

Section 2: Monitoring the Natural World

We love the great outdoors and our survey shows it: Monitor of engagement with the natural environment

- 1) NATURAL ENGLAND, DEFRA & FORESTRY COMMISSION. 2015. Monitor of Engagement with the Natural Environment: The national survey on people and the natural environment. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/481299/mene-headline-report-2014-15.pdf
- 2) NATURAL ENGLAND. 2015. Visits to the natural environment in East London: Analysis of data from the Monitor of Engagement with the Natural Environment survey (2009-13) (NECR 167). <http://publications.naturalengland.org.uk/search?q=NECR167&num=100>
- 3) NATURAL ENGLAND. 2014. Monitor of Engagement with the Natural Environment survey (2009 - 2012): Visit taking in the South Pennines (NECR150). <http://publications.naturalengland.org.uk/publication/4535521443315712>

- 4) NATURAL ENGLAND. 2015. Monitor of Engagement with the Natural Environment: a pilot for an indicator of visits to the natural environment by children - interim findings from Year 1 (March 2013 to February 2014) (NECR166). <http://publications.naturalengland.org.uk/publication/4781405798137856>

The Predatory Bird Monitoring Scheme

- 5) WALKER, L.A., J.S. CHAPLOW, POTTER, E.D., & SHORE, R.F. (2014). [PBMS archive holdings: a Predatory Bird Monitoring Scheme \(PBMS\) report](#). Lancaster: Centre for Ecology & Hydrology
- 6) SHORE, R.F., PEREIRA, M.G., POTTER, E.D. and WALKER, L.A. 2015. Monitoring rodenticide residues in wildlife. In A.P. Buckle and R.H. Smith, eds. *Rodent pests and their Control: 2nd edition*, 346-365. Wallingford: CAB International
- 7) WALKER, L.A., CHAPLOW, J.S., MOECKEL, C., PEREIRA, M.G., POTTER, E.D. & SHORE, R.F. 2015. [Anticoagulant rodenticides in sparrowhawks: a Predatory Bird Monitoring Scheme \(PBMS\) report](#). Lancaster: Centre for Ecology & Hydrology
- 8) SHORE, R.F., HENRYS, P.A. & WALKER, L.A. 2014. [Power analysis of liver second generation anticoagulant rodenticide \(SGAR\) residue data in barn owls from Britain: a Predatory Bird Monitoring Scheme \(PBMS\) report](#). CEH contract report to the Health & Safety Executive. Lancaster: Centre for Ecology & Hydrology



- 9) LESLIE, H.A., LEONARD, P.E.G., SHORE, R.F., WALKER, L.A., BERSUDER, P.R.C., MORRIS, S., ALLCHIN, C.R. & DE BOER, J. 2011. Decabromodiphenylether and hexabromocyclododecane in wild birds from the United Kingdom, Sweden and the Netherlands: screening and time trends. *Chemosphere*, 82, 88-95
- 10) CROSSE, J.D., SHORE, R.F., JONES, K.C., & PEREIRA, M.G. 2012. Long term trends in PBDE concentrations in gannet (*Morus bassanus*) eggs from two UK colonies. *Environmental Pollution*, 161, 93-100.
- 11) CROSSE, J.D., SHORE, R.F., JONES, K.C., PEREIRA, M.G. 2013. Key factors affecting liver PBDE concentrations in sparrowhawks (*Accipiter nisus*). *Environmental Pollution*, 177, 171-176.
- 12) CROSSE, J.D., SHORE, R.F., WADSWORTH, R.A., JONES, K.C. & PEREIRA, M.G. 2012. Long term trends in PBDEs in sparrowhawk (*Accipiter nisus*) eggs indicate sustained contamination of UK terrestrial ecosystems. *Environmental Science & Technology*, 46, 13504-1351
- 13) WALKER, L.A., PEREIRA, M.G., POTTER, E.D., LACORTE, S. & SHORE, R.F. 2015. **Perfluorinated compound (PFC) concentrations in northern gannet eggs 1977-2014: a Predatory Bird Monitoring Scheme (PBMS) report**. Lancaster: Centre for Ecology & Hydrology
- 14) CENTRE FOR ECOLOGY & HYDROLOGY. 2014. Predatory Bird Monitoring Scheme – Posters <https://wiki.ceh.ac.uk/display/pbms/Posters>
- 15) WALKER, L.A., GRANT, H.K, HUGHES, D., LAWLOR, A.J., PEREIRA, M.G., POTTER, E.D. & SHORE R.F. 2015. **Mercury (Hg) concentrations and stable isotope signatures in golden eagle eggs 2009-2013: a Predatory Bird Monitoring Scheme (PBMS) report**. Lancaster: Centre for Ecology & Hydrology, Lancaster
- 16) NATURAL ENGLAND. 2008. State of the natural environment 2008. Sheffield: Natural England
- 17) PREDATORY BIRD MONITORING SCHEME. 2014. *Recent PBMS reports*. <https://wiki.ceh.ac.uk/display/pbms/Recent+PBMS+reports?atoken=22afe8afcb9dob6co3534c366a908f5d65a53b33>
- 18) A list of scientific papers based on PBMS data can be found at: <https://wiki.ceh.ac.uk/display/pbms/Scientific+Papers?atoken=22afe8afcb9dob6co3534c366a908f5d65a53b33> and through the NERC Open Research Archive: <http://nora.nerc.ac.uk/>.
- 19) UK NATIONAL WILDLIFE CRIME UNIT. undated. *Current UK priorities*. <http://www.nwcu.police.uk/what-are-priorities-and-intelligence-requirements/priorities/>



The Geological Conservation Review: Underpinning geological and geomorphological SSSIs with evidence

- 20) ELLIS, N.V., BOWEN, D.Q., CAMPBELL, S., KNILL, J.L., MCKIRDY, A.P., PROSSER, C.D., VINCENT, M.A. AND WILSON, R.C.L., 1996 An introduction to the Geological Conservation Review. Geological Conservation Review Series, 1, Joint Nature Conservation Committee, Peterborough, 131pp.
- 21) ELLIS, N., 2011. The Geological Conservation review (GCR) in Great Britain – Rationale and methods. Proceedings of the Geologists' Association. 122, 353-362.

Section 3: Practical Solutions

Reintroducing the dormouse to its former range

- 1) CHANIN, C. 2014. **The Dormouse reintroduction programme**: a review. Natural England Commissioned Report NECR144. Sheffield: Natural England

The return of beavers to the River Otter

- 2) JONES, C.G., LAWTON, J.H., & SHACHAK M. 1994. Organisms as ecosystem engineers. *OIKOS*, 69, 373-386
- 3) ROSELL, F., BOZSÉR, O., COLLEN, P. & PARKER, H. 2005. Ecological impacts of beavers *Castor fiber* and *Castor canadensis* and their ability to manage ecosystems. *Mammal Review*, 35 (3 & 4), 248-276
- 4) DEVON WILDLIFE TRUST. 2013. *The Devon Beaver Project, the story so far...* Cricklepit Mill: Devon Wildlife Trust
- 5) PUTTOCK, A. & BRAZIER, R. unpublished. Devon Beaver Project Update, March 2015. University of Exeter
- 6) GURNELL, J., GURNELL, A.M, DEMERITT, D., LURZ, P.W.W., SHIRLEY, M.D.F., RUSHTON, S.P., FAULKES, C.G., NOBERT, S. & HARE, E.J. 2009. The feasibility and acceptability of reintroducing the European beaver to England. Natural England Commissioned Report NECR002. Sheffield: Natural England



- 7) IUCN/SSC. 2013. *Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0.* Gland, Switzerland: IUCN Species Survival Commission

Saving the freshwater pearl mussel

- 8) CUTTELOD, A., SEDDEN, M. & NEUBERT E. 2011. European Red List of Non-marine Molluscs. Publications office of the European Union, Luxembourg.
- 9) YOUNG, M.R. 1991. Conserving the freshwater pearl mussel (*Margaritifera margaritifera* L.) in the British Isles and continental Europe. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 1, 73–77.
- 10) BARNFATHER, N., MEASURES, G. & FOWLES, A. 2010. A conservation plan for freshwater pearl mussel *Margaritifera margaritifera* populations in England and Wales. (Unpublished report available on request)
- 11) CAUWELIER, E., VERSPOOR, E., TARR, E.C., THOMPSON, C. & YOUNG, M. 2009. *Genetic diversity and differentiation of freshwater pearl mussel (Margaritifera margaritifera) populations in the UK.* Scottish Natural Heritage Commissioned Report No.344. Inverness: Scottish Natural Heritage

Managing the disease risks of moving wild animals

- 7) IUCN/SSC. 2013. *Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0.* Gland, Switzerland: IUCN Species Survival Commission

Conserving farmland birds through agri-environment schemes

- 12) DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS (DEFRA) 2015. **Wild bird populations in England, 1970 – 2014. Annual statistical release.** Defra, London
- 13) WILSON, J.D., EVANS, A.D. & GRICE, P.V. 2009. *Bird Conservation and Agriculture.* Cambridge: Cambridge University Press
- 14) VICKERY, J.A., BRADBURY, R.B., HENDERSON, I.G., EATON, M.A. & GRICE, P.V. 2004. The role of agri-environment schemes and farm management practices in reversing the decline of farmland birds in England. *Biological Conservation*, 119, 19-39.
- 15) SIRIWARDENA, G.M., BAILLIE, S.R., CRICK, H.Q.P., WILSON, J.D. & GATES, S. 2000. The demography of lowland farmland birds. In: N.J. AEBISCHER, A.D. EVANS, P.V. GRICE & J.A. VICKERY, eds. *Ecology and Conservation of Lowland Farmland Birds*, 117-133. Tring: British Ornithologist



- 16) HINSLEY, S. A., NOWAKOWSKI, M., HEARD, M.S., BELLAMY, P.E., BROUGHTON, R.K., HULMES, S., HULMES, L., PEYTON, J. & PYWELL, R.F. 2010. Performance and effectiveness of winter bird food patches established under Environmental Stewardship: results from the Hillesden Experiment. *Aspects of Applied Biology*, 100, 151-158
- 17) SIRIWARDENA, G.M., STEVENS, D.K., ANDERSON, G.Q.A., VICKERY, J.A., CALBRADE, N.A. & DODD, S. 2007. The effect of supplementary winter seed food on breeding populations of farmland birds: evidence from two largescale experiments. *Journal of Applied Ecology*, 44, 920-932
- 18) HOLE, D. G., WHITTINGHAM, M.J., BRADBURY, R.B., ANDERSON, G.Q.A., LEE, P.L.M., WILSON, J.D. & KREBS, J.R. 2002. Widespread local house-sparrow extinctions. *Nature*, 418, 931-932
- 19) NATURAL ENGLAND, BRITISH TRUST FOR ORNITHOLOGY & RSPB. Unpublished data
- 20) BRIGHT, J.A., MORRIS, A.J., FIELD, R.H., COOKE, A.I., GRICE, P.V., WALKER, L.K., FERN, J., & PEACH, W.J. 2015. Higher-tier agri-environment scheme enhances breeding densities of some priority farmland birds in England. *Agriculture, Ecosystems and Environment*, 203, 69–79
- 21) BAKER, D.J., FREEMAN, S.N., GRICE, P.V. & SIRIWARDENA, G.M. 2012. Landscape-scale responses of birds to agri environment management: a test of the English Environmental Stewardship scheme. *Journal of Applied Ecology*, 49, 871–882
- Optimising agri-environment schemes: what works for moths?**
- 22) ALISON, J., DUFFIELD, S. J., VAN NOORDWIJK, C. G. E., MORECROFT, M. D., MARRS, R. H., SACCHERI, I. J. and HODGSON, J. A. (2016). **Spatial targeting of habitat creation has the potential to improve agri-environment scheme outcomes for macro-moths.** *Journal of Applied Ecology*, Early view. <http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12750/full>



Section 4: New Approaches

Predictive modelling of great crested newt distribution in Woking

- 1) Timothy P. Jurka and Yoshimasa (2013). Maxent: Low-memory Multinomial Logistic Regression with Support for Text Classification. R package version 1.3.3.1. <http://CRAN.R-project.org/package=maxent>

Which species might win and which might lose under climate change?

