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NATIONAL PARKS AND WILDLIFE SERVICE

# BAT MITIGATION GUIDELINES FOR IRELAND – V2

Ferdia Marnell, Conor Kelleher & Enda Mullen

An Roinn Tithíochta,
Rialtais Áitiúil agus Oidhreachta
Department of Housing,
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National Parks and Wildlife Service (NPWS) commissions a range of reports from external contractors to provide scientific evidence and advice to assist it in its duties. The Irish Wildlife Manuals series serves as a record of work carried out or commissioned by NPWS, and is one means by which it disseminates scientific information. Others include scientific publications in peer-reviewed journals.

Front cover, small photographs from top row:

**Limestone pavement**, Bricklieve Mountains, Co. Sligo, Andy Bleasdale; **Meadow Saffron** *Colchicum autumnale*, Lorcan Scott; **Garden Tiger** *Arctia caja*, Brian Nelson; **Fulmar** *Fulmarus glacialis*, David Tierney; **Common Newt** *Lissotriton vulgaris*, Brian Nelson; **Scots Pine** *Pinus sylvestris*, Jenni Roche; **Raised bog pool**, Derrinea Bog, Co. Roscommon, Fernando Fernandez Valverde; **Coastal heath**, Howth Head, Co. Dublin, Maurice Eakin; **A deep water fly trap anemone** *Phelliactis* sp., Yvonne Leahy; **Violet Crystalwort** *Riccia huebeneriana*, Robert Thompson

Main photograph:

**Daubenton's bat**, *Myotis daubentonii*, Martin Straube

# BAT MITIGATION GUIDELINES FOR IRELAND – V2

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## Executive Summary

- Bats and their roosts are protected by Irish and EU law.
- There are nine resident species of bats in Ireland, each with its own lifestyle and habitat requirements. They use a wide variety of roosts, including buildings of all sorts, trees and underground places.
- All nine bat species are protected under Annex IV of the Habitats Directive. One species, the lesser horseshoe bat, is also included on Annex II and Special Areas of Conservation have been designated to ensure the protection of its important breeding, roosting and foraging areas.
- Many bat roosts are used only seasonally as bats have different roosting requirements at different times of the year. During the summer, females of all species gather in colonies to give birth and rear their young; these maternity roosts are often in places warmed by the sun. During the winter bats hibernate, usually in places that are sheltered from extremes of temperature.
- When planning a development it is advisable to check for the presence of bats as early as possible so that any planning and licensing issues can be addressed before resources are committed. Bat surveys require specialist knowledge and equipment.
- Planning and licencing authorities are required to take account of the presence of protected species, including bats, when considering applications and may refuse applications on the grounds of adverse effects on these species or if an assessment of the impact of the development on protected species is inadequate. Conditions may be attached to the permission/licence to ensure that the conservation status of protected species is maintained.
- A grant of planning permission does not constitute a licence or permit to disturb bats or interfere with their breeding or resting places.
- A derogation licence (under the EC (Birds and Natural Habitats) Regulations 2011-2021) can permit actions affecting bats or their roosts that would normally be prohibited by law. Application for such a licence may be made to the Minister for Housing, Local Government and Heritage through the National Parks and Wildlife Service (NPWS) of the Department. The applicant must demonstrate that there is no satisfactory alternative, that the reason for the derogation is one of those listed in the legislation and that the action will not adversely affect the favourable conservation status of the bats. Each case is considered on its particular circumstances, and an application may be refused.
- Mitigation to reduce the impact of development is generally a condition of any licence issued. Mitigation measures will be proportionate to the impact and may require *e.g.* particular timing of operations, use of certain materials, and protection of existing roosts. Compensatory measures *e.g.* the creation of new roosts to replace ones being lost, may also be required. In some cases, a considerable period of time may be required to carry out this work. Follow up monitoring of the effectiveness of the measures is usually required.
- The protected species legislation applies independently of planning permission and other consents, so licences may be necessary for operations that affect bats but do not require other permissions.
- The Department of Housing, Local Government and Heritage strongly advises developers to seek the services of a professional ecological consultant with appropriate knowledge, experience and expertise in assessing bat populations when contemplating a development proposal that may affect bats or their roosts.
- This document gives generic technical advice on assessing impacts and developing mitigation plans. It does not give a comprehensive explanation of the legislation or provide legal advice.

# 1 Introduction

## 1.1 Background

These guidelines update and replace the *Bat Mitigation Guidelines for Ireland* published in 2006 (Kelleher & Marnell, 2006). They have been developed to assist those involved with land-use planning and development operations (in the widest sense) where bats are known or suspected to occur. Although the emphasis is on developments that fall within the remit of the planning system, the guidelines apply equally to other sorts of developments and contain elements of good practice that apply to a wide range of situations.

These guidelines are intended to provide generic information and advice and are not meant to be taken as a rigid set of rules. Individual sites vary considerably in terms of species present, population status, roost type and so on, and the potential impacts of different types of development also vary, so it would be impossible to develop an all-encompassing document. Decisions should be made on a site-by-site basis. The methods described are those considered to be practical and effective based on past experience, but this does not mean that other methods are ineffective, inappropriate or unlawful. Similarly, the levels of mitigation effort suggested herein are based on available information, and do not necessarily constitute a statement of the lawful minimum. Mitigation proposals will vary from site to site, but should always be based on scientific expertise and practical knowledge. It would be for a court to decide whether an offence has been committed in any particular case. The legislation does not specify mitigation methods; it prohibits certain actions.

Notwithstanding the above caveats, in developing these guidelines, we have drawn on a wide range of expertise, from Ireland and elsewhere in Europe, and believe that the advice given reflects current best practice. It is strongly recommended that developers and consultants take them into consideration at the earliest opportunity in their proposal development. The publication and application of these guidelines is expected to stimulate the collection of more information about the success or failure of mitigation plans that can in turn be used to further improve mitigation and conservation measures for bats.

Although changes to both the planning system and wildlife legislation are made from time to time, many of the principles of survey and mitigation will continue to apply, though developers should satisfy themselves that any proposals comply with current legislation.

These guidelines do not include the planning and development of national roads. For information on the conservation of bats during the planning and construction of roads, please see the *Transport Infrastructure Ireland's* documents: *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes* and *Guidelines for the Treatment of Bats during the Construction of National Road Schemes* (www.tii.ie).

## 1.2 Conservation status of bats

Populations and population trends in bats are particularly difficult to measure and there are few historical data on which to base any assessment of change. The fragmentary evidence available for Europe supports the view that bat populations have declined over the last century or so. In some cases,

such as lesser horseshoe bats, contractions of range are well documented, but as some species were not even described until relatively recently, historical data on distribution is lacking.

Because of their conservation importance and their value as biodiversity indicators, Species Action Plans have been devised for all Irish bat species; these contain objectives relating to the maintenance and restoration of bat populations and habitats, see: All Ireland Species Action Plan – Bats (NPWS, 2008) and Threat Response Plan – Vesper Bats 2009-2011 (NPWS, 2009).

A national bat monitoring programme covering most, though not all, species is now in place in Ireland, so some data about population trends are now becoming available (Aughney *et al*., 2018; Roche *et al*., 2009, 2014, 2015). Although some bat species are showing signs of population growth, and the most recent Red Data List assesses all Irish species as Least Concern (Marnell *et al*., 2019), it is generally accepted that bat populations remain vulnerable to declines at both the local and landscape level. The need to prevent any further losses is reflected in national and EU law.

## 1.3 Legal status and its implications for developers

In view of their status across Europe, all species of bat have been listed on Annex IV of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora ("the Habitats Directive") (see Section 2.1 Legislation) and some, such as the lesser horseshoe bat, are also listed on Annex II. The domestic legislation, the European Communities (Birds and Natural Habitats) Regulations 2011, (S.I. No. 477 of 2011) ("the Habitats Regulations"), which implements this Directive, combined with the Wildlife Acts 1976 to 2021, ensures that individual bats and their breeding sites and resting places are fully protected, and this has important implications for those who own or manage sites where bats occur. The Habitats Regulations came into operation in September 2011 and replaced the previous transposing legislation, the European Communities (Natural Habitats) Regulations 1997 (S.I. No. 94 of 1997).

Regulation 51 of the Habitats Regulations prohibits, amongst other things, damaging or disturbing the breeding or resting sites of bats. Such prohibition exists irrespective of whether a person is given or holds any consent, statutory or otherwise. Works which may have such impacts on bats may only be carried out in accordance with a derogation licence under Regulation 54 issued by the Minister for Housing, Local Government and Heritage. The National Parks and Wildlife Service (NPWS) have produced guidance documents on the strict protection of Annex IV species, which include bats. These documents also give advice on the process of applying for a derogation licence and what must be considered by the applicant in advance. One document is tailored for public authorities and the other for the general public. They may be found on the NPWS website along with an application form for a derogation at https://npws.ie/licensesandconsents/disturbance/application-for-derogation-licence.

Requirements regarding the consideration that Planning Authorities should give to nature conservation interests are contained in Directive 2001/42/EC of 27 June 2001, (the SEA Directive). The presence of a protected species is a material consideration when the authority is considering a developmental proposal. The protected status afforded to bats means planning authorities may require information, data and analysis (in the form of surveys, impact assessments and mitigation proposals), before determining planning applications for sites used by bats. Planning authorities may refuse planning permission solely on grounds of the predicted impact on protected species like bats. Designations of various kinds, both statutory and non-statutory, may further protect individual sites. Although the presence of bats does not in most instances preclude a land parcel from development, planning and

licensing controls may limit the extent of disturbance, the timing of activities, and may well stipulate mitigation and/or compensatory measures. Planning conditions are often used to this end. The grant of planning permission does not authorise the disturbance of bats or interference with their breeding or resting places. A separate derogation licence is required.

## 1.4 Development, mitigation and compensation

In this document, the term 'development' is used to cover a wide range of operations that have the potential to impact negatively on bats and bat populations. Typical examples would be the construction, modification, restoration or conversion of buildings (some of which require planning permission), as well as infrastructure or mineral extraction projects (which may constitute exempted development and hence not require planning permission) and site clearance and demolition (which may not need planning permission). Likewise, the term 'developer' is used to cover individuals, companies or organisations responsible for undertaking these activities, and not simply members of the construction industry.

Where the proposed development will affect sites known to be used by bats, consideration needs to be given to the likely impact on the population(s). Even when planning permission is given, or the activity does not require such permission, the wildlife legislation, including the Habitats Regulations, applies; bats and their places used for breeding or resting are still protected. In some cases, this situation may be resolved by the issuing of a derogation licence which may include conditions relating to mitigation and compensation. Mitigation is the term used to cover measures to protect the bat population from damaging activities and to reduce or remove the impact of development. Compensation for the loss of breeding or resting places may also be required, and this often takes the form of roost creation, restoration or enhancement. Such a programme of mitigation and compensation should allow the conservation status of bats to be maintained or enhanced following development, thus meeting one of the licensing criteria (see Section 2.2 Derogation licences). Note that in this document, unless otherwise stated, the term 'mitigation' is generally used in its broad sense, to encompass both compensation and mitigation.

## 1.5 Responsibility for achieving successful outcomes

In order to successfully address development issues where bats are involved, a number of key players need to work together; see Section 3. Roles and responsibilities. The National Biodiversity Action Plan 2017-2021[1] confers general responsibilities on all participants in the development process to take account of protected species. Some important messages resulting from these responsibilities are given here:

*For developers:* Sustainable Development should be a guiding principle when progressing proposals, and resolving wildlife issues requires specialist ecological knowledge. The NPWS of the Department of Housing, Local Government and Heritage (DHLGH) recommends that developers seek the services of a professional advisor (ecological consultant) when protected species issues arise in connection with a proposed development. Contact details for ecological consultants can be obtained from a number of sources, including professional bodies. One such directory is the *Professional Directory of the Chartered Institute of Ecology and Environmental Management* (http://www.cieem.net). Some consultants are also

[1] https://www.npws.ie/sites/default/files/publications/pdf/National%20Biodiversity%20Action%20Plan%20English.pdf

members of local bat groups which may be contacted via Bat Conservation Ireland (www.batconservationireland.org).

