European Site Conservation Objectives: supplementary advice on conserving and restoring site features

Barnack Hills and Holes Special Area of Conservation (SAC)
Site code: UK0030031

Pasqueflower *Pulsatilla vulgaris* at Barnack Hills & Holes. Photo credit Natural England/Peter Wakely

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About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to Barnack Hills and Holes SAC.

This advice should therefore be read together with the SAC Conservation Objectives which are available here.

You should use the Conservation Objectives, this Supplementary Advice and any case-specific advice given by Natural England, when developing, proposing or assessing an activity, plan or project that may affect this site.

This Supplementary Advice to the Conservation Objectives presents attributes which are ecological characteristics of the designated species and habitats within a site. The listed attributes are considered to be those that best describe the site's ecological integrity and which, if safeguarded, will enable achievement of the Conservation Objectives. Each attribute has a target which is either quantified or qualitative depending on the available evidence. The target identifies as far as possible the desired state to be achieved for the attribute.

The tables provided below bring together the findings of the best available scientific evidence relating to the site's qualifying features, which may be updated or supplemented in further publications from Natural England and other sources. The local evidence used in preparing this supplementary advice has been cited. The references to the national evidence used are available on request. Where evidence and references have not been indicated, Natural England has applied ecological knowledge and expert judgement. You may decide to use other additional sources of information.

In many cases, the attribute targets shown in the tables indicate whether the current objective is to 'maintain' or 'restore' the attribute. This is based on the best available information, including that gathered during monitoring of the feature's current condition. As new information on feature condition becomes available, this will be added so that the advice remains up to date.

The targets given for each attribute do not represent thresholds to assess the significance of any given impact in Habitats Regulations Assessments. You will need to assess this on a case-by-case basis using the most current information available.

Some, but not all, of these attributes can also be used for regular monitoring of the actual condition of the designated features. The attributes selected for monitoring the features, and the standards used to assess their condition, are listed in separate monitoring documents, which will be available from Natural England.

These tables do not give advice about SSSI features or other legally protected species which may also be present within the European Site.

If you have any comments or queries about this Supplementary Advice document please contact your local Natural England adviser or email HDIRConservationObjectivesNE@naturalengland.org.uk

About this site

European Site information

Name of European Site	Barnack Hills and Holes Special Area of Conservation (SAC)
Location	Cambridgeshire
Site Map	The designated boundary of this site can be viewed here on the MAGiC website
Designation Date	1 April 2005
Qualifying Features	See section below
Designation Area	23.27 ha
Designation Changes	None
Feature Condition Status	Details of the feature condition assessments made at this site can be found using Natural England's Designated Sites System
Names of component Sites of Special Scientific Interest (SSSIs)	Barnack Hills & Holes SSSI
Relationship with other European or International Site designations	N/A

Site background and geography

The site lies on the gently sloping plateau between the river valleys of the Nene and Welland at an elevation of 40m, within the Rockingham Forest National Character Area (NCA Profile 092). The underlying geology of the site consists entirely of Lower Lincolnshire Limestone, an Oolitic Limestone laid down in shallow subtropical seas during Jurassic times some 175 million years ago. The surface layers are much modified by former quarrying activity, with loose rubble of limestone spoil laying over the parent rock to a depth of 7m or more. Studies indicate typical soil pH values from 8.1 to 9.7 (very alkaline).

The site's varied topography reflects its history of quarrying, thought to have begun in Roman times. The stone, known as Barnack Rag, was highly durable and of exceptional quality. As the quarry site was situated close to the Roman roads of King and Ermine street, and only a few kilometres from the river Nene, the stone could be transported great distances by sledge and barge. Peterborough and Ely Cathedrals, Crowland Abbey and the Monasteries at Ramsey and Sawtry were all built of Barnack stone, as was the village church. Quarrying continued through into Saxon times finally ending around the beginning of the sixteenth century when the accessible stone had been exhausted. The area was probably left as an extensive wasteland consisting of irregular heaps of limestone rubble.

The rich plant community appears to have already been established by the 17th century (Howe 1650), but there is little evidence for how the site was managed, other than an annual winter burn from 1924 until 1940, until the lease for part of it was acquired in 1965 by the Northamptonshire Naturalists' Trust. By this time there had been significant invasion for hawthorn, Turkey oak and sycamore, and scrub clearance was undertaken and sheep grazing commenced.

In 1976 the site was declared as a National Nature Reserve, and fencing was added to allow further areas to be grazed. By 1984 the remaining compartments had been fenced and were grazed for the first time in probably half a century. Sheep grazing of all four compartments has been undertaken annually ever since.

