Chief Scientist Report 2022:
Nature recovery, led by evidence

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NATURAL ENGLAND

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Foreword

Science, evidence and analysis are at the heart of Natural England's advice, operations and regulatory activity.

To be successful in recovering nature, we need high quality, relevant and up to date science and evidence that is actively and confidently applied. This means we need, amongst other things, to understand what changes are happening in the natural environment and what interventions are working well.

This year's Chief Scientist Report focusses on what Natural England is doing to recover nature by being evidence-led. This aligns with the first Chief Scientist Directorate conference being held on 29 & 30 March 2023, where we are bringing together colleagues and partners across the sector to showcase our science, evidence and analysis and stretch our thinking around what works in nature recovery.

I'm always hugely impressed by the diverse depth and breadth of work illustrated in these reports and this year is no exception. The work on the natural capital account for sandeel fisheries shows that by closing these industrial fisheries and thereby ensuring sandeel availability for predators, the value of North Sea fish landings would increase. This has directly informed the development of Government policy on these fisheries today. Other innovations include combining citizen science with innovative eDNA techniques in our GenePools project to survey ponds. We have applied social science to help understand and manage wildlife conflict. And we have published a ground-breaking handbook on geoconservation to inform good practice.

It has been a real privilege to undertake the role of Chair of Natural England's Science Advisory Committee (NESAC), as I have witnessed the incredibly valuable science, evidence and analysis that Natural England produces. Sadly, this is my last year in this role, however I take great pride in having worked with like-minded peers over the years and having guided Natural England's science and evidence through some hugely valuable and challenging work.

Nature's recovery has never been more important and I know that with the highly respected, multi-disciplinary environmental science and evidence which Natural England is producing, I leave in the knowledge that this is in safe hands.

Dr Andy Clements

Natural England Board Member, Chair of Natural England Science Advisory Committee (NESAC)

Welcome and Introduction

Welcome to Natural England's Chief Scientist Report for 2022.

The fifth in our series, this report focusses on 'nature recovery, led by evidence'. It aims to shine a light on the breadth of work that we do in Natural England to both understand environmental change and describe what we're doing to develop and test interventions. If we're to succeed in recovering nature, we need to know what works and then do it well across the country.

This year's report again celebrates these and highlights the specialisms and the sheer depth and breadth of the expertise of our organisation. As in earlier Reports in this series, we have highlighted specialists working in many fields, Earth sciences, life sciences, the use of new technologies for biomonitoring, remote sensing and Earth observation. We have specialists evaluating the work we do, we have social scientists researching and monitoring how we, as a nation, engage with our natural environment – whether that be remote hillsides, wide-open Fens or urban watercourses

Over the past few years, we have been progressively strengthening our role as a leader in applied environmental science and this report illustrates further progress that we are making as we improve our understanding of the science and evidence underpinning nature's recovery.

As a science and evidence-led organisation it is also important that we share our learning and expertise as we provide objective, evidence-led advice. To that end, we have timed the launch of this report with the hosting of a conference on The Science of Nature Recovery. During the conference we will also demonstrate how we are 'Building Partnerships for Nature's Recovery'. Collaborative working with partners will be key to our success and this report demonstrates just some of the ways we are working collaboratively across the sector. The second day of our conference also focusses on developing those collaborations, by inviting partners to come together around the science of nature recovery and stretch our thinking as we consider future priorities and opportunities to collaborate.

We have a busy year ahead and 2023 will bring lots of exciting opportunities, particularly as we focus in driving our work in 'places' and as we use our expertise to support work on nature recovery and the wider goals set out in the Government's 2023 Environmental Improvement Plan. We will continue to ensure that our work is evidence-led and that we are providing the right advice, science, evidence and analytical skills & tools to support and enable nature recovery work across Natural England.

I do hope you enjoy the report.

Dr Tim Hill MIEnvSc MIoD
Chief Scientist, Natural England
March 2023

To keep up to date with science and evidence developments in Natural England, you can follow me on Twitter [@NEChiefSci](https://twitter.com/NEChiefSci).

Developing recommendations for the English Seabird Conservation and Recovery Pathway

Alex Banks, on behalf of the English Seabird Conservation and Recovery Pathway Team

Many of England's seabirds are in decline. Breeding populations of various species have declined by up to 30% since the 1990s, and seabird populations as a whole are failing to achieve Good Environmental Status. The rapid, drastic threat of Highly Pathogenic Avian Influenza is exacerbating other impacts, including from marine development tied to Net Zero targets, meaning we need to urgently drive seabird recovery whilst supporting sustainable development needs. To tackle these issues, Defra commissioned Natural England to analyse information on pressures and threats affecting 36 species of seabird and marine waterbird (sea ducks and divers) when at their nest sites and at sea, either on land within England or within waters comprising the Exclusive Economic Zone of England (out to 200 nautical miles, or adjacent national boundary). The aim was to describe a pathway to recovery for these species, underpinned by strong evidence of actions required, that Defra could align with nature recovery initiatives from the wider Environment Improvement Plan.

For birds at sea, a vulnerability assessment analysed the spatial overlap between marine bird distribution and 25 pressures (impacts resulting from human activities) of relevance. Built into this was a renewed understanding of seabird sensitivity to these pressures, such that analysis of vulnerability factored in both exposure and sensitivity to pressures of relevance.

For birds at breeding colonies, an in-depth review of issues affecting nesting birds was developed with relevant site managers. Results from the review were combined with other sources of evidence to provide an expert overview of significant issues, in partnership with RSPB.

Where vulnerability at sea or at colonies was assessed as 'high', the sufficiency of existing measures, including legislation and conservation activities, was considered.

Wherever existing measures were found to be insufficient, a recommendation for action resulted. These recommendations factored in relevant considerations relating to climate change. A final set of 19 recommendations containing 74 actions was formed, within four discrete categories: breeding, feeding, surviving and knowledge. Each considered timeframes, stakeholders and spatial extent, and were prioritised by perceived urgency and adequacy of existing measures. They include a 'pathway to action', comprised of a series of steps necessary to enact the recommendation.

