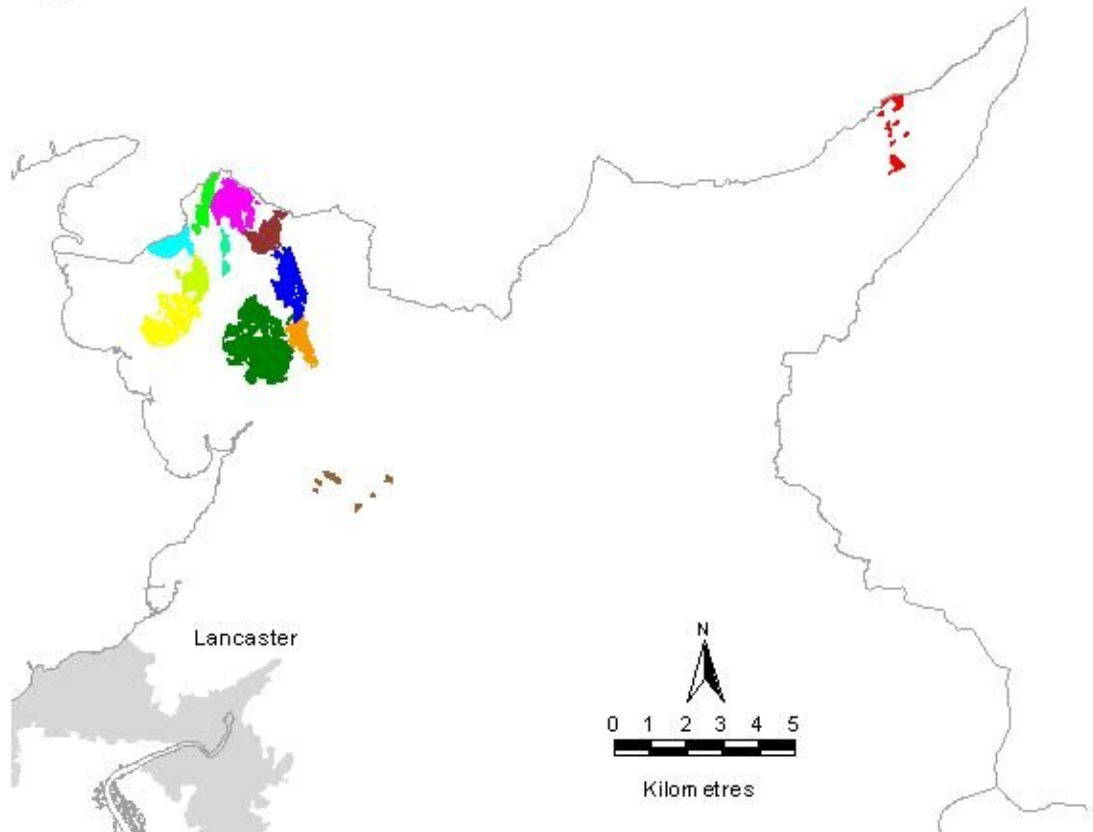
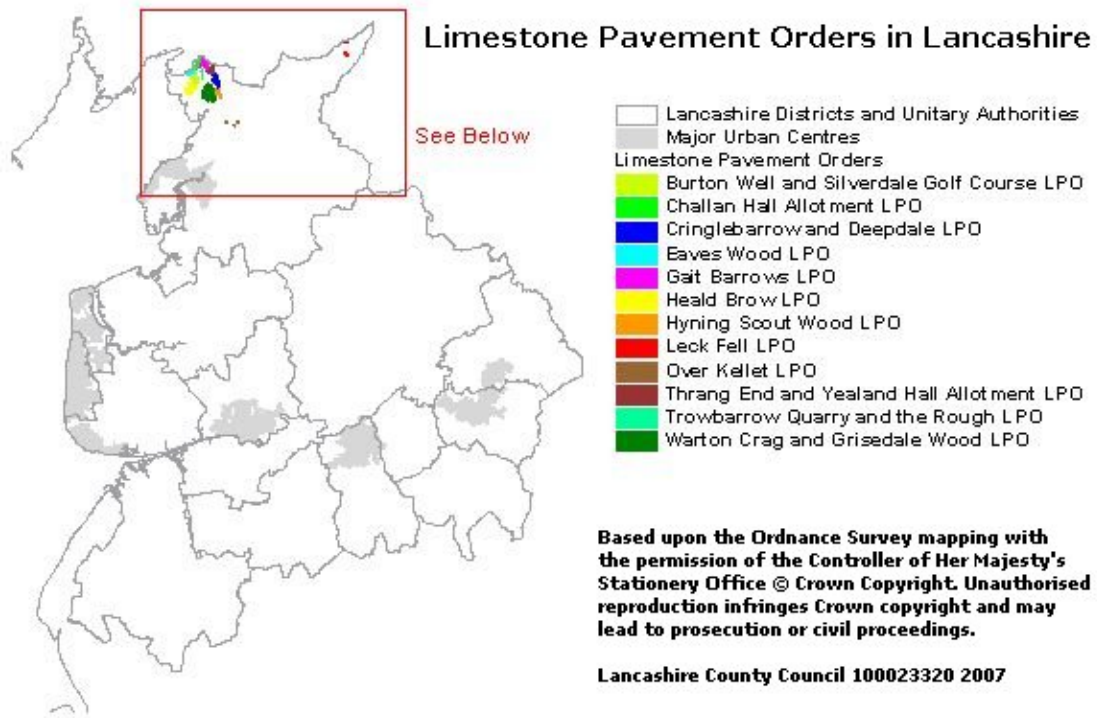


