



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

**Paston Great Barn Special Area of Conservation (SAC)
UK0030235**



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About this document

This document provides Natural England's supplementary advice about the European Site Conservation Objectives relating to Paston Great Barn SAC.

This advice should therefore be read together with the SAC Conservation Objectives available [here](#).

This advice replaces a draft version dated 11 January 2019 following the receipt of comments from the site's stakeholders.

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	Paston Great Barn Special Area of Conservation (SAC)
Location	Norfolk
Site Map	The designated boundary of this site can be viewed here on the MAGIC website
Designation Date	1 st April 2005
Qualifying Features	See section below
Designation Area	0.95ha
Designation Changes	N/A.
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)	Paston Great Barn SSSI
Relationship with other European or International Site designations	N/A

Site background and geography

The site is located in the [North East Norfolk and Flegg Natural Character Area](#); a sparsely wooded, gently undulating landscape characterised by small to medium-scale fields. A dense network of lanes provides connectivity between the many farmsteads and small nucleated villages, the majority of which have large medieval churches.

Paston Great Barn is one of the best preserved, and few remaining, Great Barns left in England. It is located in northwest Norfolk and is situated 13km to the south east of Cromer, just outside the village of Paston.

The barn is the largest building of a complex of closely linked vernacular agricultural buildings, which were erected over a period spanning 300 years between 1580 and 1870. The Great Barn itself is a designated Scheduled Ancient Monument. With the exception of the open-fronted southern boundary barn, the complex of buildings attached to the Great Barn are listed as Grade II* buildings.

The Great Barn measures approximately 70 metres long, by 9 metres wide and 16 metres high at its apex. The walls are primarily constructed of coursed, unknapped flint, averaging about 1m in thickness and tapering with height.

It has a complex roof structure that contains a multitude of voids. Many of these provide suitable roosting locations for bats. The walls also contain many cracks and crevices that support roosting bats. The thick walls help to regulate the temperature inside the barn and the barn's north-south orientation helps to ensure that in the winter, the western side maintains the constant cool conditions required by hibernating bats whilst, in the summer, the east facing side provides the warmth required by the maternity colonies for raising their young.

In addition to using the barn as a roosting location, bats also forage inside the barn, as well as using it as a mating site in the autumn.

Paston Great Barn supports an exceptional assemblage of bat species and represents one of the few known maternity roosts of Barbastelle bat *Barbastella barbastellus* in the UK (as well as one of the only confirmed Barbastelle maternity roosts in a building in the UK). In total, five species of bat are known to have used the buildings: Barbastelle, Brown Long-eared *Plecotus auritus*, Common Pipistrelle *Pipistrellus pipistrellus*, Soprano Pipistrelle *Pipistrellus pygmaeus*, Nathusius' Pipistrelle *Pipistrellus nathusii* and Natterer's *Myotis nattereri*. In addition, a further two species have been recorded from around the buildings: Noctule *Nyctalus noctula* and Daubenton's Bat *Myotis daubentonii*.

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 Species:

The site is designated under **article 4(4)** of the Directive (92/43/EEC) as it hosts the following species listed in Annex II:

- **S1308. Barbastelle bat *Barbastella barbastellus***

The Barbastelle is a medium-sized bat by British standards, with a forearm length of between 35-43mm and a body weight of between 6-13 grams. They are a distinctive looking species with creamy/golden-tipped blackish fur. Their short, broad ears are joined in the centre of their forehead, giving them a 'pug-like' expression.

The species is found from Morocco to southern Britain and eastward to the Caucasus. However, it is absent from much of southern Europe. The species is considered to be a rare and declining species throughout Western Europe and is listed as endangered or vulnerable in most European countries. Barbastelle bats are one of the UK's rarest mammals. The Barbastelle is listed in the European and British Red Data Book (RDB) as a rare and threatened species. The UK Biodiversity Action Plan estimated the UK population to be approximately 5,000 individuals and states that the overall population trend is unknown.

Paston Great Barn SAC has been selected for classification as an example of a Barbastelle bat maternity colony however studies have shown that Barbastelle bats use Paston Great Barn throughout the year with activity recorded in every month. On occasions, Barbastelle bats have been found roosting within the Great Barn and surrounding sheds. Activity in the autumn suggests that the species may also use the building for mating. However, nothing is known about how many bats hibernate at the site or how they use the building outside of the breeding season.

All species of bat present in the UK, including the Barbastelle, are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) and Schedule 2 of the Conservation of Habitats and Species Regulations 2017, making it a 'European Protected Species'. A Licence may therefore be required for any activities likely to harm or disturb individual bats at any time of year.

Further information can be found in Annex 1.

Table A: Site-specific seasonality of SAC feature

The table below highlights in grey those months in which significant numbers of each mobile qualifying feature are most likely to be present at the SAC during a typical calendar year. This table is provided as a general guide only.

