LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

ACKNOWLEDGEMENTS

The authors would like to thank the following organisations for project funding and generous contributions of staff time and equipment: Cumbria County Council, English Nature (Cumbria), English Nature (Species Recovery Programme), The Lake District National Park, and The Peoples Trust for Endangered Species.

We would like to thank everyone who responded to requests for information on bats in bridges, Erica Donnison for her help in getting the project off the ground, John Brook for his help with the database, Pam Grant for help with the photographic images, John Clayson for producing the distribution maps, 'Tradwise Plus' for producing the recording forms and assisting with the report, and John Mather for his help and support.

We would also like to thank Erica Donnison and Judy Clavey for their advice and comments on earlier drafts of this report.

Line drawings in the text are reproduced with the permission of English Nature; the drawings of Daubenton's bat and bridges are the copyright of Christine Isherwood.

REFERENCES

Anon. Unpub.(a). *Bats and Bridges.* Environment Agency, Preston, Lancashire. Information note.

Anon. Unpub.(b). *Bats and Bridges.* Environment Agency, Bodmin, Cornwall. Leaflet.

Billington, G.E. 1995. Bats in Bridges. *Bat News* **36**: 6

Billington, G.E. 1996. Bats in Bridges. *Westmorland and Furness Bat Group Annual Report* No. 4 1995.

Childs, J. 1996. *Bat work in Texas, USA.*

Department of Transport. 1995. *Trunk Road Maintenance Manual* **Vol. 1**: 4.2.

Durham Bat Group. Unpub. *Bats in Bridges Summary.*

Hewitt, S.M. 1996(a). Mammal Report 1995. In *Birds and Wildlife in Cumbria 1995.* Cumbria Naturalists Union.

Hewitt, S.M. 1996(b). *Putting Cumbria's mammals on the map. Provisional atlas July 1996.* Tullie House Museum and Art Gallery.

Hinchcliffe, G. Unpub. *Bats and Bridges.*

Keeley, B. Unpub(a). *Phase 1 Evaluation: Bats and Bridges.*

Keeley, B. Unpub(b). *The Texas Bat-Abode.*

Kermode, D. 1996. Natterer's found under a bridge. *The Westmorland Gazette* 13th December 1996.

Limpens, H. & Kapteyn, K. 1991. Bats, their behaviour and linear landscape elements. *Myotis* **29**: 39-47.

Marshall, A. 1996. Bats in bridges survey. *Westmorland and Furness Bat Group Annual Report* No. 4 1995.

Marshalls Clay Products. Unpub. *Bat Access and Bat Roost Bricks.* Marshalls Clay Products, Information Sheets.

McAney, K. 1992. *Bats and Bridges. A report on the importance of bridges to bats.* National Parks and Wildlife Service, Office of Public Works, Galway.

McCabe, M. 1996. Bat Span. *San Francisco Chronicle* 30th November 1996.

McOwat, T. Unpub. *Pipistrelles hibernating in a bridge in January.*

Mitchell-Jones, A. 1989. Bridge surveys. *Batchat* **12**: 5

Mitchell-Jones, A. 1987. *The bat worker's manual.* NCC

Norman, G.M. 1995. Bats and bridges in Cumbria. *The Carlisle Naturalist* 3: 36-37. Carlisle Natural History Society.

Norman, G.M. 1996. The Daubenton's Bat in Cumberland. *Cumberland Chiroptera, the newsletter of the Cumberland Bat Group* No. 1.

Oxford, G.S., Drewett, J., Lane, A., Moodie, J., Moodie, P., & Oxford, R.H. 1996. Studies of Daubenton's bat *Myotis daubentonii* (Kuhl) at Kexby Bridge, North Yorkshire: seasonal and annual fluctuations in numbers, and factors affecting emergence times. *Naturalist* 121: 87-96.

Parker, J. 1990. Bats and spiders. *Batchat* **13**: 5-6

Racey, P.A. 1996. The importance of the riparian environment as a habitat for British bats. In *Behaviour and Ecology of Riparian Mammals, Symp. Zool. Soc. Lond.* **No. 73**. Eds. Dunstone, N & Gorman, M.L..

