
Mesozoic and Tertiary fossil mammals and birds of Great Britain

M.J. Benton Department of Earth Sciences, University of Bristol, Bristol, UK

E. Cook Department of Earth Sciences, University of Bristol, Bristol, UK

and

J.J. Hooker Department of Palaeontology Natural History Museum London, UK

GCR Editor: D. Palmer

Published by the Joint Nature Conservation Committee, Monkstone House, City Road, Peterborough, PE1 1JY, UK

First edition 2005

© 2005 Joint Nature Conservation Committee

Typeset in 10/12pt Garamond ITC by JNCC

Printed in Great Britain by Hobbs The Printers on 100 gsm Silverblade Matt.

ISBN 1 86107 4808.

Apart from any fair dealing for the purposes of research or private study, or criticism or review, as permitted under the UK Copyright Designs and Patents Act, 1988, this publication may not be reproduced, stored, or transmitted, in any form or by any means, without the prior permission in writing of the publishers, or in the case of reprographic reproduction only in accordance with the terms of the licences issued by the Copyright Licensing Agency in the UK, or in accordance with the terms and licences issued by the appropriate Reproduction Rights Organization outside the UK. Enquiries concerning reproduction outside the terms stated here should be sent to the GCR Team, JNCC.

The publisher makes no representation, express or implied, with regard to the accuracy of the information contained in this book and cannot accept any legal responsibility or liability for any errors or omissions that may be made.

British Geological Survey Copyright protected materials

1. The copyright of materials derived from the British Geological Survey's work is vested in the Natural Environment Research Council (NERC). No part of these materials (geological maps, charts, plans, diagrams, graphs, cross-sections, figures, sketch maps, tables, photographs) may be reproduced or transmitted in any form or by any means, or stored in a retrieval system of any nature, without the written permission of the copyright holder, in advance.

2. To ensure that copyright infringements do not arise, permission has to be obtained from the copyright owner. In the case of BGS maps this includes both BGS and the Ordnance Survey. Most BGS geological maps make use of Ordnance Survey topography (Crown Copyright), and this is acknowledged on BGS maps. Reproduction of Ordnance Survey materials may be independently permitted by the licences issued by Ordnance Survey to many users. Users who do not have an Ordnance Survey licence to reproduce the topography must make their own arrangements with the Ordnance Survey, Copyright Branch, Romsey Road, Southampton SO9 4DH (Tel. 01703 792913).

3. Permission to reproduce BGS materials must be sought in writing from the Intellectual Property Rights Manager, British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham NG12 5GG (Tel. 0115 936 3100).

A catalogue record for this book is available from the British Library.