About the qualifying features of the SAC

The following section gives you additional, site-specific information about this SAC's qualifying features. These are the natural habitats and/or species for which this SAC has been designated.

Qualifying habitats:

- **H6210 Semi-natural dry grasslands and scrubland facies: on calcareous substrates (Festuco-Brometalia) ('Dry grasslands and scrublands on chalk or limestone, including important orchid sites')* priority feature**

Barnack Hills and Holes is an area of Jurassic Limestone grassland which has developed on the site of a disused quarry. The grassland is of a type which is characteristic of eastern England and which is now scarce in Britain: upright brome *Bromopsis erecta*-tor-grass *Brachypodium pinnatum* type (NVC community CG5).

There is a rich and varied flora with a number of species which are nationally scarce; the population of man orchid *Aceras anthropophorum* is considered to be the largest in the UK, and there is also a rich assemblage of other orchid species such as fragrant orchid *Gymnadenia conopsea*, frog orchid *Coeloglossum viride,* pyramidal orchid *Anacamptis pyramidalis* and bee orchid *Ophrys apifera*. Of particular note is the abundance of pasque flower *Pulsatilla vulgaris*; other endangered or vulnerable species are purple milk vetch *Astragalus danicus,* mountain everlasting *Antennaria dioica,* common dodder *Cuscuta epithymum*, night-flowering campion *Silene noctiflora* and rare spring sedge *Carex ericetorum.*

The Reserve supports the richest grassland butterfly fauna in the area including the chalkhill blue *Lysandra coridon,* brown argus *Aricia agestis* and a strong population of marbled white *Melanargia galathea.* Glow-worms *Lampyris noctiluca* are abundant in some years.

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Table 1: Supplementary Advice for Qualifying Features: H6210. Semi-natural dry grasslands and scrubland facies: on calcareous substrates (Festuco-Brometalia) (important orchid sites); Dry grasslands and scrublands on chalk or limestone (important orchid sites)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Extent and distribution of the feature	**Extent of the feature within the site**	Maintain the total extent of the feature to at least 16 ha.	There should be no measurable reduction (excluding any trivial loss) in the extent and area of this feature, and in some cases, the full extent of the feature may need to be restored. The baseline-value of extent given has been generated using data gathered from the listed site-based surveys. Area measurements given may be approximate depending on the methods, age and accuracy of data collection, and as a result this value may be updated in future to reflect more accurate information. The extent of an Annex I habitat feature covers the sum extent of all of the component vegetation communities present and may include transitions and mosaics with other closely-associated habitat features. Where a feature is susceptible to natural dynamic processes, there may be acceptable variations in its extent through natural fluctuations. Where a reduction in the extent of a feature is considered necessary to meet the Conservation Objective for another Annex I feature, Natural England will advise on this on a case-by-case basis. The NVC survey carried out in 2004 (LAMBERT) found that the majority of the reserve is referable to NVC community CG5, but there are some areas which support ranker grassland communities that are less species-rich. This is likely to be partly because of scrub removal in these areas, partly because grazing preferentially occurs in the more species-rich areas. With more intense grazing management it is hoped that over time they will move to more species-rich communities.	LAMBERT (2004) Barnack Hills and Holes NNR Grassland NVC survey. Report to English Nature (Available on request from Natural England) NATURAL ENGLAND (2015) Barnack Hills and Holes National Nature Reserve Management Plan 2015 – 2020 (available from Natural England on request) This attribute will be periodically monitored as part of Natural England's site condition assessments
Extent and distribution of the feature	**Spatial distribution of the feature within the site**	Maintain the distribution and configuration of the feature, including where applicable its component vegetation types, across the site	A contraction in the range, or geographic spread, of the feature (and its component vegetation and typical species, plus transitional communities) across the site will reduce its overall area, the local diversity and variations in its structure and composition, and may undermine its resilience to adapt to	LAMBERT (2004) Barnack Hills and Holes NNR Grassland NVC survey. Report to English Nature (Available on request from Natural England)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			future environmental changes. This may also reduce and break up the continuity of a habitat within a site and how well its typical species are able to move around the site to occupy and use habitat. Such fragmentation can impact on their viability and the wider ecological composition of the Annex I habitat. Smaller fragments of habitat can typically support smaller and more isolated populations which are more vulnerable to extinction. These fragments also have a greater amount of open edge habitat which will differ in the amount of light, temperature, wind, and even noise that it receives compared to its interior. These conditions may not be suitable for some of the typical and more specialist species associated with the Annex I habitat feature.	NATURAL ENGLAND (2015) Barnack Hills and Holes National Nature Reserve Management Plan 2015 – 2020 (available from Natural England on request) This attribute will be periodically monitored as part of Natural England's site condition assessments
Structure and function (including its typical species)	**Vegetation community composition**	Ensure the component vegetation communities of the feature are referable to and characterised by the National Vegetation Classification type • CG5 Upright brome *Bromopsis erecta*-Tor-grass *Brachypodium pinnatum*	This habitat feature will comprise a number of associated semi-natural vegetation types and their transitional zones, reflecting the geographical location of the site, altitude, aspect, soil conditions (especially base-status and drainage) and vegetation management. In the UK these have been categorised by the National Vegetation Classification (NVC). Maintaining or restoring these characteristic and distinctive vegetation types, and the range of types as appropriate, will be important to sustaining the overall habitat feature. This will also help to conserve their typical plant species (i.e. the constant and preferential species of a community), and therefore that of the SAC feature, at appropriate levels (recognising natural fluctuations). The sward in the central area of the site where the community is richest is fairly consistent in nature with sixteen constant species, the most frequent of which include *Brachypodium pinnatum, Bromopsis erecta, Festuca ovina, Cirsium acaule, Helianthemum nummularium, Sanguisorba minor, Lotus corniculatus, Briza media, Leontodon hispidus, Linum catharticum, Plantago lanceolata, Thymus praecox, Galium verum, Anacamptis pyramidalis* and *Helichotrichon pratense.*	LAMBERT (2004) Barnack Hills and Holes NNR Grassland NVC survey. Report to English Nature (Available on request from Natural England) NATURAL ENGLAND (2015) Barnack Hills and Holes National Nature Reserve Management Plan 2015 – 2020 (available from Natural England on request) This attribute will be periodically monitored as part of Natural England's site condition assessments
Structure and function	**Vegetation: proportion of**	Maintain the proportion of herbaceous species within the	A high cover of characteristic herbs, including sedges (Carex species) is typical of the structure of this habitat type.	This attribute will be periodically monitored as part of Natural

