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Draft Report of the IWG on the Protection of Overground Roosts (particularly those in buildings of cultural heritage importance)

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1. Introduction

In 2003, the Eurobats Meeting of Parties (MOP4) asked the Advisory Committee (AC) to gather information on methods used to protect roosts other than underground sites, with roosts in buildings that are part of the cultural heritage as a priority.

An Intersessional Working Group [IWG] was established at AC 9 in Vilnius in 2004 to address this issue. A questionnaire (see Appendix 2) was circulated to all Party and Non-party range states in December 2004. The questionnaire sought information on the types of overground sites used as roosts, on the administrative and practical protection of roosts and on the interactions between bats and buildings of cultural heritage. To date, responses have been received from the following 34 countries: Albania, Armenia, Austria, Azerbaijan, Belgium, Bosnia and Hercegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Hungary, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Netherlands, Norway, Portugal, Romania, Russian Federation, Serbia (including data for Montenegro), Slovakia, Slovenia, Sweden, Switzerland and the UK.

This document summarises the results from the overground roost questionnaire, provides an overview of suitable protective measures, and explores the interactions between bats and buildings of cultural heritage importance. A number of case studies are included to illustrate how conflicts between bats and cultural heritage have been successfully resolved in different situations in different parts of Europe.

2. Literature Review

The protection of bats in the man-made environment is an area of active research and the interactions between man and bats attract attention throughout Europe. Most of the published literature, however, examines this issue from the bat conservation angle; publications from the built heritage perspective are harder to come by. A large volume of literature on the protection of overground roosts has been published in the UK. It is these sources, and in particular *Bat Mitigation Guidelines* (Mitchell-Jones, 2004), *The Bat Workers Manual* (Mitchell-Jones & McLeish, 2004), The National Trust's *Wildlife and Buildings* (2001) and *The Bats in Churches Project* (Sargent, 1995), which largely inform this document. Published and unpublished materials from Austria, Estonia, France, Germany, Ireland, Italy, Latvia, Lithuania and the Russian Federation were also examined in the preparation of this report (see 8. Further Reading).

Eurobats has already produced an advisory document on underground roosts – *Protecting and managing underground sites for bats* – which can be downloaded (?) from the Eurobats website [www.eurobats.org]. This present report aims to complement that underground roost document and where overlaps occur the reader will be referred to that earlier report.

3. Use of overground roosts by bats

3.1 Bat species present in overground roosts

Because their metabolic and social requirements vary throughout the year, most bats will use a variety of roosts of different types. Some species are particularly closely associated with tree roosts, but the majority use a range of roosts, which includes trees, buildings and underground sites.

Man-made structures regularly used by bats across Europe include bridges, castles, churches, houses, blocks of flats, barns and stables. Some species have come to rely on such structures, e.g. *Eptesicus* and *Pipistrellus* species usually roost in buildings; *Myotis daubentonii* is, in some countries, particularly associated with bridges and will form roosts in suitable cracks in both old and new structures; *Myotis myotis* can be found roosting in churches over much of its range in the northern part of Europe, while *Plecotus* species have come to rely more and more on man-made roost sites in some countries due to the successive loss of suitable natural habitat.

Bats can be found in buildings all year round. In late spring, maternity roosts are formed in the roofs of buildings to take advantage of the heat provided by the sun, as during this phase of their life-cycle breeding females are seeking warm areas to minimise the energy cost of maintaining a high body temperature. Some species, such as *Pipistrellus* spp. show a clear preference for confined roost sites, such as soffit boxes, eaves or under hanging tiles, whereas others, such as the *Rhinolophus* spp. are more typically associated with open roof voids that they can fly in. There are many exceptions and many species have been recorded from a wide variety of situations. In winter, bats of most species have been recorded hibernating in various parts of buildings, such as inside cavity walls, around window frames, under ridge tiles and in cooler areas with stable temperatures such as cellars and basements. These latter are covered by the Eurobats report on underground roosts and are not considered further here.

In 2004 a Eurobats questionnaire asked national experts to estimate the dependence of individual bat species on specific roost types as high, medium, low, not important, not known or just as present when no detailed information was available. Table 1 provides a summary of the responses. [A more detailed breakdown can be found in Appendix 3.] An analysis was then conducted of the dependence of bats on different overground roost types in different countries. The main roost types identified were churches, castles/fortifications, houses/block of flats, barns/stables, bridges and trees.

A number of caveats should be borne in mind when examining the data:
i) For a large proportion of bat species the degree of dependence on specific roost types in specific countries is unknown (see Appendix 3).
ii) Dependence of particular bat species can vary greatly in different regions of the same country, but we treated each particular country as one region and this produced some confusing results, particularly in larger countries.
iii) It is not clear if all the answers dealing with castles/fortifications are only referring to overground roost types; some may include underground habitats (cellars, basements etc.).
iv) For the analysis and presentation of results we have taken the higher dependence in cases when answers provided intermediate estimates (e.g. high/medium dependence), or were unclear (e.g. high dependence?). When it was indicated that a species is just "present" in a particular roost type we treated this as "unknown" status of dependence.

Results of analysis reveals that across different Eurobats range countries at least 34 bat species (76% of known species in the Eurobats zone) are considered to have high or medium dependance on roosts in castles and fortifications; 33 species (73%) on roosts in churches, and houses or block of flats; 27 species (60%) on roosts in barns or stables; and 23 (51%) species on roosts in bridges (Fig. 1). The percentage of bat species dependant on roosts in trees (Fig. 1) is underestimated, as in many countries roosts of tree dwelling bats are unknown (App. 3).

If we consider churches, castles, houses and barns (Fig. 1, Table 2, App. 3) as probable buildings of cultural importance, we can estimate that the conservation of approximately 75% of bat species across Eurobats range countries rely for at least part of their life cycle on roosts in buildings of cultural heritage importance.

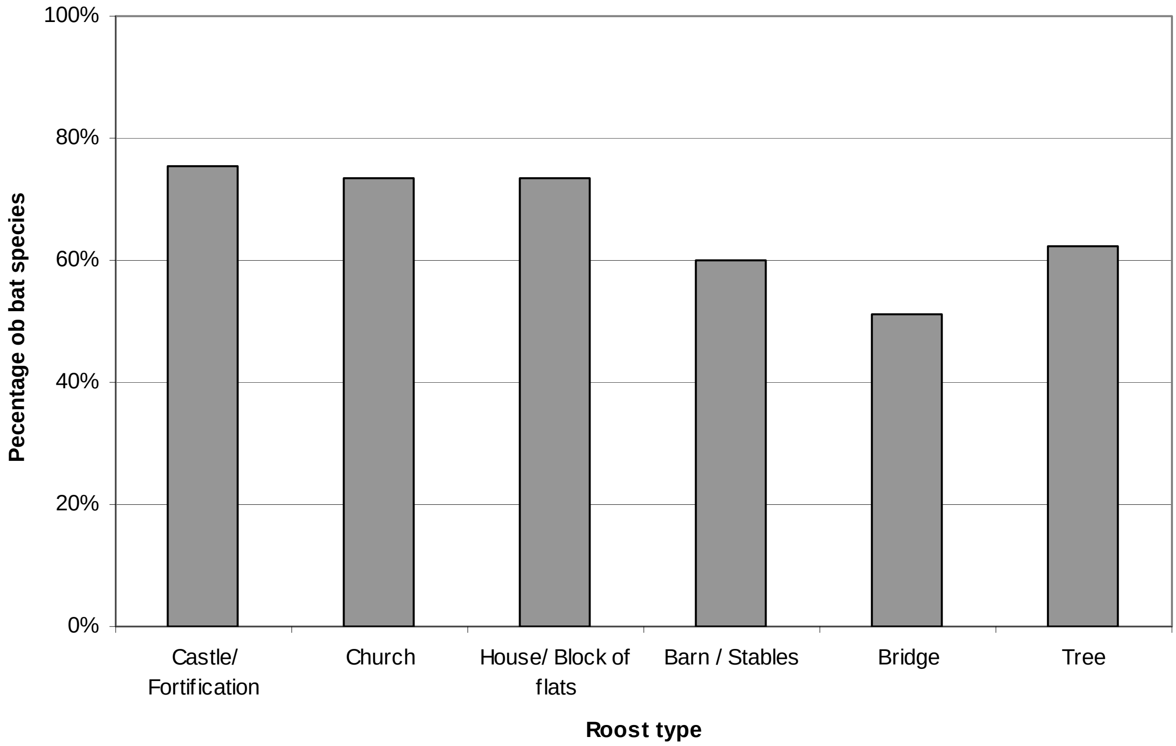

Figure 1. Percentage of European bat species dependant on different overground roost types.
(Species with high or medium dependance in at least one country were included; see App. 3)

Table 1. *Percentage of Eurobats range countries with high bat species dependence on overground roost types.*

(High dependence in: 1 – 20% of countries (+); 21 – 40% (++); 41 – 60 % (+++); 61 – 80 % (++++); 81 – 100 % (+++++). Countries that could not specify a degree of dependence (answers "not known" or "bat species present") are excluded).

Overground roost type / **Species**	**Church**	**Castle/ Fortification**	**House/ block of flats**	**Barn / Stable**	**Bridge**	**Tree**
		+	+	+		+++
Barbastella leucomelas						
Eptesicus bottae			+++			+++
Eptesicus nilssonii	+	+	+++			+
Eptesicus serotinus	++	+	++++	+		
Hypsugo savii			+			
Miniopterus schreibersii	+	+				
Myotis alcathoe						++
Myotis aurascens			++	++	++	
Myotis bechsteinii						+++++
Myotis blythii	++	+	+	+	+	
Myotis brandtii		+	++			+++
Myotis capaccinii						
Myotis cf. *punicus*						
Myotis dasycneme	++	++	+++	+		+
Myotis daubentonii	+	++			++	+++++
Myotis emarginatus	++	++		+		
Myotis hajastanicus						
Myotis myotis	++++	++	++			
Myotis mystacinus	+	+	+++	+	+	++
Myotis nattereri	+	+	++		+	+++
Myotis nipalensis						
Myotis schaubi						
Nyctalus lasiopterus						+++++
Nyctalus leisleri			+			+++++
Nyctalus noctula	+	+	++	+	+	+++++
Otonycteris hemprichii						
Pipistrellus kuhlii	+	+	++++	++	+	+
Pipistrellus nathusii	+		+++	+	+	+++++
Pipistrellus pipistrellus	++	++	++++	++	+	++
Pipistrellus pygmaeus	+	+	+++	++	+	+++
Plecotus auritus	+++	++	++	+		+++
Plecotus austriacus	+++	++	+++	+		+
Plecotus kolombatovici						
Plecotus macrobullaris	++		+	+		
Plecotus sardus						
Rhinolophus blasii						
Rhinolophus euryale	+	+				
Rhinolophus ferrumequinum	++	+	+	+	+	
Rhinolophus hipposideros	++	++	++	+	+	
Rhinolophus mehelyi						
Rousettus aegyptiacus						
Tadarida teniotis					+	+
Taphozous nudiventris						
Vespertilio murinus	+	+	++++	+		+

3.2 Geographic pattern of dependence of bat species on overground roost types

The questionnaire data merits further analysis which is largely beyond the scope of this working group. Nonetheless, some interesting patterns are obvious from the preliminary analyses presented in the figures below. Not surprisingly, it is apparent that in northern European countries a high percentage of the bat fauna rely on roosts in buildings such as churches, castles, houses and barns, compared to the percentage seen in the southern countries (see Fig. 2). It would also appear that churches and houses are important for bats throughout Europe (Figs. 3 & 5 respectively), whereas barns and bridges are only used in certain countries (Figs. 6 & 7 respectively). To some extent, of course, this is a reflection of the research that has been carried out; as mentioned previously, tree roosting species have not been well studied in most countries and consequently the importance of trees is probably underestimated for many countries (Fig. 8).

By and large, a comparison of bat dependence on specific roost types in neighbouring countries provides a coherent picture (e.g. Fig. 3). This in itself lends support to the decision to use best expert judgement in compiling the data. Where big differences between neighbouring countries do occur (e.g. Fig. 8), they can often be explained by the lack of reliable data on a country level, leading national experts to adopt a cautious approach and declare dependence of particular bat species on particular overground roost types as "unknown".