Amongst the most urgent recommendations developed were those relating to availability of sufficient fish prey, management of predation and disturbance at colonies, mitigation of disease impacts, mitigation of bycatch from fisheries (where an issue), mitigation of impacts from development of marine renewable energy (where an issue), as well as several recommendations to improve our understanding of ecological change and impacts.

The Pathway involved close working between evidence specialists from many disciplines across the Chief Scientist's Directorate, including ornithology, fisheries, disease, ecotoxicology and pollution, climate change, data science and data analysis. Colleagues from other parts of Natural England were also involved, as were stakeholders including RSPB and JNCC.

These evidence-led recommendations could promote effective recovery of England’s internationally important seabird populations, contribute to Good Environmental Status under the UK Marine Strategy, and restore these crucial marine predators for the ecological and cultural benefits they bring. Work is ongoing with Defra and other stakeholders to explore delivery mechanisms so that our evidence work can be translated into positive actions for seabird conservation and recovery.

Spotlight on…

Ben le Bas

What is your first memory of an environmental or conservation issue?

When I was at primary school in rural Hampshire in the 1970s. A keen though untalented birdwatcher (nothing's changed since), I had borrowed a 1950s/60s guide to Hampshire's birds from the local library and used it to seek out exciting things like redshanks in our local water meadows, wrynecks in the orchards, red-backed shrikes and corn buntings. I never saw any, or at least not in the plentiful Numbers promised by the book. The 1960s had done for them!

What is your role in Natural England and what does it entail?

I'm a Senior Adviser in the National Nature Reserve (NNR) team, a bit of a jack-of-all-trades covering lots of NNR matters, amongst which is the science output of our reserves, climate change adaptation and mitigation, adding new land and new reserves to the series and co-ordinating management planning.

How does science and evidence inform what you do?

That's a big question. In simple terms it informs everything from the selection of reserves through to their management. Site selection is not only based on evidence of current features: we have to consider climate change evidence and other factors. Monitoring plays a big role in identifying and prioritising management interventions. One of the purposes of NNRs written into the 1949 Act and subsequent Acts is to provide opportunities for environmental study and research, so we're producers of evidence as well as users of it. To approach that more strategically is one of Natural England's current initiatives, a crossover project between Chief Scientist Directorate and NNR teams.

Human wildlife conflict and coexistence in Natural England

James Hoggett

Work on human wildlife conflict and coexistence is of growing importance to the work we do in Natural England. It remains in Target 4 of the COP15 Framework where it is noted that there is a need to 'effectively manage human-wildlife interactions to minimize human wildlife conflict for coexistence'. It is also vital for Natural England given the prominent but contentious nature of the wildlife licensing work we do in relation to many different species.

Despite increased attention, as concepts they are rarely defined or consistently applied across research and publications. Indeed, their strength and popularity may well be due to their plasticity. From my own work as a social psychologist specialising in intergroup conflict, the concepts of conflict and coexistence may best be thought of as contextually dependent and dynamic rather than as opposing ends of a fixed spectrum. While they have been used to describe relationships between people and nature, a more accurate description may be relationships between people about nature. This is because they often involve more complex and intractable issues than the animal human relationships which symbolise them. In other words, the wildlife dimension in human wildlife conflict and coexistence is often of less relevance to understand and manage than the human dimension. That is why social science can offer a lot to this area.

I have worked with brilliant colleagues from across the organisation on several projects using social science to help understand and manage human wildlife conflict and encourage coexistence. These include an evaluation of the hen harrier brood management programme (Hoggett, Marshall and Todd, 2022), as well as the use of theoretical frameworks from social science (Procedural Justice Theory, e.g., see Ruano-Chamorro, Gurney & Cinner, 2021) to help develop new approaches to areas of wildlife licensing. For example, to inform ongoing work related to our review of wild take falconry licensing. I have also developed and commissioned innovative projects (that will be reported on later this year) which use and evaluate mental model approaches to understanding and managing human wildlife conflict and coexistence. Mental model approaches are methods for making explicit people's internal representations of the external world which act as a guide to their behaviour. The projects apply mental model approaches to two case studies, one with the Natural England Bats in Churches team, and the other on beaver reintroductions in Devon. This work will assist in identifying causes of conflict around these species as well as potential solutions to enable coexistence.

Furthermore, in relation to species reintroduction, social science work on human wildlife conflict and coexistence is key to delivering the Government's commitment in the 25-year Environment Plan to provide opportunities for the reintroduction of formerly native species. Principle 7 of the Government's code of best practice for reintroductions (Defra 2021) 'Consider societal benefits and minimise conflict with others' (p.13) reflects this. Working with colleagues, I have been involved in using social science to assist with understanding and managing human wildlife conflict and coexistence around beaver reintroductions. In particular, the research completed

provided insights around the development and utility of beaver management groups (e.g., see Auster, Barr, & Brazier, 2022), while other work involved using a conflict management approach to facilitate discussion and reconciliation among different stakeholders in a series of workshops.

The importance of species reintroductions to government environmental commitments and Natural England's continuing wildlife licensing work means that there are many important opportunities where social science could provide greater support to the important work we do.

Photo: © Elaine Gill, Natural England.

Spotlight on…

Christine Pope

What is your first memory of an environmental or conservation issue?

I grew up about 5 minutes from Spaghetti Junction in Birmingham, 4 miles from the centre of town, so I appreciated our local urban greenspace from an early age, although I just called it the park!

A regular day out was taking the bus to Sutton Park (before it was a National Nature Reserve, which is showing my age), feeding the ducks, walking round to our favourite beech tree and round the various pools. I became interested in the practical aspects of habitat management, and when I left school the first thing I did was a National Certificate in Habitat Management. Family holidays were usually to the coast of Wales or Scotland. They involved lots of walks, whatever the weather, which I often complained loudly about. However, a love of walking in the outdoors must have seeped into my DNA because for the next 27 years my career has been about Access to the Countryside and included 6 years as a Public Rights of Way officer.

What is your role in Natural England and what does it entail?

