing 1 m × 1 m plot for 20 plants. (c) Arranging the plants in the plot. (d) After planting. Photo credit: Richard Birch.

Figure 6. Capped landfill meets lowland fen. Inset: golden-ringed dragonfly (*Cordulegaster boltonii*). Photo credits: Richard Birch.

accident, so why not by informed design? Botanical survey produced two plants new to Ynys Môn: field pepperwort (*Lepidium campestre*) and marsh yellow-cress (*Rorippa palustris*). Their origin is unknown, but both are behaving as adventives and it is likely they were introduced with soil used to cap the landfill from further afield.

This second locality contains a large expanse of poor-quality derelict fen (Figure 6). A preliminary survey with canes revealed that in places it is made up of peat to a depth of nearly 2 m, which is four times the depth that qualifies as deep peat (Natural Resources Wales 2022) and deeper than some of the fens included in the Ynys Môn and Llŷn Fens SAC designation.

Following consultation with RSPB and NRW's peatland team, a strategy for re-wetting the fen is being initiated. This is potentially complex, requiring lengthy discussions with adjacent landowners and fen recovery experts. Applications for funding will take up a great deal of unfunded time but must be prioritised if the desired outcomes are to be achieved in a timely fashion. However, the prospects for success look promising, given the Senedd's commitment to restoring peatlands (Welsh Government 2020), and the scheme has fully engaged waste managers, local councillors and heads of service. Once contributing partners are on board, the collaborative effort and time spent reaps rich rewards.

There are precedents for restoring peat in uplands and lowland bogs, but fewer for fens, where the main peat-forming plant is common reed (*Phragmites australis*). The Penhesgyn fen is so degraded by drainage dykes and channels cutting across it that there is no reed remaining; instead, it has been replaced by reed canary-grass (*Phalaris arundinacea*), with patches of great pond sedge (*Carex riparia*), indicating that there was once sufficient water to support a fen community. After establishing where and how much peat there is across the site, the restoration exercise will involve blocking drains and creating a saturated environment suitable for peat formation. The funding emphasis is on peat restoration, but in this case it must incidentally provide habitat for other species, particularly those attracted by open water.

Restorers of moss peatlands would rather not have open water in the ecosystem in case it should attract too many wildfowl and cause eutrophication, but the corollary is that this would be a notable biodiversity gain on the Ynys Môn fens. In 2016, bittern nested on Ynys Môn for the first time in 20 years, just 3.5 km away from Penhesgyn, at the RSPB reserve of Gors Ddyga. A notable success would be the colonisation of the Penhesgyn fen by birds like bittern and marsh harrier. To paraphrase Kevin Costner's character in the 1989 film *Field of Dreams*, "Build it, and they will come." Now, wouldn't that be something?

Acknowledgements

Wild Landfill is an amalgamation of multiple collaborators from the public and private sectors, including Ynys Môn and Gwynedd County Councils, Natural Resources Wales, ecological consultants, web designers, media engineers, landscaping firms, landowners, charities, local societies and individuals, many of whom have given up their time to progress the project.

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Scotland's Peatland ACTION Leads the Way

Sphagnum beginning to colonise a bog pool at a peatland restoration site. Photo credit: Lorne Gill/NatureScot.

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Peatland ACTION

Keywords: biodiversity, carbon storage, flood prevention, green economy, innovative techniques, peatland restoration, water quality

Peatland ACTION is a £250 million, 10 year national programme to restore 250,000 ha of Scotland's damaged peatlands. Its work is crucial to achieving Scotland's aim of reaching net zero carbon emissions, as well as addressing the biodiversity crisis and playing an important role in developing a green economy. It is funded by Scottish Government and delivered by NatureScot in partnership with the National Park Authorities, Scottish Water, and Forest and Land Scotland. It has also been instrumental not only in developing and implementing a range of new techniques, but in training specialist contractors, transforming our ability to restore peatlands from net carbon emitters to effective carbon stores.

Introduction

More than 20% of Scotland's land total is covered by peatlands (Bruneau and Johnson 2014). This is the highest proportion of all the UK countries, and one of the highest in Europe. They're a unique habitat capable of storing vast amounts of carbon. Functioning peatlands are also important for biodiversity, as well as being a source of clean water and helping to reduce the likelihood of flooding downstream.

However, past drainage and management have damaged many of these peatlands, which are now in such poor condition that instead of acting as carbon sinks, they are emitting greenhouse gases. The good news is that we can restore peatlands to a condition where they are functioning properly again.

Types of peatland in Scotland

Peat is an organic material formed from the compressed remains of plants such

as *Sphagnum* mosses that have built up over time in wet, oxygen-deprived conditions, which prevent them from decomposing completely.

There are four main types of peatland found in Scotland, covering a total of almost 2 million ha: blanket bog, raised bog, fen and bog woodland. Blanket bog forms the biggest proportion of Scotland's peatlands at 1.8 million ha: 10% of the world's entire blanket bog habitat. Blanket bogs form in mountainous environments where rainfall is so high that nutrients are washed out from the land, which becomes saturated and collects water. Raised bogs form in depressions and lakes not fed by groundwater, and are domes of peat typically found in the flatter lowlands. Fens, unlike bogs, are peatlands which are enriched with nutrients from upwelling groundwater and their vegetative diversity tends to be higher than rain-fed bogs. Again, fens are found mainly at lower elevations and valley bottoms. Bog woodlands represent a small part of the Scottish peatlands. Their vegetation is mainly blanket bog vegetation, sparsely covered with stunted Scots pine or birch trees.

Why are peatlands important?

Peatlands are important for a number of reasons. They are key in our fight against biodiversity loss. They provide the habitat for a community of plants found nowhere else. They are home to nationally important breeding populations of waders and waterfowl. Many of Scotland's great salmon rivers originate in upland peat-dominated catchments. The fish rely on the clean, oxygen-rich waters to support the maintenance of their redds (spawning grounds) and to provide larger invertebrates for juveniles to eat.

Most of Scotland's drinking water comes from upland peatland catchments. In good condition, the peatlands reduce sedimentation by filtering water. This means the water is cleaner once it reaches the reservoirs, and needs less treatment, reducing costs to the consumer.

Healthy peatlands regulate the flow in nearby rivers and streams, reducing flood risk downstream. There is also anecdotal evidence that this also makes hydroelectric schemes more efficient by providing a more consistent flow through the turbines. Farmers, crofters and estate managers rely on peatland habitats for grazing sheep and cattle, and for sporting use like deer stalking, fishing and grouse shooting.

Peatlands are our largest land-based natural carbon stock

One of the best known benefits of peatlands is their ability to sequester and hold onto carbon. The carbon locked up in Scottish peatlands is equivalent to 140 years of Scotland's current annual total greenhouse gas emissions[1]. However, if peatlands are degraded through drainage, overgrazing, burning, peat harvesting, inappropriate tree planting or atmospheric pollution, then these carbon sinks become a significant source of carbon dioxide, fuelling climate change.

Restoration techniques

Peatland ACTION's recently published *Technical Compendium of Peatland Restoration Techniques* (www.nature.scot/doc/peatland-action-technical-compendium) is based on the experience of the many Peatland ACTION Project Officers who are based across the country with NatureScot and a number of other organisations.

The restoration techniques used in a project depend on the setting, and are rapidly developing as we use our experience to refine and adapt the methods. Before any restoration work is done detailed surveys of the site are carried out, establishing the peat depth, hydrology and species present. These dictate the choice of restoration techniques needed, which include the following.

"Peatlands are key in our fight against biodiversity loss, providing habitat for plant communities found nowhere else. They are home to nationally important breeding populations of waders and waterfowl. Many Scottish salmon rivers originate in upland peat-dominated catchments."

- A range of damming and ditch-blocking techniques, including peat dams, plastic piling and timber reinforcement. The choice of technique is dependent on a number of factors, including the width and depth of the ditch, the depth of the peat and the angle of the slope at the damming point. Peat dams are most effective where the peat is more than 50 cm deep and the ditch less than 150 cm wide and 120 cm deep, and usually with less than a 12° angle of slope. Beyond these parameters plastic piling, sometimes with timber reinforcements, is a better option.
- Gully re-profiling. Steep-sided gullies benefit from re-profiling as well as damming. This reduces erosion and

Figure 1. Blocked ditch showing peat dams and re-profiled edges, Dunlossit Estate. Photo credit: Peatland ACTION/NatureScot.

Figure 2. Digger re-profiling a peat hag. Photo credit: Peatland ACTION/NatureScot.

allows water to spread more laterally into the surrounding peat. It involves using a digger to roll back vegetated turves on either side of the drain. The sides of the ditch are then re-profiled to a shallower gradient by pulling down peat from the banks and compacting, then rolling back the turves. Re-profiling drains also makes them safer for livestock and other wildlife.

- Bunding. This is a barrier of peat created to hold water within the bog. It does this by blocking subsurface cracks that leak water out of the peat. Bunds are usually created along contour lines at the edges of a bog, but can also be used to create cells throughout the peatland. Once the planned line of the bund has been established using peat depth and hydrological survey data, the vegetation is rolled back and a trench of peat removed and used to create the bund behind it by compressing the peat. Finally the vegetation is rolled back over the bare peat.
- Hag re-profiling. Peat hags are banks of peat that are isolated when the peat around them is washed away. Their undercut sides are too steep and hostile an environment to allow the peat to revegetate, and will continue to erode unless re-profiled. This is done by rolling back the vegetation above the hag, digging out the peat to create a slope of 33–45°, and then covering the exposed peat with the vegetation, ensuring no bare peat is left. Once this has been achieved the peat will continue to revegetate and consolidate naturally.
- Restoring forest to bog. Where forestry is cleared from peatlands the water table often stays at the bottom of the furrows between the planting ridges, making it difficult to rewet the bog. To avoid this the felled trees, along with any regrowth, can be mulched and used to fill the furrows between the planting ridges. These are then compressed by the excavators to create a smoother surface, allowing the water table to rise. The cut stumps can also be flipped and pressed into the bog to provide a better surface for bog species to recolonise.
- Scrub removal. Scrub develops when the bog is drained and the lower water table allows woody growth. This becomes a vicious circle, with the scrub drawing more water out of the bog, and intercepting rainfall, so it is important to remove as much as possible as part of the wider restoration work. Depending on the height and density of the scrub this can be achieved through hand pulling, brush cutting, chain sawing or chemical control. It is mainly done between August and February to avoid the bird breeding season. Scrub clearance must continue after restoration work has been carried out until the bog is wet enough to deter future regrowth.

“Peatland ACTION monitors the impact of peatland restoration work, allowing us to understand the benefits. The programme also provides training for contractors, help with project management and support to complete grant applications.”

Ambitious targets in a growing sector

Undertaking peatland restoration is a relatively new and growing sector with the capacity to support the development of a green economy. Peatland ACTION has been at the forefront of this development, and instrumental in accelerating progress. In addition to 100% funding for restoration projects, it provides specialist advice and resources to deliver on-the-ground peatland restoration and guidance for multi-million pound, large-scale projects as well as smaller, community-based restoration projects. Peatland ACTION monitors the impact of peatland restoration work, allowing us to understand the broad range of benefits. The programme also provides training for contractors, help with project management and support to complete grant applications. As a result, the team has helped hundreds of landowners and organisations to restore over 35,000 ha of peatlands over the last 10 years. One of these is Dunlossit Estate on Islay which, with its Peatland ACTION funding, is aiming to restore 290 ha (see Box 1).

Funds of £250 million from the Scottish Government Infrastructure Investment Plan are now earmarked for 250,000 ha of peatland restoration between 2020 and 2030. However, if we are to restore all Scotland's 1.6 million ha of degraded peatland, billions of additional funding will need to be invested.

In order to meet these ambitious targets NatureScot and the other Peatland ACTION delivery partners are actively seeking to support landowners to restore their peatlands and manage them sustainably. The partners recognise that this ambition needs to go hand in hand with rapid development and training of specialist services for the peatland restoration sector.

Employment and training in peatland restoration

Nature-based solutions to climate change can be a win for local economies just as much as they can benefit nature and net zero targets. The developing industry of peatland restoration is creating new job opportunities across the country. It is estimated that around 1500 skilled

Box 1. Case study: Dunlossit Estate, Islay

The peatlands of Islay

The peatlands on Islay are mixture of lowland raised bog and upland blanket bog. Restoring peatlands on Islay is challenging. While snow rarely stops restoration activities as it might on the mountains of the mainland, there are other challenges such as getting people, machines or materials across to the island, with the logistical challenges of moving heavy equipment by ferry and heavy weather that can disrupt sailings regularly throughout the winter.

Restoration work

The Dunlossit Estate on Islay aims to restore over 290 ha of drained peatlands between 2021 and 2023. Phase one, which is already seeing results, was completed in summer 2022 with £90,900 of funding from the Peatland ACTION fund.

The areas of peat to be restored were chosen following detailed surveys of peat depth ad condition, hydrological surveys and aerial photography to map the erosion features. Peat depths were measured along transects covering 2466 ha of peatland, from which 933 ha were identified for closer investigation. In the second phase of fieldwork peat depths and condition were recorded on a 100 m × 100 m grid, and details of erosion features (e.g. drain width and depth) were recorded while crossing the bog. Herbivore impacts were assessed at 20 plots. This information was used to select the priority areas to restore.

Ninety hectares of previously drained and bare peatland habitat are now already on the way to restoration. Work has included re-profiling and blocking over 29,000 m of human-made ditches and 4490 m of eroding gullies. Using specialist low-ground-pressure machinery with extra-wide tracks to minimise the damage to the bog surface, standard width drains were blocked at regular intervals with peat dams and wider drains were blocked with timber dams.

Over 5000 m of peat hags and historic peat-cutting edges were also re-profiled to help stabilise the bare peat and reduce erosion and carbon loss to waterways and the atmosphere.

Ditch blocking is one of the most effective methods of peatland restoration to stop erosion, enhance habitats and raise water tables to more natural levels. The dams trap sediments, reducing the erosion of peat into downstream waterways. The small pools that form behind the peat dams and along the edges of the ditch encourage the growth and re-colonisation of peat-forming bog plants – particularly *Sphagnum* moss – and create vital habitats for wildlife.

Tom Luthman, forestry agent for Dunlossit Estate said: "We recognise the link between peatland restoration and improved habitat for wildlife. There are signs, already, that the area is more favourable for snipe and potentially roosting geese post-restoration. We also recognise the additional restoration benefits of access to carbon markets and improved water quality for fishing."

Figure 3. Wider ditch blocked with reinforced wooden dam, Dunlossit Estate. Photo credit: Peatland ACTION/NatureScot.

machine operators will be needed in peatland restoration over the next 10 years, in addition to hydrologists, satellite data analysts, surveyors, ornithologists, ecologists and project managers that are vital in developing any restoration proposals.

Training has been provided to support the development of this emerging sector since 2017. The Peatland ACTION training programme has been delivered by the Crichton Carbon Centre and has provided training to restoration scheme designers, contractors and staff of statutory agencies and local authorities. More information is available at carboncentre.org/peatland-action-restoration-events.

The significant expansion of restoration work underpinned by the Scottish Government's commitment of £250 million has seen the requirement for skills development increase exponentially. NatureScot is working with partners to develop skills pathways to support the range of specialist and technical jobs needed. The immediate priorities are focused on the development of skills in scheme design and an increase in skilled contractors capable of delivering the restoration work.

The role of scheme designer will typically involve site surveying using satellite and on-the-ground information, backed up by peat-depth surveys and photography. Information is drawn together into a bespoke peatland restoration plan. As well as surveying on site, a project requires detailed GIS mapping, consideration of appropriate restoration techniques, landowner liaison, contractor tendering processes, health and safety paperwork, funding applications and data management.

A short course began at Scotland's Rural College in December 2022 for those who are keen to become involved in the design of peatland restoration schemes. It ran in two 1 week blocks, one in December 2022 and another in March 2023, with self-directed learning and consolidation in the intervening timeframe. NatureScot supported 50% of the course fees for that first course.

On the practical side, North Highland College, part of the University of the Highlands and Islands, began an Introduction to Peatland Restoration course in January 2023, which aimed to give candidates an elementary understanding of peatland ecology and hydrology, health and safety in a peatland environment, surveying and data-gathering experience and practical experience of restoration techniques. The course provides a stepping-stone into practical delivery of restoration work via gaining machinery tickets or allowing candidates to explore an interest in surveying, scheme design or project management. Participants on this course benefitted from funding support from NatureScot.

NatureScot also ran a New Entrants scheme in 2022, building on a successful pilot in the Cairngorms National Park in 2021. This saw experienced machine operators mentor those who had not worked in peatland restoration before. A number of training sites were also set up to transfer practical restoration skills.

More training will be offered in the future. Follow the Peatland ACTION Twitter account @PeatlandACTION for the most up-to-date news, and check out the webpage at www.nature.scot/PeatlandACTION.

This work is all guided by a Peatland Skills Plan, which involves education and training bodies, Skills Development Scotland and the Enterprise Agencies, among other partners. The intention is to ensure that skilled people across the country, and perhaps particularly in the areas with the most significant areas of peatland to restore, are able to engage with this emerging sector.

Conclusion

Peatlands provide one of the best solutions we have for tackling the climate and biodiversity crises we currently face, as well as offering a wide range of other benefits such as flood prevention, improved water quality and opportunities to grow the green economy, finance and jobs, because they cover over a fifth of Scotland's land. By getting involved in the project, landowners of all sizes, from large estates to local community groups, can all get a piece of the Peatland ACTION.

Note

1 Total peatland carbon = 1778 Mt C (Smith *et al*. 2007) = 6525.26 CO_2 eq (conversion factor = 3.67). Annual emissions of Scotland in 2014 were 46.70 Mt CO_2 eq (Scottish Government 2016).

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A Cost-effective, Practical Methodology for Identifying Potential Freshwater Pearl Mussel Reintroduction Sites

Freshwater pearl mussels (*Margaritifera margaritifera*) feeding in a highland river. Photo credit: Sue Scott/NatureScot.

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Keywords: freshwater pearl mussel, habitat assessment, reintroduction

Freshwater pearl mussel (*Margaritifera margaritifera*) is globally endangered. Although Scotland is considered one of its strongholds, population declines continue. This has prompted a number of conservation actions, including habitat improvement works and, increasingly, population reintroductions, such as the Pearls in Peril project. Poor-quality riverbed habitat is one major factor determining whether reintroductions are successful. We describe a low-cost and easily implemented approach for identifying potentially suitable reintroduction sites developed on the River Spey that could be useful in other river catchments containing the species.

Introduction

Freshwater pearl mussel (*Margaritifera margaritifera*; or FWPM) is a widely distributed species on both sides of Atlantic with large numbers of individuals remaining. Despite this, FWPM are classified as globally endangered, as the majority of populations have lacked successful recruitment for the last 30–50 years (Geist 2010). Studies conducted in the last few decades have demonstrated that Scotland contains some of the

world's largest remaining recruiting populations, although these appear to be in decline (Cosgrove *et al.* 2016).

