8th Session of the Meeting of the Parties

Monte Carlo, Monaco, 8 – 10 October 2018

Resolution 8.9

Bats, Insulation and Lining Materials

The Meeting of the Parties to the Agreement on the Conservation of Populations of European Bats (hereafter "the Agreement"),

Recalling Article III of the Agreement, especially paragraphs 1 and 2;

Noting that bats use a network of roosts in buildings as breeding, swarming, hibernation and transient roosts;

Further noting that bat colonies roosting in buildings are seriously endangered by insulation programmes which do not take adequate account of the presence of bat roosts and that some EU-financed schemes to promote the installation of insulation are in conflict with policies to conserve bats;

Recalling Resolution 5.7 on Guidelines for the Protection of Overground Roosts, with particular reference to roosts in buildings of cultural heritage importance, which recommends to ensure that overground roosts are managed in accordance with national nature conservation legislation and taking note of any guidelines adopted by the EUROBATS Agreement;

Recalling Resolution 8.3 on Monitoring of Daily and Seasonal Movements of Bats with regard to ensuring effective protection of migratory species and their habitats and surveying breeding and hibernation areas, migration routes and stopover sites, because species threatened by insulation include distance migratory species;

Recalling Resolution 8.5 on Conservation and Management of Important Overground Sites for Bats with regard to the EUROBATS list of important overground roosts;

Recalling previous decisions of the Convention of Migratory Species which also include the protection of migratory bats, their roosts and foraging sites;

Recalling that the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the

Committee of the Regions “Roadmap to a Resource Efficient Europe” (COM/2011/0571) recommends strengthening policies and activities for promoting energy efficiency in buildings, with consideration of the wide range of environmental impacts of buildings;

Recalling Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings promoting the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost effectiveness, especially the obligation to set and apply minimum requirements for new and existing buildings;

Recalling the EU Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage, which obliges EU members to take measures to prevent, mitigate and compensate significant damages to protected species;

Recalling the Kyoto Protocol to reduce CO_2 emissions in context of combatting climate change, that buildings are responsible for more than one third of total energy use and associated greenhouse gas emissions in society, both in developed and developing countries (http://www.unep.org/sbci/pdfs/BuildingsandCDMreporteversion.pdf) hence insulation is important;

Recognising that insulation of buildings can cause bat fatalities and loss of roosts, which can negatively impact bat populations;

Recommends Parties and non-party Range States to:

1. Ensure that insulation projects are undertaken in compliance with national legislation regarding bat protection and conservation by implementing appropriate pre-insulation surveys and assessments, mitigation and compensation to avoid roost loss and bat mortality.
2. Put in place mechanisms for post-insulation monitoring to ensure mitigation and compensation has been implemented, and to assess the efficacy of mitigation measures.
3. Where mitigation and compensation measures are not effective, encourage the development of new approaches.
4. Take into account, when assessing the importance of individual losses, that the cumulative impact of fatalities and loss of bat roosts in buildings can lead to detrimental effects on bat populations.
5. Resolve any possible conflict between insulation regulations and bat conservation.

6. Include bats in the impact assessment of insulation programs at a strategic level.
7. Recommend appropriate awareness-raising campaigns, training and information materials for public and stakeholders involved in insulation projects about bat protection in buildings.
8. Encourage the sharing of data and good practice in relation to bats and insulation;
9. Encourage the collation of standardised bat records (for example, by setting up a database), so these are easily available to bat experts and officials.
10. Develop appropriate national guidelines, drawing on the general guidance to be finalised by the Advisory Committee.

Instructs the Advisory Committee:

1. To finalise draft Guidelines for Bats, Insulation and Lining Materials, currently available as Annex to this Resolution.
2. Publish the Guidelines following circulation to all Parties for approval.

Decides to repeal Resolution No. 7.11

Annex1

Bats, Insulation and Lining Materials
Edited by Kit Stoner (BCT)

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Contents

Introduction

Buildings are responsible for more than one third of total energy use and associated greenhouse gas emissions in society, both in developed and developing countries. Therefore insulation to control energy loss is important; but bat colonies are seriously endangered by insulation programmes which do not take adequate account of the presence of their roosts. Moreover, some EU-financed schemes which promote the installation of insulation are coming into conflict with policies to conserve bats, because EU members are obliged to take measures to prevent, mitigate and compensate significant damage to protected species.

Bats use a network of roosts in buildings as breeding, swarming, hibernation and transient roosts. Large-scale insulation of buildings causes fatalities and loss of roosts, which influence bat populations not only at local level, but also impact on migratory bats which often use roosts in buildings. These impacts should therefore not be underestimated.

Overground roosts should be managed in accordance with national nature conservation legislation and guidelines adopted by the EUROBATS Agreement. EUROBATS has already published guidance on the conservation and management of bat roosts in a variety of situations, but this is the first time the insulation problem has been looked at in detail.

This document summarises accesible data from European countries and adjacent territories and suggests solutions for different insulation methods, with case examples from specific countries.

1. Situation in Europe and adjacent territories – short overview

Analysis of the situation in Europe is based on results of questionnaires from 31 Parties and non Party-range states. The situation in Europe and adjacent states varies. In the north, almost all or all buildings are already insulated, where as in some southern countries insulation is used only on new buildings and the old ones so far remain without insulation. In post-communist states, insulation mostly occurs on housing estates of panel houses, whereas coastal west countries face rapid insulation of individual private houses.

In total, 20 countries are involved in insulation programs. Authorities of 26 countries do not request any pre-insulation survey to get permission prior to renovation or insulation and only 12 countries can stop (by statutory means) the insulation process when bats are found. Ten countries use compensation measures after or during insulation; however, there are not many studies about the effectiveness of the chosen mitigation measures. Post-insulation surveys are only carried out in four countries.

Most often insulated structures are private houses, office buildings and panel houses (blocks of flats); occasionally there are other buildings such as churches or monasteries. Most funding comes from private resources or local funds, but eight countries also use EU grants fo finance their insulation programs. The most affected species are pipistrelles (Pipistrellus kuhlii, P.nathusii, P.pipistrellus, P.pygmaeus) and serotine bats. In countries with panel houses the most affected species also include noctule and parti-coloured bats (fig 1.).