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
(including its typical species)	**herbs (including Carex spp)**	range 40%-90%		England's site condition assessments
Structure and function (including its typical species)	**Key structural, influential and/or distinctive species**	Maintain the abundance of the species listed below to enable each of them to be a viable component of the Annex 1 habitat: • Constant and preferential plant species of CG5 Upright brome *Bromopsis erecta*-Tor-grass *Brachypodium pinnatum* grassland NVC community which form the H6210 feature on this SAC • A rich orchid assemblage: fragrant orchid *Gymnadenia conopsea*; pyramidal orchid *Anacamptis pyramidalis*; bee orchid *Ophrys apifera*; man orchid *Orchis morio*; early purple orchid *Orchis purpurea*; common spotted orchid *Dactylorhiza fuchsia*; frog orchid *Coeloglossum viride* • Nationally scarce plant species: Man Orchid *Aceras anthropophorum*, Pasque flower *Pulsatilla vulgaris*, fine-leaved sandwort *Minuartia hybrida,* rare spring sedge *Carex ericetorum* and the Mosses *Tortella inflexa and Weissia*	Some plant or animal species (or related groups of such species) make a particularly important contribution to the necessary structure, function and/or quality of an Annex I habitat feature at a particular site. These species will include; • **Influential** species which are likely to have a key role affecting the structure and function of the habitat (such as bioturbators (mixers of soil/sediment), grazers, surface borers, predators or other species with a significant functional role linked to the habitat) • **Site-distinctive** species which are considered to be a particularly special and distinguishing component of an Annex I habitat on a particular SAC. There may be natural fluctuations in the frequency and cover of each of these species. The relative contribution made by them to the overall ecological integrity of a site may vary, and Natural England will provide bespoke advice on this as necessary. The list of species given here for this Annex I habitat feature at this SAC is not necessarily exhaustive. The list may evolve, and species may be added or deleted, as new information about this site becomes available.	This attribute will be periodically monitored as part of Natural England's site condition assessments NATURAL ENGLAND (2015) Barnack Hills and Holes National Nature Reserve Management Plan 2015 – 2020 (available from Natural England on request) CHEFFINGS, C & FARRELL, L. (eds.) (2005) The Vascular Plant Red Data List for Great Britain STROH, P *et al* (2014) A Vascular Plant Red List for England