FWPM are extremely long-lived (maximum recorded lifespan, 250 years), have a complex life cycle and very specific habitat requirements, including nearly a year living as a parasite attached to the gills of salmon or trout and 4–5 years buried in riverbed substrates (Boon *et al.* 2019). The period living buried in riverbed substrates is the primary constraint for successful recruitment as they require clean and well-oxygenated gravels for the entire period to survive.

Conservation actions have often focused on habitat restoration, but reintroductions are being increasingly utilised (Killeen and Moorkens 2016). Populations are also sometimes translocated as part of in-river development mitigation. Several different methods have been used to reintroduce or translocate FWPM populations, but there appears to be very few documented cases demonstrating successful re-establishment of self-sustaining populations. Insufficient quality of riverbed habitats at reintroduction sites may be one important limiting factor, emphasising the need to assess habitat quality prior to reintroduction. This is consistent with the IUCN guidelines on species reintroductions, which stipulate that the habitat in the proposed destination site should be suitable for self-sustaining populations (IUCN 2013). This article presents a practicable and cost-effective stepwise approach to successfully identify suitable FWPM habitats within catchments, developed from published research on the species' habitat requirements.

Methods

Study background

The described approach was developed on the River Spey, Scotland. While the catchment as a whole contains large FWPM populations, long-term monitoring indicates that the only remaining populations in the upper catchment are no longer recruiting (Sime 2014). The surveying methodology was developed to understand the causes for this. Furthermore, as the decline of FWPM in the catchment is assumed to be partly driven by the high levels of historic pearl harvesting, the current distribution of FWPM may not reflect the availability of suitable habitat. Therefore, an additional aim was to identify potential reintroduction sites in the tributaries of the upper Spey catchment, where FWPM are largely extinct. The project focused primarily on finding reintroduction sites in tributaries, as there are several already established and known non-recruiting populations in the main channel.

Modelling of river gradient

An assessment of habitat suitability occurred in 2019 in the upper River Spey catchment through a narrowing-down process, so that the most detailed surveys were conducted in restricted localities most likely to contain suitable high-quality habitat. The first step was to map river gradient to exclude areas less likely to contain suitable habitat, due to substrate instability or because of fine sediment accumulation, a methodology previously utilised in Ireland (E.A. Moorkens, personal communication). Other studies have supported gradient as a useful indicator, demonstrating that FWPM prefer an intermediate gradient range of 0.8–3 m/km (Skinner *et al*. 2003).

The river gradient map was produced by GIS modelling in ArcMap using the ESRI Arc Hydro tools and the 5 m resolution NEXTMap digital terrain model (DTM) from Intermap Technologies. The first step divided the catchment into sections of river based on the confluences between tributaries, so sections were variable in length. Gradient was then calculated for each section through a number of steps as the 10:85 slope, a commonly used parameter calculated as the elevation at 10% along the flowpath minus the elevation at 85% along the flowpath, divided by the planar length in metres (i.e. on a 2D map) between the 10 and 85% points (further details can be provided by the first author upon request).

In-stream assessment

Subsequently, in winter 2019 a visual assessment of sections of river was conducted to rule out clearly unsuitable locations and identify sections of river most likely to contain suitable microhabitats. This was undertaken by an ecologist experienced in FWPM surveys using standard protocols and who had completed the River Restoration Centre Level 1 Introduction to Hydromorphology course. The initial in-stream visual suitability assessment was based on previous surveys in Scotland (Young *et al.* 2003, ERA/Cosgrove and Hastie Associates 2007). This took place by walking in and/or alongside stretches of river and conducting a visual assessment for the presence of suitable mixed substrates (coarse sands/gravels supported by boulders), substrate stability (Table 1) and an assessment of potential threats to habitat quality (i.e. surrounding land use, river modifications and potential

Table 1. Criteria used to characterise riverbed substrate stability. Source: Young *et al.* 2003, ERA/Cosgrove and Hastie Associates (2007).

Substrate stability	Size (mm)
Stable	Signs of long-term riverbed stability. Generally characterised by extensive areas of mixed substrates. Relatively low bank profile.
Moderate	Riverbed sediments generally mobile but with a few relatively stable patches throughout and/or along river margins adjacent to banks. Generally characterised by small, confined areas of mixed substrates. Bank steepness allows some floodwater dispersal.
Unstable	Signs of large-scale sediment mobility, often with smooth clean stones and boulders. Usually dominated by well-sorted substrates, recent sediment deposits on riverbed and/or significant depositional features. Riverbanks fully constrained, likelihood of scouring high.

"In winter 2019 a visual assessment of sections of river was conducted to rule out clearly unsuitable locations and identify sections of river most likely to contain suitable microhabitats."

pollution sources; Figure 1). This sought to provide a general assessment of large stretches of river, which were only divided up into smaller sections when there appeared to be a significant change in substrate suitability in parts of the river >50 m in length. Therefore, the length of the stretches assessed varied depending on the homogeneity of the riverbed substrates. Where the river was not deemed to contain suitable mixed substrates, was considered to be too unstable or major threats to habitat quality were identified (i.e. pollution sources, damaging river modifications or high-risk land use) no further surveys were conducted.

Tributaries with a suitable gradient were also assessed for sufficient densities of host fish, using long-term data from the Spey Fishery Board. Host fish are required to complete the FWPM life cycle, with thresholds required for successful recruitment cited at 0.2–0.3 fish/m^2 (Skinner *et al.* 2003). In the upper Spey, available data suggested that host fish densities were suitable in most of the upper catchment, so no tributaries were excluded. In other catchments, an assessment of host fish densities may provide a further narrowing-down step. If no fisheries data are available, electrofishing surveys could be undertaken following the visual assessments to ascertain whether low host density could be a limiting factor. Potential reasons for low fish density would need to be addressed prior to any reintroduction proposal, such as barriers to movement in the river system.

Assessment of microhabitat requirements

Following the visual assessments, the most promising sections of river underwent detailed assessment of riverbed substrates at the microhabitat level. Sampling methodology followed standard FWPM surveying techniques, with five quadrats placed every 10 m along 50 m stretches of the selected sections. The 50 m transects, and quadrats within them, were placed in the most favourable substrates. Microhabitat suitability measurements were also conducted at six locations in the upper catchment with existing FWPM populations to determine why they were not recruiting.

Figure 1. Section of river for which visual assessments found very suitable conditions. The river had extensive mixed substrate, lots of *Fontinalis* spp. growth, dark coloured stones and a low bank profile (suggesting scouring of the riverbed during spates might be less likely). The section was also surrounded by semi-natural upland land use, with no obvious pollution risks. Photo credits: Kieran Leigh-Moy.

The measured variables were assessed during low water levels in July and August 2019, as this is when riverbed habitats are under greatest pressure from low oxygen levels and therefore most limiting for juvenile FWPM survival (Geist and Auerswald 2007). Techniques were chosen on the basis that they had published thresholds indicating suitable habitat and for the ease of making reliable measurements (Table 2). One

technique was the measurement of redox potential, which acts as proxy indicator of oxygen levels (Geist and Auerswald 2007), in the open water and in the river substrate. The gradient in redox potential between the free-flowing water and at 5 cm depth in the riverbed substrate was measured using the equipment and methodology used by Geist and Auerswald (2007). One open water redox measurement and four riverbed substrate redox measurements at 5 cm depth were taken per 1 m^2 quadrat. To provide reassurance of the reliability of the measurements recorded, 12.5 cm ungalvanised nails were hammered into the riverbed substrate to 10.5 cm depth and left for approximately 4–6 weeks (Figure 2). These were then removed and inspected for evidence of oxidation within the substrate. Yellow tape was attached to the nails so they could be easily recovered. This confirmed that oxygenated water is able to penetrate into surface gravels as part of FWPM assessments (Schmidt and Vandré 2019). The percentage algal cover on the riverbed substrate was also estimated for the 50 m transect as a whole. Algal cover is an indicator of elevated nutrient levels that could impact FWPM by reducing oxygen levels, with a cover of <5% being suitable conditions for FWPM recruitment (British Standards Institution 2017).

Survey results

Modelling of river gradient identified 21 tributaries most likely to contain suitable habitat, indicating that only a relatively small proportion of the catchment outwith the main channel was of a suitable gradient. Visual assessments of these 21 sections indicated that seven contained very suitable riverbed substrates. However, only three of these did not have significant pollution risks.

> **“One site with suitable microhabitat conditions and no known FWPM population was likely to be a good candidate for any potential reintroduction schemes.”**

Table 2. Parameters measured during the in-depth analysis of the quality of the riverbed substrate, with the levels required to indicate excellent habitat.

Parameter	Guidance for suitable habitat	Sampling strategy
Redox potential	Redox potential loss at 5 cm depth into the substrate is <20% (Geist and Auerswald 2007)	Four per quadrat (one open water)
Rust development on nails	Nail completely encrusted in rust (Schmidt and Vandré 2019)	One per quadrat
Algal cover	<5% cover (British Standards Institution 2017)	Once per 50 m stretch

Figure 2. Ungalvanised nails (12.5 cm) that had been hammered into the riverbed substrate to 10.5 cm depth and left for 4–6 weeks. The uppermost nail had been placed in oxygen-rich riverbed substrates and is heavily encrusted. Photo credit: Kieran Leigh-Moy.

Of these, one was already known to contain a very small remnant non-recruiting population of three adult individuals. Another had no known records of FWPM and a further thorough search following the standard NatureScot FWPM survey methodology was not able to find any individuals. In the third section, a previously unknown recruiting population of FWPM was discovered.

Assessment of microhabitat conditions at these three sites indicated that the site with no records of FWPM and the site with the previously unknown population had conditions that appeared to be suitable for the recruitment of FWPM, evidenced by a very small loss in redox potential in the substrate and heavily rust-encrusted nails. The remaining site with the small non-recruiting population had unsuitable microhabitat conditions. Microhabitat conditions at the non-recruiting populations elsewhere in study area were also not suitable. However, algal growth at all sites was suitable, likely reflecting the generally good water quality in the upper Spey catchment. The site with suitable microhabitat conditions and no known FWPM population is therefore likely to be a good candidate for any potential reintroduction schemes.

Conclusion

The narrowing-down process proved to be an efficient and effective method of locating suitable reaches within a large catchment-scale area. The effectiveness of the method was demonstrated by the fact that of the three 50 m stretches of river identified, two contained suitable microhabitat conditions (one with a previously unknown recruiting population) while the remaining site contained remnant population of adult FWPM but unsuitable microhabitat conditions. The application of GIS modelling of river gradient allowed the more time-consuming visual assessments to be targeted at those tributaries most likely to be suitable based on published gradient requirements. Likewise, visual assessment of rivers provided a relatively quick way of selectively removing those tributaries where more detailed microhabitat assessment was likely to reveal unsuitable conditions. The microhabitat measurements were also quick and relatively easy to collect at the smaller scale measured. Using a number of different techniques to measure the quality of riverbed substrates also provided greater reassurance in the overall assessment. All sites with microhabitat measurements outwith the acceptable levels published in the scientific literature were not recruiting, while the opposite was found for the recruiting population. This provided further reassurance as to reliability of the measures as indicators of appropriate habitat quality.

Assessing FWPM habitat quality can be complicated, requiring a good understanding of the hydromorphological and ecological requirements of the species. The method presented here used a combination of GIS and field-based techniques to develop an evidenced-based methodology for identifying suitable FWPM habitat that was also relatively low-tech, low-cost and easy to implement. The stepwise approach firstly used GIS modelling of river gradient, followed by visual assessments over entire tributaries and was completed with finer-scale microhabitat assessment of riverbed substrates. It has therefore steered away from assessing some factors which are also known to impact the suitability of habitat for FWPM (e.g. water chemistry and pollutants), due to the difficulty in assessing them in a scientifically sound way within the confines of the project and because other factors are known to be more limiting for FWPM (e.g. oxygen levels in riverbed substrates).

As a result, the methodology is likely to prove useful for a broad range of organisations wanting to explore FWPM reintroductions, either as a part of a broader conservation initiative or where existing populations are required to be translocated (e.g. as mitigation for in-river development works). Hammering nails into riverbeds proved to be a particularly easy and effective technique and lends itself well to citizen science initiatives looking to add to hydromorphological data gathered by trained practitioners.

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Feature

Wallasea Island: Showing Why and How to Rewild the Coast

Figure 1. View of the whole Wallasea Island rewilding site, 2019. Photo credit: RSPB.

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In November 2018, the largest and most ambitious coastal wetland restoration project in Europe was completed on Wallasea Island, Essex. This marked the culmination of nearly two decades of collaborative work by many partners and specialists. Previously, this 800 ha island was a flat expanse of, largely, poor-quality agricultural land. It was low-lying and vulnerable to tidal flooding. Today, the landform has changed radically. It now supports a unique and biodiverse mix of islands, mudflats, salt marshes, coastal grazing land and freshwater wetlands that are managed by the RSPB. To achieve this change, several coastal adaptation techniques were adopted. These were based on techniques applied previously in the UK and abroad, but at Wallasea they had to be distinctive and ambitious in their scale. The island is now an exemplar of sustainable landscape-scale coastal adaptation. It is also the first, and so far only, UK coastal site on the Rewilding Europe network. It shows why and how rewilding can be done at the coast and can now inform and inspire more and larger projects in the future.

Why change was needed at Wallasea

Wallasea Island lies at the confluence of the Crouch and Roach Estuaries in Essex. Several centuries ago it was a remote and wild network of small salt marsh islets interlaced with creeks and tidal mudflats. Over time, and like many other coastal areas of the UK (especially Essex), these habitats were 'claimed' from the sea as the land was converted for agriculture.

Following this progressive human encroachment, Wallasea became a single island enwalled on all sides. It was isolated from the tide and starved of estuarine sediments. The land was then reworked and compacted by farming. Consequently, the land levels dropped and the landscape was flattened. Ultimately, the land became lower than the high tides and remaining salt marshes outside the walls. In this condition it was vulnerable to sudden and catastrophic flooding.

This vulnerability was starkly demonstrated during the 1953 floods when eyewitnesses recorded how an inrush of water poured over the walls and the whole island then "filled, like a dish, within a few minutes" (Grieve 1959). However, after 1953, the island continued to be managed for agriculture. It was manipulated and flattened further over the next five decades.

While the island itself was at risk from flooding, the potential for damage was much wider. That is because, if tidal waters eventually did break through the sea walls, it would be in such large quantities over this flat, sunken landscape that the subsequent twice-daily tidal exchanges would cause significant and potentially irreversible impacts to the Roach and Crouch Estuaries. Under this scenario, Wallasea would exchange around 11 million m^3 on each tide, which is a massive 66% of the tidal exchange volume for the whole Roach Estuary. If such an uncontrolled tidal exchange were allowed to happen, it would inevitably cause erosion and have an adverse effect on flood protection, recreation and commercial activities in many parts of the estuary.

In the late 1990s and early 2000s, with sea levels rising, the underground drainage system failing and parts of the sea wall in a parlous state, it was recognised that something had to be done. The Environment Agency considered the options in a 1997 Shoreline Management Plan and a 2003 Flood Management Strategy. These recommended a managed realignment of the island's sea defences.

How the island was changed

Although this flood risk had to be addressed, there were no simple or quick solutions. The island's large size and location presented challenges that had to be met with new solutions. While several tried and tested coastal adaptation techniques are available (see Scott and Armstrong 2022 for an overview), any interventions at Wallasea had to be pioneering and ambitious in their scale.

In principle, the approach taken involved realigning the sea defences to create a more sustainable landscape and restore the lost intertidal habitats. However, this had to be done in ways that controlled the volumes of tidal exchange to avoid significant damage to the estuaries. It also had to be done in a phased manner so that any change was gradual.

One approach involved raising and shaping parts of the island using sediment brought in by sea. This included 700,000 tonnes of dredgings from Harwich and around 3 million tonnes (2.3 million m^3) of earth mainly derived from tunnels excavated by Crossrail to create the underground Elizabeth Line in London. This land raising and landscaping reduced the volume of tidal water exchanged with the estuaries while also enabling a distinctive and complex wetland to be created.

This process took nearly two decades. It required extensive partnership working between the RSPB, the Environment Agency, Defra, Crossrail, the landowner and stakeholders. Initial work was by Defra from 2003 to 2006, before the RSPB then embarked on their Wallasea Island Wild Coast Project. To over-simplify a major initiative, the project is divided here into three major phases as follows:

1. Phase 1: Allfleet's Marsh realignment (2006). The first stage was a large-scale (115 ha) sea defence realignment on the island's north bank. This included the largest beneficial use of dredged silts in the UK (550,000 m^3 from Harwich). This sediment was imported to raise part of the landscape so that salt marsh as well as mudflat habitat would be created.

Figure 2. Samphire on imported dredge sediment 1 year after tide returned to Allfleet's Marsh. Photo credit: ABPmer.

2. Phase 2: Jubilee Marsh realignment and coastal wetlands (2015). The second stage involved another major (165 ha) realignment on the east side of the island. It was here that substantial land-raising was undertaken using Crossrail material. Particular effort was made here to add morphological complexity and multiple niches to the landform to enhance biodiversity.
3. Phase 3: Beagle Lagoons (2018). In 2018, as a final stage, an existing sea wall sluice was adapted to allow controlled tidal exchange across 187 ha. Tidal water was contained and directed by a system of shallow bunds, weirs and field drains. This is now the largest regulated tidal exchange scheme in the UK.

In the years since the project was completed, valuable lessons have been learned about the effectiveness of the different techniques used. Some findings from the first two decades of this long-term project are outlined below.

The changes after rewilding

It is now 17 years since the initial Allfleet's Marsh stage of the Wallasea Island project was implemented, and over 4 years since the completion of the final Beagle Lagoons stage. Over this time, regular monitoring has been undertaken to capture the lessons learned and verify the project's success.

Habitats

This monitoring has confirmed that the habitats are functioning well. Also, much of the habitat in Allfleet's and Jubilee Marshes has successfully provided compensation for losses following east coast developments. Allfleet's Marsh is now also formally designated as an extension to the Crouch and Roach Estuaries Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) and Ramsar wetland.

"The rest of Wallasea Island includes a mix of coastal grassland and freshwater, brackish and saline wetlands as well as cropped arable land. These habitats have greatly enhanced biodiversity on the island."

The Beagle Lagoons area now includes 132 ha of unique, shallow, saline lagoon habitat which mimics the marshes and saltpans of the Camargue in France or Las Salinas in Spain. This Mediterranean-style wetland should provide an environment for southerly 'colonist' waterbirds such as black-winged stilt (*Himantopus himantopus*) and Kentish plover (*Charadrius alexandrines*), where they move north in response to changing climatic conditions. This is in addition to supporting birds that already overwinter and nest in the UK (as described further below).