I am a Principal Adviser in the Access to the Outdoors team. We focus on Open Access (OA) and National Trails (NTs). We deliver Natural England's statutory duties relating to access and have many years' experience of delivering access projects, advising how to manage access while balancing land management and nature conservation. We provide advice and training to partners and teams within Natural England. We are part of a Natural England's fantastic Connecting People with Nature agenda which ranges from social prescribing, inclusion and green infrastructure to NNR dedication and new NTs such as the England Coast Path.

How does science and evidence inform what you do?

Quantifying the benefits of access and targeting the places it can do most good can be difficult. Using science and evidence has been vital for proving the connection between wellbeing, health, economic and social benefit, and access. It helps make the case for new access close to where people live and in the wider landscape, and for better green infrastructure planning in our towns and cities. It supports investment to ensure access is available to all users of all abilities. The Chief Scientist Directorate has collated evidence that, when combined with our annual NT report shows how beneficial our NT resource is. We also use evidence to ensure access within our protected sites is appropriate and well manage and are about to evaluate interventions in relation to the England Coast Path. Behavioural science is giving us valuable insights into how people use access and what tools we have to influence where people go and how they behave when they get there. It has influenced signage and the messages we put out as part of the Countryside Code. Studies such as the long running People and Nature survey help us understand what people need so we can deliver well-used, well-designed access and connect more people with nature.

Making the case for sandeels using a Natural Capital approach and marine ecosystem modelling

Jo Bayes and Jacob Bentley

Sandeels have been described as the most important forage fish[1] in the North Sea (Figure 1). They contribute to the diets of marine mammals, seabirds, and predatory fish and in doing so signify a major conduit of energy transfer from lower trophic levels (i.e., phytoplankton and zooplankton) to higher trophic levels. Declines in the abundance of sandeels has negative impacts on dependent predators. The reduced availability of sandeels can negatively impact the condition of commercial fish (e.g., cod and whiting) as well as the reproduction and survivability of ecologically important and threatened species such as black-legged kittiwake.

Changes in the abundance of sandeels have been linked to environmental variation and an increasing mismatch in the synchrony of sandeel hatch dates and prey availability. Sandeels are also vulnerable to industrial fishing, defined as commercial fishing where the harvested fish are destined to be processed into fishmeal and fish oil. Spatially restricted closures to sandeel fishing have been historically introduced around Shetland and the southeast of Scotland for the recovery of sandeels and their predators, however the realised benefits have been limited due to environmental variation and the continued exploitation of sandeels outside of closed areas.

In 2022, Natural England used Natural Capital accounts and marine ecosystem modelling to provide evidence and advice to Defra on sandeel fishery management options for the delivery of multiple benefits for nature and society

The Sandeel Natural Capital Account

The innovative ‘Sandeel Natural Capital Account’ integrated ecosystem model simulations with a Natural Capital approach to investigate the natural capital assets, ecosystem services, and management costs associated with the industrial sandeel fishery. Information was disseminated to Defra using a natural capital extended balance sheet which displayed the economic value of assets under different management scenarios (e.g., ‘fishing sandeels at Maximum Sustainable Yield’ vs ‘no sandeel fishing’) (Figure 2). The account concluded that prohibiting industrial sandeel fisheries would increase the total value of North Sea fish landings, despite landings of sandeels falling to zero, as the reduced sandeel exploitation, and thus greater sandeel availability for predators, led to an increase in the productivity and subsequent landings of higher value commercial fish. This evidence supported Defra’s decision to close sandeel fisheries in UK waters in 2022 as had been advised by the International Council for the Exploration of the Sea (ICES) based on annual stock assessments.

[1] Forage fish are small to intermediate sized species, occurring in schools or aggregations, that function as a main pathway for energy to flow from plankton to higher trophic level predators.

Ecosystem Modelling

Natural England continued to deliver evidence and advice to Defra throughout 2022 using the same ecosystem modelling approach which underpinned the Sandeel Natural Capital Account: Ecopath with Ecosim (EwE; Figure 3). EwE is used globally to simulate marine ecosystem dynamics and services, from primary producers and zooplankton to commercial fish, mammals, and seabirds. EwE has been used to evaluate the ecosystem effects of fishing, analyse the influence and placement of protected areas, model the effect of environmental change, and simulate the trade-offs and cumulative impacts of marine use and co-use.

Natural England used EwE to shape advice requests to focus not only on the impacts of sandeel exploitation on commercial fish, but also on marine mammals, seabirds, and ecosystem structure, delivering on the UKs obligations for an ecosystem approach for fishing and the pursuit of Good Environmental Status (Figure 4). Resulting evidence is being used to outline Defra's long-term position on industrial sandeel fishing in English waters.

Vision for 2023 and beyond

The Sandeel Natural Capital Account highlighted significant evidence gaps around valuing the potential benefits to local communities and people's happiness due to increased Numbers of seabirds and marine mammals, for example through the potential for eco-tourism opportunities. Natural England are addressing these 'cultural ecosystem service' evidence gaps with projects as part of Defra's Marine Natural Capital and Ecosystem Approach (mNCEA) programme over the next two years. We see real potential to apply natural capital accounting to help support a more holistic ecosystem approach to fisheries management.

Natural England are further developing their in-house capacity for marine ecosystem modelling to continue supporting Defra and delivering ecosystem-based advice in line with UK policy objectives and Natural England priorities. Ecosystem modelling will also be used as part of international collaborations, both as partners in a Horizon Europe project (Ocean ICU: Improving Carbon Understanding), and through participation in multiple ICES working groups.

Figure 1. Sandeels; small eel-like fish, often found in large shoals, with a close association with the sandy substrate into which they bury to protect themselves from predators. Photo: © Paul Naylor.