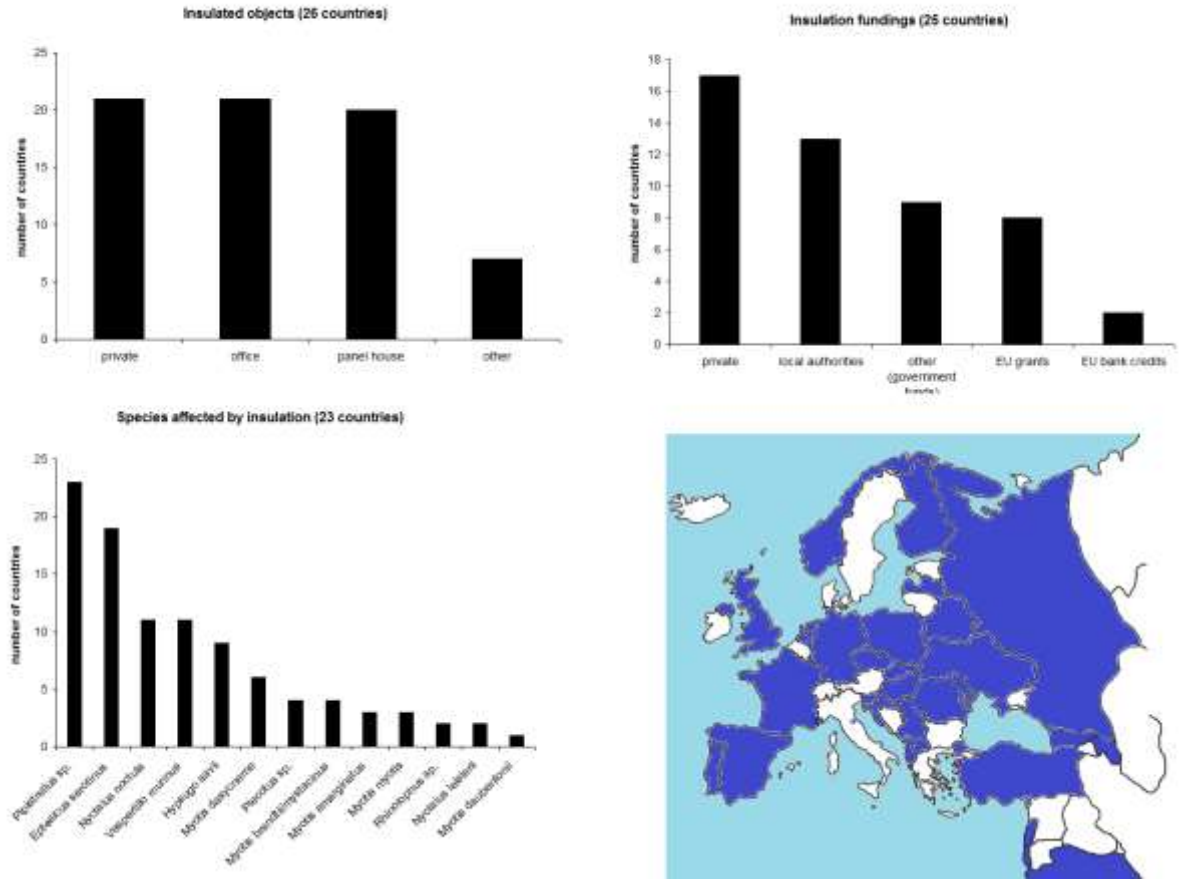


Fig.1. Bats and insulation – results from 31 questionnaires: 20 have countries are involved in insulation programs.

Only three countries have developed national guidelines detailing survey methodology prior to building insulation. However, seven countries raise awareness using information sheets and booklets or by publishing possible solutions on websites, and four countries held workshops and training sessions in relation to bats and insulation. Cooperation among stakeholders (builders, owners, state conservancy organisations) is established in eight countries.

The problem of bats and insulation is widespread and due to the migratory behaviour of several affected species, is also transboundary – the situation in one country can influence the situation in another country. Methods used in insulation are different depending on the type of building, area of building to be insulated and the company involved, who will offer their own knowledge.

We hope to build understanding of how insulation impacts bats on a global transboundary level, suggest solutions and establish cooperation at an international level.

2. Bat life strategies and insulation

Due to loss of natural roosts bats learn to inhabit also man-made structures, and they can thus get into the conflict with humans. Bats use a network of roosts in buildings as breeding, swarming, hibernation and transient roosts, and are endangered by insulation, renovation and demolition of buildings.

2.1. Life strategies

Critical period, when the large renovation works should be done, should be determined on the basis of appropriate survey.
Typical model of bat cycle (fig.2) varies accross Europe, nevertheless it has basic common characters:

- hibernation during winter period
- migration in spring
- summer colonies of females (maternity colonies)
- migration in autumn and autumn swarmig and mating

Fig.2. Cycle of bats living in temperate zone.

2.1.1 Hibernation period (winter)

During mild winter, hibernation can be interrupted and bats can appear inside building. The same behaviour was recorded in some types of roosts also in cruel winter, because residents both heat and ventilate more.
In southern countries bats can be active almost whole winter period. In countries with winters belw zero, even the large number of bats can be easily overlooked because of winter sleep and bats can be wall up in their roosts especially in case of using polystyrene or glas-fiber wall padding. Also visual inspections of deep cavities is not always reliable.

2.1.2. Migration period (spring and autumn)

Population can be mixed in particular roosts in spring time. Migratory distances can reach over 2000km. during migration could be pattern of occurence in the roost random and greatly vary during nights; number of bats can be underestimated or overestimated.

2.1.3. Maternity colonies (summer)

Colonies can reach even thousands of individuals. Bat juveniles stay inside the roost until they are fledged. If disturbed, mothers can abandon the roost together with juvenile, but also abandon their juveniles. Also part of adult bats abandon roost and part of adult bats stay inside. Males can form colonies or roost as solitaires

2.2. Types of roost in insulated buildings

All roosts of bats are protected but in some situation the exclusion of bats is necessary according to specific case depending on type of roost, season of year and facilities of bat experts or organisations. Presence of bats in the roost could both remarkable and discreet depending on season, number of bats, and type of the roost. Traces of their stay include pellets under the roost or stuck on facade, odour, noise, dark colour of roost entrance and evening or moring activity around the roost. Following the described bat cycle, bat worker must consider several points.

Fig.3. Example of bat roosts in not-insulated block of flats.

3. Pre-insulation survey

Ideally, prior to ratification of insulation projects by authorities, a pre-insulation survey should be done. Surveys should be done by bat specialists equipped with appropriate squipment, for example, ultrasound bat detectors, endoscopes, etc. A pre-insulation survey will ensure that bats are considered at an early stage and therefore reduce the likelihood of conflict between nature conservation agencies and construction companies. The process for obtaining pre-insulation surveys is different in different countries, but bat presence must always be assessed so that the correct techniques and mitigation can be applied if needed.

Tab.1. Possibilities of pre-insulation survey.

Rate of insulation	**Slow and moderate**		**Rapid (1 day)**	
type of insulation	polystyrene	wall on wall	cavity wall „house to house“	Fibreglass loft insulation
complex building	full survey/ critical period	full survey/ critical period	not applicable	assessment
single storey	full survey/ critical period	full survey/ critical period	assessment	assessment
individual house				

3.1 Pre-insulation survey scheme – slow and medium rate of insulation (e.g panel houses)

It is essential that all construction works are undertaken at the correct time of year. Bats may occupy the roosts at different times of the year. No construction works should be carried out when a maternity colony with non-volant juveniles is present (approx. from mid May till mid August) or where hibernating bats are present (approx. from early November till late March). Where construction works cannot be timed appropriately for unavoidable reasons (e.g. to meet a subsidy deadline) and some element of the works need to be carried out in the critical periods mentioned above, the situation can be resolved by using one-way closure of the roost entrance. This is not appropriate for use where non-volant juveniles are present as they will not be able to leave the roost and the mothers will be prevented from returning, The primary purpose is to maintain the existing roosts with the conditions as close to the original as possible, so that they can continue to be used by the bats after the building renovation.

Ideally the survey should cover the whole of the bat life-cycle. In central Europe bats often use roosts in buildings during whole year and ideally a survey should cover periods of hibernation, migration, and maternity colonies. In northern and southern parts the occurence of bats in buildings tends to be more seasonal, but some species will roost in buildings throughout the year.

The survey method is easy, but takes a lot of time and volunteer capacity.