Limestone Pavement



*Limestone Pavement at Gait Barrows NNR, Silverdale
Copyright: English Nature*



(For an explanation of Limestone Pavement Orders see 'National Status' section below)

Habitat Description

Lancashire's limestone pavements are flat platforms composed of carboniferous limestone rock, deposited about 350 million years ago. It is believed that, until the last ice age, this rock was covered with soil and vegetation. Water, percolating through these layers, became mildly acidic and gradually dissolved parts of the rock, imparting a typical water-worn appearance. At the end of the last ice age, large expanses of the rock were exposed by the scouring action of the retreating glaciers. The rock was then weathered further by the action of wind, rain and frost.

Today, the most characteristic surface feature of limestone pavements is their division into blocks, which are known as 'clints', bounded by deep vertical fissures known as 'grikes'. The grikes may harbour unusual and diverse plant communities that are seldom encountered elsewhere.

On a smaller scale, there are abundant shallow, gutter-like channels on the clints known as 'runnels'. These drain across the clint surfaces into the grikes. On the tops of the clints there are a variety of shallow depressions where rainwater collects, known technically as 'solution cups', 'solution hollows' or 'kamenitzas'⁽¹⁾. These features of the habitat provide the conditions for a wide range of interesting mosses and lichens to proliferate.

The vegetation of limestone pavements may be split broadly into three types - wooded, scrubby and open.

Most of the pavements in Lancashire are predominantly wooded in character. Wooded pavements have a more or less continuous tree cover which is over ground vegetation, including mosses, on the surface of the clints and ferns in the grikes. Open pavements consist of bare clints with vegetation confined to the grikes especially where grazing occurs. Scrubby pavements are a transitional stage between open and wooded pavement types.

Limestone pavements are a scarce and non-renewable resource. The biological richness of limestone pavements is directly attributable to their unique geology that provides with an invaluable record of glacial and post-glacial history.

National status

Limestone pavements are very restricted and scarce in Europe and are listed as a 'Priority Habitat' on Annex 1 of the EU Habitats and Species Directive. Limestone pavement is a Priority Habitat in the UK BAP. Yew woodland is also an EU Priority Habitat (*Taxus baccata* woods) on Annex 1 of the Habitats and Species Directive.