- 2) PEARCE-HIGGINS, J.W., AUSDEN, M.A., BEALE, C.M., OLIVER, T.H. & CRICK, H.Q.P. (eds). 2015. *Research on the assessment of risks & opportunities for species in England as a result of climate change*. Natural England Commissioned Reports, Number 175. Sheffield: Natural England. <http://publications.naturalengland.org.uk/publication/4674414199177216?category=10003>

Investigating potential refugia from climate change

- 3) SUGGITT, A.J., WILSON, R.J., AUGUST, T.A., BEALE, C.M., BENNIE, J.J., DORDOLO, A., FOX, R., HOPKINS, J.J., ISAAC, N.J.B., JORIEUX, P., MACGREGOR, N.A., MARCETTEAU, J., MASSIMINO, D., MORECROFT, M.D., PEARCE-HIGGINS, J.W., WALKER, K. & MACLEAN, I.M.D. 2014. *Climate change refugia for the flora and fauna of England*. Natural England Commissioned Reports, Number 162. Sheffield: Natural England
- 4) MACLEAN IMD, SUGGITT AJ, WILSON RJ, DUFFY JP, BENNIE JJ (2016) Fine-scale climate change: modelling spatial variation in biologically meaningful rates of warming. *Global Change Biology*. DOI: 10.1111/gcb.13343

- 5) MACLEAN IMD, HOPKINS JJ, BENNIE J, LAWSON CR, WILSON RJ (2015). Microclimates buffer the responses of plant communities to climate change. *Global Ecology and Biogeography*, 24: 1340-1350. DOI: 10.1111/geb.12359

Can we increase species resilience to climate change through landscape scale conservation?

- 6) MORECROFT, M.D., CRICK, H.Q.P., DUFFIELD, S. J. & MACGREGOR, N.A. 2011. Resilience to climate change: translating principles into practice. *Journal of Applied Ecology*, 49, 547-551
- 7) OLIVER, T., GIRARDELLO, M., REDHEAD, R., ROY, D., GILLINGS, S., NEWSON, S., PEARCE-HIGGINS, J., SIRIWARDENA, G., HARLEY, M., HODGSON, N., MORECROFT, M.D., DUFFIELD, S.J. & CRICK, H.Q.P. 2013. Testing the effectiveness of climate change adaptation principles for biodiversity conservation. *Natural England Commissioned Reports*, Number 112. Sheffield: Natural England
- 8) OLIVER, T., MARSHALL, H., HUNTINGFORD, C., PRUDHOMME, C., PEARCE-HIGGINS, J., MARTAY, B., CROWE, A., DUFFIELD, S.A. & MORECROFT, M.D. 2015. *The role of landscape and site scale characteristics in making species populations resilient to climate change and extreme events*. Natural England Commissioned Reports, Number 149. Sheffield: Natural England
- 9) OLIVER, T. H., MARSHALL, H. H., MORECROFT, M. D., BRERETON, T., PRUDHOMME, C. & HUNTINGFORD, C. 2015. Interacting effects of climate change and habitat fragmentation on drought-sensitive butterflies. *Nature Climate Change*, 5, 941-945.



- 10) NEWSON, S. E., OLIVER, T. H., GILLINGS, S., CRICK, H. Q. P., MORECROFT, M. D., DUFFIELD, S. J., MACGREGOR, N. A. & PEARCE-HIGGINS, J. W. 2014. Can site and landscape-scale environmental attributes buffer bird populations against weather events? *Ecography*, 37, 872-882
- 11) SUSSEX INSHORE FISHERIES AND CONSERVATION AUTHORITY (IFCA). (2015). *Sussex IFCA Protected Areas Byelaw and associated Regulatory Notice 1 (2015): Kingmere Marine Conservation Zone Impact Assessment*. SXIFCA003
- 12) COOKE, S.J. & COWX, I.G., 2004. The role of recreational fisheries in global fish crises. *BioScience*, 54, 857-859
- 13) LLOMPART, F.M., COLAUTTI, D.C. and BAIGÚN, C.R.M. 2012. Assessment of a major shore-based marine recreational fishery in the southwest Atlantic, Argentina. *New Zealand Journal of Marine and Freshwater Research*, 46(1), 57-70
- 14) ARMSTRONG, M. & HYDER, K. 2013. *Sea angling 2012 – a survey of recreational sea angling activity and economic value in England*. London: Defra
- 15) de MITCHESON, Y.S. 2016. Mainstreaming fish spawning aggregations into fishery management calls for a precautionary approach. *BioScience*, 66: 295-306.
- 16) BARTHOLEMUEW, A. & BOHNSACK, J.A., 2005. A review of catch-and-release angling mortality with implications for no-take reserves. *Reviews in Fish Biology and Fisheries*, 15(1-2), 129-154
- 17) WILSON D. 1958. Notes from the Plymouth Aquarium. *Journal of the Marine Biological Association of the UK*, 37, 299-307
- 18) COLLINS, K.J.C. and MALLINSON, J.J. 2012. Surveying black bream, *Spondyliosoma cantharus* (L.) nesting sites using sidescan sonar. *Underwater Technology*, 30(4), 183-188
- 19) DOGGETT, M., and OPENSHAW, M. 2016. The Black Bream Project: revealing the secrets of black bream breeding behaviour off the Dorset coast <http://www.mattdoggett.com/the-black-bream-project/>
- 20) ARLINGHAUS, R., COOKE, S.J., LYMAN, J., POLICANSKY, D., SCHWAB, A., SUSKI, C., SUTTON, S.G., THORSTAD, E.B. 2007. Understanding the complexity of catch-and-release in recreational fishing: an integrative synthesis of global knowledge from historical, ethical, social, and biological perspectives. *Reviews in Fisheries Science*, 15, 75-167
- 21) PINDER, A.C., VELTEROP, R., COOKE, S.J. & BRITTON, J. R. (2016). Consequences of catch-and-release angling for black bream *Spondyliosoma cantharus*, during the parental care period: implications for management ICES J. Mar. Sci. 2016
- 22) HM GOVERNMENT. 2011. The Natural Choice: securing the value of nature. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228842/8o82.pdf

Studying the ecology and conservation needs of black bream

Travelling on the wild side: green transport corridors research has wide-reaching impacts

- 23) NATURAL ENGLAND. 2014. Review of literature: how transport's soft estate has enhanced green infrastructure, ecosystem services, and transport resilience in the EU (NECR169) <http://publications.naturalengland.org.uk/publication/5752930789490688>
- 24) NATURAL ENGLAND. 2014. NEWP32 Transport green corridors: options appraisal and opportunity mapping (NECR168) <http://publications.naturalengland.org.uk/publication/5485064148221952>
- 25) DEFRA. 2010. Making Space for nature. <https://www.gov.uk/government/news/making-space-for-nature-a-review-of-englands-wildlife-sites-published-today>
- 26) DEFRA. 2014. The National Pollinator Strategy: for bees and other pollinators in England. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/409431/pb14221-national-pollinators-strategy.pdf
- 27) NATURAL ENGLAND. 2015. Green Bridges: A literature review (NECR181). <http://publications.naturalengland.org.uk/publication/6312886965108736>
- 28) LANDSCAPE INSTITUTE. 2015. Green Bridges. Technical Guidance Note. http://www.landscapeinstitute.org/knowledge/documents/TGN9_15GreenBridgesGuide_LI.pdf

Cultural 'heat maps' show what people value about their local landscapes

- 29) NATURAL ENGLAND. 2015. Econets, landscape & people: Integrating people's values and cultural ecosystem services into the design of ecological networks and other landscape change proposals (NECR180). <http://publications.naturalengland.org.uk/publication/6172716216352768>

A new narrative for freshwater and wetland ecosystems

- 30) MAINSTONE, C., HALL, R. & DIACK, I. 2016. A narrative for conserving freshwater and wetland habitats in England. *Natural England Research Reports, Number 064*.