- on a calm evening before sunset slowly pass along chosen buildings back and forth several times until one hour after sunset and listen to output of bat detectors
- results, both positive and negative, and basic information about the locality should be noted on a form
- ideally, the survey should be undertaken several times throughout the year: firstly during the end of hibernation and start of spring migration, the second and third period is during

maternity season, the fourth period during dispersal of maternity colonies and autumn migration, and the final period in late autumn prior to hibernation.
- if possible, two surveys should be untertaken in each period. Just one survey may give a false impression of absence of bats in a roost.

An surveyor will generally only be able to observe a short section of the building, in order to idenitfy entrance/exit points of maternity colonies or confirm the absence of bats. Long transects can not be recommended, because smaller bat colonies can emerge inconspicuously and fly directly to foraging area. Where bats are observed additional data can be obtained using simple questionnaires given to residents and/or from databases (e.g national faunistic databases, animal rescue centre databases, etc.).

There is often not sufficient time to carry out surveys in all of the periods listed above, because the insulation companies push to carry out their works quickly. Often there is only time for a single survey to assess bat presence in the locality prior to the start of insulation works, and if insulation works start in the cold part of the year, no activity can be recorded at all. If the legislation of the country does not require a pre-insulation survey and the companies put pressure on to continue, the only possibility to assess bat presence and roosting possibilities with the application of passageway bat boxes which avoid possible entrapment of bats in a roost.

Well timed pre-insulation survey and consultation with experts often prevents future complications during construction.

Case examples

3.2 Pre-insulation survey scheme – rapid rate of insulation (e.g private one-store houses)

In areas with private single stored houses where massive quick insulation is done is presumption that on every house have bats their roosts. This scheme where mitigation measures are taken, irrespectible of the precise location or number of roosts and bats, can only be done when the basis for estimates is solid. Therefore several types of urban areas in different landscape, that are a good representatation of all cities etc., should be investigated thoroughly to create the basis for the estimate. Also care should be taken for the different diversity of species in different towns and cities. Peforming night long surveys using static automatic bat detectors can show the species diversity of cities.

Cavity wall insulation is often undertaken rapidly and cheaply, however, it is important that bat presence is assessed so that the correct techniques, timing, and mitigation if needed, can be applied (see Chapter 4.3).

Case examples

4. Methods used in building insulation, main risks, technical solutions, and mitigation

It is important for a bat population that there are sufficient suitable roosting opportunities close to good foraging grounds. A town or part of a city can be be regarded as a colony's home range, and this is an important consideration for planning insulation schemes. A policy aimed at always providing sufficient roosts of sufficient quality, regardless of the type of house, block or flat to be insulated, will be beneficial for bats and will not delay insulation works.
Depending on the type of building and insulation company there are several different materials and methods that can be used. However, there are some basic principles that should be followed for all construction works. All works should be undertaken before winter, as it can be hard to locate mass hibernacula of some species. All work should be undertaken when bats are not inside the roost to prevent victims during insulation works.

- Avoid working during the most ‚vulnerable' periods: maternity season and winter season
- Any modifications should preserve the quality and conditions of the roost
- Where it is not possible to keep the roost because of technical or other unavoidable reasons, exclusion devices must be put in place prior to the start of constrution so tha bats can leave the roost but are not able to return. This process must be supervised by a suitably experienced ecologist.
- Damage of the roost should be compensated by appropriate mitigation measures guided by a suitably experienced ecologist

4.1. Polysterene or glass-fibre boards

Where legislation and construction rules allow, extensive insulation use of polystyrene boards is successfully used in many countries for the isolation of **panel buildings**. A cheaper option it is also sometimes used: the plugging of all gaps with foam. In older panel buildings bats (mainly noctules, parti-couloured bats, serotines and pipistrelles) roost in a number of parts of the building: for example, the space behind ventilation holes which lead to the space under the roof or into the pantry; fissures between panels, crevice be isolation and cladding of roof and balcony; construction joints, etc (fig X). In many cases, bats have been found to use these roosts throughout the whole year. As a cheaper option it is also used the plugging of all fissures by foam.

4.1.1. Main threats to bats

Using this technique runs the risk of blocking all entrances to the roost, resulting in the **bats becoming entombed** inside the roost. It is also possible that hibernating bats or maternity colony will be uncovered when parts of the roof are removed at the beginning of the construction works. There is not only a risk to individual **bats being harmed or killed** during insulation works, but also that the whole **roost** will be endangered. The use of insulation using polystyrene or glass fibre blocks is increasing markedly across Europe.

Figs. Left: Hundreds of bats entombed during insulation. Right: Winter colony discoverered during insulation was put in the buckets and left to die.

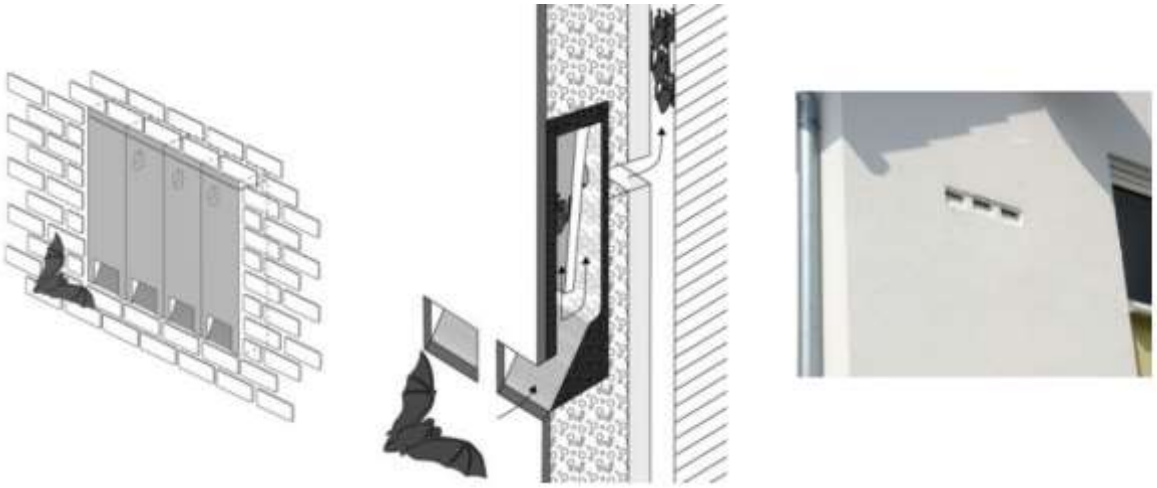
4.1.2. Technical solution

The most important consideration is correct timing of construction works, taking into account the presence of bats identified during pre-insulation survey. The bats‘ lifecycle must be taken into account. The priority is to conserve the bat roost. Ideally the roost should remain unmodified or as close to its original state as possible. If this is not practical, then the negative impact on the bat colony should be minimised. Solutions which avoid negative impact on the bats and their roost during insulation with polystyrene boards are relatively easy and cheap to implement, but the methods used always depend on the specific situation and should be discussed with project engineer to ensure that conditions such as temperature remaint he same.

4.1.2.1 Crevice roosts

Crevice roosts include gaps between panels, crevices behind isolation and cladding of roof and balcony, and construction joints. These crevice bat roosts are covered by polystyrene blocks during insulation.