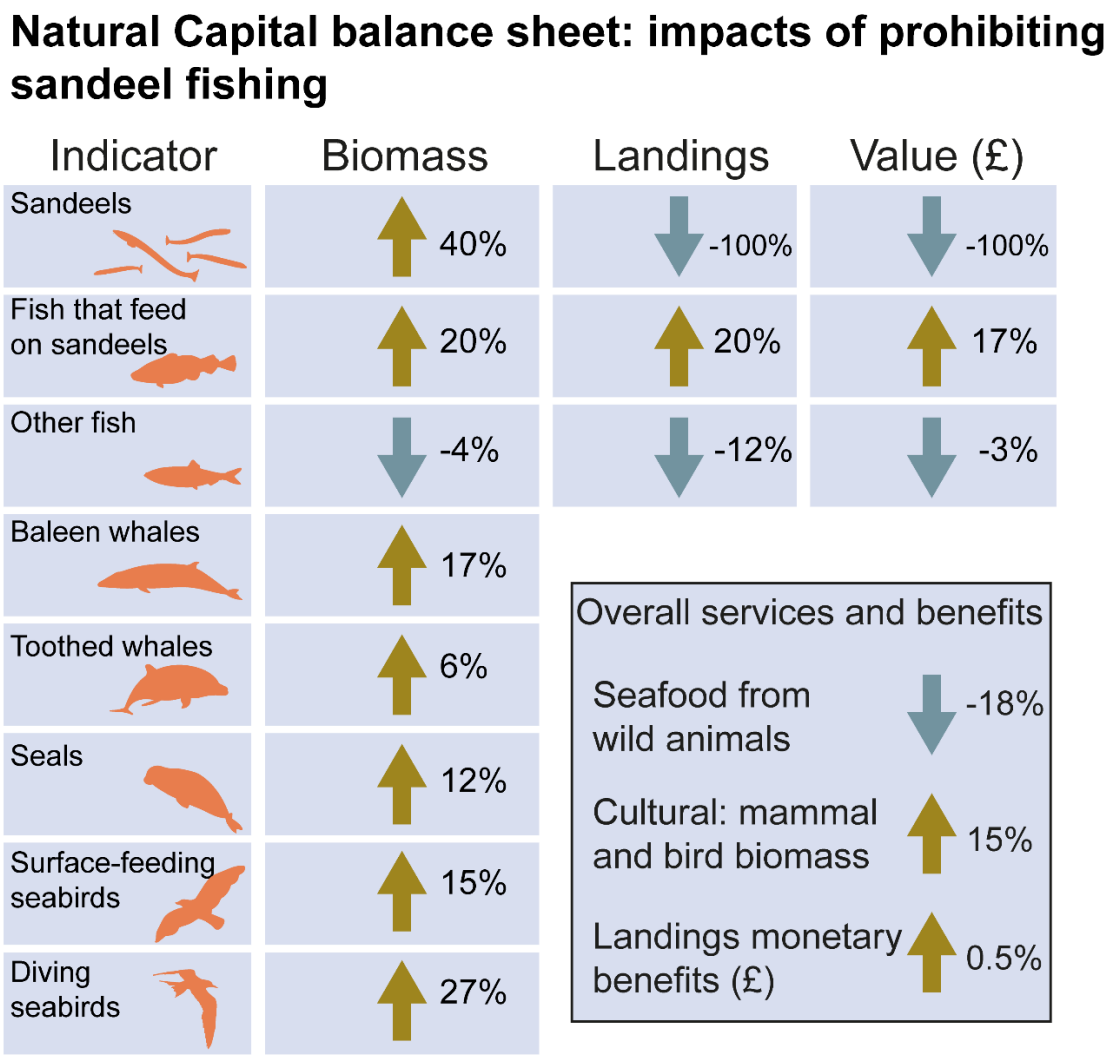


Figure 2. Overview of the Natural Capital extended balance sheet used to assess the impacts of prohibiting sandeel fishing on ecosystem assets, services, benefits, and their economic value.

