Mitigation for Bats
Sue Searle BSc, PGDip, MCIEEM

etûk

1

Course Content

- Mitigation & Enhancement - definitions
- Mitigation types

  An overview:
  - Roost loss (winter and summer)
  - Foraging loss
  - Commuting route loss and route severance
- Species Mitigation
  - Horseshoes
  - Pipistrelles
  - Daubenton's
  - Natterer's
  - Long eareds
  - Noctules
- Mitigation design by project
  - Wind Farm
  - Roads
  - Building conversions
  - Underground projects
  - Bridges
  - Trees
- Successful Mitigation
- What doesn't work
- EPSL process
- Useful references

2

Mitigation & Enhancement - definitions

Mitigation - reducing or removing damage caused by man (e.g. change layout, design, timing of works)

Compensation – offsetting damage (e.g. create new roosts)

Enhancement – adding value beyond mitigation and compensation (e.g. adding in roosting opportunities or habitat)

Ref: Bat Mitigation Guidelines p38

3

Mitigation definitions

Mitigation means to avoid or reduce impacts of a development on bats.

There are three main types:
- Avoidance – no negative impact
- Pure mitigation – improve/new roosts, improve/new habitat
- Compensation – off-site new roosts, habitat

4

Avoidance

Avoid deliberate killing, injuring or disturbance

Bat –related examples :
- Undertaking work at a time when bats are not present
- Re-routing the road or the footprint of the development to avoid a bat roost
- Moving the proposed location of the wind turbine away from a bat commuting hedge
- Seeking an alternative e.g. not converting a loft.

5

Pure Mitigation

To provide appropriate replacement to allow the population to persist

Examples:
- Mitigation for loss of flightways:
  - Tunnels/culverts/underpasses under road to re-connect commuting flightways
  - Green or wire bridges to emulate flightways
  - Replanting severed hedgelines
- Mitigation for loss of roosts
  - Creation of artificial roosts by construction of purpose built structures
  - Erection of bat boxes
  - Construction of artificial hibernacula

6

Compensation

If after mitigation measures have been taken into account, there are still significant residual adverse impacts, then these can be offset by compensation measures.

- Examples:
  - Habitat improvement through planting e.g. new hedgelines.
  - Provision of new roosting opportunities
  - Wetland creation

7

Enhancement

Under NPPF (England) there is a requirement to not just mitigate for loss but also improve an existing environment through *enhancement*

- Examples:
  - Habitat improvement through planting (e.g. hedge gap filling)
  - Provision of new roosting/foraging opportunities
  - Wetland creation
  - Woodland planting (e.g. new woodland, corners of fields, extending woodland)
  - Connection of existing woodland patches through new green corridor creation

8

Mitigation Types- An Overview

9

Broad mitigation types

Mitigation for:

- Summer roost loss
- Winter roost loss
- Foraging loss
- Commuting route loss and route severance

10

Mitigation for roost loss

11

Optimum seasons for works:

Mitigation for:

- Maternity roost - 1st Oct to 1st May
- Summer roosts (not maternity) – 1st Sept – 1st May
- Hibernation roost – 1st May to 1st Oct
- Mating/swarming – 1st Nov – 1st Aug

12

Roost mitigation

- Aim to mimic original function and conditions (e.g. size, access points, a range of temperature/humidity)
- Consider external factors
  - Lighting
  - Vegetation
  - Noise and vibration
  - Access to predators
  - Human disturbance

13

Roost type and seasonality

- Important to understand the function of a roost e.g. nursery / hibernation, transitional / night roost.
- Assume roosting at other times of year and make provision (e.g. for hibernation).
- Assess impacts throughout the construction process.

14

Mitigation for summer roost loss

- Bat houses
- Bat boxes, tubes
- Access creation
- Attic space creation
- Roost creation in stonework
- Roost creation and retention in trees

15

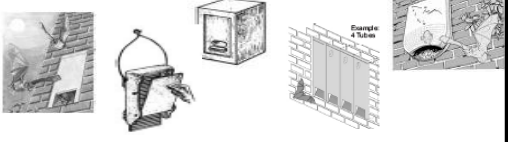
Bat boxes

For crevice dwellers

16

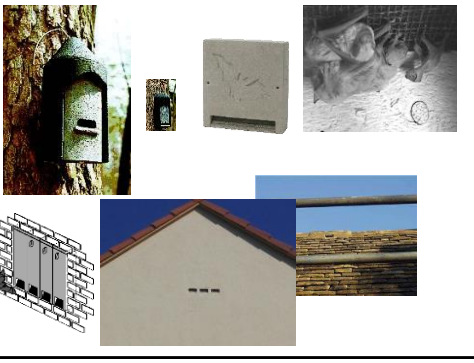
Bat boxes

- Rarely adequate mitigation on their own due to their limited size/thermal mass
- Useful stop-gap (especially for demolition)
- Can be used within roosting area to provide 'crevice accommodation'
- Ideal simple means of enhancement…