Unless otherwise indicated, the months shown below are primarily based on information relating to the general months of occurrence of the feature in the UK. Where site-based evidence is available and has been used to indicate below that significant numbers of the feature are typically present at this SAC outside of the general period, the site-specific references have been added to indicate this.

Applicants considering projects and plans scheduled in the periods highlighted in grey would benefit from early consultation with Natural England given the greater scope for there to be likely significant effects that require consideration of mitigation to minimise impacts to qualifying bat features during the principal periods of site usage by those features. The months which are *not* highlighted in grey are not ones in which the features are necessarily absent, rather that features may be present in less significant numbers in typical years. Furthermore, in any given year, features may occur in significant numbers in months in which typically they do not. Thus, applicants should not conclude that projects or plans scheduled in months not highlighted in grey cannot have a significant effect on the features. There may be a lower likelihood of significant effects in those months which nonetheless will also require prior consideration.

Any assessment of potential impacts on the features must be based on up-to-date count data and take account of population trends evident from these data and any information. Additional site-based surveys may be required.

Feature	Season	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Site-specific references where available
Barbastelle	Breeding													

Table 1: Supplementary Advice for Qualifying Features: S1308. *Barbastella barbastellus*; Barbastelle bat

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
Population of Barbastelle	Population abundance - maternity colony	Maintain or increase the breeding population at, or above, 28 females (the baseline at notification)	<p>This will ensure there is a viable population of the feature which is being maintained at or increased to a level that contributes as appropriate to its Favourable Conservation Status across its natural range in the UK. Due to the dynamic nature of population change, the target-value given for the population size or presence of this feature is considered to be the minimum standard for conservation/restoration measures to achieve.</p> <p>This minimum-value may be revised where there is evidence to show that a population's size or presence has significantly changed as a result of natural factors or management measures and has been stable at or above a new level over a considerable period (generally at least 10 years). The values given here may also be updated in future to reflect any strategic objectives which may be set at a national level for this feature.</p> <p>Given the likely fluctuations in numbers over time, any impact-assessments should focus on the current size of the site's population, as derived from the latest known or estimated level established using the best available data. This advice accords with the obligation to avoid deterioration of the site or significant disturbance of the species for which the site is designated, and seeks to avoid plans or projects that may affect the site giving rise to the risk of deterioration. Similarly, where there is evidence to show that a feature has historically been more abundant than the stated minimum target and its current level, the ongoing capacity of the site to accommodate the feature at such higher levels in future should also be taken into account in any assessment.</p> <p>Unless otherwise stated, the population size or presence will be that measured using standard methods, such as peak mean counts or breeding surveys. This value is also provided recognising there will be inherent variability as a result of natural fluctuations and margins of error during data collection.</p>	<p>Please refer to References</p> <p>Number in brackets in supporting notes text refers to the relevant reference.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>Whilst we will endeavour to keep these values as up to date as possible, local Natural England staff can advise that the figures stated are the best available.</p> <p>The population at Paston is measured through analysis of video recordings timed to capture the peaks in pre and post-parturition maternity colony numbers.</p> <p>Population numbers require careful interpretation and should be assessed in conjunction with other data pertaining to the site/population.</p> <p>The likelihood that the barbastelle maternity roost also uses locations as yet unknown in the roof structure (or outside of the Great Barn) significantly limits our ability to interpret the results of the monitoring data. Barbastelle bats regularly move roosts and colonies tend to split and coalesce depending upon the prevailing environmental conditions. Radio-tracking studies carried out by the Norfolk Barbastelle Study Group have shown that during the maternity season colonies tend to occupy several roost locations simultaneously - a main maternity roost, as well as numerous outlying 'satellite' roosts (1, 4).</p> <p>If this situation is mirrored at Paston Great Barn, then the bats present in the main door lintels may only represent a small proportion of the overall colony using the barn. In addition, core roosts observed elsewhere have been shown to vary considerably in size during the maternity period as satellite clusters split from or coalesce with them. The uncertainty that exists over what proportion of the overall colony actually uses the main door lintels at any one time is a major constraint to interpreting the annual count data and reduces confidence in the reliability of population trends based on these data.</p> <p>The colony count data from 1996 to 2007 suggest that, in Paston Great Barn, colony size decreases once peak counts reach 45 to 50 bats. Splinter groups from the maternity colony may use alternative roosts either inside or outside Paston Great Barn.</p>	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			More information is required on how the metapopulation at/around Paston functions in order to allow the results of monitoring of the lintels in the barn to be accurately interpreted.	
Supporting habitat: extent and distribution	Distribution of supporting habitat	Maintain the distribution and continuity of potential roost sites within the site, the spatial distribution of window openings/ventilation slots and entry/exit points and the distribution of plant communities surrounding the barn used for foraging.	<p>Changes in the spatial distribution of the Barbastelle bat throughout the site (resulting from changes to the buildings and/or surrounding habitat) will reduce the species' resilience to future environmental changes e.g., climate change (4).</p> <p>Changes to the distribution of external openings will affect air flow, temperature, noise and dust levels in the interior of the buildings. Such changes may adversely impact on the species' viability at this site.</p> <p>Any alteration to the distribution of the surrounding habitat may also affect the species' ability to survive at the site by altering prey species abundance/species composition, air flows and temperature. Changes to vegetation structure may reduce the availability of darkened flyways which, in turn, may reduce the species' ability to avoid predators in the period following emergence or before returning to roost.</p>	<p>Please refer to References</p> <p>Number in brackets in supporting notes text refers to the relevant reference.</p>
Supporting habitat: extent and distribution	Extent of supporting habitat	<p>Maintain the quantity of varied, suitable roost locations within the buildings, the number of window openings/ventilation slots and entry/exit points, the internal volume available for flyways and the extent of rough grassland surrounding the barn used for foraging.</p> <p>Maintain the length of coastal cliff habitat within foraging range of the colony</p>	<p>In order to contribute towards the objective of achieving an overall favourable conservation status of the feature at a UK level, it is important to maintain or if appropriate restore the extent of supporting habitats and their range within this SAC. The information available on the extent and distribution of supporting habitat used by the feature may be approximate depending on the nature, age and accuracy of data collection, and may be subject to periodic review in light of improvements in data.</p> <p>Paston Great Barn and the adjoining buildings support a multitude of roost sites Barbastelle bats.</p> <p>Barbastelle bat has naturally evolved with natural patterns of light and darkness, so disturbance or modification of those patterns can influence numerous aspects of bat behaviour. For example, light pollution (from direct glare, chronically increased</p>	<p>Please refer to References</p> <p>Number in brackets in supporting notes text refers to the relevant reference.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>illumination and/or temporary, unexpected fluctuations in lighting) can affect animal navigation, competitive interactions, predator-prey relations, and animal physiology.</p> <p>Barbastelles feed mainly on small moths, some flies and beetles. They forage up to 5-7 km from their roosts, although some individuals in less favourable habitat may forage further to reach suitable feeding grounds (Greenaway, 2001). Generally forages within woodland canopy and margins, though will feed in more open areas i.e., orchards, suburban parks.</p> <p>The structural diversity of supporting habitat will be important to maintain optimal feeding and foraging conditions in close proximity to maternity roosts.</p> <p>The earliest annual observations of the barbastelle colony have consistently been in the north large door lintel, and the colony has always moved to the south large door lintel later in the maternity season, either before or during the young being born. In addition, the colony has been observed in 18 other locations within the barn; mainly gaps in the timbers over the window slits and the roof timbers.</p> <p>A detailed visual inspection of the lower level roof timbers by Ash Murray in February and March 2009 recorded droppings (barbastelle, Natterer's, brown-long eared and pipistrelle) in many of the joints. There are also numerous other potential roosting sites in the roof which are inaccessible for inspection and difficult to view for emergence surveys. The number of roost sites inside the barn used by barbastelles is likely to be much greater than the 18 which have been identified so far. Also, the extent to which different roosts are in simultaneous use is yet to be determined.</p> <p>The colony count data from 1996 to 2007 suggest that, in Paston Great Barn, colony size decreases once peak counts reach 45 to 50 bats. Splinter groups from the maternity colony may use alternative roosts either inside or outside Paston</p>	