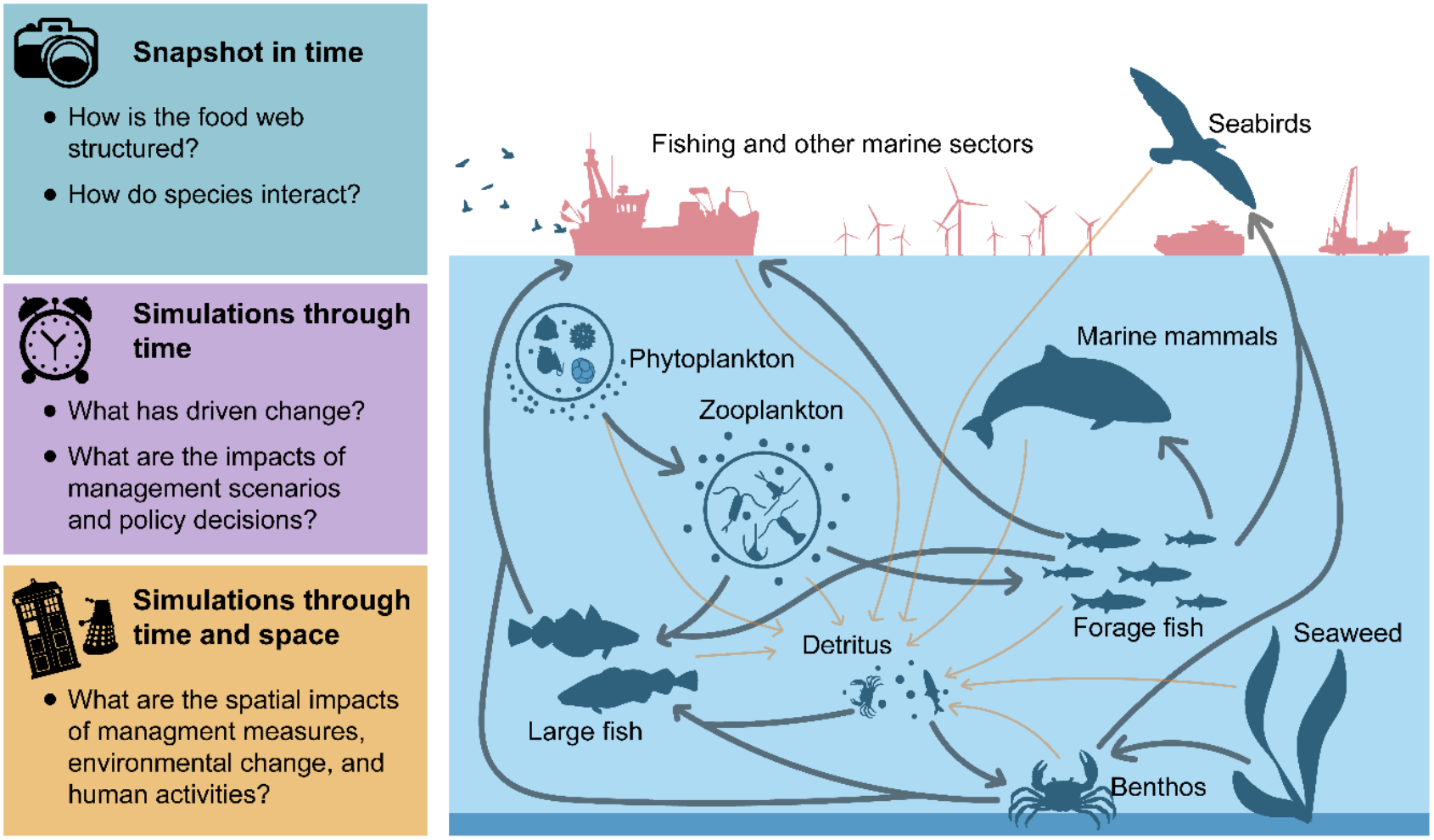


Figure 3. Conceptual diagram of the Ecopath with Ecosim (EwE) food web modelling suite. EwE has three components: Ecopath (snapshot in time), Ecosim (simulations through time), and Ecospace (Simulations through time and space).

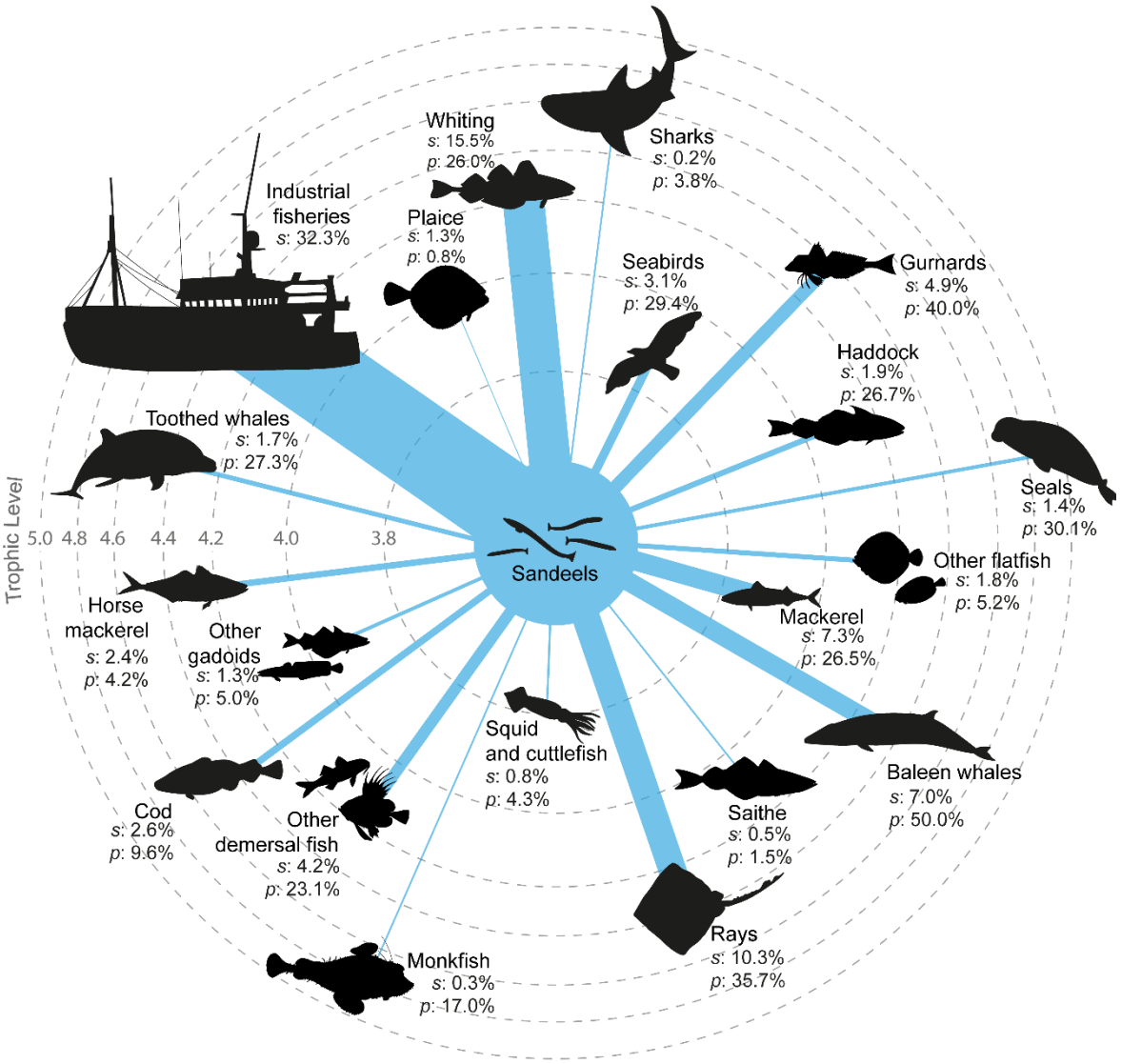


Figure 4. Ecosystem model outputs illustrating the relative biomass flow from sandeels to predators (consumption) and industrial fisheries (fishing mortality) in the North Sea calculated using Ecopath with Ecosim base estimates. Values indicate the proportion of sandeel biomass consumed by predators (s) and the contribution of sandeels to the total consumption of predators (p). Links between sandeels and food web/fishery components are proportional to the flow of biomass from sandeels. Sequential rings highlight the trophic level of the predators which consume sandeels. The trophic level of the industrial fishery is calculated based on fleet catch composition.