*For consultants:* In order to successfully resolve most bat issues, consultants should have a sound knowledge of, and experience with, the species. A thorough grounding in bat ecology can be crucial to good survey and mitigation planning. An up to date understanding of international best practise and the scientific literature is also essential. Although a derogation licence to disturb bats for scientific purposes is not essential for every type of survey, it is strongly recommended that consultants possess such a licence so they do not need to withdraw if bats are found at a site. Consultants are expected to apply population ecology principles so that the local circumstances relating to a particular development proposal can be interpreted using these generic guidelines. The outline bat report and mitigation plan structure (see Appendix 1) should be used where appropriate. It is expected that consultants will provide advice to clients, and information to NPWS, planners and others, in an impartial and accurate manner. Should cases come to light where consultants appear to have wilfully or negligently misrepresented a situation or site details, the NPWS will consider bringing its concerns to the attention of the relevant client and, if applicable, the professional body. The Irish Government has emphasised its obligations under international wildlife legislation by making it an offence under Section 69 of the Wildlife Act 1976 to 2021 to knowingly or recklessly make false statements for the purpose of obtaining a licence, whether for oneself or for another.

# 2 Legislation and licensing

Note: The information given in this section is intended as general guidance on the law relating to bats and development, and is not comprehensive. When dealing with individual cases, readers should consult the full texts of the legislation. Web addresses for the texts of legislation are given in 9. Further reading.

## 2.1 The Wildlife Acts 1976 to 2021

All bat species are protected under the Wildlife Act 1976 to 2021 which make it an offence to wilfully interfere with or destroy the breeding or resting place of these species; however, the Acts permit limited exemptions for certain kinds of situations.

All species of bats in Ireland are listed on Schedule 5 of the 1976 Act, and are therefore subject to the provisions of Section 23, which make it an offence to:

- Intentionally kill, injure or take a bat;
- Wilfully interfere with the breeding or resting place of a bat.

It should be noted that, for the purposes of this legislation, the breeding and resting places of bats are considered to be protected whether bats are actually present in them at the time or not.

A licence is required for the capture of bats for educational or scientific purposes, rehabilitating an injured bat and releasing it back to the wild, photography and filming near a breeding place and for retaining in captivity disabled bats which cannot survive in the wild. See the NPWS website for further details of how to apply for these licences: https://npws.ie/licensesandconsents/disturbance/application-for-derogation-licence

Section 23 of the Wildlife Act 1976 to 2021 contains several exemptions to the protection given to the species listed for protection on Schedule 5 (*e.g.* for agriculture or construction). In 2005 a further amendment through the European Communities (Natural Habitats) (Amendment) Regulations 2005 (S.I. No. 378 of 2005) removed all of the exemptions provided in Section 23(7) of the Wildlife Act 1976 to 2021 insofar as they relate to Annex IV species, including all species of bats. Those 2005 Regulations were revoked in 2011 except for Regulation 2 which brings about this strengthened protection for bats (and other Annex IV species).

Although there is apparent overlap between the Wildlife Acts and the Habitats Regulations, in legal terms they are construed as one. No action in relation to bats which would not be permitted under the Habitats Regulations may be licensed under the Wildlife Acts. Derogation licences granted under the Regulations include reference to the relevant provisions of the Wildlife Acts to ensure that all requirements for licensing are covered in the one document. It should also be noted that a licence only allows what is permitted within its terms and conditions; it does not legitimise any other actions related to bats at a given site.

## 2.2 European Communities (Birds & Natural Habitats) Regulation 2011-2021

Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora ("the Habitats Directive") seeks to protect rare and vulnerable species, including all species of bats, and their habitats and requires that appropriate monitoring of populations be undertaken. All species of bat found in Ireland are listed on Annex IV of the Directive. Member States are required to put in place a system of strict protection (as outlined in Article 12) for species listed on Annex IV ('European protected species'). The lesser horseshoe bat is further protected under Annex II. This Annex relates to the designation of Special Areas of Conservation (SACs). The Habitats Directive is transposed into Irish law by the European Communities (Birds & Natural Habitats Regulations) 2011 (S.I. No. 477 of 2011) ("the Habitats Regulations").

Under the Habitats Regulations (2011), all bat species are listed on the First Schedule and Regulation 51 makes it an offence to:

- Deliberately capture or kill a bat;
- Deliberately disturb a bat particularly during the period of breeding, hibernating or migrating;
- Damage or destroy a breeding site or resting place of a bat;
- Keep, sell, transport, exchange, offer for sale or offer for exchange any bat taken in the wild.

It is essential that developers note that, in regard to the third bullet point above, the onus of satisfying themselves that a development will not damage or destroy a breeding site or resting place of a bat rests with the developer, as the defence that the action was not done deliberately does not apply in this instance. "Deliberate" means that a person is aware that the consequences of their actions will most likely lead to capturing/killing or disturbing bats. This is a broader definition of "deliberate" than purposely setting out to do harm.

Provision is made in Regulation 54 of the Habitats Regulations for the Minister to grant, in strictly specified circumstances, a derogation licence permitting the above listed activities "where there is no satisfactory alternative and the derogation is not detrimental to the maintenance of the populations of the species … at a favourable conservation status…" See 2.2.1 below.

Across Europe, bats are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (CMS, Bonn Convention 1979) was instigated to protect migrant species across all European boundaries. EUROBATS (a daughter Agreement under CMS) is of particular relevance in relation to cooperation across international borders for the conservation of bats, many of which are known to migrate long distances. The Irish government has ratified both of these conventions as well as the EUROBATS Agreement.

### 2.2.1 Derogation licences

It is an offence, under Regulation 51 of the European Communities (Birds and Natural Habitats) Regulations, 2011 ('the 2011 Regulations') to:

(a) Deliberately capture or kill a bat in the wild;

(b) Deliberately disturb a bat particularly during the period of breeding, rearing, hibernation and migration;
(c) Damage or destroy a bat's breeding site or resting place, or;
(d) Keep, transport, sell, exchange, offer for sale or offer for exchange any bat taken in the wild, other than those taken legally before the Habitats Directive before the Habitats Directive was implemented.

A person may apply to the Minister under Regulation 54 of the 2011 Regulations for a derogation licence to carry out one or more of these prohibited activities. But, the Minister may only grant such a derogation licence if three criteria are met.

Firstly the Minister may only grant a derogation licence if it is for one of the following specified reasons listed in Regulation 54:

(a) In the interests of protecting wild fauna and flora and conserving natural habitats;
(b) To prevent serious damage, in particular to crops, livestock, forests, fisheries and water and other types of property;
(c) In the interests of public health and public safety, or for other imperative reasons of overriding public interest, including those of a social or economic nature and the beneficial consequences of primary importance for the environment;
(d) For the purpose of research and education, of repopulating and introducing these species and for the breeding operations necessary for these purposes, including the artificial propagation of plats, or;
(e) To allow, under strictly supervised conditions, on a selective basis and to a limited extent, the taking or keeping of bats.

Secondly, the Minister may only issue a derogation if there is no alternative to carrying out the prohibited activity. The first aim of the developer, whether from a private company or a public authority, working with professional advice, should be to entirely avoid any potential impact of a proposed development on bats and their breeding and resting places. Alternatives may involve re-designing a development so that bat roosts, and associated commuting routes and feeding areas are kept intact and that bats are not disturbed, for example by inappropriate lighting. It should be noted that the European Commission has a specific understanding of satisfactory alternative solution. "An alternative solution cannot be deemed unsatisfactory merely because it would cause greater inconvenience or compel a change in behaviour" (European Commission, 2021, page 13)[2]. Decisions about what solution is satisfactory must be science-based and should solve the problem of how to strictly protect the bats in light of the development.

Thirdly the Minister may only grant a derogation if it is not detrimental to the maintenance of the populations of bats at a favourable conservation status (FCS) in their natural range. There is case law from the Court of Justice of the European Union (CJEU) to back this up. One example is the Finnish Wolf Case C-674/17. The ruling establishes that the Member State must "clearly and precisely" identify in the derogation what the objectives of the derogation are. It must also establish that the derogation is capable of achieving those objectives and demonstrate that there is no satisfactory alternative. Cumulative effects of derogations must be taken into account when issuing derogations. The maximum number of all derogations must not be detrimental to the maintenance or restoration of the population at FCS. Consideration must be given to other human causes of mortality. Any risk to FCS must be ruled

[2] https://op.europa.eu/en/publication-detail/-/publication/bbc7ace0-27e2-11ec-bd8e-01aa75ed71a1/language-en

out by detailed conditions based on the level of population, its conservation status and its biological characteristics. The conditions must be precisely defined and they must be monitored to ensure they are implemented.

If any of these three criteria are not satisfied, the Minister cannot issue a derogation licence. It must never be assumed that a derogation licence will automatically be granted.

In summary, it is clear that a developer must first look to avoid all impacts on bats. This may mean looking at alternative solutions and redesigning the project accordingly. If this is not possible, the developer needs to check whether there are grounds to apply for a derogation licence, based on the reasons given in Regulation 54 of the Habitats Regulations. When applying for a derogation licence the developer must clearly state the reason and describe in detail all alternative solutions which were given serious consideration. Any mitigation intended to ensure that there is no impact or minimal impact on the bats must be clearly described in detail, giving examples of how it worked in other places.

**If a derogation licence has been refused by the Minister, any aspect of the development for which the derogation licence was sought, must not go ahead, no matter what other permissions are in place.**

### 2.2.2 When is a licence required?

NPWS is frequently asked by consultants whether a derogation licence is required for a particular activity. A licence simply permits an action that is otherwise unlawful and can only be issued in very limited circumstances (see 2.2 above). To ensure that no illegal activities are undertaken, it is recommended that a licence is applied for if, on the basis of survey information and specialist knowledge, it appears that:

- The site in question is a breeding site or resting place for bats and/or;
- The proposed activity could impact on a breeding site or resting place of a bat.

No licence is required if the proposed activity is unlikely to result in an offence. The advice given in this document (and see also Mullen *et al*. 2021) should assist the proponent, or those acting on their behalf, in arriving at a decision on this matter, though it must be recognised that determining whether a particular site is used as a breeding or resting place can be problematic for such mobile animals as bats. Determining whether an activity undertaken near to a roost might impact on that roost (*e.g.* by removing important flight lines or foraging areas) will also require specialist assessment. Note that if the proposed activity can be timed, organised and carried out so as to avoid committing an offence then no licence is required (see also 8.3).

Examples of works that are likely to need a licence because they may result in the destruction of a breeding or resting place and/or disturbance of bats include:

- Demolition of buildings known to be used by bats;
- Conversion of barns or other buildings known to be used by bats;
- Restoration of ruined or derelict buildings;
- Maintenance and preservation of heritage buildings;
- Introduction of artificial lighting inside a roost or near a roost entrance;
- Change of use of buildings resulting in increased ongoing disturbance;

- Removal of trees known to be used by bats;
- Significant alterations to roof voids known to be used by bats.

Examples of works that, if carefully planned, may not need a licence include:

- Works near to or at roosts (*e.g.* re-roofing) if carried out while bats are not present **and** the access points and roosting area are not affected;
- Remedial timber treatment, carried out with the correct (non-toxic to bats) chemicals while bats are not present.

### 2.2.3 Actions affecting Special Areas of Conservation (SACs)

Special Areas of Conservation (SACs) are designated under the Habitats Directive to provide protection to habitats listed in Annex I and species listed in Annex II of the Directive. The lesser horseshoe bat is the only Irish bat listed in Annex II of the Directive and 41 SACs have been designated for its protection. Regulation 28 of the Habitats Regulations regulates the undertaking of certain activities within SACs. These activities are known as Activities Requiring Consent (ARCs) previously referred to as Notifiable Actions (NAs). The ARCs selected for an SAC are intended to ensure that the habitats and species for which a site is designated (the "qualifying interests") are protected. It is an offence to carry out an ARC unless the consent of the Minister has been obtained. If an activity requires the consent of another public authority, or forms part of a project that requires the consent of another public authority, then the Minister's consent is not required.

**Figure 1** Tree removal by manual dismantling to safeguard bats. [Photograph: Conor Kelleher]

An application may be made to the Minister for consent to carry out an ARC under Regulation 30 of the Habitats Regulations. EU law and Regulation 42 of the Habitats Regulations require that all applications for consent to carry out activities within an SAC which are not directly connected with or necessary for the management of that site must be screened for appropriate assessment (AA). To ensure, therefore, that the requirements of the Regulations and the Habitats Directives are met, all applications for

Activities Requiring Consent are to be screened in view of the possible implications for the conservation objectives[3] of the site and other SACs and Special Protection Areas (SPAs). It should be noted that mitigation measures may not be taken into consideration at this screening stage of the process.

If following screening it can be excluded on the basis of objective scientific information, that the activity, individually or in combination with other plans or projects, is likely to have a significant effect on a European site (SAC or SPA), then the Minister may grant consent to the activity, with or without conditions.