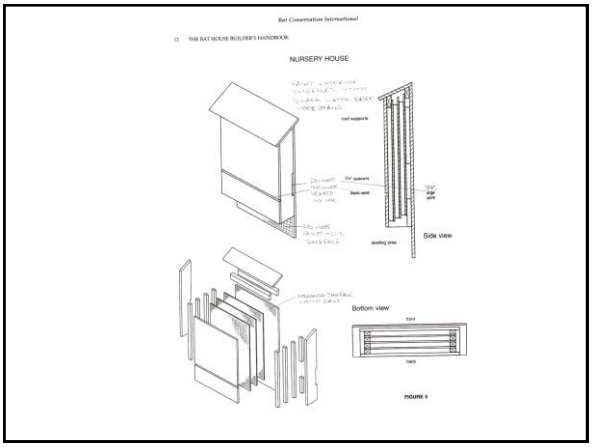


17

Bat boxes, tubes and access slits



18



19

20

Bat buildings

21

Bat buildings

22

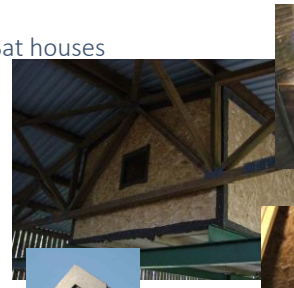
Bat houses

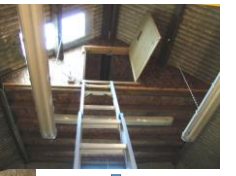
Hanging tiles with wedge to open up gap

Bat crevices

23

Bat houses





Inside

24

Attic roost creation

25

Inside

26

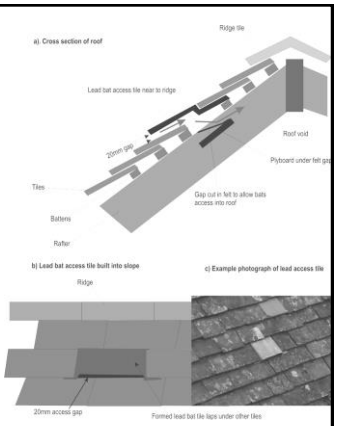
Hot box and heated panels – maternity roosts

27

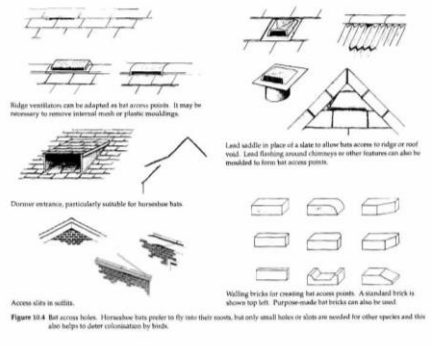
Squeeze boxes

28

Bat access creation



29

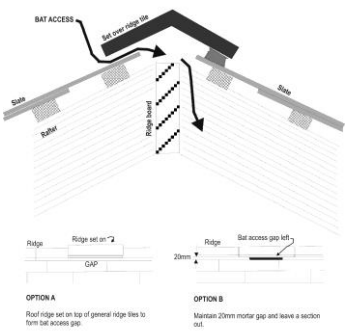


Ref: Bat Worker's Manual 2nd Ed – JNCC 1999.

30

Fly in entrances - horseshoes

31



32

Ridge entrance

33

Other entrances

34

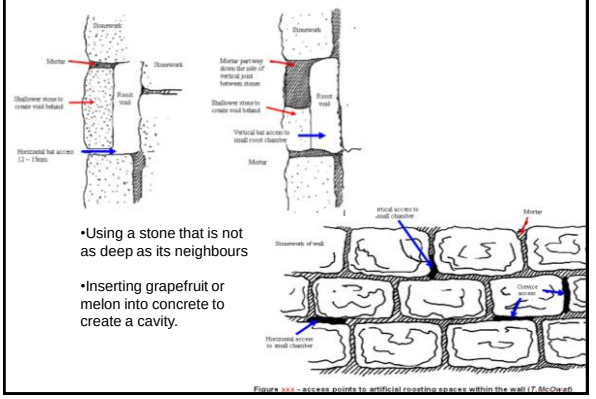
Fly in entrances

35

Horseshoe access

36

Roost Creation in stonework



- Using a stone that is not as deep as its neighbours
- Inserting grapefruit or melon into concrete to create a cavity.