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		controversa • Plant species that are additional to those listed above which are endangered or vulnerable in England: purple milk vetch *Astragalus danicus;* mountain everlasting *Antennaria dioica;* common dodder *Cuscuta epithymum*; night-flowering campion *Silene noctiflora.* • About 30 nationally rare invertebrates have been recorded including lepidoptera: chalkhill blue *Lysandra coridon;* brown argus *Aricia agestis* and marbled white *Melanargia galathea* and glow-worms *Lampyris noctiluca*		
Structure and function (including its typical species)	**Vegetation: undesirable species**	Maintain the frequency/cover of the following undesirable species to within acceptable levels and prevent changes in surface condition, soils, nutrient levels or hydrology which may encourage their spread: • Undesirable species should be no more than occasional throughout the sward or singly or together more than 5% cover • Coarse grasses individually	There will be a range of undesirable or uncharacteristic species which, if allowed to colonise and spread, are likely to have an adverse effect on the feature's structure and function, including its more desirable typical species. These may include invasive non-natives such as Cotoneaster spp, or coarse and aggressive native species which may uncharacteristically dominate the composition of the feature. Undesirable species include: *Cirsium arvense, Cirsium vulgare, Rumex crispus, Rumex obtusifolius, Senecio jacobaea* and *Urtica dioica* Coarse grasses include *Arrhenatherum elatius, Brachypodium pinnatum, Bromopsis erecta* and *Dactylis glomerata*,	This attribute will be periodically monitored as part of Natural England's site condition assessments

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
		or collectively, should be no more than 10% cover • Tree and scrub cover should be approximately 5%		
Structure and function (including its typical species)	**Vegetation community transitions**	Maintain the pattern of natural vegetation transitions Tree and scrub cover should be approximately 5%	Transitions/zonations between adjacent but different vegetation communities are usually related to naturally-occurring changes in soil, aspect or slope. Such 'ecotones' retain characteristics of each bordering community and can add value in often containing species not found in the adjacent communities. Retaining such transitions can provide further diversity to the habitat feature, and support additional flora and fauna. Scattered scrub throughout the site is considered beneficial for invertebrate and bird interest at Barnack Hills and Holes, and there is evidence to suggest that man orchid, *Aceras anthropophorum*, grows best in grassland at the edges of scrub. However other plants, such as Pasqueflower *Pulsatilla vulgaris* do not tolerate scrub	This attribute will be periodically monitored as part of Natural England's site condition assessments
Structure and function (including its typical species)	**Soils, substrate and nutrient cycling**	Maintain the properties of the underlying soil types, including structure, bulk density, total carbon, pH, soil nutrient status and fungal: bacterial ratio, to within typical values for the habitat.	Soil is the foundation of basic ecosystem function and its properties strongly influence the colonisation, growth and distribution of those plant species which together form vegetation types, and therefore provides a habitat used by a wide range of organisms. Soil biodiversity has a vital role to recycle organic matter. Changes to natural soil properties may therefore affect the ecological structure, function and processes associated with this Annex I feature. Little is known about the soils present on the site.	
Structure and function (including its typical species)	**Functional connectivity with wider landscape**	Maintain the overall extent, quality and function of any supporting features within the local landscape which provide a critical functional connection with the site	This recognises the potential need at this site to maintain or restore the connectivity of the site to its wider landscape in order to meet the conservation objectives. These connections may take the form of landscape features, such as habitat patches, hedges, watercourses and verges, outside of the designated site boundary which are either important for the migration, dispersal and genetic exchange of those typical species closely associated with qualifying Annex I habitat features of the site. These features may also be important to the operation of the supporting ecological processes on which	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			the designated site and its features may rely. In most cases increasing actual and functional landscape-scale connectivity would be beneficial. Where there is a lack of detailed knowledge of the connectivity requirements of the qualifying feature, Natural England will advise as to whether these are applicable on a case by case basis. There is little valuable habitat nearby; woodland along the southern edge is probably beneficial, but is also a source of Turkey oak seed. However, given the increase in nearby housing, it should be recognised that adjacent arable farmland and woodland are preferable to development.	
Structure and function (including its typical species)	**Adaptation and resilience**	Restore the feature's ability, and that of its supporting processes, to adapt or evolve to wider environmental change, either within or external to the site	This recognises the increasing likelihood of natural habitat features to absorb or adapt to wider environmental changes. Resilience may be described as the ability of an ecological system to cope with, and adapt to environmental stress and change whilst retaining the same basic structure and ways of functioning. Such environmental changes may include changes in sea levels, precipitation and temperature for example, which are likely to affect the extent, distribution, composition and functioning of a feature within a site. The vulnerability and response of features to such changes will vary. Using best available information, any necessary or likely adaptation or adjustment by the feature and its management in response to actual or expected climatic change should be allowed for, as far as practicable, in order to ensure the feature's long-term viability. The overall vulnerability of this SAC to climate change has been assessed by Natural England (2015) as being low, taking into account the sensitivity, fragmentation, topography and management of its habitats. This means that this site is considered to be vulnerable overall but are a lower priority for further assessment and action. Individual species may be more or less vulnerable than their supporting habitat itself. In many cases, change will be inevitable so appropriate monitoring would be advisable.	NATURAL ENGLAND, 2015. Climate Change Theme Plan and supporting NBCCV Assessments for SACs and SPAs NATURAL ENGLAND (2014) Site Improvement Plan – Barnack Hills & Holes SAC (SIP Profile 009)