Section 5: Sharing our Science and Evidence

What matters where: putting ecosystem services on the map

- 1) NATURAL CAPITAL COMMITTEE. 2014. The State of Natural Capital: Restoring our Natural Assets. Second report to the Economic Affairs Committee. <http://www.naturalcapitalinitiative.org.uk/wp-content/uploads/2014/06/1fo6ffa9eafoaf134d7022af36fe17cf.pdf>
- 2) NATURAL ENGLAND. 2014. Assessing the potential for mapping ecosystem services in England based on existing habitats (NERRO56). <http://publications.naturalengland.org.uk/publication/5280919459987456?category=7005>

Documenting the impacts of climate change on biodiversity

- 3) MORECROFT, M.D. & SPEAKMAN, L. 2015. *Biodiversity climate change impacts summary report*. Living with Environmental Change
- 4) MARINE CLIMATE CHANGE IMPACTS PARTNERSHIP (MCCIP). 2015. Annual report card and briefing notes. <http://www.mccip.org.uk/annual-report-card/>

Assessing and mapping vulnerability of the natural environment to climate change

- 5) TAYLOR, S., KNIGHT, A. & HARFOOT, A. 2014. National biodiversity climate change vulnerability model. Natural England Research Report NERRO54. Natural England <http://publications.naturalengland.org.uk/publication/5069081749225472>

Helping conservation practitioners respond to climate change

- 6) NATURAL ENGLAND & RSPB. 2014. Climate Change Adaptation Manual. Sheffield: Natural England
- 7) AUSDEN, M. 2014. Climate change adaptation: putting principles into practice. *Environmental Management*, 54, 685-698
- 8) MACGREGOR, N.A. & VAN DIJK, N. 2014. Adaptation in practice: how managers of conservation areas in eastern England are responding to climate change. *Environmental Management*, 54, 700-719

Mapping seabird sensitivity to offshore wind farms

- 9) BRADBURY G, TRINDER M, FURNESS B, BANKS AN, CALDOW RWG, HUME D (2014). [Mapping Seabird Sensitivity to Offshore Wind Farms](#). PLoS ONE 9(9): e106366. Doi:10.1371/journal.pone.0106366

Managing for people, places and wildlife: Ecosystem Transfer Toolkit

- 10) NATURAL ENGLAND. 2014. Ecosystem Services Transfer Toolkit (NECR159). <http://publications.naturalengland.org.uk/publication/5890643062685696>



Annex 2: Acknowledgements

This annex lists all the people and organisations who contributed to writing individual articles or sections of this report, to producing figures, or to carrying out the scientific work described in the articles. The authors are listed first, then all other contributors in alphabetical order. Contributors from outside Natural England are shown in italic text.

Section 1: Foreword and Introduction

Tim Hill	Nick Dales
Pete Brotherton	Helen Doran
<i>Andy Clements (BTO, NESAC)</i>	Gary Kass
Corrie Bruemmer	Nick Macgregor

Section 2: Monitoring the natural world

Long term monitoring of the natural environment

John Holdsworth	Rob Keane
Christoph Kratz	

We love the great outdoors and our survey shows it: Monitor of engagement with the natural environment

Katie Allen	Hazel Thomas
-------------	--------------

Citizen science on National Nature Reserves:

Bog Hoppers, crickets and grasshoppers

Ash Murray	<i>Stuart Newson (BTO)</i>
Jim Allitt	<i>Sonia Reveley (NNR volunteer)</i>
<i>Jamie McDonald (NNR volunteer)</i>	

Natural England's Dive team

Kevan Cook

Using novel survey techniques to estimate populations of red-throated divers in Marine Protected Areas

Richard Caldow

The Predatory Bird Monitoring Scheme

Susan Zappala	Peter Karner
Alastair Burn	<i>Richard Shore (CEH)</i>

Monitoring how environmental stewardship affects landscape character and quality

David Vose	<i>Roy Haines-Young (Land Use Consultants)</i>
Andrew Baker	<i>Sally Marshall (Land Use Consultants)</i>
Chris Bolton	<i>Carys Swanwick (Land Use Consultants)</i>
Sarah Manning	

The Geological Conservation Review: Underpinning geological and geomorphological SSSIs with evidence

Jonathan Larwood	Colin Prosser
Hannah Townley	Naomi Stevenson



Section 3: Practical Solutions

Reintroducing the dormouse to its former range

Kate Morris

*The Common Dormouse Captive
Breeders Group*

Lydia Cradick

Institute of Zoology

Paignton Zoo Environmental Park

People's Trust for Endangered Species

The return of beavers to the River Otter

Elaine Gill

The first translocation of the wart-biter in England

Jon Curson

Oliver Cheesman

Richard Dyer (South-East Water)

Malcolm Emery

Sarah Henshall (Buglife)

Saving the freshwater pearl mussel

Gavin Measures

*Freshwater Biological Association
Environment Agency*

Marine Scotland

Natural Resources Wales

Scottish Natural Heritage

Managing the disease risks of moving wild animals

Katherine Walsh

Zoological Society of London (ZSL)

Conserving farmland birds through agri-environment schemes

Phil Grice

British Trust for Ornithology

RSPB

What works for moths?

Jamie Alison (PhD student)

Liverpool University

Simon Duffield

Jenny Hodgson (Liverpool University)

Mike Morecroft

Carboniferous revisited

Jonathan Larwood

Colin Prosser

Designating new places for their natural beauty and opportunities for outdoor recreation: extending the Lake District and Yorkshire Dales National Parks

David Vose

Susannah England

Alison Farmer Associates

Julie Martin Associates

Designating Marine Conservation Zones

James Highfield

Ross Bullimore

Ian Saunders

Tammy Smalley

Assessing the impacts of development on marine mammals

Rebecca Walker

Sonia Mendes (JNCC)

SMRU Consulting



**A bee's eye view of sustainable living:
green infrastructure design at Barking Riverside**

Samantha Davenport

**The long and winding path:
evidence behind the creation of the England coast path**

Chris Burstow

Section 4: New Approaches

The nose knows: great crested newt detection dogs

Corrie Bruemmer

Aran Clyne (Conservation Dogs)

David Orchard (Salford University)

Using DNA in species identification

Keith Porter

Predictive modelling of great crested newt distribution in Woking

Richard Alexander

**Changing behaviours to benefit farmers and wildlife:
the importance of social science**

Jilly Hall

**Gaining your wings:
how to become a Natural England qualified drone pilot**

Paul Thomas

**Working better together:
the Defra futures partnership**

Helen Doran

SAMI Consulting

Which species might win and which might lose under climate change?

Humphrey Crick
 Malcolm Ausden (RSPB)
 Colin Beale (York University)
 Richard Bradbury (RSPB)
 Matthew Carroll (York University)
 Lydia Cradick
 Simon Duffield
 Nick Macgregor
 Dario Massimino (BTO)
 Colin McClean (York University)

Mike Morecroft
 Nancy Ockenden (BTO)
 Tom Oliver (CEH)
 James Pearce Higgins (BTO)
 Joanna Savage (CEH)
 Richard Smithers (Ricardo-AEA Ltd)
 Chris Thomas (York University)
 Kevin Watts (Forest Research)
 Olly Watts (RSPB)

Investigating potential refugia from climate change

Nick Macgregor
 Tom August (CEH)
 Colin Beale (York University)
 Jonathan Bennie (Exeter University)
 Nigel Brown
 Humphrey Crick
 Simon Duffield
 Richard Fox (Butterfly Conservation)

John Hopkins (Exeter University)
 Nick Isaac (CEH)
 Ilya Maclean (Exeter University)
 Mike Morecroft
 Andrew Suggitt (Exeter University)
 Kevin Walker (Botanical Survey of
 Britain and Ireland)
 Rob Wilson (Exeter University)

Can we increase species resilience to climate change through landscape-scale conservation?

Mike Morecroft
 Humphrey Crick
 Simon Duffield

Nick Macgregor
 Stuart Newson (BTO)
 Tom Oliver (CEH)

Studying the ecology and conservation needs of black bream

Randolph Velterop
 Robert Britton (Bournemouth University)
 Steven Cooke (Carleton University)

Matt Doggett (Wildlife Photographer)
 Martin and Sheilah Openshaw (Stardis)
 Adrian Pinder (Bournemouth University)

Travelling on the wild side:

green transport corridors research has wide-reaching impacts

Clare Warburton
 Nick White
 Kate Ahern (Land Use Consultants)
 Sarah Bassett (Land Use Consultants)
 Liz Bingham
 Mark Cleaver (Yorkshire Wildlife Trust)
 Kathleen Covill
 Sheena Crombie (Highways England)
 Helen Davies (ADAS UK)
 Bart Donato

Marion Frandsen (ADAS UK)
 Tim Graham (Yorkshire Wildlife Trust)
 Jamie Normington (Cumbria Wildlife
 Trust)
 Judy Palmer (Cumbria Wildlife Trust)
 Sue Plaxton
 Stephen Russell (Landscape Institute)
 Tony Sangwine (Highways England)
 Neil Strong (Network rail)
 Mike Wilkinson

Cultural 'heat maps' show what people value about their local landscapes

Andy Wharton
 Bart Donato
 Helen Davies (ADAS UK)
 Roger English (South Devon AONB)
 Alson Fleming (Research Box)
 Marion Frandsen (ADAS UK)

Hugh Inwood (Research Box)
 John Martin (Plymouth University)
 Stuart Pasley
 Gloria Pungetti (Cambridge University
 Centre for Landscape and People)

A new narrative for freshwater and wetland ecosystems

Chris Mainstone



Section 5: Sharing our Science and Evidence

Open Data: putting data and transparency at the heart of government

Hannah Ross

Map MAGIC

Andrea Ryder

Sites of Special Scientific Interest Impact Risk Zones

Michael Knight

Sarah Middlehurst

What matters where: putting ecosystem services on the map

Nick Dales

Nigel Brown

Jane Lusardi

Documenting the impacts of climate change on biodiversity

Mike Morecroft

Lydia Speakman

*Living With Environmental Change
partnership*

Assessing and mapping vulnerability of the natural environment to climate change

Sarah Taylor

*Andy Harfoot (Geodata Institute,
Southampton University)*

Michael Knight

Helping conservation practitioners respond to climate change

Andy Neale

Simon Duffield

Environment Agency

Forestry Commission

Mike Morecroft

Olly Watts (RSPB)

Mapping seabird sensitivity to offshore wind farms

Alex Banks

Gareth Bradbury (WWT Consulting)

Bob Furness (MacArthur Green)

*Duncan Hume (Marine Management
Organisation)*

Mark Trinder (MacArthur Green)

Natural England's Priority Habitats Inventory

Andy Cooke

Richard Alexander

Matt Cotterill

Bernadette Micklewright

The Pantheon invertebrate database

Jon Webb

Managing for people, places and wildlife:

Ecosystem Transfer Toolkit

Ruth Waters

Jane Lusardi

Zoe Austin (BESS Programme)

Directorate, York University)

Dean Waters (BESS Programme)

Directorate, York University)

Piran White (BESS Programme)

Directorate, York University)



Section 6: Strengthening our Capability and Leadership in Science and Evidence

Isabel Alonso
Andy Brown
Corrie Bruemmer
Chris Chesterton
Humphrey Crick
Nick Dales
Helen Doran
Simon Duffield
Paul Edgar

Rob Enever
Mike Grace
Jonathan Larwood
Jane Lusardi
Nick Macgregor
Colin Prosser
Ruth Waters
Nick White
Richard Wilson

Section 7: Forward Look

David Askew
Pete Brotherton
Nick Dales
Helen Doran

Tim Hill
Nick Macgregor
Dave Stone
Ruth Waters



Annex 3: Natural England scientific papers published in 2015 and 2016

Peer-reviewed scientific publications

ADAMS, W. M., HODGE, I.D., **MACGREGOR, N.A.** and SANDBROOK, L. 2016. **Creating restoration landscapes: partnerships in large-scale conservation in the UK.** *Ecology and Society* 21(3):1.