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>Great Barn.</p> <p>It is not known to what extent the barbastelles using Paston Great Barn are limited by roost site availability. Radio-tracking studies carried out elsewhere by the NBSG and others have shown that barbastelle bats regularly change roost locations throughout the maternity season in woodland. If the barbastelle bats at Paston Great Barn were limited in their choice of suitable alternative roost sites, then this may account for the larger than average peak roost counts noted above (1).</p> <p>To date, no roost locations for the maternity colony have been identified outside the barn, either in the adjoining cartsheds or in trees or buildings away from the site.</p> <p>Radiotracking has shown that female barbastelles forage at the coast whenever weather conditions are suitable, i.e. light or offshore winds. This habitat is of very high importance for the success of the colony during the maternity period. It is critical to maintain the dark cliff face and cliff top and avoid additional illumination from any developments in the area.</p>	
Supporting habitat: structure/ function	External condition of building - maternity colony	Maintain the structural integrity and weatherproofing of roof, walls and rainwater goods, with no significant shading of the main roost area by trees/vegetation or man -structures.	Damp, draught and increases in light levels are likely to have a negative effect on the temperature and humidity of the roost (4) .	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.
Supporting habitat: structure/ function	Flight lines from roost into surrounding habitat and foraging areas	<p>Maintain the presence, structure and quality of any linear landscape features which function as flight lines.</p> <p>Flight lines should remain unlit, functioning as dark corridors.</p>	<p>Barbastelles feed mainly on small moths, some flies and beetles. They forage up to 5-7 km from their roosts, although some individuals in less favourable habitat may forage further to reach suitable feeding grounds (Greenaway, 2001). Generally forages within woodland canopy and margins, though will feed in more open areas i.e., orchards, suburban parks.</p> <p>Barbastelle bats commute and forage along linear landscape features such as woodland edge, waterways, tree or hedge-fringed roads, hedgerows etc., though will cross extensive open</p>	Please refer to References Number in brackets in supporting notes text refers to the relevant reference.

