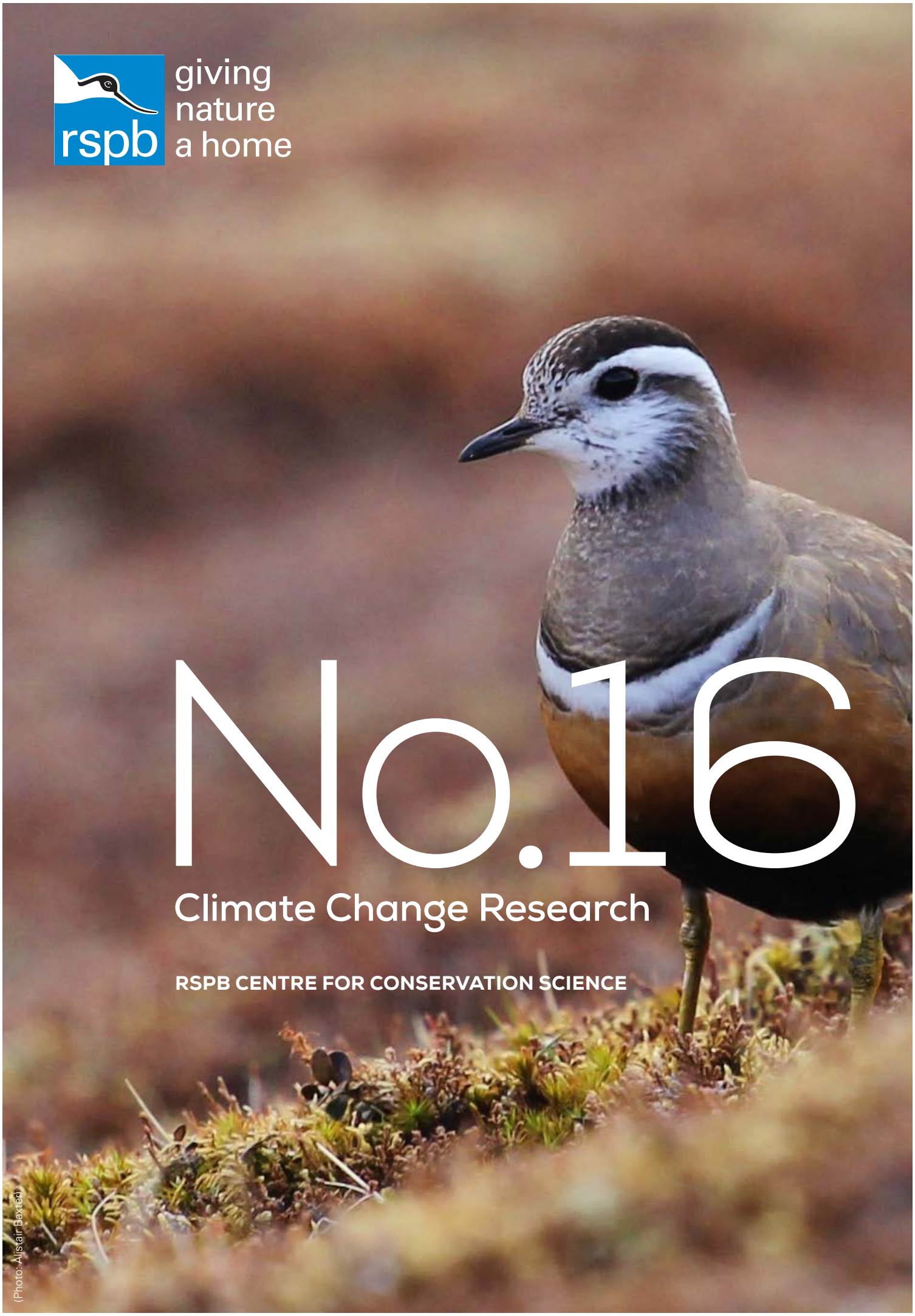
giving nature a home

No.16

Climate Change Research

RSPB CENTRE FOR CONSERVATION SCIENCE



(Photo: Alistair Baxter)

Where science comes to life

RSPB CENTRE FOR CONSERVATION SCIENCE

While the RSPB is well known for its wonderful, wildlife-rich nature reserves, and for its annual Big Garden Birdwatch, it is far less well known for the remarkable scientific work it undertakes behind the scenes, in the UK and overseas. Yet, in reality, our scientific programme is an amazing asset, matched by few other conservation organisations. Because our scientific work has had a low profile with the wider public, many are unaware of the depth and breadth of our scientific knowledge. And it is this knowledge that informs all of our conservation work. Be that the way we manage our reserves to make them better for wildlife, the advice we provide to others, or the policies that we adopt and advocate to change hearts and minds in favour of nature conservation.