ALISON, J., DUFFIELD, S. J., VAN NOORDWIJK, C. G. E., **MORECROFT, M. D.,** MARRS, R. H., SACCHERI, I. J. and HODGSON, J. A. 2016. Spatial targeting of habitat creation has the potential to improve agri-environment scheme outcomes for macro-moths. *Journal of Applied Ecology*. doi:10.1111/1365-2664.12750

ALONSO I and HÄERTLE W. 2015. **Resolving potential conflicts between different heathland ecosystem services through adaptive management,** *Ecological Questions* 21: 101-103.

ASHBROOK, K., TAYLOR, A., JANE, L., **CARTER, I.** and SZEKELY, T. 2015. **Impacts of survival and reproductive success on the long-term population viability of reintroduced Great Bustards *Otis tarda* in the UK.** *Oryx* 50: 583-592 doi:10.1017/S0030605315000368.

AUSDEN, M., BRADBURY, R., **BROWN, A.,** EATON, M., LOCK, L. and PEARCE-HIGGINS, J. 2015. Climate change and Britain's birdlife: what might we expect? *British Wildlife* 26: 161-174

BIGGS, J., EWALD, N., VALENTINI, A., GABORIAUD, C., DEJEAN, T., GRIFFITHS, R.A., FOSTER, J., WILKONSON, J.W., ARNELL, A., **BROTHERTON, P.,** WILLIAMS, P., and DUNN, F. 2015. Using eDNA to develop a national citizen science-based monitoring programme for the great crested newt (*Triturus cristatus*). *Biological Conservation* 183: 19–28

BRIGHT, J.A., MORRIS, A.J., FIELD, R.H., **COOKE, A.I., GRICE, P.V.,** WALKER, L.K., FERN, J. and PEACH, W.J. 2015. **Higher-tier agri-environment scheme enhances breeding densities of some priority farmland birds in England.** *Agriculture, Ecosystems and Environment* 203: 69-79.

BROWN, I., THOMPSON, D., BARDGETT, R., BERRY, P., CRUTE, I., MORISON, J., **MORECROFT, M.,** PINNEGAR, J., REEDER, T. and TOPP, K. 2016. *UK Climate Change Risk Assessment Evidence Report: Chapter 3, Natural Environment and Natural Assets.* Report prepared for the Adaptation Sub-Committee of the Committee on Climate Change, London.

BURGESS, M.D., BELLAMY, P.E., GILLINGS, S., NOBLE, D.G., **GRICE P.V.** and CONWAY, G.J. 2015. **The impact of changing habitat availability on population trends of woodland birds associated with early successional plantation woodland.** *Bird Study* 62: 39-55. DOI: 10.1080/00063657.2014.998622

CLARKE, S.J., HARLOW, J., SCOTT, A. and PHILLIPS, M. 2015. Valuing the ecosystem service changes from catchment restoration: A practical example from upland England. *Ecosystem Services* 15: 93-102

DUNN, J.C., MORRIS, A.J. & **GRICE, P.V.** 2015. **Testing bespoke management of foraging habitat for European Turtle Doves *Streptopelia turtur*.** *Journal of Nature Conservation* 25: 23-34.

DUNN, J.C., MORRIS, A.J. and **GRICE, P.V.** 2016 Post-fledging habitat selection in a rapidly declining farmland bird, the European Turtle Dove *Streptopelia turtur*. *Bird Conservation International* (First View Article) published online April 2016: 1 – 13. DOI: 10.1017/S0959270916000022



DUNN, J.C., STOCKDALE, J.E., MCCUBBIN, A., THOMAS, R.C., GOODMAN, S.J., **GRICE, P.V.**, HAMER, K.C. and SYMONDSON, W.O.C. 2016. **Non-cultured faecal and gastrointestinal seed samples fail to detect Trichomonad infection in clinically and sub-clinically infected columbid birds.** *Conservation Genetics Resources* 8: 97-99. DOI 10.1007/s12686-016-0518-y

EATON, M, AEBISCHER, N., **BROWN, A.**, HEARN, R., LOCK, L., MUSGROVE, A., NOBLE, D., STROUD, D.A. and GREGORY, R. 2015. Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. *British Birds* 108: 708-746

EWALD, J.A., WHEATELY, C.J., AEBISCHER, N.J., **DUFFIELD, S.J.**, **CRICK H.Q.P.** and **MORECROFT, M.D.** 2015. **Influences of extreme weather, climate, and pesticide use on invertebrates in cereal fields over 42 years.** *Global Change Biology* 21: 3931-3950.

FAY, M.F. and **TAYLOR, I.** 2015. **801. CYPRIDIUM CALCEOLUS: Orchidaceae.** *Curtis's Botanical Magazine* 32: 24-32

FAY, M.F., SAYERS, B. and **TAYLOR, I.** 2015. **802. DACTYLORHIZA VIRIDIS: Orchidaceae.** *Curtis's Botanical Magazine* 32: 33-41

FAY, M.F. and **TAYLOR, I.** 2015., **803. OPHRYS FUCIFLORA: Orchidaceae.** *Curtis's Botanical Magazine* 32: 42 - 50

FAY, M.F., **TAYLOR, I.** and SAYERS, B. 2015. **804. OPHRYS INSECTIFERA: Orchidaceae.** *Curtis's Botanical Magazine* 32: 51 - 62

FAY, M.F. and **TAYLOR, I.** 2015., **805. ORCHIS ANTHROPOPHORA: Orchidaceae.** *Curtis's Botanical Magazine* 32: 63 - 71

FAY, M.F. and **TAYLOR, I.** 2015., **806. ORCHIS PURPUREA: Orchidaceae.** *Curtis's Botanical Magazine* 32: 72 - 81

FAY, M.F. and **TAYLOR, I.** 2015., **807. CEPHALANTHERA RUBRA: Orchidaceae.** *Curtis's Botanical Magazine* 32: 82 - 90

FENN, K., MALHI, Y, **MORECROFT, M.**, LLOYD, C. and THOMAS M. 2015. The carbon cycle of a maritime ancient temperate broadleaved woodland at seasonal and annual scales. *Ecosystems* 18: 1-15. DOI: 10.1007/s10021-014-9793-1

GAMMANS, N., SEARS, J., LEE, P., HYDE, P., PERKINS, G. & **CURSON, J.** 2015. The reintroduction of the short-haired bumblebee. *British Wildlife* 26: 345-352.

GILLINGHAM, P.K., BRADBURY, R.B., ROY, D.B., ANDERSON, B.J., BAXTER, J.M., BOURN, N.A.D., **CRICK, H.Q.P.**, FINDON, R.A., FOX, R., FRANCO, A., HILL, J.K., HODGSON, J.A., HOLT, A.R., **MORECROFT, M.D.**, O'HANLON, N.J., OLIVER, T.H., PEARCE-HIGGINS, J.W., PROCTER, D.A., THOMAS, J.A., WALKER, K.J., WALMSLEY, C.A., WILSON, R.J. and THOMAS, C.D. 2015. **The effectiveness of protected areas in the conservation of species with changing geographical ranges.** *Biological Journal of the Linnean Society* 115:707-717. DOI: 10.1111/bij.12506

HELDEN, A. J., MCKENZIE, R., COBBOLD, G., **GRICE, P.V.**, ANDERSON, G.Q.A. and MACDONALD, M.A. 2015. **Field-based grassland management for ciril buntings (Emberiza cirilus L.) and its effect on plant- and leafhoppers (Hemiptera: Auchenorrhyncha).** *Insect Conservation and Diversity* 8: 272-281. doi: 10.1111/icad.12106

HOPKINS, T.C., PENICHE, G., MURPHY, S., **CARTER, I.**, SHORROCK, G., KEARNS, S., BLUNN, G., GOODSHIP, A. and SAINSBURY, A.W. 2015. **Scanning electron microscopy and energy-dispersive x-ray spectroscopy (SEM-EDX) confirms shooting of a Hen Harrier (Circus cyaneus).** *Veterinary Record Case Reports* 2015;3:e000241, doi:10.1136/vetreccr-2015-000241.

HUMPHREY, J., WATTS, K., FUENTES-MONTEMAYOR, E., **MACGREGOR, N.A.**, PEACE, A. and PARK, K. 2015. **What can studies of woodland fragmentation and creation tell us about ecological networks? A literature synthesis.** *Landscape Ecology* 30: 21-50



KIRBY, W.B., BELLAMY, P.E., STANBURY, A.J., BLADONA, A.J., **GRICE, P.V.** and GILLINGS, S. 2015. **Breeding season habitat associations and population declines of British Hawfinches *Coccothraustes coccothraustes***. *Bird Study* 62: 348-357. DOI:10.1080/00063657.2015.1046368

LARWOOD, J.G and CHANDLER, R.B. 2016. Conserving classic geological sections in the Inferior Oolite Formation, Middle Jurassic of the Wessex Basin, south-west England, *Proceedings of the Geologists' Association*, 127, 132-145.

LEE, J., CAI, X., LELLMANN, J., DALPONTE, M., MALHI, Y., BUTT, N., **MORECROFT, M.** and others. 2016. **Individual tree species classification from airborne multi-sensor imagery using robust PCA**. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 9 (6): 2554-2567.

MCMURDO HAMILTON, T., **BROWN, A.** and LEIGH, L. 2016. Kittiwake declines extend to southern England and beyond: an update on colonies at the southern edge of the species' Northeast Atlantic range. *British Birds* 109: 199-210.

MONTEITH, D., HENRYS, P., BANIN, L., SMITH, R., **MORECROFT, M.**, SCOTT, T., ANDREWS, C., BEAUMONT, D., BENHAM, S. and BOWMAKER, V. 2016. Trends and variability in weather and atmospheric deposition at UK Environmental Change Network sites (1993-2012). *Ecological Indicators* 68: 21-35.

MORECROFT, M.D., BEALEY, C.E., SCOTT, W.A. and TAYLOR, M.I.E. 2016. Interannual variability, stability and resilience in UK plant communities. *Ecological Indicators* 68: 63-72.

NEEDHAM, J., MEROW, C., BUTT, N., MALHI, Y., MARTHEWS, T. R., **MORECROFT, M.** and MCMAHON, S.M. 2016. Forest community response to invasive pathogens: the case of ash dieback in a British woodland. *Journal of Ecology*, 104: 315-330.

PINDER, A. C., **VELTEROP, R.**, COOKE, S. J., and BRITTON, J. R. 2016. Consequences of catch-and-release angling for black bream *Spondyliosoma cantharus*, during the parental care period: implications for management. *ICES Journal of Marine Science*, doi:10.1093/icesjms/fsw151.

