6.0 ROOST CREATION

6.1 Crevice selection

To be able to create artificial roosts background information is required. The following information about the type of crevices used by bats was gathered from a sample of roosting sites in bridges in Cumbria.

Bats were found in crevices from 13 - 70mm wide and 100 - >1500mm deep. Different species select a different (but overlapping) range of crevice sizes.

Table 16: Roost crevice sizes of Daubenton's and Natterer's bats

Bat species	No. of bats	Crevice width	Crevice depth
Daubenton's	1	25 - 40mm	100 >1500mm
Daubenton's	>5	30 - 50mm	300 >650mm
Natterer's	1	25 - 35mm	300 - 900mm
Natterer's	>5	40 - 70mm	500 ->1300mm

Daubenton's and Natterer's bats were most often encountered in crevices 30 - 40mm wide. The largest Natterer's bat colonies used voids of up to 70mm width. When bats had a choice of crevice widths within a bridge (frequently up to 100mm wide) they were often found in the narrower ones.

Very limited information is available on other bat species. Pipistrelles occurred in crevices >13mm width and <500mm depth and whiskered/Brandt's in crevices of around 30mm width.

6.2 Bat boxes

Wooden bat boxes in the U.K. have been successful in providing roost sites, mainly for small numbers of bats. In a large scale national bat box project (run between 1968 and 1987) of over 3000 boxes, at least 1800 bats of seven species were ringed. Four species bred in boxes; brown long-eared, pipistrelle, noctule, and Leisler's (*Nyctalus leisleri*) (Stebbings & Walsh, 1988).

Two bat box schemes with a combination of wooden and concrete boxes have been monitored in Dorset and Lancashire for several years. In both schemes bats have shown a preference for concrete boxes (Morris pers. comm.; Maclean, pers. comm.). In the Lancashire scheme three bat species were encountered more often in concrete boxes. Noctule bats were only encountered in wood boxes and Daubenton's bats only in concrete. Wooden bat boxes have better insulation properties than concrete ones - u = 2.78 compared to u = 4 (lower values indicate better insulation), but the rates of change of temperature and humidity are far slower in concrete boxes than in wooden ones (Rothwell, pers. comm.) which is thought to be the reason why most bats prefer concrete boxes. From the COBIB results the bat species most likely to be encountered in bridges is Daubenton's. Other studies of this bat have confirmed the importance of trees as roosting sites. This suggests that the microclimate conditions created within an artificial roost may be of greater importance than the material it is constructed from.

6.3 Selection of sites for artificial roosts

Where bat roosts in bridges have to be destroyed because of demolition, rebuilding, or engineering constraints, new bat roosting sites should be created within the structures duplicating the original crevice dimensions.

Often engineers have suggested fitting a bat box to structures after the works have been completed. To date no bat box has been confirmed to recreate the same thermal capacity, conductivity, and microclimate conditions that would be found deep inside a bridge, and bat boxes are also vulnerable to disturbance or destruction.

When designs of 'add on' artificial roosts have been perfected these could be fitted to suitable bridges *i.e.* bridges in favourable habitat, where roosts have been destroyed in the past, or in areas where bats are known to feed. Special care would need to be taken over positioning as bats would be far more vulnerable to disturbance and harm. Even though the available range of bat boxes are not ideal, they are likely to be of benefit to bats where there are no existing roosting sites in bridges.

Crevice width selection by bat species encountered in this survey suggests that any artificial roosting sites should contain a variety of crevice widths of 13 - 70mm width and 350 - >1000mm depth for summer roosts, and deeper for winter hibernation sites. Bats generally avoid wider crevices, but they can occasionally roost in open situations on the walls of enclosed voids *eg.* pipistrelle bats in Cefn Coed y Cymmer Bridge, Glamorgan, - a concrete box construction; and long-eared bats at Stanley Bridge, Cumbria, - a hollow concrete arch.

Where opportunities occur to incorporate bat roosting crevices into sites during repairs, rebuilds, or construction of new sites these should be taken up. If possible roosting sites should be incorporated into bridge spans as this is where 75% of bat roosts were found in bridges in Cumbria. Otherwise they should be sited as high as possible in the abutment walls (a number of roosts have been found in piers, abutments and external walls in Cumbria - see Table 4).

6.4 Roost creation cases

6.4.1 Cumbria

Cambeck Footbridge
This new bridge of steel and concrete deck over stone faced abutments was built in 1996 with bat roosting crevices incorporated into the abutments (see Appendix VII).

