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The conservation of Jurassic heritage in the UK – a critical review of the role of governmental organisations and their effectiveness

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ABSTRACT: In 1949 the concept of protected geological sites was first established in UK law by Nature Conservancy (NC) as ‘Sites of Special Scientific Interest’ (SSSIs). In 1977 a systematic site selection process - the Geological Conservation Review (GCR) was established by the UK-wide Nature Conservancy Council (NCC) which identified over 3000 features of geological interest nationally (excluding Northern Ireland), including around 275 representing aspects of Jurassic stratigraphy and palaeontology. These GCR sites formed the basis for all subsequent geoconservation SSSI designation including under strengthened legislation in 1981 and 2002. The fragmentation of the NCC in 1991 established separate country conservation bodies in Scotland (Scottish Natural Heritage), Wales (Countryside Council for Wales), and England (English Nature) with a fourth, the Joint Nature Conservation Committee (JNCC) to oversee certain national and international activities. In Northern Ireland, however, nature conservation remained the responsibility of the Environment and Heritage Service of the Department of the Environment. With the establishment of these five separate organisations, policy and practice began to diverge. The consequences of this divergence are discussed with particular reference to its effects on the conservation of sites of Jurassic palaeontological and stratigraphical importance. Recommendations for future conservation strategies and procedures are proposed.

INTRODUCTION

The loss of key exposures and materials due to human activity has always been an issue for geologists and palaeontologists. As long ago as 1859, Leckenby, a pioneering Yorkshire amateur geologist complained that fossil collecting had become so intense from rocks on the shore below Scarborough Castle – a key Callovian/Oxfordian boundary locality – commenting that “*So diligently have they been explored that hardly a block is to be found to reward the industrious*

collector”. By the beginning of the twentieth century, the area had site suffered further and much of the Leckenby’s former collecting ground had disappeared behind a sea wall and promenade – a mechanism for site loss which remains all too common today. These early losses still had ramifications many years later for Jurassic stratigraphy as Scarborough is the type locality of *Cardioceras scarburgense* (Young and Bird) index fossil of the first subchronozone of the Oxfordian Stage – as a result of the loss of most of the key Callovian/Oxfordian boundary section below the

town, Osgodby Nab to the south consequently became an early candidate GSSP (Global Stratotype Section and Point) for the definition of the base of the Oxfordian Stage (Callomon 1990).

Other lamentations and observations about site loss are scattered through the geological literature. Even W. J. Arkell, one of UK's most famous Jurassic specialists, noted in his monograph of Oxfordian ammonites (1935-1948) that his work was no longer repeatable as development was already rapidly filling some of the most important sources of his Middle Oxfordian ammonite faunas around Oxford itself. Remarkably, however, during the Second World War as a part of a vision to rebuild Britain, a working group was established and produced the first list of key UK geological sites as prelude to their conservation. In 1949 the legal framework for this protection was established through the National Parks and Access to the Countryside Act. The Act referred to both 'geological monuments' and 'physiographic features' (*i.e.* geomorphological sites) and legal protection was established through designation of what became known as 'Sites of Special Scientific Interest' (or SSSIs).

The initial site selection primarily highlighted famous or 'classic' localities but had no underlying methodology and it was not until 1977 with the establishment of the Geological Conservation Review (GCR) by the national Nature Conservancy Council (NCC) that the process at last became systematic (Wimbledon *et al.* 1995; Ellis *et al.* 1996). The GCR process led to the identification of over 3000 features of geological interest in England, Scotland and Wales within thematic selection 'blocks', as a basis for all subsequent geological SSSI designation. This selection included around 275 sites representing aspects of Jurassic stratigraphy and palaeontology (Page, Prosser 1994). The GCR process did not include Northern Ireland (Ulster), however, where a parallel system using GCR principles was established, with sites notified as 'Areas of Scientific Interest' (ASIs) under similar legislation.

