

Caves, karst and limestone habitats

(Substantial revision in 2007. Derived from the former Caves, karst and mines action plan)

1. A Definition

Devon's caves, karst and limestone habitats are important and fascinating features which attract much interest from the biologist, geologist and archaeologist alike.

Karst is formed through the dissolution of bedrock typically limestone, by ground water to produce a network of enlarged joints and cavities through which the water then preferentially flows. When these cavities are large enough to allow some form of access, they are known as caves. As a result, karstic landscapes are often relatively dry, with surface streams being seasonal or non-existent and most drainage therefore taking place underground. In addition, they can have a range of characteristic surface features, including bare rock exposures such as crags and pavements, dolines and poljes. In Devon, although areas of karst are rarely large enough to develop characteristic landforms, underground drainage systems, including caves locally, are typical. In south Devon karst is well represented over outcrops of Devonian limestone - although typically broken up by tectonic activity into separate, discontinuous blocks. Smaller areas are also present in other parts of the County, such as chalk-karst in east Devon, in the Carboniferous limestones of the Westleigh area and in relatively thin bands of Devonian limestone in north Devon. Karst features in Devon include caves, sink holes, karst springs, solution pipes and hollows.

Cave systems in the County are characterised by two important types; lowland solution caves associated with river valleys, such as the Chudleigh and Buckfastleigh systems, and coastal solution caves, such as at Berry Head. Sediments and other deposits in these caves can reveal evidence of past landscapes and climatic conditions and include both interglacial faunas such as sabre-toothed cat, hyena, rhinoceros, hippopotamus and forest elephant and ice age faunas with woolly rhinoceros, mammoth, bear, wolf and reindeer. These caves have also provided evidence of the first hominid inhabitants of the region including flint artefacts belonging to a *Homo heidelbergensis*-like species from around 350,000 years ago and some of the earliest remains of modern 'Cro-Magnon' hominids known in Britain, dating from around 35,000-13,000 years ago.

Caves also provide a unique habitat and although there is no true specialist cave fauna in Devon, the very rare shrimp *Niphargus glennei* is present, apparently living in cracks in the limestone. Caves also provide ideal roosting sites for bats, which favour the stable environmental conditions and protection that these underground spaces provide. Several Devon caves are

internationally important for colonies of Greater Horseshoe Bat. Included within this plan are the former Beer Stone mines of East Devon, which although not natural features, are excavated in limestone bedrock and do contain important bat colonies.

The limestone rock itself is also important, as it includes part of the historical type area of the Devonian Period of geological time - Devon being the only county in Britain to give its name to a geological system of world-wide recognition. The Devonian limestone of the county is unique in the UK, and includes evidence of ancient barrier reef systems and associated lagoons. The rocks are often richly fossiliferous and include remains of corals, coralline sponges, bryozoa, brachiopods, gastropods, bivalves, ammonoids, ecninoderms and woodlouse-like trilobites. Many species of these groups were first recognised in the limestone rocks of the county.

The surface of limestone outcrops also important for the natural diversity of Devon. Although well developed karstic landscape features, such as sink holes, natural cave entrances and limestone pavements are few, the shallow, nutrient poor and alkaline soils produce a unique limestone grassland habitat. Due to the relatively mild climate of Devon, especially in coastal areas, the floral content of limestone grasslands in Devon have a special 'southern' character and although of limited extent are still of national importance. These plants in turn support rich invertebrate faunas, including rare butterflies. The rocks themselves, where bare, also maintain distinctive lower plant assemblages including lichens and ferns. Elsewhere, woodlands developed on limestone soils can have a special floristic character, and include rare species of whitebeam.

Very minor areas of limestone habitat can also occur in wide range of situations, including rare ferns on limestone-cemented beach sands and on mortar on old buildings in N Devon and a range of both lower and vascular plants on limestone walls elsewhere. The action plan also includes small areas of tufa development, for instance associated with springs in East Devon. Karst-like features may also rarely be developed in other rocks apart from limestone, including within sandstones; such features are not included in this plan.

2. Why an Action Plan?

Karstic features such as caves and surface limestone habitats have a tremendous range of interests for many disparate groups including botanists, entomologists, geologists, archaeologists, climbers and cavers. They therefore require particularly careful thought and effort to ensure that they are conserved for all to study and enjoy, whilst giving highest priority to the often fragile biological assemblages and geological formations contained within them. As a result these often delicate environments can be under threat from visitor pressure. In caves the issues can be particularly extreme, and include inappropriate specimen collecting, erosion by trampling of cave floor sediments of geological or archaeological importance, or the disturbance, often unintentional, of roosting bats and other cave-dwelling species. In surface

areas, specimen collecting can also locally be an issue, but erosion of thin soils and their associated plants by visitors and eutrophication and disturbance by animals including dogs and livestock are often much more significant issues.