The rest of Wallasea Island (nearly 400 ha) includes a mix of coastal grassland and freshwater, brackish and saline wetlands as well as cropped arable land. These habitats have greatly enhanced biodiversity on the island. Some have also provided mitigation for effects on protected or threatened species including water vole (*Arvicola amphibius*), badgers (*Meles meles*), reptiles and corn bunting (*Emberiza calandra*).

Detailed hydrodynamic (flow speeds and patterns) and bathymetric surveys have confirmed the absence of adverse effects on the estuaries. Where changes were detectable, they were minor, localised and closely matched modelled expectations. This included a modest 0.2 m/s increase in flow at the mouth of the Roach Estuary during spring tides from the extra tidal volume added by Jubilee Marsh. The sea wall breaches have also remained stable (ABPmer 2022).

The created habitats are evolving as anticipated and the site is increasingly becoming hydrodynamically, ecologically and visually integrated with the estuaries it has long been separated from. The most visual indication of this is that sediment is being progressively deposited over lower-lying parts of Allfleet's and Jubilee Marshes. The sedimentation rate varies across the site and will decline as bed levels rise, but it is currently around 3 cm/year in many areas and over 1.5 m deep in some parts. This greatly exceeds UKCP18 sea level rise projections (e.g. around 17 cm in 20 years' time) which confirms that the site is sustainable in response to climate change.

Relatively high sedimentation is typical in managed realignments, although the rate varies between sites (roughly from 1 to 10 cm/year) in response to bed elevations and suspended sediment supply. This reflects the fact that these environments are often bouncing back after centuries of isolation from tidally transported sediments. As this sedimentation occurs, and new drainage creeks form, the tidal waters move with increased efficiency over the new habitats.

Flora and fauna

The sheltered conditions which prompt this sedimentation have led to rich benthic infaunal assemblages in the mudflat. Typically, mobile marine invertebrates moved in within a few weeks and months. These early colonisers include the mud-snail *Peringia ulvae*, the bivalve *Abra tenuis* and ragworm *Hediste diversicolor,* which are important prey for wading birds. The mudflat assemblages typically then matured over 4–5 years as species (notably bivalves such as *Macoma balthica* and *Scrobicularia plana*) increased in abundance.

The sedimentation is also facilitating the sequestration and storage of carbon (mainly as organic matter). While there is still work to be done to develop a marketable carbon code for these restored habitats, it is estimated that Allfleet's and Jubilee Marshes are trapping around 16 $tCO_2e \cdot ha^{-1} \cdot year^{-1}$. This has an estimated market value of around £2 million over a decade (ABPmer 2021).

In the softer imported dredged sediments of Allfleet's Marsh there was a rapid maturation of salt marsh. These habitats developed 100% plant coverage over 4 years. Without any need for planting, this area was colonised by samphire/glasswort (*Salicornia* spp.), sea-aster (*Tripolium pannonicum*), sea-purslane (*Atriplex portulacoides*), sea-blite (*Suaeda maritima*) and common cord-grass (*Spartina anglica*). By contrast, salt marsh vegetation cover is still relatively sparse across Jubilee Marsh, although that is now 7 years old. This is because the sediment is relatively consolidated and was compacted by earth-moving equipment during the landscaping. The vegetation cover in this area is not yet

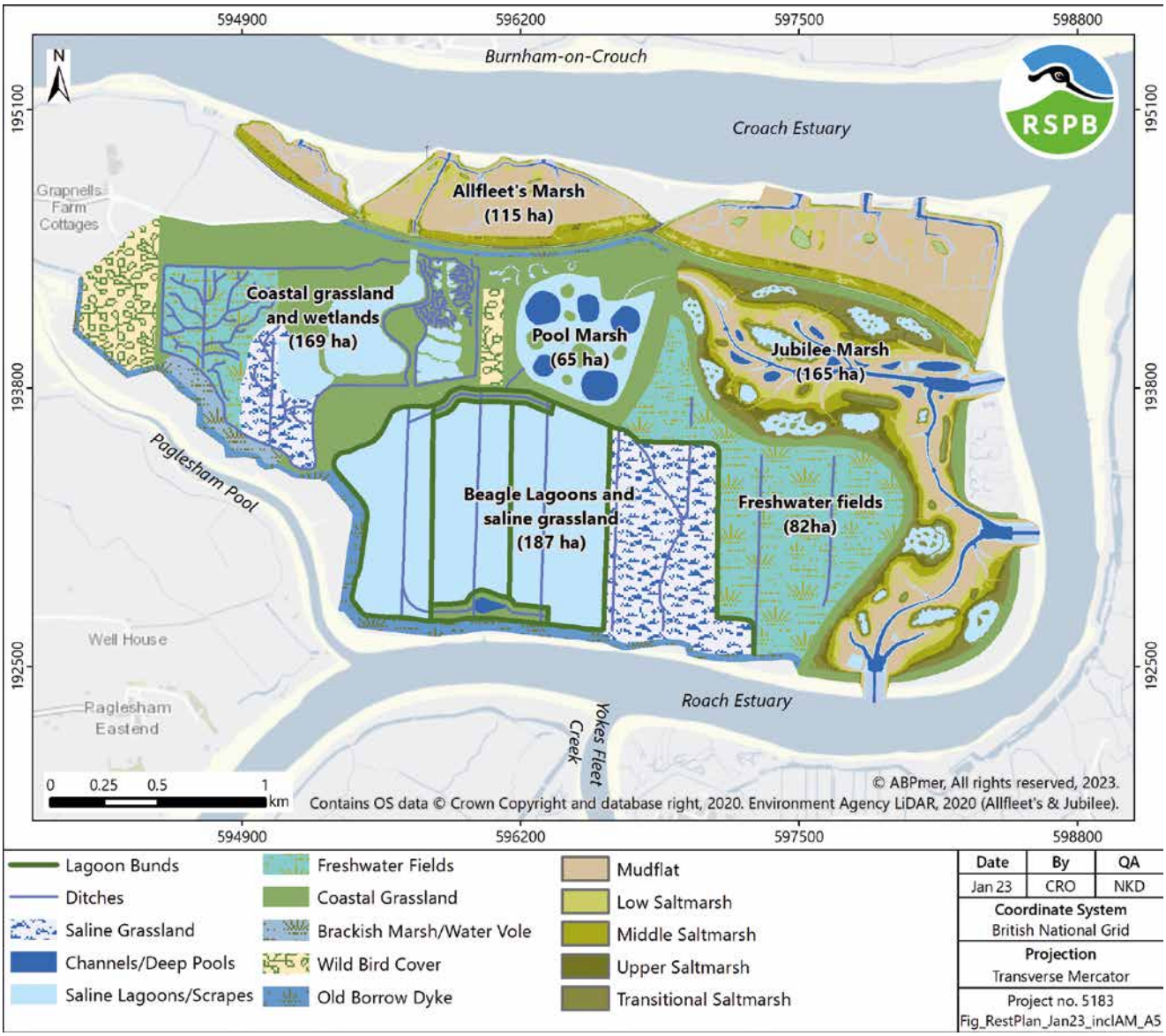

Figure 3. Plan of the whole Wallasea Island restoration area.

dense enough for nesting redshank (*Tringa totanus*), for example.

Similarly slow plant growth is seen along haul roads in other restored intertidal habitats, and this highlights the need to think about compaction and reworking during managed realignment projects. However, this slow development towards full vegetation coverage must not be viewed as problematic. Instead, it means there is a distinctive but still evolving habitat with its own value within the overall ecological mosaic of the site. The vegetation cover will also increase gradually as the surface sediments accrete over time.

Realistic expectations

This aspect highlights how important it is to have a realistic understanding and expectation about the evolution of restored habitats. It is valuable to understand that some respond rapidly (e.g. soft sediment benthos) while others may take longer (e.g. marsh in compacted soils), but all will progressively change and have structural and functional value during their evolution. Often there is also an aspiration for success to be defined against pre-defined reference or historic conditions and this can be inappropriate for managed realignment sites where distinctive conditions are created.

At Jubilee Marsh, for example, the current sparsity of vegetation may be one reason why shorelarks (*Eremophila alpestris*) have been seen on this part of the island. The scattered vegetation, and gradually sloping nature of Jubilee Marsh, may also be reasons why a greater abundance and diversity of fish species – including gobies (*Pomatoschistus* spp.) and European seabass (*Dicentrarchus labrax*) – was recorded in this realignment when compared with a nearby mature salt marsh (University of Plymouth 2017).

At Jubilee Marsh, it is notable also that there are large, rare and valuable expanses of transitional habitat that grade from salt marsh to non-tidal grassland. The high-elevation areas include rare plant species such as perennial samphire (*Suaeda vera*) and slender hares ear (*Bupleurum tenuissimum*). They are also home to scarce and uncommon invertebrate species, including black oil beetle (*Meloe proscarabaeus*).

> **The manner and scale of this project means that it has achieved multiple long-term social, environmental and economic benefits for society.**

These quickly forming habitats have provided foraging, refuge and nesting sites for a wide range of birds. Within weeks and months, the higher elevation bunds and islands became regularly used as high-water roosts by waterbirds. Then, as the wider habitats matured, and prey species increased, the numbers of wintering waders and wildfowl increased. Over the past 3 years, peak counts of over 30,000 overwintering birds were recorded across the island.

Breeding waterbird numbers have also increased. In recent seasons there have been peak breeding populations of 159 avocet (*Recurvirostra avosetta*) pairs and 46 pairs of Mediterranean gulls (*Ichthyaetus melanocephalus*). There are also large breeding populations and high densities of corn bunting and yellow wagtails (*Motacilla flava*). Other special features of Wallasea Island are its wintering raptors, which include short-eared owl (*Asio flammeus*) and hen harrier (*Circus cyaneus*) (Ausden *et al*. in preparation).

The saline lagoons furthermore support valuable specialist species, such as lagoon cockles (*Cerastoderma glaucum*) and the rare lagoon sand shrimp (*Gammarus insensibilis*). Measures are also taken to enhance the abundance of invertebrate and fish species in these lagoons.

The large, shallow Beagle Lagoons particularly are managed to try to maintain salinity levels between 15 and 45 parts per thousand (ppt) (seawater being around 35 ppt). The water levels in these lagoons are also adjusted seasonally to control vegetation and to provide food and habitat for ground-nesting birds. The salinities, water levels, invertebrates and fish species are therefore regularly monitored to inform management. This distinctive habitat is rich in seeds for waterfowl such Eurasian teal (*Anas crecca*), and new lessons are being learned continually about how to maximise the habitats' value for species such as Eurasian spoonbills (*Platalea leucorodia*), egrets, greenshank (*Tringa nebularia*) and spotted redshank (*Tringa erythropus*) that feed on fish and shrimp species.

Overview

The Wallasea Island project has sustainably recreated an ancient landscape of mudflats and salt marsh, lagoons and pasture. These habitats provide a haven for a diverse array of nationally and internationally important wildlife, including nursery areas for commercially important fish species. This was recognised in 2019 when the island was included in the European Rewilding Network (https://rewildingeurope.com/).

The manner and scale of this project's implementation also means that it has achieved multiple long-term social, environmental and economic benefits for society. In particular, it is now a popular recreational site. It was not easily accessible or very safe for people previously, but now visitors can explore 15 km of trails running through the reserve, and can visit viewing shelters and platforms that overlook the site. Today, around 20,000 people visit Wallasea every year.

Many different social and economic benefits arose from this project but, by way of summary, these include:

- providing increased public access to the coast
- creating habitats with benefits for amenity, health and community engagement
- avoiding major damage from a future unmanaged sea wall breach
- promoting sedimentation to accommodate future sea level rise
- contributing to climate change mitigation through carbon sequestration
- providing a beneficial use for dredgings and tunnel excavations instead of placing them offshore or in landfill
- facilitating the sustainable transport of material by sea, not road
- reducing costs to society/ Government that would be incurred for coastal protection.

Today, Wallasea Island is not just wild again but it is a 'living library' of the many different sustainable coastal adaptation practices that are available for implementing and managing fresh, brackish and saline wetlands. In the same way that these measures were informed by lessons from previous smaller projects, it is very much hoped that this site, and the lessons learned from it, can provide a springboard for larger and more ambitious projects in the future.

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Supporting Declining Insect Pollinators in our Urban Spaces

Marmalade hoverfly (*Episyrphus balteatus*) feeding on ox-eye daisy

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Pollinators have been declining at worrying rates over the last few decades, due to factors such as intensive farming, excessive use of insecticides and habitat loss. While changes in industry and environmental law are hugely important aspects with the power to mitigate this decline, individual effort can also make significant differences when practised by many. In this article, using the decking of my rented Bristol flat as an example, I highlight the potential that we have as individuals to turn a small urban space into a pollinator-friendly habitat. I aim to demonstrate how these changes can help pollinators and showcase the effectiveness of the changes. I also summarise the available options for various situations including gardens and larger developments. By providing resources for pollinators – be that abundant flowers, aphids for the larvae of hoverflies to consume or shelter for hibernating insects – we are able to create important habitats for these essential animals.

Why are pollinators declining in the UK?

A myriad of factors, such as habitat loss/fragmentation, intensive agricultural practice, climate change and the abundant use of pesticides have all led to significant declines in insect numbers,

not just in the UK but the world over (van der Sluijs 2020). Among these insects, the decline of pollinating species has received particular attention (Powney *et al*. 2019).

Focus is given to pollinating insects as these provide, in essence, a 'free' ecosystem service to us. About 75% of all crops grown in agriculture are pollinated by insects (Goulson *et al*. 2015), contributing to our global food production significantly. Currently, many crops depend on commercial honeybee hives because when vast areas are covered by crops there is limited wild land left to support native pollinators, resulting in the need for humans to import domesticated honeybees in their portable hives.

While honeybees carry the larger share of pollinating, commercially bred solitary bees (mason bees of the *Osmia* genus) are also used in some orchards. Other crops such as tomatoes and cucumbers even use commercially bred *Bombus* bumblebees (Kraus *et al*. 2011), which have long tongues required for the specific flower shapes. Being so heavily dependent on a single species (the western honeybee, *Apis mellifera*) or a small collection of commercially bred pollinators is laden with risk; a new disease or parasite could conceivably result in a sudden decline in these species and, in turn, a collapse in the crop-pollinating industry. This risk is not hypothetical: scientists and beekeepers are currently battling colony collapse in honeybee hives due to deformed wing virus (DWV), a disease transmitted by the parasitic mite *Varroa destructor*. Native pollinators, on the other hand, comprise a huge range of species across a number of insect orders. Flies, for example, contribute greatly to flower pollination (Ssymank *et al*. 2008), as well as wasps, beetles and moths/butterflies. Provision of habitat and resources for native pollinator species will therefore increase insect diversity while also providing the services we rely on with reduced risk.

What can we do as individuals?

There are many ways we can contribute as an individual to help tackle the decline of native pollinators. Some of these can be 'indirect', such as donating to wildlife charities, writing to politicians to promote wildlife-friendly initiatives, supporting sustainable and organic agriculture (Montañez and Amarillo-Suárez 2014, Grabovska *et al*. 2020) and reducing your carbon footprint (Yang *et al*. 2021). Often these efforts can feel insignificant on the grand scale of things and it is easy to feel helpless, which is why I am an advocate for taking a direct physical approach: a project to pour your passion into, an outlet for your desire to help. Indeed, there are some realistic individual approaches we can take to help insects and provide resources and shelter at a time when their populations are vulnerable and in decline.

An increasingly popular trend is 'no mow May' where people are encouraged to leave their lawns unmown during the month of May (or longer, preferably!) to allow wildflowers in lawns to bloom and provide a food source for various insects. While this is a brilliant movement, enticing to many in its low-effort simplicity, it offers little help to those with balconies, decking or landlord-owned paved gardens. Nevertheless, there are plenty of other options available to create insect-friendly features in an urban setting. It is easy to provide native flowers as a source of forage for pollinators in planters, or solitary-bee boxes for nesting/sheltering insects. I hope to demonstrate this and inspire others to do the same.

An urban pollinator garden: how I made mine

I live in Bristol and was lucky enough to move into a flat with a large, east-facing decking. While not your

Figure 1. The urban pollinator garden, with raised beds made from discarded wooden pallets. Boxes for solitary bees are mounted on the wall.

'traditional' garden, to me it still offered a brilliant opportunity for helping insects (and other wildlife). Most pollinators fly, in fact some travel great distances, so plants being on a raised decking or balcony rather than in a ground-level garden will pose no obstacle for most visiting insects.

My approach was to provide as many wildflowers and other niches as possible while still respecting the space needs and requirements of my two flatmates. The local garden centre was giving away wooden pallets which I used to make rather crude raised beds to hold the pots and trays of soil. I seeded cornfield annual wildflowers which were a huge success with pollinators and also planted perennial flowers that will flower year after year. Some I planted as plugs that I had been growing from the previous year, others I started from seed. I had a small herb garden in the middle of the decking on an upturned barrel, with spearmint (*Mentha spicata*) and wild marjoram (*Origanum vulgare*) that produce flowers later in the summer. Shade-tolerant plants like foxgloves (*Digitalis purpurea*) and red/white campions (*Silene dioica/latifolia*) occupied the areas that were in shadow for longer parts of the day.

Pond habitats can just as easily be created without having to dig a hole in a lawn or flower bed. to provide some plant diversity and introduce another niche for insects, I also bought a pair of large bucket-like pots and filled them with water to host the aquatic plants lesser spearwort (*Ranunculus flammula*) and brooklime (*Veronicca beccabunga*). The larvae of hoverfly species such as *Myathropa florea* and drone flies (various *Eristalis* species) are aquatic and feed on organic matter in water, which is a habitat the pond buckets provide, with some dead leaves added to provide organic matter. Another simpler and more effective option, in terms of attracting hoverflies, is creating 'hoverfly lagoons', which are essentially pots filled with any dead organic matter and water, with some sticks to provide a means of exit. These are less flashy and require 'topping up' with water if they are unable to be replenished naturally, particularly in summer, but will provide home to many *Eristalis*, *Helophilus* and *Myathropa* hoverfly species.

Figure 2. Orange-tip butterfly caterpillars (*Anthocharis cardamines*) on garlic mustard.

Flowering species like wild garlic (*Allium ursinum*; donated from a friend's garden), lesser celandine (*Ficaria verna*) and garlic mustard (*Alliaria petiolata*) provided an important early source of nectar for early-season bees and flies. Excitingly, the garlic mustard in its sunny spot enticed an orange-tip butterfly (*Anthocharis cardamines*) to lay eggs on the flower heads (Figure 2), giving rise to three caterpillars over the spring and summer. Borage (*Borago officinalis*) grew quickly from seed and was very attractive to bees and the climbing nasturtiums (*Tropaeolum* spp.) provided large flowers for long-tongued bee species such as bumblebees, while the leaves are also a food plant of large and small white butterflies (*Pieris brassicae* and *P. rapae*). The potted meadow grasses with yellow rattle (*Rhinanthus minor*) growing among was also a hit with common carder bees (*Bombus pascuorum*) in particular.