37

Wall top gaps

38

Supervised roof removal

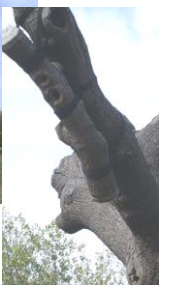
39

40

Roost creation and retention in trees

41

Trees – the original roost cavity is always first choice.



42

Slots, holes, shattered crowns.

43

Mitigation for winter roost loss

Artificial Hibernaculum

44

Artificial hibernacula – conversions and purpose built

45

Hibernaculum

46

Mitigation for foraging loss

- New woodland planting
- Hedgerow planting
- Wetland/pond creation
- Existing habitat – changing management regimes
  - Hedges left to become tall and 'leggy'
  - Grassland mowed/grazed less frequently – allowing some areas to become 'rank'
  - Introduction of organic cattle breeds to graze pastures and produce non-sterile manure

47

48

Mitigation for commuting route loss & route severance

- Hedgerow replanting
- Tree line planting
- Wall building
- Tunnels
- Underpasses
- 'Green' bridges

49

Hedgelines, treelines and walls



50

Bat corridors




51

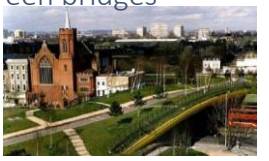
Underpasses & tunnels



52


53

Green bridges




54

A465 Abergavenny – wildlife (bat) crossings

55

Wire gantry bat bridge

Dobwalls in Cornwall

56

Species Mitigation

57

Horseshoe bats – what to take in to consideration when designing mitigation:

- Roosting needs:
  - Can't land (except by their feet)– need fly in
  - Need sheltered warming up area
- Commuting needs:
  - Tall leggy hedges providing weather shelter, to fly next to when commuting
- Foraging needs:
  - Greater horseshoes feed on dung beetles for part of summer
  - Perch feeding

58

Horseshoe bats

- Commuting route – leggy hedges to provide shelter

- Foraging for Greater horseshoes using organic herds

59

Horseshoe bats

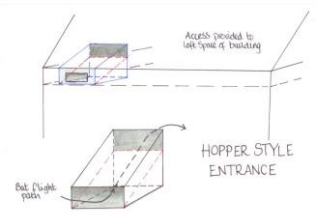
- Roosts – need fly-in access and warmth for breeding

Post box slit into boiler room

60

Measures to prevent bird entry

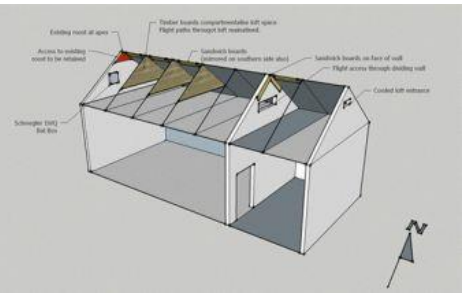
- Turnarounds
- Baffles



61

Internal baffles

- Reduce light and draughts



62

Baffles

63

Horseshoe entrance

64

Exclusion devices

65

Pipistrelle bats – what to take into consideration when designing mitigation:

- Roosting needs:
  - Crevice dwellers
  - Small access hole
  - Well connected landscape surrounding
- Commuting needs:
  - Hedges, treelines, lanes, vegetated streams
- Foraging needs:
  - Wide variety of insects

66

Pipistrelle bats

- Roosts – cracks, crevices and crawl in access





67

Daubenton's bats – what to take in to consideration when designing mitigation:

- Roosting needs:
  - Crevice roosting
  - Near water?
- Commuting needs:
  - Waterways – rivers, streams, lakes, ponds
- Foraging needs:
  - Vegetated banks of rivers, streams, lakes, ponds – trawling bat

68

Daubenton's bats

- **Roosts – need crevices within bridges accessible from the river**

Existing pillars on one side of the bridge were blocked up with brick and concrete breezeblocks.