PIRODDI, C., TEIXEIRA, H., LYNAM, C.P., SMITH, C., **ALVAREZ, M.C.**, MAZIK, K., ANDONEGI, E., CHURILOVA, T., TEDESCO, L., CHIFFLET, M., CHUST, G., GALPARSORO, I., GARCIA, A.C., KÄMÄRI, M., KRYVENKO, O., LASSALLE, G., NEVILLE, S., NIQUIL, N., PAPADOPOULOU, N., ROSSBERG, A.G., SUSLIN, V. and UYARRA, M. C. 2015. **Using ecological models to assess ecosystem status in support of the European Marine Strategy Framework Directive**. *Ecological Indicators* 58: 175-191

READ, S. A. K., **KASS, G. S.**, SUTCLIFFE, H. R. and HANKIN, S. M. 2015. **Foresight Study on the Risk Governance of New Technologies: The Case of Nanotechnology**. *Risk Analysis* 36: 1006-1024 doi:10.1111/risa.12470

ROSE, R., MONTEITH, D. T., HENRYS, P., SMART, S., WOOD, C., **MORECROFT, M.**, ANDREWS, C., BEAUMONT, D., BENHAM, S. and BOWMAKER, V. 2016. Evidence for increases in vegetation species richness across UK Environmental Change Network sites linked to changes in air pollution and weather patterns. *Ecological Indicators* 68: 52-62.

SPARKS, T.H. and **CRICK H.Q.P** 2015. **The impact of climate change on biological phenology in the UK**. *Biodiversity Climate Change impacts report card technical paper 12*. Living With Environmental Change, NERC, Swindon.

SUGGITT, A.J., WILSON, R.J., AUGUST, T.A., FOX, R., ISAAC, N.J.B., **MACGREGOR, N.A.**, **MORECROFT, M.D.** and MACLEAN, I.M.D. 2015. **Microclimate affects landscape level persistence in the British Lepidoptera**. *Journal of Insect Conservation* 19: 237-253

SUGGITT, A.J., JONES, R.T., CASELDINE, C.J., HUNTLEY, B., STEWART, J.R., BROOKS, S.J., **BROWN, E.**, FLETCHER, D., GILLINGHAM, P.K., **LARWOOD, J.**, **MACGREGOR, N.A.**, **SILVA, B.**, THOMAS, Z., WILSON, R.J. and MACLEAN, I.M.D. 2015. **A meta-database of Holocene sediment cores for England**. *Vegetation History and Archaeobotany* 24:743-747

SUNDERLAND, T & BUTTERWORTH, T. 2015. **Meeting local economic decision-maker's demand for environmental evidence: The Local Environment and Economic Development (LEED) toolkit**. *Ecosystem Services* 17: 197-207



SUTHERLAND, W.J., BROAD, S., CAINE, J., CLOUT, M., DICKS, L.V., **DORAN, H.**, ENTWISTLE, A.C., FLEISHMAN, E., GIBBONS, D.W., KEIM, B., LEANSTEY, B., LICKORISH, F.A., MARKILLIE, P., MONK, K.A., MORTIMER, D., OCKENDON, N., PEARCE-HIGGINS, J.W., PECK, L.S., PRETTY, J., ROCKSTROM, J., SPALDING, M.D., TONNEIJCK, F.H., WINTLE, B.C. and WRIGHT, K.E. 2015. **A Horizon Scan of Global Conservation Issues for 2016**. *Trends in Ecology and Evolution* 31: 44-53

WATTS, K., FUENTES-MONTEMAYOR, E., **MACGREGOR, N.A.**, PEREDO-ALVAREZ, V., **BROWN, N.**, FERRYMAN, M. and PARK, K.J. 2016. Using historical woodland creation to construct a long-term, large-scale natural experiment: the WREN project. *Ecology & Evolution* 6: 3012-3025.

WEBB, J.R. 2015. Beetle records from Chartley Moss National Nature Reserve, Staffordshire VC 39. *The Coleopterist* 24: 87-92

WEBB, J. and **BROWN, A. F.** 2016. The Conservation Status of British Invertebrates. *British Wildlife* 27: 410-421.

WEBB, J.R. and MOTT, N. 2015. Beetle records from Dune Slacks at Braunton Burrows, North Devon, VC 4. *The Coleopterist* 24: 80-86

Other scientific publications

ALONSO, I., UNDERHILL- DAY, J. and LAKE, S. (eds.), 2015. **Proceedings of the 11th National Heathland Conference**, 18 - 20 March 2015, Sunningdale Park, Berkshire. Natural England, York

BROWN, A. and MACCALLUM, J. 2016. *Birds in Norfolk: a national and international perspective*. Langford Press, Norfolk.

CARTER, I. 2015. BB Eye: Ethnic cleansing, or a fight for identity and survival? *British Birds* 108: 120-121

CRICK, H.Q.P. 2015. Review of *Nests, Eggs, and Incubation: New Ideas about Avian Reproduction* by D.C. Deeming and S.J. Reynolds. *BTO Book Reviews*. <http://www.bto.org/about-birds/book-reviews?page=1>

CUTTS, B. 2015. National Nature Reserves: Dedication for Public Access under the Countryside and Rights of Way Act 2000 (CROW), CIEEM, In Practice Edition 90, Dec 2015

GOLDBERG, E. 2015. The UK's Ancient Woodland Inventory and its Use. In Kirby, K.J. and Watkins, C. (Eds) *Europe's Changing Woods and Forests: From Wildwood to Cultural Landscapes*. CABI Publishing

GREENWOOD, J.J.D. and **CRICK, H.Q.P.** 2015. "It seemed like a dream come true" – Derek Ratcliffe and the Peregrine surveys. Chapter 14, pp 255-279 in Thompson, D.B.A., Birks, H.H. & Birks, H.J.B. (Eds) *Nature's conscience: The life and legacy of Derek Ratcliffe*. Langford Press, Norfolk.

INWOOD, H., **WHARTON, A.** and DAVIES, H. 2015. **Integrating cultural services and values into landscape and ecological planning**. Pre-published conference proceedings, Ian D. Rotherham and Christine Handley (eds), *Wild Thing?? Managing Landscape Change and Future Ecologies*, Wildtrack Publishing, Sheffield

MORECROFT, M.D. and KEITH, S.A. 2016. Plant ecology. In Letcher, T.M. (ed) *Climate and global change: observed impacts on Planet Earth*. 2nd edition. Elsevier.

PEEL, S. 2015. Grassland biodiversity: meeting our international commitments. *Proceedings of the 12th British Grassland Society Research Conference*. British Grassland Society

STRINGELL, T., CARTER, C., **COPLEY, V.**, HALL, K., MANSON, F., MENDES, S. and SMITH, K. 2015. Environmental assessments and marine mammals: an advisor's (and regulator's) perspective, UK. In EVANS, P.G.H. (Ed) *Proceedings of the ECS/ASCOBANS/ACCOBAMS Joint Workshop on Introducing Noise into the Marine Environment – What are the requirements for an impact assessment for marine mammals?* Held at the European Cetacean Society's 28th Annual Conference, Liege, Belgium, 6th April 2014. European Cetacean Society Special Publication Series No.58

* Natural England authors highlighted in bold text.



Annex 4: Natural England reports published in 2015-16

The following is a list of our reports and information notes published in 2015 and up to the end of September 2016.

Natural England Commissioned Reports (NECR)

NECR012 – Scientific research into the effects of access on nature conservation: Part 1 access on foot – third edition

NECR013 – Scientific research into the effects of access on nature conservation: Part 2 access on bicycle and horseback – second edition

NECR134 – A review of the beetles of Great Britain: The Soldier Beetles and their allies – second edition

NECR148 – A review of the beetles of Great Britain: The Darkling Beetles and their allies – second edition

NECR149 – The role of landscape and site scale characteristics in making species populations resilient to climate change and extreme events

NECR159 – Ecosystem Services Transfer Toolkit – second edition

NECR164 – Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS)

NECR165 – Condition assessment of Thanet Coast Special Area of Conservation

NECR166 – Monitor of Engagement with the Natural Environment: a pilot for an indicator of visits to the natural environment by children - interim findings from Year 1 (March 2013 to February 2014)

NECR167 – Visits to the natural environment in East London: Analysis of data from the Monitor of Engagement with the Natural Environment survey (2009-2013)

NECR170 – The impact of phosphorus inputs from small discharges on designated freshwater sites

NECR171 – Development of a risk assessment tool to assess the significance of septic tanks around freshwater SSSIs: Phase 1 – Understanding better the retention of phosphorus in the drainage field

NECR172 – Waterbird population trend analysis of the Mersey Estuary SPA, Mersey Narrows & North Wirral Foreshore pSPA and Ribble & Alt Estuaries SPA

NECR173 – Review and analysis of changes in waterbird use of the Mersey Estuary SPA, Mersey Narrows & North Wirral Foreshore pSPA and Ribble & Alt Estuaries SPA

NECR174 – A review of the stoneflies (Plecoptera) of Great Britain

NECR175 – Research on the assessment of risks & opportunities for species in England as a result of climate change.

NECR176 – Review of Favourable Conservation Status and Birds Directive Article 2 interpretation within the European Union



NECR177 – Monitor of Engagement with the Natural Environment: Analysis of expenditure during visits

NECR178 – Isles of Scilly eelgrass bed voluntary monitoring programme: 2014 Annual Survey

NECR179 – A review of the effectiveness of different on-site wastewater treatment systems and their management to reduce phosphorus pollution

NECR180 – Econets, landscape & people: Integrating people’s values and cultural ecosystem services into the design of ecological networks and other landscape change proposals.

NECR181 – Green Bridges: A literary review

NECR182 – Investigation of the impact of changes in pesticide use on invertebrate populations

NECR183 – River Eye SSSI: Strategic Restoration Plan

NECR184 – River Eye SSSI: Strategic Restoration Plan – Technical Report

NECR185 – The status of Habitats Directive Annex I, saltmarsh habitats, transition zones and *Spartina* species in England

NECR186 – A review of the millipedes (Diplopoda), centipedes (Chilopoda), and woodlice (Isopoda) of Great Britain

NECR187 – A review of the Orthoptera (Grasshoppers and Crickets) and allied species of Great Britain

NECR188 – A review of the Hemiptera of Great Britain: The Aquatic and Semi-aquatic Bugs

NECR189 – A review of the beetles of Great Britain: Ground Beetles (Carabidae)

NECR190 – A review of the Hemiptera of Great Britain: The shieldbugs and allied families

NECR191 – A review of the status of the caddis flies (Trichoptera) of Great Britain

NECR193 – A review of the status of the mayflies (Ephemeroptera) of Great Britain

NECR194 – Expanding delivery of care farming services to health and social care commissioners

NECR196 – Pink-footed Goose anthropogenic mortality review: Avoidance rate review

NECR197 – Pink-footed Goose anthropogenic mortality review: Collision risk modelling

NECR198 – Pink-footed Goose anthropogenic mortality review: Population model

NECR199 – The ecological effects of air pollution from road transport: an updated review – second edition

NECR200 – Potential risk of impacts of nitrogen oxides from road traffic on designated nature conservation sites – second edition

NECR201 – Mersey Narrows and North Wirral Foreshore Sites of Special Scientific Interest – Investigation into the impacts of Recreational Disturbance on Bird Declines

NECR203 – The state of the UK’s long-term experiments



NECR204 – A review of nature-based interventions for mental health care.

