Periglacial landscapes (and related ice age features)

(A new plan included in May 2009)

1. A Definition

Most of Devon lay to the south of the maximum extent of the ice sheets of the Pleistocene 'Ice Ages' but, with the ground still permanently frozen, a tundra landscape developed. Summer thawing of the topmost metre or so of this permafrost resulted in a slow flow of loose rock and soil downslope in a process known as solifluxion. The resulting stony and muddy deposits which clog many of the counties smaller valleys and still blanket many slopes are known as 'head'. This process was aided by the warm and humid climates of the intervening interglacials, which deeply weathered the bedrock of Devon creating considerable amounts of stony soil on which these periglacial processes could then act.

The most spectacular of the county's periglacial landscapes is Dartmoor, where soil creep revealed rocky outcrops as tors and distributed blocks of granite downslope as stone stripes and garlands – known locally and collectively as 'clitter'. Dartmoor is the largest area of unglaciated upland in the UK and is justly famous for its periglacial landscapes. Periglacial and related ice age features and deposits are, however, widespread elsewhere in the county and include stone stripes on Exmoor, ancient landslip systems in east Devon and the thick and extensive head deposits of the Culm. Although the surface expression is lost, pingos appear to be present in the Bovey Basin.

Most of the periglacial features seen in Devon are likely to date form the last ice age, the Devensian (around 110,000-11,000 years ago), as older deposits would have been removed or modified during interglacial phases or were simply 'reprocessed' at this time. The most extensive of all Pleistocene ice sheets, however, during the Anglian (around 600,000 – 350,000 years ago), just reached the north Devon coast. As it melted, the ice dumped large blocks of blocks of far-transported rocks on the beaches of the Saunton and Baggy Point areas, and clays near Barnstaple. These features are also included within this Action Plan.

Periglacial processes, as well as creating some of the county's most important landscapes, have also contributed to some of its key habitats. These include many of the moorland habitats of Dartmoor and Exmoor, especially where rocky outcrops and stony slopes are important, but also on the Culm where the widespread blanket of muddy head is a major factor on creating its characteristic wet grassland and boggy habitats, including Rhôs pastures. In east Devon, ancient landslip systems in particular create areas of marsh and springs with key habitats.

2. Why an Action Plan?

Devon's periglacial features and deposits are some of the most important in the UK, a consequence of the absence of glaciation. On Dartmoor, tors and their associated features on open moorland are typically well protected within the context of existing designations, including the national park itself. An absence of comprehensive mapping of periglacial features and deposits, however, combined with an ignorance of their significance means that unintentional and unnecessary damage is still possible whenever development takes place on the moor, including movement of surface rock and forestry operations. Nevertheless, the intimate relationship between the tors and clitter slopes and the ecology of Dartmoor means that such issues are likely to be very locally relevant.

Elsewhere the picture is rather different, however, as features are often less obvious and little information is available. On the Culm, where most valleys have infills of periglacial head deposits and locally associated soil creep features and small landslips, drainage works, tree planting and waste disposal are amongst the threats to important features. Again, ignorance of their significance is a major factor. Similarly in east Devon, ancient landslip systems associated with the scarps of the Blackdown hills and their equivalents near the coast may be at risk , although engineering works including roadbuilding have a limited threat as such areas can remain potentially unstable. In south Devon, especially around the coast, relatively soft periglacial deposits are often at risk from coastal defence works.

A major theme throughout is lack of awareness of the significance of such features and deposits and as many are intimately related to key species, an Action Plan is appropriate. In addition, features such as the tors of Dartmoor are considered to be of international significance through the Global Geosites programme.

3. & 4. Characteristic wildlife & special species

Periglacial processes and the landscapes they have produced include a range of habitats and species. Perhaps the most significant, however, are the bare rocks habitats of tors and boulder fields – most extensively on Dartmoor, but also present elsewhere. Lichens are probably the most important group present, but especially where conditions are wet, other lower plants such as mosses and ferns may also be significant. Such areas also provide shelter for invertebrates and ground-nesting birds.