If it is technically possible to save the roost, it is recommended that a special ‚passageway‘ bat box is installed to act as an access point for the bats; this has entrances on both sides and enables bats to enter the original roost after insulation. There are several types of wooden-concrete bat boxes. They are usually 8-12 cm wide and can be very simply integrated into the isolation layer. In some cases it is necessary to underlay or cover them (ensuring that gaps are left uncovered) with isolation material to fit the smooth surface of facade. The method of fixing them depends on the type of bat boxes; they can be glued in the same way as polystyrene blocks or they are secured using metal plates and screws. The surface of boxes should be covered by gauze fabric and can be painted the same colour as the rest of the facade. Once the works are completed, only the entrance of the roost is visible. These types of transit bat „access bricks“ boxes are used successfully in Germany, Czech Republic and Slovak Republic.



Schwegler bat boxes (ask for permission)

If it is technically not possible to save the roost, it is necessary to ensure that all bats leave the roost prior to the covering of its entrance. At least a week prior to works, the square **„exclusion flap“** made from soft wire grid (mesh should not be bigger than 0.5mm) should be placed over the entrance and fixed only at the top. It is also possible to use a firmer plastic square. Three sides of the square remain free, but should not stand away from the wall. This one-way enclosure made in correct way enables bats fly out from the roost, but does not allow them to return back. Similarly a metal or plastic tube can be used (length 20cm, diameter a bit more than 4 cm but not much bigger, according to the bat species), to fasten to the roost entrance, angled downwards. The slope, diameter and smooth surface of these tubes prevent the bats returning. It is necessary to ensure that bats do not enter the roost by different entrances, e.g in long fissures. Loss of the roost should be compensated by placing bat boxes close to the previous roost.

Fig. Exclusion flap allows bat to leave the roost but prevents return. The flap is fixed on the top and it must closely cover the whole entrance and not stand away from the wall. Petra Schnitzerová

Fig. Variation of exclusion flap is a sloping plastic tube with at least 4 cm in diameter. The plastic cover around the tube prevents entering of swiftlets. Martin Celúch

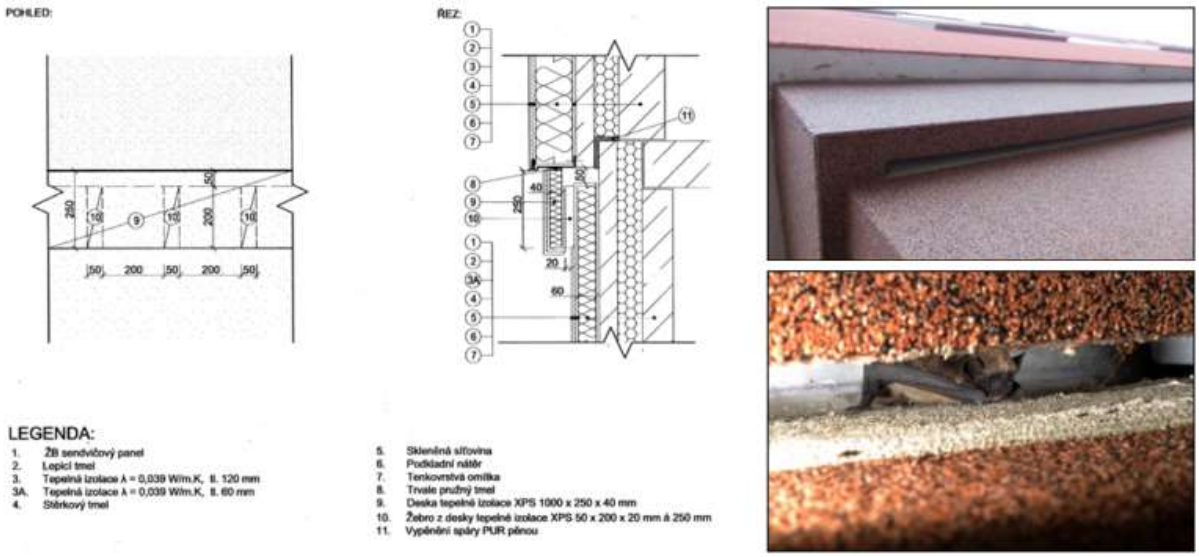


Fig. Long line bat boxes simulating the crevice roost in fissure between panels.

4.1.2.1 Cavern roosts behind ventilation holes

The bats use cavities behind ventilation holes which lead directly to the pantry in flats, or caverns which function as an extraction system of roof spaces. All mitigation measures should be in place before the original roost is lost.

When bats use caverns under the roof spaces, there are three possible methods:

a) the insulation plan includes only izolation of the walls of the building and not the roof. In this case it is necessary to keep all ventilation holes open. During insulation, holes must not be covered by izolation even for a short time. Holes in izolation material are usually provided to prevent rain and water leaking in, but often they contain grids or horizontal plates. Circle openings can be cloased at the end using a classic plastic end cover, but the lamells should be removed to keep the entrance to the roost. The lower edge should be rasped to ensure it is sufficiently rough for bats to land and hold on to. Instead of using a plastic end cover, a plastic tube that has a diagnonal cut at the end (so the upper part forms a ‚roof', see figure below) could be placed at the end of the vent plastic tube. The inner parts of this plastic tube must also be rasped to help bats crawl in and out. Rectangular horizontal openings should be equipped with a ‚roof' made from a metal plate fixed on the previous wall before the insulation material is laid. A plastic rough plate should be fixed to the lower edge of the opening. A smilar approach should be taken with rectangular vertical plates. The surface of the inner part of the metal plate should also be rough, e.g by spreading the layer of construction glue on the metal plate and ensuring that it has dried before the bats return.

b) the insulation plan includes both izolation of the walls of the building and the roof, or only the roof but the roof remains ventilated. In this case is changed and rebuilt the roof constuction, but the ventilation holes and caverns are kept. It is crucial that works are carried out at the correct time of year: the works must not be undertaken during the hibernation or breeding seasons, because during construction cavities are uncovered. Other methods are simalar to the previous section.

Fig. Covers of ventilation holes were modified to serve both bats and swiftlets. Martin Celúch, Lukáš Viktora.

c) the insulation plan includes the insulation and reconstruction of the roof, which should change from a ventilated to an insulated roof. In this case all cavities are filled with isolation material. Works must be timed appropriately as per the previous examples, and before work is started, it must be etablisehd that all bats have left the roost. The one-way enclosure method described above is used in this case. The loss of the roost needs to be compensated by placing bat boxes close to the previous roost. It is also possible to make new artificial cavities by digging them into the panel, or by installing bat boxes inside the roof wrapped in isolation material which lead to ventilation hole. These two methods can only be applied in some cases, where the heat audit of

building stays unchanged. Parameters of artifical cavities should be at least 30 x 15 x 15 cm with entrance 4 x 7 cm.

Fig. Insulation and reconstruction of the roof, which changed from a ventilated to an insulated roof, which led to destruction of all cavities. One possibility is make artificial cavities. Lukáš Viktora, Ivan Řehoř.