The resulting space was then lined with wood to create a variety of roosting opportunities within the spaces

69

Roosting opportunity within bridge arch

70

71

Natterer's bats – what to take in to consideration when designing mitigation:

- Roosting needs:
  - Crevice roosting – mortice joints
  - Covered fly-through access
  - Need indoor/sheltered warming up area before emergence
- Commuting needs:
  - Connectivity through woodland edge, trees, hedges
- Foraging needs:
  - Woodland edge, habitat diversity – gleaning bat

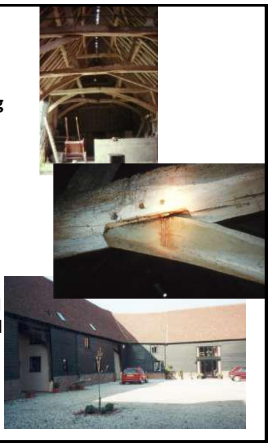
72

Natterer's bats

- **Roosts – need large warming up area before emergence and covered fly-in access**

In this barn conversion the door of the barn openings were retained with recessed screens set back about 2m.

This retained the main bat roosts which were in the mortice joints around the old doors and provided sheltered access and flight area.



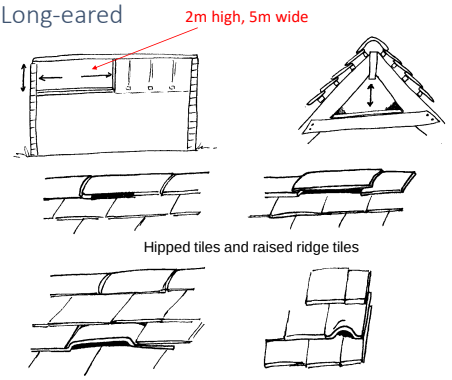
73

Long eared bats – what to take in to consideration when designing mitigation:

- Roosting needs:
  - Large volume – 5m x 2m high
  - Hanging and crevice roosting
  - Fly through access as well as landing at a small access hole
- Commuting needs:
  - Well connected landscapes
- Foraging needs:
  - Woodland, woodland edge, hedges, habitat diversity moths – gleaning and perch feeding bat

74

Long-eared



75

Noctule bats – what to take into consideration when designing mitigation:

- Roosting needs:
  - Tree holes – especially woodpecker holes
  - Uncluttered access
- Commuting needs:
  - Open areas
- Foraging needs:
  - Rough grassland, scrub, hedges – hawking bat

76

Noctules

- Roosts – mainly tree hole dwellers

77

Mitigation for other projects

78

Wind farms

What you might have to mitigate for:

- Loss of connectivity
- Habitat severance
- Blade collision
- Attracts bats to the blades?

79

Wind Farms

Measures that have been used or suggested in some projects:

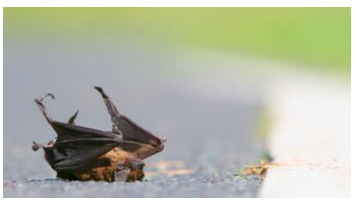
- Re positioning of turbine locations away from bat commuting and foraging routes
- Planting new hedge lines to direct pipistrelles down 'safe' flight routes
- Switching off of blades at key times of the night and season
- Blade design with protective shield

80

Roads

What you might have to mitigate for:

- Habitat severance
- Habitat loss
- Direct collisions with cars
- Disturbance
- Lighting



81

82

83

Building development

What you might have to mitigate for:

- Roost loss and destruction
- Habitat severance
- Foraging and commuting loss
- Disturbance
- Lighting

84

Lighting

Low lux
Hoods/lids

85

Case studies

- Successful case studies from the Bat Mitigation Conference.

86

Barn Conversion

Totterdown Farm Barns near Fairford, Gloucestershire

87

Totterdown Farm Barn

- **Species** Natterers bats – 30 individuals maternity roost in one stone barn
- **Site description** A disused farm site (two Cotswold stone barns barns) in Gloucestershire
  converted into residential units.
- **Proposed works** Works commenced in Autumn 2007 and
  were mostly complete by Spring 2008 except for internal finishing works
- **Surveys undertaken** Autumn 2004 - Summer 2007
- **Mitigation** Conversion of part of the attic space and front porch for sole bat use