Not only did the wildflowers attract pollinators, but they also provided the niches for them to multiply. With native plants come aphids that arrive by wind and feed upon the sap. Aphids are an important food source to many different species of hoverfly and also some specific solitary wasp species (i.e. those of the *Pemphredon* genus). The previously mentioned garlic mustard and annual wildflowers not only acted as a pollen and nectar source, but also hosted large colonies of aphids which I observed a female *Eupeodes* hoverfly laying eggs among, and later found the larvae. Small, circular holes in the seed heads of the red campions highlighted the presence of caterpillars of the campion moth (*Sideridis rivularis*) which live and feed inside the seed capsule. The micromoth (*Dichrorampha* spp.) was also present among the ox-eye daisies (*Leucanthemum vulgare*), its tiny caterpillars feeding on the roots, while the leaves of the daisies and campions were covered in the mines of various fly species (Agromyzidae family). I have also recently found the caterpillars of large yellow underwing (*Noctua pronuba*) and angle shades

Figure 3. Large yellow underwing caterpillar (*Noctua pronuba*) in one of the grass, yellow rattle and other herb pots. The caterpillars will feed throughout the winter.

Figure 4. Rose chafer (*Cetonia aurata*) among the annual wildflowers.

(*Phlogophora meticulosa*) moths in the planters, feeding on the foliage. These species feed on a range of plants and remain active in winter, rather than spending the cold months buried underground as a pupa like many other moth species.

In the shaded corner I stacked three log rounds in a makeshift shelter, covered with some old pond liner to keep them dry. Log piles/wood stacks provide dry sheltering options for many insects that spend the winter hibernating as adults. In the crawl spaces of the wood I discovered a queen common wasp (*Vespula vulgaris*) and a pair of parasitic wasps (*Ichneumon stramentarius*). Both of these species are pollinators, visiting flowers during their adult stage.

Finally, the two boxes for solitary bees were a great addition to the south-facing wall. I hoped that the flowers would attract bees to visit the boxes later in the summer, but I was very pleased to find red mason bees (*Osmia bicornis*) had moved in before most of the plants had even bloomed. In urban environments naturally occurring nesting sites such as sand/mud banks or deadwood with holes from exiting beetle larvae are not common and thus artificial nest sites like these boxes are very important.

> **“A shift in the attitudes of many individuals can have profound effects. Gardens and allotments have been shown to be an essential resource for pollinators in urban environments.”**

Wider implications

A shift in the attitudes of many individuals can have profound effects. Gardens and allotments have been shown to be an essential resource for pollinators in urban environments (Baldock *et al*. 2019), with some studies even showing that bumblebee numbers

Table 1. Wildlife options for different sized spaces.

Available space	Wildlife options
Balcony/decking area	Pots/trays/raised beds of native plants; wildflowers flowering at different times of the year; shade-tolerant species if sunlight is restricted; small shrubs
	Small tub/bucket ‘pond’ with flowering aquatic plants and some dead organic matter (with a means of exit provided)
	Bee boxes and sheltered log stacks for hibernating insects
Small garden with lawn	Unmown sections of the lawn over spring and summer; ‘wild’ area in a corner, left undisturbed; use of native hedgerow species in place of non-native species
	Small herb garden in a sunny spot
	Log piles and bee boxes on south-facing walls
	Drainpipe-fed ‘wetland’ planter with aquatic plants
Large garden/ community spaces	Wildflower meadow area; species-rich flower beds with year-round flowering species
	Wildlife pond (no ornamental fish) and bog garden
	Native trees and shrubs within hedgerows; orchard-style area of fruiting trees
	Log piles and bee boxes on south-facing walls
Larger developments	Designated wildlife areas, connected to surrounding areas if possible
	Use of native, insect-pollinated hedgerow and tree species used in landscaping
	Green roofs
	A pond (may be necessary to covered or fenced off for safety reasons)
	Drainpipe-fed ‘wetland’ planters
	Raised beds with drought-tolerant flowering species
	Solitary-bee boxes on south-facing walls
	Amenity grassland areas left unmown over spring and summer; mown borders and/or dissecting pathways to give an intentional look; possible use of small informative signs
	Log piles in quieter areas

> **“This approach can easily be translated to larger-scale developments; landscaping options can prioritise native trees and shrubs, amenity areas can be mown less, outer walls can support solitary-bee boxes and logs can be left in a quiet corner.”**

can be higher in domestic gardens than in rural settings (Osborne *et al*. 2008). Even a small urban space can be effective at providing an important habitat for pollinators. One can choose from the options I have set out to suit their individual circumstances, budget and ability.

This approach can just as easily be translated to larger-scale developments; landscaping options can prioritise native trees and shrubs, areas of amenity grassland can be mown less frequently, outer walls can support solitary-bee boxes and logs of any trees lost to development can be left in a quiet corner. With increased contributions comes the ability to support larger initiatives such as Urban Buzz (www.buglife.org.uk/our-work/pollinator-projects/urban-buzz/) and B-Lines (www.buglife.org.uk/our-work/b-lines) created by Buglife to promote the provision of pollinator resources across the UK's towns and cities. Ultimately, the normalisation of such features in commercial or private situations has the potential to be hugely beneficial, bringing a positive shift in the public's attitude towards pollinators and wildlife in general.

Simple interventions to increase invertebrate diversity

While the example I have given revolves around the urban setting of my own wooden decking, the pollinator-friendly suggestions are transferrable to other settings. Table 1 briefly outlines various options available in a range of different situations.

Final remarks

It goes without saying that I appreciate everyone's situation is different, not just financially but also in terms of available space and free time. We all have to work within our means. However, I would emphasise that the only costs in my decking project were a handful of plastic trays, two 'pond buckets', some nails for knocking together the wood, the bee boxes and the annual flower seeds. The pallets were free and the plant pots were give-aways. I borrowed tools for the basic woodwork and sourced all the remaining plants from wild-collected seeds and transplanted plants collected from my parents' garden in Exeter. Home-made bee nests are also easy to make by drilling holes (>10 cm deep) of different diameters into logs/wooden posts.

To conclude, I would like to emphasise the joy this wild space has brought me and others that have visited the flat. Not only has it had a positive effect on the local insects, but it has also brought me great happiness. Seeing wildlife right outside my bedroom window despite living in a city, hearing the buzz of pollinators and smelling the scent of wildflowers is something special. The conversations I've been able to have with people about this project, the questions asked and interest shown by the landlord, painters, roofers and other visitors, not to mention the countless colleagues and friends/family I have shown pictures to, makes me know that small individual efforts can have a big difference.

Acknowledgement

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What Lies Beneath? The Importance of Substrates in Delivering Biodiversity Net Gain

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To achieve meaningful Biodiversity Net Gain ecologists must work with other disciplines to deliver successful outcomes. In this article we draw attention to an overlooked resource that plays a fundamental role in the landscape that is literally under our feet. It underpins many ecological processes, yet it is entirely ignored by the formal Metric. In being silent, the Metric risks practitioners and policy-makers omitting the value that substrates deliver.

Introduction

Biodiversity Net Gain (BNG) is a key pillar in England's nature conservation policy and aims to deliver a 10% net gain in biodiversity post-development. The process is dependent on vegetation cover, which has raised concerns about the lack of consideration of mega-species-rich groups such as invertebrates (e.g. Wilson 2021).

There is a further consideration that underpins and influences biodiversity, which BNG similarly entirely ignores, functionally connecting the vegetation cover (or indeed, lack of it) and the species-rich faunas already mentioned. For BNG to have a chance of succeeding beyond the spreadsheet, understanding the significance and importance of what lies beneath the vegetation blanket of a study or receptor site's enhancement is as important as the proposed higher-scoring habitats, which BNG condition assessments focus on.

We acknowledge that the BNG Metric is not viewed as a panacea that covers all inputs that coalesce a site's ecology, so we present the case that this additional consideration is essential to maximise genuine BNG outcomes. In

considering a site's baseline value, we urge practitioners and policy-makers to pay attention to what lies beneath, to support their objectives of delivering meaningful BNG. We present examples and case studies that illustrate the opportunities that ecologists, working with landscape architects, in close collaboration with developers can and have achieved in delivering novel designs using various substrates to support biodiversity gain. Further, these approaches have a concurrent benefit of reducing a development's carbon footprint, recycling readily available material locally to the site and reducing landfill.

The bare necessities of life

For this article, substrates include native geology such as gravels, sands and tills deposited by past edaphic processes; exposed or degrading made-ground prevalent in many urban environments, notably brownfield sites; and soils. Buried substrates can be exposed by natural processes including the action of burrowing mammals, flood events depositing silts and sands, natural deposition by rivers (exposed riverine sediments) or erosion. In artificial environments, substrates can be exposed through vegetation clearance, habitat management (e.g. ploughing) or deliberate deposition for future human use. However they are exposed, specialist faunas including invertebrates and flora such as annual plants and some bryophytes seek these exposures for breeding, foraging or establishing.

Substrates underpin the vegetation blanket that influences surface biodiversity, but it must not be forgotten that it represents a diverse habitat, supporting little-studied faunas such as earthworms which have recently been reported to have experienced large-scale declines (British Ecological Society 2022).

Substrate abuse?

The Biodiversity Metric 3.1 *Technical Supplement* and *User Guide* (Panks *et al*. 2022a, 2022b) make a single, passing reference to 'substrate' in the context of assessing the condition of a site's baseline habitat. The Urban Habitat Type (Panks *et al*. 2022a, p. 170), under Additional Criterion 4a (only applicable to Open Mosaic on Previously Developed Land habitat type) states that (bold text, our emphasis):

> The site shows spatial variation, forming a mosaic of at least four early successional communities (a) to (h) PLUS **bare substrate** AND pools. (a) annuals; (b) mosses/liverworts; (c) lichens; (d) ruderals; (e) inundation species; (f) open grassland; (g) flower-rich grassland; (h) heathland.

The value of the substrate in this context is that it is denuded of vegetation, but, as stated above, they have value and influence biodiversity even when they are partially or entirely covered. No mention is given to the type of substrate, its properties and to what extent, in this instance, it influences Open Mosaic habitat and, by extension, the fauna (particularly invertebrates) and flora that may be present (see Figure 1). That the substrate's significance is overlooked

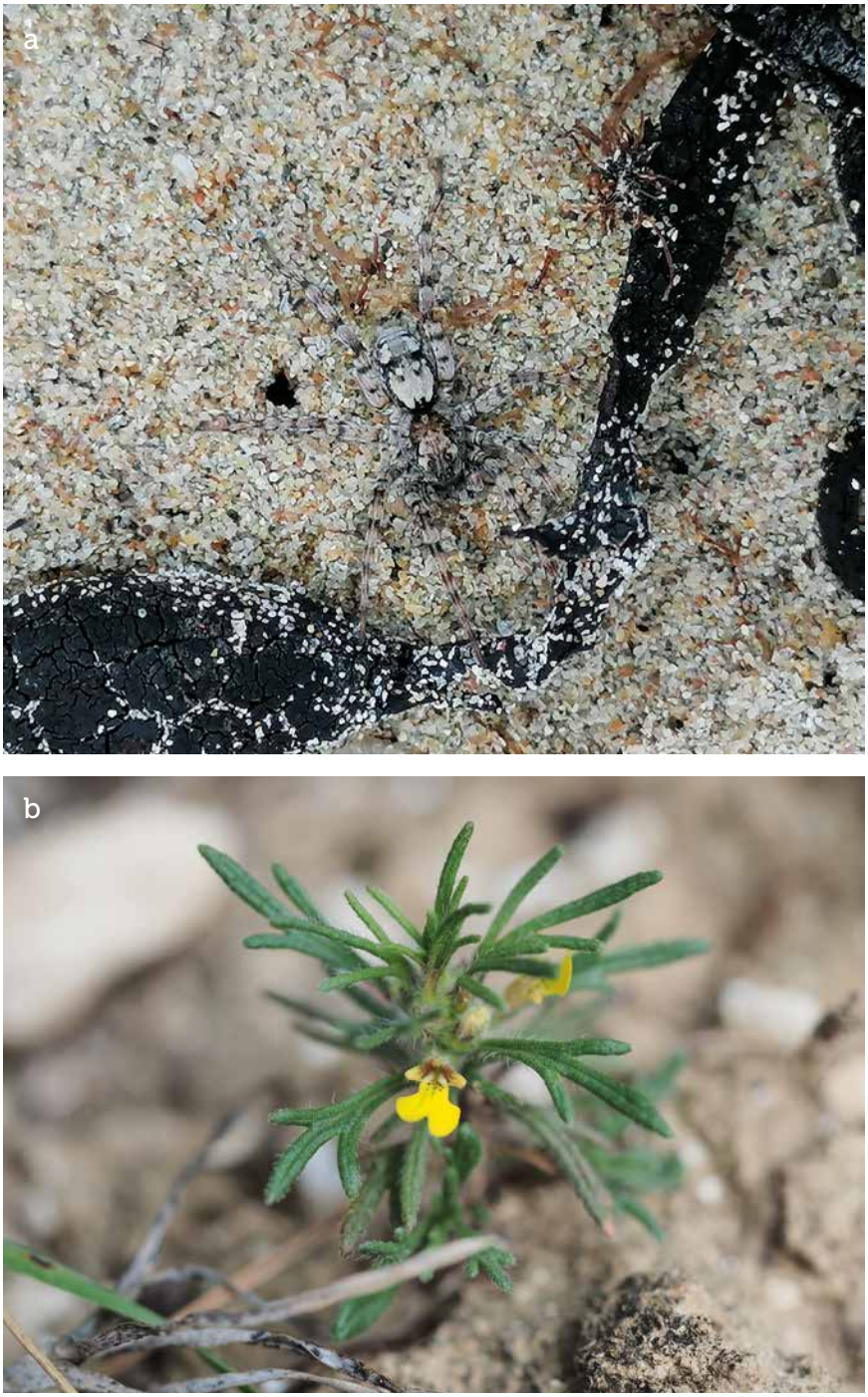

Figure 1. (a) A wolf-spider (*Arctosa perita*). Photo credit: Richard Wilson. (b) Ground-pine (*Ajuga chamaepitys*). Photo credit: Tristan Norton.

Figure 1. (c) Winter stalk-puffball (*Tulostoma brumale*). Photo credit: Brian Eversham.

Table 1. Types of substrate available for use in ecological landscaping.

Substrate type	Description
Crushed concrete type 1/3	Useful substrate; readily available as an alternative to mined granite/limestone type 1. The particle size mix works well, and, if not compacted, drains well. Seeds readily germinate; high pH suits a lot of species associated with open mosaic landscapes.
Crushed ceramic dust from sanitary ware waste	Smaller particle size (8 mm to dust) works well at ground level and on green roofs; free-draining, low-fertility substrate. It act likes horticultural grit. One of the most useful materials in brownfield landscapes.
Thanet sand	A fine sand embedded with some silt/clay; a favourite for a range of ground-nesting bees as the texture ensures nest cavities do not collapse. This sand can be used to form south-facing slopes. By keeping the vegetation down, solitary bees quickly colonise. Using drought-tolerant plants planted towards the apex of the slope ensures the strong capillary action of this fine sand avoids keeping the plants too wet through winter.
Recycled sharp sand	Screened from soils/waste taken off sites that would otherwise go to landfill. Very good substrate for most plants; cheaper than standard sharp sand. It often out-performs this substrate in JL's experience because of its wider particle size enabling moisture retention and some nutrients. A default option for planting, though rarely used by ground-nesting invertebrates. Encourages deep rooting and reduced watering.
Crushed brick and concrete	Wonderful choice, comes in various grades: 10, 20, 50 and 50–100 mm; all clean or with fines. Using 50–100 mm in 'spoil heaps' or in gabions provides niches and voids for a wide range of invertebrates. The material remains unvegetated for longer, creating a long-term bare ground environment for basking (see Case study 1). Using material with fines ensures the clay content from the brick dust retains moisture, in addition to being higher in phosphorus. This invites more competitive forbs and grasses that reduce plant diversity.
Crushed glass	Sold as a recycled alternative to mined sharp sand; inert, safe and low-fertility planting medium. One of the most hostile and stressed substrates available, providing superb opportunities to grow species that don't tolerate competition. Calcicolous plants thrive; though this is a poor medium for ground-nesting invertebrates.

and not signposted is concerning giving the potential to undermine the likelihood of replicating the biodiversity in any habitat restoration. As BNG will be a key policy driver in determining habitat restoration, getting the substrate right, in terms of its make-up, chemistry and installation is a fundamental stage in the process when delivering on the recommendations presented in the BNG report and habitat condition targets. This will be important for ensuring the target habitat is achieved, but also ensuring that the ongoing ecological needs of certain faunas such as aculeate Hymenoptera ('stinging' bees and wasps) and the soil fauna are met.

The remainder of this article expands on the principles such as inter- and intra-habitat complexity in brownfield sites referred to by Jukes (2021) but extending these to other habitats.

The nitty gritty

So how do ecologists utilise substrates to better achieve BNG objectives? Where do they source them? In what form should they be applied and manipulated on site to achieve better results?

Substrates come in various guises (see Table 1). Their physical (e.g. particle size), chemical (base-rich) and hydrological (free-draining or impeding) properties in combination with the topographical heterogeneity and aspect will influence the vegetation blanket and therefore the faunas associated with them. In preparing a habitat management plan that includes substrates, understanding is needed of the surrounding landscape's natural geology by reference to the UK nations' natural or landscape character areas such as Natural England (2014), NatureScot (2022) and Natural Resources Wales (2022). These can guide and help formulate an appropriate substrate management plan (see Box 1).

One of us (John Little) has worked with substrates and landscaping since the late 1990s and has been experimenting with various materials in his Essex garden to inform landscaping that incorporates brownfield sites on a smaller scale into public spaces. In doing so, this helps meet one of the sector's substantial challenges: alleviating the tension between the demand for new housing while meeting biodiversity goals at the local and regional level.

Box 1. The Lincolnshire Coversands

The Lincolnshire Coversands are post-glacial wind-blown sands that extend north into Yorkshire and south to Nottinghamshire. They have given rise to heathlands and acid grasslands, some of which are designated as SSSIs. In the English Midlands and Yorkshire, a waste material associated with former coal-fired power stations forms spoil heaps of variable extent and vegetated cover comprising pulverised fuel ash (PFA), which mimics the native blown sands such as being free-draining, friable and nutrient-poor, thus suppressing vegetation growth. Given their proximity to the blown sands these brownfield sites have recorded high-value invertebrate assemblages, partly because of the high percentage of exposed PFA present in highly heterogenous topographies. Understanding the context of the brownfields' substrate with the natural geology informs the need for survey, helps explain their value and, importantly, underpins the mitigation design. Simply providing flower-rich swards on a uniform top soil, while scoring highly in the Metric, would fail to replicate the site's baseline substrate.