There are other potential threats to karstic features including caves, particularly by infilling of old quarries with landfill and other waste disposal such as tipping of agricultural refuse, or the contamination of underground water courses and bodies by agricultural run-off containing fertilisers or slurry. Any such pollution can be extremely damaging to underground habitats and also to habitats in areas fed by springs emerging from karstic sources.

The relative hardness of the limestone and its alkaline character mean that quarries are characteristic of areas of limestone outcrop. These formerly often produced building stone and agricultural lime, although nowadays, aggregate is the main product from a very small number of large sites. Although covered with the Action Plan for *Pits, quarries and cuttings*, these sites sometimes intersect karstic features such as caves and solution pipes. Crucially, however, restoration of active quarry sites and the management of old quarry sites provides opportunities for the re-establishment of limestone habitats, especially limestone grassland.

3. Characteristic wildlife

Caves are environments with stable conditions of temperature and humidity and therefore provide an ideal location for bats, both for maternity and hibernation roosts. Devon boasts all 16 British species, some rare, some common, but all deserving particular conservation attention.

In damp shaded situations, as is often the case around the entrance to caves, mosses, ferns and liverworts, abound. One notable species of moss possesses a luminous quality which has been described "*a beautiful golden-green lustre to the plant and seems to fill with light the crevices and caves where it grows*". Many of these plants can also be found in shady areas of surface limestone outcrop.

Since fungi do not require any light to live; many species thrive in the damp dark environments of caves, where unique assemblages can develop.

Life exists even in the seemingly most inhospitable of environments, and in the perpetually dark world of underground streams and crevices, a number of invertebrates can survive, feeding on organic debris brought in by floods or dropped by bats. Although no specialised cave fauna is known in Devon, the rare shrimp *Niphargus glenniei* is widespread,

Surface limestone habitats are varied and include bare rock, grassland and woodland. Rock outcrops can support a range of lichen species and where damp mosses, ferns and liverworts as well. Some vascular plants also prefer such surfaces, where small pockets of soil allow them to establish. These 'rock plants' included various species of stonewort.

Limestone grassland is well developed locally, although often at risk from the growth of scrub. Significant areas exist in Torbay in coastal locations, such as Berry Head Local Nature Reserve. Around Newton Abbot, and elsewhere in SE Devon, broad-leaved woodland is developed over limestone and in spring provides a magnificent display of flowers including orchids, violets, and wild garlic. A number of rare species are also associated with such habitats including species of whitebeam.

Please note: this action plan has been developed from the former *Caves, karst and mines* plan. Mines are now dealt with separately in the new *Mines and mineral waste tips* plan. The emphasis during the revision of this plan has been on geological features rather than wildlife. In due course, the 'Characteristic wildlife' and 'Special species' sections will be revised to take into account the new presence in this plan of **limestone habitats**, which are only lightly touched on above and below.

In the meantime, much information on these habitats can be found in the local BAPs for East Devon and Torbay which, along with Plymouth, represent some of the key areas for this feature in geographical Devon:

Torbay BAP: www.countryside-trust.org.uk/bap/lowland.html

4. Special species

The following species of conservation concern are associated with caves, karst and limestone habitats in Devon. Species marked (p) are 'Species of Principal Importance in England' (NERC Act, S.41).

- **Mammals:** Greater horseshoe bat (p), Bechstein's bat (p), lesser horseshoe bat (p), Natterer's bat, Daubenton's bat
- **Crustaceans:** Cave shrimp *Niphargus glenniei* (p)
- **Beetles:** water beetle *Hydrochus nitidicollis* (p)
- **Bryophytes:** luminous moss *Schistostega pennata*
- **Lichens:** *Acarospora sinopica*, *Lecanora soralifera*, *L. handelii*, *L. epanora*, *Rhizocarpon oederi*, *Veizdaea leprosa*, *Placopsis gelida*, *Stereocaulon pileatum*, *S. nanodes*.
- **Vascular plants:** Tunbridge's filmy fern *Hymenophyllum tunbridgense* (c)

The caves and mines (see *Mines and mineral waste tips HAP*) of Devon contain the largest population of greater horseshoe bats in Britain, and the only population containing more than 1000 adults. Beer Quarry and Caves (a SAC) is home to the rare Bechstein's bat. The cave shrimp *Niphargus glenniei*, an endemic to Britain, inhabits interstitial water and is mainly reported from caves.

