

3.9 Inland rock

This section focuses on the biological interest of natural and semi-natural rock habitats (the geodiversity interest is discussed in Section 2.4). The term 'inland rock' describes all exposed rock surfaces, whether natural or artificial, as well as skeletal soils over rock. It includes inland cliffs, caves, limestone pavements and scree, as well as quarries and quarry wastes. It also includes calaminarian grassland. However, coastal cliffs are covered in Section 3.11 as they form part of the 'maritime cliff and slope' UK BAP priority habitat.

Limestone pavements are large areas of rock exposed by the scouring of glaciers during the Ice Ages and then weathered over thousands of years. They contain complex patterns of deep crevices known as grikes, between which are massive blocks of worn limestone, called clints. The vegetation of limestone pavements is unusual because of its structure, and includes woodland edge species and rocky habitat species.

Calaminarian grasslands occur on soils that have high levels of heavy metals, such as lead, zinc, chromium and copper, which are toxic to most plant species. They typically occur on artificial sites associated with past mining activities. However, near-natural examples are found on serpentine rock and mineral vein outcrops. Calaminarian grasslands also occur on stable river gravels rich in lead and zinc, where the heavy metal content may be partly a result of past mining activity in the river catchment.

Natural rock exposures and scree habitats occur on a wide range of rock types, from acidic to highly calcareous. They are found throughout the uplands, and are particularly characteristic of higher altitudes in northern England. Many rock habitats, especially cliff faces, rock ledges, gorges and boulder fields are inaccessible to grazing animals. Others are more accessible, such as fine screes and gently sloping rock outcrops, where grazing may keep the vegetation closely cropped.

Natural caves are formed by the erosion of soluble rocks, such as limestone. They typically form the subterranean components of a distinctive 'karst' landscape, and are associated with various topographic features, including gorges, dry valleys and limestone pavements.

UK BAP priority inland rock habitats in England:

- Calaminarian grassland
- Inland rock outcrops and scree habitats
- Limestone pavement

A number of vegetation types are associated with rock habitats. These include:

- Chasmophytic vegetation (plant communities that colonise the cracks and fissures of rock faces).
- Certain types of tall herb and fern vegetation vulnerable to grazing, now largely confined to areas inaccessible to grazing animals, such as cliff faces and ledges.
- Early pioneer communities on skeletal substrates often associated with quarries and other 'brownfield' land.

3.9.1 Importance of England's inland rock habitats

Limestone pavements are scarce and non-renewable, and within Europe only occur in the UK, Ireland and Sweden (English Nature 2001). England holds a large proportion of the UK's resource of limestone pavement (80%). Eight inland rock and scree habitat types that are found in England are listed in Annex I to the EC Habitats Directive.

3.9.1.1 Inland rock species

Over much of upland England, rock outcrops and screes act as refuges for species that have been lost from more accessible habitats by centuries of grazing pressure. They are among the few near-natural habitats remaining in England. By contrast, habitats in the lowlands, such as sand and gravel workings, railway cuttings and quarries, may be colonised by a range of opportunistic species, some of which might otherwise be absent because of the lack of an equivalent natural habitat.

Limestone pavements support unusual combinations of plants, including woodland and woodland-edge species. Plants grow mainly within the grikes, which provide sheltered, humid conditions with very thin soils. One rare species, the rigid buckler fern *Dryopteris submontana*, has its main centre of population in limestone pavement and, in common with two other rare species, dark-red helleborine *Epipactis atrorubens* and angular Solomon's-seal *Polygonatum odoratum*, flourishes in the low to mid-altitude pavements. Other rare species, such as baneberry *Actaea spicata*, green spleenwort *Asplenium viride* and the English sandwort *Arenaria norvegica* subspecies *anglica*, occur in more montane pavements.

The limestone habitats around Morecambe Bay in Cumbria are important for their butterfly populations such as the high brown *Argynnis adippe* subspecies *vulgoadippe*, pearl-bordered *Boloria euphrosyne* and small pearl-bordered *B. selene* fritillaries, and northern brown argus *Aricia artaxerxes* subspecies *salmacis* (all UK BAP priority species). These species make use of the nectar and larval food plants, the shelter of the glades and grikes, and warm conditions for basking on the limestone (Webb & Glading 1998).