Case examples

4.2. „Wall on wall“ insulation = Zero-on-the-counter

’Zero-on-the-counter’ or ’Rapid’ is a insulation scheme where the cost of insulating is being paid for by the reduction of the energy use. It comprises placing a complete new outer wall over the original outer wall. The new walls are fabricated in a factory and are placed in situ in a rapid process. A street of ten buildings can be completed using this method in two weeks. This kind of insulation is targeting rental houses that are poorly insulated. These buildings typically hold many bat roosts (crevice-type). The `Rapid` process also involves other technical installations, and it is regarded as a industrial process, with quick turnover times and pre-fabricated solutions. Full pre-insulation surveys are not done, but the presence of bat roosts of certain species is assumed.

4.2.1. Main threats to bats

Original **roosts** are either **destroyed** or made unreachable. When **bats** are present during the work, they might be **trapped or physically harmed**. As it is done on a large scale and per block or street, the local and regional impact is high. The mitigation and compensation measures might be work for common pipistrelle, but not for many other house-dwelling species such as serotine, pondbat, soprano pipistrelle, and in some areas, whiskered bat and Geoffroy‘s bat.

Additionally, as some birds use houses as nesting places, measures are also taken to prevent damage from birds. These measures however might harm the bats (e.g. putting nets up to prevent birds from using the nestplaces).

4.2.2. Technical solution

The current solution is to place a built in bat box in the newly installed outer walls and leave small spaces. Work in the most vulnerable periods (maternity season and winter) is only undertaken when there is certainty that hibernacula or (large) maternity roosts are not present. If work has to be done in these two periods, measures are taken to prevent bats from using the roosts. Prior to starting work measures are always taken to prevent bats from using the roosts and to remove bats from roosts. Measures considered are opening the original outer wall to expose the wall cavity to make an unfavourable climate for the bats. Exclusion flaps and/or filling gaps are also used.

Case examples

Netherlands

In this country, most of the insulaton works are undertaken using rapid rate by wall to wall insulation.

To prevent groups of bat casualties the maternity season is avoided for works, and if this is not possible for some reason, measures are taken to prevent bats being present in the cavity walls. Other mitigation measures are always undertaken, e.g. large built in batbox, and leaving several small spaces for bats, irrespective of whether or not bats are present.

A so called 'surroundings check' evaluates whether the standard measures are adequate. The ‚surroundings check' is heavily based on existing data, which is not thorough as there are a lot of areas where there is no data present. Both the Dutch network of ecological bureaus and several NGOs have strongly protested this approach. They fear the ‚surroundings check' is not complete enough and state that measures taken are not proven to work for species other than common pipistrelle.

Fig. Left: House with completely new outer walls and roof (note solar panels as well). Right: Entrance to a large built-in bat box is visible in the new outer wall.

4.3. Cavity Wall Insulation

Bats are known to roost in cavity walls during all seasons. The degree of importance for any one species in each season is difficult to discern due to the inaccessibility of the structure. A concern about the carbon footprint of housing stock has led to an emphasis on having cavity walls insulated. Cavity wall insulation is often undertaken on existing homes, as well as those that are being constructed. This is often a quick process carried out by private households; however, an assessment must still take place to assess any use by bats of the cavity wall, and the works must be undertaken at a suitable time of year and using methods that will minimise impact to the bats (see below).

Types of injectable insulation:

- Blown mineral wool (glass or rock wool). It consists of mechanically granulated spun glass or rock wool, treated with a binder or water repellent during manufacture.
- UF Foam. Urea Formaldehyde Foam is injected into the cavity in a wet foam state 90-95% pre expanded through 19mm holes. It completes its expansion by moulding itself to the unusual shapes within a cavity and sets to form a rigid insulant.
- EPS beads. The expanded polystyren bead used for cavity wall insulation is in the form of virgin pre-formed bead which are usually combined with a binding agent or adhesive at the time of injection. Polystyrene beads are produced to a specified size and density which remains unaltered during the installation process.

Fig. Example of filling up cavity wall and a bat victim of polyurethan (PUR).

4.3.1. Main threats to bats

The micro-beads, fibre glass or foam can **physically trap** bats and also block entrance / exit points, entombing bats within the cavity wall. This is a particular issue during the hibernation period as bats cannot react in time to potentially escape and the summer maternity period as babies may get left behind. It is also possible that the materials used in the process may be **toxic** to bats, e.g. PVA (polyvinyl actetae) glue used for adhering the EPS beads together.

4.3.2. Technical solution

To avoid entombing bats in cavity walls it is advised that works are undertaken only when outside temperatures are 10° C or above and that insulation should start from the bottom of the cavity wall and work upwards, thus giving any bats still remaining in the wall a chance to wake and escape. If possible, a gap at the top of the cavity wall should be left for bats.
Then can be done on gable walls using 'horizontal brushes' or by removing the mortar internally in the loft, placing wooden planks to stop the insulation from rising, and then removing and sealing once insulation was fitted. In the UK, this may only be undertaken with blown-in expanded polystyrene (EPS) beads since use of an alternative material is unlikely to be given a

guarantee by the insulation contractor. The BBA (British Board of Agrément) permits partial filling of the gable apex (i.e. limiting the fill to several brickwork courses above ceiling level) provided the top of the wall is protected by the roof and the roof void is not an occupied space and where the loft insulation is at ceiling level.
However it must be always checked with the installer whether the method is appropriate; it may be that the type of filling, wall in question or building construction means that this isn't possible.

Case examples

Netherlands:
Stimulated by a government programme to reduce energy consumption, private households are insulating their cavity walls. Cavity walls are filled with pellets, mineral wool or PUR. Typically walls are filled up in half a day. The cost is low, much less than E1000,-.
Based on `Feiten en Fabels na-isoleren van spouwmuren. Milieu Centraal, 2015` several tens of thousands of houses are being insulated.

Tab: Number of houses insulated via cavity wall filling in the Netherlands

Year	Number of houses (estimation)
2010	20.000
2011	50.000
2012	40.000
2013	45.000

4.4. Other types of roof and wall insulation

4.4.1. Fibreglass loft insulation

Bats are threatened by entombing. The addition of insulation on the underside of the roof may entomb bats by blocking entrance and exit holes into the roof void. Additionally, if bats are present, they can be disturbed by workers accessing the roosting site in the loft. If the roost is saved, there would be a change in the conditions (for example, temperature) which may mean the roost is no longer suitable for the original species.

The roof void should be inspected by a suitably qualified ecologist prior to works taking place, to ensure access points are located and to ensure that no bats are present when the work is carried out. When installing insulation it is important to retain the bat access points to the roost. It is advised to pare back the insulation a minimum of 10cm from the eaves (this also helps to maintain building ventilation); or to insulate the floor of the loft only and leave the roof as a cold space. Make sure bats have other types of material to cling onto when they return after the insulation has been added e.g. rough sawn timbers at ridge.

4.4.2. Spray foam insulation

This method is being used as a replacement for fibre glass loft insulation in the UK. This insulation foam solidifies when sprayed directly to the inside of the roof therefore completely sealing it from the outside. The spray foam is prepared using two liquid components mixed within the nozzle of a spray gun, during the spraying process. It is applied to various substrates and built up in layers not exceeding 20 mm in thickness.

Bats are threatened by entombing. The spray on foam insulation may entomb bats themselves or by blocking entrance and exit holes into the roof void. Also, bats that are present can be disturbed by accessing the roosting site in the loft. The foam and fumes may be toxic to bats. If the roost is saved, there could be a change in conditions (such as temperature) that would make it not suitable for the original species.