Recommended example citation

Contents

Acknowledgements

Access to the countryside

Conserving our fossil heritage — JNCC policy statement

Preface

1 Introduction to Mesozoic and Tertiary fossil mammals and birds M.J. Benton

A history of the study of fossil mammals and birds

Bird evolution

Mammal evolution

Fossil mammal and bird sites: distribution and range

The selection of Mesozoic and Tertiary fossil mammal and bird GCR sites

2 British Mesozoic fossil mammal GCR sites M.J., Benton, J.J. Hooker and E. Cook

Introduction: Mesozoic stratigraphy and sedimentary setting

Mammal evolution during the Mesozoic Era

British Mesozoic Mammal GCR sites

Early Jurassic mammal and tritylodont sites

Windsor Hill Quarry, Shepton Mallet, Somerset

Holwell Quarries, Frome, Somerset

Bridgend Quarries, Glamorgan

Middle Jurassic mammal sites

Stonesfield Slate Mines, Oxfordshire

Kirtlington Old Cement Works, Kirtlington, Oxfordshire

Loch Scavaig, Skye and Lochalsh

Watton Cliff, Dorset

Late Jurassic Mammal sites

Upper Chicksgrove Quarry, Wiltshire

Early Cretaceous mammal sites

Durlston Bay, Swanage, Dorset

Wealden mammal sites

Cliff End, East Sussex

3 British Tertiary fossil mammal GCR sites J.J. Hooker, E. Cook and M.J. Benton

Introduction

Tertiary stratigraphy and sedimentary setting

Mammal evolution in the British Tertiary Sub-era

British Tertiary mammal sites

Ferry Cliff; Suffolk

Abbey Wood, Greater London

Creechbarrow Hill, Dorset

Hordle Cliff Hampshire

Headon Hill, Isle of Wight

Lacey's Farm Quarry, Totland, Isle of Wight

Whitecliff Bay, Isle of Wight

Bouldnor Cliff, Isle of Wight

4 British Tertiary fossil bird GCR sites M.J. Benton and E. Cook

Introduction

Bird evolution in the British Tertiary Sub-era

British Tertiary bird sites

Abbey Wood, Greater London

The London Clay Formation

Walton-on-the-Naze, Essex

Bognor Regis, West Sussex

Warden Point and the Isle of Sheppey, Kent

Burnham-on-Crouch, Essex

Lee-on-the-Solent, Gosport, Hampshire

Hordle Cliff Hampshire

Bouldnor Cliff; Isle of Wight

References

Glossary

Fossil index

General index

Acknowledgements

Work on the British fossil mammals and birds part of the GCR project was initiated by the Nature Conservancy Council (which existed up to 1991) and has been seen to completion and publication by the Joint Nature Conservation Committee on behalf of the three country agencies, English Nature, Scottish Natural Heritage and the Countryside Council for Wales. The late Dr George Black, Head of the Geology and Physiography Section of the Nature Conservancy Council, initiated the GCR project in 1977, and the 'Mesozoic Mammalia', 'Tertiary Mammalia' and 'Ayes' GCR Blocks were considered early on in the site-selection programme. In the site-assessment and GCR site-selection phase of the project, work was co-ordinated by the late Kenneth Kermack for Mesozoic Mammalia and Alan Insole for the Tertiary Mammalia; the late Colin Harrison co-ordinated the selection of 'Ayes' sites, with guidance from Bill Wimbleton (then Head of the GCR Unit).

Many specialists, too numerous to mention by name, were involved in the assessment and selection of sites, but this vital work is gratefully acknowledged.

JNCC invited the University of Bristol to undertake the preparation of a text for publication for JNCC in the late 1990s, and later invited Jerry Hooker to join the authorship team. Many people were involved in the peer-reviewing of early drafts, but Mike Benton and Elizabeth Cook would particularly like to acknowledge Brian Daley (University of Portsmouth), Gareth Dyke (University College, Dublin), and the late Bob Savage (University of Bristol) for their helpful comments on the site reports relevant to their areas of study, and on the various introductory sections of the present volume.

Jerry Hooker would like to thank the many collectors who have kindly donated important fossil specimens to the national collections, thereby contributing to the substance of this volume, especially: David Bone, John Bruce, Jim Bryant, Barbara Butler, Paul Clasby, Ray Curtis, Peter Davey, Paul Ensom, the late Roy Fowler, Roy Gardner, Brian Gasson, Bill George, Jean Hole, Paul Jeffery, Mike Jurd, Allan Lawson, Chris Millbank, Tony Mitchell, the late Alan Packman, D. Peppit, John Quayle, David and Martin Rayner, Adrian Rundle, Mike Smith, Malcolm Symonds, David Ward and Andy Yule.

Thanks also go to the following people who have helped greatly with fieldwork: Margaret Collinson, John Cooper, Andy Carrant, Steve Grimes, Dave Matthey, Nick Sille and David Ward. Bexley Council, English China Clays, The National Trust, Nigel Lewis and John and Marion Smith have given access to and logistic help at key localities, which was much appreciated.

Thanks are also due to the many museum curators over the years who have provided access to collections in their care and loaned relevant specimens, including Hans de Bruijn (Instituut voor Aardwetenschappen, Utrecht), Jean-Yves Crochet, Jean-Louis Hartenberger, Bernard Sigé, Jean Sudre and Monique Vianey-Liaud (Universite des Sciences et Techniques du Languedoc, Montpellier H), Burkart Engesser (Naturhistorisches Museum, Basel), Paul Ensom (Yorkshire Museum), Jorg Erfurt, Hartmut Haubold and Gunter Krumbiegel (Geiseltalmuseum, Halle), Phil Gingerich and Gregg Gunnell (University of Michigan Museum of Paleontology, Ann Arbor), David Harrison (Harrison Zoological Institute, Sevenoaks), Elmar Heizmann (Staatliches Museum für Naturkunde, Stuttgart), Dave Kemp (Gosport Museum), Bob Markham (Ipswich Museum), Martin Munt (Dinosaur Isle Museum, Sandown), Paul Sartenaer (Institut Royal des Sciences Naturelles, Bruxelles), Claudine Sudre (Museum d'Histoire Naturelle de Toulouse), Pascal Tassy, Don Russell and Marc Godinot (Museum National d'Histoire Naturelle, Paris) and Marc Weidmann (Museum Géologique de Lausanne). Jerry Hooker is also grateful to Bill Clemens for critically reading an early draft of the Mesozoic mammal

chapter and to Simon Parfitt for help with references on the Red Crag.