5. Special geodiversity features

Key Geological Features, including potential Global Geosites, well represented in rocky foreshore exposures in Devon include:

- Stratigraphical (Phanerozoic): Devon (marine) carbonates and clastics
- Stratigraphical: Sub-Albian regional unconformity
- Stratigraphical (Quaternary): Late Pleistocene interglacial/glacial, cave/beach sediments (Saalian-Weichselian) [provisionally includes Pleistocene giant mammal/ hominid assemblages]
- Stratigraphical (Quaternary): Late Pleistocene Interglacial (OIS7, 5e) raised beaches

Other important Earth heritage features (which are well represented in exposures of pits, quarries and cuttings in Devon:

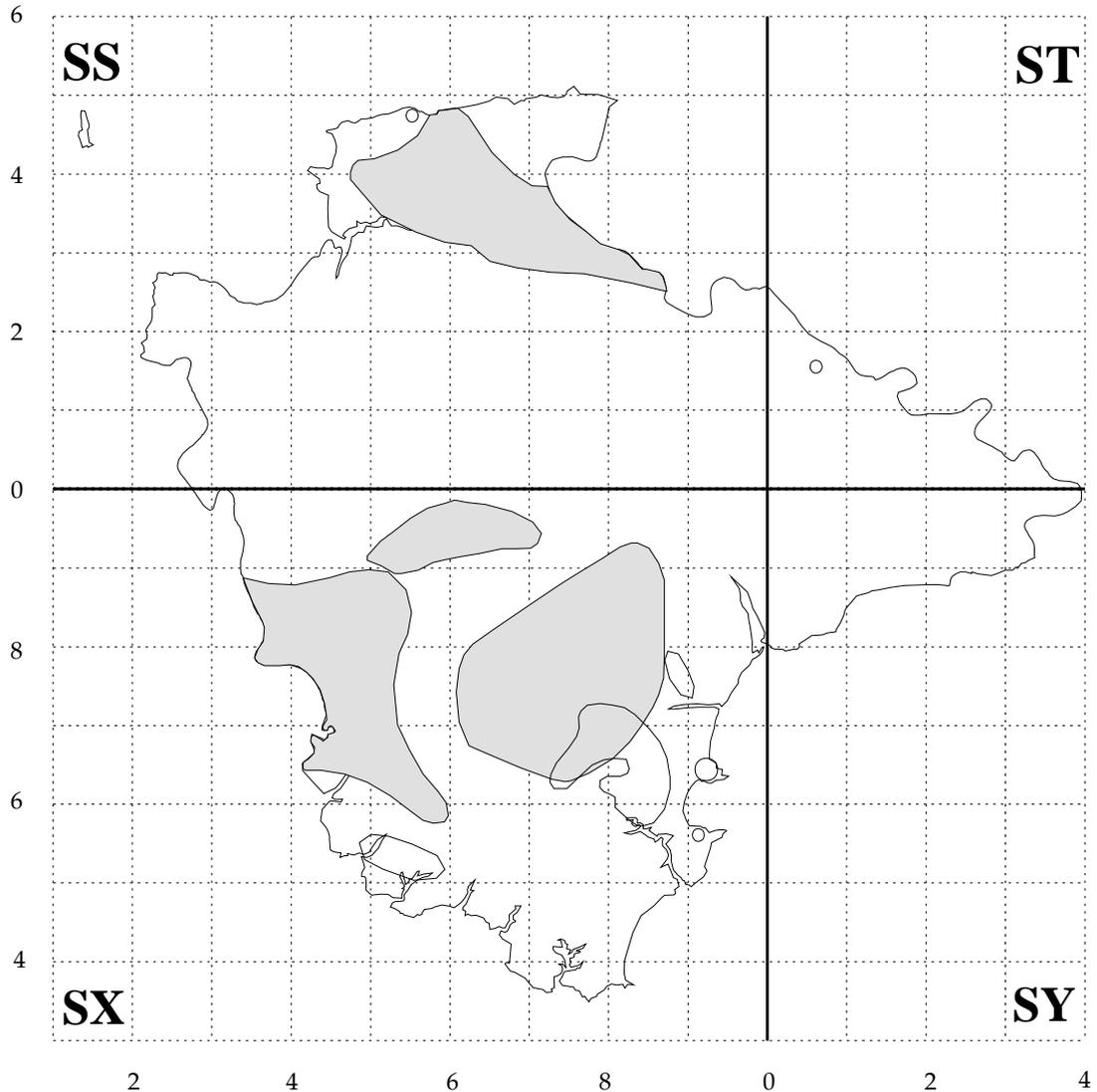
- Lower Carboniferous stratigraphy and palaeontology (marine)
- Albian (upper Lower Cretaceous) stratigraphy and palaeontology (marine)
- Cenomanian to Maastrichtian (Upper Cretaceous) stratigraphy and palaeontology (marine)
- Palaeogene-Neogene ('Tertiary') tropical weathering features
- Quaternary glacial and periglacial deposits and landforms