Fig 2 shows the percentage of bats across Europe which are highly dependant on overground roosts in potential cultural heritage buildings (churches, castles, houses and barns combined). Figs. 3-8 present the absolute number and percentage of bat species highly dependent on specific overground roost types in each country.

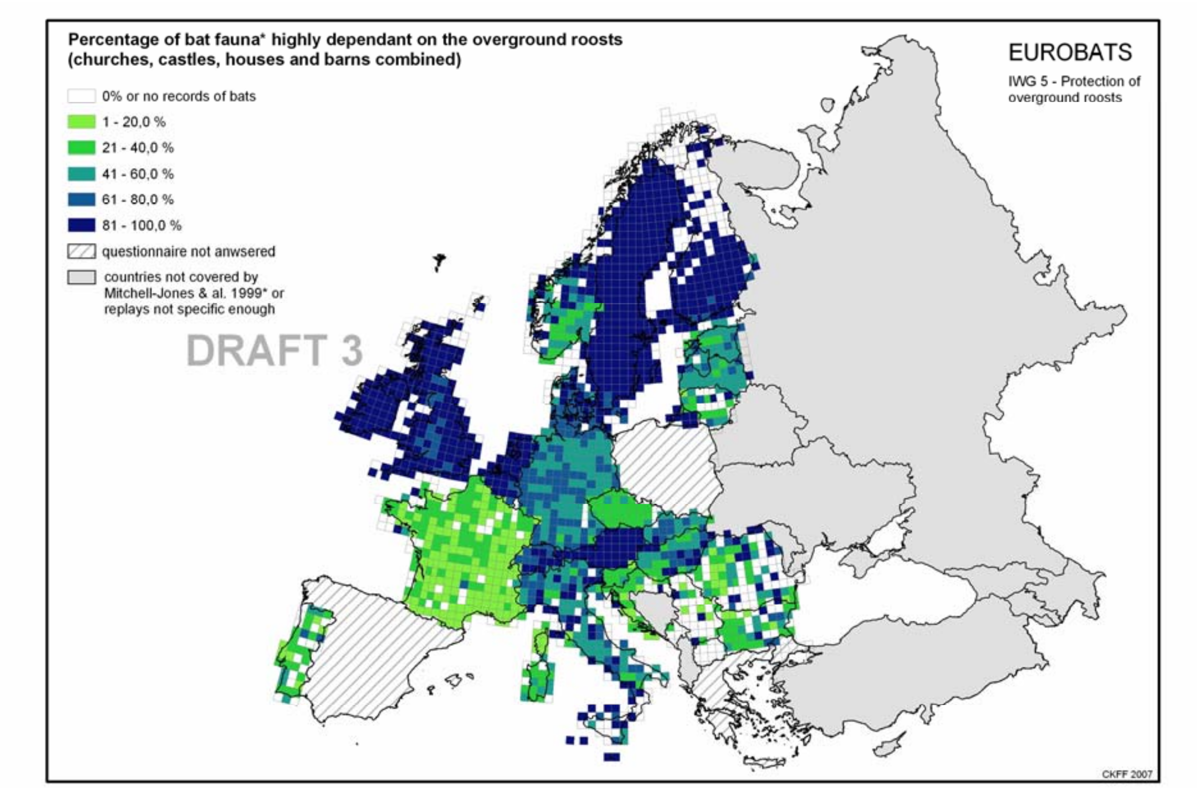

Figure 2. Percentage of bat fauna* highly dependant on overground roosts in potential cultural heritage buildings (churches, castles, houses and barns combined)
(* Only species mentioned by Mitchell-Jones *et al.*1999 are considered)

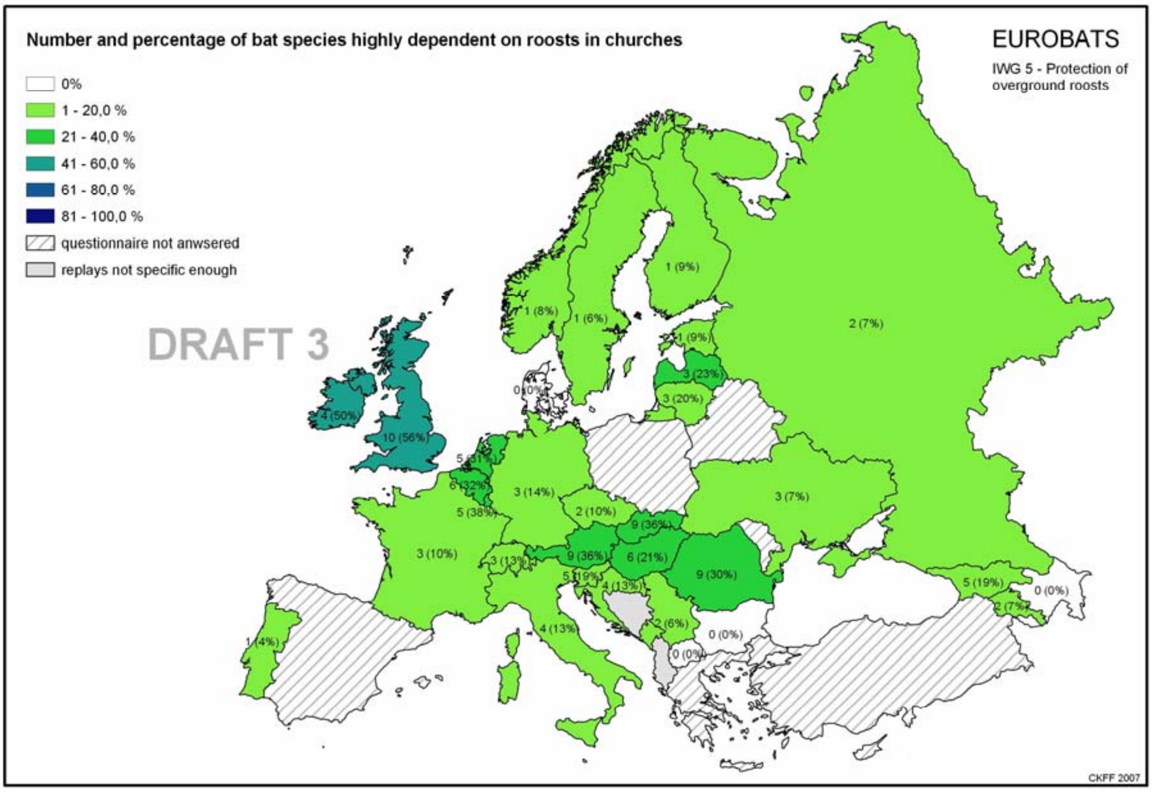

Figure 3. Absolute number and percentage of bat species highly dependent on roosts **in churches** in Eurobats range countries.

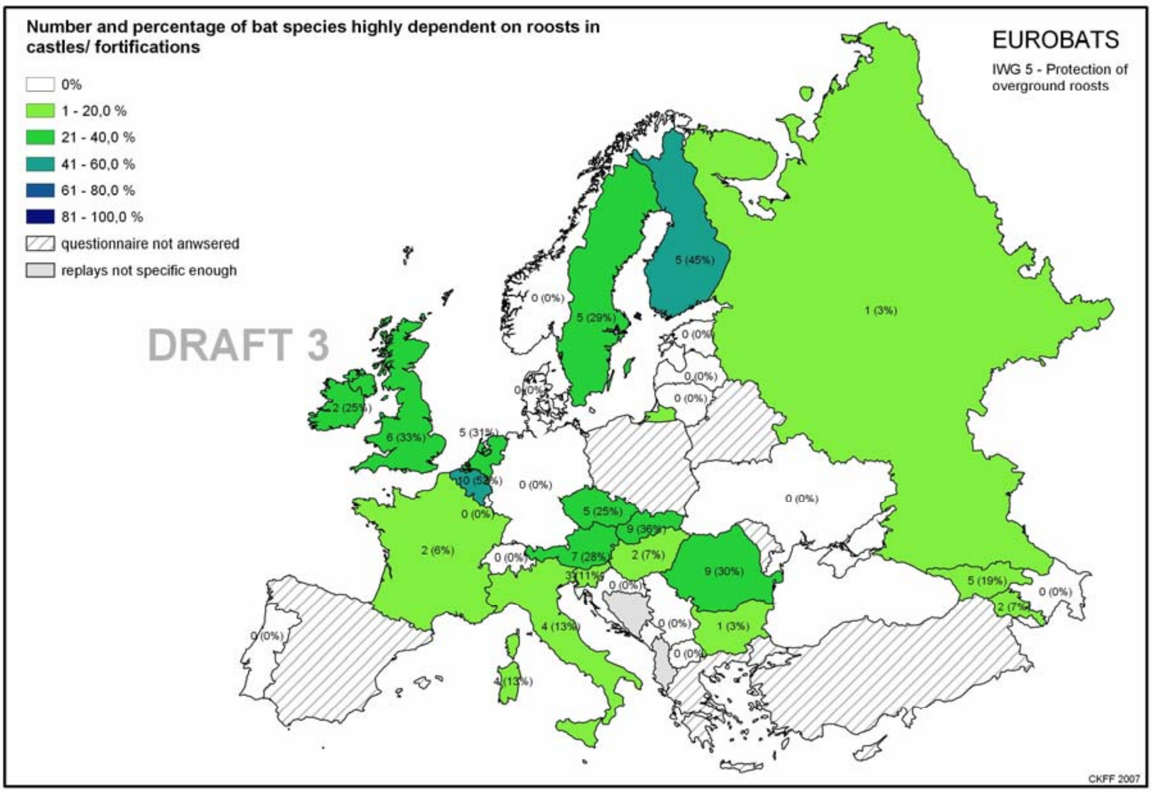

Figure 4. Absolute number and percentage of bat species highly dependent on roosts **in castles/fortifications** in Eurobats range countries.

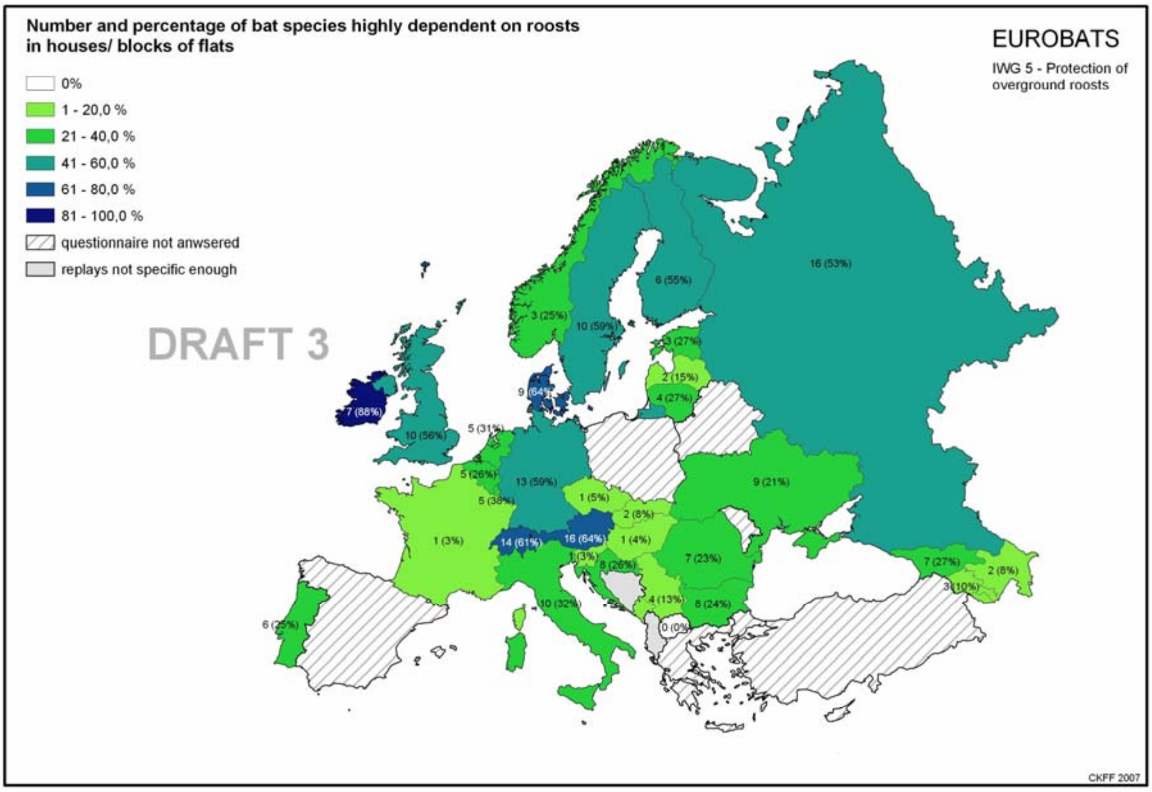

Figure 5. Absolute number and percentage of bat species highly dependent on roosts **in houses/block of flats** in Eurobats range countries.