An acknowledgement must be given for the massive contribution to our knowledge of British Mesozoic mammals, through the collecting efforts over the last few decades by the late Kenneth Kermack, Frances Mussett and Pat Lees, who were initiated in this quest by the pioneering collecting of the late Walter Kühne.

Thanks are also due to the GCR Publication Production Team — Neil Ellis, GCR Publications Manager, and Anita Carter and Emma Durham, GCR Production Editors — for their guidance during the drafting of text, resolution of technical issues and their painstaking production work. The diagrams were produced to a high standard by JS Publications of Newmarket by Drs Susanne White and Chris Pamplin.

Where the content of illustrations has been replicated or modified from the work of others appropriate acknowledgements are given in the captions. The National Grid is used on diagrams with the permission of the Controller of Her Majesty's Stationery Office, 0 Crown copyright licence no. GD 27254X/01/00. Photographs are accredited in the captions.

Access to the countryside

This volume is not intended for use as a field guide. The description or mention of any site should not be taken as an indication that access to a site is open. Most sites described are in private ownership, and their inclusion herein is solely for the purpose of justifying their conservation. Their description or appearance on a map in this work should not be construed as an invitation to visit. Prior consent for visits should always be obtained from the landowner and/or occupier.

Information on conservation matters, including site ownership, relating to Sites of Special Scientific Interest (SSSIs) or National Nature Reserves (NNRs) in particular counties or districts may be obtained from the relevant country conservation agency headquarters listed below:

Countryside Council for Wales, Maes-y-Ffynnon, Penrhosgarnedd, Bangor, Gwynedd LL57 2DW

English Nature, Northminster House, Peterborough PE1 1UA.

Scottish Natural Heritage, 12 Hope Terrace, Edinburgh EH9 2AS.

Conserving our fossil heritage — JNCC policy statement

Fossils are a key part of our natural heritage and a major scientific, educational and cultural resource. They are fundamental to understanding the evolution of life and the character of ancient environments. Fossils also provide a basis for comparing the ages of rocks the world over.

The discovery, collection and study of the fossilized remains of ancient life can be enjoyable and stimulating activities that give people a fascinating insight into the geological and biological history of the Earth. However, the available fossil resource is finite. It is only through maintaining a prudent approach to the management of important fossil sites that future generations will be able to experience, study and enjoy them.

Responsible fossil collecting

In most circumstances, responsible fossil collecting is not harmful to the conservation of fossil sites. It can actually benefit our understanding of geology. This is particularly true where the fossils are relatively common or the sites in which they are found are subject to high levels of natural or artificial degradation, such as coastal cliffs that are being eroded, or quarries that are being actively worked. In such situations collecting fossil specimens that might otherwise be destroyed can be beneficial to science, provided that they are properly documented and made available for study. Responsible fossil collecting can therefore be a valuable activity in the sustainable management and safeguard of our fossil heritage.

Irresponsible fossil collecting

Irresponsible collecting provides no scientific or educational gain and is therefore an unacceptable activity resulting in irreparable damage to our fossil heritage. It will pose a clear threat where fossils are rare or the fossil source is limited in extent, for example in a cave or a river channel deposit. Collecting without proper recording and curation, inexperienced collecting, over-collecting and inappropriate use of power tools and heavy machinery are likely to reduce or even destroy the scientific value of such sites. Unless the activity is undertaken in an appropriate manner, the statutory nature conservation agencies, the Countryside Council for Wales, English Nature, Environment and Heritage Service and Scottish Natural Heritage, will oppose fossil collecting on the small number of Sites of Special Scientific Interest / Areas of Special Scientific Interest where this activity would cause significant damage to the features of special interest.

Code of good practice

Adopting a responsible approach to collecting is essential for conserving our fossil heritage. The basic principles set out below should be followed by all those intending to collect fossils.

Access and ownership — permission to enter private land and collect fossils must always be gained and local bylaws should be obeyed. A clear agreement should be made over the future ownership of any fossils collected.

Collecting — in general, collect only a few representative specimens and obtain these from fallen or loose material. Detailed scientific study will require collection of fossils *in situ*.