SSSIs in mainland Britain are now all notified using the provisions of the Wildlife and Countryside Act 1981, as strengthened by the Countryside and Rights of Way Act 2002 (or 'CROW' Act) in England and Wales. Differences in aspects of Scottish Law mean that the latter does not apply, although its principles are incorporated within the Nature Conservation Act 2004. Throughout the three countries, however, the designation is still as a Site of Special Scientific Interest.

Site conservation activity by the Nature Conservancy Council was on a learning curve in the earlier days with the legal possibilities of the 1981 act being explored and techniques and philosophies being developed – as summarised in the first published UK Geoconservation Strategy in 1990 (Nature Conservancy Council 1990). Political moves, however, led to the fragmentation of the national body in 1991 and the establishment of separate country organisations in Scotland (Scottish Natural Heritage or SNH), Wales (Countryside Council for Wales or CCW) and England (English Nature or EN) with a fourth to service the country agencies on certain national and international activities (Joint Nature Conservation Committee or JNCC). The latter also produce the Geological Conservation Review volumes, descriptive monographs for all mainland UK geoconservation sites. In Northern Ireland, however, nature conservation remained the responsibility of the Department of the Environment, within its Environment and Heritage Service (EHS).

With the establishment of these five separate organisations, policy and practice inevitably began to diverge. Wales established a regionalised distribution of geologists in local area teams working on site-based casework and site management. In Scotland, a small group of centrally based geologists provides advice nationally, although in practice most casework is carried out by local, typically ecological-trained, conservation officers. In England, however, a trend established towards the end of the NCC continued, with more and more key decisions being made by a centrally-based group of geological advisors with limited external scientific input. In addition, local, ecological conservation officers have increasingly been expected to not only give day-to-day advice on the management of geological sites, but also to set conservation objectives and monitor the same sites. These approaches have not only contributed to losses of key parts of several protected Jurassic sites and their contained palaeontological heritage, but also to a high level of under-recording of such damage. In contrast, in Northern Ireland, strong links exist with regional museums and scientific specialists, which are reflected not only in site based work but also in approaches to site management.

Beyond the SSSI network protected by national conservation law, sites of local importance for nature conservation are protected through Town

and Country planning legislation, including area development plans and strategies. For ecological conservation, the selection of, for instance, 'SINCs' (Sites of Interest for Nature Conservation), is well established. For geological heritage, however, the scenario is less satisfactory, with many areas of the UK still without a formally adopted network of 'local' sites. Known collectively as Regionally Important Geological Sites (or RIGS), these locations provide a 'second tier' to the UK's geoconservation sites networks and although no comprehensive national database exists, the number of additional protected Jurassic sites could easily number 200-300. RIGS are typically selected on a county by county basis by local, typically voluntary groups. Although the status of these sites is recognised by central government (*e.g.* in Planning and Policy Statement 9, Wildlife and Geological Conservation) little support for their protection is often provided, and 'RIGS Groups' typically depend on voluntary effort and grants from local government organisations to support their activities.

The relationship of this second tier of sites to the national SSSI network raises some questions, however. In principle all SSSIs are of at least national importance and all RIGS are of regional importance. In reality, however, the picture is not so simple and some RIGS are certainly of international importance – the current inertia of the SSSI selection and designation process, as administered by the JNCC, makes any updating of the national GCR/SSSI network difficult. As a result, RIGS designations are often used as a 'holding mechanism', pending a future revision of the national networks. The role of the non-governmental and voluntary sector organisations (*e.g.* 'NGOs'), including RIGS groups is not discussed further, however, as this would be a study in its own right and most activities of such groups are still strongly influenced by governmental agencies and existing legal frameworks.

The approach of each country agency is reviewed further below, including an exploration of case histories displaying both successes and failures. This information is synthesised with principles and practice from elsewhere in the world to establish a series of guidelines on which future geological conservation work on Jurassic sites in

the UK could be based, thereby ensuring that their value to science is adequately maintained.