This case study forms part of a collection that aims to highlight RSPB science from the last decade. We have chosen these studies as they demonstrate great science, and have had, or are likely to have, a major impact on conservation.

The first ten case studies originally featured as part of the report (shown above) about the RSPB Centre for Conservation Science.

If you would like to recieve a copy of the report, please email: **consciadmin@rspb.org.uk**

Alternatively, you can download a copy from our website **rspb.org.uk/science**

No.16

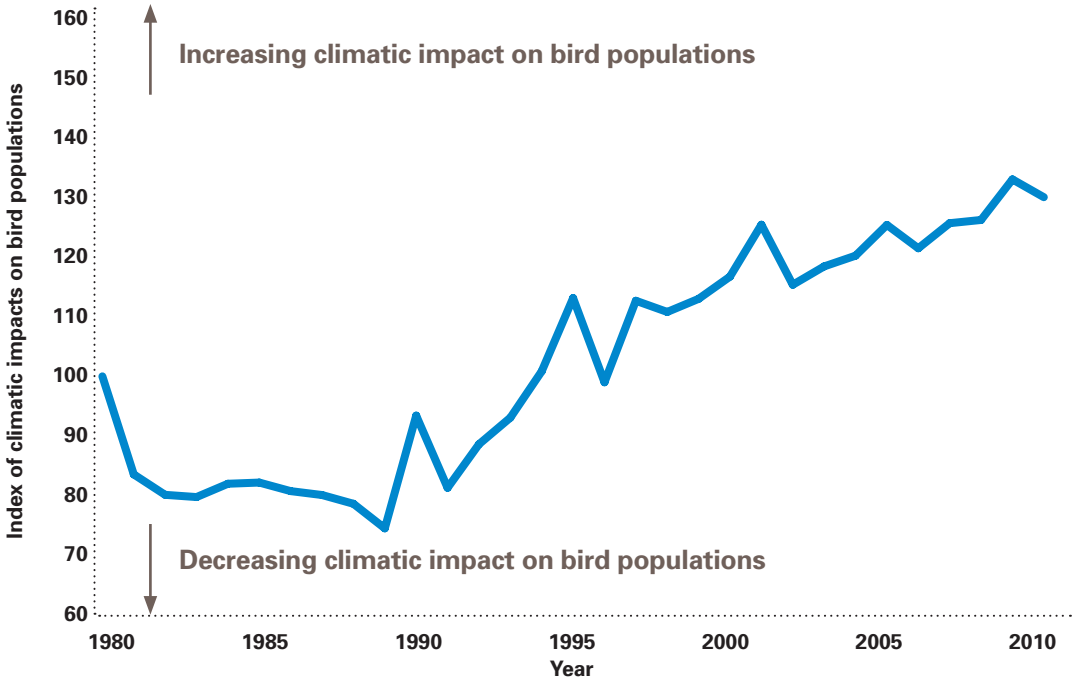
Climate Change Research

Climate change is a substantial and growing threat to wildlife in the UK and globally, causing large-scale shifts in species' ranges, disrupting key ecological processes, and potentially leading to species' extinctions. Scientists at the RSPB Centre for Conservation Science have developed a diverse research programme, often in collaboration with a range of excellent partner organisations, to better understand how climate change affects sensitive species, and to develop practical conservation measures that can be implemented on our reserves, assisting species and ecosystems to adapt to a changing climate.

Our initial work focused on predicting possible future changes in species' distributions under climate change, to discover the scale of the potential threat and to identify vulnerable species. Working with colleagues at Durham University, we assessed the likely future impact of climate change on the distributions of almost all European birds, showing that many species are predicted to move north to track suitable climate. Building on this, we contributed to the development of a framework, led by colleagues at the University of York, that quantifies the balance of threats and opportunities posed by climate change to individual species, which has subsequently been applied to a range of organisms in the UK.