NECR205 – Small-scale effects: How the scale of effects has been considered in respect of plans and projects affecting European sites - a review of authoritative decisions

NECR206 – Temporary effects: How the longevity of effects has been considered in respect of plans and projects affecting European sites - a review of authoritative decisions

NECR207 – Functional linkage: How areas that are functionally linked to European sites have been considered when they may be affected by plans and projects - a review of authoritative decisions

NECR208 – Monitor of Engagement with the Natural Environment: a pilot to develop an indicator of visits to the natural environment by children - Results from years 1 and 2 (March 2013 to February 2015)

NECR210 – Assessing the effects of small increments of atmospheric nitrogen deposition (above the critical load) on semi-natural habitats of conservation importance

NECR211 – Is it nice outside? - Consulting people living with dementia and their carers about engaging with the natural environment

NECR212 – Tern verification surveys for marine sites

NECR213 – Designing and applying a method to assess the sensitivities of highly mobile marine species to anthropogenic pressures

NECR214 – Developing Datasets for Biodiversity 2020: Outcome 1D (Omnicom 24951/ITT455)

NECR215 – Natural Connections Demonstration Project, 2012-2016 – final report

NECR216 – Disease risk analysis for the reintroduction of the short-haired bumblebee (*Bombus subterraneus*) to the UK

NECR218 – Lyme Bay - A case study: Response of the benthos to the zoned exclusion of towed demersal fishing gear in Lyme Bay; 4 years after the closure

NECR219 – Lyme Bay - A case study: Response of the benthos to the zoned exclusion of towed demersal fishing gear in Lyme Bay; 5 years after the closure

NECR220 – Lyme Bay - A case study: Response of the benthos to the zoned exclusion of towed demersal fishing gear in Lyme Bay; 6 years after the closure.

NECR221 – Phosphorous in Package Treatment Plant effluents

NECR222 – Development of a Risk Assessment Tool to Evaluate the Significance of Septic Tanks Around Freshwater SSSIs

NECR223 – Investigating the Impacts of Marine Invasive Non-Native Species

NECR224 – A review of the status of the beetles of Great Britain: The stag beetles, dor beetles, dung beetles, chafers and their allies - Lucanidae, Geotrupidae, Trogidae and Scarabaeidae

NECR226 – Monitor of Engagement with the Natural Environment - The national survey on people and the natural environment - Visits to coastal England



Natural England Reports

NE601 – Improvement programme for England’s Natura 2000 Sites (IPENS) programme report: a summary of the programme findings

NE612 – Natural England’s climate change risk assessment and adaptation plan (2015)

Natural England Research Reports

NERRo11 – The historic peat record: Implications for the restoration of blanket bog

NERRo61 – Integrated Site Assessments 2013/14: A report on Natural England’s assessments of Sites of Special Scientific Interest and Higher Level Stewardship agreement.

NERRo62 – Investigating the potential increase in health costs due to a decline in access to greenspace: an exploratory study

NERRo63 – Is the management of Local Wildlife Sites affected by the urban fringe?

NERRo64 – A narrative for conserving freshwater and wetland habitats in England

NERRo65 – Core reef approach to Sabellaria spinulosa reef management in The Wash and North Norfolk Coast SAC and The Wash approaches

Marine Evidence Reports

RPoo609 – Condition Monitoring of the Intertidal Mudflats and Sandflats Feature of the Fal & Helford SAC

RPoo838 – Plymouth Sound & Estuaries SAC: diving condition assessment of kelp forest communities 2012 – (MFPO26)

RPoo839 – Plymouth Sound & Estuaries Complex: condition assessment of seagrass bed communities 2012 – (MFPO27)

RPoo842 – Lyme Bay & Torbay cSAC: sea cave survey 2011-12

RPoo844 – Severn Estuary SAC and SPA: Intertidal mudflats and sandflats condition assessment 2012

RPo1044 – Plymouth Zostera Marina Sublittoral Monitoring Studies 2009

RPo1053 – Tamar Tavy & St Johns Lake SSSI intertidal Biotope Survey 2010

RPo1054 – Lynher Estuary SSSI Littoral Biotope Survey

RPo1134 – Monitoring of Fal and Helford SAC 2011

RPo1472 – Plymouth Sound & Estuaries SAC: Subtidal Mixed Cobble and Gravel Subfeature and Subtidal Rocky Reefs Subfeature condition assessment

RPo1489 – Lyme Bay & Torbay cSAC biogenic reef drop-down video survey

RPo1490 – Lyme Bay and Torbay cSAC Acoustic Interpretation Study

RPo1603 – Verification survey of intertidal rocky shore features in the Allonby Bay recommended MCZ 2013

RPo1605 – Condition assessment of the Lyme Bay - Annex I reef habitats in the Lyme Bay and Torbay cSAC



RPo1679 – Population Structure, Mobility and Conservation of Bottlenose Dolphins in the South West of England from Photo-identification studies 2007 - 2013

RPo2178 – Lundy SAC: Subtidal Reef Condition Assessment and No Take Zone Benthic Monitoring Survey 2014/15

RPo2200 – Spawning success and population structure of Shad (*Alosa* spp) in the River Teme 2015, with supplementary notes on Sea Lamprey spawning

RPo2205 – Morphological characterisation of the Severn Estuary and Solway Firth 2015

RPo2262 – Identification of wintering waterfowl high tide roosts on the Severn Estuary SSSI/SPA (Brean Down to Clevedon) 2015

RPo2269 – Plymouth MPAs migratory fish survey part 1 2015

RPo2304 – Plymouth Sound and Estuaries SAC: Allis Shad genetic analysis

RPo2458 – Fal & Helford Subtidal sandbanks extent Seagrass/Diving 2015

RPo2465 – Isles of Scilly eelgrass bed voluntary monitoring programme: 2015 Annual survey

RPo2496 – A habitat survey for spawning ground and nursery areas for Annex II fish species within the Severn Estuary river catchment 2015

RPo2533 – Intertidal sediment surveys of Langstone Harbour SSSI, Ryde Sounds and Wootton Creek SSSI and Newton Harbour SSSI 2015

RPo2543 – Solent Maritime SAC Subtidal habitat mapping report 2015

RPo2732 – Shell Flat and Lune Deep Site of Community Importance (SCI) drop-down video survey 2015

RPo2742 – South Wight Maritime SAC reef feature attribute survey 2015

RPo2885 – Monitoring of Plymouth Sound and Estuaries SAC subtidal boulder and cobbles

RPo2899 – Flamborough Head SSSI potential renotification

RPo2887 – Fal & Helford SAC GIS Habitats Mapping Project

RPo2900 – Possible notification of an area of coast as a SSSI from Filey Brigg to Scarborough South Bay

RPo2918 – Lower Fal and Helford Intertidal SSSI Baseline Survey 2012

RPo2988 – Mapping Annex I reef habitat present in specific areas within the Lyme Bay and Torbay cSAC

RPo2989 – Lyme Bay and Torbay cSAC, Torbay Seagrass Bed Monitoring Surveys 2008, DDV

RPo3082 – Photo-identification Analysis of White-beaked Dolphins off South West and North East England 2007-2014

Marine Conservation Zone Factsheets

MCZo30 – Beachy Head West MCZ Factsheet

MCZo31 – Chesil Beach and Stennis Ledges MCZ Factsheet



[MCZo38 – Fylde MCZ Factsheet](#)

[MCZo43 – South Dorset MCZ Factsheet](#)

[MCZo46 – The Manacles MCZ Factsheet](#)

[MCZo47 – Torbay MCZ Factsheet](#)[Torbay MCZ Factsheet](#)

[MCZo49 – Upper Fowey and Pont Pill MCZ Factsheet](#)

[MCZo50 – Natural England’s advice to Defra on recommended Marine Conservation Zones to be considered for consultation in 2015](#)

Technical Information Notes

These are notes on scientific and technical issues, including practical advice to help our staff, partners and others implement work.

[TIN167 – Proposals for a marine extension to the Dungeness, Romney Marsh and Rye Bay Special Protection Area](#)

[TIN169 – A possible new marine Special Protection Area for birds in The Greater Wash – second edition](#)

[TIN171 – Proposals for a marine extension to the Outer Thames Estuary Special Protection Area](#)

[TIN172 – A possible extension to the Teesmouth and Cleveland Coast Special Protection Area](#)

[TIN173 – A possible marine extension to Hamford Water Special Protection Area \(SPA\)](#)

[TIN174 – Proposals for an extension of Liverpool Bay/Bae Lerpwl Special Protection Area \(SPA\)](#)

Access to Evidence Information Notes

These notes improve access to the evidence that we generate and use.

[EINo12 – Summary of Evidence: Soils](#)

[EINo13 – Summary of Evidence: Landscape](#)

[EINo14 – Natural England Evidence published in 2014/2015](#)

[EINo15 – Connection to Nature: evidence briefing](#)

[EINo16 – Methods, Glossary and Evaluation Resources: evidence briefing](#)

[EINo17 – Links between natural environments and learning: evidence briefing](#)

[EINo18 – Links between natural environments and mental health: evidence briefing](#)

[EINo19 – Links between natural environments and physical activity: evidence briefing](#)

[EINo20 – Links between natural environments and physiological health: evidence briefing](#)



[EINo21 – Links between natural environments and obesity: evidence briefing](#)

[EINo22 – Putting economic values on green infrastructure improvements](#)

Natural England Joint Publications

These are collaborative documents published by us or partner organisations jointly, or in association.