Geoconservation: Principles and Practice

Colin Prosser

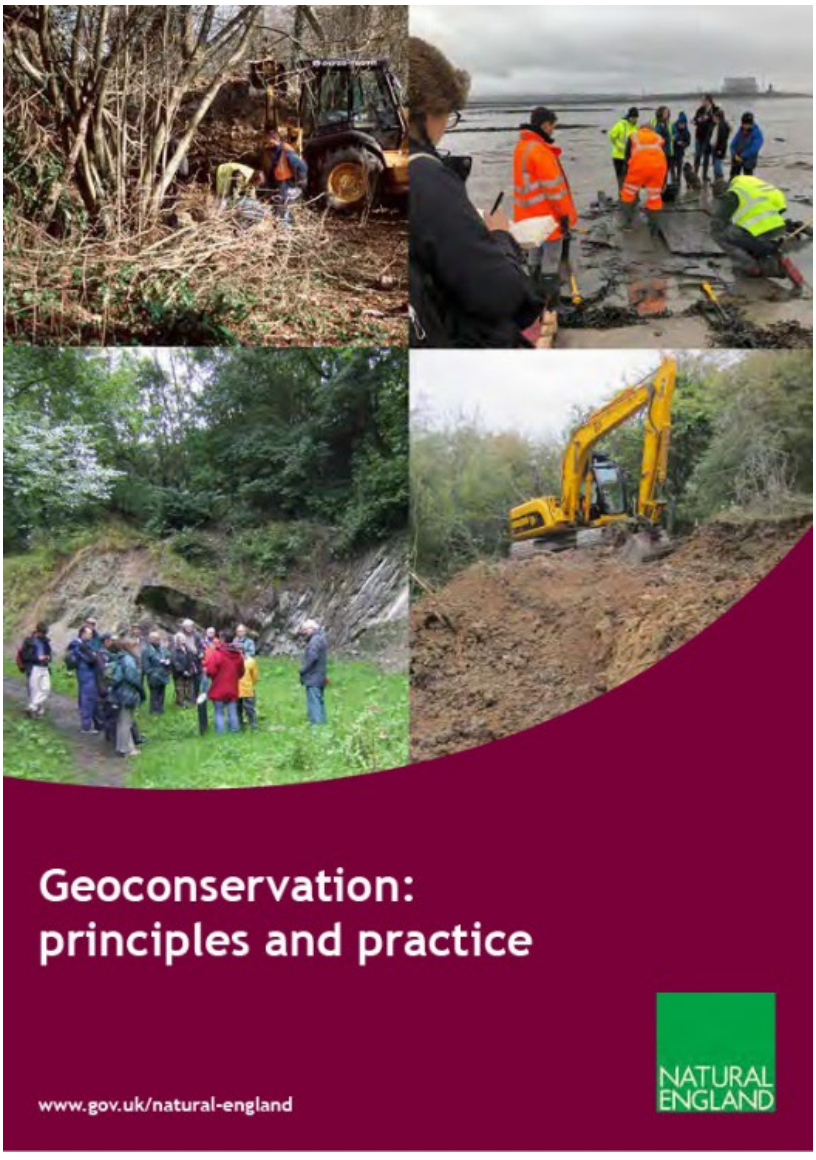
England is extremely geodiverse with numerous geological and geomorphological sites, features and processes of great importance for science, education, recreation and tourism. Our geodiversity is a product of natural processes operating in the past as well as those shaping our landscapes at present. It provides the only record we have of past environmental change and the evolution (and extinctions) of life on Earth. Furthermore, geodiversity underpins and defines the character and distribution of our wide range of varied and locally distinctive landscapes, the nature and distribution of habitats, species and land use, as well as the cultural and social identity and character of different parts of the country. As such, it is extremely important that appropriate action is taken to conserve, manage and celebrate our most important geological and geomorphological features in their own right (as reflected in our protected sites networks) but also for their role as an integral part of nature and of nature recovery.

The publication this year of 'Geoconservation: principles and practice', a downloadable publication authored entirely by Natural England's geoscientists, provides the evidence required to inform and support the decision making and interventions of anyone interested or involved in planning or delivering geoconservation in practice. It substantially updates and expands on a previous publication, now 17 years old, which has been used, adopted and widely cited in scientific literature across the World.

In addition to those involved with the conservation and management of protected sites such as geological/geomorphological Sites of Special Scientific Interest, NNRs, Local Sites or UNESCO Global Geoparks or World Heritage Sites it should also be invaluable to anyone seeking to integrate, conserve or promote geodiversity and geoconservation as part of wider nature recovery projects. A particular strength of the evidence set out is that it draws upon more than seventy years of practical experience accumulated by Natural England and its predecessor bodies, partners and stakeholders. It provides context to geoconservation such as why it matters, how sites are selected for conservation and how conservation legislation is applied, but also focuses on the principles and practice of conserving, managing, and promoting geological and geomorphological features on the ground. It illustrates the challenges, opportunities, threats and solutions associated with practice through real case studies, demonstrating approaches that have worked well, and just as importantly approaches that have not worked so well. It covers a wide range of site types and settings including coastal cliffs, dynamic and static geomorphological features, active and disused quarries, road and rail cuttings, stream sections, caves and mines and buried deposits as well as exploring issues around the responsible collection of fossils and minerals.