The karst in Devon is a well represented but, apart from caves, a somewhat neglected aspect of the County's geology. A feature of much of Devon's karst is that it is overlain by more recent surface deposits, including of periglacial origin, and hence surface features are often not obvious. Such cover, however, can enhance the solution processes that generate karstic features and it is likely that the county's underground is better developed than might otherwise be expected. A number of examples of Devon's karst features (including caves) were selected by the Geological Conservation Review as a basis for SSSI notification, but recent studies have revealed further important features requiring protection. Specific karstic features include caves, swallow-holes, karst resurgence and exurgence springs, karst collapse sites and alluvial dolines, buried karst doline fields, karst shafts, scarps and escarpments, dry (karst) valleys or overflow valleys. Ancient, i.e. pre-Quaternary, karstic features in Devon include solution hollows in the surface of Devonian limestones beneath a Cretaceous (Albian) unconformity near Newton Abbot and presumes Palaeogene-Neogene red clay and stone-filled solution pipes in the Cretaceous chalk of east Devon.

The absence of glaciation in Devon has allowed the survival of a particularly rich record of bone and archaeological deposits in cave sediments covering a remarkably long interval, of at least half a million years. Coastal solution caves such as those at Berry Head have the potential to yield some of the longest and best records of Quaternary sea level variations in Britain. Cave formations in Devon include speleothems such as helictites, heligmites stalactites, stalagmites, and features such as rimstone pools, cave lakes, solution tubes, canyons, pillars and curtains and carbonate crystal masses. Where speleothems can be dated, they provide information on groundwater chemistry and climate over the last half a million years.

Devon's caves include a number of famous and internationally important bone deposits. A range of different climates and their associated faunas are represented, from warm interglacial (with forest elephant and rhinoceros, hyena, lion and sabre-toothed cat) to cold glacial (including woolly mammoth and rhinoceros, reindeer and bear)

6. Limestone karst distribution in Devon



□ Location of major limestone karst units in Devon

7. Current extent

Areas of limestone outcrop have been systematically mapped by the Geological Survey. This information is available on published geological maps which are a useful guide to the potential location of limestone habitats (although locally overlying deposits such as periglacial head might be present and create a different habitat character).

There are over 100 recorded caves in Devon; only local inventories have currently been compiled and there is no comprehensive database for the county. The full extent of karstic features in the limestone outcrops of the county has yet to be determined, however.

8. Current problems for caves, karst and limestone

habitats in Devon

One of the biggest issues facing caves and other forms of karst and associated limestone habitats in Devon is **the lack of documentation** of their location and character. Such information is crucial if appropriate management decisions are to be made in the future. Specific issues include lack of targeted survey, including biological and the significant amount of information on caves and karstic features held in private hands and therefore not readily available to decision makers. The latter is linked to an absence of a geological records centre for the county.

Quarrying, mining and other major developments such as road-building and housing developments: Although some caves have been discovered by quarrying, and quarries can provide access to some caves, there is also potential threat of destruction from these activities. The opening of entrances also changes a cave's climate which may potentially harmful to cave-dwelling invertebrates – although beneficial to bats if a new roost site is created - or lead to a deterioration of sediments or bone deposits. Quarrying can also damage other karstic features and interrupt, divert or contaminate underground streams and other drainage systems. In contrast, however, the low-level restoration of limestone quarries offers marvellous opportunities for habitat recreation, which are not always realised.

Landfill and waste disposal: The filling of old quarries and karstic features leads to the partial or complete loss of the geological features and habitats present, and can also lead to a loss of access to cave systems. Pollution of surface and ground water systems from these sources can lead to degradation of the habitat of aquatic invertebrates. Problems may also occur due to seepage of dangerous landfill gas into cave and mine passages which can affect both bats and visitors.

A range of **land management activities** can adversely affect the limestone habitats and karstic systems, for instance ploughing can lead to soil erosion and the subsequent deposition of sediment in cave passages. Pollution, from domestic sewage or farm slurry/silage effluent, nitrate runoff from fields and runoff from farm yards can seep into caves creating deposits which damage cave features and degrade the habitat of aquatic invertebrates.

Eutrophication of limestone grassland as a result of fouling by dogs in areas of public access or intensive agricultural activities.

Scrubbing up of limestone grassland is a major issue in Devon as a result of changes in farming practice and a lack of available or appropriate stock. As a result, the encroachment of scrub onto limestone grassland leads to the loss of characteristic flora and fauna and the obscuring of geological exposures and geomorphological features.

Blocking or poorly designed gating of cave entrances for safety reasons prevents access both for survey and to wildlife such as bats. It can also lead to

bats being entombed and killed and to air quality problems elsewhere in a larger system.