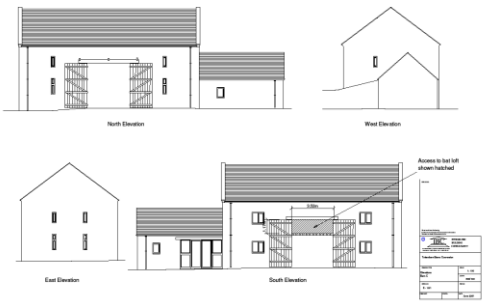
88

November 2004

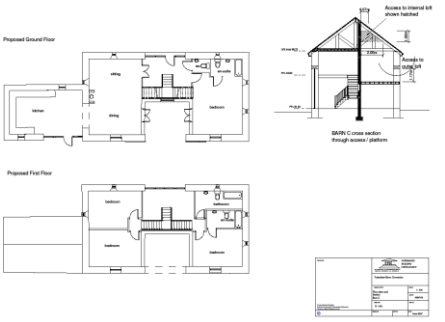
89

October 2007

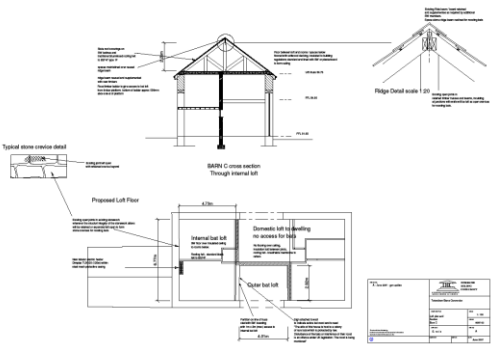
90



91



92



93

94

95

96

July 2008

97

July 2008

98

Totterdown Farm Barn

- **Monitoring Results**

  Thirty Natterers bats had returned in Summer 2008 when new roost was complete. It was uncertain as to whether they had reared young that year.

  Thirty four Natterers had returned in Summer 2009 and evidence of breeding was noted

99

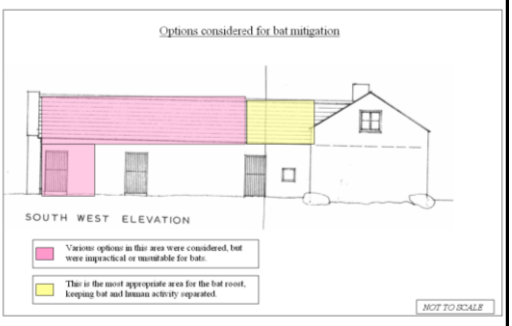
Welsh Barn Conversion

- **Species** Lesser horseshoes
- **Site description** A disused farm barn in West Wales to be converted into a dwelling.
- **Mitigation** Conversion of part of the attic space

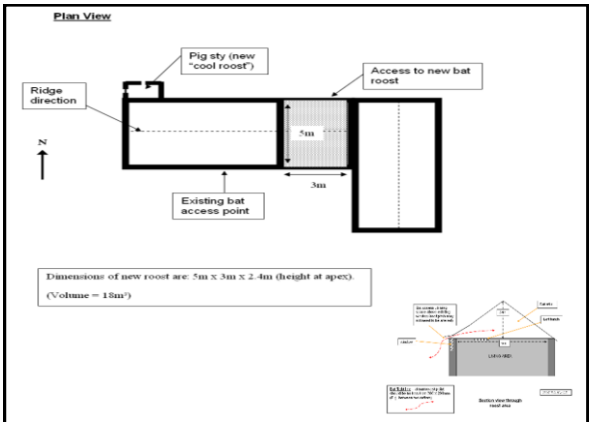
100

101

102



103



104

Factory Demolition in Wales

- **Species** Pipistrelle
- **Site description** Factory site
- **Mitigation** Bat box on wall of remaining building on site

105

106

107

Devon Barn Conversion

- **Area of country:** North Devon
- **Species:** Lesser horseshoe bats
- **Site:** Traditional two storey barn
- **Type of roost:** Maternity roost of c20 bats
- **What work was done:** Upper floor was converted into an office so loss of roost.
- **What mitigation was put in place:** Bats were given dedicated roof space above new build and two storey combined barn and garage 10m away. Infra-red heaters were fitted to ceiling with flight opening with internal canopy (to reduce light spill). Exclusion of original roost and works were delayed for a full season to allow bats time to find the new roost.

108

Devon Barn

Heater installation into roof void

109

Devon Barn

- Monitoring results

  Number of bats started using new roost within 3 months of it being completed so the mitigation was successful. The key elements were having heaters, non-breathable felt, and the new roost being available for a full season before original lost.

110

Underground sites

What you might have to mitigate for:

- Hibernation roost loss

111

Underground projects

- Warren Lane Tunnels, Grays, Essex

112

Warren Lane Tunnels, Grays, Essex

- **Species** Natterer's bats, Daubenton's bats, common pipistrelle, brown long-eared bats, serotine (also possibly whiskered bat and soprano pipistrelle)
- **Site description** Three tunnels in total (T1 – upper, T2 – middle, T3 – lower). Constructed in mid 1900"s to enable quarry operators to gain access below Warren Lane and between two chalk pits- Warren Gorge to the North and Lion Gorge to the South.