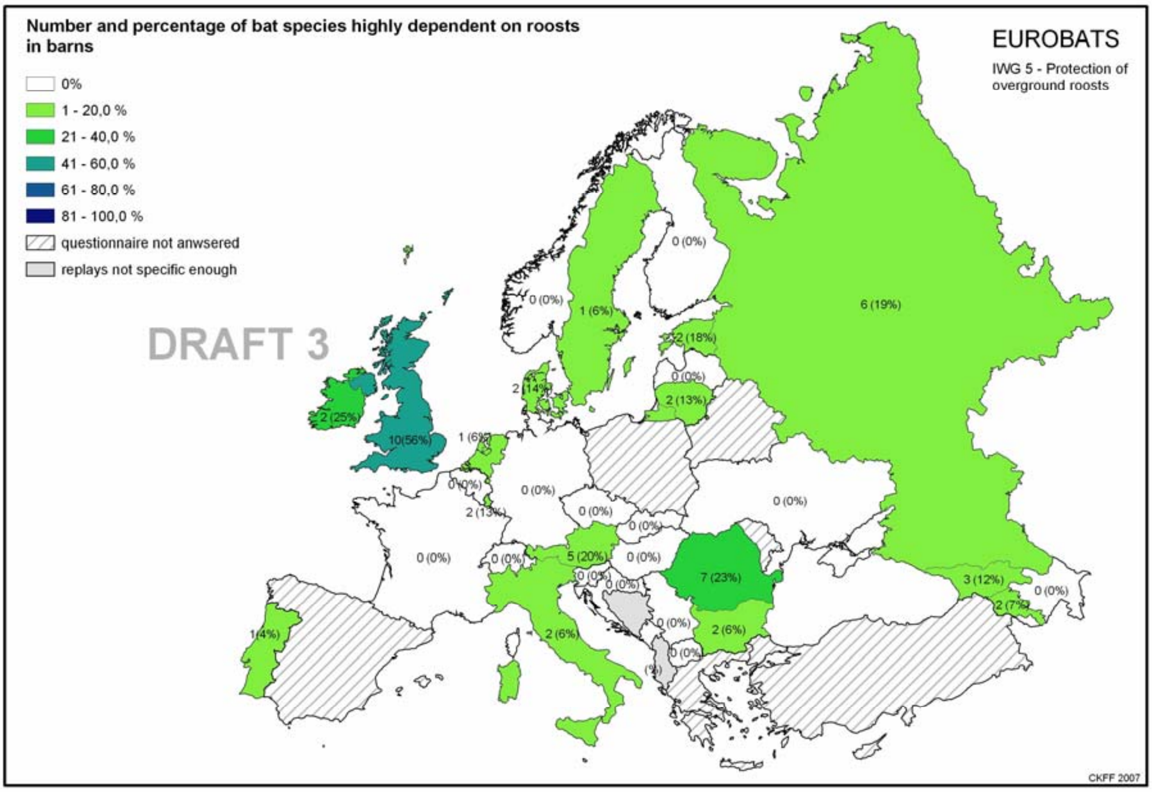

Figure 6. Absolute number and percentage of bat species highly dependent on roosts **in barns/stables** in Eurobats range countries.

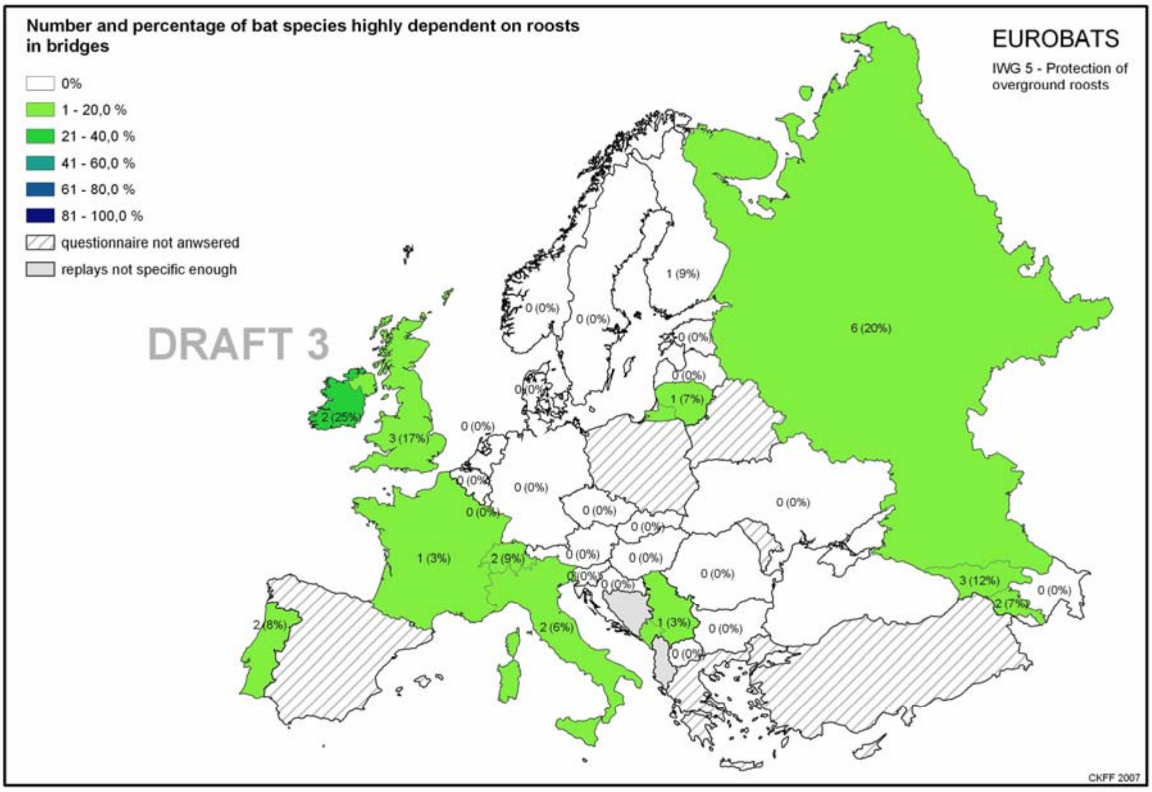

Figure 7. Absolute number and percentage of bat species highly dependent on roosts **in bridges** in Eurobats range countries.

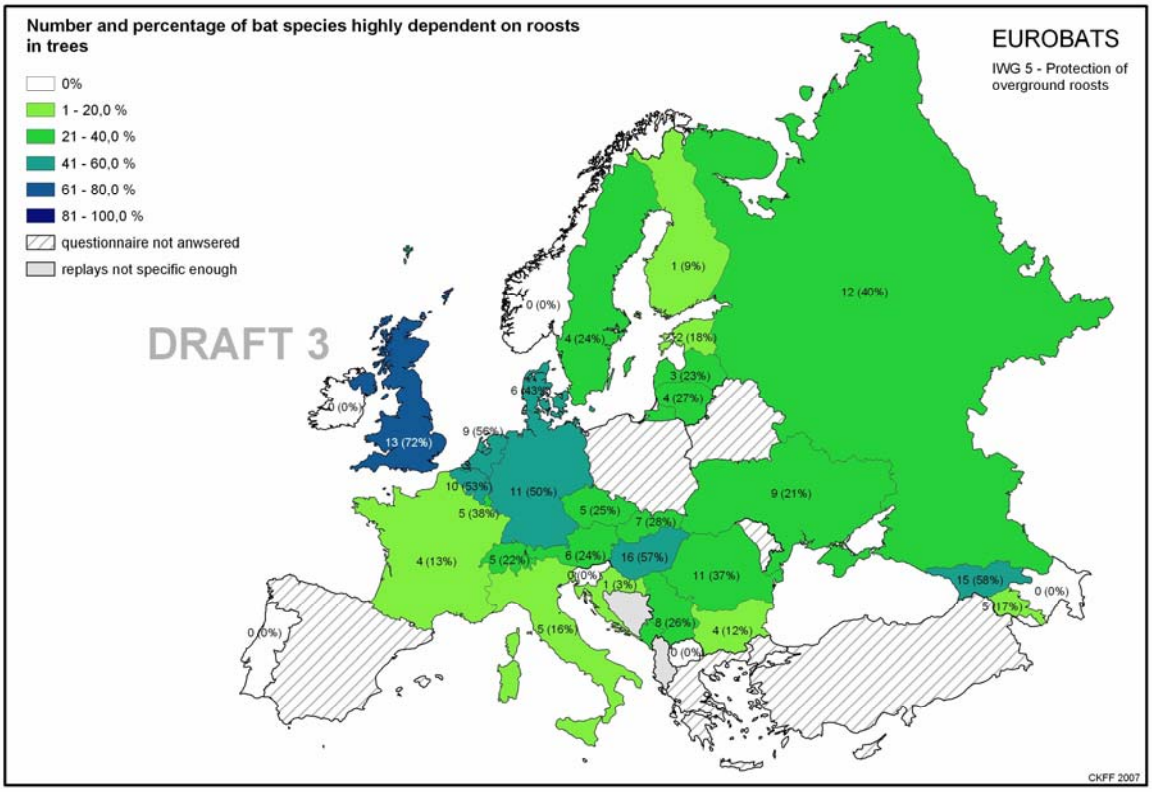

Figure 8. Absolute number and percentage of bat species highly dependent on roosts **in trees** in Eurobats range countries.

3.3 Intraspecific variation across the European range

It is clear from the responses to the questionnaire that while certain bat species can be found in the same type of overground roosts across their range, other bats show marked variation in their roost choices across Europe. To some extent this reflects the availability of specific roost types.

Rhinolophus hipposideros provides a good example of this. Churches are highly important for this species in Austria, Slovenia and Slovakia and are of medium importance in neighbouring Hungary, Czech Republic, Germany and France. Further south and east, in Serbia and Montenegro, Bulgaria, Ukraine, Russia and Georgia, churches are less important for *R. hipposideros*. Much of this variation can probably be attributed to differences in church construction. In general, catholic/evangelic churches, which predominate in western and central Europe, have large accessible attics suitable for use by *R. hipposideros*. Large attics are not so common in the orthodox churches further east. In contrast to this general trend, the churches in Ireland and in parts of the Meditteranean tend not to have attic spaces, and when they are present they usually do not have openings large enough for *R. hipposideros* to use. Consequently, in these areas, this species is seldom found roosting in churches, but uses houses and barns instead. In general, houses and barns are often very important for *R. hipposideros* where churches and castles are not. The Figure below illustrates this further.