WALES

Nature conservation in Wales became the responsibility of the Countryside Council for Wales (CCW) in 1991, together with aspects of landscape management and rural access and recreation – the functions of the former Countryside Commission in the area being combined. CCW maintained some of the scientific ethos of the former national Nature Conservancy Council as reflected, for instance, in its methodical approach to site management planning (Wimbledon *et al.* 2003).

With a headquarters in Bangor in north Wales and relative poor communications in rural and often mountainous terrain – a strong regional framework developed including a network of four area-focussed geologists. The latter provide conservation advice to regional offices as well as carrying out site monitoring functions. Wales also benefits from strong regional government – the Welsh Assembly – which has specifically supported a range of geological initiatives. These include RIGS survey projects, the establishment of a British Geological Survey Office in Cardiff (including support for the long-overdue completion of baseline mapping for the country) and LANDMAP, a novel landscape survey and characterisation project, which includes a 'Geological Landscapes' GIS layer (see www.ccw.gov.uk).

	ENGLAND	WALES	SCOTLAND	NORTHERN IRELAND
1949	Nature Conservancy (NC)			Environment and Heritage Service (EHS) Department of the Environment (Northern Ireland)
1973	Nature Conservancy Council (NCC)			
1985				
1991	Nature Conservancy Council for England (NCCE) (1991-2)/English Nature (EN) (from 1991)	Countryside Council for Wales (CCW)	Nature Conservancy Council for Scotland (NCCS) (1991-2)/ Scottish Natural Heritage (SNH) (from 1992)	
2006	Natural England (NE)			

Fig. 1. Governmental organisations with responsibility for nature conservation in the UK with their dates of formation.

Although Jurassic outcrops are largely limited to the Glamorgan coast of the south Wales (Simms *et al.* 2004; Benton and Spencer 1995; Benton *et al.* 2002), they do include key Triassic-Lower Jurassic sequences with internationally known littoral facies. Conservation work on geological SSSIs in this area is typically concerned with limiting the damaging effects of coastal defence works and there have been some notable conservation successes. A more significant issue for the Jurassic, however, is the current lack of a RIGS activity in most of the country and consequently key sections of the Glamorgan coast, including lithostratigraphical stratotypes, are still without protection and several former quarry sites have recently been lost to development. Selection of 'RIGS' as geological Sites of Interest for Nature Conservation (SINC)s is underway elsewhere, however, and surveys supported by CCW geologists have already identified potential conservation sites for Lower Jurassic sequences in south-east Wales, including in the Newport area (Davies 2006).

Another problem reflects a common theme in UK geoconservation as a whole, the lack of a unified approach to palaeontological heritage conservation and the high profile of commercial collecting in certain areas. Bendrick Rocks SSSI, near Barry, displays a remarkable assemblage of late Triassic dinosaur footprints (Benton, Spencer 1995) – or at least it used to. In around 2005, fossil collectors quarried a substantial area of the outcrop and sold it to several fossil dealers, the bulk going to a well-known fossil shop in Lyme Regis, Dorset, England. A subsequent raid on the premises by the combined South Welsh and Dorset police forces and CCW seized the latter material and returned it to Wales, with formal prosecution under consideration. The Dorset location is key, however, as in that County the commercialisation of fossils is actively promoted (see below), a policy which is having consequences elsewhere in the UK with issues of conservation and legal ownership being ignored when geological materials have a market value.

Further information on CCW including details of all geological SSSIs in the country can be found at: www.ccw.gov.uk

SCOTLAND

In a similar approach to Wales, combined nature conservation and 'countryside' issues became the

responsibility of a single organisation, Scottish Natural Heritage (or SNH) in 1992. The basic legal framework for conservation in Scotland is similar to that in England and Wales, with SSSI notification being carried out under the Wildlife and Countryside Act 1981. Due to differences in aspects of Scottish law, however, which include a separate Parliament, the principles of the Countryside and Rights of Way Act (CROW) have been implemented separately though the Nature Conservation (Scotland) Act 2004. SNH now has its corporate head office in Inverness, although a number of sections remain elsewhere, including Edinburgh.