Recreation: Caves which are heavily used by visitors are most at risk from damage, particularly if used by novice groups. Particular problems include: damage to and removal of cave sediments, decorations and fossils (unless sensitively managed for scientific purposes); leaving litter and other contaminating substances; trampling and other damage to sediments and cave decorations, both accidental and deliberate; use by inexperienced or inappropriately large groups; disturbance of wildlife, especially bats at key times of the year (e.g. during hibernation)..

A **lack of information** of the distribution and ecology of certain species such as the cave shrimp *Niphargus glenniei* and other invertebrates, and the effect of disturbance and other influences of man on the productivity and survival of bats and other species using caves and mines.

Many user groups have interests in cave systems ranging from scientific to recreational. Misunderstanding and **lack of communication** between such groups has the potential to adversely effect the conservation of caves. Sometimes, there can be apparent conflicts between conservation for wildlife (e.g. bats) and geological conservation or research. Joined up planning can help to resolve such conflicts.

Encroachment by non-native invasive plants such as buddleia, holm oak and cotoneaster may cause a reduction in the naturalness of some limestone habitats and in many cases leads to the loss of less competitive native plant species.

Lack of awareness of geological issues and the scientific and heritage significance of geological materials, leading to a lack of appropriate management regimes (including insufficient scrub clearance, footpath or access road construction across delicate geomorphological features, and either an absence of effectively managed protection for geological features, including fossils, or alternatively unnecessarily restrictive regimes).

Lack of understanding on the part of land managers and the general public of the importance of limestone grassland and hence public relation difficulties when undertaking management tasks such as scrub cutting/burning, which may appear to some as destroying important wildlife habitats for no good reason.

The presence of rare mineral or fossil deposits can attract **inappropriate collecting** and the resulting disturbance of and damage to key geological exposures can seriously affect some sites. Such collecting rarely offers scientific or heritage gain, as the material is typically lost into a private collection or global marketplace. In certain circumstances the operation may also be illegal, especially in the context of a protected site.

Most geologists (*including* amateur), however, and geological societies and educational institutions now apply national guidelines for the responsible use

of sites, including concerning sample collecting for educational and scientific purposes. Responsible site use such as this is beneficial to conservation and both raises awareness of broader issues concerning the habitat, as well as improving the documentation and understanding of the features being studied.

Unlike surface exposures, the collecting of specimens from caves should only be part of a sensitively planned and authorised scientific study. For surface exposures, specimen collecting is also an essential part of the scientific and educational process but, unlike, in the former areas, not necessarily a major conservation issue. Nevertheless, limestone outcrops can be very delicate features and it may take many decades for a fossil to weather out in such a way that it is visible – any attempt to collect such specimens is therefore likely to be highly damaging to the site concerned, unless part of a *bone fide* scientific project.

Nevertheless, many new geological discoveries have been made by a range of site users, but there is currently no centralised repository for the site and specimen records generated. As a result, key documentary information of potentially great value to conservation bodies, site managers and science is not being recorded. In addition, key specimens representing facets of Devon's rich geological heritage are being 'lost' as deposition in a Devon-based museum is not always encouraged or promoted. Conservation in a museological context is a natural extension of site-based conservation.

9. Recent changes in extent

Recorded losses of caves are rather few in the recent history of Devon, except for Elliot's Cave encountered during operations in Eastern Tors Quarry near Yealmbridge in 1954, which had been completely quarried by 1981, and a small cave at Brixham harbour which was filled in during the construction of a marina. Extensive recent redevelopment in Plymouth may also have led to the loss of parts of cave systems, although records may not be available.

More common are instances of partial loss of such as at Raiders Rift Cave (note: location of this cave is now unknown), which was exposed by quarrying activity, and numerous cases of degradation caused by a variety of reasons (see below). Uncontrolled "cave digging" can also damage ancient sediment deposits.

Discovery of new cave systems is likely to be restricted to accidental encounters during quarrying, building or other civil engineering works in the limestone areas, or by systematic survey by caving groups, although it likely that many caves remain to be discovered. Some excavation of known caves continues.