  Tunnels fell into disuse when quarrying ceased and lie within a very large residential development.
- **Proposed work** Tunnel infilling and strengthening and grilling of entrance portals. Strengthening works were needed to meet an increase in highway loading to 40 tones on Warren Lane. This included infilling works.
- **Possible impacts** Roost loss and modification, disturbance
- **Type of roost/habitat** Summer non-breeding, socialising and night roost, feeding perch and hibernation
- **Surveys Completed** February 2004

113

Warren Lane Tunnels, Grays, Essex (cont.)

- **Mitigation**
  - T1:. Retaining a small (15cm long) unfilled area of the tunnel.
    - Creation of gaps and cracks and installation of Schwegler bat tubes & bat bricks in the filled end of tunnel.
    - At the entrance portal, half the height of the brick wall was given an internal skin with gaps and bat tubes.
    - The upper portion of the entrance was grilled
  - T2: The lower half of the entrances had cracks and bat tubes installed in brick walls
    - Gaps and cracks were created in these walls by casting in a cavity and then installing two breezeblocks horizontally (per cavity) with 20mm wide gaps between.
    - Bat tubes and bat bricks were also installed.
    - A baffle wall was built halfway down the tunnel to reduce air flow
  - T3: This was not grilled as entrances needed to remain open for vehicle access.
    - The swallow hole was filled with concrete.
    - Cracks c300mm long by 25mm wide were drilled into concrete plug to create roosting gaps for bats.

114

Warren Lane Tunnels

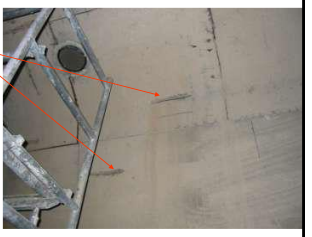
- T2 prior to works

- T2 *new entrance wall and grill installed in portal*

115

Warren Lane Tunnels

T3 – slots created in concrete plug to allow bats to roost within them.



116

Warren Lane Tunnels

- Monitoring Results

T1 = no use, T2 = limited use, T3 = increased use by a number of species.

117

Bridge works

What you might have to mitigate for:

- Roost loss

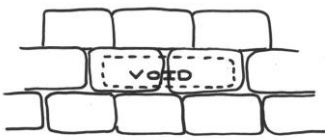
118

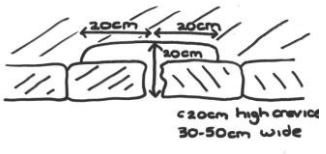
Bridge in Cumbria

- **Area of country:** Cumbria
- **Species:** Up to 45 Daubenton's bats using crevices in central pier.
- **Site:** Steel and wood deck bridge built on stone abutments.
- **Type of roost:** Summer
- **What work was done:** Not known
- **What mitigation was put in place:** Partial mitigation was installed but it wasn't quite what was asked for. Stones were replaced to form a T-shaped crevice going in 20cm, with a suitable narrow gap.

119

Bridge in Cumbria





120

Bridge in Cumbria

- **Mitigation Results:**

25+ Daubenton's bats moved in same season. Other crevices in the bridge were used by colony of c45 bats.

121

Tree works

What you might have to mitigate for:

- Roost loss
- Habitat severance
- Foraging and commuting route loss

122

Dumfries & Galloway

- **Species** Multiple species
- **Site description** Double arch ancient stone bridge
- **Proposed work** Offline road improvement – eight bat roosts were destroyed due to the felling of trees in 2007.
- **Possible impacts** Disturbance, roost loss
- **Type of roost/habitat** Multiple roost use

123

Dumfries & Galloway

- **Mitigation**
- Nine trees were used to facilitate the bat roosts and bat boxes as compensation for loss of trees containing bat roosts.
- The re-erected roosts and bat boxes were assessed for security within the tree and usage by bats.
- The sections of timber containing the bat roost cavity/crack were cut, allowing adequate distance either side of the feature to avoid damaging it, and then lowered carefully to the ground. The section was then re-erected into a suitable tree as close to the original tree as possible. Consideration of orientation, height from ground, opening direction, surrounding habitat, and other environmental influences such as air temperature were taken into account when choosing the new location.
- In addition, safety to the public was considered when choosing the location and method of attachment to the tree.