Areas of cover or accumulation of periglacial head can often be poorly drained and especially on the Culm can form the ideal substrate for the development of Rhôs pasture. This frequently wet grassland supports a diverse range of plant

communities and an important invertebrate fauna such as the now very rare marsh fritillary (the caterpillars of which feed on devil's-bit scabious, a characteristic plant of Rhôs pasture). Springs and seepages associated with ancient landslip systems can also be especially important for the insect populations that they support.

Please note: this action plan has been developed during a review to enhance the geological content of this integrated BAP. The emphasis has been on geological features rather than wildlife. In due course, the 'Characteristic wildlife' and 'Special species' sections of this Habitat Action Plan will be revised and enhanced.

In the meantime, you can get a good feel for the wildlife associated with key periglacial landscapes by viewing the Rhos pasture HAP of this Devon BAP and also by visiting the web sites of the Dartmoor and Exmoor local BAPs:

Dartmoor: www.dartmoor-npa.gov.uk/au-baptoc

Exmoor: www.exmoor-nationalpark.gov.uk/index/learning_about/wildlife/about_biodiversity.htm

5. Special geodiversity features

Key geological features well represented within or associated with Devon's periglacial landscapes include:

- Stratigraphical (Phanerozoic): Devon (marine) carbonates and clastics
- 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
- Igneous and metamorphic geology: Igneous rocks linked to the northern European Variscan fold-belt
- Igneous and metamorphic geology: Permian-Carboniferous igneous rocks of Britain
- Mineralogical, economic: Minerals and mineral assemblages in igneous intrusions
- Mineralogical, economic: Sn-Cu-AS veins associated with Cornubian batholith
- Mineralogical, economic: Contact metamorphic assemblages
- Geomorphological features, erosional and depositional processes, and landscapes: Landslides (both relic and active)
- Geomorphological features, erosional and depositional processes, and landscapes: Granite tors of Devon/ Cornwall
- *Structural: Variscan nappes and allochthon/ parautochthon of Devon and Cornwall

Other important Earth heritage features which are well represented in Devon's periglacial landscapes include:

- Devonian Igneous rocks
- Lower Carboniferous stratigraphy and palaeontology (marine)
- Upper Carboniferous stratigraphy and palaeontology (marine and non-marine)
- Permian and Triassic stratigraphy and palaeontology in central and east Devon (non marine)
- Albian (upper Lower Cretaceous) stratigraphy and palaeontology (marine)
- Cenomanian to Maastrichtian (Upper Cretaceous) stratigraphy and palaeontology (marine)
- Palaeogene ('Tertiary') sediments
- Palaeogene ('Tertiary') igneous rocks (the Lundy granite and associated dykes)
- Quaternary glacial and periglacial deposits and landforms

6. The distribution and current extent of periglacial landscapes and features in Devon

Periglacial deposits are present throughout Devon although the extent to which they affect the character of the landscape and its associated habitats is variable. The key areas and their characteristics are listed below:

- Dartmoor granite massif and metamorphic aureole – tor features, block fields, scree slopes, valley and slope head deposits, etc, with habitats including bare-rocks surfaces, rhôs pasture, heather moorland, valley mire, etc.
- The 'Culm' of mid and north west Devon – valley and slope head deposits, soil creep and small landslip features with habitats including Rhôs pasture.
- Exmoor Devonian sandstone and slate massif - valley and slope head deposits, tors, patterned ground, rare glacial deposits, etc with habitats including Rhôs pasture and heather moorland.
- Taw-Torridge estuary and associated valleys – complex of raised beaches, drowned river features and associated periglacial and glacial deposits (see also Estuaries and Sea cliff and slope HAPs).
- Blackdown Hills – degraded, ancient landslip systems with associated springs and valley and slope head deposits, etc, with habitats including springs and wet flushes.
- South Devon, including coast - valley and slope head deposits including aprons on coastal slopes, marine platforms and ancient cliff lines. Habitats include vegetated sea cliffs (see Sea cliff and slope HAP).

7. Current problems for periglacial landscapes in Devon

- An absence of comprehensive mapping of significant periglacial features on a county-wide basis, including on older geological survey maps, resulting in a lack of information to guide decision makers and land owners and managers.