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>areas (i.e., arable fields) to reach foraging grounds and may feed to a certain extent within these more open areas. Flight lines will extend beyond the designated site boundary into the wider local landscape. Such flight-lines should remain dark, unlit and well-connected to roosting and feeding areas.</p> <p>Radiotracking studies (1, 2, 3) have demonstrated the importance of linear habitat features surrounding this site. These should be maintained and, where possible, improved to ensure a continuity of cover (trees/hedges), a diverse mix of tree and shrub species are present and that hedges are allowed to grow tall and broad.</p> <p>Radiotracking has shown that female barbastelles forage at the coast whenever weather conditions are suitable, i.e. light or offshore winds. This habitat is of very high importance for the success of the colony during the maternity period. It is critical to maintain the dark cliff face and cliff top.</p>	
Supporting habitat: structure/ function	Internal condition of building - maternity	Maintain appropriate light levels, humidity, temperature and ventilation.	<p>The requirements of these species vary greatly throughout the maternity period and they will shift their roost sites accordingly. There is currently insufficient information available in the academic press to provide specific targets on humidity, temperature, light levels and ventilation preferred by the species during the hibernation and maternity period.</p> <p>Relative humidity and temperature data within the roost site have been collected since 1996 (1, 2, 3, 4). Specific data for this site can be provided by contacting Natural England.</p>	<p>Please refer to References</p> <p>Number in brackets in supporting notes text refers to the relevant reference.</p>
Supporting habitat: structure/ function	Roost access	Maintain the number of access points to the roost at an optimal size and in an unlit and unobstructed state, with surrounding vegetation providing sheltered flyways without obstructing access.	This will prevent any negative internal climatic changes within the roost and maintain the ability of bats to freely enter and leave the roost as necessary (1, 4) .	<p>Please refer to References</p> <p>Number in brackets in supporting notes text refers to the relevant reference.</p>
Supporting habitat: structure/ function	Woodland site - maternity colony	Restore the extent and structural diversity of supporting woodland habitat used for feeding and foraging.	The structural diversity of supporting habitat will be important to maintain optimal feeding and foraging conditions in close proximity to maternity roosts; key aspects of woodland structure will include good canopy cover (typically 50-90%), an	<p>Please refer to References</p> <p>Number in brackets in supporting notes text refers to the relevant</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>abundance of standing and fallen dead wood, areas of permanent and open space and the retention of open water and/or wetland features.</p> <p>Paston Great Barn supports a young, small stand of sycamore. This provides cover for bats as they emerge from the barn and should be maintained (4). The area surrounding the site supports several small parcels of woodland. These should be managed to ensure that their extent and structural diversity is maintained. Where possible, additional woodland (strips or blocks) should be planted in the surrounding area.</p>	reference.
Supporting processes (on which the Barbastelle bat maternity roost and/or its supporting habitat relies)	Water quantity/quality	Restore water quality and quantity to a standard which provides the necessary conditions to support the Barbastelle colony.	<p>For many SAC features which are dependent on wetland habitats supported by surface and/or ground water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year. Poor water quality and inadequate quantities of water can directly affect individuals within the colony (alterations to drinking water supply) and indirectly through changes to the supporting habitats (changing species composition and abundance). Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the achievement of SAC Conservation Objectives but, in some cases, more stringent standards may be needed to reflect the ecological needs of the species feature. Further site-specific investigations may be required to establish appropriate water quality standards for the SAC.</p> <p>The Barbastelle bat is often described as a species preferring riparian woodland. In Norfolk, Barbastelle bat colonies exist in a variety of woodland types, including both wet and dry woodland. However, in most situations, the woodland supporting the maternity roost is in close proximity to water (either ponds, streams or other wetland habitats). There are a number of possible reasons for the Barbastelle's general association with water. The most obvious, direct link is that they require water for hydration, especially whilst lactating.</p> <p>However, wetland habitats are also important for foraging,</p>	<p>Please refer to References</p> <p>Number in brackets in supporting notes text refers to the relevant reference.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>supporting a range and abundance of suitable food species. Linear wetland habitats, such as streams, provide corridors, along which Barbastelles can forage and move through the countryside. In addition, wetland habitats often support large amounts of dead, dying or damaged trees that provide suitable roost sites for this species (e.g., delaminated bark slabs, collars of bark around dead branches, cracks and crevices).</p> <p>In contrast to most other Barbastelle maternity roosts in Norfolk, the colony at Paston is not in close proximity to wetland habitats. The closest streams are over one mile away: Mundesley Beck is located 1.7 kms to the NW and a tributary of the Dilham Canal is located 2.7 kms to the SW. In addition, Paston village has a permanent pond, located 0.6 kms to the NW.</p> <p>Paston Hall used to have a swimming pool which the Barbastelles used to drink from upon emerging from the roost, but this is no longer in existence. The grounds to the barn have two infilled ponds that would once have served as drinking ponds for livestock and work horses. One of these was re-excavated in 2005, but developed a leak and has since failed to consistently hold water (4).</p>	
Supporting processes (on which the feature and/or its supporting habitat relies)	Adaptation and resilience	Maintain the ability of the Barbastelle colony and that of its supporting habitat, to adapt or evolve to wider environmental change, either within or external to the site.	This recognises the increasing likelihood of supporting 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 precipitation and temperature for example, which are likely to affect the extent, distribution, composition and functioning of the Barbastelle bat colony within this site. The vulnerability and response of Barbastelle bats 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.	<p>Please refer to References.</p> <p>Number in brackets in supporting notes text refers to the relevant reference.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			No information on the direct effect of environmental changes on barbastelle bats is known. The overall vulnerability of this particular SAC to climate change has been assessed by Natural England (5) as being low, taking into account the sensitivity, fragmentation, topography and management of its supporting habitats; this means the 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	
Supporting processes (on which the feature and/or its supporting habitat relies)	Air quality	Restore 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).	<p>Broad-leaved woodland is key supporting habitat for the Barbastelle bat colony at Paston Great Barn and 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 (including food-plants), changing invertebrate species diversity and abundance; In turn, reducing supporting habitat quality and population viability of the Barbastelle bat colony.</p> <p>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 (NO_x) 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.</p> <p>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</p>	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).