The climate change risk assessment predicts that Mountain Ringlet, the UK's only montane butterfly species, is liable to be highly susceptible to the effects of climate change. Richard Revels (rspb-images.com)

Climate Impact Indicator for populations of European birds, 1980-2010



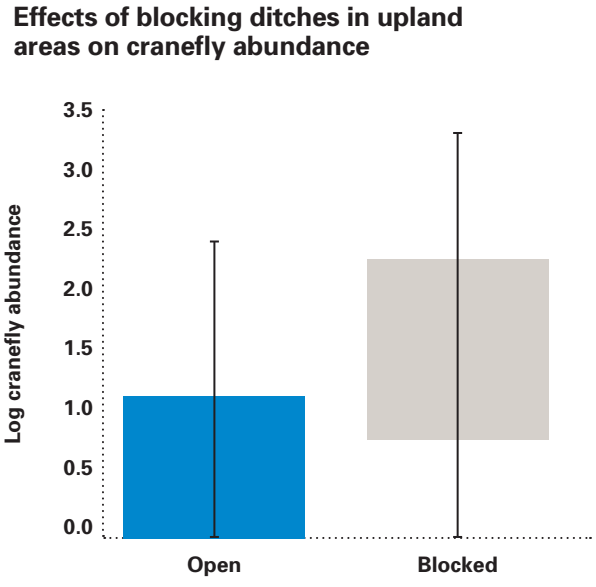
The Climate Impact Indicator (CII; blue line), which is the ratio of the index for species whose potential geographical ranges are expected, from bioclimate models, to expand to that for those expected to contract because of climatic change. The indicator is set to 100 in 1980.

As well as predicting future impacts, we monitor bird populations to assess whether observed changes may be due to climate change. Collaborating with European Bird Census Council, Durham and Cambridge Universities, we devised a Climate Impact Indicator (CII) for European bird populations using long-term bird monitoring data from across the continent and bioclimate models, which has since been adopted by the EU. In recent work we have updated and improved the CII and have developed an equivalent CII for the USA. In the UK, we monitor populations of several rare and potentially climate-sensitive birds at intervals through the SCARABBS programme (see acknowledgments), with recent surveys showing some species shifting to more northerly latitudes and higher altitudes in line with climate change predictions.

We also aim to discover the biological mechanisms through which climate change affects species, as this is essential for devising conservation solutions to help species to adapt. In upland habitats, we found that warmer, drier Augusts result in reduced cranefly abundances the following spring. Several moorland bird species feed on craneflies during the breeding season, and can experience lower breeding success when craneflies are less abundant. Modelling has shown that under realistic scenarios of future warming, cranefly declines would be sufficient to drive the local extinction of southern Golden Plover populations. Further work has shown that blocking moorland ditches may increase the resilience of upland birds to climate change by raising soil water levels and increasing cranefly abundance. We are developing a similar mechanistic understanding for bird species in the marine and montane environments, such as the Dotterel featured on the front cover.

Our research also aims to understand the effectiveness of existing conservation measures, such as nature reserves, for helping species adapt to climate change. Recent work suggests that existing protected area networks will continue to be important. Working with BTO, the University of York and others, we found that UK Special Protection Areas are likely to retain internationally-important populations of wintering waterbirds and breeding seabirds under future climate change, although the species composition may change at some sites. Further analyses have shown that protected areas may already be helping to resist range retreat at the trailing edge of species' range, and at the leading edge they appear to be important for facilitating range expansion, providing an initial point of settlement from which individuals can colonise the surrounding landscape.

Adult craneflies form an important component of the diet of upland breeding birds but their abundance is affected by management and summer drought. Figure: Abundance of craneflies captured in emergence traps at open and blocked ditches in upland areas of northern England. Note that cranefly abundance is measured on a log scale. (Photo: Matthew Carroll, rspb-images.com)



Protected areas have enabled Cetti's Warbler to expand their range in the UK, providing an initial point of settlement from which individuals can then colonise other areas. (Photo: David Tipling, rspb-images.com)

Recommended citation

Ewing, S.R., Gregory, R.D., Carroll, M.J. & Bradbury, R.B. 2016. Climate change research. RSPB Centre for Conservation Science, Case Study No. 16.