10. Current site protection

The following sites have karstic features or include limestone habitats and are Devon BAP
Version: May 2009

Sites of Special Scientific Interest either for their geological or wildlife interest, or both:

Axmouth to Lyme Regis NNR, Babbacombe Cliffs SSSI, Beer Quarry and Caves SSSI, Berry Head to Sharkham Point SSSI, Buckfastleigh Caves SSSI, Torbryan Caves SSSI, Chudleigh Caves and Woods SSSI, Daddihole SSSI, Dyer's Quarry, East Ogwell Quarry SSSI, Faraday Road SSSI, Furleigh Chalk Pit, Hele, Sampson's and Combe Martin Bays SSSI, Hope's Nose to Walls Hill SSSI, Kent's Cavern SSSI, Lower Dunscombe Quarry SSSI, Lower Whipcott Quarry SSSI, Lummaton Quarry SSSI, Lydford Gorge SSSI, Mount Wise SSSI, Napp's Cave SSSI, Plymouth Sound, shores and cliffs SSSI, Potters Wood SSSI, Pridhamsleigh Caves SSSI, Ransley Quarry SSSI, Richmond Walk SSSI, River Lemon Valley Woods SSSI, Saltern Cove SSSI, Saunton to Baggy Point Coast SSSI, Shapwick Grange SSSI, Sidmouth to Beer Coast SSSI, Stout's Cottage SSSI, Torbryan Caves SSSI, Wallsend Industrial Estate SSSI, Western King SSSI.

Axmouth to Lyme Regis Undercliffs and Berry Head to Sharkham Point are National Nature Reserves.

Several Special Areas of Conservation (SACs) under the EC Habitats Directive cover this habitat in Devon: South Hams (component SSSIs are Berry Head to Sharkham Point, Buckfastleigh Caves - which include Rock Farm Barns - Bulkamore Iron Mine, Chudleigh Caves and Woods and Haytor and Smallacombe Iron Mines), Beer Quarry and Caves, Plymouth Sound and Estuaries, and Sidmouth to West Bay.

Some sites are Scheduled Ancient Monuments, including Ash Hole Cavern, Brixham; The Old Grotto, Torbryan; Kent's Cavern; Pixie's Hole; Cow Hole; Tramp's Shelter, Brixham Cavern. Consent is required from the Secretary of State for most works which may affect a SAM.

A significant number of County Geological Sites are limestone exposures, several of which include caves. The recent establishment of a database of CGS in Devon will ultimately facilitate the listing of all sites with such features.

11. Current positive initiatives for caves, karst and limestone habitats

- The County Geological Sites (CGS) and County Wildlife Sites (CWS) schemes identify non-statutory sites of (at least) County importance for their geology and wildlife, and provide planning authorities with this information to steer development away from such sites or to ameliorate potential damage. Devon RIGS Group (see below) and the Devon Biodiversity Records Centre co-ordinate the identification of CGS and CWS, respectively.
- Devon RIGS (Regionally Important Geological/Geomorphological Sites) Group promotes geological conservation, by working with local

authorities, landowners and others, and provides advice, on request on County Geological Sites and the management needed to retain or enhance their geological interest. The RIGS Group is undertaking detailed LA by LA surveys, completed projects include for the North Devon AONB, mining districts in West Devon, Torbay, Exeter, South Hams, East Devon, Teignbridge, the Teign Estuary and Dartmoor.

- Devon County Council, the Unitary Authorities and National Park Authorities, as the Mineral Planning Authorities of Devon, implement policies for mineral planning (as set out in the Devon Minerals Local Plan), which include striking a balance between the demand for mineral resources and the need to protect the environment, having regard to the need for sustainable development, and to ensure the satisfactory after-use of sites after working, with a move away from restoration. Principles established in the plan on a site by site basis can help minimise adverse effects on karstic systems and promote the restoration of limestone habitats.
- The Ussher Society is a forum for presenting and discussing the results of geological research into Earth heritage sites in the South West of England. These results are published annually in *Geoscience in south-west England*.
- The British Geological Survey has recent completed new surveys of parts of the County (including Plymouth and Torbay). New geological maps have been published, supported by a descriptive memoir (Plymouth) and a brief review (Torbay). A new survey of the Tiverton area is currently taking place (2007). All three areas include important limestone outcrops.
- DCC/EN co-ordinated Devon Roads and Geology Pilot Project, aimed to identify opportunities to conserve geological exposures on Devon's road network, and to develop interpretation and education facilities.
- Devon Educational register of Geological sites provides a web-based resource for educational groups and includes over 80 CGSs and SSSIs (www.devon.gov.uk/geology).
- An English Nature (now part of Natural England) initiative with the minerals industry fostered awareness and develop partnerships for conservation. A new suite of useful publications have resulted.
- The Devon Geodiversity Audit of working quarries was completed in 2003, providing a resource for developing site use and decision making. The document is available on CD or via www.devon.gov.uk/geology and includes detailed descriptions of the main active aggregates quarry sites in the county. Several of these quarries work limestone.
- The Devon Aggregates and Biodiversity Project, a partnership between Aggregates Industries UK and Devon County Council and funded by the Aggregates Levy sustainability fund produced Parish Geodiversity Audits

for 10 parishes in the county. These PGAs not only document the geodiversity present, they also identify opportunities for conservation and community participation. Several of the parishes covered included significant areas of limestone outcrop.