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			<p>timescales.</p> <p>Currently (July 2018) the Air Pollution Information System (APIS) shows that deposition of both nitrogen and acidity in this area is above the critical load, indicating that these pollutants will be affecting the woodland habitat of the barbastelle bats outside of this SAC. No data are available on the significance of this effect at this site level, or if there is any direct effect on the bats themselves.</p>	
Supporting processes (on which the feature and/or its supporting habitat relies)	Conservation measures	Maintain the management measures (either within and/or outside the site boundary as appropriate) which are necessary to maintain the structure, functions and supporting processes associated with the Barbastelle colony and its supporting habitats.	<p>Active and ongoing conservation management is needed to protect, maintain or restore this feature at this site. Further 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.</p> <p>Radiotracking studies at this site have shown that the bats using Paston Great Barn travel several kilometres to forage (2, 3). Thus, conservation measures outside the boundary of the SAC are also critical for the continued survival of the colony e.g., planting new woodlands to provide additional roosts for the future, managing hedges appropriately, establishing flower-rich grasslands, restoring/creating ponds etc.</p> <p>Tracking studies in the surrounding area have also confirmed the presence of other maternity roosts and, whilst no cross-over has been found to date, it is highly likely that the Barbastelle bats at Paston Great Barn form part of a larger metapopulation. Tracking of Barbastelle bats elsewhere in Norfolk (e.g., Ken Hill Woods, nr Snettisham) has confirmed the presence of satellite colonies in the vicinity of maternity roosts and has shown that individual females move between different maternity roost loci within the wider area. It is likely that this is also the case at Paston. If so, then the survival of the colony at Paston may well be reliant upon the continued survival of other colonies</p>	<p>Please refer to References.</p> <p>Number in brackets in supporting notes text refers to the relevant reference.</p>

Attributes		Targets	Supporting and Explanatory Notes	Sources of site-based evidence (where available)
			within the wider area.	
Supporting processes (on which the feature and/or its supporting habitat relies)	Disturbance from human activity	Control and minimise human access to roost sites.	Site should be secured against unauthorised access, which can result in disturbance to bats at critical times of year and which can affect their population viability and use of the site. Doors on site access points should be kept locked and maintained (4) .	Please refer to References . Number in brackets in supporting notes text refers to the relevant reference.
<p>Version Control Advice last updated: 19022019: Addition of illumination and costal foraging supporting notes within extent of supporting habitat and flight lines from roost into surrounding habitat and foraging areas attributes</p> <p>Variations from national feature-framework of integrity-guidance: Attributes relating to Hibernation roost have been removed as although bats may be present all year round, the SAC is selected as an example of a maternity roost for this species. All species of bat present in the UK, including the Barbastelle, are fully protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) and Schedule 2 of the Conservation of Habitats and Species Regulations 2017, making it a 'European Protected Species'. A Licence may therefore be required for any activities likely to harm or disturb individual bats at any time of year.</p> <p>Attribute on Soils, substrate and nutrient cycling removed, as not relevant at this site. Target on population abundance of maternity roost modified to fit this site.</p>				