Ransome, R.D. 1991. Greater horseshoe bat, and Lesser horseshoe bat. In *The Handbook of British Mammals 3rd. Edition.* Eds. Corbet, G.B. & Harris, S. Blackwell.

Richards, B. 1992. *The importance of canal bridges and tunnels as roost sites for bats and the environmental factors that may influence roost site selection.* BSc. thesis. University of Aberystwyth.

Roberts, D. 1989. Bats under bridges in North Yorkshire. *Bat News* **16**: 6-7.

Russ, J.M.R. 1995. *Bats, Bridges and Acoustic Signalling.* BSc. thesis. University of Aberdeen.

Rydell, J., Bushby, A., Cosgrove, C.C. & Racey, P.A. 1994. Habitat use by bats along rivers in North-east Scotland. *Folia Zoologica* **43** (4): 417-424

Sargent, G. 1991. *The Importance of Riverine Habitats to Bats in County Durham.* MSc. thesis. University of Durham.

Schober, W. & Grimmberger, E. 1989. *Bats of Britain and Europe.* Hamlyn.

Skinner, B. 1984. *Moths of the British Isles.* Viking.

Smiddy, P. 1991. Bats and Bridges. *Irish. Nat. J.* **23**: 425-426

Smith, G.M. & Altringham, J.D. 1988. *Fife and Kinross Bridge Survey.* Fife Bat Group.

Speakman, J.R. 1991. Daubenton's bat. In *The Handbook of British Mammals, 3rd Edition.* Eds. Corbet, G.B. & Harris, S.. Blackwell.

Speakman, J.R., Racey, P.A., Catto, C.M., Webb. P.I., Swift, S.M., & Burnett, A.M. 1991. Minimum summer populations and densities of bats in N.E. Scotland, near the northern borders of their distribution. *J. Zool. Lond.* **225**: 327-345.

Stebbings, R.E. 1991. Introduction to Chapter 6 / Bats: Order Chiroptera, and Bechstein's bat. In *The Handbook of British Mammals, 3rd. Edition.* Eds. Corbet, G.B. & Harris. S. Blackwell.

Stebbings, R.E. & Walsh, S. 1988. *Bat Boxes: A guide to their History, Function, Construction, and Use in the Conservation of Bats.* FFPS/NCC/VWT

Swift, S.M. 1990. *Survey of Angus glens for bat roosts.*

Swift, S.M. 1996. Species Recovery in Myotis bats in Perthshire - baseline surveys. *Bat News* **41**: 2.

The Norfolk Bat Group. Unpub. *The Bat-zzz-Brick.* The Norfolk Bat Group, Leaflet No. 4.

Turner, N. 1995. *Practical engineering and environmental problems associated with the strengthening of rubble filled masonry bridges inhabited by bats : including suggestions for measures compatible with the engineering solution and the preservation of bat roosts.* Report to English Nature.

Tyler, S.J. & Ormerod, S.J. 1994. *The Dippers.* T. & A.D. Poyser

Walsh, A.L., Harris, S. & Hutson, A.M. 1995. Abundance and habitat selection of foraging vespertilionid bats in Britain: a landscape-scale approach. *Symp. Zool. Soc. Lond.* **No.67**: 325-344.

Whittaker, S. Unpub. *Natural Heritage Interest of Road Verges and Bridges in Highland Region.* Scottish Natural Heritage North West Region.

Winlow, A. 1995. The provision of bat roosting sites in tunnels and bridges. *Bat News* **38**: 3.

APPENDIX I

Bats in Bridges: Guidance notes for bridge owners and engineers

1 Bats in Britain

Bats in Britain have declined in numbers due to habitat degradation (largely through agricultural intensification), the widespread use of pesticides, persecution, and the incidental destruction of their roosting sites. Like many mammals the place that they live in - the roost - is of great importance to their survival. Many roosts are traditional and have been used by generations of bats. Due to the apparent decline and numerous threats that they face, bats and their roosts received legal protection in the United Kingdom under the **1981 Wildlife and Countryside Act** (as amended). Under this legislation **it is illegal to deliberately kill or injure a bat, disturb a roosting bat, or damage, destroy, or obstruct access to any bat roost**. The protection of roosts means that any site used by a roosting bat at any time is protected, even if there are no bats present. If a roost may be damaged during essential bridge works the relevant Statutory Nature Conservation Organisation (SNCO) must be consulted (see Section 5). It is only permitted to disturb bats under licence, so detailed surveys of bridges with bats should only be undertaken by appropriately licensed persons (contacted through the SNCO or the network of local bat groups).