References

Bradbury, R.B., Pearce-Higgins, J.W., Wotton, S.R., Conway, G.J., and Grice, P.V. (2011) The influence of climate and topography in patterns of territory establishment in a range-expanding bird. Ibis 153: 336-344.

Carroll, M.J., Heinemeyer, A., Pearce-Higgins, J.W., Dennis, P., West, C., Holden, J., Wallage, Z.E. and Thomas, C.D. (2015) Hydrologically driven ecosystem processes determine the distribution and persistence of ecosystem-specialist predators under climate change. Nature Communications 6, 7851.

Carroll MJ, Butler A, Owen E, Ewing SR, Cole T, Green JA, Soanes LM, Arnould JPY, Newton SF, Baer J, Daunt F, Wanless S, Newell MA, Robertson GS, Mavor RA, Bolton M (2015) Effects of sea temperature and stratification changes on seabird breeding success. Climate Research 66, 75-89

Ewing, S.R., Benn, S., Cowie, N., Wilson, L. Wilson, J.D. (2013) The effects of weather variation on a declining population of Slavonian Grebes Podiceps auritus. Journal of Ornithology 154: 995-1006.

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. & Thomas, C.D. 2015. The effectiveness of protected areas to conserve species undertaking geographic range shifts. Biological Journal of the Linnean Society 115: 707-717.

Green, R., Collingham, Y.C., Willis, S.G., Gregory, R.D., Smith, K.W., Huntley, B. (2008) Performance of climate envelope models in retrodicting recent changes in bird population size from observed climatic change. Biology Letters 4: 599-602.

Gregory, R.D., Willis, S.G., Jiguet, F., Vorˇíšek, Klvanˇová, A., van Strien, A., Huntley, B., Collingham, Y.C., Couvet, D. and Green, R.E. (2009) An indicator of the impact of climatic change on European bird populations. PloS one 4: e4678.

Hiley, J.R., Bradbury, R.B., Holling, M., and Thomas, C.D. (2013) Protected areas act as establishment centres for species colonising the UK. Proceedings of the Royal Society B: Biological Sciences 280: 20122310.

Huntley, B., Collingham, Y.C., Willis, S.G. & Green, R.E. (2008) Potential impacts of climate change on European breeding birds. PLoS one 1: e1439.

Johnston, A., Ausden, A., Dodd, A.M., Bradbury, R. B., Chamberlain, D. E., Jiguet, F., Thomas, C. D., Cook, A. S. C. P., Newson, S. E., Ockendon, N., Rehfisch, M. M., Roos, S., Thaxter, C. B., Brown, A., Crick, H. Q. P., Douse, A., McCall, R. A., Pontier, H., Stroud, D. A., Cadiou, B., Crowe, O., Deceuninck, B., Hornman, M. and Pearce-Higgins, J. W. (2013) Observed and predicted effects of climate change on species abundance in protected areas. Nature Climate Change 3: 1055-1061.

Stephens, P.A., Mason, L.R., Green, R.E., Gregory, R.D., Sauer, J.R., Alison, J., Aunins, A., Brotons, L., Butchart, S.H.M., Campedelli, T., Chodkiewicz, T., Chylarecki, P., Crowe, O., Elts, J., Escandell, V., Foppen, R.P.B., Heldbjerg, H., Herrando, S., Husby, M., Jiguet, F., Lehikoinen, A., Lindström, A., Noble, D.G., Paquet,J.Y., Reif,J., Sattler, T., Szép,T., Teufelbauer, N., Trautmann, S., van Strien, A.J., van Turnhout, C.A.M., Vorisek, P., Willis, S.G (2016). Consistent response of bird populations to climate change on two continents. Science 352, 84-87, doi: 10.1126/science.aac4858.