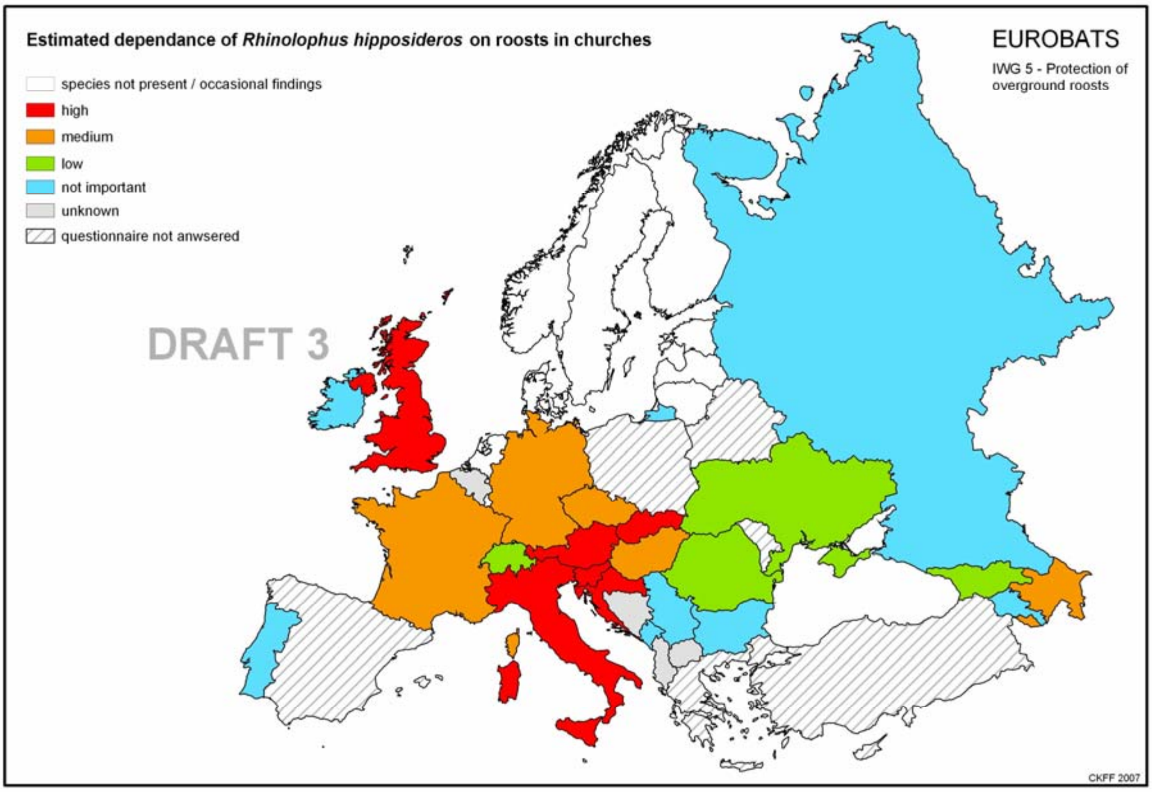

Figure 9. Estimated dependence of *Rhinolophus hipposideros* on roosts in churches.

Another good example of this changing dependence on overground roosts types is *Myotis myotis*. In Bulgaria, Romania and Serbia nursery roosts for *Myotis myotis* are predominantly in caves. In the southern parts of Slovenia, nursery groups can still be found in caves, however, in northern Slovenia and further north again, in Austria and Germany, all nursery roost of *Myotis myotis* are located in buildings. Similar clinal (south to north) changes of *Myotis myotis* dependence on overground roosts can be expected in other parts of Europe as well.

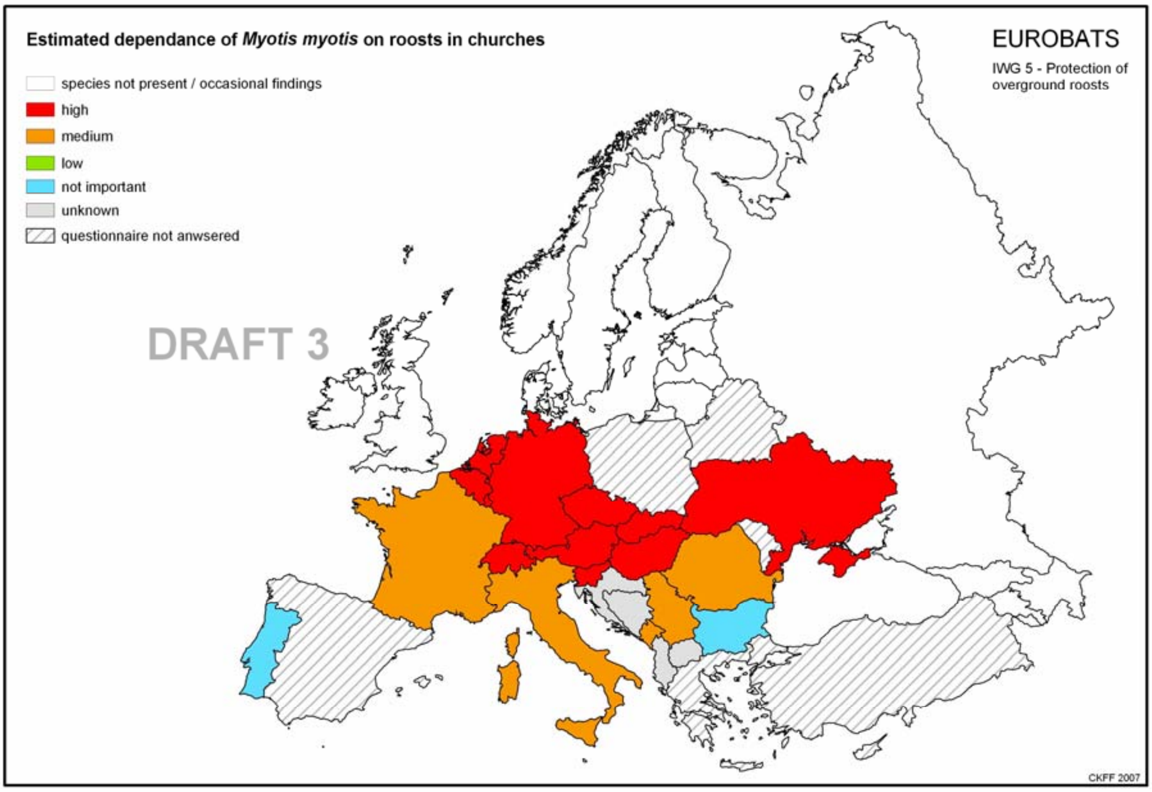

Figure 10. Estimated dependence of *Myotis myotis* on roosts in potential cultural heritage buildings (churches, castles, houses and barns combined)

4. Roost protection

Three main forms of protection for overground roosts can be recognised: legal protection, physical protection and education / information.

4.1 Legal protection

Most Eurobats range states have some form of national legislation protecting bat roosts, although a small number do not. Furthermore, specific legislation applies to the 27 EU Member States – in particular all microchiroptera species are listed on Annex IV of the EU Habitats Directive [92/43/EEC]. Article 12(1) of this Directive requires Member States to implement a system of strict protection. 12 (1) b) and 12 (1) d) are particularly relevant, they prohibit:

> "b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration; …….
>
> d) deterioration or destruction of breeding sites or resting places."

The full text of this Directive can be found at : http://europa.eu.int/comm/environment/nature/ nature_conservation/eu_nature_legislation/habitats_directive

It is worth noting that the transposition of this Directive into national law can lead to some variation in implementation between countries. Furthermore, ongoing discussions within EU Working Groups, and in some cases infraction proceedings against Member States, are helping to clarify the actual interpretation of Article 12.

The Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) was instigated in 1979 in recognition of the fact that migratory animals can only be properly protected if activities are carried out over the entire migratory range of the species. The Eurobats Agreement was set up in 1994 under this Convention. This Agreement aims to protect all 45 species of bats identified in Europe, through legislation, education, conservation measures and international co-operation between Parties and with non-Party range states.

Across Europe, bats are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982). All bat species are listed on Appendix II (Strictly protected fauna species), except *P. pipistrellus*, which is listed on Appendix III (Protected fauna species).

Bat roosts can also be afforded effective legal protection through NGO or State ownership. In these cases particular buildings may be bought or leased for the specific protection of an important bat roost, or with roost protection being one of a number of conservation goals. For example, The Vincent Wildlife Trust, manages over 50 reserves for horseshoe bats in England, Wales and Ireland.

4.2 Physical protection

Overground roosts can be protected from disturbance by a number of means, including grilling, fencing and blocking off. All in effect restrict public access and the statutory nature conservation authority should always be consulted before such measures are applied. In all cases it is important that these protective measures should not have any accidental adverse impact on the bats themselves; the frequency of comings and goings and the number of bats using an individual roost should always be considered. It should also be remembered that different species could respond in different ways to certain measures e.g. grilling of cave entrances can have a negative impact on *Miniopterus schreibersii* populations, so fencing may be more appropriate for this species. Wherever possible, the necessary works should be timed to avoid disturbing the bats. Extensive details on physical protection methods can be found in the Eurobats report *Protecting and Managing Underground Sites for Bats* and many of these approaches are equally relevant to overground roosts. Numerous examples of physical protection measures for bat roosts in buildings are also assembled in Mitchell-Jones (2004), Mitchell-Jones & McLeish (2004), The National Trust (2001), Sargent (1995), Simon *et al*. (2004) and in Reiter & Zahn (2006).

4.3 Education / Information

The availability of readily accessible and practical information is key to the protection of bat roosts. This can include web-based resources as well as published materials and telephone help-lines. While generic guidance is valuable, for maximum effect, focussed information should also be available e.g. information on bat friendly bridge repairs for local authorities; information on bats in churches for church authorities.

4.3.1 Web sites

Web based information sources are becoming more common. They allow easy and free access to the latest information on best building practise as well as bat ecology and biology from a wide range of countries and in different languages. The availability of this information can be particularly useful or conservationists with limited personal experience of conservation measures for bats in different kinds of buildings. It should always be borne in mind, however, that situations will vary between bat roosts and even the same species can have different requirements in distant parts of its range.
Non-governmental organisations (NGOs) and academic research groups play an important role in the area of bat education and the provision of related information throughout Europe. They often act as a focal point for frequently asked questions from the public and media. See for example the websites of:

- the Dutch Mammal Society [www.vzz.nl];
- the Italian Chiroptera Research Group [http://fauna.dipbsf.unisubria.it/chiroptera];
- the Russian Bat Research Group [http://zmmu.msu.ru/bats];
- Bat Conservation Ireland [www.batconservationireland.org]
- And in France: http://www.museum-bourges.net/

The Eurobats website provides an extensive list of links to bat conservation organisations across Europe [www.eurobats.org].

One recent good example of publishing on the web project results that have general application comes from an INTERREG III B project in Austria and Germany. The Co-ordination Centre for Bat Conservation and Research in Austria (KFFÖ) and the Co-ordination Centre for Bat Conservation in South Bavaria looked in detail at the effects of renovation works in buildings for various bat species. The resulting report, *Guidelines for the renovation of buildings hosting bat roosts in the Alpine area* / Leitfaden zur Sanierung von Fledermausquartieren im Alpenraum (Reiter & Zahn 2006), includes, on a species by species basis, an examination of critical factors that have to be considered before, during and after renovation works. The report can be downloaded from the following websites in German or in English:
www.fledermausschutz.at/Sets/Literatur-Set.htm or
www.stmugv.bayern.de/de/natur/lsn/de/pilot_fl.htm

Some other very useful general publications available on the web include:
- Mitchell-Jones (2004) *Bat mitigation guidelines* [www.english-nature.org.uk/pubs/publication/PDF/Batmitigationguide2.pdf]
- Mitchell-Jones & McLeish (2004) *The bat workers manual* [www.jncc.gov.uk/page-2861]
- Kelleher & Marnell (2006) *Bat mitigation guidelines for Ireland* [www.npws.ie/PublicationsLiterature/IrishWildlifeManuals/]

4.3.2 Telephone help-lines

The personal approach in providing advice is often vital, particularly in emergency situations where immediate action is threatened or required. Help-lines are available in many countries, often run by NGOs and sometimes through direct or indirect Government funding. If you don't have a helpline in your country, you may find helplines in adjacent countries can offer general advice.

4.3.3 Site notices

Although conservationists in general often prefer to keep the location of important, unprotected sites secret, sensible use of site notices can be an effective way of alerting developers to the importance of a building or bridge for bats. The notice might usefully state the legal provisions under which bats are protected and provide contact details for the relevant statutory nature conservation authority or NGO as appropriate. If the site is only important for bats for part of the year, the notice could explain this as well.