However, if following the screening it cannot be excluded, on the basis of objective scientific information that the activity, individually or in combination with other plans or projects, is likely to have a significant effect on a European site, then an AA must be carried out.

Where an activity falls to the consent of another authority, such as the planning authorities in regard to development consent, then that authority is the relevant consent authority for the activity and the consent of the Minister is not required for an ARC. However, other consent authorities must also comply with the screening and AA requirements. These are covered under Part XAB of the Planning and Development Acts, in respect of activities requiring development consent; and in Regulation 42 of the Habitats Regulations in respect of other consents, for example foreshore licences.

ARCS are generally small scale activities which are listed because it is possible that they might have a negative impact on a European site. Many developments are larger scale. The Habitats Regulations state that any plan or project which a public authority implements or to which it grants consent, must be screened for any likely significant effect on European sites. The developer will be asked to provide an AA Screening Report to assist the public authority with the screening process. If that plan or project screens in a full AA must be undertaken.

An AA is a more in depth assessment as to whether or not an activity, plan or project would adversely affect the integrity of a European site. A report termed a Natura Impact Statement (NIS) is prepared by the developer's ecologist. This report is a scientific examination of the likely effects of the development on the European sites and will be used by the consent authority to assist in its assessment. In these circumstances an AA must be completed before consent is granted. Consent may be granted only after having determined that the activity, plan or project will not adversely affect the integrity of a European site.

Regulation 35 of the Habitats Regulations prohibits a person, without lawful authority, from the carrying out of any plan, project or activity outside an SAC that may have a significant effect on, or adversely affect the integrity of an SAC.

It will be apparent, therefore, that a developer proposing to carry out any activity which, even though outside the boundary of an SAC, may adversely impact on the integrity of that SAC, needs to ensure beforehand that all of the necessary consents are in place before the operation or activity commences.

Further information on these issues is available here: https://www.npws.ie/development-consultations

[3] Both generic and site-specific conservation objectives have been prepared for the lesser horseshoe bat. These should be examined when assessing the potential impact of a development on an SAC designated for this species. They are available here: https://www.npws.ie/protected-sites/conservation-management-planning/conservation-objectives

## 2.3 Interpretation and enforcement

As both the Wildlife Acts 1976 to 2021 and the 2011 Habitats Regulations apply to a wide range of species, their provisions are generic in nature and there are no detailed definitions of, for instance, exactly what constitutes a 'resting place' for a bat, nor what has to be proven to establish that an act was wilful. It should be noted that, for the purposes of both pieces of legislation, the breeding and resting places of bats are considered by NPWS, in line with European Commission guidance, to be protected whether bats are actually present in them at the time or not. Were a breach of the law to be alleged, a court would have to decide whether an offence did in fact occur.

The NPWS is the main enforcement authority for wildlife offences. Penalties differ depending on the nature of the offence and in relation to the legislation under which the offence is committed. Under the Wildlife Acts, offences such as wilfully interfering with or destroying the breeding place or resting place of a bat carry penalties of fines and/or imprisonment or both.

Under the Habitats Regulations penalties for offences range from: on summary conviction, a Class A fine (€5,000) or imprisonment for a term up to 6 months or both; and on conviction on indictment, to a fine up to €500,000 or imprisonment for a term up to 3 years or both. Note that fines may be imposed in relation to each offence committed, so operations involving many animals or repeated offences can potentially accrue large fines. In addition, items which may constitute evidence of the commission of an offence may be seized and detained.

# 3 Roles and responsibilities

## 3.1 Introduction

In order for bats to be protected successfully when development is planned, a number of organisations will need to interact effectively. Each organisation has its own role, and in some cases its statutory duties, to carry out. This section spells out the roles and responsibilities of the main players connected with development, with the intention of promoting more effective liaison.

## 3.2 National Parks and Wildlife Service

The National Parks and Wildlife Service is the Government's statutory nature conservation authority. In the current context it has the following functions:

- Statutory consultee for planning issues affecting nature conservation and protected species issues, including on planning applications where bats are thought to occur;
- Provision of general advice to developers, consultants and others on protected species cases (NPWS regional staff may also provide site-specific advice, though this will vary with local circumstances);
- Provision of observations and submissions to Planning Authorities on forward planning (*e.g.* commenting on County Development Plans);
- Provision of generic advice to Planning Authorities, including the legal background to protected species casework;
- Determining applications for licences for bat survey work (scientific and conservation licences);
- Assessing and deciding on bat derogation licence applications;
- Provision of advice about bats in dwelling-houses;
- Keeping and updating the National Lesser Horseshoe Bat Roost Database;
- Management of National Parks;
- Monitoring bat populations at the national level;
- Designating SACs for the protection of the lesser horseshoe bat;
- Enforcement of wildlife legislation.

Contact details (head office): The National Parks and Wildlife Service , Department of Housing, Local Government and Heritage, 90 North King Street, Smithfield, Dublin 7; www.npws.ie; Email: natureconservation@housing.gov.ie. For initial discussions about individual sites, the relevant local Conservation Ranger should be contacted; contact details for Rangers are available from the head office, npws.ie or within the State Directory section of local telephone directories. For licensing enquiries contact: wildlifelicence@housing.gov.ie .

## 3.3 Developers and ecological consultants

The developer and their advisor(s) share the responsibility for the following:

- Ensuring that they provide to Planning Authorities a satisfactory and accurate assessment of application sites, including surveys for bats if their presence is suspected;
- Designing their project to avoid impacts on bats and their roosting/breeding places;
- Applying for a derogation licence to NPWS, should they judge one to be required;
- Providing a sound and objective assessment of the potential impact of the proposed development on bat populations;
- Where necessary, designing and implementing a mitigation scheme that meets planning and licensing requirements, and in particular will ensure as far as possible the long term future of any populations affected; such schemes should employ 'best practice';
- In many cases, monitoring the relevant populations after completion of development, as required under the terms of a derogation licence;
- Reporting to NPWS on the results/compliance with the licence.

**Figure 2** A training course in bat ecology and conservation. [Photograph: Conor Kelleher]

## 3.4 Planning Authorities

Planning Authorities have the following roles:

- Ensuring that all of the requirements of the relevant environmental legislation have been met in applications submitted;

- Ensuring that protected species issues are taken into account as a material consideration when determining planning applications. This may involve refusal, deferral, conditions or agreements;
- Satisfying themselves that in submitting plans, developers have satisfactorily assessed the presence of bats and the potential impact on bats of the proposed development;
- Ensuring that protected species issues are taken into account in forward planning *etc.* (this is best addressed through species protection policies in development plans);
- In order to achieve the above, ensuring the availability of appropriate expertise to assess information on the implications of the proposed development for bats in order to inform planning decisions; this may include consultation with the NPWS, the National Biodiversity Data Centre, eNGOs or liaison with local voluntary groups;
- Raise awareness of protected species in their area;
- According to information available, advising developers about statutory species protection provisions affecting an application site;
- Enforcement of planning conditions.

## 3.5 Other organisations

The *National Biodiversity Data Centre* will have useful information on the location of bat roosts and can provide such details to consultants, developers and Planning Authorities. Contact details: *National Biodiversity Data Centre*, Beechfield House, Waterford Institute of Technology Campus, Carriganore, Co. Waterford; http://www.biodiversityireland.ie/. Similarly, local bat groups often collect data and may be able to provide a more detailed assessment of status; some may also be willing to undertake bat surveys in advance of planning applications. These voluntary groups are associated with Bat Conservation Ireland (BCIreland), which has a national database on all known species' roosts and sightings. BCIreland also organise training courses in bat handling and identification. Contact details: www.batconservationireland.org.

**Figure 3** Examining a bat specimen during a Bat Conservation Ireland bat identification workshop. [Photograph: Conor Kelleher]

# 4 An introduction to bats

## 4.1 General overview

In order to understand the potential effects of development work and plan effective mitigation, it is essential to have knowledge of bat ecology. This knowledge is likely to be most relevant to ecological consultants, whose role it is to undertake site surveys, predict impacts and propose mitigation. Staff in the National Parks and Wildlife Service and Planning Authorities will also benefit from such understanding given their role in reviewing applications. This section is not intended as a comprehensive description of bat ecology, as consultants are expected to have developed their own knowledge through study and field experience. It is meant as a general introduction, mainly for developers, to the life-cycle of bats and aspects of their biology. Roche *et al*. (2014) provides an up to date and comprehensive overview of Irish bats and their conservation status; a range of other references is also given in Section 9. Further reading.

Bats are the only true flying mammals. Like us, they are warm-blooded, give birth and suckle their young. They are also long-lived, intelligent and have a complex social life. Although they are often thought of as flying mice, they are not closely related to mice but form a special group of their own: the Chiroptera. Worldwide, there are over 1,300 different sorts of bat, ranging from the tropical flying foxes, with a wing-span of almost 2m (6'), down to the hog-nosed bat of south-east Asia, which is little bigger than a large bumble-bee.

In Ireland, currently, there are nine known resident species, of two families (Vespertilionidae and Rhinolophidae) all of which are small (many weigh less than a €2 coin) and eat insects and spiders:

### 4.1.1 Vespertilionidae

Common pipistrelle *Pipistrellus pipistrellus*

This species was only separated from its sibling, the soprano pipistrelle *Pipistrellus pygmaeus* in 1997 (Barratt *et al*., 1997). The common pipistrelle's echolocation calls peak at 45 kHz. The species forages along linear landscape features such as hedgerows and treelines as well as within woodland. Summer roost sites are usually in buildings (often occupied houses) but tree holes and heavy ivy are also used.

Soprano pipistrelle *Pipistrellus pygmaeus*

The soprano pipistrelle's echolocation calls peak at 55 kHz, which distinguishes it readily from the common pipistrelle on detectors. The pipistrelles are the smallest and most often seen of our bats, flying at head height and taking small prey such as midges and small moths. Summer roost sites are usually in buildings (often occupied houses) but tree holes and heavy ivy are also used. Roost numbers can exceed 1,500 animals in mid-summer.

Nathusius' pipistrelle *Pipistrellus nathusii*

Nathusius' pipistrelle is a relatively recent addition to the Irish bat fauna (Russ *et al*., 1998) and, while the only confirmed maternity roosts are in the north-east of the island, the species has been found widely though sporadically elsewhere as far as Cork, Kerry and Wexford (Aughney *et al*., 2018). Roche *et al*. (2015) refer to the species as "widespread but rare". The known roosts have all been in old buildings, but elsewhere in its range tree roosts may also be used. Little is known

about its seasonal movements in Ireland, but it known to be migratory over much of its European range with evidence of long distance migrations and migrations across open seas (*e.g.* Brabant *et al.,* 2020).

Leisler's bat *Nyctalus leisleri*

This species is Ireland's largest bat, with a wingspan of up to 320 mm; it is also the 3rd most common bat, preferring to roost in buildings, although sometimes found in trees and bat boxes. It is the earliest bat to emerge in the evening, flying fast and high with occasional steep dives to ground level, feeding on moths, caddis-flies and beetles. The echolocation calls are sometimes audible to humans, being around 15 kHz at their lowest. The audible chatter from their roost on summer days is sometimes an aid to location. This species is uncommon in Europe and the large population in Ireland may constitute as much as 20-25% of the global population (Marnell *et al*., 2009).

**Figure 4** Leisler's bat. [Photograph: Conor Kelleher]

Natterer's bat *Myotis nattereri*

This species has a slow to medium flight, usually over trees but sometimes over water. It usually follows hedges and treelines to its feeding sites, consuming flies, moths, caddis-flies and spiders. Known roosts are usually in old stone buildings but they have been found in bridges, underground sites, trees and bat boxes. The Natterer's bat is one of our least studied species and further work is required to establish its status in Ireland.

Daubenton's bat *Myotis daubentonii*

This bat species feeds close to the surface of water, either over rivers, canals, ponds, lakes or reservoirs but it can also be found foraging in woodlands. Flying at 15 kilometres per hour, it gaffs insects with its over-sized feet as they emerge from the surface of the water - feeding on caddis flies, moths, mosquitoes, midges *etc.* It is often found roosting beneath bridges or in tunnels and also makes use of hollows in trees.

Whiskered bat *Myotis mystacinus*

This species, although widely distributed, is rarely recorded in Ireland. It is often found in woodland, frequently near water. Flying high, near the canopy, it maintains a steady beat and

sometimes glides as it hunts. It also gleans spiders from the foliage of trees. Whiskered bats prefer to roost in buildings, under slates, lead flashing or exposed beneath the ridge beam within attics. However, they also use cracks and holes in trees and sometimes bat boxes. The whiskered bat is one of our least studied species and further work is required to establish its status in Ireland.