The roof void should be inspected by a suitably qualified ecologist prior to works taking place, to ensure access points are located and that there are no bats around when work done. When installing insulation it is important to retain the bat access points to the roost. It is advised to pare back the insulation a minimum of 10cm from the eaves (this also helps to maintain building ventilation). This may be difficult with the way spray foam insulation is applied.

4.4.3. Sheepswool insulation

This method is being used in modern ecohomes as a sustainble natural roofing and wall insulation material. The it is not known how widespread this practice is in the UK.

Bats are threatened by entnglement. The wool strands become loose and beome tangled around a bats' feet and wings, resulting in bats becoming immobilised and eventually dying. Also, present bats can be disturbed by accessing the roosting site in the loft. If the roost is saved, there yould be change in conditions which will make the roof less drafty / warmer and possibly not suitable for original species.

The roof void should be inspected by a suitably qualified ecologist prior to works taking place, to ensure no access points are blocked and no bats are around when the is work done. Sheeps wool could be packaged loosely in some sort of pillow case to stop the spreading at the eaves and the bats coming into contact with this. Avoid disturbance to the roost by working when bats aren't present and ensure any wool is covered by fabric with entrances and exits remaining clear

of material to retain access. No material should block roosting areas at roof apex or on roof surface; these should be retained or reinstated with the addition of rough wooden boards.

Fig. shows sheeps wool insulation wrapped around a serotine pup. There were a total of three deceased pups tangled in the insulation fibres. The roost is monitored each summer and the max. count is around 25-30 bats, in winter the roost is cleaned to minimise the droppings for the roost owner and gives an opportunity to check there are no further issues with the insulation. The insulation is now covered over with dust sheets to prevent bats getting tangled and there haven't been any further problems since doing this (Credit - Pers.coms. Sally-Anne Hurry, Mountfield Ecology)

Case examples

4.5. Non-woven roofing membranes (NWRMs)

NWRMs are installed in many buildings. The breathable versions (BRMs) allow the roof to breathe so that traditional ventilation is not required and the non-breathable versions are lighter and easier to manage than traditional bitumen, and so are preferred. Research (Waring 2014) shows that all non–woven roofing membranes, produced using spun-bond filaments pose a serious threat to bats as a result of entanglement. In addition, the functionality of the membranes is affected by the bats.

4.5.1. Main threats for bats

The spun-bond filaments in modern roofing membranes are exposed to abrasive forces not tested for by manufacturers when placed in a bat roost; bat claws tease filaments loose from the surface of non-woven membranes forming a 'fluffed up' appearance on the surface. These loose filaments can become entangled around a bat's feet and wings, resulting in bats becoming immobilised and eventually dying. Currently all BRMs are non-woven. This means that the risk of entanglement also extends to all other non-woven non-breathable membranes currently on the market. There are also modern types of bitumen felt that contain polypropylene filaments (for example type 5U). These membranes, despite being called bitumen, still pose a risk of entanglement to bats.

Findings from the research indicate that the functionality and longevity of the membranes can be affected in those parts altered by the presence of bats. The research also found that the microclimatic conditions of the roof voids varied between different types of membrane.

4.5.2. Technical solution

There are currently no known non-woven roofing membranes that do not pose a risk to bats; therefore these products should not be installed into a roof or wall used by bats. Only woven bituminous roofing felt that does not contain polypropylene filaments should be used. For example bitumen felt type 1F, which is hessian reinforced.

Case examples

4.6. Roost compensation – commercial bat boxes

Roost compensation is usually done by placing various types of bat boxes on/in the building or very close to the roost. The bat boxes could be used as a feature of the insulated building, for example, if they are painted with bat motives. However, bat expert advice is needed during installation to ensure the correct type of box is used for the species, type of building, etc.

4.6.1. Preconditions of installing new bat boxes

The design, temperature and size of the boxes differ according to species and situation (e.g seasonal bat boxes, whole-year bat boxes). The correct temperature specifications inside the bat box are regarded as a precondition of any technical solution. As the measures are taken in an industrial way their functioning should be based on evidence and their thermal characteristics should be tested. For some species-function combinations these measures will not be feasible (e.g. mass hibernacula or huge maternity colonies). It is not recommended that new bat boxes are installed above the windows. In existing roosts that have a passageway bat box installed, it is recommended that a narrow metal shelf is placed under the entrance of the roost above the windows to prevent droppings falling down. It is also recommended that those that live in the flats/houses net curtains at the window to prevent bats from flying through the open window into the flat.

It is better to place more than one box on a wall near the destroyed roost to let bats choose the box with the most suitable microclimatic conditions. In cases where the roost has not been destroyed, often one passageway bat box placed on the original bat roost entrance is enough. In cases, where the original roost has been lost, it is recommended that four potential roosts are provided for each roost lost. The number of bat boxes should suffice to compensate the loss of the original roosts. As bat boxes are not always effective and some bat boxes will not be used, overcompensation is necessary. Results from field surveys in the area and from comparable areas can give a good basis for this estimate.

4.6.2. Types of bat boxes available

Polystyrene boxes
This type is made from extruded polystyrene and they are lightweight, but not particularly durable. Some of them contain a thin inner layer of concrete which enables the bats a better grip. In some types of boxes there can be issues with bat urine mixed with bat droppings, which can result in colour change on the facade.

Fig. Plastic boxes in the facade can be used for both swiftlets and bats (Ecoplastics)

Fig. XPS Polysterene boxes for noctule hibernation installed in the facade (BAT-MAN, Slovakia)

Wooden-concrete boxes
Bat boxes made from wooden-concrete mixture are durable, permeable, and are used with success for a number of bat species in several countries. However they are rather heavy and can be broken during transport.

Non-passageway boxes
Boxes are installed on the facade, which results in different and original designs of bat boxes. These bat boxes placed outside the building should fulfil the bats‘ requirements of the roost (type of box, where it is placed on the wall, etc.). They can also serve as an interesting design element, and can be used as an example for public education. They are made from different materials and can be placed both inside and outside the facade. ‚Built in‘ batboxes are placed behind the outer wall, in the wall cavity, and are accessible via the outer wall. Different species and functions (e.g. maternity, mating, male summer roost) will require different bat boxes in size.

Fig. Different types and design of non-passageway box attached to facade (Schwegler).