5. Focus on buildings of cultural heritage

5.1 Introduction

As a general principle, older structures can support a greater variety of bat species than newer ones. Thus, buildings of cultural heritage importance such as castles and churches can play a key role in providing roost sites for many of Europe's bat species. In certain areas, bats may occupy the vast majority of older buildings. In one German study, evidence of use by bats was found in 80% (46/55) of the church attics investigated (Simon *et al.* 2004).

General features of older buildings that make them attractive to bats include the greater use of natural stone and large hardwood timbers, a wide range of constructional features, limited human disturbance and a certain amount of weathering (Hutson, 1995). It is also a notable feature that bats show a greater degree of site fidelity in old buildings than they do in modern structures, although to some extent this is as much to do with the species concerned as the buildings themselves.

Land use around a building can help determine whether or not the structure itself will be suitable for bats. Frequently, the landscape around heritage buildings is managed in a traditional way that helps retains features suitable for bats and their insect food (such as trees, permanent pasture and water bodies).

When conflict arises between bats and buildings of cultural heritage importance it is usually in one of two ways : either restoration/renovation works are planned for the building that will impact on the bats, or the bats themselves are causing a disturbance or damage within the building. In some cases these conflicts may be supported by opposing legislation, with the bats being protected under wildlife law and the building and / or its contents protected under other heritage legislation. However, there are many examples to show that such conflicts can normally be resolved to the satisfaction of both the built heritage and the natural heritage.

5.2 Protection of cultural heritage

There are numerous international agreements, treaties and conventions devoted to the protection of our cultural heritage. One of the leading organisations in this area is the International Centre for the Study of the Preservation and Restoration of Cultural Property [ICCROM] in Rome. This is an intergovernmental organization [currently 110 countries are members] dedicated to the conservation of cultural heritage. The decision to found ICCROM was made at the 9th UNESCO General Conference in New Delhi in 1956, at a time of mounting interest in the protection and preservation of cultural heritage. The Centre was subsequently established in Rome in 1959 at the invitation of the Government of Italy. It exists to serve the international community as represented by its Member States. It is the only institution of its kind with a worldwide mandate to promote the conservation of all types of cultural heritage, both movable and immovable. ICCROM aims at improving the quality of conservation practice as well as raising awareness about the importance of preserving cultural heritage.

UNESCO's Convention Concerning the Protection of the World Cultural and Natural Heritage signed in Paris in 1972, recognised the dual need for protection of both natural and built heritage elements. Further information on this agreement can be found at :
http://whc.unesco.org/world_he.htm
In many countries, the responsibility for the protection of natural heritage and the conservation of the built heritage fall under different government department. The need to address the issues relating to bat conservation in historic buildings through cooperation between separate government sections has been recognised recently in Italy. In 2006, a joint project was initiated there by the Ministry of Environment and the Ministry of Culture. This project will lead to the creation of a database of bat roosts in heritage buildings as well as the preparation of guidelines for public works in historic buildings. Similarly, the Slovenian Ministry of the Environment and Spatial Planning has commissioned a project (which runs until September 2007) to produce a harmonized database of bat roosts and buildings of cultural heritage.

There are many examples from throughout Europe to show how bats need not be impacted during building works (see Case studies below). Indeed, with some careful planning, the status of bats in a building of cultural heritage can often be enhanced during such operations. Equally, it has been shown that if bat expertise is involved from the early planning stages of a restoration project, and a flexible approach is taken to the scheduling of the works, the bats can be satisfactorily accommodated throughout the project, at little or no additional cost, and without compromising the aims of the works.

5.3. Damage by bats in buildings of cultural heritage

Bats flying around within an occupied building can sometimes be a cause of disturbance or concern. Furthermore, bat excreta may cause damage to vulnerable objects and furnishings in buildings.

Droppings, over a protracted period of time, may cause pitting, long-term staining and etching to porous materials such as painted wall surfaces, wooden monuments and stone sculptures. Bat urine (which is 70% urea) is chemically more aggressive and therefore of even greater conservation concern. It can cause spotting and etching of wooden, metal and painted surfaces (Paine 1993 & unknown year).

Picture XXX Damage to stonework at Penmon Priory, Wales due to long-term exposure to bat urine [photo: J. Matthews]

Before any management of these situations begins it is essential to assess bat activity and its effects on the building's contents. In most cases, there are practical steps that can be taken to manage these problems without compromising the status of the bats or the cultural heritage.

In each individual case information will need to be gathered on the bats themselves, the rate of deposition and the seasons when it occurs, the area / articles being damaged and the extent of the damage. Once these assessments have been carried out an informed decision can be made on which of the following management techniques may be most usefully implemented [these are adapted from advice prepared by S. Paine (unknown year) for English Heritage]:

- **Do nothing –** Bats may not be a problem if they occur in very small numbers or only use parts of a building without vulnerable or significant objects.
- **Moving objects –** If an object being exposed to bat excreta is freestanding, it may be possible to move it to a location with a lower rate of deposition.
- **Covers –** Covers may be appropriate when deposition is localised or if there are a few vulnerable objects. They are not suitable if deposition occurs throughout a room, as there would be a great aesthetic impact. Porous materials such as linen or natural carpet are suitable covers, however, polythene should not be used as this may create a moist microclimate around the object.
- **Coatings –** Synthetic lacquers offer some protection against bat damage and may be acceptable on historically and artistically insignificant metal and wooden objects. Natural organic coatings (such as beeswax) offer little protection against bat urine.
- **Deflector boards –** A wooden board 100-150mm wide and 1-2m long can be positioned at an angle beneath a roost or access point to deflect and/or catch any droppings. This can be useful to reduce rates of deposition in specific areas. The board can be erected for the summer and removed at other times of the year for cleaning.
- **Relocation of roosts or access points –** This has been used with some success in the past. Excluding bats from one roost site will reduce the impact in the immediate area, but may cause them to move to another part of the building and have an undesirable effect there. This can be avoided by blocking off potential roost sites first. Relocation should be considered carefully, with the relevant Statutory Nature Conservation Organisation [SNCO] and bat experts or local bat group being contacted for advice and permission.
- **Exclusion –** This decision, only to be taken by the SNCO, will depend upon a variety of criteria, including the value of the object at risk and the rarity of the bat species. Advice and permission should be sought from both the relevant SNCO and those responsible for the conservation of the historic artefacts. Exclusion may be difficult and expensive. The provision of an alternative roost is usually required.

Case Study 1: Ratková Church, Slovakia

The loft of the Lutheran church in the village of Ratková, Slovakia, is occupied by a nursery colony of *Myotis myotis* and *Myotis blythii* in summer. The colony was discovered in 1992 and is the biggest colony of this type known in Slovakia, with up to 5,000 individuals present. A thick layer of bat guano had accumulated below the colony over the years; in places the layer of guano exceeded 1 m. The weight of the guano was about 10 tonnes, giving rise to concerns about the ceiling of the church.

On 3rd and 4th of December, 2004, the loft of the church was cleaned with the help of the employees of the Muránska Planina National Park and Slovak Bat Conservation Group [SON] members. The guano was bagged and distributed to members of the local community as fertiliser. The colony continues to thrive and the ceiling of the church is no longer threatened with collapse.

© Slovak Bat Conservation Group

See SON website for further details of this work:
http://www.netopiere.sk/en/index.php?page=a1&submenu=aktuality

5.4 Accommodating bats during renovation / restoration

5.4.1 Avoidance [adapted from Mitchell-Jones (2004)]

The most common and effective method of minimising the impact of renovation or restoration works on bats is to carry out the work at an appropriate time of the year. More than half of respondent countries to the overground roost questionnaire had employed this approach. The great majority of roosts in buildings are used only seasonally, so there is usually some period when bats are not present. Although there are differences between species, maternity sites are generally occupied between May and September and hibernation sites between October and March, depending on the weather and geographical area. An adequate survey and good understanding of the seasonal activity patterns of the particular species involved will help in determining the optimum time to carry out the proposed work. The recommended times shown in the Table below should be modified in the light of site-specific species information. For example, some species, most notably *Plecotus auritus* and *R. hipposideros*, tend to remain in summer sites until well into autumn or even winter, so care may be needed when drawing up works timetables where these species are present.

Table 2. *Optimum season for works in different types of roosts (modified from Mitchell-Jones, 2004).*

The period of works may be extended if the way in which the bats use the site is well understood.

Bat usage of site	**Optimum period for carrying out works (some variation between species, and geographical regions)**
Maternity	1st October – 1st April
Summer (not a proven maternity site)	1st September – 1st May
Hibernation	1st May – 1st October
Mating/swarming	1st November – 1st August

Bats are at their most vulnerable in buildings during the summer, when large numbers may be gathered together and young bats, unable to fly, may be present. Operations to known breeding sites should therefore be timed to avoid the summer months. Very large rebuilding or renovation projects may take many months to complete and may need to continue through the summer, which is the favoured season for re-roofing. The best solution in such cases is to complete and secure the main roosting area before the bats return to breed. If this is not possible, work should be sufficiently advanced by May or June for returning bats to be dissuaded from breeding in that site for that year. As part of the mitigation, alternative roosts appropriate to the species should be provided in a nearby location. Another possible solution is to divide the roof with a temporary barrier and work on one section at a time. This procedure has been used successfully on a number of occasions (e.g. Reiter & Zahn 2006).

Where the same structure is used by bats throughout the year, the optimum time for works of all types is likely to lie outside the main breeding season, to avoid times when females in later stages of pregnancy and non-flying babies may be present, and outside the main hibernation season, to avoid times when disturbance may impact on survival, or bats may not be sufficiently active to get out of the way. Spring and autumn generally provide the optimum period for such operations.

In spring and autumn bats will be able to feed on most nights, but may be active or torpid during the day, depending on weather conditions. Active bats will usually keep out of the way of any operations, but torpid bats may need to be gently moved to a safe place, preferably without causing them to fly out in daylight. Wherever possible, the objective should be to persuade bats to move of their own accord and they should be physically moved only as a last resort.

In many cases it is not easy to determine if a building is used for hibernation, except occasionally in the case of lesser horseshoe and long-eared bats in cellars. Where bats are known to be present, significant disturbance during the winter must be avoided and work should be delayed until after hibernation if possible. Repeated disturbance to bats during the winter can seriously deplete their food reserves, but, unless significant numbers of bats are known to be hibernating in a building, there is no advantage in requesting a deferment of scheduled works.

If there are overriding reasons for carrying out works during a sensitive period, for example in roosts that are used throughout the year, it will be necessary to structure and time the works so as to ensure that the bats always have some undisturbed and secure areas. This may involve the installation of temporary partitions and adopting working practices that minimise disturbance to sensitive areas.

Case Study 2: St Cadoc's Church, Wales

Three species of bat roost in St. Cadoc’s church in Wales - *Rhinolophus hipposideros*, *Plecotus auritus* and *Myotis nattereri*. The church dates back to the early 1200s and is of considerable historical importance. In 2002 it was discovered that essential repairs were required and scaffolding was immediately erected to stop the roof from collapsing. No further works were carried out, however, until the bats had left the church in the autumn. At that stage a polythene tent was constructed over the roof to allow the restoration works to be carried out over the winter months with a view to having the building ready for occupation by bats again the following spring.

The work took longer than expected, however, and the builders were still on site when the bats returned. Through agreement with the local SNCO [Countryside Council for Wales], work was able to continue on the main roof, but the tower where the bats roosted was left untouched during the breeding season. The bats successfully reared their young, despite the ongoing restoration works nearby, and the remaining works were completed over the autumn.

The numbers of lesser horseshoe bats, which have been counted at the site each year, appear to indicate no negative impact of the buildings work:

2001: 140
2002; 133
2003; 152
2004: 116
2005: 126
[Peak counts, J. Matthews, pers. comm]

PHOTO

An interesting, unexpected benefit of the restoration works was the discovery of a hidden medieval wall painting, thought to have been covered up since the Reformation.