Brown long-eared bat *Plecotus auritus*

This species of bat is a 'gleaner', hunting amongst the foliage of trees and shrubs, and hovering briefly to pick a moth or spider off a leaf, which it then takes to a sheltered perch to consume. They often land on the ground to capture their prey. Using its nose to emit its echolocation, the long-eared bat 'whispers' its calls so that the insects, upon which it preys, cannot hear its approach (and hence, it needs oversize ears to hear the returning echoes). As this is a whispering species, it is extremely difficult to monitor in the field as it is seldom heard on a bat detector. Furthermore, keeping within the foliage, as it does, it is easily overlooked. Roosts are normally in buildings, typically churches or mansions with large attic spaces, but also stone barns and sheds.

### 4.1.2 Rhinolophidae

Lesser horseshoe bat *Rhinolophus hipposideros*

This species is the only representative of the Rhinolophidae family in Ireland. It differs from our other species in both habits and looks, having a unique nose leaf with which it projects its echolocation calls. It is also quite small and, at rest, wraps its wings around its body. Lesser horseshoe bats feed in woodlands close to the ground, gleaning their prey from branches and stones. They often carry their prey to a perch to consume, leaving the remains beneath as an indication of their presence. The echolocation call of this species is of constant frequency and, on a heterodyne bat detector, sounds like a melodious warble. The species is confined to six counties along the Atlantic seaboard: Mayo, Galway, Clare, Limerick, Kerry and Cork – see Figure 6. Summer roosts are typically in derelict rural buildings while winter roosts are usually found underground – caves, cellars and mines. This species is reluctant to cross open ground and will follow hedgerows, treelines and stone walls when moving between roosts and foraging areas. The lesser horseshoe bat is listed on Annex II of the Habitats Directive and 41 SACs have been designated in Ireland for its protection.

**Figure 5** Torpid lesser horseshoe bats in winter roost. [Photograph: Conor Kelleher]

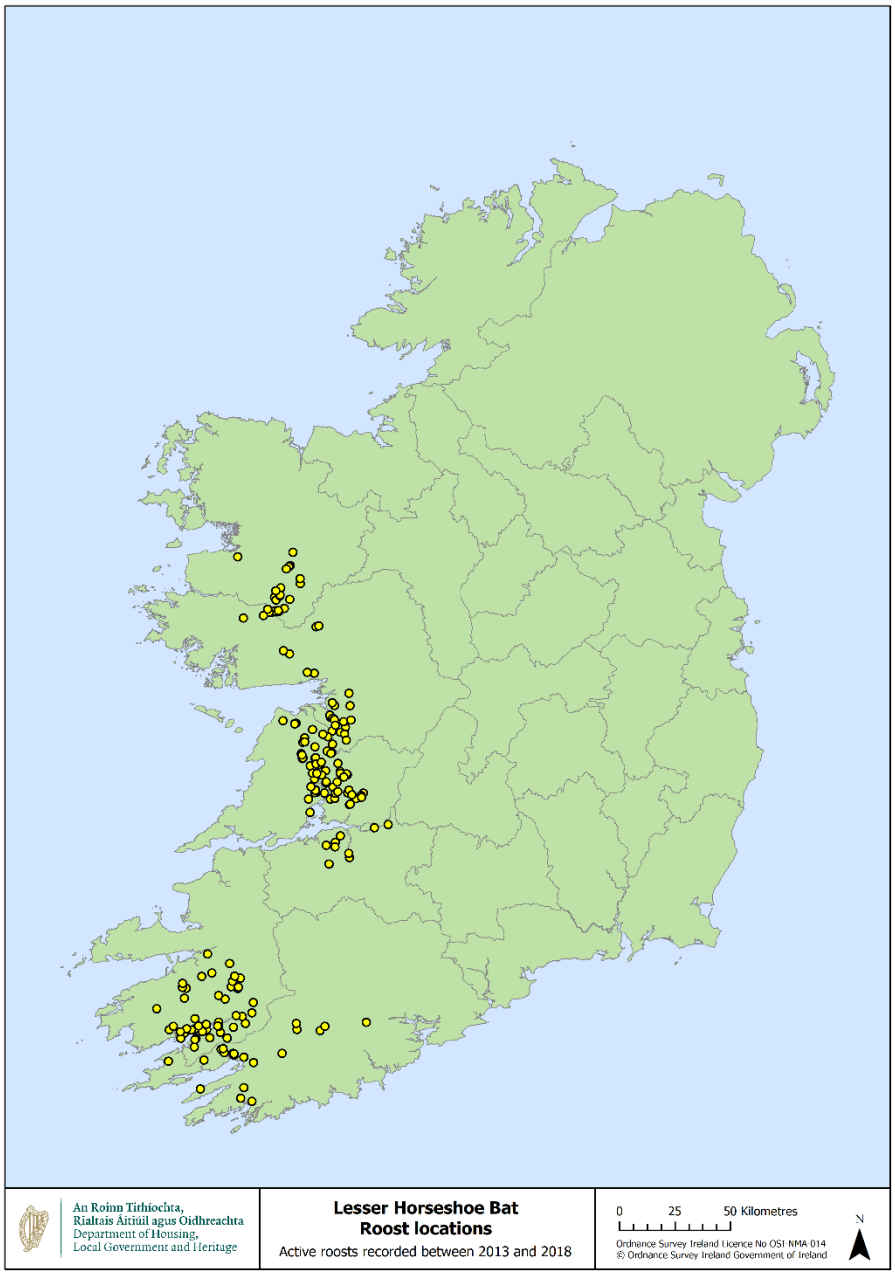


**Figure 6** Lesser horseshoe bat distribution in Ireland (source: NPWS database, 2021).

Bats have evolved a number of unusual features, mainly connected with their ability to fly. Their wings are formed from a web of highly elastic skin stretched over greatly elongated finger bones, the legs and tail, though their thumbs remain free to help them cling on when roosting. Bats have also developed a highly sophisticated echolocation system that allows them to avoid obstacles and catch tiny insects, even in complete darkness. When they're flying, bats produce a stream of high-pitched calls and listen to the echoes to produce a sound picture of their surroundings. Most of these echolocation calls are too high pitched for humans to hear, but electronic bat-detectors that pick up these calls and turn them into sounds that we can hear are now widely used by specialists. In most cases, it is possible to identify the bat species from the type of sounds produced.

In cool climates such as Ireland, bats eat only insects and other invertebrates such as spiders, which they catch in flight or pick off water, the ground or foliage. Some bats specialise in catching large insects such

as beetles or moths but others eat large numbers of very small insects, such as gnats, midges and mosquitoes, every night. Bats gather to feed wherever there are lots of insects, so the best places for them include traditional pasture, woodland, marshes, ponds and slow moving rivers.

During the winter there are relatively few insects available, so bats hibernate. In September and October they put on weight and then, as the weather gets colder, they seek out appropriate sheltered roosts, let their body temperature drop to close to that of their surroundings and slow their heart rate to only a few beats per minute. This greatly reduces their energy requirements so that their food reserves last as long as possible. Bats don't hibernate right through the winter but may wake up and go out to feed and drink on mild evenings when some insects are about. Even on very cold nights, bats may be seen on the wing as they move to more sheltered roosts. Waking up and flying in winter uses up lots of energy which the bats can't easily replace, so hibernating bats should not be disturbed as this might reduce their chances of surviving the winter.

Bats have a unique way of fitting their breeding cycle in with hibernation. They mate during the autumn and winter, but the female stores the sperm in her body and only becomes pregnant the following spring. Pregnancy lasts for six to nine weeks depending on the weather. Usually only one pup is born each year. This is looked after carefully and suckled for between four and five weeks until it is old enough to fly out and hunt for itself. Bats don't build nests and don't bring food back to the roost to feed their young, so the pup lives only on its mother's milk until it is old enough to fly.

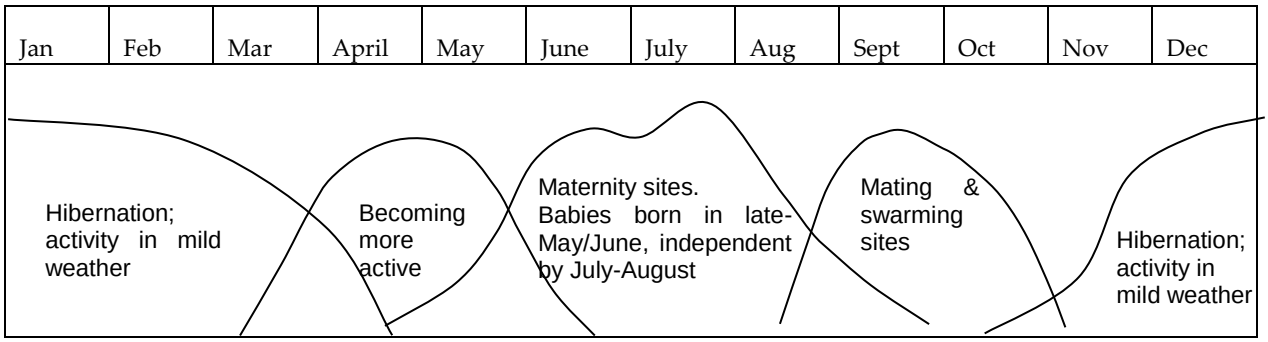


**Figure 7** The bat year. Although there are species-specific differences, the bat year can be divided into the two major phases of breeding and hibernation, with other activities interspersed.

During this spring and summer period female bats gather together into maternity colonies for a few weeks to give birth and rear their pups. Once the pup is independent, the colony breaks up and the bats generally move to other roosts. Bats may gather together from over a large area to form these colonies, so any disaster at this summer breeding site can affect all the females from this area. Many of these maternity sites are used every summer and bats have a strong tradition of returning to the same site year after year.

## 4.2 Roost requirements

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, the majority use a range of roosts which includes trees, buildings and underground sites and some species use primarily buildings and underground places. Classifying such sites can be difficult because of the varying conditions they provide and the way in which bats select sites. For example, Natterer's bat has

frequently been recorded in mortise joints in churches, old barns and similar buildings; from the bats' perspective, such sites must appear very similar to crevices in trees underneath a thick tree canopy. Other species too, show a similar tendency to roost in contact with timber rather than stone or brick.

Some species, such as the brown long-eared bat, are frequently recorded in underground sites during the winter, but the small number of individuals recorded at any one site suggests that this common species does not depend heavily on underground sites. Rather few trees are ever searched for bats and it seems likely that many species hibernate in tree cavities or under bark and so are significantly under-recorded.

**Table 1**. Bat species associations with roost types.

| Species | Trees | | Buildings | | Underground | |
|---|---|---|---|---|---|---|
| | Maternity | Hibernation | Maternity | Hibernation | Maternity | Hibernation |
| Lesser horseshoe bat *Rhinolophus hipposideros* | L | L | H | M | L | H |
| Daubenton's bat *Myotis daubentonii* | M? | L? | M | L | M? | H |
| Whiskered bat *Myotis mystacinus* | M? | M? | H | L | N | H |
| Natterer's bat *Myotis nattereri* | M? | M? | H | L | L | H |
| Nathusius' pipistrelle *Pipistrellus nathusii* | | | H? | | | |
| Common pipistrelle *Pipistrellus pipistrellus* | M | M | H | H | N | L |
| Soprano pipistrelle *Pipistrellus pygmaeus* | M | M | H | H | N | L |
| Leisler's bat *Nyctalus leisleri* | M | M | H | L | N | N |
| Brown long-eared bat *Plecotus auritus* | H | H | H | H | N | M |

Key
Trees – includes all types of crevice and hollow as well as bat-boxes attached to trees
Buildings – above-ground areas, with an emphasis on roof voids and other areas warmed by the sun.
Underground – anywhere that provides cool humid conditions buffered against rapid temperature change. Includes caves, mines, tunnels, souterrains, fortifications, cellars, ice-houses, lime kilns *etc.*

N – not recorded in recent times
L – low dependence; unusual, but has been recorded
M – some usage recorded, though not the most important type of site
H – the most frequently recorded type of site for this species/activity

The lesser horseshoe bat clearly has the strongest affinity with underground sites. In winter, it is rarely found in any other type of site and the species has even been recorded breeding underground, though the great majority of maternity sites are now in the roof voids of buildings. Other species which are

considered typical hibernators in underground sites are Natterer's bat, Daubenton's bat, whiskered bat and brown-long-eared bat.