Kirkby Stephen Station/Croglin Bridge
In 1996-97 a five arch stone disused rail bridge was completely infilled to make it safe, effectively destroying roosting crevices. As a mitigating measure a 1.3m internal diameter horizontal concrete tube has been built into one of the arches with both ends grilled, and holes made through the top of the pipe connecting into 500 mm deep vertical crevices positioned below the original ones. These were made by slotting pieces of narrow polystyrene down the middle of 225mm diameter concrete pipes and filling in around the foam with concrete. Once this had set the foam could be scraped out creating a narrow parallel sided crevice the full length of the pipes.

The bridge was infilled to about 3/4 height with gravel (into which the horizontal concrete pipe was bedded). The top section was filled with concrete pumped in under pressure which caused a problem for the contractors as the vertical pipes began to shift. Pieces of wood were inserted from underneath into the vertical pipes, which kept them in position but meant the wood became firmly jammed and had to be burnt out. The crevices then had to be cleaned with acid and water to remove the soot. To overcome this problem the vertical pipes should have been firmly anchored in position (see Appendix VII).

Griseburn Bridge
This bridge was re-decked with concrete early in 1997 and vertical bat roosting crevices were incorporated into the abutments which were cast out of concrete.

Grizedale Bridge
A single stone arch bridge repointed in 1996. The contractors created a selection of deeper crevices than had existed before the works had started.

6.4.2 Outside Cumbria

At Brynich Aqueduct, Powys, roosting crevices of at least three bat species were destroyed during repair works in 1996. Circular 'Belfry' concrete bat boxes were set into 300 mm diameter holes drilled into the brickwork (Smith, pers. comm.).

At Fort Augustus, Inverness, Forest Enterprise drew up a design for an artificial roost site with their Civil Engineers and the first roost site was completed in February 1994. The roost was built into a bridge abutment about 650mm above water level. The roost cavity is approximately 450mm cubed and has a layer of bricks on the outside face with access slits between the brickwork. 6mm diameter drainage holes were incorporated into the wall. The interior was filled with loose rock - no bat use has yet been confirmed (Whitaker, unpub.). A design adaption is proposed by Whitaker to include a vertical crevice of 150 mm width within the structure (see Appendix VII).

In Hertfordshire a new bridge was built on top of an existing bridge over a canal. A Daubenton's bat colony gains access to a cavity between the two through holes drilled through the original bridge (Briggs, pers. comm.).

During construction of a new road on the Isle of Wight one end of a single arch stone road bridge was infilled, which improved the microclimate of the existing crevices. This bridge is now used by small numbers of hibernating Daubenton's, Natterer's and whiskered bats (Pope, pers. comm.).

In North Yorkshire, during construction of the Ripon bypass, a crevice for bats was created the full width of a new concrete bridge (Hunt, pers. comm.).

The Roman Bridge, Lancashire, (an ancient stone arch structure) had to be demolished in 1996 and bat roosting crevices were built into the abutment of the new bridge (Bradley, pers. comm.).

The Bat Conservation International Bats and Bridges project has been experimenting on concrete bridges with alternating panels of black and white (this may affect the temperature of the crevice), adding plastic mesh (to improve grip for the bats), and putting dividers in the larger crevices (to reduce the size). A removable wood and plastic mesh panel is also inserted into the bridge so a sample of bats can be inspected and the sex ratio determined. In other sites multi-chambered wooden bat abodes consisting of vertical crevices formed into a wooden box are set between concrete beams (Keeley, unpub. (b); Childs, 1996).

6.5 Products currently available (see Appendix IX)

Few artificial roosts suitable for bridges are available. A bat roost unit consisting of a hollow cube with three open sides is designed to be built inside a structure and faced with bat access bricks which have a slit to allow bats into a void of 110mm x 150mm x 215mm (Marshalls Clay Products, unpub.).

A clay brick with seven crevices incorporated through its width has proved successful in underground sites (The Norfolk Bat Group, unpub.).

A multi-crevice concrete bat box has been designed (by Billington) to fit to the underside of bridges or soffits, and has been used at Ellel Grange ice house in Lancashire. It consists of several vertical 150 mm deep crevices 13-40 mm wide.

Two new Schwegler bat boxes 1FF and Type 27 are available. 1FF is a mixture of concrete and wood designed for crevice dwelling bat species. The inside forms a 40mm wide and 300mm deep crevice. It is designed to be fixed to a vertical wall and could be fitted to the upper reaches of high vertical bridge abutments that are safe from disturbance. Type 27 is a concrete rectangular box 180 mm x 290 mm x 235 mm designed to be built into a brick wall (one brick wide and deep x three bricks high).