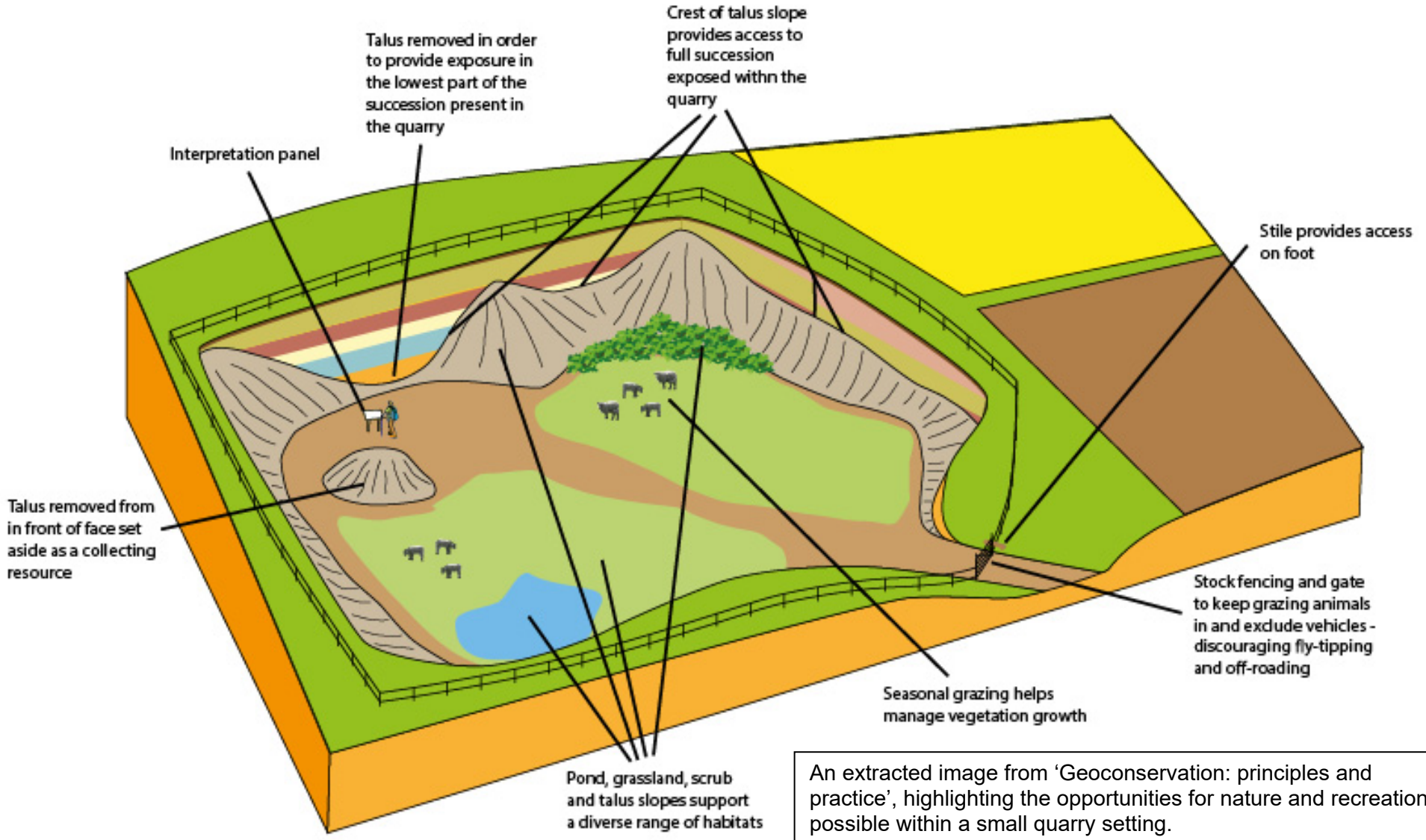
With the condition of ‘geological and geomorphological heritage features’ being an official indicator of the successful delivery of the government’s Environmental Improvement Plan[2] and the government’s expectation that the Nature Recovery Network will achieve ‘reinforcement of geological and cultural diversity of our landscapes’[3] it is hoped that this report will help drive evidence-led delivery of these ambitions.

EVANS, D., Brown, E., Larwood, J., Prosser, C., Silva, B., Townley, H. and Wetherell, A. 2023. Geoconservation: principles and practice. *Natural England General Publication* NE802. ISBN 978-1-78367-390-2. 312 pp.



The front cover of ‘Geoconservation: principles and practice.’ Natural England Report number NE802.

[2] Indicator: G2 - Condition of heritage features including designated geological sites and scheduled monuments - Outcome indicator framework for the 25 Year Environment Plan (defra.gov.uk)
[3] Nature Recovery Network - GOV.UK



An extracted image from 'Geoconservation: principles and practice', highlighting the opportunities for nature and recreation possible within a small quarry setting.

Spotlight on…

Katherine Tonge

What is your first memory of an environmental or conservation issue?

Like a lot of people who grew up in Manchester, I was blown away on my first visit to the Lake District when I was about 11 or 12. It was definitely the point at which I started thinking about working in the environmental sector. At the time, I was mainly struck by the scale and awesomeness of the landscape but when I go back, it's fascinating to read the landscape more by recognising different habitats and whether they're in good condition, observing different types of management and noticing some of the issues and impacts there.

By the time I started high school, climate change was on the curriculum, and I was lucky enough to have geography teachers who made the whole class sit-up and listen about what has become one of the defining challenges of our generation.

What is your role in Natural England and what does it entail?

I'm a Senior Adviser for Regulation in the Protected Sites team in Strategy and Government Advice. I spend most of my time advising the area teams on complex casework, particularly around issuing permissions and preventing damaging activities. I also collaborate with external organisations on best-practice approaches to casework.

How does science and evidence inform what you do?

Difficult decisions about what should and shouldn't be permitted on Protected Sites can impact people's lives and livelihoods. Therefore, it's vitally important that the assessments we carry out to inform our decisions and advice are led by the best, most up-to-date evidence available. This includes everything from peer-reviewed studies on the impacts of different activities to site-specific monitoring data collected by Natural England staff, partners and volunteers. There's often a need for professional judgement to fill the gaps but it's the science and evidence that allows our decisions and advice to be robust, reasonable and defensible.

Integrating DNA delivery across Natural England: testing the waters

Debbie Leatherland and Harriet Knafler

DNA based methods have the potential to significantly change how we monitor and assess the natural world. However, translating relatively new methods from research into routine monitoring requires a coordinated effort. DNA methods are predominantly used within Natural England to monitor great crested newts but expanding these techniques further is a key aim. Equipping Natural England staff with an understanding of when to use DNA techniques and how to interpret the results is an essential step in the introduction of DNA for monitoring. We run regular 'introduction to DNA' training courses, and in 2022 introduced intermediate and advanced courses in DNA taught by experts from the University of Sheffield. This increasing expertise amongst our staff is being put to good use in a wide range of projects using DNA, with the increased knowledge adding value to every stage in the process from specifying contracts to understanding the confidence in the results. One of several areas in which we are working to operationalise DNA methods is for pond monitoring. Ponds are important hotspots of freshwater biodiversity which can be relatively easily monitored using DNA. The Natural Capital and Ecosystem Assessments (NCEA) England Ecosystem Survey ponds pilot collected DNA samples from ponds across the country and generated data on vertebrates, aquatic invertebrates, amphibians and mammals. As this survey expands, it will build a library of DNA samples from ponds throughout England, an invaluable resource for monitoring and research.