124

Monitoring results not known

125

Successful Mitigation Examples

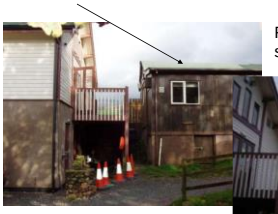
126

What makes mitigation successful

- Should be based on thorough survey information
- Use of appropriate materials that bats can grip onto or fly through
- Location of mitigation so that it can be found by target species and is sited in association with known flightlines
- Mitigation appropriate to target species
- Mitigation appropriate to roost type
- Mitigation fit for purpose
- Ensuring the measures have been correctly installed by the contractors
- Long term education of ultimate property users

127

Common pip roost in old station building in Lake District 2005



Replacement roost – one pip seen and droppings found 2008

128

Pip droppings and one pip in school building 2005

Extension complete, access slots provided, pip droppings found 2006

129

Oxfordshire barn conversion

Before conversion 2005
Lesser horseshoe bat <5 individuals

Common and soprano pipistrelle <16 individuals

Serotine 1-2 individuals

Brown long-eared <5 individuals

Myotis species <14 individuals.

After conversion 2007
Pipistrelle & long eared droppings and 2 lesser horseshoes for night feeding

130

Unsuccessful Mitigation

131

What doesn't work & why?

- Smooth landing surfaces that bats cannot grip
  - Examples?
- Access holes too large (let birds in) or too small for target species or in the wrong place
- Not situated close to original feature
- Not connected by linear features
- Measures ill suited to the target species e.g. crevices for horseshoe bats
- Inappropriate mitigation not suited for purpose e.g. bat box as a replacement for maternity roost.

132

EPSL process

Conservation of Habitats and Species Regulations 2017

Three tests

- Imperative reasons of over-riding public interest.
- No satisfactory alternative
- 'Favourable conservation status' – no net loss of the species in the area

133

Test 1

Regulation 53 (2) (e) states that **'licences may be granted to 'preserve public health, or public safety or other imperative reasons of overriding public interest, including those of a social or economic nature and beneficial consequences of primary importance for the environment'.**

Examples of satisfactory purposes (not an exhaustive list):

- Structure is unstable and there is a report from a structural engineer or a tree surgeon to justify the claim.
- There is a high degree of need for affordable housing in an area already allocated for development in the Local Plan.

134

Test 2

Regulation 53 (9) (a) states that a licence may not be granted unless the licensing authority is satisfied '**that there is no satisfactory alternative'**.

- The applicant needs to provide evidence to show that they have explored other alternatives and found them to be inadequate.
- The 'do nothing' option must also be considered as a possible alternative, and if this is not a satisfactory option then evidence will be required to support this decision.

135

Test 3

Regulation 53 (9) (b) states that a licence cannot be issued unless the licensing authority is satisfied that the action proposed '**will not be detrimental to the maintenance of the species concerned at a favourable conservation status in its natural range'**.

- Natural England advises that there should be no net loss in the local population status of the species concerned and they base this decision on the information provided by your ecologist in the wildlife survey reports. Therefore sufficient survey work is needed to find out which species are present, gain an estimate of likely numbers and to determine how the species are using the site (e.g. for breeding or hibernation).
- It is possible that the conservation value of the site may be deemed to be too important to permit the development, for example if it is a breeding site for a rare species. However, in many cases this test can be satisfied by providing suitable mitigation that aims to maintain a population of equivalent status on or near the original site.

136

Monitoring

- Monitoring is essential – how else will we know what works?
  - Should be proportional effort to importance of roost.
    - E.g. a small transitional roost may need a single compliance check.
    - A lesser horseshoe maternity roost may need checking several times per year for several years.

137

Before and After photos

138

Crapstone, Devon

Before

After

139

Gorse Blossom, Devon

Before

After

140

Peterhayes, Somerset

Before

After

141

Case Study- Discussion

Using the case studies you have been given discuss a suitable mitigation strategy including monitoring.

142

Case study 1

Introduction

Stone farm buildings in West Devon. An underground stone walled drainage channel runs perpendicular to the southern elevation.

Project proposal

Conversion of barns into a single residential dwelling. Planning constraint that buildings should retain open space to the roof and therefore no loft spaces can be installed.

Drainage tunnel to be retained but moisture levels to be reduced to prevent rising damp in walls of barns.

143

144

145

Survey Results

November 2017
Barns - small numbers of droppings of LHS and Long-eared (LE)
Tunnel - small numbers of droppings of LHS and GHS

December 2019
Barns - small numbers of droppings of LHS and LE
Tunnel - 1 torpid LHS

July 2020
Emergence survey - 2 LHS and 2 GHS emerged from barns

August 2020
Emergence survey - 11 soprano pipistrelles emerged from wall top crevice of barn and 1 soprano pipistrelle emerged from tunnel

January 2021
Tunnel - 1 torpid LHS

146

Survey Results

Location	Species	Roost
Barns	Greater horseshoe	Occasional summer roost. Maximum count (2)
Barns	Lesser horseshoe	Occasional summer roost. Maximum count (2)
Barns	Soprano pipistrelle	Summer roost. Maximum count (11)
Barns	Long-eared	Small numbers of droppings.
Tunnel	Lesser horseshoe	Small hibernation roost. Maximum count (1)
Tunnel	Greater horseshoe	Small maternity roost. None counted but small numbers of droppings seen.