5.4.2 Incorporating existing roosts into renovated buildings [adapted from Mitchell-Jones (2004)]

The renovation of heritage buildings used by bats can provide opportunities to incorporate existing roosts into the final structure. Apart from the timing of the works, the two most critical issues in maintaining a roost in situ are the size and suitability of the final roost and the disposition of the entrances and flight paths, including the location of any exterior lighting or vegetation.

Case Study 3 Grad na Goričkem, Slovenia

Grad na Goričkem lies in northeastern part of Slovenia, close to Austria and Hungary. It is a castle of cultural heritage importance dating from the middle ages. When plans were developed to transform the castle into a visitor centre for cross-border landscape parks, it provided an opportunity to improve the roosting habitat of the castle's bats.

Bats were first discovered in the castle in 1999. Intensive research followed on the composition of the bat fauna, seasonal dynamics of species and the microclimates of the areas being used by bats. Conservation work was also undertaken to protect the bats from disturbance. Funding was provided by the State and also through an INTERREG IIIA project (Conservation of amphibians and bats in the Alpine & Adriatic region.). Volunteer involvement was also important in developing an understanding of the importance of the building for bats.

9 bat species (1/3 of all Slovenian species) were discovered to use the site; the cellars provide hibernation sites for *Rhinolophus hipposideros, Myotis myotis, Barbastella barbastellus* and even occasionally for *Myotis bechsteinii*. *M. myotis* use the cellars as mating quarters as well. Up to 100 *Miniopterus schreibersii* have been recorded in the castle, making it one of the biggest known roosts for this species in the Pannonian basin. *R. hipposideros* also forms a small nursery group in the attic of the castle. As underground habitats are generally rare in the region, the cellars are thought to be an important swarming site for bats in the wider area.

The building works required the complete demolition and reconstruction of parts of the castle used by bats. On the basis of the research, mitigation measures were recommended during the renovation, including the designation of part of the cellars as a bat roost. Extensive discussion took place between nature conservation and cultural heritage officers to agree the position and size of a new entrance for bats (fig. XXX). Follow up monitoring is now required to ensure that the conservation measures are effective, but it seems that the conservation efforts to date have been successful.

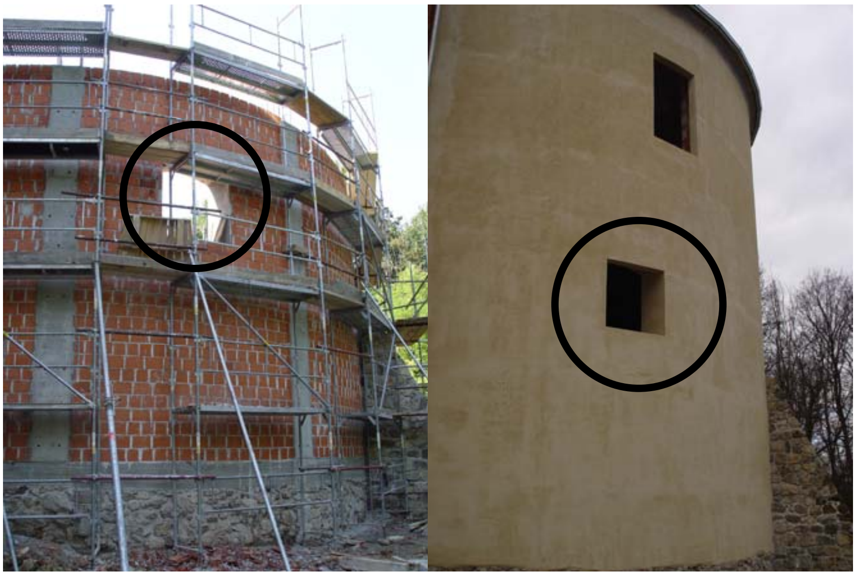

Fig. XXX. Northwest tower of Grad na Goričkem castle, during and at the end of reconstruction in year 2006.
(circles marks new entrance openings for bats) (photo . P. Presetnik)

5.4.2.1 Roost size

The size of roost required depends on the species, as some require voids sufficiently large to fly into whereas others are more likely to roost in crevices and use direct exterior access. In addition, some species may require light-sampling areas where they can fly in and out before finally emerging. Hibernation roosts in buildings are normally underground. The table below gives an indication of summer roost preferences for some species, though there is a great deal of variation; the overall objective should be to maintain the roost size as close to the original as possible.

Table. 3. Specific roost types and sizes for bat species highly dependant on roosts in building.

[Compiled from Mitchell-Jones (2004), Limpens et al. (2000), Reiter & Zahn (2006), Simon et al. (2004) and answers from IWG 5 questionnaires, Eurobats national reports and personal unpublished data, see also Table 1]

Species	Summer/maternity roosts
Rhinolophus euryale *Rhinolophus ferrumequinum* *Rhinolophus hipposideros*	Horseshoe bats require large roost areas with flight access into them, where they hang free such as attics of churches, schools, private houses. Normally require associated sheltered light-sampling areas.
Myotis myotis *Myotis blythii*	Nursery roosts are located in larger roof spaces (such as lofts and towers of churches), and more rarely also in bridges and (heated) subterranean spaces. The nursery communities mostly hang free in the roosts and are rarely hidden in crevices
Myotis nattereri	Crevice/hole dweller; may require light-sampling areas. Frequent in crevices in timbers in old barns and stables.
Myotis emargiantus	Nursery roosts are mainly located in roof spaces (e.g. attics and haylofts). In the roosts, the animals mostly hang free, or more rarely are found in confined spaces, such as in mortise joints. It uses comparatively light and only moderately warm spaces that are well structured, for example by having several different levels.
Myotis mystacinus	Crevice dweller, but may enter roof voids and fly around, often located behind vertical outer wall coverings.
Myotis accathoe	Crevice dweller
Myotis brandtii	Crevice dweller, but may enter roof voids and fly around. In buildings, hanging places are encountered particularly in lofts, although the animals populate the nooks and crannies (e.g. in false ceilings, gaps between beams, or between metal sheeting and wall, as well as holes in beams).
Myotis daubentonii	Hole dweller. May enter roof voids and roost at apex. Relatively rare in houses sometimes found in wall facades and behind window shutters or the casings for roller shutters, but may use castles, tunnels etc. Nurseries and also colonies of males can be found under bridges.
Myotis dasycneme	Check Limpens et al.
Nyctalus noctula	Hole dweller. Seldom found in houses, but can be found in cervices in higher floors of block of flats, sometimes also in church attics and bridges.

Nyctalus leisleri	Crevice/hole dweller. Sometimes in buildings, but unlikely to fly inside.
Pipistrellus kuhlii	Crevice dweller found in wide range of cracks and small hollows, such as shutters, roller shutter boxes, fissures in walls, in wall facades, false ceilings or crevices in the roof area. Winter roosts are found in buildings. These can, for instance, be in hollow spaces in walls, and their facades.
Pipistrellus nathusii	Crevice dweller.
Pipistrellus pipistrellus	Usually use crevice roosts, such as exterior wall cladding, roller shutter boxes, false ceilings, flat roof cladding, hollow blocks of un-plastered house walls, shutters, hiding places in roofs as well as cracks in walls. Additionally, tree hollows and nest boxes are also used as mating roosts, and individual animals can be found in a great variety of hiding places. Does not normally require light-sampling areas.
Pipistrellus pygmaeus	
Eptesicus serotinus	Roosts in roof spaces. However the hanging places are mostly well hidden in crevices (chimney breasts, ridge boards, etc) as well as behind wall facades, or in roller shutter boxes.
Eptesicus nilssonii	Crevice dwellers. Where?
Eptesicus botae	
Vespertilio murinus	Crevice dweller. Usually associated with blocks of flats and private house dwellings.
Plecotus auritus	Hole dwellers. Readily fly within roof voids, churches, private houses. Often in crevices in the roof frames by day, although sometimes in the open.
Plecotus macrobullaris	
Plecotus austriacus	
Plecotus kolombatovici	
Barbastella barbastellus	Crevice dweller; may require light-sampling areas. Roosts behind window shutteres, behind outer wall panneling and similar crevices.
Miniopterus schreibersii	In the northern part of its range, some nursery groups are found in church lofts or towers; requires large entrance openings.

For species that fly within roof voids, notably species of horseshoe bats and long-eared bats, it is essential that a sufficiently large space, unobstructed by constructional timbers, is available for the bats to fly in. Based on a sample of known roosts, it is unlikely that a void height (floor to ridge board) of less than 2 m will provide sufficient volume or that an apex length or width of less than 4 m will provide sufficient area. An ideal roof void would have an apex height in excess of 2.8 m and a length and width of 5 m or more (Mitchell-Jones, 2004). These species are generally found in older roofs of traditional construction giving a large uncluttered void, so typical trussed rafter construction must not be used. Suitable construction methods are purlin and rafter ('cut and pitch') with ceiling ties or possibly attic trusses, which are designed to give a roof void large enough to be used as a room.

Some recent UK studies on Natterer's bats in barns due for conversion have illustrated some of the difficulties of maintaining appropriate roosts. In these cases, bats were roosting in mortise joints, which presumably mimic tree cavities, and using the void of the barn as a light-sampling area. In several cases, the bats abandoned the site after conversion, probably because insufficient 'indoor' flight opportunities remained. Full details and recommendations can be found in Briggs (2002).

5.4.2.2 Roost entrances

Horseshoe bats and *Miniopterus schreibersii* generally prefer entrances they can fly through (see Mitchell-Jones & McLeish (2004) Chapter 11 for details and designs), but other species will generally use smaller holes or slits to crawl through. Wherever possible, it is preferable to maintain entrances in their original position so the bats will have no difficulty finding them. Retention of vegetation close to roost entrances can also be important. This provides continuity of flight routes and may also deter avian predators. External lighting, such as security lights or road or path lighting, close to roost entrances should be avoided (see Downs *et al*. 2003; Reiter & Zahn 2006).

PHOTO OF ROOST ENTRANCE

5.4.3 Incorporating new roosts into buildings

The extent to which new roosts can easily be incorporated into new or refurbished buildings depends on the species of bat and the type of building. For those species that require a large roof void to fly in, principally horseshoe and long-eared bats, careful attention must be paid to the design in order to provide a suitable roof void. See above for guidance on roost size and construction and note that trussed rafter construction should normally be avoided. For species that typically roost in crevices, roosting opportunities can be provided in a variety of ways including:

- access to soffits boxes and eaves via a small gap (15-20 mm) between soffits and wall
- timber cladding mounted on 20-30 mm counter battens with bat access at the bottom or sides
- access to roof voids via bat bricks, gaps in masonry, soffit gaps, raised lead flashing or purpose-built bat entrances
- access to roof voids over the top of a cavity wall by appropriately constructed gaps.

As well as suitable access points, bats also need suitable roosting sites and an appropriate temperature regime.

Most species of bats appear to prefer roosting on timber rather than brick, stone or other similar materials, so the provision of rough timber surfaces may be helpful. Bats may also roost by clinging on to roof lining materials, especially around the roof apex and 1m or more down the slope. Some types of modern plastic roof linings are too smooth for bats to cling to and should be avoided where possible. If their use is essential, rough timber planks should be placed along the ridge beam to provide roosting opportunities.

For maternity roosts, bats appear to prefer maximum daytime temperatures of between 30º and 50ºC, so it is important that the roof receives full sunlight for a large part of the day. This can be assisted if the roof has two ridges at right angles, oriented to capture sunlight throughout the day. As an alternative, a combination of baffles and electric heaters can be used to produce pockets of warm air at the apex of the roof. This technique has been used successfully with horseshoe bats and would probably be suitable for other species as well.