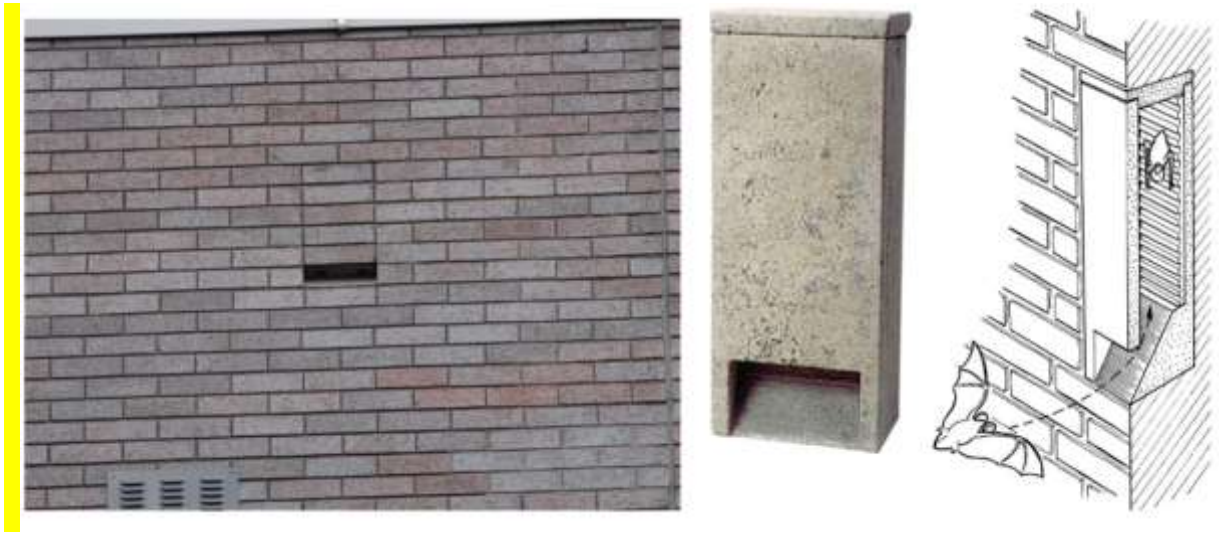


Fig : Left: Habibat integrated bat box in grey brick © Graham Jeffery / BCT. Right: Inside facade bat box (Schwegler)

Passageway boxes
These boxes are used, when the original roost can be saved or there is cavity where bats can live instead of their original roost. Bats crawl through the bat box to the original cavity or they can stay in a box.

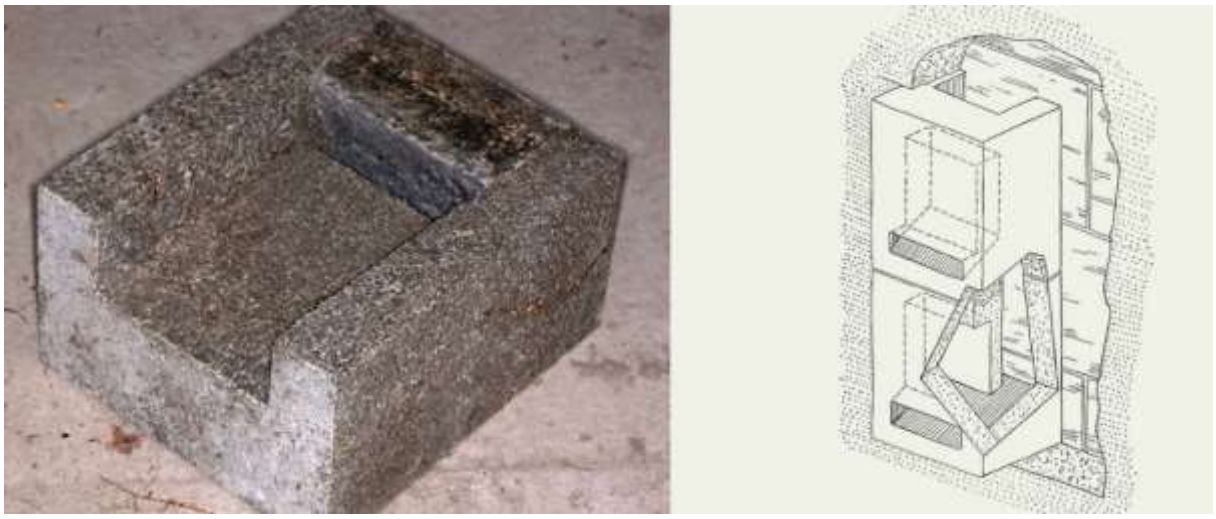


Fig. Passageway bat box – Naturschutzbedarf Strobel

4.6.3. Made-to-measure boxes (custom made)

If it is possible to make an artificial bat roost which resembles the original roost in both design and physical conditions (temperature, humidity), it should be used for specific cases. This solution can prove much more effective. The type of new roosts on buildings, even the more unusual solutions, should be recorded so that others can learn from them.

5. Post-insulation survey and and results of mitigation measurements

To assess impact of insulation on bat populations and the efficiency of mitigation measures, a post-insulation survey is needed. Unlike a pre-insulation survey, lack of time should not be a critical factor influencing the method of survey, so a post-insulation survey should be done thoroughly and across the bats‘ life cycles. The ideal survey should cover hibernation, spring and autumn migration and the maternity season, and if possible, include two surveys in each of these periods. A smaller number of surveys within a period may give a false impression of absence of bats in a roost.

Using bat-detectors and the direct observation of emergence from roost is often effective, but takes a lot of time and volunteer capacity. It may be possible to include the general public in such monitoring in some countries, but positive records would need to be checked by bat specialists.

The presence of bats in a supplementary roost, compensatory roost or modified old roost can be confirmed also by bat droppings or changes of colours of the facade close to the entrances of the bat box. Direct observation during day with an endoscopic camera may be possible, if the bat box is easily accessible for the volunteer, but this more invasive survey will require a permit in some countries. Some types of bat boxes attached to the facade allow the presence of bats during the day to be confirmed with a strong torch.

Case examples

Czech Republic:
During 2015 and 2016 the efficiency of mitigation measures used during building insulation was evaluated. New bat boxes were checked during three periods throughout the bat life cycle on 93 buildings in 15 towns. Emergence behaviour with the use of bat detectors was observed by 35 volunteers of the Czech Bat Conservation Trust. Use of bat boxes in at least one time period was recorded in 76% of observed buildings. The most frequently recorded species were Nyctalus noctula and Pipistrellus pipistrellus, with Vespertilio murinus, Eptesicus serotinus and Hypsugo savii also being recorded. In 46% of the buildings, the presence of bats was recorded during all three time periods, which suggests that these boxes are inhabited during the whole year. The number of inhabited buildings was a little higher in the autumn migration period which is the same as dynamic observed in non-insulated buildings. No clear pattern was observed in relation to south-north or east-west orientation of boxes.

6. Communication with public

Raising public awareness is crucial for nature conservation. Information on bats and insulation can be communicated at a number of different levels, ranging from the general public to running more specialist workshops.

The general public can be reached through specific bat events, for example, **International Bat Night (IBN) and bat walks**, which are very popular across the whole of Europe. During IBN, information can be given using presentations about bat biology, or through information leaflets, or quizzes or games for children. At a local level, **exhibitions or traveling exhibitions of bat life cycles** with information on insulation can be installed. A promotion can also involve **schools in educational programs for children** or **literary or art competitions**.

For effective help is necessary to have **a network of experienced bat workers and volunteers**, who can hold **specialist workshops for stakeholders, companies and officials**. It can be beneficial to **cooperate with ornithologists**, who often face similar insulation-related problems with swiftlets, and also with **bat rehabilitation centres**, which receive hundreds or thousands of bats (often from buildings). They can provide useful data when you are assessing whether there is bat presence prior to installing insulation.

The system is not effective if the public do not receive any response from bat workers. It is necessary to establish **web pages** with appropiate information, including contacts, to set up a **hot line** for people to report bats at risk from insulation projects, and establish a **database of bats recorded in buildings** that is easily accessible and easy to use by officials.

If the law is broken by companies, **media** (TV, local newspapers, web, social networks) should be contacted to draw their attention to particular cases.