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			Reason for restore target: The site is heavily used by visitors, particularly dog walkers, and there are concerns about the impacts (loss of habitat through an extensive network of heavily used paths, nutrient enrichment, disturbance etc.). The site is designated open access land under the CROW Act. In order to reduce the impact on a small area, it would be beneficial to restore a significantly sized adjacent area.	
Supporting processes (on which the feature relies)	**Air quality**	Restore as necessary the concentrations and deposition of air pollutants to at or below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	This habitat type is considered sensitive to changes in air quality. Exceedance of these critical values for air pollutants may modify the chemical status of its substrate, accelerating or damaging plant growth, altering its vegetation structure and composition and causing the loss of sensitive typical species associated with it. Critical Loads and Levels are recognised thresholds below which such harmful effects on sensitive UK habitats will not occur to a significant level, according to current levels of scientific understanding. There are critical levels for ammonia (NH3), oxides of nitrogen (NOx) and sulphur dioxide (SO2), and critical loads for nutrient nitrogen deposition and acid deposition. There are currently no critical loads or levels for other pollutants such as Halogens, Heavy Metals, POPs, VOCs or Dusts. These should be considered as appropriate on a case-by-case basis. Ground level ozone is regionally important as a toxic air pollutant but flux-based critical levels for the protection of semi-natural habitats are still under development. It is recognised that achieving this target may be subject to the development, availability and effectiveness of abatement technology and measures to tackle diffuse air pollution, within realistic timescales. Reason for restore target: Annual average nitrogen and acid deposition are within the critical thresholds for calcareous grassland	More information about site-relevant Critical Loads and Levels for this SAC is available by using the 'search by site' tool on the Air Pollution Information System (www.apis.ac.uk). NATURAL ENGLAND (2014) Site Improvement Plan – Barnack Hills & Holes SAC (SIP Profile 009)
Supporting processes	**Conservation measures**	Maintain the management measures (either within and/or	Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further	NATURAL ENGLAND (2015) Barnack Hills and Holes National

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
(on which the feature relies)		outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting processes associated with the feature	details about the necessary conservation measures for this site can be provided by contacting Natural England. This information will typically be found within, where applicable, supporting documents such as Natura 2000 Site Improvement Plan, Site Management Strategies or Plans, the Views about Management Statement for the underpinning SSSI and/or management agreements. In recent years grazing has been only late in the growing season, and evidence from the most recent condition assessment shows that there has been a recent increase in the cover of grasses indicating under-management, such as *Brachypodium pinnatum*, and a corresponding decrease in the frequency of positive indicator species. The site is still in good condition, but more grazing earlier in the grazing season would be beneficial to reverse this trend. High numbers of dog walkers in summer months with occasional dog attacks on grazing animals has partly led to the timing of grazing (see 'Adaptation and resilience' target above).	Nature Reserve Management Plan 2015 – 2020 (available from Natural England on request) NATURAL ENGLAND (2014) Site Improvement Plan – Barnack Hills & Holes SAC (SIP Profile 009)
Version Control Advice last updated: N/A				
Variations from national feature-framework of integrity-guidance: **Supporting off-site habitat** attribute has been removed because there is no habitat nearby that is known to support the feature.				

References

CHEFFINGS, C. M. & FARRELL, L. (eds.) 2005. The Vascular Plant Red Data List for Great Britain, Joint Nature Conservancy Council.

RODWELL J.S. (ed.) 1992. British Plant Communities. Volume 3: Grasslands and Montane Communities. Cambridge University Press

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