147

Case Study 1- Mitigation

Notes: Slate roof. Block walls clad in timber.

148

Mitigation Strategy

- Conversion of a nearby modern open-fronted agricultural building to incorporate a loft space dedicated for use by bat species.
- Installation of a moisture membrane over drainage tunnel to prevent surface run-off entering the tunnel, but retention of ground water flowing in.
- Works to roof structure of barns to commence during the period November to end of February. Works to drainage tunnel to be undertaken during the period May to the end of September.

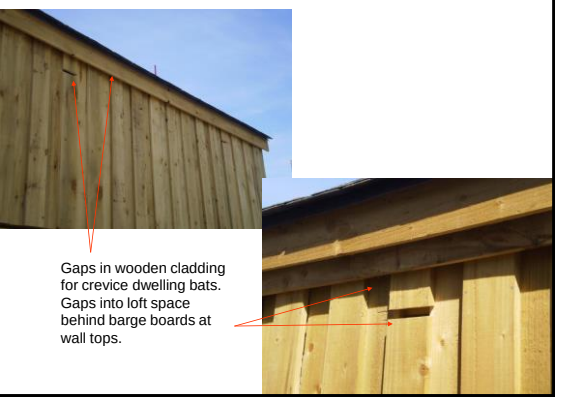
149

Fly-in access on gable end wall. Internal baffle to reduce light level and draughts. Block walls rendered internally.

150

Roof lined with bitumen roofing felt. Squeeze boxes and baffles at ridge.

151



Gaps in wooden cladding for crevice dwelling bats. Gaps into loft space behind barge boards at wall tops.

152

Moisture barrier installed above channel. Reduction in entrance space to retain flight access for bats but reduce airflow. Grilled entrance on opposite end of tunnel.

153

Case Study 2

Introduction

Former miniature railway attraction in Devon. In the centre of the site there is an area known as 'Chicken Island', which consists of a 'castle' and 'mountain' constructed of rocks and concrete blocks. It is fairly cool and damp within these structures.

The disused miniature railway track runs around the 'island' and passes through several corrugated metal tunnels. The site has areas of scrub, ponds and rough grassland. Bordering the site is countryside consisting of permanent pasture, and a woodland with CWS (County Wildlife Site) status.

154

Case Study 2

Proposal

'Chicken Island' is planned to be removed to allow yurts to be erected for holiday makers.

155

Case Study 2

Survey findings

Surveyed in April.

Four lesser horseshoe bats were seen within the room underneath the 'mountain'. Lesser horseshoe droppings of a variety of ages were detected within both the 'mountain' and the 'castle'.

156

Case Study 2

Mitigation and compensation strategy

A tunnel used for the miniature railway was converted to provide conditions similar to those found within the structures upon 'Chicken Island'.

The entrances to the tunnel were boarded-up, with a locked door allowing bat worker access and a bat access point within that. Holes were drilled into ceiling allowing moisture in, and a rafter-like structure installed to allow bats to hang from.

The previous roost was re-roofed in the winter but collapsed. A new roost was also provided in a new open-fronted wooden building on site where an enclosed loft space with an open loft hatch was provided.

157

Before

After

158

Case Study 3

Introduction

Complex of farm outbuildings located approximately 3 km from the edge of a large town, and directly beside a busy road. The buildings were originally built in 1888 and are predominantly constructed of brick, with roman tile or corrugated metal roofing.

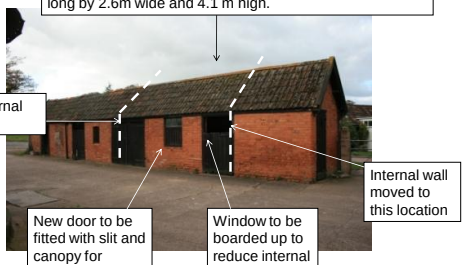
Proposal

It is proposed to convert the farm outbuildings into office space.

159

Bat access point above partially blocked wall as well as many open doorways

160



161

References

BCT Mitigation Conference Proceedings
University of Leicester
25-26 April 2007

2004 A. Mitchell-Jones
Bat Mitigation Guidelines pub English Nature

1993 Tuttle M. & Hensley D.L.
The Bat House Builders Handbook pub BCI

2008 Schofield H The Lesser Horseshoe Bat Conservation Handbook pub VWT

162