- Devon County Council and English Nature (now Natural England) have supported Devon RIGS Group in the establishment of a database of County Geological Sites, including descriptions, maps and photographs. Some of this information is available via the newly established Devon RIGS website.
- The development of the UNESCO-supported Global Geosites initiative provides a context within which the international importance of certain geological and geomorphological features of Devon's limestone exposures can be independently demonstrated.
- Torbay is now a 'European Geopark', a programme supported by UNESCO. Details of the English Riviera Geopark can be found here: www.englishrivierageopark.org.uk
- The Dorset and East Devon 'Jurassic Coast' World Heritage site has implications for sites near the coast of East Devon and a Local Geodiversity Action Plan has been prepared.
- Local authority projects have led to the clearing and restoration of geological exposures at key CGS sites, most notably including limestone exposures at Wolborough Quarry CGS in Teignbridge. English Nature's 'Facelift' programme has also re-exposed overgrown and degraded sections of several other quarry SSSIs in the county.
- Torbay Coast and Countryside Trust have included a limestone grassland HAP within Torbay's BAP. Important scrub clearance projects on limestone grassland sites which include the reintroduction of grazing livestock, have been carried out at Berry Head and Hope's Nose. Scrub clearance at Lummaton Quarry SSSI has not only improved geological exposure, it has also expanded a colony of small blue butterfly.
- Scrub clearance in limestone areas of Plymouth carried out by Plymouth City Council has not only re-created areas of limestone grassland, it has also demonstrated the longevity of a dormant seed bank and hence the potential for restoration elsewhere.
- The William Pengelly Cave Studies Trust manages a study centre and bone cave for educational use at Higher Kiln Quarry, Buckfastleigh.
- Devon and Cornwall Underground Council (DCUC), part of the National Caving Association (NCA), have a Conservation Officer. Initiatives include the production of several cave conservation plans using national NCA guidelines, and conservation works including gating at several sites.
- Kents Cavern Limited manage Kent's Cavern show cave and have

recently invested in new interpretative materials and exhibits, thereby enhancing the heritage value of visits to the cave system. The cave management collaborates extensively with scientific and heritage projects.

- The Torbay Coast and Countryside Trust have initiated a 'Loving our Limestone' project to restore and enhance areas of limestone grassland.

12. Biodiversity planning context

National BAP Context

Habitats of Principal Importance in England (NERC Act, S.41):

- Lowland calcareous grassland
- Inland rock outcrop and scree habitats

Current national BAP targets can be viewed on the [Biodiversity Action Reporting System](#) (BARS).

Regional BAP Context

Regional targets for priority BAP habitats can be found on the website of [Biodiversity South West](#).

Associated Action Plans within the Devon BAP:

- Cities, towns and villages
- Devon whitebeam and associated species
- Greater horseshoe bat
- Pits, quarries and cuttings
- Sea cliff and slope

13. Biodiversity objectives and targets for caves, karst and limestone habitats in Devon

Objective 1

Improve the documentation and understanding of the geological features and fauna and flora of caves and other karstic features and limestone habitats to both facilitate educational and scientific study and inform decision making.

Targets:

- An inventory of caves and other karst sites to be produced by 2010.
- An inventory of all actual or potential limestone grassland and woodland sites to be produced by 2010.
- Establish a county geological records centre to gather and manage site records and reports. Cross-referencing to archaeological records is essential in the case of caves.
- Encourage the reporting of new discoveries and deposition of important specimens on county-based institutions.

Objective 2

Ensure that no further loss or degradation of caves and other key karstic features in Devon.

Targets:

- Establish appropriate access arrangements at all known sites at risk from over-use or inappropriate use by 2010.
- Produce management plans for all underground sites of conservation importance by 2010.
- Establish detailed monitoring, including of temperature and humidity, in all major bones caves in the county and, based on the results, install appropriate equipment to maintain an environment under which deterioration is minimised.

Objective 3

Establish improved communication and co-ordination between all groups with conservation, research, educational or recreational interests in caves and karst in Devon and seek to reduce potential

conflicts between the aims and objectives of each.

Targets:

- Establish a liaison network by 2008.
- Agree, wherever appropriate, reasonable guidelines for access to all key sites in the context of their biological and geological features.

Objective 4

Foster a greater understanding and awareness of caves, karst and limestone habitats, and their wildlife, geological and archaeological interests, including amongst site user groups, visitors, managers and decision makers.

Targets:

- Each Show Cave in Devon to promote education about cave wildlife and geological and archaeological conservation by 2011.
- Develop, by 2009, interpretation and education programmes at appropriate target sites.
- Ensure adequate educational materials including codes of good practice are available via publications and / or web sites.