Engineers have requested a complete unit that can be incorporated into a cast concrete structure. As a follow up to the Cumbria project it is proposed to construct units of this type, and suitable boxes that can be fastened to bridges.

7.0 RECOMMENDATIONS FOR FUTURE WORK

7.1 Cumbria

All the road bridges have been surveyed (with the exception of bridges over railways and motorways). A survey of the remaining bridges in Cumbria suitable for bats should be carried out by trained surveyors.

A number of disused railway bridges, railway underpasses, footpath and private bridges are still to be surveyed. Most of these are less well maintained than road bridges but bat roosts still face a number of threats. There are proposals to demolish two large disused viaducts and to re-open two disused lines.

Footpath bridges have to be maintained to a safe standard by their owners, or by local and county authorities. Bat roosting sites in these are likely to be at greatest risk. No comprehensive register of these structures exists which presents a major problem in identifying potential bat sites. 25% of private bridges carrying tracks (can also include footpaths) contained bat roosts - this was the second highest proportion of any bridge type. If local authorities compiled comprehensive lists of footpath bridges this would make it easier to survey sites for bats and birds in advance of any repairs, and ensure the works are appropriately timed.

Bat surveys should be carried out on all grade four and five bridges and previously unsurveyed bridges before any works commence. Liaison should be maintained between engineers and English Nature on roost conservation, creation, and exclusions.

More information is needed on the importance of concrete structures to bats. Further investigations should be made (preferably with access equipment) to assess the extent and numbers of bats that use them and the potential for improvements to make them more suitable.

Training seminars should be run for Cumbria County Council Highways and British Waterways engineers and any other relevant maintenance bodies. Liaison should be initiated with British Rail Property Board and Railtrack over bridges and the training of maintenance staff.

There should be training seminars for batworkers and appropiate English Nature staff to ensure they are aware of the issues involved, including how bats use sites, bridge maintenance procedures, site visits to see bat roosts and exercises in surveying and formulating advice for engineers.

In Cumbria there are 112 sites where artificial bat roosts would be beneficial. All efforts should be made to enhance these sites for bats.

Further research is needed to establish how bats use bridges and this will enable the works being carried out on bridges to be timed to cause minimum disturbance to bats using the site. This should include dusk emergence counts at bridge roosts in May, July and September (giving initial priority to significant sites). A programme needs to be set up to revisit grade 4 and 5 sites. Bat workers often have difficulty in counting emerging bats as Daubenton's and Natterer's bats can emerge in very low light levels. Accurate counts could only be conducted at some sites with the aid of image intensification equipment.

A mating roost survey in April, August and September, surveying bridges one to three hours after emergence for presence of mating calls and behaviour would supply useful additional information. Research is needed to determine the extent that bats use bridges and culverts as hibernation sites as these would be highly sensitive to disturbance. This would require the use of fibrescopes to survey deep crevices. To provide a greater understanding of how far bats travel from their roosts tracing work could be conducted by tracing bats with chemi-luminescent marking or radio tracking. Monitoring of microclimate (temperature and humidity) conditions in bridge roosts with data loggers would produce useful data for the production of artificial roosts. Most of these mentioned projects will require funding.

Cumbria County Council staff and any other maintenance bodies need to ensure that their staff contact English Nature prior to any works proceeding on bridges graded four or five or any bridges previously unsurveyed.

7.2 The U.K. outside of Cumbria

The project has gathered considerable information from throughout the U.K. and the U.S.A. on what is known about bats in bridges and the surveys that have been carried out. It appears that in large areas of the U.K. there are sufficient unsurveyed bridges to merit major surveys being carried out (varying from several hundred to thousands of bridges in each county/area).

To gather relevant information major surveys could be organised on a county basis. It may be possible to obtain funding from the maintenance bodies, the SNCO's, and other conservation bodies. Smaller scale surveys could target specific bridge construction types or sites where there are key habitats present *i.e.* broadleaved woodland or slow flowing water.

Only trained surveyors should survey bridges for bats to maintain consistency of results and advice to engineers, and ensure safe working practices. Carrying out an initial assessment of bat roost potential does not require a licence until bats or their signs have been found. Working relationships should be cultivated with engineers who can be very useful in locating bat roosts during bridge inspections. A North Lancashire engineer has assessed over 420 bridges for bats whilst carrying out inspections (Bradley, pers. comm.).

Obtain maintenance lists and try to ensure that all bridges are surveyed prior to works being carried out on them, and gradually attempt to survey all sites in your area.