In a more extreme scenario to Wales, small rural roads, large distances and typically remote or mountainous terrain can create problems for the small centrally based geoconservation advisor group in Edinburgh. Most site-related casework is inevitably, therefore, carried out by regionally based conservation advisors who typically have no geological background. Geological advisors, however, will lead on complex and sensitive issues, such as development pressure in urbanised areas in the Midland Valley and specimen collecting throughout. Locally, such as on the Isle of Skye, close working relationships exist with geologists and palaeontologists in Scottish museums and universities. Site management planning has developed in Scotland to allow effective management of all geological SSSIs, each having its own management statement. In addition, interpretation and educational provision on geological sites is some of the best in the UK.

Due to the remoteness of much of Scotland and the unique geological resource of many Scottish sites, geological specimen collecting has become a major issue in the country. Stories of helicopter-raids by foreign collectors are part of UK geo-heritage folklore but the reality is no less disturbing with many accounts of damage to SSSIs. Large sections of the unique Lower Carboniferous Granton Shrimp Bed with its conodont animal have been removed by mechanical excavators and rare Devonian fish from the famous Orcadian Basin rock-sawn out for international sale. One of the most famous cases is that of 'Lizzie the lizard', a tiny 15 cm early Carboniferous reptile, the prospect of loss through export of which necessitated a public appeal to raise the £195,000 asked for by the fossil dealer who had collected it from public land (Grayson 1990) – literally, the people of Scotland were forced to buy back their own heritage.

One of the most worrying stories, however, is that of the primitive Silurian fish of Birks Knowe SSSI, removed by a German collector and sold to the Humbolt Museum in Berlin. Despite numerous attempts by SNH (Macfadyen 2006) the museum has refused to return the rarest and most spectacular specimens collected to their rightful owners in Scotland. The compliance of certain museums and academics in supporting illegal specimen collecting such as this has unfortunately been a common theme not only in the UK but elsewhere – and a number of well known UK institutions are also guilty of failing to adequately ascertain whether the specimens they have been offered for sale have been obtained legally. Such actions are also not only unethical, they inevitably undermine site conservation efforts by actually encouraging illegal activity at the most scientifically important and sensitive sites.

In reality, however, unlike in England and Wales, geological specimens in Scottish sites should actually benefit from greater protection as all loose materials – or moveable items – remain the property of the landowner. In England and Wales such materials can be considered as having been abandoned and in the absence of instructions to the contrary can be legally removed from areas with public access, for instance from most beaches. This scenario in Scotland, however, can sometimes create additional problems for field geology, especially where large privately owned estates persist. In some areas, landowners have begun to expect payment for allowing geological sampling – despite access itself being considered as open to most areas under Scottish law – and this has already lead to problems for undergraduate teaching, as on the Isle of Arran of the west coast.

The Jurassic of Scotland, which is well exposed on both the east, and more famously the west, coasts (Simms *et al.* 2004; Cox and Sumblar 2002; Wright and Cox 2001) has not been immune to these issues. On the east coast, parts of the famous Brora coastal sections in the Middle Jurassic have been reported as being virtually closed to geological sampling and on the west, especially on the Isles of Skye, key parts of the island's Jurassic, including the well known Hettangian-Sinemurian sections at Broadford, may now be on 'pay to sample' basis or with research being 'rationed' by private land-owning interests. Nevertheless, certain other areas are now publicly owned and managed by the Scottish Executive's Environment and Rural Affairs Department (SEERAD) who work in close colla-

boration with SNH and the local community to ensure that the geological sites which they have responsibility for are adequately protected, whilst remaining available for scientific study. Such sites include the proposed GSSP (Global Stratotype Section and Point) for the base of the Kimmeridgian Stage in Staffin Bay (Wierzbowski *et al.* 2006) and the important Lower and Middle Jurassic sections on the east coast of the adjacent Isle of Raasay (Morton, Hudson 1995).