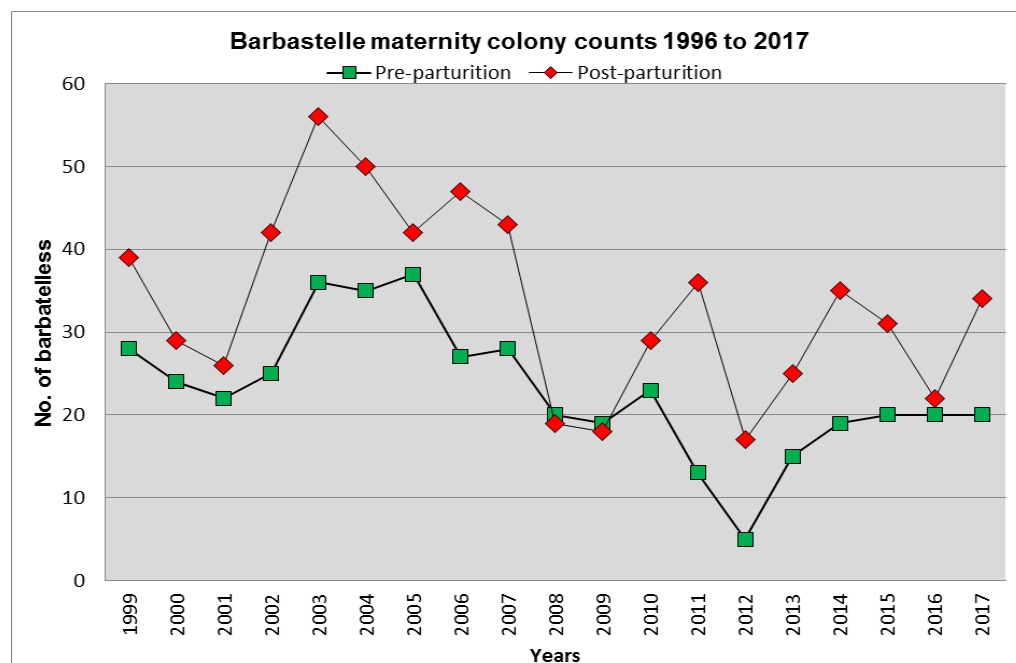
References

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Annex 1: The Barbastelle colony at Paston Great Barn

The Barbastelle colony at Paston Great Barn was first discovered in 1996 and has been the subject of various research and monitoring studies that have provided a great deal of information about roost sites, the size and behaviour of the Barbastelle colony and commuting and foraging activity.

Figure 1: Barbastelle maternity colony counts 1996 to 2017 (*taken from Harris, J. 2017*)



Monitoring of the maternity cluster shows that it has supported approximately 5 and 37 adult females between 1996 and 2017. The counts of Barbastelle bats (adults and adults and young) undertaken since 1996 are presented in Table 1 below.

Table 1. Summary of colony counts since observations started in 1996 (*taken from Harris, J. 2017*)

Year	Adults	Number of Obs.	Mean	S.D.	Adults & young	Number of Obs.	Mean	S.D.
1996	unknown				40($\pm 10\%$) *			
1997	unknown				50($\pm 10\%$) *			
1998	30 *				60($\pm 10\%$) * 43 #			
1999	28 #	4	26	3.5	39 #	5	34	6.84
2000	24 #	10	23	2.37	29 #	4	28	2
2001	22 ~				26 ~			
2002	25 #	10	24	2.3	42 #	9	38	3.28
2003	36#	5	31	2.88	56#	5	51	8
2004	35#	4	34	0.5	50#	5	44	7.44
2005	37#	4	34	1.89	42#	8	35	4.71
2006	27#	3	27	0	47#	6	44	2.84
2007	28#	3	23	9.24	43#	4	33	10.14
2008	20#	2	19	1.41	19#	1**		
2009	19#	3			18#	1**		
2010	23#	3	21	0	29 ~			
2011	13**	2			37#	3	34	2
2012	5*				17#	4	15	
2013	15^				25^			
2014	19^				35^			
2015	20^				31^			
2016	20^				22^			
2017	20^				34^			

* maximum numbers counted by visual observation of colony
maximum numbers counted emerging from colony on video tape
~ single count from video tape
** some recordings unsuccessful
^ continuous nightly video recording

Use of the Great Barn by Barbastelles:

Observations made during monitoring between 1996 and 2017 indicate that the Great Barn is used as a maternity roost and as a hibernation roost. Radio tracking also suggests that the Great Barn may also be used for mating purposes. The Great Barn and adjacent buildings are therefore vital to the survival of the Barbastelle colony providing suitable roosting habitat throughout the year.

The Barbastelles roost in many different parts of the Great Barn often moving from one roosting location to another. They select open roost sites and are therefore more likely to be vulnerable to disturbance than other species such as Natterer's bat, which occupies internal crevices in beams.

In total, Barbastelles have been recorded from 19 different roost locations within the Great Barn. The main breeding clusters are usually located between the large oak lintels over the cargo doors, but on a number of occasions, the clusters could not be found suggesting they are using other parts of the barn yet to be identified, possibly higher in the roof structure.