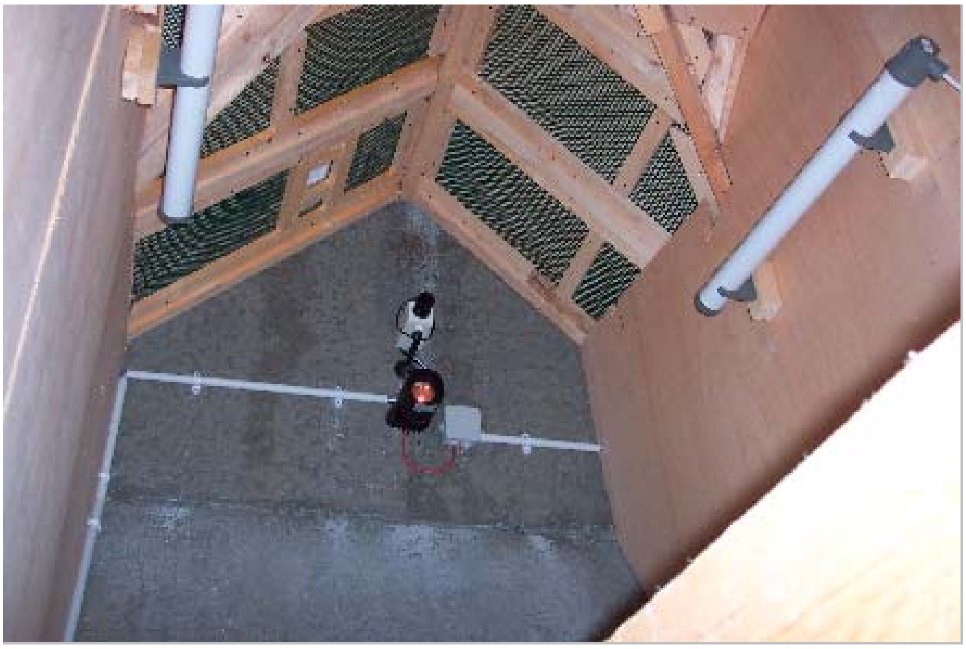

Fig XXX. Roof space modified as nursery area for lesser horseshoe bats with baffles and electric heaters on either side (and video camera for remote monitoring) Co. Clare, Ireland.

Where space permits, large 'bat-boxes' can be built into existing roofs. This approach has the advantage of providing some segregation between the bats and the human occupants of the building. Detailed guidance is given in the Scottish Natural Heritage (SNH) publication *The design and construction of bat boxes in houses* (Simpson & Brown Architects, 1996). SNH have recently published a follow up report which includes sugested modifications to previous designs (Bat Conservation Trust, 2006). For some practical examples of mitigation measures and alternative roosts see also Reiter & Zahn (2006).

One problem with providing roosts in buildings intended as dwellings may be acceptability to the future inhabitants and for this reason planners and developers are often reluctant to adopt this solution. There is much to be said for providing a dedicated bat roost as these problems of acceptability can be greatly reduced. Mitchell-Jones (2004) provides extensive advice on the design and construction of such dedicated roosts.

Case Study 4: Glaninchiquin, Kerry, Ireland

When an old cottage which contained a colony of *R. hipposideros* was being renovated in south-west Ireland an adjacent outbuilding was modified to provide an alternative roost.

PHOTO

***Fig. XXX** Outbuilding at Glaninchinquin renovated to allow lesser horseshoe bats roost in the attic. Arrow indicates access point made for bats into attic space.*

A maternity roost of c. 150 *R. hipposideros* was heavily disturbed in the summer of 2004 as a result of renovation works to an old cottage in Kerry in south-west Ireland. Despite the high level of disturbance, the female bats (with young) remained in the gutted building until the autumn of 2004. Inclusion of a suitable roost in the renovated cottage was not feasible, so it was decided to undertake works to an adjacent stone outbuilding to accommodate the bats. The outbuilding, which was 12m by 5m and approximately 10m from the original cottage, was roofed with slate, with an underlay of mineral felt.

A loft was created in the building, with two trap doors and an access point in one of the gables directly into the loft (the original roost had also had a direct gable entrance into a loft). The floor of the loft was insulated to help minimise disturbance as the owner planned to store materials on the ground floor of the outbuilding.

The original roost had a count of 150+ bats in 2003, the year prior to disturbance, and c130 in 2004 after the roost had been gutted. The new roost was constructed at the end of 2004 and by May 2005, the bats had moved in. The peak count for the new roost in 2005 was c120. Bats were not able to enter the original roost by this time as all access points had been sealed. The peak count in the new roost in 2006 had risen to 130+ animals.

5.4.4 Barns

Old barns play an important role as roosts for some bat species in certain countries. A study in the UK has shown that many old timber-framed barns, some dating back several centuries, are now being converted into dwellings. Briggs (2002 and 2004) found that the vast majority (77%) of converted barns have not maintained their bat species and she questions whether barns with bats should ever be converted. She looked at how bats could best be accommodated in these conversions and provides details of mitigation measures that should be built into future barn conversion designs. The features covered include:

- Species specific design
- Roost site retention
- Light pollution
- Access
- Conservation and enhancement of adjacent habitats
- Timing of the works

The reader is referred to Briggs (2002 & 2004) for further details.

Case Study 5. Paston Barn, England

Paston Barn was built in 1581 and is home to a breeding colony of *Barbastella barbastellus* as well as *Pipistrellus pipistrellus* and *Myotis nattereri*. The building is owned by the North Norfolk Historic Buildings Trust, which had initially planned to turn the barn into a visitor centre for the nearby gas works before the bats were discovered. English Nature has now taken a 50-year lease on the building.

The barn has been subject to massive renovation over the last few years, including complete re-thatching, re-pointing, replacement of doors, and restoration of its associated buildings. A steering group, including BCT, English Nature, the local bat group and the buildings trust, has controlled restoration work at the site. Measures to minimise the disturbance to the bats have included timing of works outside of the breeding season (though due to delays work sometimes overran), replacing doors with temporary structures while work was done off site, use of traditional materials and carrying out work by hand where possible. The roost spaces above the lintels, which were favoured by the Barbastelles, were maintained and the new doors were constructed to give continued access for the bats.

PHOTO

The collaboration of all parties and the sensitive nature of the works to date have ensured the continued use of this historic barn by the bats.

5.4.5 Bridges

Bridges are not technically buildings. However, bridges are known to be of particular importance for at least 13 species of bats across Europe (see Table 1). Old bridges, normally made of stone, regularly form part of our cultural heritage as well. These are subject to different types of disturbance and require different forms of maintenance to other man-made structures which might host bat roosts. We provide some general guidelines here on the protection of bats in these structures.

In older, smaller, stone bridges bats are commonly found in small numbers. A survey of 200 known bridge roosts of *Myotis daubentonii* in Ireland showed that 75% were occupied by 1-5 bats and only 5% held 20 or more bats. Individual bats will use crevices as small as 50mm deep and 12mm wide, but larger groups require bigger, deeper roosting sites. Large, concrete motorway bridges with big interiors can provide shelters for many bats (e.g. one of the biggest known maternity roosts of *Rhinolophus hipposideros* in Austria is found in such a bridge)

Société Française pour l'Etude et la Protection des Mammifères (SFEPM) have produced a useful leaflet (in French) about the use of bridges by bats. The leaflet can be downloaded here:
http://www.sfepm.org/NuitChauveSouris/images2/Savoirplus/plaqponts.pdf
They estimate that about 10% of bridges in France are used by bats and provide helpful advice on how to accommodate bats in both old and new structures.
[Expand further to include the study of Dietz 2000]

5.4.5.1 Bridge surveys

Bat surveys of bridges require a certain degree of expertise. Likely roosts can be identified quite readily, providing there is convenient access to the underside of the bridge, but determining whether they are used by bats is not always easy. The presence of bat droppings may provide a clue, but a fibrescope may be necessary to investigate some cracks. If there is evidence that a bridge is used by bats then the national nature conservation organisation should be contacted and measures should be taken to ensure that any impact on bats is avoided, or, where this is not possible, minimised.

5.4.5.2 Mitigation measures

In general the bridge should be as suitable for bats after the required works as it was before. In some cases it may be possible to improve conditions for bats by incorporating specific bat roosts into the structure. As with restoration work of other structures of cultural heritage importance, timing the works to coincide with the period when bats are absent may be sufficient to avoid any impact.

In most cases, the implementation of the following mitigation measures should ensure that bridge renovation works do not negatively impact on bats:

- Careful timing of the works, especially if breeding or hibernating bats roost in the bridge
- Preserving individual roosting spaces wherever possible
- Hand pointing in sensitive areas, e.g. around crevices to be retained
- Creation of new roosts – bat bricks or boxes can be incorporated into a bridge to replace lost crevices.

Case Study 6. Lisconny Bridge, Sligo , Ireland

Lisconny Bridge is a beautiful five-arch masonry bridge spanning the Unshin River in north-west Ireland. It is as approximately 200 years old and in 2003 it was determined that the bridge was in need of major strengthening work. There was a large deep fissure running across two of the arch barrels. In addition, the bridge abutments were being seriously undermined by the river and were becoming unstable.

The bridge was known to hold a nursery roost of approximately 25 *Myotis daubentoni*. The roost was located in a deep fissure running across the barrel of one of the arches. Several other crevices were also being used by individual bats. A bat expert was employed by the local authority to work with the local engineer and with the contracting firm –Leamac Ltd, (an engineering company which specializes in the restoration of heritage bridges). It was agreed that 3-4 small crevices would be retained under each arch for individual bats. These were ring-marked with white paint before work began. It was also agreed that sections of the large fissure would be left open to accommodate the nursery colony.

Fig. XXX: Lisconny Bridge, after restoration [©Caroline Shiel]

Strengthening works commenced at the end of September 2003. This included the laying of new cement floors under the arches, pressure grouting to fill internal voids in the bridge and pressure pointing under the bridge arches. Prior to pressure pointing all crevices that had been marked for retention were blocked with polystyrene to prevent the infill of grout. Crucially, a fine nozzle was used to apply grout to the undersurface of the arches. The work was done carefully to fill in voids around the stonework so as not to cover the surface of the stones and not to spray over targeted bat crevices. Not only did this allow the bat crevices to be maintained, but it also retained the beauty of the bridge's stonework.

Works were completed by late October. In early July 2004 only 4 bats were recorded in the nursery crevice. However, most of the other smaller crevices which had been retained held single bats. In July 2005 a nursery colony of approximately 25 were recorded bats in the nursery site where they were first recorded in 1988. Lisconny Bridge is an excellent example of how bats can be accommodated during bridge strengthening procedures. But it also clearly illustrates that close liaison between a conscientious contractor and bat specialist is necessary both prior to and during strengthening works.

Fig. XXX: The three sections of the deep fissure that were left open to accommodate the nursery colony of Daubenton's bats. The nursery roost is located in the lowest section. Note how the stonework was carefully grouted around and not over.

A further bridge repair case study can be viewed here:
http://www.whelan.me.uk/bats/Tattynure/BatsAndDippersInBridges.htm

5.4.6 Timber treatment, pest control and lead poisoning

Repair and restoration of old buildings often requires timber treatment against infestations of wood-boring insects. *In situ* remedial timber treatment with organochlorine insecticides and some fungicides is thought to be a significant cause of bat mortality across Europe (Hernandez *et al.*, 1993; Jefferies, 1976; Racey & Swift 1986). In recent years, the widespread replacement of certain toxic chemicals, such as lindane, with relatively harmless alternatives (e.g. synthetic pyrethroids) has improved the situation for bats. Nonetheless, the guiding principle is that treatment should take place at a time when no bats are present. In most situations, where bats are only present seasonally, this is fairly straightforward. Certain species, however, may be present in buildings all year round and there is no ideal solution in these cases. Advice should be sought from the SNCO.

The control of pest insects or rodents need not lead to any disturbance of bats providing it is done sensitively. Ideally any treatments would be applied while bats are not using the roost, but localised applications of insecticide powder or rodent poison is unlikely to harm bats. If the control work must be done while the bats are present and needs to be more extensive then advice should be sought from the SNCO. Extensive guidance on best practise in the areas of timber treatment and pest control is given in the JNCC's Bat Worker's Manual (Mitchell-Jones & McLeish 2004).

Fig. XX Ch. de Trevarez, Breton, France

A particular problem with some older buildings is the existence of lead based paints on girders or other metal structures. Bats can develop lead poisoning by ingesting flakes of this paint during grooming. Such a situation arose in the Chateau de Trevarez in north-west France. The chateau contained a nursery roost of 300 *R. hipposideros*. Lead poisoning was found to be the cause of high juvenile mortality at the site and in this case it was decided that the best solution was to build a new roost for the bats.