Fossil collecting issues are locally significant and the classic Aalenian-Bajocian sections of the Berreraig Bay area which include the Auxiliary Stratotype for the Bajocian Stage (Pavia and Enay (1997) have suffered from intensive, irresponsible collecting, including the use of rock saws to extract well preserved graphoceratid ammonites – once a common site in UK fossils shops. Several ichthyosaur skeletons are reported as having also been removed from here and exported – and their current whereabouts do not appear to be known. The Isle of Raasay has also been targeted by fossil collectors and material removed from the islands main SSSI in contravention of the conservation restrictions in place. On a more positive, however, a unique dinosaur bone from Skye was secretly returned when its collector realised the consequences of their actions and SNH and Scottish museums continue to raise the awareness of local communities as to the intrinsic value of their geological heritage. Newspaper articles such "European thieves steal fossils to order" (*Sunday Times*; 5th May 2002) are helping this process – although perhaps ironically some of these culprits will be from the UK and some are certainly Scottish...

The new Nature Conservation (Scotland) Act 2004 includes provision to establish a legally enforceable code of good conduct for fossil collecting in Scotland and SNH commenced consultation on its contents in 2007. Crucially, the scientific community has been invited to comment (see www.snh.gov.uk), including through notices in publications such as the UK Palaeontological Association's Newsletter (Macfadyen 2006). Hopefully by building a consensus and raising awareness, some of the excesses of the past can be avoided and any future issues effectively dealt with. Crucially this process represents the first time that there has been a genuinely open consultation in the UK on this emotive but fundamental aspect of geological conservation. The results may well have relevance beyond Scotland's national boundaries and help guide policy development elsewhere...

NORTHERN IRELAND

Northern Ireland was not included in the original Geological Conservation Review process and still remains outside of its site-selection regulatory process. Nevertheless, an analogous process, the Earth Science Conservation Review (ESCR) broadly based on GCR principles has been developed leading to the selection of ESCR sites. A programme of designating these as Areas of Special Scientific Interest (ASSIs) is underway. Nature Conservation administration is the responsibility of the Environment and Heritage Service, within Northern Ireland's Department of the Environment, which includes a small geological section. A scientific focus is maintained by this group with close collaboration with the Geological Survey for Northern Ireland together with academic institutions and the Ulster Museum. Management planning for geological sites is particularly thorough and fully recognises the needs of improved documentation through future research. Full documentation for the ESCR site series can be accessed through the ESCR website: www.habitas.org.uk/escr. Increasingly collaboration with initiatives in the south of Ireland is apparent and this may indicate the future direction of geoconservation practice in the region.

Northern Ireland's Jurassic sites are few but include possibly the most expanded and complete surface exposures of the Triassic-Jurassic

boundary in the UK within the Waterloo ASSI (Simms and Jeram 2006) – a section of very high potential for future research.

ENGLAND

The establishment of English Nature (or EN) in 1991 radically changed approaches to Nature Conservation in England as the organisation embarked on a series of major reorganisations. As a consequence, the influence of the Nature Conservancy Council's former Earth Science Directorate (or 'Branch') became absorbed into a larger Environmental Impacts Team. Unlike in CCW, geological control remained centralised in English Nature, with locally based conservation staff – typically ecologically trained – directing most site-based work and enquiries concerning geological SSSIs to the head offices in Peterborough. The removal of the original Geological Conservation Review (GCR) site selection unit to the JNCC in 1991, however, and its conversion into primarily a publishing organisation for descriptive 'GCR volumes', effectively removed the scientific advisory group for the organisation (and for CCW and SNH as well of course). As a result, the organisation has increasingly made conservation decisions based on its own internal procedures and policies.