Many species of bats are closely associated with the built environment, both for breeding and hibernation and some species have rarely been recorded anywhere else. The majority of species form maternity roosts 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 areas with high temperatures to minimise the energy cost of maintaining a high body temperature. Some species, such as the common pipistrelle, show a clear preference for confined roost sites, such as soffit-boxes, eaves or under hanging tiles, whereas others, such as the lesser horseshoe and long-eared bats 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 range 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.

## 4.3 Habitat associations

As well as suitable sites for roosting, bats also need suitable food resources. All species eat insects, or similar small invertebrates, though they hunt them in a variety of ways and a variety of places. Some species specialise in catching small insects in flight, some specialise in larger insects such as moths and beetles and some get part of their food by picking insects off foliage or even spiders' webs. Understandably, the highest densities of bats occur where insects are most plentiful and surveys of hunting bats have shown that areas of wetland and woodland edges are particularly good for bats.

**Figure 8** Deciduous woodlands are favoured by most species of bats. [Photograph: Conor Kelleher].

Bats need to be able to move freely around the countryside between roosts and feeding areas. Research has shown that many species, particularly the smaller ones, follow linear features, such as hedges, tree-

lines or waterways, and are reluctant to cross wide open spaces. This behaviour means that activities which sever these sorts of connections are likely to have consequences for bats (Kyheröinen *et al*., 2019).

Recent studies using radio-tracking have shown that bats are very variable in the distances that they travel from their roosts to forage. For example, at some roost sites for Daubenton's bats activity took place within 2 km of the roost whereas at other roosts some individuals travelled up to 19 km to forage. Brown long-eared bats appear to be a relatively sedentary species, with few individuals travelling more than 2 km whereas other species such as Leisler's bat will frequently travel more than 5 km. Travelling distances can be even greater between summer and winter roosting sites when distances of 100+ km have been recorded for certain species.

Some preliminary investigations of swarming sites have been conducted in Ireland. These sites are usually large caves and significant numbers of bats of several species have been shown to congregate at them over short periods in the autumn. The full purpose of these aggregations has yet to be elucidated and further research is required to help understand the usage of swarming sites by bats in Ireland. Nonetheless, it is clear that some species will travel 10s of km to visit particular swarming sites in the autumn and they appear to play an important role in the social and reproductive cycle of many Irish bat species.

Finally, it is worth bearing in mind that seasonal migrations may occur in some species. This behaviour is well established in the Nathusius' pipistrelle where it has been studied elsewhere in Europe (*e.g.* Alcalde *et al*., 2020; Brabant *et al*, 2020) although it is unclear yet what proportion of the Irish population may migrate. Given the proven ability of Nathusius' pipistrelle to cross open seas, it is important to bear this species in mind when planning off-shore wind-farm projects.

# 5 Survey objectives, methods and standards

## 5.1 The importance of a good survey

The importance of a thorough site survey prior to considering development cannot be over-emphasised. The following descriptions of survey techniques and their correct application are aimed at assisting consultants (to appreciate the type of survey that is expected), the developer (to be assured that their consultant is recommending a survey to help them meet legal and policy requirements), and planning authorities and National Parks and Wildlife Service (to be sure that an accurate assessment of the site and the extent of its bat interest has been made). Without a sound survey that includes an assessment of all available evidence, it is difficult to predict the likely impact of development.

From the developer's perspective, the primary objective of a survey for protected species is to ensure that any development can proceed without breaking the law. The consequences of not carrying out a survey on sites which subsequently prove to have a significant protected species interest can be severe and may include delays, additional costs and, in exceptional cases, the cancellation or curtailment of projects. The UK *Bat Conservation Trust* published the 3rd edition of *Bat Surveys: Best Practice Guidelines* in 2016 (Collins, 2016) and the recommendations contained therein should be referred to, bearing in mind, in particular, the different bat faunas of the two jurisdictions..

## 5.2 Some general points on surveys

A survey for bats may be indicated when background information on distribution and occurrence suggests that they may be present. More detailed indicators are:

- Any recent or historical records for bats on the site, or bat roosts in the general area, though note that bats are very under-recorded;
- Built structures (including bridges), which appear to have a high probability of use by bats;
- Underground structures such as abandoned mines, tunnels, souterrains, kilns, cellars or fortifications which provide appropriate hibernation conditions;
- Trees with a high probability of use by bats.

Some factors influencing the probability of particular places being used by bats are listed in Table 2. However, it should be emphasised that this can, at best, only highlight sites with a high probability of bats being present and the high mobility of bats means that it is virtually impossible to rule out any type of structure. The age of a building may be a consideration when it comes to its potential to harbour bats as older structures are often the haunts of these animals but new buildings are also regularly colonised by bats and indeed bats have been known to take up residence in newly built dwellings prior to the owners moving in! In addition, regional variation in building styles and species' distributions means that some local interpretation of these guidelines may be needed

**It is the responsibility of the developer to produce, normally via a consultant, evidence on the presence of bats on a site at which works are proposed. It is for the consultant to advise on the level of survey required (taking these and other guidelines into account)**.

The National Parks and Wildlife Service will not generally agree or endorse the methods and effort prior to a survey, as this is not the NPWS's role, and site circumstances vary considerably. However, if the NPWS or the Planning Authority considers that insufficient survey work has been carried out to enable the determination of a licence or planning application, further work may be required of the developer and consultant in the first instance, or recommended to be requested by the relevant planning authority, in the latter. NPWS will generally visit sites only where there is an exceptional need to do so, so it is crucial that the submitted reports are thorough.

**Table 2** Factors affecting the probability of bats being present.

| | |
|---|---|
| **Factors affecting the probability of a building being used by bats in summer** | |
| Increased probability | Disused or little used; largely undisturbed<br>Large roof void with unobstructed flying spaces<br>Large dimension roof timbers with cracks, joints and holes<br>Uneven roof covering with gaps, though not too draughty<br>Entrances that bats can fly in through<br>Hanging tiles or wood cladding, especially on south-facing walls<br>Rural setting<br>Close to woodland and/or water<br>Pre-20th century or early 20th century construction<br>Roof warmed by the sun<br>Within the distribution area of horseshoe bats |
| Decreased probability | Highly urbanised area with few feeding places<br>Small or cluttered roof void (esp. for brown long-eared bat)<br>Heavily disturbed<br>Modern construction with few gaps around soffits or eaves (but be aware these may be used by pipistrelles in particular)<br>Prefabricated with steel and sheet materials<br>Active industrial premises<br>Roof shaded from the sun |
| **Factors affecting the probability of trees being used by roosting bats** | |
| Increased probability | In ancient woodland or parkland<br>Large trees with complex growth form<br>Species that typically form cavities, such as beech, willow, oak or ash<br>Visible damage caused by rot, wind, lightning strike *etc.*<br>Loose bark providing cavities |
| Decreased probability | Coniferous plantation with no specimen trees<br>Young trees with simple growth form and little damage |
| **Factors affecting the probability of underground sites being used by roosting bats** | |
| Increased probability | Large enough to develop stable temperature in winter<br>High humidity<br>Undisturbed<br>Close to woodland or water (but note that bats will also use upland sites)<br>Many cracks and crevices suitable for bats |
| Decreased probability | Small and draughty<br>Heavily disturbed<br>In urbanised areas<br>Smooth surfaces with few roosting opportunities |

Considering the great variation between sites, it is not possible to give exact prescriptions for survey work here that will cover all circumstances. Therefore, survey plans need to be formulated on a site by site basis and the experience of the consultant should help shape this. Surveys must be carried out by licensed personnel, where there is a risk of bats being disturbed, and should not entail undue site damage or disturbance to roosts. Guidelines on survey effort and methodologies for wind energy developments have been published in recent years by EUROBATS, *Natural England*, the *Northern Ireland Environment Agency* and by *Bat Conservation Ireland* and the recommendations in these documents should be referred to when planning any such surveys.

Survey reports are expected to:

- State what the survey objective was, what work was done, by whom, and when. A suggested outline for survey reports within mitigation plans is given in Appendix 1 Survey and Mitigation Report Structure;
- Be clear and unambiguous, with appropriate evidence to support conclusions;
- Contain relevant raw data as well as processed data, and any negative results obtained;
- Contain contextual information, such as weather conditions, which may have affected results;
- Contain good site descriptions, plans and maps enabling a proper assessment of the proposal;
- Include a summary which is understandable by people without detailed knowledge of bats;
- Present the qualifications and experience of the surveyors and authors;
- Be accessible to third parties. Note that as survey reports are used in the decision-making process for planning applications and licences, they should not be confidential and should comply with GDPR.

## 5.3 Setting survey objectives

Before setting foot in the field, it is important to define the purpose of the survey; in other words, why is it being undertaken? In turn, objectives for field survey can be set, the two most common objectives in relation to development being:

- Presence/absence survey: is there evidence that bats use a particular site or structure?
- Investigation of the type, extent and pattern of usage by bats as a precursor to the development of a mitigation proposal.

The former may be a first stage, when assessing potential development sites and the latter will normally be required prior to determination of planning permission, to inform an opinion as to what effect development will have on a particular site (see Section 6 Predicting the impact of development). In practice, the two objectives are often combined, particularly when the conservation significance of the site is low.

Presence/absence surveys may be further subdivided into surveys designed to detect whether bats are present on a site (and thus trigger a more detailed investigation) and surveys to demonstrate beyond reasonable doubt that bats are not present. Although these may appear to be similar objectives, the effort (sampling intensity) required to demonstrate the negative may be much higher than conventionally accepted to detect the positive.

## 5.4 Survey area

As a minimum, the survey should normally cover any land or structures which are proposed for development. For phased developments, the entire site should be surveyed, not just the area of the first phase, and considered as a whole unit when assessing impacts and possible mitigation. This will help to avoid the undesirable situation where mitigation methods implemented during an earlier phase are likely to be affected by a later phase. Remember that as well as construction work itself, there are other development-related activities which can affect bat sites (see Section 6.2 Major types of impact and their effects on populations). However, certain parts of the land may be excluded from survey if it is considered that bat roosts are highly unlikely to be present or development on that area would not affect them. Examples of such areas might include playing fields or arable land (without trees) which provide no opportunities for roosting. Although foraging areas and commuting routes are not legally protected, the effects of development proposals on these may be taken into consideration when assessing the impact of the proposal on the continued ecological functioning of roosts and on the maintenance of favourable conservation status. Similarly, they may be taken into account by planning authorities, certainly where specially protected sites are involved. For example, the impact of planning proposals close to SACs (European sites) for lesser horseshoe bats is likely to receive close attention.

## 5.5 Desk study

The following sources can be consulted for existing information on local bat roosts (perhaps within 5 km of the area): Planning Authorities (*e.g.* on 'constraint plans'), National Biodiversity Data Centre, Bat Conservation Ireland, local bat group and, for lesser horseshoe data, NPWS. This consultation can result in lists of recent sightings and an indication of status and distribution in the general area. However, it should only be used as background information, because such archives are likely to become out-of-date quite quickly and should never be considered as a substitute for a field study.

## 5.6 Field survey methods

This section describes the main methods used to detect and record bats or evidence of bats. This manual does not provide a substitute for training and experience and should not be considered a definitive guide to bat survey techniques or approaches. Although a licence to disturb bats for scientific purposes is not essential when looking for previously unknown roosts, the requirement to withdraw if bats are discovered will limit the ability of the surveyor to carry out this work. For this reason, it is advisable for surveyors to be licensed. The appropriate licence is a Derogation Licence as provided for under Section 16 of the Habitats Directive. See how to apply here: https://npws.ie/licensesandconsents/disturbance/application-for-derogation-licence.

### 5.6.1 Inspection of buildings or other structures

The most commonly used survey method for both presence/absence surveys and detailed usage surveys is close inspection of sites or structures for bats or evidence of bats. To undertake such surveys to a high standard, surveyors need training and experience, both in identifying bats and knowing where bats, or signs of bats, are likely to be found. Surveys for signs can be carried out at any time of year by an

experienced surveyor, but bats are most likely to be seen or heard in roofs during the summer or autumn or seen in subterranean areas during the winter.