Natural rock exposures and screes support a wide range of species. The inaccessibility of rock habitats to grazing animals, especially of rock ledges and scree, provides a refuge for many vascular plants that are sensitive to grazing. These include numerous local and rare species, such as alpine lady-fern *Athyrium distentifolium*, rock sedge *Carex rupestris* and bird's-foot sedge *Carex ornithopoda*, and the UK BAP priority species alpine blue-sow-thistle *Cicerbita alpina* and oblong woodsia *Woodsia ilvensis*. Chasmophytic vegetation (that which grows in rock crevices) supports a number of uncommon ferns, including green spleenwort, brittle bladder-fern *Cystopteris fragilis* and Wilson's filmy fern *Hymenophyllum wilsonii*. Bryophytes and lichens also occur in crevices but are able to flourish on the open rock surfaces, where there is a lack of competition from vascular plants (see box).

Rock and scree habitats, Ingleborough NNR (North Yorkshire)

Rock and scree habitats have been studied less than most other upland habitats and, where investigations have taken place, they have tended to concentrate on higher plants. An investigation of the lichen and bryophyte communities on rock habitats in upland Britain, focusing upon 16 selected SACs including Ingleborough, was completed in 2006. At Ingleborough, 13 different communities were found, including over 30 species that are regarded as being nationally rare or scarce.

Calcareous scree – main habitat for the near-threatened lichens *Lemmopsis arnoldiana* and *Leptogium massiliense*, and the nationally scarce lichen *Clauzadea metzleri*.

Rock crevices and fissures – main habitat for nationally scarce short-beaked thyme-moss *Mnium thomsonii*.

Source: Orange (2008)

Calaminarian grasslands and associated rock outcrops are typically species-poor but provide a habitat for several scarce plants, including the forked spleenwort *Asplenium septentrionale*, spring sandwort *Minuartia verna*, alpine penny-cress *Thlaspi caerulescens* and Young's helleborine *Epipactis youngiana*. Heavy metal toxicity of the soils, perhaps combined with a low nutrient status, is believed to maintain the open vegetation and retard succession. The rarer species are favoured by lack of competition from colonists that are otherwise more vigorous.

Natural caves are important for their cave-dwelling species (cavernicoles), including bacteria, algae, fungi and various groups of invertebrates (for example insects, spiders and crustaceans). The endemic crustacean *Niphargellus glenniei* is only found in Devon in the UK. Some caves also provide hibernation sites for bat species, including all four species listed in Annex II to the EC Habitats Directive (for example lesser *Rhinolophus hipposideros* and greater horseshoe bats *R. ferrumequinum*) (pictured overleaf).

3.9.2 Extent of habitat

There are estimated to be 112,700 ha of inland rock (all types) in England based on Land Cover Map 2000 data, covering 1% of the total area of England. The total area of limestone pavement in England is 2,340 ha (English Nature 2001) and the rare calaminarian grassland type is estimated to cover less than 200 ha (Mountford & Strachan 2007). Reliable extent data are not available for other types of natural rock exposures and scree habitats but the Joint Nature Conservation Committee (JNCC) gives broad estimates for those listed in Annex I to the EC Habitats Directive that occur in England (Table 3.15). There are also around 1,300 active mineral extraction and quarry sites in England, covering over 64,000 ha of land, of which around 87% has the potential to support one or more BAP priority habitats (Davies 2006).

The most extensive limestone pavements occur on the Carboniferous limestone of northern England, from Morecambe Bay in Cumbria to the Yorkshire Dales. The rare calaminarian grassland type is very locally distributed with its main concentrations in the Derbyshire White Peak and the North Pennines. Inland rock and scree habitats are widespread in upland areas of England, with more limited occurrence in the lowlands. Acidic rock and scree are widespread, whereas calcareous communities are more restricted, and good stands of tall-herb ledge vegetation also tend to be confined by heavy grazing. Natural caves, which are important for their specialist fauna, are particularly characteristic of the limestone areas of the North Pennines, the Peak District and the Mendips.