- Ignorance of the significance of periglacial features resulting in unintentional and unnecessary damage (e.g. during development, forestry operations, landfill operations, agricultural activities, etc).

- Coastal defence works where deposits are present in bays and cliff tops, leading to loss of exposure.

- A lack of recording of periglacial features in working pits and quarries and other active sites, linked to the absence of any centralised repository for the records generated.

- Disturbance to periglacial features, including movement of boulders and stones as part of agricultural or other land management operations or as a source of stone.

- Forestation including furrowing across periglacial features and slopes and construction of associated tracks.

- Excavation of ponds and development of landfill sites on areas of relatively impervious periglacial head across the Culm.

- Insufficient grazing leading to blanketing of geomorphological features by gorse, scrub, etc.

8. Recent changes in number and extent

As the extent of periglacial features is not systematically recorded in the county, changes in extent cannot be fully assessed. The very widespread occurrence of such features and deposits, however, inevitably means that losses are frequent - but this does not automatically mean that all such losses are significant in terms of the feature as a whole.

9. Current site protection

Nationally selected SSSIs for periglacial and related features and deposits include Merrivale SSSI, Laugher Quarry SSSI and Two Bridges Quarry SSSI on Dartmoor, and Westward Ho! Cliffs, West Exmoor Coast and Woods SSSI, Saunton to Baggy Coast SSSI, Fremington Claypit SSSI and Prawle Point and Start Point SSSI. Other sites where such features are important to the designation include Hallsands to Beesands SSSI.

Other SSSIs with significant periglacial features and related habitats include: Brent Tor SSSI, East Dartmoor SSSI, Haytor Rocks and Quarries SSSI, Marsland to Clovelly SSSI, Plymouth Sound Shores and Cliffs SSSI and many Culm grassland SSSIs.

A number of County Geological Sites are likely to include periglacial features and deposits. The recent establishment of a database of CGS in Devon will ultimately facilitate the listing of all such sites.

10. Current positive initiatives for periglacial landscapes in Devon

- 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 Group (Regionally Important Geological/Geomorphological Sites) 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 district by district surveys, completed surveys include North Devon AONB, mining districts in West Devon, Torbay, Exeter, South Hams, east Devon, Teignbridge and Dartmoor.

- The Ussher Society is a forum for presenting and discussing the results of geological and geomorphological research into Earth heritage sites in south west 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 Exeter, Plymouth, Torbay and Sidmouth). New geological maps have been published, supported by two descriptive memoirs (Exeter, Plymouth) and two brief reviews (Torbay and Sidmouth). A new survey of the Tiverton area is currently taking place (2007). These maps include a systematic mapping of periglacial head terrace deposits.

- 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). A number of the sites included demonstrate periglacial features including tors.

- Devon County Council and Natural England have supported the 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 periglacial landscapes 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 Meldon Interpretation Project, established by Dartmoor National Park Authority and Devon County Council, has produced a range of interpretative materials, including a guide book, sign boards and web based educational resources to support the educational and recreational use of one of the county's most important geological areas. Previous interpretative projects on Dartmoor include the Burrator Landform Trail – with a central periglacial landscapes theme - and the exhibition '*350 million years in the making*', both relevant to quarry exposures. The materials produced are also available via the Dartmoor National Park Authority's website.

- Local authority projects have led to the clearing and restoration of geological exposures at key CGS sites, most on Dartmoor where a key section showing the process of tor-formation was cleared at Cherrybook.

11. Biodiversity planning context

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

- Purple moor-grass and rush pastures
- Upland heathland
- Blanket bog
- Upland flushes, fens and swamps

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:

- Marsh Fritillary
- Cave, karst and limestone habitats
- Cities, towns and villages
- Estuaries
- Rhôs pasture
- Rivers, streams, floodplain and fluvial processes
- Sea cliff and slope
- Mines and mineral waste tips
- Curlew

12. Biodiversity objectives and targets for periglacial landscapes in Devon

Objective 1

Seek to integrate the objectives of wildlife and Earth heritage conservation in the management of periglacial landscapes.