Britain contains a very significant proportion of the European resource but this amounts to an estimated area of only 2,600 ha⁽²⁾. Most of this occurs in Cumbria (1,052 ha), the Yorkshire Dales (1,324 ha) and North Lancashire (224 ha).

Limestone pavements are unique amongst British habitats in having their own legislative measures. Section 34 of the 1981 Wildlife and Countryside Act enables local authorities to make 'Limestone Pavement Orders' (LPOs). Removal of pavement within an order area is a criminal offence.

Regional status

North west England contains internationally important examples of limestone pavement around Morecambe Bay, in the Cumbrian Pennines and near Orton in Cumbria.

Local status

The total area covered by LPOs in Lancashire is 827 ha, which is equivalent to 0.3% of the county. However, it should be noted that this figure gives an overestimate of the actual amount of exposed limestone pavement in Lancashire since Order areas follow definable boundaries rather than the exact edges of exposed pavements.

Every significant area of limestone pavement in Lancashire is now covered by an LPO. All the county's limestone pavements occur in Lancaster District. Most lie within the Arnside/Silverdale AONB, with the only other exposures being on Leck Fell, east of Kirby Lonsdale and around Over Kellet, near Carnforth.

There are 12 LPOs, as follows:

- Burton Well and Silverdale Golf Course (47.4 ha)
- Challan Hall Allotment (38.5 ha)
- Cringlebarrow and Deepdale (84.7 ha)
- Eaves Wood (52.4 ha)
- Gait Barrows (98.1 ha)
- Heald Brow (97.3 ha)
- Hyning Scout Wood (48.0 ha)
- Leck Fell (25.1 ha)
- Over Kellet (11.8 ha)
- Thrang End and Yealand Hall Allotment (61.2 ha)
- Trowbarrow Quarry and the Trough (13.7 ha)
- Warton Crag (249.1ha)

Important Sites

The following is a list of designated sites where the habitat is significant.

- Cringlebarrow and Deepdale SSSI & cSAC;
- Eaves Wood SSSI;
- Gait Barrows SSSI, NNR & cSAC;
- Hawes Water SSSI & cSAC;
- Jack Scout SSSI;
- Leck Beck Head Catchment Area SSSI;
- Silverdale Golf Course SSSI;
- Thrang End and Yealand Hall Allotment SSSI & cSAC;
- Thrang Wood SSSI & cSAC;
- Trowbarrow Quarry SSSI, LNR;
- Warton Crag SSSI, LNR.

All other major areas of limestone pavement are Biological Heritage Sites.

Current factors affecting the Habitat

Historically, limestone pavements have been exploited for stone for wall building, gate posts and lime production. However, the main concern during the last 50 years has been the systematic destruction of the habitat to provide decorative stone for garden rockeries.

In the 1970s concern about the extent of damage led to a nationwide survey initiated by the Nature Conservancy Council (NCC). Of the 537 pavements visited, only 16 (3%) were found wholly intact. 40% of the habitat had been completely destroyed^(3, 4).

The results of the NCC survey led to powers being included in the Wildlife and Countryside Act 1981 allowing local authorities to make LPOs. However, it was not until the early 1990s that LPOs were actually applied in Lancashire and, in the meantime, further damage is known to have taken place. The wooded character of most of the pavements makes detection of damage difficult.

Since the orders were made, significant damage is known to have occurred on only one site in Lancashire. This was due to the tipping of material to infill grikes rather than the removal of stone.

Nevertheless, illegal removal of pavements to supply stone remains a serious threat. There still appears to be a level of public demand for water-worn limestone. It should be remembered that, unlike many other habitats, creation of new limestone pavements is not an option. Damage is irreversible. Prevention of any further loss or damage is a priority of this plan.