In general terms, the breeding clusters form in early May (earliest date 28th April in 2007 & 2010) and remain well into September, or sometimes persisting until early October (latest recorded dispersal date 25th October) . After September, Barbastelle bats have either been seen in roost sites or recorded on bat detectors throughout the winter period. It is considered likely that Barbastelles are roosting in the Great Barn throughout the whole winter period and are active at different times throughout the winter.

Table 2. Barbastelle maternity cluster arrival and dispersal dates.

Year	Maternity colony formed	First young born	First young flying	Maternity group dispersed (not seen in door lintels)	Total days present
1999	13-May	#	26-Jul – 01 Aug	26-Aug	106
2000	24-May	#	07 Aug – 14 Aug	06-Sep	106
2001	01-Jun	#	#	04-Oct	126
2002	28 -May	01 Jul – 07 Jul	24-Jul –30 Jul	22-Sep	118
2003	28 -May	#	#	23-Sep	119
2004	22-May	#	#	21-Sep	123
2005	27-May	17 Jul – 20 Jul	#	28-Sep	124
2006	4-May	#	#	28-Aug	117
2007	30-April	26 Jun – 28 Jun	16 Jul – 19 Jul	5-Aug	98
2008	23-May	#	#	29-Aug	99
2009	1-May	#	#	10-Aug	102
2010	30-April	#	#	11-Aug	104
2011		#	#		
2012	9-June	#		25-Oct	138
2013	3-May^	20 July	6 – 16 Aug	30-Sept	152
2014	18-May^	24 Jun – 29 Jun	13 – 21 Jul	13-Aug	91
2015	4-May^	3 Jul – 10 Jul	26 Jul – 3 Aug	5-Oct	155
2016	8-June^	7 Jul – 11 Jul?	28 Jul – 7 Aug	22-Aug	75
2017	23-June^	6 Jul -13 July	24 – 28 th July	30-Aug	68

All figures are estimates

insufficient observations to make estimate

^ Continual emergence counts allowing more accurate determination of peak numbers

The likelihood that the barbastelle maternity roost also uses locations as yet unknown in the roof structure (or outside of the Great Barn) significantly limits our ability to interpret the results of the monitoring data. Barbastelle bats regularly move roosts and colonies tend to split and coalesce depending upon the prevailing environmental conditions. Radiotracking studies carried out by the Norfolk Barbastelle Study Group have shown that during the maternity season colonies tend to occupy several roost locations simultaneously - a main maternity roost, as well as numerous outlying 'satellite' roosts. More information is required on how the metapopulation at/around Paston functions in order to allow the results of monitoring of the lintels in the barn to be accurately interpreted.

Emergence of Barbastelle bats from maternity clusters:

Barbastelles leave their roost site in the Great Barn approximately twenty minutes before emerging from the barn. During this time they fly around inside the barn checking other roost sites and interacting with other bats present.

The emergence from the Great Barn itself appears to coincide with the light levels inside the barn being roughly equivalent to external light levels. This behaviour is reported at woodland Barbastelle sites where the bats fly inside the dark tree canopy for about the same period as the bats stay in the barn at Paston.

Early in the breeding season, juvenile bats remain in the roost, as they are unable to fly. As soon as they are able to fly, however, they also leave the roost. Early in the breeding season bats come and go throughout the hours of darkness, but from approximately August onwards the bats stay away from the roost for most of the hours of darkness.

Barbastelle commuting and foraging activity:

Radio tracking studies and video monitoring of the barn indicate that Barbastelles currently leave the barn through two principal entrances: over the top of the large southern threshing door and window Slit 5 into the central covered shed on the east side of the Great Barn. Other exit routes are used in addition to the aforementioned.

Upon leaving the Great Barn, the Barbastelle bats have been recorded flying beneath the open-fronted sheds on the eastern side and to the south of the Great Barn before dispersing to feeding areas. Barbastelles also fly around the sheds prior to dawn before returning to the roost site. The covered sheds are thought to provide important cover from predators and an area used for social interaction between individual bats.

Results of radio tagging in 2000 of a female and a male Barbastelle bat indicate that the preferred feeding area of the female included areas around Stow windmill and along the cliffs south of Mundesley. Both male and female foraged along the cliffs when the wind was not off the sea. The male, however, predominantly foraged to the south of the site along woodland rides, hedges, roads and paths enclosed by overhanging trees. The male never roosted during the day in the barn, but did visit in the evenings. It was located roosting in three different places under bark of dead or dying trees. Two near Bacton Wood and one by the road side at Paston Green.

More recently, in 2013, 2014 and 2015, a significant amount of radio tracking has been carried out by Jane Harris. This has greatly improved our understanding of how the bats using Paston Great Barn forage in the wider area.

The total number of adult female barbastelle bats tracked in 2013 and 2014 and the tracking period are summarised in table 3 below.