Targets:

- Ongoing.

Objective 2

Identify all significant areas of periglacial landscapes and deposits in Devon and development guidelines for land managers and decision makers.

Targets:

- Complete survey and identification, including as a basis for County Geological Site or County Wildlife Site designation, by 2010 and inform all relevant decision makers in governmental bodies and local authorities.

Objective 3

Seek to reduce any potential conflicts between land management regimes and the recreational/educational use of periglacial landscapes and their associated fauna and flora.

Targets:

- Continued liaison with all user groups and production of guidance for site owners, occupiers and site users.

Objective 4

Foster greater public awareness and understanding of the significance of periglacial processes in creating some of Devon's most famous landscapes and the habitats that they support.

Targets:

- By 2012 have a network of public trails which demonstrate the geology and geomorphology of Devon's key areas of periglacially produced landscape.
- Ensure adequate educational materials including codes of good practice are available via publications and / or web sites.

Objective 5

Improve the documentation of the geological and geomorphological features and the fauna and flora of periglacial landscapes to both facilitate educational and scientific study and inform decision making.

Targets:

- Establish a county geological records centre to gather and manage site records and reports.

13. Wider benefits from pursuing these objectives

The pursuit of the objectives and targets set out in this Plan will not only benefit the Earth heritage interest and biodiversity of periglacial landscapes in Devon. Conservation also 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 bio- and geodiversity will also enhance the interests of society as a whole.

In the context of periglacial landscapes, an improved understanding of their characters and significance is relevant to many cultural and artistic pursuits, as the features they can demonstrate have inspired artists and writers for hundreds of years.

14. Priority or indicative actions for periglacial landscapes in Devon

Action	Key Partners
1. Ensure that full account is taken of PPS9 (and revisions) and other relevant policy and guidance to ensure that development does not damage key periglacial features and deposits and their related flora and fauna.	LAs; NE; DWT; DNPA; DRIGSG.
2. Seek to fully integrate geological and ecological conservation in the management of areas with periglacial features and deposits.	NE; DRIGSG.; Site owners; LAs; DNPA DWT.
3. Manage and control access and use of sites only where they are particularly sensitive and at times of year when vulnerable species are breeding. Access for continued bone-fide geological research should however be maintained.	NE; DRIGSG; RSPB; DWT; Site owners; DBWPS
4. Provide advice to LAs, site managers, etc, about the significance of periglacial features and deposits (especially of CWS & CGS) to achieve sympathetic management for Earth heritage and wildlife.	DWT; DRIGSG; NPAs; DBG; Site owners; LAs
5. Compile information on periglacial landscapes in Devon, including the identification of key areas with such features by 2010. Inform all relevant decision makers in governmental bodies and local authorities.	DRIGSG: DBWPS; DWT; NE; BTO; BC; BSBI; DIF; DBRC.
6. Promote understanding amongst the general public and particularly amongst site users of the significance and sensitivity of periglacial features, including the production of appropriate codes of conduct for user groups e.g. climbers, geologists, walkers, etc.	NE; SWCP Team; DWT; RSPB; CCMS; DCC; NT; FWAG; DRIGSG
7. Establish a geological records centre for Devon and promote the compilation of records of key periglacial features and deposits.	DRIGSG, museums, universities.

Periglacial landscapes Action Plan Champion – To be appointed

Abbreviations used in text and table

BC	Butterfly Conservation
BGS	British Geological Survey
BSBI	Botanical Society of the British Isles
BTO	British Trust for Ornithology
CGS	County Geological Site
CWS	County Wildlife Site
DBWPS	Devon Birdwatching and Preservation Society

DCC	Devon County Council
DIF	Devon Invertebrate Forum
DNPA	Dartmoor National Park Authority
DRIGSG	Devon RIGS Group
DWT	Devon Wildlife Trust
HA	Highways Agency
LAs	Local Authorities
NE	Natural England
NFU	National Farmers Union
NPAs	National Park Authorities
RIGS	Regional Important Geological/Geomorphological Sites
RSPB	Royal Society for the Protection of Birds
SWCP	South West Coast Path