Construction waste and sands are user-friendly materials as they are already graded and sorted for the building industry, but in this instance they are being used in a novel way, mimicking brownfield sites in Essex. However, this principle can be readily extended to sites beyond the east Thames corridor (Harvey 2000), for example where there are natural geologies with free-draining soils such as on chalk or limestone; sandstones or mudstones.

Table 1 provides some examples of substrates that can be applied in ecological landscaping, offering a range of textures and aesthetics. In ecological terms they benefit biodiversity and have differing drainage and nutrient levels. Importantly, there is a very minimal seed bank, a substantial advantage as direct seed sowing is possible immediately the substrate is put down. No preparation is required before the seeds are sown. This reduces costs (no top soil or fertilisers required) and direct sown landscapes require no pots or compost, reducing bespoke transport and with very low carbon release. Further, seed can be sourced locally via green hay and there is no demand to import from continental horticultural nurseries, avoiding accidentally bringing in plant pathogens and non-native invertebrates. This is a truly sustainable way to create new landscapes.

The effect of the base soil beneath has a huge impact on the way each substrate performs. There is a movement of nutrients from the base soil into the new substrates that happens very quickly, often within a year. We still don't understand this process but are guessing it could be pioneer mycorrhizas moving into the new material or maybe simply a process of diffusion. Therefore, a barrier may be necessary to prevent the capillary action, depending on the depth of material installed. A geotextile barrier seems to have little impact on nutrient transfer and is only used to subdue any very aggressive species already on site.

All substrates listed in the Case study examples come from a certified source, such as from a local recycling plant 4 km from the receptor site in Case study 1. It is important to ensure substrates are safe for the site.

Case study 1. Essex Wildlife Trust car park and new visitor centre (summer 2020)

The brief was to design and create biodiversity-friendly landscaping in Langdon Nature Reserve's car park with a budget of £40,000. A decision was made to replicate a brownfield site environment which aesthetically complemented the harder landscaping, contrasting with the reserve's habitats and thereby enhancing biodiversity.

Gabion baskets formed the main structure which defined the parking bays, provided a retaining wall for the new substrates and importantly, acted as a vessel to create nesting and

Figure 2. Invertebrate-friendly landscaping at Essex Wildlife Trust car park using various substrates. (a) Gabion baskets before sand. (b) Sands and substrates behind gabion. (c) Flower-rich grassland. Photo credits: John Little.

hibernation for invertebrates and mammals. Rather than mined gabion stone, often transported many miles to the site, 75–150 mm crushed demolition waste was sourced from within 4 km of the site. Eight of the planned 150 parking bays were replaced with steel boxes of equivalent dimensions and filled with a mix of construction waste and local sand. These were planted and seeded with taxa that require minimal watering. A bee post was added to give space to aerial nesting solitary bees.

The rear of the perimeter gabions was backfilled with sands sourced from the nearby A13 road-widening scheme which provided the ideal weed-free, low-fertility substrate to take the native seed mix. The sand also had the advantage of providing nesting habitat for many local bees and wasps, especially as we added the topography to ensure plenty of warm, south-facing slopes.

A sterile car park was transformed into a bespoke high-value ecological landscape delivering BNG using locally sourced waste materials without compromising the aesthetic.

“Rather than mined gabion stone, often transported many miles to the site, 75–150 mm crushed demolition waste was sourced from within 4 km of the site.”

Case study 2. Trent corridor, Nottinghamshire (summer 2022)

Invertebrate surveys within an existing energy facility were undertaken on a 5 ha elevated platform of made ground that included a raised mound comprised of pulverised fuel ash (PFA)-rich soils, partially exposed by the actions of rabbits and badgers.

Botanically, the land parcel was unremarkable, comprising immature plantation woodland and a flower-rich sward, sown around a decade earlier. However, the invertebrate assemblage supported three Priority species: *Carabus monilis* (necklace ground beetle), *Bembidion quadripustulatum* (scarce four-dot pin-palp beetle) and *Odynerus melanocephalus* (black-headed mason-wasp) in addition to several other Nationally Scarce taxa. All the priority species are dependent on exposed free-draining substrates for breeding.

The elevated platform's heightened invertebrate interest belies the small area within which it is located. Its value is explained by the energy facility's context with the wider resource available in the ecological landscape, including its connectivity with the native geology exposed in sand quarries and natural exposures of the Lincolnshire Coversands.

In designing within-site mitigation, the importance of the substrate, its properties mimicking the wider natural geology and its position in the landscape as a stepping stone site was positively acknowledged by the client, enabling bespoke croissant-shaped mounds to be constructed using the PFA resource to ensure the continued availability and function of this important feature.

The key ingredient that must be absent is soil. The introduction of this medium, richer in nutrients and with a seed bank likely to include competitor species, such as coarse grasses and broad-leaved dicots such as nettles, docks and willowherbs, will potentially result in these taxa rapidly outcompeting the desired community.

Conclusion

If asked, ecologists know that what lies beneath the vegetation blanket is important, but many schemes rely on the age-old application of top soil to establish a repetitive planting scheme recognisable across the UK. Clever use of substrates, using novel techniques, offers ecologists and landscape architects an opportunity to deliver on BNG, supporting the Metric's objectives alongside evidence obtained from, for example, invertebrate surveys.

Identifying this opportunity is potentially arriving concurrently with emerging national policy on improving the built environment in that it could provide an immediate and beneficial solution, addressing Michael Gove's concerns expressed in the foreword to the Policy Exchange's paper, *A School of Place* (Ijeh 2022). In this paper, Gove writes, "How often have we seen what would otherwise be good housing developments let down by poor landscaping or indifferent or insipid urban character?" As ecologists, we can point to what lies beneath as a means to transform the insipid to the inspiring, and the indifferent to the exceptional.

About the Authors

Richard Wilson CEnv, MCIEEM specialises in invertebrate ecology, working with a range of clients throughout Britain, providing bespoke invertebrate survey work, and sits on the Yorkshire CIEEM Committee. He has a particular interest in arachnids, aculeate Hymenoptera and some Diptera; and acts as the spider recorder for Yorkshire, County Durham and Northumberland for the national Spider Recording Scheme.

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John Little started the Grass Roof Company in 1998 and has designed and built over 300 small green-roof buildings. At Clapton Park estate, Hackney, he produced a sustainable grounds maintenance contract that puts people first. In 2008 he launched a range of small green roof shelters based on shipping containers and designed portable structures including bike and bin storage.

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Suggested websites

https://riosoils.co.uk/products/aggregates-concretes

https://soilsandstone.co.uk/recycled-aggregates/recycled-sub-base/

Spotlight on CIEEM Registered Practices

The commitments made by our Registered Practices include following the principles of our Good Working Practices guidance (https://cieem.net/resource/good-practice-guidance-for-habitats-and-species/) by supporting staff professional development, managing workloads effectively and providing a healthy and supportive working environment.

We feel that it is important that, if we are holding up our Registered Practices as being good employers, we ought to be checking that they are, so towards the end of last year we introduced a new working practices auditing scheme for all Registered Practices with three or more employees.

The audit

The audit consists of a short online survey to all eligible staff, with responses and comments being anonymised. We are not auditing every Registered Practice every year but aim to audit between a half and a third of those with three or more employees each year. The surveys are run through late summer and the autumn to give employees as long as possible to respond.

Employees are invited to comment on how well their employer:

a. supports their training and development
b. supports their health, safety and well-being, and
c. manages their working hours (or provides flexibility for individuals to manage their own working hours) to enable them to perform effectively.

Finally, employees were asked whether they would recommend their employer to another ecologist or environmental manager and, if so, at what career stage(s).

Employees were asked to give ratings of between 0 and 100 on a sliding scale for each area (a)–(c) as well as having the opportunity to provide specific examples or comments to illustrate their feedback. A guarantee of anonymity was important to facilitate honest feedback.

The results are in

This year we audited 31 Registered Practices with three or more employees. We were very pleased and proud of the results!

To get a 'green' overall rating the average score for each of the categories above had to be 70 or more. Twenty-nine Registered Practices did so, with most of them scoring in the 80s and 90s across all of the categories. One was judged as not completing the audit because insufficient employees took part and one company was just below the 70% threshold for one category so had an 'amber' rating. Both of these companies will be audited again this year along with other Registered Practices that were not audited in 2022.

There were some great comments from many of the respondents as well:

- *"A friendly, compassionate company who value me and my work."*
- *"It's a great company that [is] very supportive of career progression."*
- *"A genuine and caring employer."*
- *"Best ecology company I have ever worked for."*
- *"A great team of people and you really do feel respected, appreciated and supported."*

So, take a bow, 'green' Registered Practices. But please remember that not all Registered Practices were audited this time, so not being shown here does not mean that they are not good employers – it will be their turn next time.

Registered Practices eligibility

Please note that there has been a recent amendment to the eligibility criteria for Registered Practices in that the threshold for the requirement for relevant staff to be members or member applicants of CIEEM has been reduced from 90% to 80%. This is to acknowledge that, in some organisations, staff eligible for membership of CIEEM may already be members of other environmental professional bodies and it would not be fair to expect them to join two or to transfer. Accordingly, an organisation is eligible to apply for registration as a Registered Practice if at least 80% of relevant staff are members or member applicants of CIEEM and the remainder are members of one of the following:

- a licensed body of the Society for the Environment
- Landscape Institute
- Institute of Agriculture and Horticulture.

If you would like to find out more about the Registered Practices scheme please visit https://cieem.net/i-am/registered-practices/

Ethical Dilemmas

This is our series of problems and conundrums that can face members during their professional practice. The purpose of the feature is to encourage you to reflect on and explore scenarios that you may face during the course of your work and to consider the appropriate ways to respond to ensure compliance with the *Code of Professional Conduct*.

In the December 2022 issue of *In Practice* we described a situation where, as a level 2 Bat licence holder, you are commissioned by a person renovating a barn into a new home for his family to undertake a bat survey of the premises. He has been told of the requirement by the council. You are sent photos of the premises in the tender process. The client accepts the tender but states there is no wildlife within the premises.

On arrival with a colleague, you meet the owner's partner. On looking at the barn you see immediately that it is likely to need further bat surveys as there are key features evident.

You then complete the inspection with your colleague and conclude that the building has moderate potential to support roosting bats due to gaps beneath lots of the roofing tiles, a small number of gaps leading behind the wooden boarding below the roofing overhang and missing mortar on a hip tile. These features all provide opportunities to crevice-dwelling bat species.

The next day you write to the owner informing them of this. He responds by stating that he no longer wishes to employ you and will only pay for the fieldwork element and that he thinks that the stated potential for bats is simply a ruse to take more money from him.

We asked how you would respond to this. How might you have dealt with this client differently? What is the professional approach to ensure that appropriate surveys are indeed undertaken of the premises?

Our thoughts

This is a challenging situation. The forceful nature of the client's response means that it is unlikely that their 'buy in' to the process can be achieved, although there is no actual evidence to support the client's claim of a ruse to make money. Nevertheless, consideration should be given as to whether a phone call to the client to try to explain further and reassure may be a way forward, and whether this could be undertaken with the support of a senior colleague/member of staff. Notes should be kept of any conversation for potential review and use in the future.

Integrity is key to the work we undertake, and trust is paramount. There are instances where an inexperienced client may have a predetermined view of your work and your motivations and, ultimately, you may not be able to influence that. However, it is important to remain professional and calm, and to respond factually and impartially, even when challenged. You may wish to consider a written (as opposed to verbal) response and involve a senior colleague or independent member of staff in reviewing that response (adding their

signature to it, where necessary). The response should include a firm rebuttal to suggestions of unprofessional conduct and reference the levels of competency, training and qualifications (including licences held) that make you suitably experienced for the tasks carried out.

How might you have dealt with this client differently?

Although it is perfectly reasonable to make an early judgement of a building/structure, you should consider the potential response of the client to such an assessment before conveying it to them. Regardless of your motivation, an immediate assessment may be viewed with cynicism and, in most cases, it makes more sense to keep your initial thoughts to yourself, or at least temper these, until you have had a chance to reflect further and you can explain the full (evidence-based) conclusions in more detail. It may be helpful to talk a colleague through your reasoning (on site, at the time, where possible) to obtain a different perspective.

If the client is present, spending a little longer on site and explaining its potential for bats (patiently, in simple terms, where needed) should alleviate any adverse reaction to the conclusions drawn. Observing their behaviours and listening to comments made can be of benefit in judging your own responses and the way in which you share information. If you sense doubts, then consider asking the client about this. Try to put yourself in their shoes; a small developer may have a huge amount riding on the results of your assessment and it may require spending a little longer on site and/or in your responses than originally planned.

What is the professional approach to ensure that appropriate surveys are indeed undertaken of the premises?

There is little that can be done if the client does not want you to pursue the work further. However, you still have a responsibility to ensure that an offence does not occur. You may wish to consider whether you would be happy to recommend another experienced professional (someone that you have worked with previously and trust), to give the option of a second opinion or as an alternative to take the work forward.

The local records centre should be informed of any clear evidence of bats found at the site, and consideration should be given to informing the local planning authority ecologist of the circumstances under which you ceased working on the project. Informing the local bat group is also worthy of consideration if the response of the client remains unreasonable, aggressive and/or dismissive and you feel that it is likely that an offence may or will take place. However, such measures should only really be progressed once all other options and attempts to resolve the relationship have been exhausted first.

The next dilemma

You are a senior ecologist in a medium-sized regional consultancy specialising in bats. You have been doing bat work for years and as such you have established links with the local and national bat community. You have good links with several local councils and your name is provided as a reliable bat contact. Outside work, you organise research-orientated surveys for several county bat groups and have verbal approval by your line manager to assist several friends who undertake commercial surveys for their much smaller consultancies. This is seen to be a good thing for both you and your employer building on your existing skills and learning new techniques.

One of your friends calls to ask for assistance on a bat survey at very short notice. She is really stuck and she needs at least one surveyor. The survey was one part of a series of surveys so had to occur as planned. You have a free night and you agree to help. When you arrive, it is suggested that, due to your experience, you can lead the survey on the night – to which you agree. The site is a large redundant water treatment centre and although survey locations have been identified and provided to you, you wondered about why more surveyors were not being used.

The survey was fine and no bat roosts were found in the buildings on the site. A few days later, following a quick catch-up with your friend, it was agreed that your name would be included in the report as the survey lead. You also agreed to receive a small payment to cover your travel. It was also mentioned that, due to confidentiality, you will not be provided with the report, but the report will be available on the planning portal once the planning application has been submitted.

Six months later you learn that the bat survey report had been rejected by the local planning authority. Apparently, the survey that you led did not have enough surveyors and survey data were missing from several survey points. In addition, the site needed further and more in-depth surveys which were not undertaken. You feel that these were survey design and management issues and not your responsibility. The planning application was withdrawn due to issues with the bat report.

Concerned, you immediately go to the planning portal but the application documents are no longer available. However, the applicant's name has been left on the planning portal and it is a major national house builder who are your consultancy's main client and who you manage projects for. An internet search shows that the bat survey that you led was undertaken for a small local development company who then sold the site to the major national house builder soon after the bat survey was completed. You immediately contact your line manager to discuss the issue and learn that the major national house builder has recently organised an unexpected commercial meeting with your consultancy's owners regarding the professionalism of their ecologists.

What needs to be done now and what are the learning points?

New to the Team

CIEEM welcomes Dr Mark Nason MCIEEM as Head of Professional Practice

I am thrilled to be joining CIEEM at what is a pivotal moment for UK ecology and environmental management. Our sector plays a leading role in addressing the climate change and biodiversity crises, and CIEEM is here to make sure that members are empowered to protect and restore nature. This means providing clear and up-to-date guidance, respected and fit-for-purpose competency frameworks and joined-up training opportunities that meet current and future needs of practitioners.

I've always been passionate about nature, and at the age of 3 or 4, my earliest memory is of admonishing my friends for confusing mites with spiders. I did my ecology degree at Bangor University in the mid-1990s, and have worked in environmental research and education for 23 years, starting with a PhD and two research posts creating habitats at post-industrial sites. Since then I have tried hard to improve equity of access to, success in and progression from further and higher education. I am most proud of the number of people that I've helped to support into rewarding careers, either through mentoring or by creating accessible training. I'm a qualified teacher and have written and introduced new environmental access courses, undergraduate and postgraduate degrees, and apprenticeships.

Alongside my role in education I have managed restoration and research projects and undertaken consultancy. I champion professional standards in education as a Committee Member of the Quality Assurance Agency, and in the environmental sector as a Committee Member of the Society for Ecological Restoration and as an Ordinary Council member of the British Society of Soil Science. I feel that my career to date has given me a broad and general understanding of ecology, with specialist knowledge and experience of the principles and practice of ecological restoration and plant–soil–microbe interactions.

I'm very lucky to live on the north Cornwall coast with my wife Joceline and our four children. I enjoy walking the dogs on the coast path, and less well-trodden paths inland, and I play cornet with my eldest daughter in our village's silver band.

My job is to support and challenge CIEEM members to be ambitious for themselves and for nature. As Head of Professional Practice, I will be working in the CIEEM team to promote the highest standards of practice for the benefit of nature and society, and doing my very best to ensure that ecology is a rewarding and inclusive sector to work in.

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Embracing Neurodiversity

Lea Nightingale
(she/her)
EDI Engagement Officer, CIEEM

The week of 13–19 March is Neurodiversity Celebration Week – a worldwide initiative that challenges stereotypes and misconceptions about neurodiversity. What is neurodiversity, how does it challenge and shape the neurodiverse, and how does it affect our abilities and the way we approach work? Here I share my experiences in this 10-minute read.

Neurodiversity is the term that describes the idea that there is naturally occurring variation in the human brain which can impact a series of brain functions such as how we interact with one another or how we process information. Whilst statistics vary, scientists suggest that 15–20% of us show some form of neurodivergence – and that many of us don't even realise we are neurodivergent!

"Neurodiversity may be every bit as crucial for the human race as biodiversity is for life in general." – Harvey Blume, *The Atlantic*, 1998 (the first recorded use of 'neurodiversity' in print)

My neurodivergent abilities began to present during childhood. I was, and still am, an avid reader but I found my 'reading speed' was slower compared to my peers as I struggled to keep my eyes from jumping around the page. I really struggled to focus on written tasks and would procrastinate because I was so anxious of 'getting things wrong'. The classic comment at my parent/teacher evenings was always: *"Lea's a really bright child, if only she'd apply herself more!"* I hated these comments because I really felt like I was applying myself, just not in a way that one could see in my grades. In place of progressing with my written assignments I would hyper-fixate on one topic, often cornering unsuspecting teachers and giving them random 'info dumps' on topics totally tangential to what we were covering in class. After one of these info dumps an incredibly supportive teacher suggested I visited the school's Learning Support Team to talk over some of the 'issues' I was experiencing and thus after several tests they concluded that I have dyslexia. As a result, I was then given extra support in class and extra time in my exams – what we would today call reasonable adjustments.