Site management — avoid disturbance to wildlife. Many invertebrates and lower plants live on or under loose rocks that should be replaced in their original positions whenever possible. Do not leave the site in an untidy or dangerous condition for those who follow.

Recording and curation — always record precisely the locality at which fossils are found and, if collected *in situ*, record relevant details of the position of the rock layer from where the fossil was collected. Ensure that these records can be directly related to the relevant specimens. Where necessary, seek specialist advice on specimen identification and care. Fossils of prime scientific importance should be placed in a suitable repository, normally a museum with adequate curatorial and storage facilities.

Management of our fossil heritage

In order to achieve the successful management of the fossil heritage of the United Kingdom, the statutory nature conservation agencies will:

- Promote the responsible approach outlined in the *Code of Good Practice*, above.
- Encourage the placement of scientifically important fossils into a suitable repository (such as a museum) in order to ensure their proper curation, longterm security and accessibility
- Recognize the contribution that responsible fossil collectors can make to geological and palaeontological study.
- Encourage collaboration within the geological community to ensure that maximum educational and scientific gain is made from our fossil resource.
- Support and encourage initiatives that increase awareness and understanding of the value of our fossil resource and the need to conserve it.
- Increase awareness and understanding of the differing management needs of fossil sites. In particular, encourage landowners and occupiers to become advocates for conservation of the fossil resource.
- Review the need for export and import controls on the international trade in fossil specimens.

JNCC, 1997

Preface

There is such a diversity of rocks, minerals, fossils and landforms packed into the piece of the Earth's crust we call 'Britain' that it is difficult not to be impressed by the long, complex history of geological change to which they are testimony. But if we are to improve our understanding of the nature of the geological forces that have shaped our islands, further unravel their history in 'deep time' and learn more of the history of life on Earth, we must ensure that the most scientifically important of Britain's geological localities are conserved for future generations to study, research and enjoy. Moreover, as an educational field resource and as training grounds for new generations of geologists on which to hone their skills, it is essential that such sites continue to remain available for study. The first step in achieving this goal is to identify the key sites. This is the aim of the Geological Conservation Review.

The GCR, launched in 1977, is a world-first in the systematic selection and documentation of a country's best Earth science sites. No other country has attempted such a comprehensive and systematic review of its Earth science sites on anything near the same scale. After over two decades of site evaluation and documentation, we now have an inventory of over 3000 GCR sites, selected for 100 categories covering the entire range of the geological and geomorphological features of Britain.

This volume, describing the Mesozoic and Tertiary Mammals and Birds GCR sites, is the 32nd to be published in the GCR series, which will stretch to over 40 volumes. Not only does the present volume contain the descriptions of key localities that will be conserved for their contribution to our understanding of the palaeontology and palaeobiology of mammals and birds, but also provides an excellent summary of the faunal evolution during Mesozoic and Tertiary times, and the considerable research that has been undertaken. The book will be invaluable as an essential reference book to those engaged in the study of these fossils and will provide a stimulus for further investigation. It will also be helpful to teachers and lecturers and for those people who, in one way or another, have a vested interest in the GCR sites: owners, occupiers, planners, those concerned with the practicalities of site conservation and indeed the local people for whom such sites are an environmental asset. The conservation value of the sites is mostly based on a specialist understanding of the stratigraphical, palaeontological and sedimentological features present and is therefore, of a technical nature. The account of each site ends, however, with a brief summary of the geological interest, framed in less technical language, in order to help the non-specialist. The first chapter of the volume, used in conjunction with the glossary, is also aimed at a less specialist audience. This volume is not intended to be a field guide to the sites, nor does it cover the practical problems of their ongoing conservation. Its remit is to put on record the scientific justification for conserving the sites.

This volume deals with the state of knowledge of the sites available at the time of writing, and must be seen in this context. Palaeontology, like any other science, is an ever-developing pursuit with new discoveries being made, and existing models are subject to continual testing and modification as new data come to light. Increased or hitherto unrecognized significance may be seen in new sites, and it is possible that further sites worthy of conservation will be identified in future years. Nevertheless, there is still much more to learn and the sites described in this volume are as important today as they have ever been in increasing our knowledge and understanding of the palaeontology of Britain, and the history of fossil mammals and birds. This account clearly demonstrates the value of these sites for research, and their important place in Britain's scientific and natural heritage.

N.V. Ellis and M.J. Benton January 2005.

[References](#)