The GenePools project, also funded through the NCEA, is using citizen science in combination with DNA technologies to study biodiversity within urban ponds. GenePools engages citizen scientists to take samples from their local garden or community pond, and then uses DNA metabarcoding to detect vertebrates, invertebrates, prokaryotes and microeukaryotes. The project is building a picture of urban freshwater biodiversity which we would not have access to without these techniques.

There are exciting opportunities to use this pond biodiversity data further. We are working in an exciting new partnership project with CEFAS, UK Centre for Ecology and Hydrology, the Freshwater Habitats Trust and an academic partner to analyse new and existing datasets to identify species and groups indicative of pond health, with the ultimate aim of developing novel metrics for pond condition based on DNA data. This will help us to build a picture of pond health across England, and improve our ability to assess pond ecological quality, supporting delivery of our 25-year environment plan goals.

DNA techniques for freshwater are now well developed and tested in the field and becoming more widespread across the organisation. Understanding the limitations of methods is a step on the road to operationalisation. One such limitation is gaps in the reference libraries, meaning we are unable to match all DNA sequences to species, particularly for less studied groups such as invertebrates and microbes. To help address these gaps Natural England is working with the Defra DNA Centre of Excellence in partnership with the Natural History Museum on the UK Barcode of

Life project. This project has the ambitious aim to sequence barcodes of all 75,000 eukaryotic species in the UK, further improving the state of DNA monitoring for the whole community.

Collecting a water sample for eDNA analysis.
Photo: © Natural England/Andy Nisbet

Spotlight on…

Michael Miller

What is your first memory of an environmental or conservation issue?

My first memory of a conservation issue, was a scheme on the family farm that was delivered by Ministry of Agriculture, Fisheries & Food in the early 1980s. Part of one of our fields help some rare species of orchid which was not in existence in other parts of the district and had been protected because my Dad had given up using many pesticides in the late 1960s. I remember scientists descending on the farm to come and study the flora of the field and being quite excited about this pocket of conserved plant life.

What is your role in Natural England and what does it entail?

I am a Team Leader for Sustainable Development, Marine and Tree Action Plan Delivery. My job entails ensuring statutory casework is delivered to a high quality to agreed deadlines, whilst ensuring staff develop and enhance their roles through learning and maximising their potential. I look after their pastoral care and ensure all training needs are met, whilst ensuring they maintain job satisfaction in their roles.

How does science and evidence inform what you do?

When assessing consultations for development and Marine and Tree Action Plan Delivery proposals, data and resources are vitally important – in that they inform, enhance, and provide context to everything we do. They signpost to what our advice will be in each and every scenario and inform decisions on how we can proactively enhance and protect the natural environment.

Botanical Heatmaps: using volunteer records to identify valuable botanical sites for nature recovery and preservation

Becky Trippier

Natural England has been working with the Botanical Society of Britain and Ireland (BSBI) to develop new mapping products derived from their volunteer plant records. The project will help inform tree planting and woodland establishment decisions on a national scale and add to the UK Government's ambition to increase tree and woodland cover in England from 14 to 17%. This will more than treble annual planting rates by 2050, representing a major shift in land use policy.

Recording *Carex muricata*. Photo: © BSBI/Pete Stroh

As well as enhancing carbon sequestration, new woodlands and trees have a pivotal role in supporting nature recovery, by increasing structural complexity of landscapes. Where and how we establish these woodlands profoundly influences their value for the range of public benefits sought; crucially their locations need to be carefully targeted to ensure they do not negatively impact habitats which are important for biodiversity and carbon storage.

As part of the Natural Capital and Ecosystem Assessment (NCEA) programme, we have been working in partnership with the BSBI to utilise their vascular plant datasets, collected by their network of expert volunteers.

The new maps help to identify areas of high botanical value and highlight sites where nationally Rare, Scarce and Threatened (RST) species are known to occur. By doing so, they help ensure such areas are appropriately considered and protected when making land management decisions likely to impact such sites, like tree planting schemes.

Two new data products have been produced to help support land management decision making:

1. The 'Botanical Heatmaps' summarise data at the 100m scale for nationally RST plant species, and at the 1km scale for Priority Habitat Positive Indicator species – these are species that reliably indicate the presence of high-quality, semi-natural habitat. These heatmaps provide valuable insights into the locations and types of habitat present, with the finer scale records helping to locate areas of interest for species of conservation concern, and therefore requiring more detailed site assessment.
2. The 'Summarised Botanical Value Map' further reviews this data, assigning a simple 'High', 'Moderate' and 'Low' value score to each 1km grid square. This map provides a more easily interpretable view for the general public. Although not suitable for detailed site assessment, this map is ideal for high-level spatial planning on a landscape scale. The map has now been made available under an Open Government Licence and is widely available on our data platforms, including MAGIC and Natural England's Open Data Portal.

These maps have been created through partnership with the BSBI focussing on ensuring better protection for important plant sites and demonstrating the value of close partnership working between Government bodies and national recording schemes. Development of these new products was only possible due to the high-quality species data collected nationally by BSBI volunteers, highlighting the importance of biological data recording and how working alongside expert recording societies can help support policy decision making on the ground. The value of these data is also enhanced by collection at high-resolution; the datasets used to create these products only include records captured at the 1km spatial resolution or higher.

Both datasets have been made available to Natural England staff and the Botanical Value Map has been widely published. Due to the sensitivity of the botanical heatmap species data, the team are working alongside BSBI to ensure key stakeholders can access these valuable data securely. It is anticipated that both products will have a wide range of uses, for example, providing evidence for site inclusion in the Ancient Woodland Inventory update.

More information on how the maps have been created is available on the Natural England Access to Evidence Catalogue page 'Botanical Heatmaps and the Botanical Value Map: Technical Report (NERR110)'. If you have any questions, please contact the team at botanicalheatmaps@naturalengland.org.uk.

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