2 Bats and bridges

Many bridges have suitable roost crevices for bats which offer safety, stable temperature conditions, high humidity, and nearby drinking water and feeding areas. A large number of bridges have been recorded as bat roosts in Britain and Ireland. Some studies have found up to 16% of bridges used as roosting sites. Bridges are particularly important as roosts for Daubenton's bats and Natterer's bats.

Bats require different roost conditions with the changing seasons, but all roosts need to be dark and undisturbed. Hibernation roosts need to have stable, cool temperatures, nursery roosts where the females give birth and rear their single young (June-August) need to be in warm sites, and male roosts and transition roosts tend to be more variable in nature. Although these varying conditions may occasionally be found in one site, bats often make local movements, or sometimes even short migrations, between summer roosts, hibernacula and transition roosts.

Bats can be found in bridges at any time of year as different bridges and different crevices within bridge structures have different environmental conditions. The cool, stable conditions found in many bridge crevices are ideal for bats roosting in spring and autumn, and males in summer, when bats may wish to enter daily torpor. Nursery roosts in bridges are presumably heated indirectly by the sun, by the clustering of large numbers of females, or a combination of the two. Bridges with deep crevices may offer good hibernation sites if they are sufficiently isolated from external temperature fluctuations. Partially blocked arches are particularly suitable as hibernacula.

All bridges can provide suitable night roosts for resting, eating large prey, or socialising, and male pipistrelles use bridges as mating stations.

2.1 Types of bridge and crevice used by roosting bats

Bats use a wide range of bridge types to roost in. Stone bridges are more likely to provide suitable crevices than concrete, steel, or wood structures, but the Conservation of Bats in Bridges Project survey of Cumbria's bridges in 1996 still found that 25% of concrete bridges had suitable roost crevices and 5% had bat roosts.

Most roosts are located in bridge spans but roosts have also been found in abutments, spandrel walls, and parapets. Bats can roost in almost any type of crevice that is greater than 100mm deep, and 12mm wide, and protected from the elements. The wide variety of crevice types that have been used are listed below:

- Crevices between stones where mortar has fallen out, or in damaged stonework.
- Drainage holes and pipes, including ceramic and steel pipes.
- Expansion joints.
- Constructional joints, including widening joints in the arch.
- Gaps between beams and stone slabs in bridge spans and corbels.
- Gaps created where the span overlies the piers or abutments.
- Box voids in concrete structures.

Where thick growths of ivy occur on bridges they may be used as roosts. Bats roost behind ivy on trees but have not yet been proved to use such sites on bridges.

2.2 Threats to bridge roosts

Bridge roosts are threatened by unsympathetic bridge repair, maintenance, strengthening, and demolition. Most bridge works can have a damaging effect on bat roosts but in most cases it is possible to prevent any damage to the roost, or reduce it to negligible levels, if suitable steps are taken at an early stage in the planning of works (see Section 5).

In the past, bridge roosts have been destroyed by pointing, pressure grouting, re-saddling, demolition, and infilling of arches. When bats have been inside roosts during works they will have been entombed or crushed by grouting and re-building work, and bats have even been killed by the spraying of herbicide onto bridge surfaces.

All works (including shot-blasting of metalwork) can disturb roosting bats, and at critical times of year, *i.e.* during the nursery and hibernation seasons, this can be disastrous. Young bats can be abandoned and bats disturbed in winter may die because their fat reserves have been used up in moving to an alternative roost.