Thomas, C. D., Hill, J. K., Anderson, B. J., Bailey, S., Beale, C. M., Bradbury, R. B., Bulman, C. R., Crick, H. Q. P., Eigenbrod, F., Griffiths, H. M., Kunin, W. E., Oliver, T. H., Walmsley, C. A., Watts, K., Worsfold, N. T. and Yardley, T. (2011) A framework for assessing threats and benefits to species responding to climate change. Methods in Ecology & Evolution 2: 125-142.

Thomas, C.D., 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., 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 Hill, J.K. (2012). Protected areas facilitate species' range expansions Proceedings of the National Academy of Sciences USA 109: 14063-14068.

Authors

Dr. Steven Ewing
Senior Conservation Scientist
Contact: steven.ewing@rspb.org.uk

My research focuses largely on assessing climate change impacts in rare and declining range-edge bird species in the UK. This includes autecological research to understand potential impacts on Dotterel and another project examining the potential role of climate change in driving recent changes in northern European Slavonian Grebe populations. I am also interested in how landscape structure can be modified to facilitate adaptation to climate change, particularly for species such as woodland grouse.

Dr. Richard Gregory
Head of Species Monitoring and Research
Contact: richard.gregory@rspb.org.uk

The work of my team includes biodiversity monitoring and indicators, climate change impacts, setting conservation priorities, conducting autecological studies of birds in uplands, wetlands, woodlands, and wet grasslands, and studying ecological processes such as predation and climate change. I have a particular interest in turning conservation science into policy actions and biological outcomes, linking science, policy and the management of natural resources.

Dr. Matthew Carroll
Conservation Scientist
Contact: matthew.carroll@rspb.org.uk

I carry out research into the impacts of climate change on UK species. This has included examining the effects of drainage and soil moisture on peatland craneflies and the birds that feed on them, and modelling future distributions of UK plants, birds and insects. Most recently, I have been studying the way that changing ocean conditions could influence seabird populations via the plankton and fish in their food webs.

Dr. Richard Bradbury
Head of Environmental Research

My team conducts research on whether and how climate change causes problems for species, researches the design and efficacy of adaptation solutions and seeks to understand the impacts on wildlife of renewable energy technologies. I am also interested in how strategies for biodiversity conservation relate to ecosystem service provision and human well-being and how the social sciences can develop our understanding of cultural ecosystem services and pro-environmental behaviour change.

Acknowledgements *SCARABBS is the Statutory Conservation Agency and RSPB Annual Breeding Bird Scheme which is in partnership with and co-funded by, Natural England, Natural Resources Wales, Northern Ireland Environment Agency and Scottish Natural Heritage. The research projects described here have been conducted in partnership with BirdWatch Ireland, the BSBI, BTO, Butterfly Conservation, CEH, CCW, EBCC, Forestry Commission, Forest Research, GISOM, JNCC, LIPO, NRW, Paris Natural History Museum, RBBP, SNH, SOVON, and the Universities of Aberystwyth, Bournemouth, Cambridge, Durham, East Anglia, Exeter, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Oxford, Sheffield, Turin and York. Funding for this work was provided by Defra, the European Environment Agency, European Commission, Natural England, NERC, and Scottish Natural Heritage.*

Kittiwake, a species we have been studying to help us understand climate change impacts in the marine environment (Andy Hay rspb-images).

The RSPB

UK Headquarters
The Lodge, Sandy,
Bedfordshire SG19 2DL
Tel: 01767 680551

Northern Ireland Headquarters
Belvoir Park Forest,
Belfast BT8 7QT
Tel: 028 9049 1547

Scotland Headquarters
2 Lochside View, Edinburgh Park,
Edinburgh EH12 9DH
Tel: 0131 317 4100

Wales Headquarters
Sutherland House, Castlebridge,
Cowbridge Road East,
Cardiff CF11 9AB
Tel: 029 2035 3000

rspb.org.uk

The RSPB is the country's largest nature conservation charity, inspiring everyone to give nature a home.

The RSPB is a member of BirdLife International, a partnership of conservation organisations working to give nature a home around the world.

BirdLife INTERNATIONAL

As a charity, the RSPB is dependent on the goodwill and financial support of people like you. Please visit rspb.org.uk/supporting or call 01767 680551 to find out more.

The Royal Society for the Protection of Birds (RSPB) is a registered charity: England and Wales no. 207076, Scotland no. SC037654

rspb.org.uk/science