The main threat to the biodiversity of the county's pavements is thought to be a lack of sympathetic management.

In the case of wooded pavements, coppicing has lapsed on sites where this formerly occurred and where this practice would be beneficial. The scrubbing-over of open pavements by invasive species such as bramble, hawthorn and blackthorn can lead to the loss of species characteristic of open sites. Such sites would benefit from regular scrub removal. Care needs to be taken, however, to ensure that management prescriptions are tailored to the particular biological interest of the site. Certain invertebrates (e.g. the hoverfly, *Doros profuges*) seem to inhabit mainly the transition between scrub/woodland and more open habitats. Alteration of the balance of scrub or woodland on sites where these species occur could affect their survival. Wooded pavement can itself support interesting mosses and fungi, while the dead timber in them is often of invertebrate interest.

A certain level of grazing of open pavement areas is desirable but overgrazing can lead to the depletion of the plants of grikes in this habitat.

Non-native plants like *Cotoneaster* are becoming established on some sites, threatening to displace rarer native species

Current Action / Mechanisms

A large proportion of Lancashire's pavements are owned and/or managed by conservation organisations including English Nature, the National Trust, the Wildlife Trust, the RSPB and the Woodland Trust. Two sites are owned by Lancaster City Council and managed as Local Nature Reserves.

Nevertheless, a significant number of pavements remain in private ownership. Of these, some are managed through MAFF's Countryside Stewardship scheme, whilst others are managed under the Forestry Commission's Woodland Grant scheme. There is potential to use both these grant schemes to assist with management of additional areas.

Despite the extent of pavement already under conservation management, there remains a need to contact private owners and occupiers of limestone pavements and to provide help and advice where appropriate on LPOs, conservation management and grants available.

There is also an ongoing need to promote an increased awareness and understanding of the biological and geological importance of limestone pavements by garden centres, retail outlets, landscape architects and the general public.

Currently no monitoring occurs of the extent and quality of limestone pavements in Lancashire except on SSSIs and on some nature reserves. Although the County Council holds aerial photographs of relevant areas, given the wooded nature of most pavements in Lancashire, this resource is of limited use for monitoring purposes.

The Limestone Pavement Action Group, co-ordinated by the Cumbria Wildlife Trust and English Nature, campaigns nationally for the protection of limestone pavements. The Group has published materials on the importance of limestone pavements and advice on their management^(6, 7).

Indicators of Habitat Quality

Limestone pavements are moving towards favourable condition when:

- There is an absence of physical damage to pavement structure;
- Non-native species such as Cotoneaster, sycamore, beech and certain conifers are absent;
- There are light stock grazing levels on open pavements at the right time of year to maximise species diversity, but maintain open character;
- Scrub is not encroaching upon open pavements;
- Coppicing is maintained at sites where this has been traditionally practised;
- A diversity of plants, fungi and invertebrates is to be found including many on the lists in Tables 2a & c.

Table 1: NVC Communities associated with limestone pavement in Lancashire

Code	Community	Code	Community
W8	<i>Fraxinus excelsior</i> - <i>Acer campestre</i> - <i>Mercurialis perennis</i> woodland	CG9	<i>Sesleria caerulea</i> - <i>Galium sternerii</i> grassland.
W9	<i>Fraxinus excelsior</i> - <i>Sorbus aucuparia</i> - <i>Mercurialis perennis</i> woodland.	OV38	<i>Gymnocarpium robertianum</i> - <i>Arrhenatherum elatius</i> community.
W13	<i>Taxus baccata</i> woodland.	OV39	<i>Asplenium trichomanes</i> - <i>Asplenium ruta-muraria</i> community
W21	<i>Crataegus monogyna</i> - <i>Hedera helix</i> scrub.	OV40	<i>Asplenium trichomanes-ramosum</i> - <i>Cystopteris fragilis</i> community