Objective 5

Promote low-level restoration and the development of limestone habitats as after-use of limestone quarries, whilst ensuring that key geological features and exposures are also accessible.

Target:

- Ensure that every working limestone quarry includes within its restoration plans the establishment of limestone grassland, wherever appropriate, and the maintenance of key geological exposures.

Objective 6

Seek opportunities to restore or otherwise improve the management of limestone grassland and woodland sites throughout the County.

Target:

- Establish at least one demonstration site for the management of limestone grassland or related habitats in every applicable Local Authority area by 2010.

14. Wider benefits from pursuing these objectives

The objectives of this Plan aim to strike a workable balance between recreational activities and conservation objectives for the Earth heritage and wildlife features of caves, karst and limestone habitats. The pursuit of the objectives and targets set out above will, therefore, not only benefit the biodiversity and Earth heritage interest of karst, caves and limestone habitats. Conservation has wider benefits and advantages for society, by providing a resource which is the basis of many aspects of the local economy, and by adding to the quality of life of the people of Devon in ways which are beyond financial measure. Thus enhancing the interests of biodiversity will also enhance the interests of society as a whole.

In the case of caves and limestone habitats most of these benefits are cultural although enhanced tourism revenue from the sensitive development of show caves will locally benefit the economy.

Where specimen collecting as part of genuine scientific projects, including from within cave systems and surface exposures takes place, conservation involves aspects of both site and specimen conservation. Working with county-based museums will ensure that such material remains available for future study and display, including for raising awareness of Devon's rich geological heritage, thereby fulfilling a number of the key functions of such institutions. The plan will also aid the identification of sources of traditional building materials which can be invaluable for the restoration of historic buildings.

15. Priority or indicative actions for caves, karst and limestone habitats in Devon

Action	Key Partners
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1. Ensure that Local Authorities take full account of PPS9 and other relevant guidance when preparing Local Plans/Local Development Frameworks and considering planning applications for operations which may damage or degrade cave, karst, and limestone habitats. Also ensure that restoration proposals for limestone quarries include the establishment of limestone habitats and geological exposures.	LAs; DRIGSG; Caving Groups; Research Institutions; DBG; NE
2. Produce cave management plans for all accessible caves in the county. Use these to ensure that cave systems are appropriately managed for access, geological activities and biological conservation and restrict activity where appropriate.	Site owners; Caving groups; NE; DBT; VWT, DCUC
3. Provide advice and resources to owners of caves and limestone habitats to achieve sympathetic management for geological and wildlife conservation.	DRIGSG; DWT; EN; DNPA
4. Continue to survey, monitor and carry out research on cave-dwelling invertebrates at sample sites throughout Devon to improve current information on impacts of water quality, water levels and other ecological factors.	EA; NE; Research Institutions; DKRS
5. Promote public understanding, access and enjoyment at appropriate cave sites through the use of interpretation, open days and articles on these features and their associated wildlife.	All
6. Encourage interested members of the public to join caving, geological, and wildlife (including bat) groups such that they may gain an informed view of relevant conservation issues.	Caving Groups; DCPS; DRIGSG; DBG; VWT; DWT; EN; Site Owners; Museums
7. Encourage co-operation between user groups and other interested parties for the formulation of Cave Conservation Plans, codes of conduct, monitoring of wildlife, etc.	All
8. Carry out a county-wide survey of actual and potential limestone habitat sites and identify key areas for improving existing management or restoration.	DCC; DWT, Las, etc.
9. Establish a geological records centre for Devon and bring together all existing reports on caves and karst in Devon. Also promote the reporting and recording of new finds.	DRIGSG, museums, universities, DCC, DKRS, landowners including NT

Caves, Karst and Limestone Habitats Action Plan Champion - to be established

Abbreviations used in text and table

BAP	Biodiversity Action Plan
BGS	British Geological Survey
DBG	Devon Bat Group
DBRC	Devon Biodiversity Records Centre
DCC	Devon County Council
DCPS	Devon and Cornwall Prospecting Society
DCUC	Devon and Cornwall Underground Council
CGS	County Geological Site (aka RIGS)
CWS	County Wildlife Site
DBP	Devon Biodiversity Partnership
DKRS	Devon Karst Research Society
DNPA	Dartmoor National Park Authority
DRIGSG	Devon RIGS (Regionally Important Geological and Geomorphological Sites) Group
DWT	Devon Wildlife Trust
EA	Environment Agency
EH	English Heritage

KCL Kents Cavern Ltd
LAs Local Authorities
NE Natural England
NCA National Caving Association
VWT Vincent Wildlife Trust