Table 3. Summary of radio tracking in 2013 & 2014 (*taken from Harris, J. 2014*)

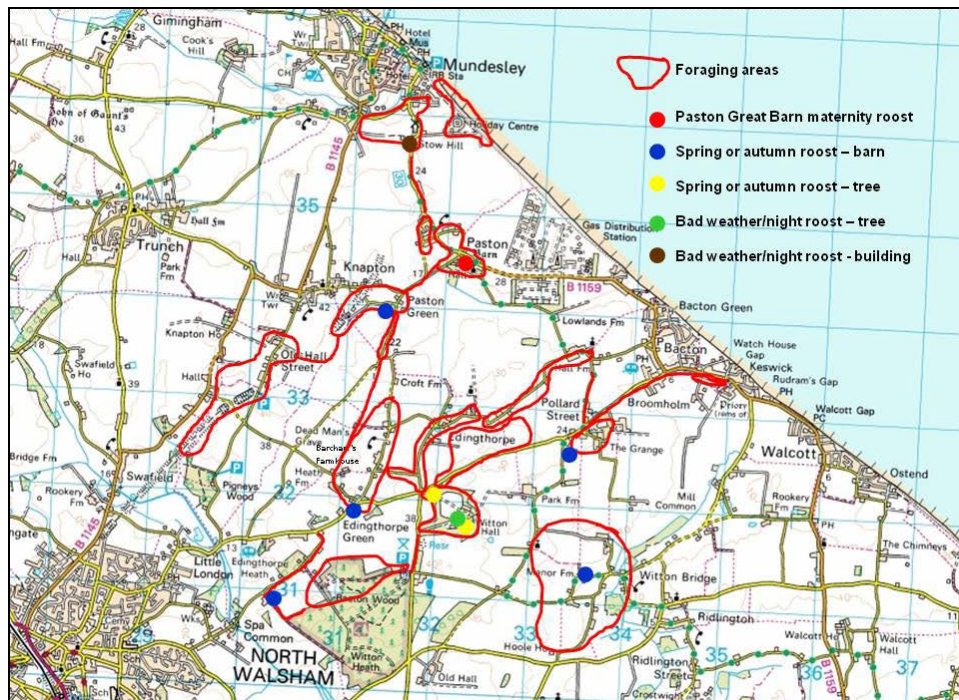
Tracking period	No. of bats tracked	
	2013	2014
May	-	2
Mid-July to August	3	3
September to October	2	2
Total	5	7 (included 2 bats tagged in 2013)
Colony count (adult females)	15	19
% of colony tagged	33	37

Apart from several barbastelle bats ringed in 2000, no further ringing has been carried out and there is been no way of identifying which animals have been trapped in previous years, except where evidence of fur clipping was apparent. In 2014, two female barbastelle bats were caught and tagged which showed signs of fur clipping. These were judged to have been tagged in the previous autumn. These have provided information on inter-annual differences in foraging and roosting behaviour.

All sites regularly used for foraging during 2013 & 2014 were within 4km of the Great Barn. So far, it appears that the coast is only used for foraging during the maternity period.

All females had alternative inland foraging areas and, in some cases, shared foraging locations. Both the coast and inland foraging areas may be used in the same night, sometimes on multiple occasions each night.

Map 1: Summary of Barbastelle radio tracking in 2013 & 2014 (taken from Harris, J. 2014. Paston Great Barn NNR. Barbastelle Colony Monitoring and Radiotracking Report 2014).



The recent radio tracking has highlighted the importance of undeveloped barns as favoured roost sites for female barbastelle bats dispersing from the maternity colony at the Great Barn. Whilst tagged bats from the NNR have also been recorded using trees for roosting, the number of suitable woodlands for in the area is limited, perhaps increasing the importance of barns as post maternity roosting locations.

Refer to Harris, J. 2015 Barbastelle Colony Monitoring and Radiotracking Report 2014 for a map detailing foraging locations for these radio tracking surveys.

Barbastelle metapopulation research:

A key reason for setting up the Norfolk Barbastelle Study Group was to instigate research into the species that would help to further our understanding of how isolated or otherwise the barbastelle colony at Paston is (and other colonies across Norfolk).

In 2014, Natural England commissioned Jane Harris and the John Innes Centre to carry out a trial project to test the validity of using faecal matter as the source material for DNA extraction, amplification and sequencing. This project proved successful and demonstrated the efficacy of using faecal matter for this purpose, thus negating the need to rely on wing punches. This non-invasive technique provides significant opportunities for increasing our understanding of barbastelle metapopulation dynamics and, therefore, conserving the species in the long term.

The phylogenetic tree that was created using the data from the study showed a level of genetic variation in Norfolk populations; with the Paston haplotypes (which also include the Witton, Felbrigg and Watlington females) separating from the Lenwade, Blickling, Sheringham and Barningham haplotypes. The continuation of this project will enable the development of a better 'library' of mitochondrial material for analysis.

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