Table 2a: Invertebrates associated with limestone pavement in Lancashire

Common name	Scientific name	Status
A cranefly	<i>Tipula alpina</i>	NR, In1
A hoverfly	<i>Doros profuges</i>	UK & LSAP
High brown fritillary	<i>Argynnis adippe</i>	UK & LSAP
Pearl-bordered fritillary	<i>Boloria euphrosyne</i>	UK & LSAP
Northern brown argus	<i>Aricia artaxerxes</i>	UK & LSAP
Small pearl-bordered fritillary	<i>Boloria selene</i>	Le4
Duke of Burgundy	<i>Hamearis lucina</i>	NS, Le2
Dark green fritillary	<i>Argynnis aglaja</i>	Le3

Least minor moth	Photodes captiuncula	NR, Le1
Cistus forester moth	Adscita geryon	NS, Le2
A pill woodlouse	Armadillium pictum	NR, In1
Narrow-mouthed whorl snail	Vertigo angustior	UK SAP
Door snail	Clausillia dubia	NS, Mo2

Table 2b: Vascular plants associated with limestone pavement in Lancashire

Common name	Scientific name	Status
Trees		
Ash	Fraxinus excelsior	
Oak spp.	Quercus spp.	
Wych elm	Ulmus glabra	
Yew	Taxus baccata	
Wild cherry	Prunus avium	
Shrubs		
Spindle	Euonymus europaeus	
Blackthorn	Prunus spinosa	
Hazel	Corylus avellana	
Hawthorn	Crataegus monogyna	
Herbs		
Wood-sage	Teucrium scorodonia	
Dog's mercury	Mercurialis perennis	
Herb-Robert	Geranium robertianum	
Common dog-violet	Viola riviniana	
Wall lettuce	Mycelis muralis	
Ferns		
Maidenhair spleenwort	Asplenium trichomanes	

Green spleenwort	<i>Asplenium viride</i>	
Wall-rue	<i>Asplenium ruta-muraria</i>	
Male fern	<i>Dryopteris filix-mas</i>	
Hard shield-fern	<i>Polystichum aculeatum</i>	
Hart's-tongue fern	<i>Phyllitis scolopendrium</i>	
Polypody	<i>Polypodium vulgare</i>	

Table 2c: Some uncommon vascular plants, lichens and bryophytes associated with limestone pavement in Lancashire

Juniper	<i>Juniperus communis</i>	UK SAP
Lancaster whitebeam	<i>Sorbus lancastriensis</i>	NR, LSAP
Mezereon	<i>Daphne mezereon</i>	NR, Ff1
Baneberry	<i>Actaea spicata</i>	NS, Ff2
Stinking hellebore	<i>Helleborus foetidus</i>	NS, Ff2
Angular Solomon's seal	<i>Polygonatum odoratum</i>	NS, Ff2
Dark-red helleborine	<i>Epipactis atrorubens</i>	NS, Ff2
Fingered sedge	<i>Carex digitata</i>	NS, Ff2
Narrow-leaved bitter-cress	<i>Cardamine impatiens</i>	NS, Ff2
Limestone fern	<i>Gymnocarpium robertianum</i>	NS, Ff2
Rigid buckler-fern	<i>Dryopteris submontana</i>	NS, Ff2
Downy currant	<i>Ribes spicatum</i>	NS, Ff2
Spring cinquefoil	<i>Potentilla neumanniana</i>	NS, Ff2
Northern bedstraw	<i>Galium boreale</i>	Ff3
Lily-of-the-valley	<i>Convallaria majalis</i>	Ff4a
Pale St John's-wort	<i>Hypericum montanum</i>	Ff4a
Bloody crane's-bill	<i>Geranium sanguineum</i>	Ff4a
Small-leaved lime	<i>Tilia cordata</i>	Ff4b
Limestone bedstraw	<i>Galium sternerii</i>	Ff4b

Lichens		
A lichen	Synalissa symphorea	NR
Bryophytes		
A moss	Pleurochaete squarrosa	NS, Br2