Table 3.15 Inland rock and scree habitats in England

Habitat	Estimated extent in England (ha)
Inland rock habitat (broad habitat)	112,700
Limestone pavement	2,340
Calaminarian grasslands	200
Siliceous rock and scree types	4,000–5,000
Calcareous rock and scree types	400–1,000
Tall-herb ledge vegetation	Unknown
Natural caves (host specialist or endemic cave species)	Unknown

(Source: Countryside Survey 2000, JNCC 2007b)

3.9.3 Protection

There are 23 SSSIs containing 1,396 ha of limestone pavement in England (60% of the total resource) (English Nature 2001). Twelve SSSIs contain a total of 76 ha of calaminarian grassland (38% of the resource) and a further 18 SSSIs have been notified for other rock and scree habitats (957 ha). Over 600 SSSIs have been designated in former quarries or mines, of which 38 are for biodiversity interests (the remainder for their geodiversity exposed by the extraction process). The locations of these SSSIs (excluding geodiversity sites) are shown in Figure 3.22.

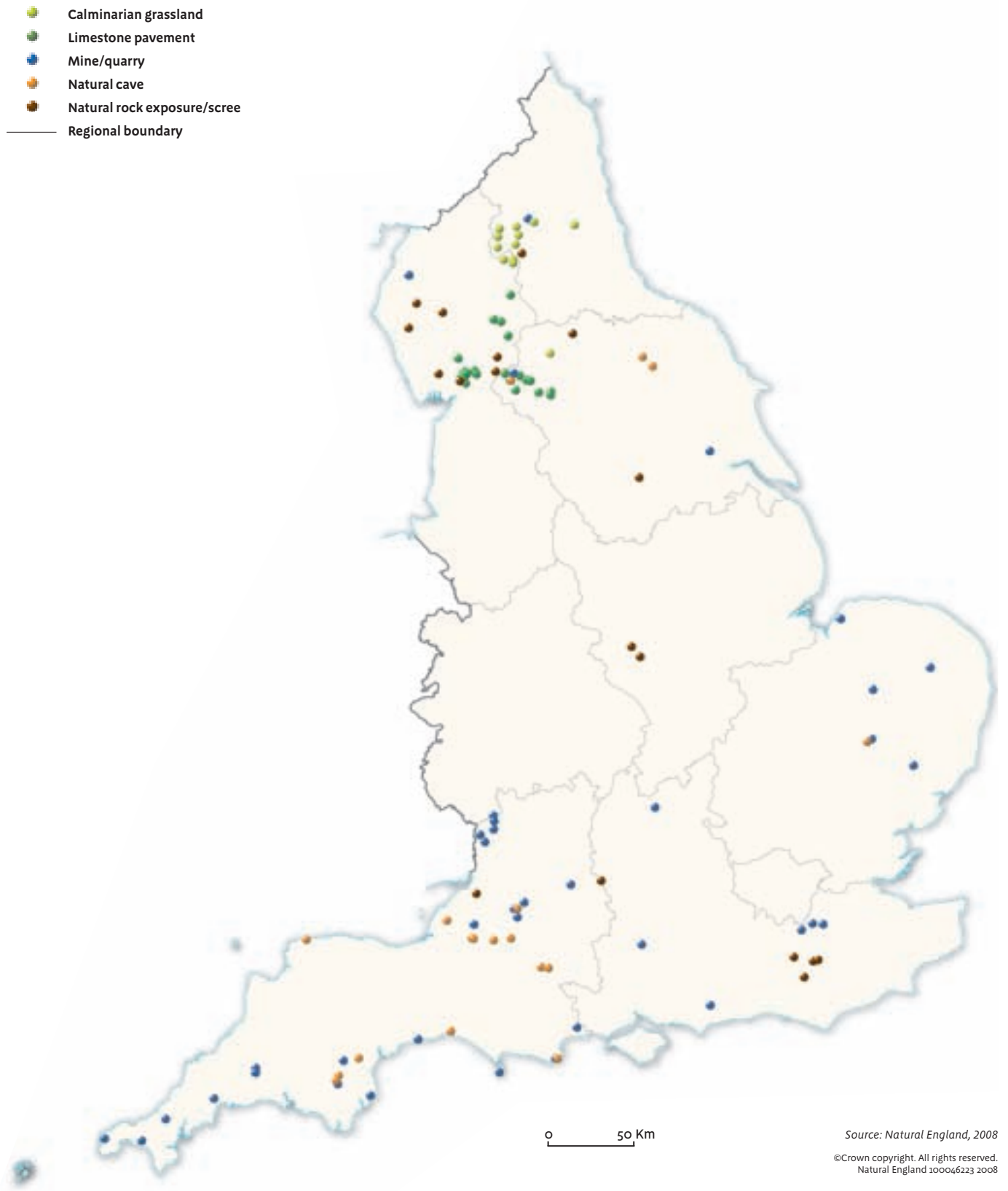
Sites of European importance designated as SACs for inland rock habitats include the Asby Complex, Morecambe Bay Pavements and Lake District High Fells in the North West; the Craven Limestone Complex and Ingleborough in Yorkshire & the Humber; Moor House - Upper Teesdale in the North East and North West, and the Peak District Dales in the East and West Midlands.