Neurodiverse versus neurodivergent

Neurodiversity: describes the range of neurological differences in human brains.

Neurodivergence: a person's atypical neurological state, and development.

Neurodiverse: a group of people who are neurodivergent. Simply put, a group of people are neurodiverse; an individual is not. As individuals, we are neurodivergent or neurotypical.

Neurodivergence is a **spectrum**, not a **scale**. It takes different forms and covers a range of conditions dependant on the individual. These forms include:

- **Applied neurodiversity** (e.g. dyslexia, dyspraxia, dyscalculia, dysgraphia and dysnomia)
- **Clinical neurodiversity** (e.g. autism, ADHD and Tourette's)
- **Acquired neurodiversity** (e.g. traumatic brain injury, mental-health conditions, post-stroke cognitive and communication difficulties, dementia and long COVID).

In my early 20s my acquired neurodivergence began to present, which amplified my applied neurodivergent traits. For me this has been the most challenging part of understanding and coping with my neurodiversity. I have Generalised Anxiety Disorder (GAD) and when this flares up, it is like a fog descends and all of the mechanisms I have put in place to support myself go out the window. Even very simple tasks like focusing on a TV show or reading a recipe to make supper become really challenging. It has been fascinating to hear people talk about 'COVID brain fog' because this is exactly what my 'GAD fog' feels like. It is interesting to see more long COVID conditions now being recognised as forms of acquired neurodivergence!

Identifying strengths

Despite these challenges I see many strengths in my neurodivergence. Neurodivergent skills can bring out-of-the-box thinking, offering new opportunities and fresh perspectives. Neurodivergent minds can be questioning; some have extraordinary pattern-spotting or problem-solving skills, whilst others have incredible recall for facts, details and distant memories. Diverse perspectives – in every sense – can rebalance a task, project, team, organisation or community.

Whoever and wherever you are, and whatever age, you will have developed skills and mechanisms to support yourself in a neurotypical world. It is important to identify your strengths and ensure that your coping mechanisms do not suppress or mask your neurodivergent abilities. I believe research is so vital here. Asking trusted acquaintances for support, and finding people with similar traits can be incredibly empowering. No two people have identical experiences but if you ask, they may offer you new perspectives on your neurodivergence and help identify your strengths.

It's useful to work out what environments serve you best; for

Inclusive teams

For decades, workplaces and teams have been developed around neurotypical thinking. Here are some practical ways to support neurodiversity in your teams and organisation:

- Provide or attend training to understand neurodiversity, wider diversity and unconscious bias.
- Challenge negative conversations; it is not the sole responsibility of neurodivergent individuals to confront unhelpful comments and behaviours.
- Get to know the sunflower lanyard; it's a discreet signal that people with neurodivergent abilities – and others – wear to indicate they may need additional support, help, space or time.
- Support confidentiality around an individual's neurodivergence, they may have disclosed this information in confidence – if in doubt it's always best to check! Respect your colleagues' needs, whether or not they disclose their neurodivergent abilities.
- Pay attention to the language that people use about themselves and try to mirror it wherever possible. If in doubt, ask what terms people use and which they prefer to avoid.
- Take a sensitive approach using person-first language; people have neurodivergent abilities, they are not 'neurodivergent people'. Avoid phrases such as *"everyone's on the spectrum", "everyone has neurodivergent traits"* or *"you don't seem neurodivergent"*. These can undermine an individual's experience or play down their personal challenges.

Be prepared to accommodate your colleagues, by:

- Providing an accessible list of reasonable adjustments that your organisation offers, especially when recruiting, and offer to discuss additional adjustments.
- Communicate flexibly; perhaps discuss tasks verbally and follow up with a clear email.
- Share an agenda before you meet to give people time to prepare themselves.
- Be inclusive; set up meetings with audio captions or record them for people to watch again to absorb what you've discussed.

Spread the word about Access to Work and similar schemes. The more people know about support, the easier it is for people to apply for it.

And finally, whether you are neurodivergent or neurotypical, learn what your colleagues need and offer them kindness and support.

example, do you work best in the office or from home? Consider and record what you find unhelpful – such as noise, bright lights or dress codes. Make notes about what you experience, what happens around you, and when. It's all too easy to invalidate your own experiences when you stand outside them. By recording what you need and what is unhelpful you can work with your colleagues to agree reasonable adjustments at work.

In the UK, the government-funded Access to Work initiative helps people with mental health and physical disabilities or challenges to find and stay in work. There are also a range of funding and support schemes in Ireland which offer practical assistance to people at all career stages.

Supporting others

Embracing neurodiversity reduces stigma and encourages a better and more inclusive workplace and world for everyone. If someone asks for support with their neurodivergent abilities, they have probably fought uncertainty for years. These conversations can be emotive, so support your colleague by finding an environment that makes them comfortable, and give them your full attention. Understand that they may be speaking to you in confidence and may not want you to share this with anyone else. If in doubt, ask.

Under the Equality Act 2010, people do not need a formal diagnosis to ask for reasonable adjustments within the workplace. Adjustments will vary by the neurodivergent abilities and requirements of the individual, as well as by workplace and work type.

If you're unsure about how to support the person who approaches you, listen carefully, then work with them to offer support. Do your own research. Be there for that person by following up the conversation, support them in devising a plan to seek the assistance they need, or to connect with someone who knows more about the topic. Access to Work and similar schemes provide advice and training to applicants, their teams, and the wider workplace.

This article was written with the support of Emily Clarke (CIEEM's Early Career Professional), and is written using our personal experience and knowledge. I hope this article empowers you to seek or provide support. Together we can create an environment to allow everyone to flourish because of their abilities, not in spite of them.

I'll end with an appeal, September's edition of *In Practice* will be focused on 'Diversity, Accessibility and Capacity in the Sector'. This issue will explore the people element of our profession. We welcome article submissions on improving diversity and inclusion in the sector, removing barriers to enter the profession and creating new routes into the sector, addressing capacity issues and skills shortages in the sector, and improving the status and standing of the profession. The deadline for submissions will be 19 May 2023.

Find out more

Access To Work: www.gov.uk/access-to-work

British Dyslexia Association: www.bdadyslexia.org.uk

Mind: www.mind.org.uk

National Autistic Society: www.autism.org.uk

About the Author

Lea is CIEEM's Equality, Diversity and Inclusion Engagement Officer. She combines this part-time role with her role as Assistant Environmental Analyst and BREEAM Infrastructure Assessor with JBA Consulting. Contact Lea at: leanightingale@cieem.net

Let's Talk About Training

Krystie Hamilton
Professional Development Coordinator, CIEEM

The CIEEM training programme offers around 120 courses each year, covering a range of topics for members and non-members from beginner to advanced level.

The programme provides a great opportunity to undertake structured continuing professional development (CPD) to help you maintain and improve your knowledge and skills, and develop the personal qualities required in your professional life.

To deliver these courses, CIEEM is proud to work with some of the most well respected trainers in the sector who have specialist skills and expert knowledge.

We would like to introduce you to some of our trainers below and the courses that they deliver:

Carlos Abrahams MCIEEM
– Baker Consultants

Carlos has over 25 years' experience as an ecologist and environmental manager, including work with public and private sector clients on a diverse range of high-profile projects. This has involved ecological survey, environmental impact assessment, design and implementation of mitigation measures and practical site management.

Carlos' key areas of expertise are in bioacoustics and wetland creation/ management. He has carried out research on habitat selection by wetland invertebrates, the landscape ecology of amphibian communities, the vegetation communities of reservoir drawdown zones, and the use of acoustics for biodiversity assessment.

Dr Katie Pollard BSc MSc PhD MCIEEM
– KP Ecology

Katie has been an ecologist for over 25 years. She worked at Dorset County Council for 10 years in the Natural Environment Team and started working as a freelance consultant in 2011. Although she has been involved in many different types of projects over the years, working with a variety of organisations, she now specialises in small-scale projects involving bats and barn owls. Her work mostly covers surveys of listed buildings, agricultural buildings and small householder projects such as loft conversions and extensions. She is an active member of Dorset Bat Group and is their current training officer. Katie delivers courses on: 'Introduction to Bat Ecology and Bat Surveys' as well as 'Bats: Assessing the Impact of Development on Bats, Mitigation & Enhancement'.

George F. Smith PhD CEcol MCIEEM – Blackthorn Ecology

George is a plant ecologist with extensive experience in habitat survey and mapping. His main areas of interest are peatlands, forests, restoration ecology and bryology. He is the lead author of the Heritage Council's *Best Practice Guidance for Habitat Survey and Mapping*. George routinely uses GIS and mobile GIS apps for collecting, managing, analysing and presenting habitat survey data. He has provided CIEEM training courses in QGIS since 2013. George delivers courses on: 'Beginners QGIS for Ecologists and Conservation Practitioners (Ireland)' and 'Intermediate QGIS for Ecologists and Environmental Practitioners (Ireland)'.

Dr Julia Baker CEnv MCIEEM – Mott MacDonald

Julia has designed and delivered Biodiversity Net Gain (BNG) on a variety of infrastructure developments including highways, railways, housing and power infrastructure. Here, Julia's work has included both the design and construction phases of BNG, as well as engaging clients and stakeholders on BNG. Julia is the lead author of the UK's *Good Practice Principle*s for BNG and co-author of the accompanying practical guide. Julia also chaired the first British Standard on BNG and is a Visiting Researcher at Oxford University. Julia leads on the Biodiversity Metric training at CIEEM.

Would you like to join the training team?

Do you have a course to deliver?

We are also keen to expand the training programme to include new courses, so if you have a course that you would like to deliver or some ideas, then do contact us to discuss further.

There are several benefits of being a trainer with us:

- Promotion of your training course to over 7000 members – great exposure to build new connections across the sector.
- All course admin, including bookings and liaising with delegates, is managed by CIEEM.
- Opportunities to work collaboratively with other trainers.
- Being part of the trainer community – including the trainer forum to share best practice, network and input into the training programme.
- Playing an active role in developing the skills and understanding of practitioners across the profession.
- Develop your own CPD and skills.

If you are interested in becoming a trainer or have a course that you would like to deliver with us, then please do get in touch via email at training@ciem.net for further details.

Upcoming courses

Some upcoming training highlights over the next few months:

- **'Peregrine Falcon: Ecology, Survey and Mitigation' (10:00–17:00, 19 April) in Birmingham.**
  Using a combination of presentations, case studies and field work, participants will see a number of mitigation projects and gain an understanding of the legislative framework surrounding the species. The aim of the course is to provide participants with the skills to undertake competent surveys, produce relevant and rational reports in line with national guidelines, and to advise on developments in respect of ecological constraints and mitigation measures. The trainer for this course is Dr Stefan Bodnar BSc PhD CIEEM.
- **'Identifying and Managing Non-Native Invasive Plant Species' (10:00–13:00, 19 & 20 April) Online.**
  Delivered by Chris Toop MCIEEM, this training course will provide an introduction detailing what non-native, invasive and invasive non-native species (INNS) are and why they may be a problem, before then moving onto legislation listing INNS and the control of INNS across the British Isles. The course will focus on 10 'common' species, including the 'big three' (giant hogweed, Himalayan/Indian balsam and Japanese knotweed), aquatics (*Azolla, Crassula* and the *Elodeas*) and others, including cotoneasters, Japanese rose, montbretia and rhododendron. For each taxon, the course will discuss their ecology and dispersal, survey techniques, sources of up-to-date information, reporting and devising mitigation measures. Finally the course will examine where to find out more about control measures, proposing on-site mitigation, writing and implementing management plans, and associated control measures on active sites.
- **'Phase 1 Habitat Survey' (09:30–17:00, 20 & 21 April) in Scotland.**
  This course is aimed at consultants, botanists and ecologists involved in the conservation, surveying and classification of habitats in Scotland. The 2 days of training provide an introduction to vegetation identification to identify the characteristics of main Phase 1 habitats during the winter months and plan surveys for the following summer season. This will involve excursions (weather permitting) to a range of habitats within the JNCC Phase 1 habitat survey system. Methods for appraisal for ecological habitat assessment in relation to land management will be discussed. Adrian Davis MCIEEM leads the course and has over 30 years' experience in Phase 1 habitat survey from initial Phase 1 surveys of Lancashire and Fife.
- **'Breeding Bird Surveys and Checks' (09:30–16:30, 9 May) in Hereford.**
  The course aims to provide a baseline for breeding bird surveys and checks on sites. It will cover the relevant legislation and its interpretation and definitions; how this translates into practice, site inspections and approaches; a review of species and habitats that are commonly encountered; understanding of breeding cycles and seasonal timing; what constitutes disturbance and Schedule 1 species. The course will also look at exemptions, licensing, enforcement, reporting and non-licensed method statements. The trainer for this course is Dr Stefan Bodnar BSc PhD MCIEEM.

To view a full list of training courses we have to offer visit: www.cieem.net/events

Policy Activities Update

Douglas Lewns
Policy Officer, CIEEM

Overall update

Since our last update there have been a number of new announcements by the UK Government, including new legally binding targets for protecting the environment, the publication of a Great Britain-wide Plant Biosecurity Strategy and the second Environmental Improvement Plan (EIP23).

As well as these new announcements, the UK Government has rejected amendments to the Retained EU Law (Revocation and Reform) Bill which sought to ensure environmental rules were protected from powers within the Bill. There has been continued backlash against this Bill across the environmental sector, as well as from the Governments of the devolved nations, as the Bill infringes on legislations within the competence of the devolved countries. CIEEM continues to work with partners and independently to rebut the Bill.

On a more promising note, December 2022 saw the signing of the Kunming-Montreal Global Biodiversity Framework at the UN Biodiversity Conference, COP15. This a landmark agreement, setting out four main goals for achieving an 'ecological civilisation' by 2050 and 23 targets for immediate action to be completed by 2030. These targets range from biodiversity-focused commitments such as restoring 30% of degraded land to providing tools to actually implement the four goals, like providing financial assistance and ensuring that indigenous peoples are fully represented throughout.

UK and England

Our policy team and volunteers have been busy as ever and at the start of the year we responded to the draft guidance for the Biodiversity Gain Requirements (Irreplaceable Habitats) Regulations as well as the Office for Environmental Protection's consultation on Environmental Assessment Regimes. We are now in the process of responding to two consultations from the Department for Levelling up, Housing and Communities, the National Planning Policy Framework (NPPF) and the Levelling up and Regeneration Bill: Reforms to National Planning Policy.

We have continued to rebut the Retained EU Law Bill, and, through our membership of Wildlife and Countryside link have been able to amplify our voice alongside other environmental organisations to emphasise the damage this law could do to nature within the UK.

In January, we collaborated with Kew Gardens to hold an event for the All-Party Parliamentary Group for Nature (APPG for Nature) on the outcomes of COP15. We discussed the importance of the new Biodiversity Framework, focusing on how it will affect the UK, and what the UK Government needs to do to meet the targets set out in the agreement. A report from the event is due out shortly.

Scotland

Our Scotland Policy Group have been continuing to keep pace with the many consultations being sent their way, and since the last update have responded to two more consultations from NatureScot, on the Future for National Parks in Scotland and the Plant Biodiversity Strategy for Scotland.

The Group is currently in the process of responding to the Scottish Government's consultation on its Highly Protected Marine Areas (HMPAs), and are using their expertise to ensure that the right policies are in place to provide high levels of protection to marine ecosystems.

Wales

In November 2022, the Wales Policy Group submitted their response to the Sustainable Farming Scheme survey, and, through our membership of Wales Environment Link, have responded to two consultations from Welsh Government, the first being the Agriculture (Wales) Bill and the second a Just Transition to Net Zero Wales, emphasising the importance of Green Jobs for Nature and nature-based solutions.

Members of the Wales Policy Group are now examining the further amendments to *Technical Advice Note (TAN) 15: Development, flooding and coastal erosion* to evaluate if there are any areas where we can contribute to the consultation.

Ireland

In January 2023, the Ireland Policy Group responded to the Republic of Ireland's consultation on the Draft Arterial Drainage Maintenance Activities 2022–2027 and the associated SEA Environmental Report and AA Natura Impact Statement Report.

The group is currently considering its responses to a number of open consultations, including the Public Consultation on Wild Birds Declarations, the Sustainable Development Goals: Voluntary National Review 2023 and the Draft Ammonia Strategy for Northern Ireland.

The Ireland Policy Group also recently hosted a webinar on nature-positive approaches in Ireland, and have agreed to draft a discussion paper on possible ways forward in Ireland.

Further priorities

At the time of writing the policy team is engaging with our Strategic Policy Panel to discuss future priorities, and preparing for the many consultations expected in the next few months.

Contact the CIEEM Policy team at:
policy@cieem.net

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

ARCADIS Design & Consultancy for natural and built assets
RSK biocensus EXPERTS IN ECOLOGY
EPR ECOLOGICAL EXPERTISE, EVOLVED
Stantec

Membership Update

It's Not (Always) Rude to Shout

Stuart Parks
Head of Membership and Marketing, CIEEM

If you read my update in the last issue, you'll be aware that we welcomed lots of new Qualifying members last year. In fact, in 2022 we admitted an average of 52 new Qualifying members every month. I'm pleased to say that this remains our fastest growing grade of membership: I'm writing this just 2 weeks into January and we've already admitted 50 new Qualifying members.

As I mentioned then, this is positive news. We established the Qualifying grade to provide a straightforward route for those at the earliest stages of their professional journey to be able to access the benefits and support of membership – and importantly to access the collective experience and wisdom of the wider membership.

Wearing a different CIEEM hat, I'm also part of a team working to develop the Green Jobs for Nature initiative. You'll have seen *In Practice* articles by Sally Hayns about this, and (hopefully) many of you will have seen the website promoted on social media. Green Jobs for Nature's primary aim is to place the huge breadth of opportunities available in the sectors in which you work firmly on the radar of young people. Reviewing the growing library of job profiles on the website – www.greenjobsfornature.org – I was reminded of the common thread that runs between the people delivering these many and diverse roles. That thread is a fascination with the outdoors, very often ignited at a young age, that grew into a passion that continues today.

I see that passion coming through too in the posts of ecologists and environmental managers on social media – you might be one of those who has posted. There are sometimes healthy differences of opinion around ways to address key issues or grapple with new legislation, and at certain times of year it's clear that sometimes you forget why you're still doing what you do, or why you ended up doing it in the first place, yet there you are. Despite all the challenges – and there are many – you do what you do because you know it matters.

More years ago than I'm keen to admit I worked for a national charity – Learning through Landscapes – whose objective is still to create spaces in school grounds that give all children the opportunity to develop that same passion and interest for the outdoors by using it as their classroom. More recently, I worked for STEM Learning; my role was to persuade Heads of STEM departments in schools to accept willing Ambassadors into their classrooms to inform young people about their career in STEM. That's when I noticed that you were missing – your roles are largely invisible to young adults ready and waiting to be inspired. *"If you can't see it, you can't be it"*, was our guiding principle.