It is essential that liaison takes place between bat workers, bridge maintainers and the SNCO's. Highways and other maintenance organisations and individuals should be informed about bats in bridges and given training in roost conservation techniques.

A proposed addition to the roost visitor licence training programme is to include a section on surveying bridges and giving advice over maintenance. Proficiency should be demonstrated in assessing bridge potential for bat use, and drawing up procedures to ensure bats will not be harmed and the roosting sites will be retained during maintenance works.

Engineers should be encouraged to incorporate new roosting sites into bridges that are being rebuilt.

Consider conducting research to determine which bridges are inhabited, when, and with how many bats, by carrying out dusk surveys.

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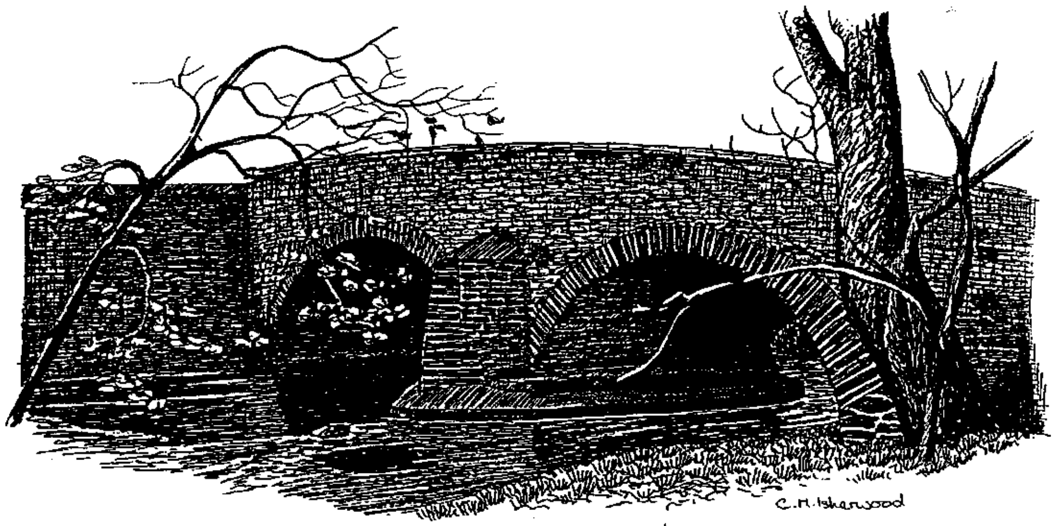

SUMMARY

The Conservaton of Bats in Bridges (COBIB) Project was set up in June 1996 to carry out a bat survey of bridges in Cumbria, to liaise with bridge owners and managers over bat conservation, and to promote the conservation of bats in bridges. Two project workers were employed for seven months.

2,555 bridges were surveyed during the project. 320 (12.5%) were confirmed as bat roosts, and 1039 (41%) had suitable crevices but no proven roost. Daubenton's bat (*Myotis daubentonii*) was the most frequently identified species, and was found in 92 bridges (3.6%). Natterer's bat (*M. nattereri*) was recorded in 25 (1%) bridges. Other species recorded in small numbers were pipistrelle (*Pipistrellus pipistrellus*), brown long-eared bat (*Plecotus auritus*), and whiskered/Brandt's bat (*M. mystacinus/brandtii*). 196 (7.7%) roosts were not identified to species.

Most roosts (75%) were located in bridge spans but bats were found to roost in a wide variety of crevices in a range of bridge structures. The main requirement for a potential roost site is that the crevice should be at least 100mm deep and protected from the elements.

Roosts were more frequently recorded in bridges over watercourses than other bridge types, and bridges with roosts showed a strong association with slow-flowing water and broad-leaved trees. Bats showed little selection for altitude or arch height although bridges less than one metre high were less likely to be used. Bridge occupation rates appeared to show a positive correlation with bridge size measured by length of span but not with bridge width. Bridges with concrete spans were less likely to contain roosts than stone span structures, which corresponded to the relative scarcity of suitable crevices in concrete spanned bridges. Bridges carrying active railway lines had a very low occupation rate (2%), whilst bridges carrying farm tracks had a high occupation rate (25%). Bridges over the Lancaster Canal showed a very high occupation rate (43%). The peak month for recording bridge roosts during the survey was September.

Three bridges with roosts received maintenance work during the project. The roost holes were retained in each case and works at two sites necessitated the exclusion of bats before works. Four artificial bridge roosts were created or advised on during the project. Nine training sessions were held for staff from Cumbria County Council Highways Department, The Lake District National Park, East Cumbria Countryside Project and British Waterways.