**Figure 9** Disused ice-house - such structures are often used by hibernating bats. [Photograph: Conor Kelleher]

A typical approach to surveying buildings would include the following elements:

- Allow sufficient daylight hours to permit a thorough inspection of each structure;
- Ensure that all parts of the structure can be inspected. This may require prior arrangement with owners, occupiers, caretakers *etc.* Access and inspection equipment, such as ladders, binoculars and a good torch, should always be available;
- Carry out a risk analysis and ensure safe working methods are adopted;
- Ask appropriate people (owners, neighbours *etc.*) whether there is any history of bats using the site;
- Carry out an external inspection of the structure looking for bat droppings on the ground or stuck to walls, suitable entry and exit points around eaves, soffits, flashing, under tiles *etc.*;
- Carry out an internal inspection of the structure. This should focus particularly on areas which provide appropriate environmental conditions for bats. This may include warm darker areas, joints and crevices in wood, ridge beams and hips as well as cool subterranean areas suitable for torpor or hibernation. Listen for bats; be aware of the characteristic smell of a bat roost; examine floors, walls and structural elements for droppings; check for other signs of bat use, such as corpses or skeletons, oily marks (from fur) around possible access points and roost areas, lack of cobwebs along beams, feeding remains such as moth wings or other insect parts;
- Record any signs of bats found on a plan of the structure and collect samples of droppings, bones or feeding remains for comparison with a reference collection and / or DNA analysis;
- Active or static detector surveys may also be necessary to ensure a full assessment of the bat usage of a building, especially where full access to all areas is not possible.

### 5.6.2 Inspection of trees

Surveying trees presents particular problems at any time of the year as bats will use a wide variety of roost sites in cavities, splits, cracks, knotholes and under loose bark, many of which are not easily detected from the ground. A careful survey using high-quality binoculars may pinpoint potential or actual roost sites and some species, most notably Leisler's, may be quite noisy at times during the summer. Endoscopes may also be useful for inspecting likely cavities, though their use may be limited by the need for access equipment. Infra-red cameras may be useful in finding bat roosts under ivy. Confirmation of the presence of bats may be attempted by using bat detectors for an emergence survey at an appropriate time of the year (see Section 5.6.3), but the nomadic nature of tree-dwelling bats means that the success rate is likely to be very low. Detector surveys just before dawn, which aim to detect bats returning to their roost, have a slightly higher chance of success as bats will often swarm around a roost for some time before entering.

### 5.6.3 Use of bat detectors

Bat detectors provide a sensitive way of detecting active bats in some situations and can be a necessary adjunct to the search methods described in Section 5.6.1. Considerable expertise is needed to identify bats to the species level, though the technology to assist with this task has improved significantly in recent years. Both hand held detectors and static detectors, which can be mounted and left in place for days or weeks, are widely available in numerous makes and models. Different types of detector are appropriate for different types of survey and broadband detectors are probably best for surveys of new areas. Training courses in the effective use of bat detectors are available and are recommended for those starting out.

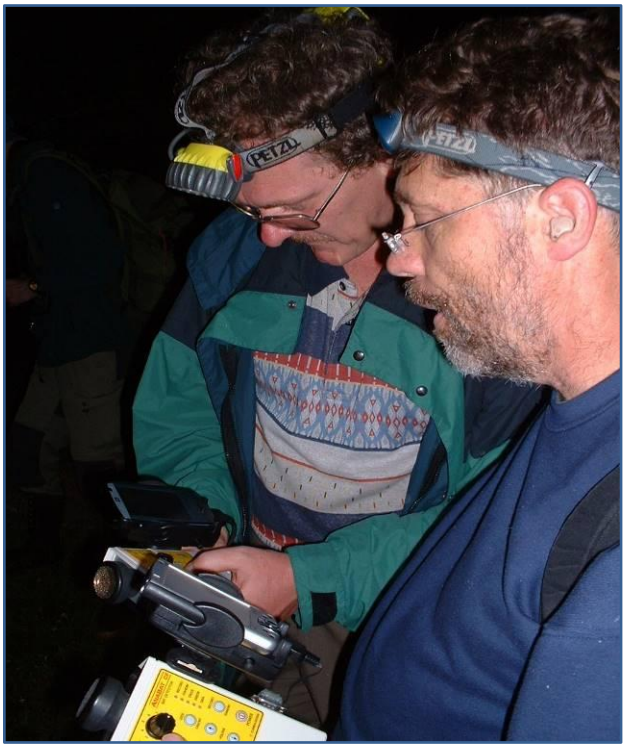


**Figure 10** Using heterodyne and time-expansion bat detectors in the field. [Photograph: Conor Kelleher]

The seasonal and daily pattern of bat activity and the use of different types of roost at different times of the year will impact on the appropriateness of this methodology. Handheld detectors can be used on visits to roosts between dusk and dawn during the summer (buildings and trees) or autumn (some underground roosts) to detect active bats entering or leaving the site. The optimum time for dusk surveys at buildings, particularly during early summer is for the two hours after the first bats emerge as this will cover the emergence period as well as the first return to the roost for some species. The time of first emergence varies between species, with Leisler's leaving around sunset and Natterer's bats leaving about 1 hour after sunset. Bats using underground sites during the summer may not emerge till much later, perhaps even 4 hours after dark. Towards dawn, many bats swarm outside their roosts and surveys beginning about 90 minutes before sunrise and continuing until 15 minutes after sunrise ('sunrise surveys') are recommended. In autumn, it is possible to detect the social calls of males of some species of bats, notably Leisler's and pipistrelles. Surveys at this time of the year should begin about 30 minutes after the species' emergence time and it may be necessary to set the bat detector to record lower-frequency social calls.

Automated detectors linked to data-loggers have proved useful in some situations, particularly recording bats moving in and out of underground sites but the technology is constantly changing with improved systems being marketed each year. A static bat detector system is a system that will record bat calls in the absence of a person. Usually a broadband detector is used so that all types of bat calls are recorded. In addition, the timing of a recorded bat call and GPS position are also recorded. No single system is suitable for all situations and needs but many options now exist.

The use of static detectors has increased significantly in recent years as the technology has improved and equipment has become more affordable. These devices offer many advantages over conventional hand held detectors due to the length of time they can be left in situ. It is recommended that they are left in place for a minimum of one week, but for larger projects it can be useful to leave them in situ for longer. As well as recording the species present, including quieter species potentially missed during a walked survey, the resulting data from these devices can provide an overview of diurnal and even seasonal activity patterns. Paired detectors can also be useful in comparing two parts of a site to identify areas of higher usage. Static detector technology is evolving all the time and it is advisable to keep abreast of the latest developments and its potential uses while also being aware that devices and their related software need to be tested and proven in the field. Comparing outputs from different devices is also a potential source of confusion and error and this should be borne in mind when interpreting survey results.

Cameras, including infra-red cameras, also have potential to improve species recording at certain sites and can be particularly useful for emergence counts. Photography within roosts requires a licence from NPWS (see www.npws.ie/licences/disturbance/photograph-or-film-protected-wild-animal-or-bird) but is often the most effective and least disturbing way of counting large numbers of lesser horseshoe bats in a roost.

### 5.6.4 Netting and harp-trapping

Mist netting and the use of harp traps to catch bats with or without the aid of ultrasonic lures, are well-established research methods. However, it is rarely necessary to catch bats in flight for the purposes of surveys associated with development, although there may be occasions when the positive identification of species is required. These methods are invasive, time-consuming and require specialist training and

licencing. It would be wise to discuss survey requirements with the National Parks and Wildlife Service before undertaking such work.

### 5.6.5 Radio-tracking

Radio-tracking provides the most powerful way of determining what commuting routes and foraging areas are used by bats from a particular roost or whether the bats from a particular roost have alternative roosts nearby. Bats can be caught at, or close to, the roost, fitted with miniature radio transmitters and then tracked as they move to, and between, foraging areas or other roosts. Such a technique is unlikely to be necessary for the majority of developments, but may be required with large scale projects (*e.g.* road projects) or when developments may affect a SAC for bats. Specialist training and licencing is required and the need for such surveys should be discussed with the NPWS before commissioning any work.

**Figure 11** Using radio-telemetry to track bats has proven a successful method for roost location. [Photograph: Conor Kelleher]

### 5.6.6 Timing of surveys

As indicated above, bat survey methods vary in their applicability to different types of roost at different times of the year. Careful inspection of buildings due for demolition, alteration, repair or redevelopment is probably the most frequently required survey method and it is fortunate that this method is applicable throughout the year. However, interpreting the results can be difficult during the winter when bats are unlikely to be present in large numbers, if at all. In particular, the distribution and appearance of the droppings does not always lead to an unambiguous conclusion as to which species is present and further work may be required to determine this. Happily, DNA analysis of droppings is now possible and can provide definitive identifications in many instances.

The table below gives a summary of when the two main survey methods may be applicable. A more detailed table of species and habitats and survey effort and methods is given in Appendix 1.

**Table 3.**The applicability of survey methods.

| Season | Roost type | Inspection | Bat detectors and emergence counts |
|---|---|---|---|
| Spring (Mar – May) | Building | Suitable (signs, perhaps bats) | Limited, weather dependent |
| | Trees | Difficult (best for signs before leaves appear) | Rarely useful |
| | Underground | Suitable (signs only) | Static detectors may be useful |
| Summer (June-August) | Building | Suitable (signs and bats) | Suitable |
| | Trees | Difficult | Limited; use sunrise survey |
| | Underground | Suitable (signs only) | Rarely useful |
| Autumn (September –November) | Building | Suitable (signs and bats) | Limited, weather dependent |
| | Trees | Difficult | Rather limited weather dependent; use sunrise survey? |
| | Underground | Suitable (signs, perhaps bats) | Static detectors may be useful |
| Winter (December-February) | Building | Suitable (signs, perhaps bats)) | Rarely useful |
| | Trees | Difficult (best for signs after leaves have gone) | Rarely useful |
| | Underground | Suitable (signs and bats) | Static detectors may be useful |

## 5.7 Survey standards

It is for the person planning the survey to decide what level of effort is required, according to the objective of the survey and local conditions and to advise the project proponent accordingly. However, this section gives guidelines on reasonable minimum standards for survey methods and effort. Deviation from these guidelines should be justified by a supporting statement, giving reasons for the use of a different set of methods, or level of effort. Obviously, for presence/absence surveys, in many cases bats will be detected in much less time than the number of visits indicated here (sometimes within a few minutes of a site visit commencing), and there may be no need to undertake the full effort indicated if the objective is purely to determine presence.

### 5.7.1 Presence/absence surveys

#### *5.7.1.1 Buildings*

The presence of a large maternity roost can normally be determined on a single visit at any time of year, provided that the entire structure is accessible and that any signs of bats have not been removed by others. However, most roosts are less obvious. A visit during the summer or autumn has the advantage that bats may be seen or heard. Buildings (which for this definition exclude cellars and other underground structures) are rarely used for hibernation alone, so droppings deposited by active bats provide the best clues. Roosts of species which habitually enter roof voids are probably the easiest to detect as the droppings will normally be readily visible. Roosts of crevice-dwelling species may require careful searching and, in some situations, the opening up of otherwise inaccessible areas. If this is not possible, best judgement might have to be used and a precautionary approach adopted. Roosts used by a small number of bats, as opposed to large maternity sites, can be particularly difficult to detect and may require extensive searching backed up by bat detector surveys (including static detectors) or emergence counts. The time spent searching will vary greatly with the situation, but as a guide the roof areas (void, gables and soffits) of a normal-sized unexceptional domestic property could probably be

searched thoroughly in 1-2 person-hours whereas a large building complex such as a hospital or stately home is likely to take more than 1 person-day and may take several days if there are many buildings. Evening surveys with bat detectors at an appropriate time of year may be helpful in narrowing down the area to be searched.

If the entire building is not accessible or signs of bats may have been removed by others, or by the weather, bat detector or exit count methodologies may be required to back up a limited search. In this case, the season available for the work is significantly curtailed. If surveys of open structures, such as barns, are undertaken during the winter, there is a significant chance that signs of bats will have been removed by weathering and extra care will be required to detect bat usage. If there is doubt as to whether a structure is used by bats, further visits during the summer or autumn will be required (see Table 5.2). The underlying principle is that enough survey work is required to fully establish the importance of the building/structure for bats and to allow for appropriate mitigation measures to be developed.

**Figure 12** Derelict building with bat potential. [Photograph: Conor Kelleher]

#### *5.7.1.2 Trees*

Except in the simplest cases, it is extremely difficult to survey trees and be certain that any bat roosts have been detected. Tree cavities (which includes under bark or in splits or cracks) are used throughout the year by a variety of species, many of which are known to move unpredictably between roosts. Suitable cavities include rot cavities that orient upwards from the entrance, long splits where limbs have fallen and places where the bark has separated from the underlying trunk.