Objectives, targets and proposed actions for limestone pavement in Lancashire

Broad Objective:	A. To ensure no loss of or damage to, limestone pavements in Lancashire. (224 ha)			
Operational Objective	Action Required (Priority)	Partners	Time-scale	Type
1. Maintain an up-to-date database of all LPO areas	1. Establish and maintain LPO database including area in favourable management and list of landowners and managers (High)	LCC, Lancaster City Council	S	RM
	2. Devise strategy for monitoring the quality and extent of limestone pavements. (High)	LCC	M	RM
	3. Implement monitoring strategy. (High)	LCC	M	RM
	4. Extend LPOs to the small areas of pavement not currently covered. (Medium)	LCC	M	SS
2. Ensure that the planning and legislative systems protect limestone pavements.	1. Strengthen links between relevant police and local authority officers to assist with enforcement of existing legislation (High).	LCC, Police, Lancaster City Council	S	SS
	2. Ensure no planning permissions are granted which could result in loss of, or damage to, limestone pavements. (High)	Lancaster City Council & LCC	O	SS

	3. Ensure that the Structure Plan, Local Plan, Minerals and Waste Local Plan and relevant non-statutory plans contain appropriate policies to protect limestone pavements at future reviews. (High)	Lancaster City Council & LCC	O	P, SS
	4. Lobby DETR to improve legislative protection for limestone pavements.	LPAG, DETR, EN	O	P, PR

Broad Objective:	B. To ensure the favourable conservation condition of 75% of limestone pavement in Lancashire by 2005 and 100% by 2010.			
Operational Objective	Action Required (Priority)	Partners	Time-scale	Type
1. Ensure that management of pavements in SSSIs is contributing towards achieving favourable status on all sites by 2010.	1. Assess the condition of all limestone pavement SSSIs by 2002. (High)	EN	M	RM
	2. Seek management agreements so that at least 75% of pavement SSSI in unfavourable condition will be positively managed by 2005. (High)	EN, Land-owners, managers	L	LM
	3. Promote management agreements and/or WES with landowners / managers (Medium)	EN, MAFF	O	A, PR
2. Achieve sympathetic management of at least 50% of limestone pavement BHSs by 2005.	1. Ensure all owners and managers are contacted by 2003 and offered information and advice on the importance of limestone pavements and on appropriate management. (High)	BHSP, FWAG	M	A
	2. Encourage and assist owners and occupiers of wooded pavements to apply for Woodland Grant Schemes to assist with appropriate management. (High)	BHSP, FC, FWAG	O	A, LM

	3. Encourage and assist owners and occupiers of open pavements to apply for Countryside Stewardship grants to assist with appropriate management. (High)	BHSP, MAFF, FWAG	O	A, LM
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Broad Objective:	C. End the demand for and supply of water-worn limestone for decorative purposes.			
Operational Objective	Action Required (Priority)	Partners	Time-scale	Type
1. Foster an increased awareness of the importance of limestone pavements with garden retail outlets, landscape architects and the general public.	1. Increase awareness of the importance of limestone pavements in Lancashire, and the legal protection afforded to them, through the media, leaflets, articles, guided walks, reserve interpretation, etc. (Medium)	LPAG, EN, WT, NT, AONB CMS, Woodland Trust	O	PR
	2. Contact all garden centres/retail outlets by 2002, with a view to persuading them to end the sale of water-worn limestone. (Medium)	LPAG, WT	M	PR
2. Achieve a trade ban on all sales of waterworn limestone by 2010.	1. Lobby for trade ban. (Medium)	LPAG, WT, DETR	L	P, PR

Other Action Plans:

- Calcareous grassland HAP
- Broadleaved & mixed woodland HAP
- Lancaster whitebeam SAP
- Northern brown argus SAP
- High brown fritillary SAP;
- Pearl-bordered fritillary SAP.

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