Where am I going with this?

Right now you're at the front line in tackling the climate emergency and biodiversity crisis. The good news is there are others wanting to tackle them alongside you. But there can never be too many protectors of the environment. There can never be too many advocates for the importance of the natural world. So how do we make sure the ranks keep swelling and that their passion is underpinned by the knowledge and competence they need to be their most effective?

- Share your passion. You could put your role profile online or consider becoming a STEM Ambassador, but how else can you make not only you but also the work that you do more visible? Think about what inspired you down the route you're currently treading. We all have that same fascination when connecting with the outdoors: what can you do to fan that ember and ignite that passion in someone else?
- If you have yet to do so, please consider signing up to be a mentor. Student and Qualifying members that take part in our focus groups tell us just how valuable this is to them. You control the time commitment, you determine the comfort zone and you can make a difference.
- Encourage progression. Talk to your colleagues, friends, employees and employers about the importance of being the best professional you can be. Who just needs a final nudge to be persuaded to join a professional body or upgrade their current membership?

For more information, contact the team at
Membership@cieem.net

From the Country Project Officers

Annie Robinson – Scotland Project Officer

Hello everyone,

We started the New Year with a visit to Blawhorn Moss NNR with Fiona Hyslop MSP, Deputy Convener of the Net Zero, Energy and Transport Committee. Ms Hyslop is our MSP Nature Champion for Blanket Bogs, which we are co-hosting with Amphibian and Reptile Conservation Trust. The Nature Champion Initiative (www.scotlink.org/link-campaigns/nature-champions/) co-ordinated by Scottish Environment LINK encourages Members of the Scottish Parliament to champion threatened species and priority habitats, raising awareness and promoting action to restore and safeguard Scotland's environment. We look forward to working alongside Ms Hyslop to highlight the importance of blanket bogs for biodiversity, carbon sequestration and flood management as well as the threats they face and action needed.

2022 was a very busy year for the Scottish Policy Group with nine consultation responses submitted as well as many other activities as shown in the policy infographic (see the website). It is great to see the increasing profile of our policy activities in Scotland. There are spaces on the Scottish Policy Group so please get in touch if you would like to be involved.

This year the Scottish conference will be tree-themed, in October, in person. There will also be several Member Network events on this theme so 2023 really will be #TwentyTwentyTree. We were delighted to host a talk from RSPB on avian flu with the Marine and Coastal SIG. As well as planning lots of member network events and the conference the Scotland committee are supporting lots of career events at HEIs.

Thanks, Annie

Contact Annie at:
AnnieRobinson@cieem.net

Elizabeth O'Reilly – Ireland Project Officer

Dia Dhaoibh/Hello everyone,

It has been an exciting start to 2023 with organisation of the annual Irish conference well under way. This year we are discussing 'Aiming for a Nature Positive Ireland' and we look forward to exploring how our sector can work towards that goal. This will be the first in-person conference in Ireland for 4 years, so get your tickets now!

We are delighted with the engagement with our Lunchtime Chat webinar series in particular on 'Adapting BNG for Implementation in Ireland'. The discussion was very insightful and informed our briefing document *'Biodiversity Enhancement for New Developments in Ireland'* available online. The recording from this event and our other lunchtime talks are available on request.

In January we were delighted to be a part of the Irish Ecological Association's 4th Ecology and Evolution conference. CIEEM sponsored the *'Donut with a Doctor'* session where delegates had the opportunity to network, while eating a tasty snack!

We have also been working on submitting consultation responses. I would like to give a huge thank you to the input provided by our volunteers that is essential to this work. All our responses can be found in the website's Resource Hub and we welcome any new volunteers looking to support these efforts in future.

But for now, I wish you all luck in the upcoming summer survey season and I look forward to updating you again in the next edition.

All the best, Liz

Contact Elizabeth at:
Elizabeth@cieem.net

Mandy Marsh – Wales Project Officer

S'mae pawb/Hello everyone,

Water, water everywhere. In this stereotypically rainy country we have swung from last summer's drought to, as I write, a stormy winter with flood warnings across the whole country.

Rivers suffer greatly from agricultural pollution, and this is being compounded by an increasing amount of raw sewage being released into waterways. Welsh Government, via its Agriculture Bill, is proposing a new Sustainable Farming Scheme and National Minimum Standards. These will have long-reaching consequences even for confirmed urbanites who barely know one end of a sheep from the other. How farmers conduct their business has direct effects on biodiversity, air quality and, perhaps most noticeably, water quality. Water companies, too, are preparing their management plans for the next 5 years. Through its membership of Wales Environment Link, CIEEM has been contributing to a two-pronged attack aimed at improving river health by liaising with both the water companies and the agriculture sector.

All water ultimately ends up in the sea. It's yet to be confirmed, but we hope our annual conference will have a marine theme, and be an in-person event held in September.

None of this work would be possible without the help of our volunteers. I'm delighted to welcome new members to both our Wales Policy Group and our Wales Member Network Committee (who organise the conference, amongst other things). Please get in touch if you would like to know more about volunteering with CIEEM.

Hwyl, Mandy

Contact Mandy at:
MandyMarsh@cieem.net

International Focus

Fraser Wilkinson
International Biodiversity Consultant, SLR Consulting

Whilst restoration is exciting and has growing momentum, it certainly raises some challenges. In the international sector, one of the key challenges is a lack of data and information that are easily accessible, but the STAR metric is a tool designed to help alleviate that problem.

STAR stands for Species Threat Abatement and Restoration and was released by the IUCN in 2021. In their own words, *"the STAR metric assesses the potential of particular actions at specific locations to contribute to global sustainability targets, supporting science-based targets for species biodiversity"*. Its global terrestrial coverage means it can be a very helpful tool to a large organisation (be they a business, charity or government department) to understand the key risks and opportunities in the areas in which they are operating. This could be a business understanding its supply chain or a conservation charity trying to determine the best way to use its resources, for example.

It has taken me a while to fully understand the science and maths behind the metric, but I can summarise it as follows: the $STAR_T$ score represents the potential for threat abatement actions to reduce species' extinction risk in their current range; the $STAR_R$ score represents the potential for restoration actions to reduce species' extinction risk in their former ranges. The scores are then broken down by specific threat types (e.g. agriculture, mining, etc.) for both $STAR_T$ and $STAR_R$.

I recently assisted a large multinational company with improving their biodiversity performance using the STAR metric. Their consumable product relies on crops grown in various tropical regions of the world, including Latin America, Africa and Asia. They wished to understand what the key threats were to biodiversity in a selection of the regions they work in, and then use this as a tool to guide targeted conservation measures. The aim was to connect threats identified by the STAR tool to their own practices.

For example, a common threat type was *"annual and perennial non-timber crops"* as this can lead to deforestation, ultimately driving habitat loss, degradation and fragmentation. In fact, the IUCN says, *"24% of global extinction risk reduction could be achieved by increasing sustainability in crop production"*. As these were crops in the client's supply chain, it would be feasible for them to implement actions to reduce the associated threat level by implementing agroforestry practices, for example.

The client wished to go beyond what was happening directly on the farms they purchased from and aimed to become a positive actor in the landscape with regards to biodiversity. STAR was an invaluable tool in understanding where in the landscape was most appropriate for landscape-scale habitat restoration. At a glance, you could clearly see where there were areas with a high potential for threat abatement and restoration activities.

Of course, the STAR tool is most useful when used in conjunction with other tools, and stakeholder engagement is arguably top of that list. The STAR tool was combined with species data from the IUCN, protected area information, and additional data from a literature review to gain an understanding of the landscape and how the client could contribute to conservation objectives for the area. This then paved the way for discussions with stakeholders, most of whom had an existing relationship with the client and could provide a strong connection point to the local communities and farmers.

The individuals we consulted with were representatives from academia, businesses and charities. Whilst the secondary data had provided a great overview of what would be ideal to implement, the discussions with stakeholders confirmed what would be possible to implement, given each location's context. Their experience and advice were invaluable to the success of the project.

This led to a clear list of recommendations for biodiversity-positive actions to take. This included landscape restoration, mostly centred on reforestation, but also measures to implement on farms (such as using organic processes and materials; implementing agroforestry and intercropping systems; or reducing the spread of alien invasive species).

Thanks to the data available, it was possible to assign each recommended action to particular fauna and specific threats, whilst having a good understanding of where in the landscape actions should be targeted. This meant that the client had a base from which to develop a plan to determine the priority actions.

Overall, STAR is an invaluable tool in many contexts for supporting a variety of organisations to implement actions aimed at restoring biodiversity.

More information can be found at:

www.iucn.org/resources/conservation-tool/species-threat-abatement-and-recovery-star-metric

www.ibat-alliance.org/pdf/star-business-user-guidance.pdf

British Ecological Society

Are you an LGBTQIA+ Ecologist? Join the ALDER Network!

The British Ecological Society (BES) launched the ALDER Network in 2022 to provide a space for the LGBTQIA+ ecologist community to interact, share and support each other. The name ALDER stands for Advancing LGBTQIA+ Diversity, Equality & Representation.

For LGBTQIA+ scientists, a supportive working environment can be hard to come by. In 2019, the Institute of Physics, Royal Astronomical Society and the Royal Society of Chemistry surveyed their members to find out what working life was like for LGBTQIA+ physical scientists. 32% of trans people surveyed had been excluded, intimidated or harassed in the previous year and 28% of LGBTQIA+ respondents sometimes considered leaving their work due to workplace climate or discrimination.

Over the past few years, the British Ecological Society's Pride Month blog series has provided a space for queer ecologists to talk about their work and has been a fantastic source of representation for other ecologists reading their stories. However, the blog posts also revealed that LGBTQIA+ ecologists still face a variety of challenges, including hetero-/cis-normative assumptions or a hostile environment. It can make it difficult for them to come out at work, experiencing being misgendered, having to do fieldwork in non-welcoming or unsafe environments without appropriate facilities and lacking representation, especially at the supervisor level.

In answer to this, the BES LGBT Network, which previously didn't do much outside of hosting socials at BES events, was relaunched and revitalised as the ALDER Network, led by a committee of eight queer ecologists.

Rainbow chameleon

The ALDER community is growing, with over 100 email subscribers already. Over the next couple of years, the Network will focus on developing mentoring schemes for LGBTQIA+ ecologists and resource banks for supervisors, mentors and queer ecologists. This will include guides on how to prioritise safety in the field both in the UK and abroad, safety and inclusion at conferences, and setting up a community communication forum. We will also plan events to bring LGBTQIA+ ecologists together, including meet-ups at conferences and Pride events.

The Network's launch event at the BES Annual Meeting in December 2022 was a great success, with over 50 LGBTQIA+ ecologists enjoying the opportunity to meet like-minded people. The Network will soon publish its advice on pronoun use, aimed to help the whole ecologist community, but especially to guide managers, supervisors and those facilitating and speaking at events.

ALDER also has a column in the British Ecological Society members' magazine *The Niche*, promoting LGBTQIA+ ecologists and developments in the community.

We are looking for new members and would love to hear from you if you're interested in joining the Network. You don't have to be a BES member to join the Network (but you may discover the many benefits of being a member!).

Email alder@britishecologicalsociety.org to join the mailing list and see member profiles, news, events and opportunities for getting involved.

From the Patrons

It Couldn't Happen Here – Could It?

Sir John Lawton

Any project to rewild and restore habitats in a cultural landscape or re-introduce lost species will have risk registers as part of good governance. But in my own (admittedly limited) experience the biggest risks are so unthinkable that we can all too easily miss them.

I chair the two Boards guiding habitat restoration. One is a stand-alone project (Tees-Swale Naturally Connected[1] funded by the National Lottery Heritage Fund) working across 845 km^2 of the North Pennines AONB and the Yorkshire Dales National Park to encourage and enhance nature-friendly farming in a cultural landscape. The second (the Endangered Landscapes Programme (ELP)[2], supported by the Arcadia charitable fund and managed through the Cambridge Conservation Initiative) is massive, with restoration and rewilding projects stretching across continental Europe, including the UK. Currently well over 1000 km^2 of land and sea have been restored and over 400 km^2 of newly protected areas created. They all have risk registers. Which work. Sometimes.

Projects like these are inevitably complicated and difficult not least because they involve people from many walks of life, of different political persuasions and with different aspirations. On a Venn diagram there can appear to be, at least initially, worryingly little overlap between the actors. The physical act of habitat restoration itself is also complicated, with plenty of room for things to go wrong. The point of risk registers is to flag up problems before they get too serious and find workarounds and solutions. The worse problems are some combination of those over which managers have little or no control, and no means of responding to, and which are totally unexpected.

Tees-Swale's risk register has evolved to be (hopefully) comprehensive, but when the project was first being developed the UK was still in the EU, and the risk of leaving the EU and all that might entail for farm subsidies was not part of our thinking. Nor were subsequent 'political' developments at home. For example, we had (and still have) ambitions for woodland restoration in appropriate places. However, soaring timber prices have made fencing new woodlands very expensive – not a risk we anticipated. And delays in developing Government policy on farmer support means that Defra's Higher Level Stewardship (HLS) scheme (a key part of our farmers' incomes) has been rolled over for 5 more years. Land in HLS cannot be converted to woodland, which means that those farmers in the scheme cannot sign up to planting more trees, at least not yet. Fortunately, in this case there are workarounds.

Potentially far more worrying, and definitely not on the risk register, is the wholesale abandonment of environmental protection enshrined in EU law, being considered (as I write) by the Westminster Government. Nor is the possibility (also being considered) of scrapping Environmental Land Management (ELM) schemes, which aim to pay (not subsidise) farmers for delivering 'public goods', despite ELMs taking 6 years of careful development. If these wanton acts of political vandalism happen, Tees-Swale (and many other conservation initiatives) will be in deep trouble. They were not something we even thought vaguely possible as a serious risk, and there is essentially nothing we can do about them anyway, if they come to pass.

All that pales into insignificance beside the damage currently being inflicted by President Vladimir Putin on Belarus and particularly Ukraine. For the ELP a war in Europe was unthinkable. Nor had we anticipated that before the invasion of Ukraine was even being hinted at, the Director of one of our projects (Polesia – Wilderness Without Borders) would be imprisoned by the President of Belarus, Alexander Lukashenko. And as Putin's invasion unfolded, Russian tanks rampaged over one of Polesia's most precious sites on the Belarus side of the border. Conservation work there has stopped, and a grant application to the ELP for a major new project in Ukraine, to protect and restore Black Sea steppe, is on hold as war rages along the coast of one of the largest remaining steppe complexes in Europe, and Ukrainian staff had to flee their homes.

A recent *environmental Scientist*[3] edition is devoted to ecosystem restoration. In it there are 14 excellent articles written by experts on how to do it, covering almost every aspect, except how to cope with wilfully destructive politicians and worse. I have no idea what the answer is, except I know a risk register won't help.

Notes

1. www.northpennines.org.uk/what_we_do/tees-swale-naturally-connected/
2. www.endangeredlandscapes.org
3. *environmental Scientist* (2022). Ecosystem restoration. Securing biodiversity, complexity and resilience. *Journal of the Institution of Environmental Sciences*, **31**(3).

About the Author

John is an environmental scientist, conservationist and science administrator. He was Director of the Centre for Population Biology at Imperial College (1989–1999), Chief Executive of the Natural Environment Research Council (1999–2005) and Chairman of the Royal Commission on Environmental Pollution (2005–2011). He trained as a zoologist at the University of Durham, and subsequently held posts at Oxford and York Universities. He was elected FRS in 1989, awarded a CBE in 1997 and knighted in 2005 for his contributions to ecological science. His report on *Making Space for Nature* in 2010 presenting an independent review of England's wildlife sites and ecological network to policy-makers; the hugely influential report still has policy impacts today.

By Members ForMembers

Your Member Networks Need You!

All CIEEM Member Networks groups (both geographic sections and special interest groups) are led entirely by CIEEM's amazing volunteers, and without the work of these dedicated individuals our groups would not be able to deliver valuable networking and engagement opportunities for CIEEM members and the wider sector. We have already held our annual Member Network volunteer elections. However, this does not mean that you cannot still be involved. Did you know that as a CIEEM member, you can join a Member Network committee (with vacancies) at any time of the year through the co-opting process?

Our Member Networks volunteers have a role to play in helping their committee organise great events in their area (topic or region), engage with members and potential members, and attend careers fairs and other events to talk to students about the benefits of CIEEM and careers in our sector. Volunteers on these committees are also welcome to contribute articles and updates about the group's activities for publication in *In Practice* and also on the CIEEM website. They also have a key role to play in promoting professional standards, feeding into policy consultations and representing the views of CIEEM members at local and national levels.

You can find out what volunteers had to say about their roles within our member groups in the 'Let's Celebrate Volunteers: Members Groups' blog on the CIEEM website from 5 June 2022. Aside from having the opportunity to build on their continuing professional development (CPD), volunteers on member group committees really felt that they valued the opportunity to use their skills, share knowledge and experiences, and have a laugh along the way! They also enjoyed being able to build connections between people, helping find opportunities to take positive action on the ground in areas they are particularly passionate about.

We have plenty of volunteer roles at CIEEM currently available, and we would love it if you could be a part of this journey with us! You can find more information about which roles are available in CIEEM Member's Groups on the My CIEEM area of our website, in the 'Volunteer Opportunities' section. To enquire about a specific role, please contact us by emailing membernetworks@cieem.net

Drew Lyness

Volunteer Engagement Officer, CIEEM

Early Careers Special Interest Group

Welcome Workshop

In November 2022, the Early Careers Special Interest Group held their first ever event for members! It was a fantastic session allowing the volunteer committee to meet the new group members and supporters. This session featured introductions from committee members, and offered a chance to take questions from the audience about the committee members' own career journeys and experiences. The topics coming from this session were insightful and enlightening, highlighting the struggles that those who are new to the sector may face in their early career, but also generated some ideas for how the Early Careers SIG (ECSIG) could tackle the key areas of peer support, raising awareness of issues affecting early career ecologists and environmental managers, and push for a real attitude change towards early career members in the sector! Visit the CIEEM website for a detailed blog covering the questions raised at this brilliant first event.

UK Overseas Territories Interest Group

Conserving a globally important ecosystem: The Cloud Forest of St Helena

The SIG was treated to an excellent talk from Shayla Ellick and Kirsten Ellis regarding the fascinating St Helena Cloud Forest Project. A highly collaborative, multi-year project working to implement the Peaks Management Plan for St Helena's Peaks National Park. This globally significant area holds over one sixth of the UK's total endemic biodiversity (approximately 250 unique species), provides the majority of the island's freshwater through mist capture and groundwater recharge and offers a unique wilderness experience in an area that has been voted one of St Helena's 'Seven Wonders'. Currently project funding has been secured via the UK Government's Foreign, Commonwealth and Development Office through the Conflict, Stability and Security Fund: Environmental Sustainability and Climate Change Programme until March 2025.