[JPo11 – Working together to make space for nature: Recommendations from a conference on large-scale conservation in England](#)

[JPo12 – Refining the priority river habitat map for England](#)

[JPo13 – River Dove Restoration Plan](#)

[JPo14 – Monitor of Engagement with the Natural Environment headline report: March 2014 to February 2015](#)

[JPo15 – Monitor of Engagement with the Natural Environment technical report: March 2014 to February 2015](#)

[JPo18 – A trial of self-closing bridlegates: 2015](#)

The data files for this page have also been updated to include the latest findings:

[Monitor of Engagement with the Natural Environment 2009-14: Datasets and guidance on use \(DATA001\)](#)

Improvement Programme for England's Natura 2000 Sites

[IPENSLEo3 – Improvement programme for England's Natura 2000 Sites: Final event report and presentations](#)

[IPENSoo1a – River Wensum SSSI: Exemplar Diffuse Water Pollution Plan and Action Plan](#)

[IPENSoo1b – Ant Broads and Marshes SSSI: Exemplar Diffuse Water Pollution Plan and Action Plan](#)

[IPENSoo2 – Healthy Estuaries 2020: Towards Addressing Coastal Squeeze in Estuaries](#)

[IPENSoo4 – Lower Avon Valley Macrophyte Survey 2013](#)

[IPENSoo8a – Application of a cross sector pollutant source apportionment modelling framework to protected sites](#)

[IPENSoo8b – SCIMAP Sediment Risk Mapping for Designated Site Catchments](#)

[IPENSoo8c – Pollution Risk Assessment and Source Apportionment: River Axe](#)

[IPENSoo8d – Pollution Risk Assessment and Source Apportionment: Camel Catchment](#)

[IPENSoo9 – Humber Estuary Clay Pits – Water Quality Briefing \(2013-2014\)](#)

[IPENSoo12 – Alde-Ore Estuary Complex NVC 2013](#)



IPENSo18 – Fal and Helford SAC Maerl Drop-down Video and Dive Survey 2013

IPENSo21 – Drigg Coast SAC, Ravenglass Estuary Intertidal Survey

IPENSo22 – Ribble Estuary SSSI/Ribble & Alt SPA Intertidal sediments condition monitoring

IPENSo25 – Predicting the mussel food requirements of oystercatchers in the Exe Estuary

IPENSo26 – Condition monitoring of saltmarsh features in The Wash and North Norfolk Coast SAC: Volume 2 – North Norfolk Coast

IPENSo27 – Condition monitoring of saltmarsh features in The Wash and North Norfolk Coast SAC: Volume 1 – The Wash

IPENSo31 – Berwickshire Intertidal Rocky Reefs

IPENSo32 – An Investigation into the Nutrient Levels of Breckland Fluctuating Meres

IPENSo35 – Distribution of selected non-native species within the intertidal zone of the North East Kent Marine Protected Areas

IPENSo38 – Deben Estuary NVC 2013

IPENSo39 – Westleton Heath NNR NVC 2013

IPENSo41 – *Spartina anglica* and its management in estuarine Natura 2000 sites: an update of its status and monitoring future change in England

IPENSo46 – Understanding impacts of non-native species on protected sites

IPENSo49 – Site Categorisation for nitrogen measures: Case Studies A - F

IPENSo50 – Case Studies for Delivering Ammonia Measures

IPENSo51 – A desk-based study to consolidate existing data and literature to help inform the conservation status of Annex II features (migratory fish species) within the Severn Estuary river catchment area

IPENSo54 – Allis Shad Fish Passage Options Appraisal – Gunnislake Weir

IPENSo55 – Burning in the English Uplands – A Review, Reconciliation and Comparison of Results of Natural England’s Burn Monitoring: 2005 - 2014

IPENSo58 – White-clawed Crayfish (*Austropotamobius Pallipes*) Survey of the River Dove between Hollinsclough and Beresford Dale, Peak District National Park.

IPENSo60 – Design of a vegetation monitoring scheme for the Border Mires

IPENSo61a – SAC status reporting on *Vertigo Moulinsiana* at Westbere Marshes, Kent 2014

IPENSo61b – SAC status reporting on *Vertigo Moulinsiana* in Norfolk and Suffolk 2014

IPENSo61c – SAC status reporting on *Vertigo Moulinsiana* in England: Monitoring at selected sites on the Hampshire/Wiltshire River Avon and tributary rivers Wylde and Bourne

IPENSo65 – White-clawed crayfish survey for Ensor’s Pool SSSI/SAC (Warwickshire)

IPENSo66 – Analysing change in moorland management in the North York Moors Special Protection Area



[IPENSo67 – Surface water catchment mapping for Natura 2000 Diffuse Water Pollution Plans](#)

[IPENSo71 – Water Quality Catchment Assessment: Detailed SAGIS spreadsheets – technical note](#)

[IPENSo75 – Improvement programme for England’s Natura 2000 Sites: Summary of evidence projects published 23/09/2015](#)

[IPENSo76 – Improvement programme for England’s Natura 2000 Sites: AfterLIFE Plan](#)

[IPENSTPo13 – Atmospheric nitrogen theme plan](#)

[IPENSTPo14 – Climate change theme plan](#)

[IPENSTPo15 – Diffuse water pollution theme plan](#)

[IPENSTPo16 – Grazing theme plan](#)

[IPENSTPo17 – Habitat fragmentation theme plan](#)

[IPENSTPo18 – Hydrological functioning theme plan](#)

[IPENSTPo19 – Coastal management plan](#)

[IPENSTPo20 – Invasive species theme plan](#)

[IPENSTPo21 – Lake restoration theme plan](#)

[IPENSTPo22 – Public Access and disturbance theme plan](#)

[IPENSTPo23 – River restoration theme plan](#)

Natural England Evidence Reviews

[NEERoo8 – A desk review of the ecology of Heather Beetle](#)

[NEERoo9 – Desk review of burning and other management options for the control of Heather Beetle](#)

Data Sets

[DATAoo1 – Monitor of Engagement with the Natural Environment 2009-15: Datasets and guidance on use](#)

Other evidence

BTO Research Report No. 669 [Collision, Displacement and Barrier Effect Concept Note](#) has been published. This report is a NE commissioned report published as a BTO research report on their website. See project [RPo2866](#).

Results for the seventh year of the **MENE** survey which provides data on how people use the natural environment in England were published on Gov.UK on 12 August 2015 [Monitor of Engagement with the Natural Environment: 2015 to 2016](#)

[Bushy Park and Home Park SSSI notification and supporting evidence](#)

[Land Use Policy Group \(LUPG\) – The role of agroecology in sustainable intensification](#)

[LUPGo24 – Scoping the environmental implications of Pillar 1 reform 2014-2020](#)

[LUPGo25 – Learning the lessons of the Greening of the CAP](#)

For a list of contributions made by Natural England staff to journals, books and reports, please see appendix 2 in our publication [Natural England’s evidence published in 2014/15](#).



Annex 5: Mapping and Data Information

Unless otherwise stated, all Ordnance Survey data used in this report is reproduced by permission of Ordnance Survey. © Crown copyright and database right 2016. All rights reserved. Ordnance Survey Licence number 100022021.

All data available under the Open Government Licence (OGL) is published under the following terms: <http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Section 2: Monitoring the natural world

Long term monitoring of the natural environment

Long term monitoring sites map produced by Natural England using Natural England data (figure 1).

Data produced by our long term monitoring activities can be downloaded [here](#).

OGL: © Natural England copyright. Contains OS data © Crown copyright and database right (2016).

Using novel survey techniques to estimate populations of red throated divers in marine protected areas

The Outer Thames SPA with bathymetry and aerial survey transect lines (figure 2).

This map was published in a report commissioned by Natural England (APEM (2013). Aerial bird surveys in the Outer Thames Estuary SPA. APEM Scientific Report for Natural England, July 2013, Final 67pp).

Different versions of this map were published in an article in British Birds in 2015. Goodship, N., Caldow, R., Clough, S., McGovern, S. & Rehfish, M. 2015. Digital aerial surveys reveal record red-throated diver *Gavia stellata* numbers in the Outer Thames Estuary. British Birds, 108, 506-513.

OGL: © Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right 2016.

© British Crown Copyright. All rights reserved. Permission Number Defra012016.001 This product has been derived in part from material obtained from the UK Hydrographic Office with the permission of the Controller of Her Majesty's Stationery Office and UK Hydrographic Office (www.ukho.gov.uk).

Monitoring how environmental stewardship affects landscape character and quality

- 1 The spatial framework hierarchy (figure 6).
- 2 The spatial distribution of overall landscape effects (left hand map) and an example of the effects of ES against one of the landscape themes (semi-natural habitats) (figure 7).
- 3 Location of survey squares with overall 'enhancing' or 'conserving' effect in relation to ALTs (figure 8).
- 4 Summary of overall effects by Agricultural Landscape Type (figure 10).

All maps produced by Land Use Consultants under contract to Natural England.

This work was originally published in the report, Monitoring the contribution that Environmental Stewardship is making to the maintenance and enhancement of landscape character and quality: Report of the 2014 and 2015 Rapid Surveys (Prepared by LUC in association with Rural Focus Ltd, April 2016).

This project is supported by the Rural Development Programme for England (RDPE) for which Defra is the Managing Authority, part financed by the European Agricultural Fund for Rural Development: Europe investing in rural areas.

The work represented in this report is part of a three year project, with 2016 being the final year. The final report will cover all three years and, on completion, the data will be handed over to Natural England.

Copyright statements relating to these maps include OGL: © Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right 2016 and Ordnance Survey data under license.

Section 3: Practical Solutions

Reintroducing the dormouse to its former range

The range of the hazel dormouse in 1885 compared with the range in 2013 (figure 1).

Maps produced by Natural England with the data shown in the maps produced through joint research between Natural England and the People's Trust for Endangered Species.

OGL: © Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right 2016.

Carboniferous revisited

Carboniferous Period map.

Map produced for internal use in Natural England.

Geological data from BGS 1:625,000 scale digital geological map of Great Britain available [here](#).

Based upon DiGMapGB-625, with the permission of the British Geological Survey.

OGL: Contains OS data © Crown copyright and database right (2016).

Designating Marine Conservation Zones

Three maps in one image:

- 1 Habitat map for Mounts Bay produced by the Finding Sanctuary Project in their 2011 recommendations.
- 2 Current understanding of broad-scale habitats in Mount's Bay.



3 Current understanding of habitat 'features of conservation importance' in Mount's Bay.

Further details can be found on the [Finding Sanctuary website](#).

Copyright relevant for all 3 maps is OGL: Contains OS data © Crown copyright and database right (2016); Contains, or is derived from, information supplied by Ordnance Survey. © Crown copyright and database rights 2016. Ordnance Survey 100022021.. For map 1, OGL: Contains OS data © Crown copyright and database right (2016); Admiralty Charts © Crown Copyright, [Year]. All rights reserved. License No. EK001-GOV001. NOT TO BE USED FOR NAVIGATION.; Contains, or is derived from, information supplied by Ordnance Survey. © Crown copyright and database rights 2016. Ordnance Survey 100022021. is also relevant.