6. Literature and further reading

http://www.nationaltrust.org.uk/wildbuildings/html/roof/bats/index.htm

http://www.npta.org.uk/bats.htm

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Appendix 1 Working Group members

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Appendix 2 Questionnaire

Intersessional Working Group 5 - Protection of overground bat roosts

Resolution 4.9; 3a) states that:
Information on methods used to protect roost sites other than underground sites should be gathered by the Advisory Committee, with roost sites in buildings that are part of the cultural heritage as a priority.

QUESTIONNAIRE

Country:	………………………………………………………………………..
Completed by:	………………………………………………………………………..
Contact details:	………………………………………………………………………..
Date:	....

General

1) Is there a national bat roost database for your country? Y / N

2) If you know who holds this database, please give details here ………………………………..

………..

………..

3) Does it allow you to identify roost types? Y / N

4) What type of overground roosts is used by which species of bats in your country?
Please indicate the dependence of individual species on specific roost types as High **(H),** Medium (**M**), Low (**L**), not important (-) or not known (**?**).

Species	Overground roost type						Other, please specify
	Church	Castle/ Fortification	House/ block of flats	Barn / Stables	Bridge	Tree	
Rousettus aegyptiacus							
Taphozous nudiventris							
Rhinolophus blasii							
Rhinolophus euryale							
Rhinolophus ferrumequinum							
Rhinolophus hipposideros							
Rhinolophus mehelyi							
Barbastella barbastellus							
Barbastella leucomelas							
Eptesicus bottae							
Eptesicus nilsonii							
Eptesicus serotinus							
Hypsugo savii							
Myotis alcathoe							
Myotis aurascens							
Myotis bechsteinii							
Myotis blythii							
Myotis brandtii							
Myotis capaccinii							
Myotis dasycneme							
Myotis daubentonii							
Myotis emarginatus							
Myotis hajastanicus							
Myotis myotis							
Myotis mystacinus							
Myotis nattereri							
Myotis nipalensis							
Myotis cf. punicus							
Myotis schaubi							
Nyctalus lasiopterus							
Nyctalus leisleri							
Nyctalus noctula							
Otonycteris hemprichii							
Pipistrellus kuhlii							
Pipistrellus nathusii							

Pipistrellus pipistrellus							
Pipistrellus pygmaeus							
Plecotus alpinus							
Plecotus auritus							
Plecotus austriacus							
Plecotus kolombatovici							
Plecotus sardus							
Vespertilio murinus							
Miniopterus schreibersii							
Tadarida teniotis							

Administrative and practical protection

5) Are bat roosts legally protected? Y / N

If yes, please give details of the legislation (e.g. "Irish Wildlife Acts (1976 and 2000) protect all bat roosts from intentional disturbance or destruction") :

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

6) Are some roosts protected through state ownership or NGO ownership? Y / N

7) Is there physical protection of overground roosts in your country? Y / N

If yes, what forms of protection are used?

a) Grilling Y / N
b) Fencing Y / N
c) Blocking up Y / N
d) Access restriction Y / N

Other, please specify:
……………………………………………………………………………………..

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Interactions with built heritage

8) Can conservation of built heritage (e. g. churches, castles) conflict with bat conservation? Y / N

9) What types of conflict arise?

a) Disturbance of bats by humans Y / N
b) Disturbance of humans by bats (e.g. noise) Y / N
c) Damage to property by bats Y / N
d) Exclusion of bats from buildings / bridges / trees Y / N

Other, please specify:
………………………………………………………………………………………..

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10) Please give an example, if you have one, of how such conflict has been successfully resolved.
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11) Is it a legal requirement to carry out bat surveys before renovation / restoration works of buildings of cultural importance? Y / N

12) Where bats are known to be present in a building of cultural importance due for renovation / restoration, are mitigation measures for the conservation of the bats legally required ? Y / N

If yes, what forms of mitigation are practised?

a) Timing of works to minimise disturbance Y / N
b) Creation of limited access areas to protect bats Y / N
c) Translocation of bats Y / N
d) Provision of alternative roosts Y / N
e) Exclusion of bats Y / N

Other, please specify:
………………………………………………………………………………………..

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13) Is there information / education (e.g. advisory leaflets, training courses) available for owners of cultural heritage buildings / cultural heritage officials / architects etc. about bat conservation?
Y / N

If yes, please give brief details:
……………………………………………………………………………

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14) Please list relevant literature and/or web pages on conservation measures for bats in overground roosts.
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Thank you for taking the time to complete this questionnaire!

Appendix 3 Summary of questions on dependence of bat species on overground roost types

Number of countries with estimated dependence of bat species on overground roost types. (dependence: high (**H**)**,** medium (**M**), low (**L**), not important (**NI**), not known (**?**), just present (**P**); by combination of the estimation categories the higher dependance was considered; CH categories valid for Switzerland; **bold** are marked values of H & M dependence which sum exceeds 4)

Overground roost type	**Church**						**Castle/ Fortification**						**House/ block of flats (CH Buildings)**						**Barn / Stables**						**Bridge (CH Bridge/Rock)**						**Tree**					
Species	**H**	**M**	**L**	**NI**	**P**	**?**	**H**	**M**	**L**	**NI**	**P**	**?**	**H**	**M**	**L**	**NI**	**P**	**?**	**H**	**M**	**L**	**NI**	**P**	**?**	**H**	**M**	**L**	**NI**	**P**	**?**	**H**	**M**	**L**	**NI**	**P**	**?**
		1	4	9		2	**1**	**5**	1	6	1	3	**2**	**3**	5	5	1	5	3		4	4		5			2	7		7	9	1	3	1	1	5
Barbastella leucomelas			1	1								1						1						1						1			1	1		
Eptesicus bottae				1				1					1											1				1			1	1				
Eptesicus nilssonii	1	3	4	7	1	1	1	3	3	5		2	**7**	**4**	2	2	1	2		2	1	3		5				6		7	2	1	3	2		6
Eptesicus serotinus	**9**	**5**	4	2	1		**3**	**4**	2	5	1	1	**16**	**3**	1		2	1	2	2	4	2		3		2	2	8		2		1	4	6		3
Hypsugo savii		2		7	1	2		2	1	5	1	2	**2**	**4**		3	1	2		1		3	1	5		1		4		5		1		4		4
Miniopterus schreibersii	1	1	2	4		2	1		2	5		2			3	6	1	2			1	5		3				6	1	3				7	1	2
Myotis alcathoe				4						3		1		1		3		1				3		1				3		1	1			2		2
Myotis aurascens				4						3		1	1			2		1	1			2		1	1	1		2						3		1
Myotis bechsteinii		1		11		1		1	3	7		2		1	3	7	1	3		1		8		3		1		8		4	**15**				1	3
	6	**3**	2	2	1		**2**	**3**	3	3	1	1	3	1	2	3		2	1	1		4		3	1	1	1	4	1	3			1	5		3
Myotis brandtii		2	3	8		4	3	1		7		6	**5**	**8**		4		4		2	1	4		8		1		7		8	8	1		2		6
Myotis capaccinii			1	5					2	4					1	5					1	4		1				4	1	2				4		2
Myotis cf. *punicus*				1						1					1	1					1	1					1	1						1		
Myotis dasycneme	**5**	**1**		3		2	**3**	**2**	1	3		3	**6**	**2**	1			3	2			4		4				3		7	1	3	2			5
Myotis daubentonii	1	1	4	7		4	**5**	**2**	4	2		6	**2**	**7**	4	3		4		3	2	6		7	**5**	**3**	7	2	2	5	**19**	**2**			1	4
Myotis emarginatus	**8**	**4**	1	3			**6**	**5**	1	3	1		**3**	**5**	4	2	1	1	3	2	2	3	1	3			1	7	1	5				5		6
Myotis hajastanicus				1						1						1						1						1				1		1		
Myotis myotis	**11**	**3**		1	2		**5**	**4**	2	1	1	1	**4**	**3**	3	3	1			3		5		2		2	2	5		3		1		4	1	5
Myotis mystacinus	2	2	5	6		4	**4**	**2**	2	5		6	**11**	**5**	1	2	2	4	4	1	2	3		8	1	2	1	5		10	**7**	**2**	1	2		8
Myotis nattereri	2	2	3	6		5	**3**	**3**	2	3	1	7	**7**	**5**		2	1	7	2	4	1	2	1	8	1	2	2	6	1	8	**10**	**1**	1			10
Myotis nipalensis				1						1						1						1						1						1		
Myotis schaubi				1						1						1						1						1				1		1		
Nyctalus lasiopterus		1		6				1		5		1		1	1	4		1		1		4		2				4		3	**6**				1	2
Nyctalus leisleri		1		11		3		2		8		4	1	3	5	6	1	3		1	1	7		5			1	8		5	**17**				2	4
Nyctalus noctula	3	1	3	6		3	2	1		9		4	**9**	**4**	3	1	1	2	1		1	7		6	1	1	2	5		7	**21**				2	3
Otonycteris hemprichii				1						1						1						1						1						1		
Pipistrellus kuhlii	**3**	**2**	2	6	1	1	**2**	**3**		5	1	2	**12**	**2**		1	1		3	1	1	4	1	3	2	1		5	1	3	2			4	2	6
Pipistrellus nathusii	2	2	3	8		3		2	3	7		3	**11**	**5**	1	2	1	3	2	1	3	5		6	2	1		6	1	7	**17**	**2**	1			4
Pipistrellus pipistrellus	**8**	**3**	4	4	2	1	**5**	**3**	3	4	2	3	**18**	**4**		2	3	1	**5**	**2**	4	3	1	4	3	1	4	4	2	5	**8**	**2**	3	1		6
Pipistrellus pygmaeus	**4**	**1**	4	6		3	**3**	**2**		5		6	**8**	**4**		3		6	3	1	2	1		9	2	1		5		8	**8**	**3**	1	1		8
Plecotus auritus	**12**	**5**	4	3	2	2	**7**	**4**	3	1	1	5	**10**	**8**	2	1	2	2	**2**	**4**	6	2		7		2	1	6		10	**11**	**5**	1		1	6
Plecotus austriacus	**9**	**3**	3	1	1	2	**6**	**2**	3			4	**7**	**3**	3		1	3	2	2	3	2		4		2		5		7	2	2		3		7
Plecotus kolombatovici				1						1						1						1						1						1		
Plecotus macrobullaris	**2**	**3**	1	1	2			2		1		2	1	3		1		1	1		1	2		2				3		2		2	1	2		2
Plecotus sardus				1						1						1	1					1						1						1		
Rhinolophus blasii		1	1	3				1	1	3					1	3					1	3						3		1				3		1
Rhinolophus euryale	2		1	5			1		2	5					3	5					1	7						5	1	2				6		1
Rhinolophus ferrumequinum	**6**	**2**	4	2	2	1	**4**	**5**	4		2	1	**3**	**7**	4	2	1		2	2	5	4		1	2		1	6	1	3				11		1
Rhinolophus hipposideros	**5**	**4**	4	4	2		**7**	**5**	4	1	2		**7**	**5**	3	1	2		4		7	4	1		1	2	2	4		4			1	10		2
Rhinolophus mehelyi		1	1	5		1				5		2				5		2				5		2				5		2				7		1
Rousettus aegyptiacus				1						1						1						1						1						1		
Tadarida teniotis			1	4	1					2		1		1	1	1	1	1				2		1	1		1	2		1	1			2		1
Taphozous nudiventris				1						1						1						1						1						1		
Vespertilio murinus	1		4	6		4	1		2	5		6	**14**	**5**		1		2	2		1	3		9			1	3		9	2	1	2	3		8

Appendix 4

EUROBATS Resolution No. 5.7 Guidelines for the Protection of Overground Roosts, with particular reference to roosts in buildings of cultural heritage importance

scan of resolution

Appendix 5.

Summary of good practise for protection of overground roosts

(particularly those in buildings of cultural heritage importance)