Where appropriate expertise existed internally, such decisions retained scientific validity, but reluctance to involve external specialists in the process, except as a last resort, has led to a number of questionable decisions and consequent site loss (*e.g.* of Tithonian, non-marine vertebrate-bearing levels at Upper Chicks Grove, Wiltshire and key parts of Lower Jurassic sections near Watchet, West Somerset and at Robin Hood's Bay and Whitby, North Yorkshire coast – all SSSIs). English Nature also allowed the last remaining traces of exposures on the shore below Scarborough Castle to be covered by boulders without any consultation with key specialists – the latest instalment of the sad story of the loss of the town's famous geological heritage, as first highlighted by Leckenby in 1859.

A programme of site enhancement works, latterly referred to as 'Face-Lift' has, however, meant that a number of geological SSSIs have now been cleared and sections re-exposed. Such activities could be of great benefit to science, although only occasionally have key workers on the sites been closely involved, or even informed.

ENGLAND	WALES	SCOTLAND	NORTHERN IRELAND
National Parks and Access to the Countryside Act 1949			
Wildlife and Countryside Act 1981			
			The Nature Conservation and Amenity Lands (Northern Ireland) Order 1985
Countryside and Rights of Way Act 2002			The Environment (Northern Ireland) Order 2002
		Nature Conservation (Scotland) Act 2004	

Fig. 2. Key national nature conservation legislation in the UK relevant to geological features, with dates of applicable Acts (N.B. Each successive Act adds to that in place and typically modifies rather than replaces pre-existing legislation).

As a consequence important areas have been overlooked and remain obscured, or made virtually inaccessible – as occurred when Kilmersdon Road SSSI near Radstock in Somerset (a classic site for condensed facies in the Pliensbachian) was deepened. Where geoscientists have been involved, there have been some important results as at several Aalenian-Bajocian SSSIs in Dorset and Somerset (SW England; Chandler *et al.* 2006). Inadequate supervision, however, has meant that at least one of these sites (South Main Road Quarry SSSI, Dundry, south of Bristol) is now reported to be in a worse condition than previously as the aims of the funded excavation were to access buried ammonite-rich levels and English Nature failed to ensure that new and improved sections were left for future visitors to examine (S. Carpenter and A. Bentley, Avon RIGS Group, *pers. com.* 2007).

Inevitably, with a relatively small centrally-based group to advise on a large number of geological SSSIs in England, much of the actual site work has been left to regionally based non-geologists. Most significantly, this includes the setting of conservation objectives for the management of geological sites. Clearly a high level of geological knowledge may be required to correctly identify the geological features for which a site may be notified as an SSSI, including within the national standards established by JNCC (where such features have been termed ‘manifestations’). These site objectives guide the organisation’s approach to each site, so it is clearly crucial that they are appropriately developed. In the current system, however, a geological site is just as likely to have an objective to conserve the lichens obscuring the finer points of the geology as it is to maintain the existing geological features for which that site was originally selected. Similarly, ecologically-trained area conservation officers, although dedicated and experienced in their own biological fields, are often not in a position to assess aspects of site loss and damage, especially due to specimen collecting and under-recording of such damage is therefore a reality. Fortunately, however, certain local offices such as that in Devon (SW England) have developed strong relationships with local geological specialists and groups and the result is a very healthy symbiosis which not only benefits conservation, it also benefits science.

Despite these internal issues, however, there have been many geoconservation successes and the 1981 Act has been successfully used to defend and protect a range of geological sites from loss due to

develop, including coastal defence works. Geoconservation legislation in the UK, however, has always remained focussed on site protection matters and although often quite successful in this context, it usually fails to protect ‘moveable’ geological heritage materials, such as fossils and minerals. When appropriately informed by scientific knowledge, legislation such as the 1981 and 2002 Acts can be quite successful in defending the boundaries of a conservation site. To address the issue of ‘moveable heritage’, especially issues associated with its collection, voluntary ‘codes of conduct’ have often been developed in Britain, especially in England, in an attempt to address such problems. Most of these codes are site or area specific although some have a more general application, such as English Nature’s guide to responsible fossil collecting (English Nature 1996). As there is typically no legislative backing for such codes, their effectiveness is debatable, although they do at least establish some basic principles to guide site users and managers.