Whilst maternity colonies of some species such as Leisler's may be relatively easy to detect, small summer roosts of other species or hibernating bats leave few clues to their presence. The best time to carry out surveys for suitable cavities is between November and April, when the trunk and branches are not obscured by leaves. If inspection suggests that the tree has suitable cavities or roost sites, a bat detector survey at dusk or dawn during the summer may help to produce evidence of bats, though the nomadic nature of most tree-dwelling species means that the success rate is very low. It can also be difficult to pinpoint exactly which tree a bat emerged from. A dawn survey is more likely to be

productive than a dusk one as swarming bats returning to the roost are much more visible than those leaving the roost.

Because tree-dwelling bats move roosts frequently, a single bat-detector survey is unlikely to provide adequate evidence of the absence of bats in trees that contain a variety of suitable roosting places. Several dawn or dusk surveys spread over a period of several weeks from June to August will greatly increase the probability of detecting significant maternity roosts and is recommended where development proposals will involve the loss of multiple trees.

**Figure 13** Decaying tree showing loose bark with potential for bat roosting. [Photograph: Conor Kelleher]

Climbing trees to look for roosts, using appropriate equipment and safety precautions, is a possible approach for small numbers of trees with a high probability of bats, but the results of radio-tracking studies of some species suggest that bats may use cracks or crevices that are far from obvious.

The recently produced Bat Tree Habitat Key (Andrews *et al*., 2013) is a useful guide to tree-use by bats and the features and signs to look for when undertaking a survey of trees for potential bat roosts.

#### *5.7.1.3 Caves, mines and other underground structures*

Underground structures are used mainly for hibernation, so surveys should generally be carried out during the winter, though it would be unwise to proceed with the destruction or modification of such sites without a prior inspection. Presence/absence surveys for hibernating bats are most productive during January and February for most species, though bats are likely to be found in winter sites between November and March, depending on the weather. For sites used by significant numbers of bats (> 5-10), a single survey during cold weather in January or February has a high probability of detecting at least one bat, but outside these core months two or three visits between November and March are recommended. As well as looking for bats, careful inspection for droppings or oil staining around cracks and crevices may also yield evidence of use. The probability of seeing bats is influenced by the nature of the site, as most species except horseshoe bats tend to conceal themselves in crevices, if available. Activity loggers, as described in Section 5.6.3, may also be used.

Daubenton's and lesser horseshoe bat, have been recorded breeding in underground sites in the UK and may do so in Ireland on occasion, so surveyors should be aware of this possibility and record the presence of any significant accumulations of droppings or stained or marked areas indicating the presence of large numbers of bats. Revisits during the summer may be required in these rare cases. There is also the possibility of finding small numbers of bats using underground sites as night roosts during the summer.

**Figure 14** Lesser horseshoe bat hibernating underground. [Photograph: Conor Kelleher]

Some underground sites are also used as swarming sites during the autumn. This behaviour, which is believed to have a social function, begins in early August, peaks in mid-August to mid-September and ends in October. During this period, many bats may arrive at the site after dusk, stay a few hours then leave, so few bats may be present at the site during the day. The species composition of swarming bats may be very different from that of hibernating bats found at the site, though *Myotis* species are most frequently recorded. Surveys for swarming bats can be carried out during August, September and October beginning at dusk (1 hour after sunset) and continuing through the night as most activity has been recorded in the hours prior to dawn. Bats can be recorded using detectors – static detectors are particularly useful - or by netting or harp-trapping under licence, though the latter two techniques are highly invasive and more suitable for detailed studies

### 5.7.2 Extent and pattern of usage

Confirming the extent and pattern of usage can be difficult in some cases. Where significant quantities of droppings (piles which cover areas of the floor) are present in the roof void of a building, it is reasonable to assume that this is a maternity site, unless there are clear indications to the contrary. Interpreting the status of roosts in buildings with lesser quantities can be difficult and here there are two options; either take a precautionary approach and assume that the site is a maternity site, or carry out further survey work in the appropriate season to either prove or disprove the existence of a maternity site. Sites with very small quantities of scattered droppings are unlikely to be of high conservation significance as they are unlikely to be maternity sites but this is not always the case. Again the use of static detectors over a period of time can help inform conclusions.

## 5.8 Interpreting and evaluating survey results

### 5.8.1 Low numbers and absence

'Presence/absence' surveys may determine presence but in fact it can be extremely difficult to demonstrate absence for highly mobile animals such as bats. The guidance here is designed to suggest a reasonable level of effort that, at the majority of roosts, will detect the presence of bats. However, where survey conditions are difficult, buildings are large or inaccessible or where populations are small, it can be exceedingly difficult to detect bats, particularly at some times of year. It is feasible, for example, that for winter visits to sites used by few bats, several visits could be carried out with no bats detected, but a further visit might find them. In many sites, usage is heavily influenced by the external temperature.

It is for the consultant to decide on the level of effort to employ according to site conditions; the fundamental issue is that the survey should be able to provide the National Parks and Wildlife Service and the Local Planning Authority with an assessment of the effects of development.

### 5.8.2 Site, colony or population size class assessment

Most surveys of bat roosts attempt to estimate the number of bats using the site and, from this, come to a conclusion about the way the site is used and its importance to the local population of the species recorded. These estimates are most frequently based on the number of bats seen on a visit or the size of any accumulated pile of droppings, allied, perhaps, with other clues from the site.

It is very difficult to establish the true size of a population of bats using a roost, due to a range of factors including:

- The variable sampling efficiency attained in different types of roost;
- The complex population dynamics involved;
- The differing habits of males, females and juveniles (especially at maternity sites);
- The seasonal nature of occupation of most roosts;
- Species-specific factors.

At one end of the spectrum lie maternity roosts for a site-faithful species such as the lesser horseshoe bat, where a reasonable estimate for the size of population (or colony) associated with the site might be possible, even though few males will ever be seen. At the other, lie large complex hibernation sites, where only an unknown fraction of the bats present might be visible and where individual bats come and go throughout the winter.

Given these difficulties, it is important that the underlying data on which any conclusions are based are included in the survey report. Significant information items include:

- Species identification details, including bat detector information;
- Dated counts of bats, either in the roost or exit counts;
- Position of bats in roost (clustered, dispersed *etc.*);
- Pattern and extent of any accumulation of droppings, with information about their age;
- Presence of food remains, such as moth wings.

Except in exceptional circumstances, it will be necessary to provide a map or plan of the site, indicating where any bats or signs of bats were encountered.

### 5.8.3 Factors influencing survey results

The presence of bats in a particular roost at any point in time is, of course, influenced by all the factors referred to in Section 5.8.2. In addition, the recent and current weather can have a marked effect. During the winter, bats will move around to find sites that present the optimum environmental conditions for their age, sex and bodyweight and some species will only be found in underground sites when the weather is particularly cold. During the summer, bats may be reluctant to leave their roost during heavy rain or when the temperature is unseasonably low, so exit counts should record the conditions under which they were made. Similarly, there may be times when females with young do not emerge at all or emerge only briefly and return while other bats are still emerging thus confusing the count. Within roosts, bats will move around according to the temperature and may or may not be visible on any particular visit. Bats also react to disturbance, so a survey the day after a disturbance event, may give a misleading picture of roost usage.

**Figure 15** Pipistrelle droppings on window sill beneath roost access point. [Photograph: Conor Kelleher]

Care must also be exercised when recording signs of bats. The volume and layout of droppings and food remains can provide important information about roost usage, but depend on these clues remaining undisturbed. It is essential to check whether disturbance, such as floor sweeping or tidying up has taken place, as this could have a significant impact on the conclusions drawn.

### 5.8.4 Site status assessment

Patterns of roost use can be complex, but a basic starting point is to consider whether bat usage of a site falls clearly into one or more of the following categories:

- Maternity site, where pups are born and raised to independence;
- Hibernation site, where bats may be found during the winter;

- Mating site, where males and females gather during the autumn;
- Feeding site (night roost), where bats rest between feeding bouts during the night but are rarely present by day;
- Transitional (or swarming) site, where bats may be present during the spring or autumn;
- Satellite roost, used by males and non-breeding females.

## 5.9 Sub-optimal surveys

In some circumstances, for example where the presence of bats is discovered only after a development project has commenced, it may be necessary to conduct surveys in sub-optimal conditions, such as where some disturbance has already taken place or where evidence of bats has been compromised or destroyed. The conditions under which the survey was done, and any constraints, should be carefully noted in the survey report and any interpretation of the results should be qualified by these constraints. Unless there is clear evidence to support an alternative interpretation, it should be assumed that any significant bat roost is a site of importance for the local bat population and the mitigation should be configured accordingly.

**Figure 16** Bridge repair works which may impact bat roosting sites. [Photograph: Conor Kelleher]

# 6 Predicting the impact of development

## 6.1 Introduction

In order to determine what impact the proposed development will have, it is important to examine the survey information, and compare this with the proposals for development. This task is made easier by good survey information and detailed plans, showing pre-development and post-development site layout and roosts. Sometimes called impact assessment, this is a critical phase of mitigation planning, since the type and extent of mitigation required will depend on the likely impacts on roosts. Impact assessments can also help in considering alternative sites or alternative site layouts. Even when a statutory impact assessment is not required, Planning Authorities do have powers to direct developers to provide any information they may reasonably require to enable them to fully assess the application. Ideally, an impact assessment should inform the drawing up of detailed development plans, so that impacts can be avoided where possible. It is therefore important that this stage is undertaken as early as possible in the planning process. Guidance on the suggested structure for describing impacts is given in Appendix 1. Survey and Mitigation Report Structure.

It is important to consider impacts both at the site level and in a wider perspective. The latter element relates to the assessment of the overall importance of the site (see Section 5.8.4 Site status assessment). The development 'context' of the site should also form part of the impact assessment. For example, if the site is part of a larger phased development the potential consequences for the target population(s) need to be considered. Building a replacement roost only to have it destroyed during a later phase of development does not constitute mitigation.

**Figure 17** Brown long-eared bat roosting within crevice beneath bridge. [Photograph: Conor Kelleher]

## 6.2 Major types of impact and their effects on populations

### 6.2.1 Disturbance

Works associated with development or building work are likely to lead to an increase in human presence at the site, extra noise, lighting and changes in the site layout and local environment. All these may have a detrimental effect on the bats, which seek particular environmental conditions, such as a low incidence of direct human disturbance, particular temperature, lighting and humidity regimes and a stable internal and external layout so they can continue to follow established flight-paths.

### 6.2.2 Roost modification

Modifications to roost sites, which includes the construction of new entrances, the reduction of roost space available to the bats, changes to ventilation and air-flow *etc.*, can have a significant impact on the bats' use of the roost and thus damage it Mackintosh (2016). In some cases, roosts can be carefully adapted and altered to create new entrances and flight paths; in others, reduction in the space available to the bats has resulted in the desertion of roosts (see Bat Conservation Trust (2017), Briggs (2002) for examples). There are clear species-specific differences in the extent to which bats will accept changes to their roost (including entrances and flight paths) and these should be taken into account when considering such operations.

### 6.2.3 Roost loss

The impact of the loss of roosts on bat populations is poorly understood and difficult to study, though it is believed to be an important factor in the decline of bat populations generally. For some species which are known to move between roosts, and which rely less heavily on sites with special characteristics, the loss of a single maternity or hibernation roost may be less critical than for more specialised species. For example, pipistrelles, which are crevice roosters and are known to move between maternity sites, may find it easier to locate suitable new roost sites than long-eared bats, which favour buildings with large unobstructed roof voids of a type not commonly associated with modern building methods. Hibernation sites used by significant numbers of bats may be a critical resource for the local bat population, particularly in times of cold weather, and may be used by bats from a wide area.

**Figure 18** Removal of older buildings with potential as bat roosting sites. [Photograph: Conor Kelleher]

In view of the uncertainties in predicting the effect of roost loss on bat populations, the continuous attrition of the stock of suitable roosts should be avoided and a guiding principle should be that there is no overall loss of roosts. The only exceptions to this may be that the loss of very minor roosts, such as feeding perches, can be tolerated, provided there is no overall loss of habitat. Development proposals that would result in the loss of roost sites with no proposed mitigation would require substantial supporting evidence to demonstrate clearly that there would be no adverse effect on favourable conservation status.