3. Other species

Bats are not the only protected species that may be affected by bridge works. The Cumbrian survey found that up to 12% of bridges may be used by nesting birds. **All active bird nests are protected under the Wildlife and Countryside Act 1981 (as amended) and therefore works should not proceed when nesting birds are present**. Otters frequently use bridges to mark their territories and may use hollows in bridge abutments, drainpipes, and river banks adjacent to

bridges as resting sites or holts. **Otters and their holts are also receive protection under the Wildlife and Countryside Act 1981 (as amended) and it is illegal to deliberately disturb an otter or destroy its holt.**

4. Procedures to follow in bridge inspection and works

The COBIB Project in Cumbria was established to address the problems of bat conservation in bridges. The recommendations that follow have been drawn from experience gained during the project and consultation with bat workers and bridge engineers.

4.1 Bridge inspections

It is important to be aware of the possibility of finding bat roosts during regular bridge inspections or strength testing. If a roost is found then prior knowledge of its presence will make it easier to plan works on the bridge in the future. The details of the roost and its location should be noted on the bridge card and full details passed on to the local office of the SNCO (see Section 6). Once the conservation bodies know of a roost they can gather further information on the type of roost and when it is occupied by bats (this work is usually carried out by local voluntary bat groups).

Bats are sometimes visible when crevices are inspected with a torch, but roosts are more often found using the following signs:

1. Bats audible - if disturbed by torchlight or noise bats may make a high pitched chattering noise.
2. Staining - where sites are heavily used by bats the stonework around the roost entrance may become stained a dark brown colour with oil from the bats fur. Scratches on the stonework and stonework worn smooth by the passage of bodies are also used as evidence of bats but roosting or nesting birds can make similar marks.
3. Droppings - bat droppings in crevices, stuck to walls below suitable crevices, and on the ground below suitable crevices, are useful evidence of bat roosts. They are similar in appearance to mouse droppings but can be distinguished by their crumbly texture, and often their position on vertical walls where small rodents would not be able to climb.
4. Bat-fly pupae - these flies are parasitic on bats, especially the Daubenton's bat. The dark brown, pin head sized pupae are found attached to the stonework where the bats roost and are fairly distinctive if seen.

4.2 Bridge works

The procedures involved in planning bridge works with respect to bats are summarised in Figure 1. If a bridge requires works of any kind its potential for bat use should be ascertained. The local SNCO should be informed of the pending works at the earliest opportunity. If no records are available for the bridge in question the SNCO will arrange for the bridge to be surveyed, usually by a volunteer from the local bat group. The survey will reveal whether the bridge is suitable or not, but inspection from scaffolding with a fibrescope may be necessary to establish with certainty whether or not bats are present before works. The SNCO will provide advice on the timing and

nature of works based on the bridge survey. The bat survey should also reveal the presence of any bird nests and otter holts and the SNCO may give advice on the timing of works if these are present.

All holes with evidence of bat use should be preserved, and if bat use is not confirmed by the detailed survey a selection of suitable holes should be retained as a positive measure. If structures need to be re-built then the roosting holes should be re-constructed. Any opportunities for creating suitable crevices in re-built or new bridges should be pursued.

4.2.1 Timing of works

The timing of works is crucial as bats will generally only be present at certain times of year in a specific bridge, and disturbance at critical times can have a highly detrimental affect on bat colonies (see Section 3.2). General guidelines on timing are presented in Figure 2, but each case should be advised on individually by the SNCO. No bridge works should be carried out if bats are present and bats should not be disturbed during the nursery season (mid-summer) or during hibernation (winter). In spring and autumn bats can be temporarily excluded from roosts (by suitably licensed persons) to allow works to continue.

If the bridge has no potential for bats then works can proceed at any time, providing other wildlife will not be adversely affected.

4.2.2 Techniques for preserving roosts

Many crevices that bats use can easily be retained without detrimental effects on bridge safety. Hand pointing of stone arches can be carried out in a sensitive manner in order to retain roost crevices, but problems occur when bridges or parts of bridges need to be demolished, re-built, or pressure-grouted. If a bridge with a bat roost needs to be re-built then new roost crevices can be incorporated. Pressure grouting presents more complex problems but two solutions have been successful:

- Crevices have been blocked with polystyrene or paper which is removed after grouting
- The area around the holes to be retained is grouted at low pressure until grout appears in the holes. Pumping is then stopped and the process is repeated until the crevices are isolated. The rest of the bridge can then be grouted as normal.

In deeper, more complex crevices it may be necessary to remove stonework and re-build the crevices