In a well known scenario within the SSSIs that comprise the Dorset and East Devon ‘Jurassic Coast’ World Heritage site in southern England, such a code (Edmonds 2001) has been used as a substitute for direct intervention by conservation authorities, in particular English Nature and the World Heritage management group of Dorset County Council. The area is world famous for its Jurassic rocks and fossils and has become the focus of intensive commercial fossil collecting activity and a related international trade in palaeontological heritage. As discussed already by Page (2005b), rather than address the consequences of this activity, the Fossil Collecting Code has created a mechanism through which commercial activity can flourish by effectively ‘giving away’ any collected fossil, no matter how rare or unusual it is, to the collector providing that they report certain types of find. Virtually the only additional condition is that UK institutions are allowed 6 months to raise the funds necessary to match whatever commercial price is asked for in order to purchase the specimen, should they so wish, before it is placed in a broader, potentially global market place. In addition, as the code’s guidelines virtually discard whole classes of important fossils such as ammonites, much material still remains unrecorded and is therefore lost to science without even being recorded by the system in place (Page 2005b).

Analysis of the register of finds provides an indication of the level of this loss, when compared

to scientifically gathered records from an adjacent road building scheme. These figures indicate that over 1300 specimens of particular scientific note should have been recorded from the World Heritage site over the period 1999-2002. The actual reported figure of only 36 specimens over the period, even allowing for a few unrecorded academic studies, demonstrates that the code has delivered little scientific benefit and that the loss of palaeontological heritage from the area continues to be very significant. Not surprisingly the publication of these results has not been welcomed by certain of the authorities responsible for the management of the World Heritage site and certain benefiting commercial collectors, with attempts being made to discredit the analysis and prevent their further dissemination (see Page 2006). Criticisms published by others (*e.g.* Macadam 2000; Harrison and Upton 2002; Darmon 2006) have been accepted with no more grace and rebukes – often in print – have always followed.

Even with figures up to 2005, only around 40 more specimens are recorded, around 30 of which were small insect fragments, most of which are reported to have been found amongst waste materials as larger fossils were prepared in local workshops (Page 2005b, 2006). By 2006 the number of specimens recorded by the Dorset 'Code' stood at 106, and although 5 specimens are noted as having been donated to museums ('including' a collection of 34 insects), 3 had been *sold* to museums and 6 *sold privately* and are therefore lost to science (Jurassic Coast World Heritage Team 2007, p.8). The latter report also includes a photograph of a local commercial fossil collector in his workshop proudly holding a partial ichthyosaur skeleton with the caption: "*A potentially new species of ichthyosaur from Seatown. The West Dorset Fossil Code continues to be successful.*". The current whereabouts of the specimen is not stated, however, neither is its price tag.

In reality, therefore, the Dorset Code effectively 'legalises' the intensive commercial fossil collecting from (in theory) protected sites that had been taking place for many years in the area. The economic 'benefits' to the area of this trade were clearly appreciated by Dorset County Council as it developed the Code. English Nature, however, should have had regard for the scientific consequences of its implementation as part of their national natural heritage management responsibilities – they must therefore bear full responsibility for the continuing loss of palaeontological heritage and related

damage that continues to take place within the Jurassic Coast' World Heritage site.

Beyond the Dorset coast, this commercially focussed approach to site management is having consequences elsewhere as sites in other areas are subjected to similar intensive commercial exploitation. The internationally important Hettangian-Sinemurian sections on the West Somerset coast have suffered in particular, with several groups connected with fossil shops in Dorset having been 'caught' excavating fossils without permission and seriously damaging sections in both the Blue Anchor to Lillstock Coast SSSI (Page 2004, 2005a; Webber 2001) and the Bridgewater Bay National Nature Reserve (Larwood *et al.* 2001). Throughout Dorset and Somerset ammonite-rich Aalenian and Bajocian localities first made famous by S. S. Buckman in the late nineteenth and early twentieth centuries – and subsequently used to establish the high-resolution time scale of Callomon and Chandler (1990) – have been targeted and often seriously damaged. After years of successfully promoting a respect for SSSIs in the UK, this Dorset-based attitude is now sending a highly damaging message to fossil collectors and others and creating a view that geological heritage in the UK is a freely exploitable resource – the Bendrick Rocks scenario in South Wales mentioned previously is certainly an example of such consequences.