Determining the effects of wind farm pilings to harbour porpoises in the North Sea

English North Sea wind farms (figure 8).

Map produced by Natural England.

Admiralty Charts © Crown Copyright, 2016. All rights reserved. License No. EK001-20120601. NOT TO BE USED FOR NAVIGATION. Contains information from the Ordnance Survey © Crown Copyright and database rights 2016. Ordnance Survey 100022021. UKHO Data © British Crown Copyright. All rights reserved. Permission Number Defra012012.001. This product has been derived in part from material obtained from the UK Hydrographic Office with the permission of the Controller of Her Majesty's Stationery Office and UK Hydrographic Office (www.ukho.gov.uk). Map copyright © Natural England 2016.

Section 4: New Approaches

Predictive modelling of great crested newt distribution in Woking

- 1 Outputs from the pond level GLM using HIS score, shading and distance to arable land as explanatory variables (figure 1).
- 2 Results from the GLM using the 17 positive and 43 negative presence records for great crested newt (figure 2).
- 3 Output from the connectivity model (figure 3).

All maps produced by Natural England.

The base data used in these maps include aerial photography (from SPIRE) and Ordnance Survey MasterMap. The datasets used for modelling were collected by Natural England (eDNA and HSI) and the Surrey Amphibian and Reptile Conservation Trust. Landcover raster layers were derived from CEH Landcover 2000 and the climate data came from <http://worldclim.org/>. Other than Natural England's survey data, all other data was provided under licence.

The eDNA and HSI data are confidential.

Credits for assistance provided in developing the maps are:

- i) Centre for Ecology and Hydrology, Landcover Map 2000.
- ii) WorldClim: Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978.
- iii) R Core Team (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <http://www.R-project.org/>.

- iv) Maxent: Timothy P. Jurka and Yoshimasa Tsuruoka (2013). maxent: Low-memory Multinomial Logistic Regression with Support for Text Classification. R package version 1.3.3.1.
<http://CRAN.R-project.org/package=maxent>

OGL: Contains OS data © Crown copyright and database right (2016); © 2016 Getmapping plc and Bluesky International Ltd.

Which species might win and which might lose under climate change?

Examples of three species with contrasting projected changes in patterns of climate suitability across England.

© Natural England. Maps produced by Natural England with the data shown in the maps produced through joint research between Natural England and York University.

OGL: Contains OS data © Crown copyright and database right (2016).

Investigating potential refugia from climate change

Refugium potential all variables and Refugium potential microclimate (figure 5).

© Natural England. Maps produced by Natural England with the data shown in the maps produced through joint research between Natural England and Exeter University.

OGL: Contains OS data © Crown copyright and database right (2016).

Studying the ecology and conservation needs of black bream

Bathymetry data showing black bream nests as pitted craters on the sea floor (figure 9).

© Tarmac and Hanson.

Cultural 'heat maps' show what people value about their local landscapes

Morecambe Bay cultural services study 2015.

For more information on the PGIS Tool, which contains a link to the tool itself, please see [this information](#) on the Ecosystems Knowledge Network website.

© Natural England; Maps produced by ADAS for Natural England with the data shown in the maps produced through joint research between Natural England and Research Box.



Sites of Special Scientific Interest Impact Risk Zones

Figure 2 shows how SSSI IRZs for discharges to surface water have been shaped by the mapping of surface water catchments for water quality sensitive SSIs.

Figure 3. This map illustrates our understanding of the local requirements of SSSI bird populations and the sensitivity of SSSI habitats and their catchments to impacts on water quality have helped to shape the IRZs for rural residential development in this area.

Maps and data produced by Natural England. The data can be downloaded [here](#).

OGL: © Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right 2016; OGL: Contains OS data © Crown copyright and database right (2016).

What matters where: putting ecosystem services on the map

Mapping Ecosystem Services – climate regulation potential (figure 4).

Map prepared by Natural England.

This map was first published in this [Natural England research report](#). The map – and all others contained in the report are available to download via this link.

© Natural England. Based upon LCM2007 © NERC (CEH) 2016. © Crown Copyright 2007, Licence number 100017572. © third party licensors.

Assessing and mapping vulnerability of the natural environment to climate change

Worked example of using the NBCCVA in Morecambe Bay.

Maps and data produced and owned by Natural England. © Natural England. The data is available to download [here](#).

Derived from OGL: © Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right 2016.

Contains, or is derived from, information supplied by Ordnance Survey. © Crown copyright and database rights 2016. Ordnance Survey 100022021.

Mapping seabird sensitivity to offshore wind farms

Two maps in one image:

- 1 Predicted density of guillemots in the breeding season (figure 8).
- 2 Confidence in guillemot model predictions (figure 9).

Zip files containing SeaMaST data can be downloaded after registering [here](#).

Derived from SeaMaST (Seabird mapping and sensitivity tool), commissioned by Natural England and the Marine Management Organisation. Tool developed with WWT Consulting and MacArthur Green.

Natural England's Priority Habitats Inventory

Mapping of Priority Habitats on the North Cornwall Coast showing lowland heath, maritime cliff and slope and broadleaved woodland (figure 10).

Priority Habitat Inventory (England) data is available to download [here](#).

OGL: © Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right 2016.

Contains, or is derived from, information supplied by Ordnance Survey. © Crown copyright and database rights 2016. Ordnance Survey 100022021.

Annex 6: Species mentioned in the report

Amphibians

Common name	Scientific name
Great crested newt	<i>Triturus cristatus</i>
Natterjack toad	<i>Bufo calamita</i>
Pool frog	<i>Pelophylax lessonae</i>

Birds

Common name	Scientific name
Avocet	<i>Recurvirostra avocetta</i>
Barn owl	<i>Tyto alba</i>
Blue tit	<i>Parus caeruleus</i>
Bullfinch	<i>Pyrrhula pyrrhula</i>
Cetti's warbler	<i>Cettia cetti</i>
Corn bunting	<i>Miliaria calandra</i>
Dartford warbler	<i>Sylvia undata</i>
Duncock	<i>Prunella modularis</i>
Gannet	<i>Morus bassanus</i>
Golden eagle	<i>Aquila chrysaetos</i>
Golden plover	<i>Pluvialis apricaria</i>
Great spotted woodpecker	<i>Dendrocopus major</i>
Grey partridge	<i>Perdix perdix</i>
Guillemot	<i>Uria aalge</i>
House sparrow	<i>Passer domesticus</i>
Kittiwake	<i>Rissa tridactyla</i>
Lapwing	<i>Vanellus vanellus</i>

Linnet	<i>Carduelis cannabina</i>
Little egret	<i>Egretta garzetta</i>
Red kite	<i>Milvus milvus</i>
Red-throated diver	<i>Gavia stellata</i>
Reed bunting	<i>Emberiza schoeniclus</i>
Skylark	<i>Alauda arvensis</i>
Song thrush	<i>Turdus philomelos</i>
Sparrowhawk	<i>Accipiter nisus</i>
Starling	<i>Sturnus vulgaris</i>
Stock dove	<i>Columba oenas</i>
Tree sparrow	<i>Passer montanus</i>
Turtle dove	<i>Streptopelia turtur</i>
Twite	<i>Carduelis flavirostris</i>
Whitethroat	<i>Sylvia communis</i>
Yellowhammer	<i>Emberiza citrinella</i>

Cnidarians

Common name	Scientific name
Stalked jellyfish	<i>Stauromedusae</i>

Fish

Common name	Scientific name
Allis shad	<i>Alosa alosa</i>
Black bream	<i>Spondyliosoma cantharus</i>
Goldsinny wrasse	<i>Ctenolabrus rupestris</i>

Insects

Common name	Scientific name
Bog bush cricket	<i>Metrioptera brachyptera</i>
Ghost moth	<i>Hepialus humuli</i>
Green hairstreak butterfly	<i>Callophrys rubi</i>
Hairy-footed flower bee	<i>Anthophora plumipes</i>
Honey bee	<i>Apis mellifera</i>
Large marsh grasshopper	<i>Stethophyma grossum</i>
Large wainscot moth	<i>Rhizedra lutosa</i>
Mountain ringlet butterfly	<i>Erebia epiphron</i>
Oak processionary moth	<i>Thaumetopoea processionea</i>
Orange ladybird	<i>Halyzia sedecimguttata</i>
Red-shanked carder bee	<i>Bombus ruderarius</i>
Ringlet butterfly	<i>Aphantopus hyperantus</i>
Speckled wood butterfly	<i>Pararge aegeria</i>
Triangle hammock spider	<i>Saaristoa firma</i>
Violet click beetle	<i>Limoniscus violaceus</i>
Wart-biter	<i>Decticus verrucivorus</i>
White line dart moth	<i>Euxoa tritici</i>

Mammals

Common name	Scientific name
Badger	<i>Meles meles</i>
Beaver	<i>Castor fiber</i>
Domestic cat	<i>Felis catus</i>
Domestic dog	<i>Canis familiaris</i>
Harbour porpoise	<i>Phocoena phocoena</i>
Hazel dormouse	<i>Muscardinus avellanarius</i>
Otter	<i>Lutra lutra</i>
Rabbit	<i>Oryctolagus cuniculus</i>
Wood mouse	<i>Apodemus sylvaticus</i>

Molluscs

Common name	Scientific name
Freshwater pearl mussel	<i>Margaritifera margaritifera</i>

Plants

Common name	Scientific name
Common beech	<i>Fagus sylvatica</i>
Cornflower	<i>Centaurea cyanus</i>
Cotton grass	<i>Eriphorum angustifolium</i>
Eelgrass	<i>Zostera marina</i>
Lady's slipper orchid	<i>Cypripedium calceolus</i>
Mountain crowberry	<i>Empetrum hermaphroditum</i>
Oak fern	<i>Gymnocarpium dryopteris</i>
Rare spring sedge	<i>Carex ericetorum</i>



Photo credits

Front cover: © Natural England/Kevan Cook

Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.

Catalogue Code: NE622

ISBN: 978-1-78367-217-2

Natural England publications are available as accessible pdfs from www.gov.uk/natural-england. Should an alternative format of this publication be required, please contact our enquiries line for more information: 0845 600 3078 or email enquiries@naturalengland.org.uk

www.gov.uk/natural-england

This publication is published by Natural England under the Open Government Licence v3.0 for public sector information. You are encouraged to use, and reuse, information subject to certain conditions. For details of the licence visit www.nationalarchives.gov.uk/doc/open-government-licence/version/3

Please note: Natural England photographs are only available for non-commercial purposes. For information regarding the use of maps or data visit www.gov.uk/how-to-access-natural-englands-maps-and-data.

© Natural England 2016

www.gov.uk/natural-england