Limestone pavement has special protection under Section 34 of the Wildlife & Countryside Act 1981, which allows Limestone Pavement Orders to be issued by local authorities to protect pavements. There are currently 99 Limestone Pavement Orders, covering the best sites in England.



© David Hosking/FLPA

Figure 3.22 Distribution of SSSIs with inland rock habitat in England



3.9.4 Condition

By area, 73% of SSSI inland rock is in favourable or recovering condition. Of this, 28% (2,004 ha) is in favourable condition and 45% (3,265 ha) is recovering.

Calaminarian grassland is in the poorest condition with only 37% favourable or recovering, compared to 70% of limestone pavement and 85% of other rock and scree habitats.

The main cause of unfavourable condition in inland rock SSSIs is overgrazing, which contributes to the adverse reasons in 57% of the total area. Other factors include inappropriate management practices, public access and disturbance from recreational activities.

Bloody crane's-bill

Overgrazing on upland limestone pavements threatens characteristic species such as bloody crane's-bill *Geranium sanguineum* that are intolerant of grazing. The pavements of the Asby area on the eastern side of Ingleborough NNR, North Yorkshire, illustrate the effects of high levels of sheep grazing, where species such as bloody crane's-bill survive only in deep grikes. In contrast, lower grazing pressure at Scar Close allows the species to grow out of the grikes and onto the clint tops.

Source: English Nature (2001)



© Natural England/Peter Wakely

In the Peak District, 50% of 'lead rakes' (calaminarian grasslands created by former lead mining activity) have been lost over the last century, and losses are continuing (Peak District National Park Authority 2008). Calaminarian grasslands on river deposits in Northumberland are declining rapidly and, of those that remain, it is estimated that no more than 12 ha are in favourable condition (Northumberland County Council 2007).

3.9.4.1 Changes in inland rock habitats and species

Many natural or semi-natural rock habitats have undergone less change than habitats that are more actively managed. Some of the particular factors affecting inland rock habitats are:

- Increase in mineral extraction, especially in lowland river valleys, which has created (at least temporarily) large areas of quarried land.
- Road cuttings, which have given rise to new rock exposures, sometimes in areas where there are few natural rock outcrops.
- 'Landscaping' of quarried land and the use of gravel pits and quarries for landfill, which has destroyed some of the available habitat.
- Mechanised removal of limestone pavement in the uplands has had a dramatic effect: by 1975 only 61% of the total area was intact and only 3% of the remaining pavements were undamaged (Braithwaite *et al.* 2006).

Analysis of the results of the two national vascular plant atlas surveys has shown that many characteristic species of inland rock habitats have declined over the last 40 years (Preston *et al.* 2002b). The decline has been greatest in northern and western parts of England, while in some lowland areas, there has been a relative increase in species abundance (Braithwaite *et al.* 2006). Studies at a local level have also shown a decline in species of inland rock habitats. For example, a study of limestone pavements in the Ingleborough area of North Yorkshire showed that most pavements lost more species than they gained between 1975 and 1985 (Margules *et al.* 1994). The main causes of decline were thought to be due to recreational pressure and high levels of grazing on limestone pavements.

3.9.4.2 BAP inland rock action plan threats

The main issues posing a threat to inland rock habitats are (BRIG 2006a):

- **Unsuitable grazing management**, especially overgrazing, which is the main cause of unfavourable condition on upland sites.
- **Lack of suitable management**, leading to development of scrub and woodland at the expense of open, species-rich vegetation.
- **Recreational pressure** from walkers and climbers, causing damage to fragile vegetation communities.
- **Redevelopment**, which is targeted on 'brownfield' land, such as quarries, including housing, industrial and commercial use, and landfill.
- **Atmospheric pollution** (nitrogen deposition, acid precipitation) and **climate change** affecting species composition.