Similar scenarios have been recorded throughout England where commercially attractive fossils and minerals are present, but very locally authorities have taken a distinctly different stance, for instance mineral collecting from open moorland of part of the Lake District requires a licence from the National Park Authority (see Townley 2003) and the owner of the classic Triassic-Jurassic boundary sequences of the West Somerset coast near Watchet, has taken legal steps to protect the palaeontological resource of their site. In such cases, somewhat ironically, it is the landowner or manager themselves that have taken direct action to protect the geological resource, not the governmental conservation authority.

In October 2006, English Nature combined with a number of other 'countryside' organisations to form 'Natural England'. This 'new' organisation is now responsible for nature conservation administration in England in combination with a broader 'countryside' function as in Countryside Council for Wales and Scottish Natural Heritage. The beginnings of the new organisation do not bode

well for the future, however, with nature conservation issues seemingly being low on its agenda and with geological conservation even lower. It is early days, however, and it is still hoped that the new organisation will develop closer links with the scientific community and that the past policies and procedures of English Nature will be reviewed – it is indeed ironic that in the 21st century in one of the countries that first established a systematic approach to geological conservation, especially site selection, significant damage to and losses of Jurassic heritage continue to be recorded...

The geology and palaeontology of English Jurassic sites is described by Benton and Spencer (1995), Benton *et al.* (2002, 2005), Cleal *et al.* (2001), Cox and Sumbler (2002), Simms *et al.* (2004), and Wright and Cox (2001) (see www.jncc.gov.uk for availability). Information on all SSSIs in England can be found at: www.naturalengland.org.uk

CONCLUSIONS

A series of general principles are relevant to the future of geological heritage conservation in the UK, based on the experiences of nearly 50 years of site selection and management:

1. The establishment of a new national **scientific** advisory panel – for instance based on Geological Conservation Review (GCR) specialists – is essential to provide country agencies with relevant and up-to-date scientific and contextual information on which to base site selection and management decisions.
2. Funding for site based research is essential to improve documentation, including of temporary excavations, and to better inform the conservation decision-making process. Such funding is not available from any conventional science-funding source in the UK as research councils are typically focussed on high-profile scientific ‘outcomes’ rather than an improved knowledge of the UK geology and heritage.
3. Establishment of a periodic review by subject area of GCR networks and a ‘fast track’ process for new SSSI designations is essential for maintaining the relevance of the GCR/SSSI network and for dealing with discrepancies between Regionally Important Geological Sites (RIGS) and Sites of Special Scientific Interest (SSSIs) status.

4. A review of the geological management of the Dorset and East Devon ‘Jurassic Coast’ World Heritage site is required, to reflect broader national and international principles and practice in geoconservation. Issues include: commercialisation of palaeontological heritage, management plans, zoning of conservation requirements, enforcement of conservation legislation, establishment of a representative scientific advisory group and a scientifically informed revision of the existing fossil collecting code.
5. Legislative protection for moveable heritage is urgently required, based on sound scientific and heritage principles (*e.g.* based on the classification of palaeontological heritage for conservation of the Geoconservation Working Group of the International Subcommission on Jurassic Stratigraphy – see Page 2004). Any such legislation should fully recognise the necessity to sample for science and education and the contribution of voluntary (*i.e.* amateur) activities to geosciences in the UK, as well as providing the necessary articles to control illegal collecting activities and prevent the loss, including through export, of specimens which are important for scientific studies and as part of a national, natural heritage.

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