The talks highlighted how, over the next 5 years, there will be a focus on biodiversity through improving, restoring and creating cloud forest habitat and conservation of associated species with the aim of safeguarding an internationally important wildlife hotspot from further extinctions. Water security and climate change will also be key considerations, with vital actions being taken including re-vegetating around native habitat fragments in key areas of mist capture, and monitoring and research to inform and secure the island's water security and climate change adaptation efforts.

Wales Geographic Section

LIFE Dee River Project: Guided Walk

The Wales Member Network took the opportunity to put on their walking boots and head to the banks of the Afon Tryweryn with Joel Rees-Jones, Team Leader, LIFE Dee River Restoration Team, to understand more about the salmon life cycle. They journeyed up the river trail to an area just below Celyn to see evidence of salmon spawning. During this event, they discussed the impacts of dams on riverine functions, and the negative impacts that dams can cause. They also heard about the mitigation techniques for these impacts, and the results that have been seen in the area.

The guided walk on the banks of the Afon Tryweryn. Photo credit: Megan McNutt/Dee LIFE project.

Promoting Jobs in the Sector

We have recently launched a new website – www.greenjobsfornature.org – as part of our campaign to promote jobs in the ecology and environmental management sector to young people and potential career changers.

The website is packed with useful information about what a green job for nature is, how to get one and who you can work for. On the website is a library of job profiles from those working in the ecology and environmental management sector to promote the variety of jobs available and the wide range of employers.

Critical to promoting these opportunities is creating a library of lots and lots of job profiles from all employment sectors so we have a rolling collection of job profiles to use.

If you are able to help by telling us (and others) about your job please go visit the website (www.cieem.net/green-jobs-for-nature) to fill in the form and upload a photo of yourself at work. We are also on the lookout for great short videos telling others about your job, so if you are interested in this, then please do let us know. To help inspire you, have a look at Ashleigh's profile.

Career Profile

Ashleigh Kitchiner

RMarSci MIMarEST MCIEEM
Senior Marine Mammal Consultant
CIEEM Scottish Section Committee Member
CIEEM Marine and Coastal Special Interest Group Member
STEM Ambassador

Please describe the work that you do.

I have been working in the marine sector for around 6 years and offer services ranging from fieldwork, survey design, analysis and reporting. My key duties include desk-based reviews of species and habitats, environmental monitoring, mitigation, and writing scientific and technical reports, including Marine Mammal Risk Assessments, Monitoring and Mitigation Plans, and conducting assessments. I have completed numerous fieldwork projects internationally.

What do you most like about your job? Any dislikes?

I like that no two days are the same and when I look back at the last year alone, I have worked on such a variety of projects. It really helps you grow and develop, the greater variety you have. I really like the team I work with too, everyone is rooting for each other, and the collaboration effort is faultless.

What inspired you into this career?

I love nature and conservation but actually had no idea about all the jobs in this world! I was going down the route of being a medical professional and then I had a work placement with a Wildlife Trust and got chatting with the people there. From then on, I feel like my horizons have broadened and I now know of some of the roles out there in this field, I'm sure there are so many more that I don't know about yet!

Have you faced any challenges in progressing your career so far?

Absolutely! I think most fields are competitive and it was certainly difficult getting that 'first' job; however, looking back, it doesn't actually take long. I think it just feels longer after so much study time! On reflection though, it's not necessarily a bad thing because it makes you better and learn more. That said, we need to make more opportunities and increase diversity and inclusion in this sector as well as others.

What education/training did you have?

I completed an undergraduate degree in biology and a Masters of Research in marine mammal genetics. Since then I have completed numerous continuing professional development courses and enrolled in courses where relevant.

What advice would you give to someone coming into the profession?

Try everything! This will help you to figure out what you like and what you are good at. Turn your hand to path clearing whilst volunteering for a Wildlife Trust, volunteer on bird surveys, set up bottle traps to collect newts and complete a marine survey on a boat. The more varied experience you get, the more you will understand about careers in this field, and you will meet new people. These people will have experience and be able to tell you about other opportunities and ways to learn more.

Have a look at
www.greenjobsfornature.org for other examples of job profiles to help inspire you.

BOOKS, JOURNALS AND RESOURCES

Compiled by the Academia Special Interest Group

Paper Review

Fungi of Temperate Europe (2 volumes)

Læssøe, T. and Petersen, J.H.

(2019) Princeton University Press. ISBN (two volume set): 978-0-691-18037-3

English edition of this Danish work.

Fungi are increasingly included in ecological impact assessments but, with 15,000 species in the UK alone, surveys can be daunting. Læssøe and Petersen have made the task easier. These two volumes provide over 2800 species accounts supported by approximately 10,000 images. To assist identification, the authors have divided the fungi into 'form groups' consisting of morphologically similar types. This is supported by numerous, cross-referenced 'fungal wheels', pragmatic photographic arrangements presented as visual alternatives to dichotomous keys. The large format (resembling A4) and cost suggests they are for indoor use when examining collected samples or field photographs. For me, care is also needed because the images are of such high quality, it is easy to become distracted and forget what I was originally looking up.

Paper Review OPEN ACCESS

An evidence-based approach to identifying resting sites of Eurasian otter *Lutra lutra* from camera-trap and field-sign data

Findlay, M.A., Briers, R.A., Ingledew, R.P. and White, P.J.

Wildlife Biology, e01036

https://doi.org/10.1002/wlb3.01036

Eurasian otter (*Lutra lutra*) resting sites are strictly protected in the UK, but the legislation is difficult to apply given the poor understanding of what defines either a rest or a resting site. The authors camera-trapped 26 otter holts across the River Tweed catchment in southern Scotland and northern England for an average of 1 year each, with the aim to (i) find a method to identify resting sites, (ii) investigate whether field-signs differed between resting and non-resting sites and (iii) describe any behaviours recorded on camera traps that are associated with resting. All sites were visited by otters, but the vast majority only during short (often <4 min) visits, while only six sites saw otters spend prolonged periods of time in the structures (often for a few hours between feeding bouts during the night, or else resting for the entire daylight period). No single field-sign (spraints, paths, footprints, etc.) had a clear association with resting sites and indeed both resting sites and non-resting sites had overlapping ranges of these commonly associated field signs. Collection of bedding recorded on camera-traps was often a positive sign of a resting site. The authors also discovered that otters at resting sites commonly used latrines (for defecation), distinct in both form and function from spraint sites (for scent-marking) and absent from any sites not used for resting. The paper recommends that camera-trapping is the only known reliable method to positively identify resting sites and rule sites out as resting sites, although this is contingent on a robust camera-trapping approach; the authors makes specific practical recommendations regarding the placement of camera traps as well the timing and duration of camera-trap surveys required to be confident about the function of a site.

Paper Review OPEN ACCESS

The gender gap in land sciences: a review of women's presence on the editorial boards of peer-reviewed journals

Hamidi, S.M., Rezaei-Pandari, M., Fakheran, S. and Fürst, C.

Land 2022, 11(11), 1876

https://doi.org/10.3390/land11111876

Women are disadvantaged across all stages of academic publishing – and arguably in academia in general with men still outnumbering them in higher positions and in earnings. In this paper the authors use the relative proportion of women on journal editorial boards as a disadvantage indicator as holding such a position is evidence of a high reputation within a specialty or field. The authors assessed the gender composition of editorial boards in 60 peer-reviewed land-based sector journals and found that out of a total of 5197 editorial board members just 25.47% are women. This inequality was even greater in the journals with a higher impact factor. While there has been some improvement in recent decades the results show there is still a long way to go to achieve gender equality, and confirm previous findings of a considerable gender difference in urban land science, geoscience community, biodiversity conservation and veterinary sciences. Fortunately, the *In Practice* Editorial Board currently has good representation of women, with 7 out of 11 members being female.

Paper Review OPEN ACCESS

A general optimal adaptive framework for managing a threatened species

Nicol, S., Ferrer-Mestres, J., Lloyd, H., Brazill-Boast, J., Gorrod, E. and Chades, I.

Ecological Solutions and Evidence 2022, 3(4), e12186
https://doi.org/10.1002/2688-8319.12186

We are probably all familiar with the term adaptive management and the basic concept but, as these authors suggest, this has not necessarily translated into wide implementation. The basic idea – setting a target and then learning by doing from constant monitoring and re-evaluation of actions to refine it and achieve the goal – is expensive in time and resources. The reasons for the implementation gap are explored with a view to making the approach simpler and so cheaper without losing the overall benefits. Using a new app in R this was tested using a known scenario – invasive red fox (*Vulpes vulpes*) predation of long-footed potoroo (*Potorous longipes*) in Australia: one species with one main threat. It was concluded that producing generalised adaptive management models could, with the broader uptake of R and low cost of Shiny app development, be applicable to many threatened species, including those with multiple threats. The paper demonstrates how to formulate a general archetype for species–threat adaptive management problems and suggests others could be created for a range of adaptive management problems, such as overharvesting. Creating a library of these models would reduce costs and increase effective implementation of adaptive management.

Paper Review OPEN ACCESS

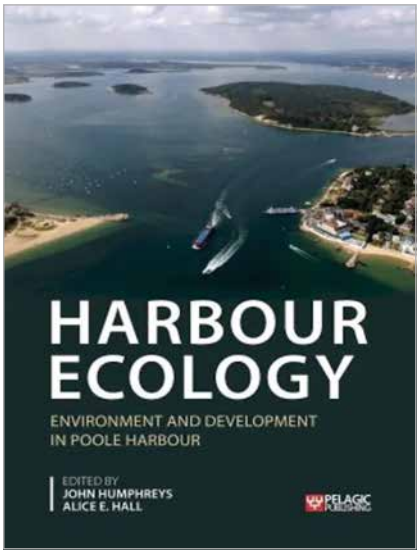
The relative importance of COVID-19 pandemic impacts on biodiversity conservation globally

Gibbons, D.W., Sandbrook, C., Sutherland, W.J., Akter, R., Bradbury, R., Broad, S., Clements, A., Crick, H.Q., Elliott, J., Gyeltshen, N. and Heath, M.

Conservation Biology 2022, 36, e13781
https://doi.org/10.1111/cobi.13781

This paper provides a comprehensive review of the observed and potential impacts of COVID-19 on biodiversity and its conservation globally. The study used a three-step process of expert consultation and assessment to identify and categorise impacts and potential impacts on global biodiversity conservation. The impacts included: impacts from increased plastic waste; reduced income from wildlife-based tourism; economic recovery prioritised over the environment; and nature-friendly regulation and its weakened enforcement. Some positive effects from increased wildlife-trade restrictions were noted, however many of the beneficial impacts that were reported in the early stages of the pandemic such as reduced emissions and less disturbance to wildlife were of short duration and therefore not highly ranked overall. The paper concludes that 60% of the impacts the pandemic has had and potentially will have on biodiversity conservation globally are negative. Although it is not clear which will have the greatest overall impact there are substantial challenges ahead to tackle the prioritisation of rapid economic growth over the environment.

BOOK REVIEW



Harbour Ecology: environment and development in Poole Harbour

Edited by Humphreys, J. and Hall, A.E. (2023) Pelagic Publishing, London, 277 pp.

This sequel to *The Ecology of Poole Harbour* (2005) focuses on natural resources and ecological services within Poole Harbour. The 20 guest-written chapters cover four key themes of historical background, macro-ecology, fisheries and water quality.

The underlying theme of problems associated with the sustainable exploitation of natural resources in a geographically restricted area ties the different chapters together. But what makes this volume different from other accounts of coastal pressure is the emphasis on the ongoing and developing local solutions based on research, investment and stakeholder involvement.

Part 1 'Background' contains the stuff I expected – a potted history of local development and industry, along with a novel section on how to capture these aspects and issues using infographics. But a chapter on dumped oyster shells? Unusual, but these represent a unique resource which can be used to describe long-term industrial and social change.

Part 2 'Ecology' is not a 'who's who' of local native and invasive species but an account of how the major players interact and how these interactions have changed over time. The base of the food chain, harbour plankton, is different to that of the open sea and have impacted bird, fish and seal top predators. These top predators are discussed in terms of long-term change by both academics and a local fisherman with first-hand experience. The section rounds off with an account of the ecology at one key location, Holes Bay, a critically important microcosm of Poole Harbour and a model of its issues.

Part 3 'Fisheries' is, as expected, an account of commercial and recreational fishing of the principal shellfish and finfish. What is different is the suggestion that introductions of the non-native Manilla clam, *Ruditapes philippinarum*, and Pacific oyster, *Magallana gigas*, are not regarded as 'invasive pests' but as new valuable commercial resources. These feed local higher predators, have minimal impact on native species and may even future-proof local ecology because they may adapt more favourably than native species to climate change. This shift from 'alien pest' to a valuable resource at the centre of future management plans is beautifully presented.

Part 4 'Water Quality' is cached in terms of Poole Harbour, its river catchment systems, which of these are being improved, and how. The harbour shows many 'symptoms' of eutrophication, most notably an abundance of *Ulva intestinalis*, an opportunistic alga which is a major focus of the section starting with using drones to quantify its occurrence. There are numerous published accounts on the benefits of drone aircraft in terms of improving resolution, low cost and repeatability of results. This is more useful, describing post-flight data capture and filtering using the near infra-red spectrum rather than the more usual, and rather blunt, tool of visible light. Drone surveys are given a thorough traditional context of extensive aerial photography with ground-truth monitoring. This is rounded off with a largely conceptual/pilot study account of how *Ulva* may be used as a 'blue carbon' resource and a means of removing excess nitrate from Poole Harbour. The methods, while in development, show clear potential.

Part 5 'Conclusion' summarises Poole Harbour as a coastal lagoon system with a complex morphology, varied hydrology and a rich biodiversity of native and immigrant species. The area has suffered long-term chronic pollution, continues to be exploited and needs balanced but effective legislation to protect its structure, biological communities and continued, but sustainable, human exploitation. The current problem is how to differentiate effective and long-term improvement strategies from the purely short-term and immediately evident 'quick fixes'.

Harbour Ecology is more than a resumé of how a fragile coastal system has dealt with the change since it was first colonised. The volume, written by local academics, environmental managers and other stakeholders, identifies local problems, local solutions and how these can be managed. This future-proofing with respect to pollution, climate change and resultant shifts in biological communities is neither a warning nor a plea. It is a case study of what can be done and how this is being done, a veritable toolkit for other harbours and lagoons facing pressure from encroachment, pollution and global change. That makes it important. The book belongs on the shelves of those who plan and legislate as well as those who educate. The latter should view this as an essential text for students with an interest in both ecology and sustainable resource management.

About the Reviewer

Dr Philip J.A. Pugh, Senior Lecturer, Anglia Ruskin University, joined ARU in 2000 to teach conservation biology and develop new marine biology modules. He currently teaches on the BSc (Hons) Ecology and Conservation and BSc Zoology courses. His recent research has centred on Antarctic biogeography, cladistics and multivariate analysis.

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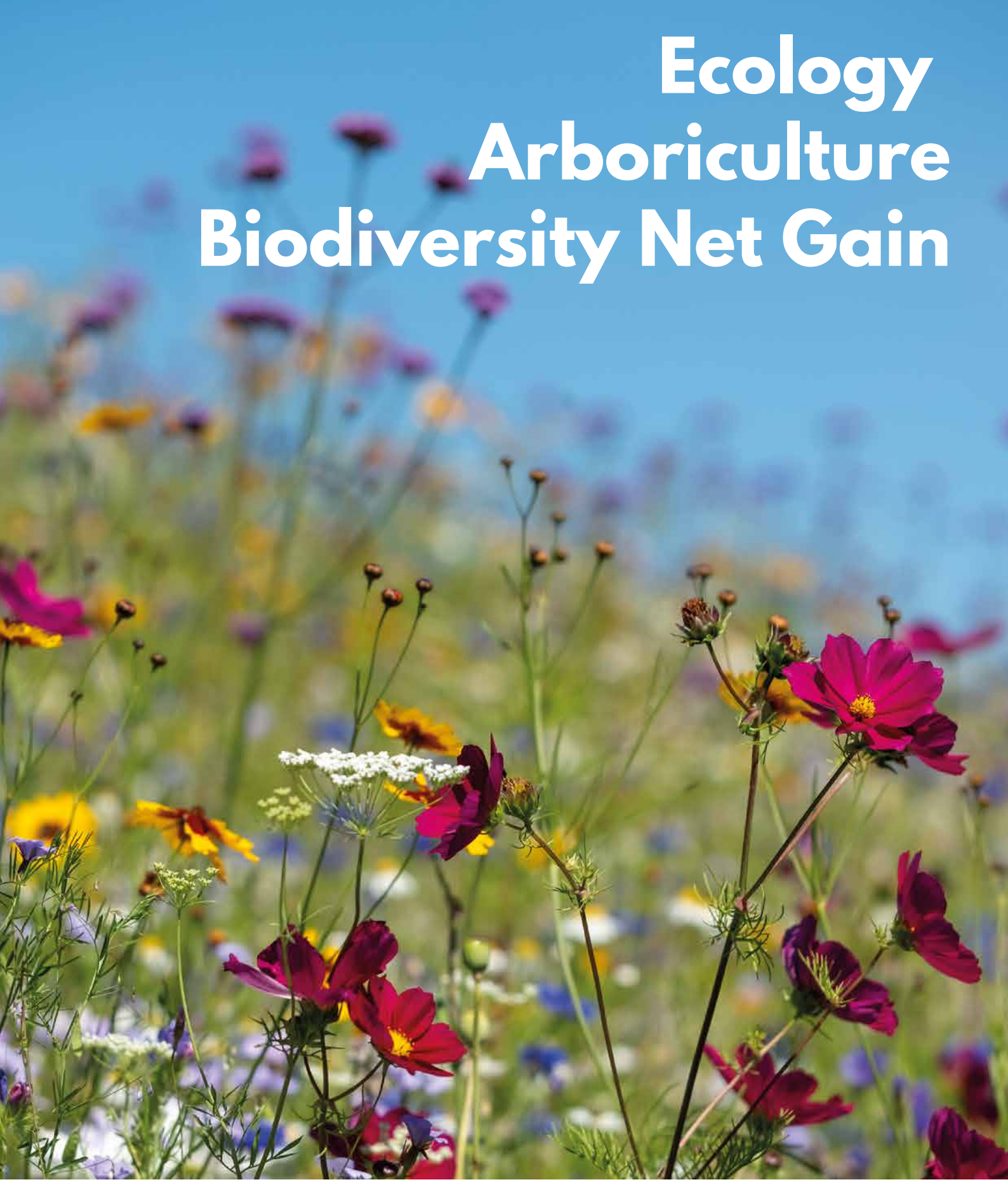
Ecology
Arboriculture
Biodiversity Net Gain



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