Case examples

Czech Republic:
In 24th February 2009 a hibernating colony of noctule bats was uncovered during insulation works. The workers of the company put the bats in buckets, covered by tarry paper and left. The following day a passer-by heard the bats and uncovered the buckets. The workers of the NGO Nyctalus were contacted and found 670 individuals, only 328 of which were alive. Those individuals that were not injured were placed in a hibernation cellar, but many of these individuals were stressed and refused to hibernate. Injured animals were euthanised. 244 bats survived and in spring were fed with the help of volunteers. The case was devolved on NGO ČESON (Czech Bat Concervation Trust) which resolved this case with lawyers and Czech inspection of Environment. The case was publicised through the media, which started public interest and highlighted the potential conflict between insulation and the conservation of protected species. Based on resolution 7.11 Bats and Insulation it was stated by the Ministry of Environment in 2015, that every company which plans to insulate buildings and asks for government financial support, must include in their request the results from a basic pre-insulation survey for bats.

7. List of websites dealing with bats and insulation

Czech Republic
http://ceson.org/ukryty.php
http://www.sousednetopyr.cz/?page_id=20
http://www.ceson.org/document/brozura_Netopyri_2015_final.pdf

Switzerland
http://fledermausschutz.ch/Ratgeber/Sanierungen.html

http://fledermausschutz.ch/Ratgeber/Holzschutzmittel.html
http://www.ville-ge.ch/mhng/cco/proteger/service-batiments/

United Kingdom
http://www.bats.org.uk/pages/bats_and_buildings.html

8. Links to companies offering bat boxes

There are several companies producing different type of commercial bat boxes. Bat boxes are traditionally used as a mitigation measure, but we have lack of research into their efficiency. Custom-made bat boxes are often installed with knowledge of internal design of the roost and bat species and thus they can prove more effective. We are now at a stage of collecting evidence of efficency and proper monitoring of both custom-made and commercial bat boxes used as mitigation measures is needed.

Czech Republic
Ecoplastics
https://www.ecoplastics.cz/fotogalerie-budky.html

Zelená domácnost (offer bat boxes from Fa Schwegler, Germany, and also make their own)
https://www.zelenadomacnost.com/k/budky-pro-netopyry

Germany
Hasselfeldt
https://www.nistkasten-hasselfeldt.de/fledermauskaesten.html

Schwegler
http://www.schwegler-natur.de/fledermaus/

Strobel, Fa.Pröhl
http://naturschutzbedarf-strobel.de/fledermausquartiere/

Slovakia
BAT-MAN Ltd.
www.bat-man.sk

United Kingdom
Habibat
http://www.habibat.co.uk/category/bat-boxes

Nestbox
https://www.nestbox.co.uk/collections/bat-boxes

9. References

BCT

Schnitzerová P., Cepáková E., Viktora L. 2015. Netopýři v budovách: rekonstrukce a řešení problémů (Bats in buildings: reconstruction and problem solution). ČESON, 2nd edition; online at http://www.ceson.org/document/brozura_Netopyri_2015_final.pdf

Bat cycle and biology general

Annex 1. Resolution 7.11

7th Session of the Meeting of the Parties, Brussels, Belgium 2014
Bats and Building Insulation
(later replace by res 8.8. Monaco)

The Meeting of the Parties to the Agreement on the Conservation of Populations of European Bats (hereafter "the Agreement"),

Recalling Article III of the Agreement, especially paragraphs 1 and 2;

Noting that bat colonies are seriously endangered by insulation programmes which do not take adequate account of the presence of bat roosts and that some EU financed schemes to promote the installation of insulation are in conflict with policies to conserve bats;

Further noting that bats use a network of roosts in buildings as breeding, swarming, hibernation and transient roosts;

Recalling Resolution 5.7 on Guidelines for the Protection of Overground Roosts, with particular reference to roosts in buildings of cultural heritage importance, which recommends to ensure that overground roosts are managed in accordance with national nature conservation legislation and taking note of any guidelines adopted by the EUROBATS Agreement;

Recalling previous decisions of the Convention of Migratory Species which also include the protection of migratory bats, their roosts and foraging sites;

Recalling that the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "Roadmap to a Resource Efficient Europe" (COM/2011/0571) recommends strengthening policies and activities for promoting energy efficiency in buildings, with consideration of the wide range of environmental impacts of buildings;

Recalling Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings promoting the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and costeffectiveness, especially the obligation to set and apply minimum requirements for new and existing buildings;

Recalling the EU Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage, which obliges EU members to take measures to prevent, mitigate and compensate significant damages to protected species;

Recalling the Kyoto Protocol to reduce CO2 emissions in context of combatting climate change, that buildings are responsible for more than one third of total energy use and associated greenhouse gas emissions in society, both in developed and developing countries (http://www.unep.org/sbci/pdfs/BuildingsandCDMreporteversion.pdf) hence insulation is important;

Recognising that large-scale insulation of buildings causes fatalities and loss of roosts, which influence bat populations;

Calls upon Parties and non-party Range States to:

1. Work to ensure that insulation projects are undertaken in compliance with national legislation regarding bat protection and conservation and the requirement to avoid bat mortality by implementing appropriate mitigation and compensation for roost loss;

2. Take into account, when assessing the importance of individuals losses, that the cumulative impact of fatalities and loss of bat roosts in buildings can lead to detrimental effects on bat populations;

3. Work to resolve any possible conflict between insulation regulations and bat conservation;

4. Include the impact on bats in the environmental assessment of insulation programs at a strategic level;

5. Look into the problem of bat roosts and different types of insulation in relation to privately or community owned buildings;

6. Recommend appropriate awareness-raising campaigns, trainings and information materials for stakeholders involved in insulation projects about bat conservation in buildings;

Requests the Advisory Committee to develop guidelines on best practice in taking account of bats in insulation projects.

Annex 2. Questionairee

Questionnaire: Bats and insulation (new version)

Country:

1. Is your country involved in insulation programs?
   - yes
   - no

2. Which object are insulated? *multi-choice*
   - panel houses (block of flats)
   - private houses
   - office buildings
   - other: churches, monasteries

3. Who funds insulation *multi-choice*
   - EU grants
   - European bank credit
   - Local authorities
   - Private
   - Other-specify: Ministry of Culture

4. Is in your country requested pre-insulation survey to get permit for reconstruction/insulation of building?
   - yes
   - no

5. Can you stop by statutory means insulation progress when bats are found in the building?
   - yes
   - no

6. Do you use any mitigation and compensation (e.g bat boxes) during/after insulation?
   - yes
   - no

7. Do you carry out any post-insulation survey?
   - yes
   - no

8. Which species are affected by insulation in your country? Assess also number of findings (A – found many times, B – found not so often, C – found only occasionally)
   - Nyctalus noctula
   - Pipistrelles (kuhlii, nathusii, pipistrellus, pygmaeus)
   - Vespertilio murinus
   - Hypsugo savii
   - Eptesicus serotinus
   - Myotis dasycneme
   - Others (specify)

9. Do you have any national guidelines of methodological survey prior to insulation of a building? (if yes, please link or citation)
   - yes
   - no

10. Do you have any references (papers, booklets, information sheets, etc.) concerning bats and insulation from your country? (if yes, please link or citation)
    - yes
    - no

11. Do you hold any workshops/trainings concerning bats and insulation?
    - yes
    - no

12. Do you have documentation (photo, studies, case examples) concerning bats and insulation which you can share??
    - yes
    - no

13. Does cooperation between stakeholders (builders, owners, state conservancy) exist?
    - yes
    - no

Contact person (you or somebody else):