### 6.2.4 Fragmentation and isolation

Recent radio-tracking and bat detector studies have demonstrated clearly the importance of linear features in the landscape to many species of bats. Features such as hedges, treelines and waterways are used by bats to navigate between roosts and feeding areas and the continuity of such features is important to them (Kyheröinen *et al*., 2019). Most bats, other than high-flying species such as Leisler's, tend to fly close to linear features or close to a tree canopy, so the presence of protected flight routes around roosts is important. The loss of linear features, leaving roosts isolated in the landscape can thus be damaging. A typical example may be where a maternity roost is protected from development but is left isolated from feeding areas when surrounded by high density housing, roads or car parking areas. The European Commission emphasises the need for the "continued ecological functioning" of roosts. That means that elements of the environment which support the presence of the roost should be taken into account when considering impacts. It is after all, an offence to cause the deterioration of a roost by such human activity (European Commission, 2021a; Section 2.3.4 d).

### 6.2.5 Post-development interference impacts

The long-term impact of increased human activity around a roost should be considered when deciding on appropriate mitigation. In particular, the placement of external lighting close to roost entrances should be avoided as this may impact on the emergence behaviour of bats. Many bat species show a

clear preference for avoiding well-lit areas, so shaded flight paths joining the roost to habitats such as woodland or hedgerows are recommended.

**Figure 19** Woodland track used as foraging area and connective element by bats. [Photograph: Conor Kelleher]

## 6.3 Temporal and spatial considerations

Most bats show clear seasonal changes in behaviour and roost selection, so the impact of development may vary seasonally. This is perhaps most easily understood when considering the impact of direct disturbance on seasonally used roosts, but timing can have other impacts as well. If a traditional roost is to be lost to development, the replacement must not only be suitable in terms of its internal environment, but it must also be known to the bats, which generally have a strong attachment to their traditional roost. Consideration of the timing of operations is therefore fundamental to the development of a mitigation strategy.

## 6.4 Poor data situations and 'last-minute' discoveries

It is difficult to predict impacts accurately when no or few data are available. Planning Authorities may refuse or defer planning permission in such cases. Where attempts have been made to predict impacts based on poor data, mitigation plans will be assessed in the light of the information contained in this section and the previous section on surveys; should the impact assessment not adequately address these points it is unlikely that the proposals will be viewed favourably. A recommendation for further survey is likely in such circumstances. One exception would be where other evidence strongly indicates that the area to be affected by development is of very low importance, and the impacts will be negligible; in this case, a lower standard of survey might be acceptable (though of course detailed survey is always preferable).

In the case where bats are discovered after planning permission has been granted, or after development has commenced, works that would be likely to lead to a breach in the law should cease, NPWS should be contacted and a survey undertaken (note that species protection legislation applies even when planning consent has been granted). Mitigation plans should be developed, recognising that in some cases the potential for mitigation will be reduced. Where a robust survey has been undertaken prior to the development and this failed to detect bats, it is understandable that a developer might feel frustrated at having to delay works or incur significant extra costs. In such circumstances – effectively where the presence of bats could not reasonably be predicted – mitigation plans should be discussed with NPWS and a derogation licence applied for if necessary. However, where there was no prior survey, or the survey was undertaken to a poor design, it is likely that the developer would have insufficient grounds for a defence should prohibited activities be undertaken subsequent to the discovery of bats. This might mean that a development needs to be delayed for several months in order to undertake adequate surveys, devise appropriate mitigation and obtain a licence from the NPWS. Cases like this are legally complex and each should be considered on its own merits; the NPWS should be contacted for advice on the best way to proceed.

## 6.5 Summarising the scale of site level impacts

Tble 4 below gives a simple classification of the potential scales of impact for the most commonly encountered development effects. In general, the greater the predicted impact the greater the level of mitigation that will be required. When viewing this table, there are a number of important caveats to consider:

- The scale of impact here refers to impact at the site level; it does not consider the consequences of the development effects in a wider context (for which, see Sections 5.8.4 Site status assessment and 7.2 Key principles of mitigation).
- The assessment here relates to impacts on roosts in terms of likely damage to population viability, and should not be confused with an assessment of the risk of killing or injuring individuals.
- Development effects will be cumulative to some degree, so that a number of low impact effects may combine to increase the overall impact. However, as there is so much variation in the level of impact, and as the ways in which development effects interact to influence populations is complex, a simple additive relationship cannot be derived. In other words, it would be inappropriate to conclude that, for example, two low impact effects always combine to give a medium impact. A judgement on the combined impact should be derived by assessment and reasoning on a case specific basis.
- "Low" impact as stated here does not mean no impact. Generally some mitigation will still be required. However, there will be cases where a given development effect will have no (or negligible) effect on the population or on individuals, and will not therefore require mitigation.

**Table 4** The scale of main impacts at the site level on bat populations. [**NB** This is a general guide only and does not take into account species differences. Medium impacts, in particular, depend on the care with which any mitigation is designed and implemented and could range between high and low.]

| Roost type | Development effect | Scale of impact | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| Maternity | Destruction | | | ✓ |
| | Isolation caused by fragmentation | | | ✓ |
| | Partial destruction; modification | | ✓ | |
| | Temporary disturbance outside breeding season | ✓ | | |
| | Post-development interference | | | ✓ |
| Major hibernation | Destruction | | | ✓ |
| | Isolation caused by fragmentation | | | ✓ |
| | Partial destruction; modification | | ✓ | |
| | Temporary disturbance outside hibernation season | ✓ | | |
| | Post-development interference | | | ✓ |
| Minor hibernation | Destruction | | | ✓ |
| | Isolation caused by fragmentation | | | ✓ |
| | Partial destruction, modification | | ✓ | |
| | Modified management | | ✓ | |
| | Temporary disturbance outside hibernation season | ✓ | | |
| | Post-development interference | | ✓ | |
| | Temporary destruction, then reinstatement | ✓ | | |
| Mating | Destruction | | ✓ | |
| | Isolation caused by fragmentation | | ✓ | |
| | Partial destruction | ✓ | | |
| | Modified management | ✓ | | |
| | Temporary disturbance | ✓ | | |
| | Post-development interference | ✓ | | |
| | Temporary destruction, then reinstatement | ✓ | | |
| Night roost | Destruction | ✓ | | |
| | Isolation caused by fragmentation | ✓ | | |
| | Partial destruction | ✓ | | |
| | Modified management | ✓ | | |
| | Temporary disturbance | ✓ | | |
| | Post-development interference | ✓ | | |
| | Temporary destruction, then reinstatement | ✓ | | |

# 7 Planning mitigation and compensation

## 7.1 Why mitigate?

This section is intended to assist consultants and developers decide *what* mitigation is required, whilst 8 Mitigation and compensation methods, gives guidance on *how* to undertake it.

The aim of the consultant and developer should be to seek to achieve one of the following outcomes, in decreasing order of preference:

- Avoidance of impact; no negative impact on bat populations or existing roosts and hence bat populations;
- On-site mitigation; compensation by the improvement of existing roosts or the provision of new roost opportunities within the site or building;
- Off-site compensation; where on-site mitigation is not possible, the creation of new roosts of an appropriate type in an appropriate nearby location.

The potential impacts of the development should be considered at the outset, so that, where possible, plans can be modified in order to achieve the first outcome listed above (no impact). This could entail the use of alternative sites, or the repositioning of structures to avoid impacts. Note that derogation licences to destroy breeding or resting places can only be obtained where there is no satisfactory alternative to that course of action. If impacts can be avoided completely, the Habitats Regulations are not contravened and no licence is required (NPWS Guidance is available at https://npws.ie/sites/default/files/files/strict-protection-of-certain-animal-and-plant-species.pdf (NPWS 2021)).

## 7.2 Key principles of mitigation

The term 'mitigation' is frequently used to refer to all works required to comply with the legislation when developing areas occupied by protected species (indeed, these guidelines use the term mitigation in this broad sense). Strictly speaking, there are two elements to this process:

- Mitigation - which, in this strict sense, refers to practices which reduce or remove damage (*e.g.* by changing the layout of a scheme, or altering the timing of the work);
- Compensation – which refers to works which offset the damage caused by the development (*e.g.* by the creation of new roosts).

Both of these elements need to be considered, with the overall aim being to ensure that there will be no detriment to the conservation status of bats. In practice, this means maintaining and preferably enhancing populations affected by development. The following points should be considered when planning mitigation:

*Mitigation should be proportionate.* The level of mitigation required depends on the size and type of impact, and the importance of the population affected. This is a complex site- and species-specific issue, but the following table gives general guidance as to what the National Parks and Wildlife Service would consider an appropriate starting point for preparing a mitigation scheme.

| | Roost status | Mitigation/compensation requirement (depending on impact) |
|---|---|---|
| Low | Feeding perches of common/rarer species | Flexibility over provision of bat-boxes, access to new buildings etc. No conditions about timing or monitoring |
| | Individual bats of common species | |
| | Small numbers of common species. Not a maternity site | |
| | Feeding perches of Annex II species | Provision of new roost facilities where possible. Need not be exactly like-for-like, but should be suitable, based on species' requirements. Minimal timing constraints or monitoring requirements |
| | Small numbers of rarer species. Not a maternity site | |
| | Hibernation sites for small numbers of common/rarer species | Timing constraints. More or less like-for-like replacement. Bats not to be left without a roost and must be given time to find the replacement. Monitoring for 2 years preferred. |
| | Maternity sites of common species | |
| **Conservation significance** | | |
| | Maternity sites of rarer species | Timing constraints. Like-for-like replacement as a minimum. No destruction of former roost until replacement completed and usage demonstrated. Monitoring for at least 2 years. |
| | Significant hibernation sites for rarer/rarest species or all species assemblages | |
| | Sites meeting SAC guidelines | Oppose interference with existing roosts or seek improved roost provision. Timing constraints. No destruction of former roost until replacement completed and significant usage demonstrated. Monitoring for as long as possible. |
| | Maternity sites of rarest species | |
| High | | |

**Figure 20** Guidelines for proportionate mitigation. The definition of common, rare and rarest species requires regional interpretation.

*Plans should be based on adequate knowledge.* Sound survey, site assessment and impact assessment is required. The plan should take each predicted impact and address how it can be avoided, lessened and/or compensated for.

*Mitigation should aim to address the characteristics picked up by the site assessment*, as follows:

- Quantitative characteristics: There should be no net loss of roost sites, and in fact where significant impacts are predicted there will be an expectation that compensation will provide an enhanced resource compared with that to be lost. The reasoning behind this concept is that the acceptability of newly created roosts by bats is not predictable (see Section 6.2.3 Long-term impacts: Roost loss).
- Qualitative characteristics: the plans should aim to replace like with like. As an extreme example, it would be unacceptable to replace maternity roosts with hibernation sites.
- Functional characteristics: compensation should aim to ensure that the affected bat population can function as before. This may require attention to the environment around the roost.

**Figure 21**. Riparian and woodland habitat frequented by bats. [Photograph: Conor Kelleher]

*Preparing an appropriate replacement site (or sites) may require considerable time and effort*. The success of the scheme will depend to a great extent on this decision. For high impact schemes, additional land may need to be purchased or buildings constructed, and hence the costs of compensation can be considerable. Depending on the circumstances, a considerable period of time may be needed to demonstrate the acceptability of the new roost to the bats if this is required by the licence. Although planning permission is needed as usual, no derogation licence is required to build a new replacement roost and developers are encouraged to construct these, where necessary, well in advance of the main development. Specialist advice will be required to ensure the design is fit for purpose.

*The long-term security of the population should be assured*. Mitigation should aim to ensure that the population will be free from further disturbance, and is subject to adequate management, maintenance and monitoring. Any proposals should be confirmed, ideally by a legal agreement or planning obligation, and not left as open-ended options. This may require careful attention when the end result is a dwelling-house and is an argument in favour of providing dedicated facilities.

*Mitigation plans will be open to public scrutiny*. The National Parks and Wildlife Service will make plans available to third parties on request wherever possible, because they are part of a decision-making process for a statutory function (licensing) and because freedom of information legislation requires this. If submitted as part of a planning application, they will also be held on file by Planning Authorities and therefore be available for public viewing.

*Mitigation plans should address the impacts of all phases in phased developments.* Individual phases will normally be mitigated for individually, but there should be an overall plan which takes the impacts for the entire scheme into consideration. Although no licence is required to construct a new dedicated bat roost, the restoration of an existing roost as mitigation may require a derogation license. See https://npws.ie/licensesandconsents/disturbance/application-for-derogation-licence

*Precautionary mitigation, i.e. going ahead with mitigation before a proper survey has been undertaken, is not normally acceptable.* Only in certain limited cases, notably where there is good evidence to indicate that the site is of very low importance and there will be negligible impacts, will it be acceptable to submit mitigation plans based on little or no survey (see Section 6.4 Poor data situations and 'last-minute' discoveries).

**Figure 22** There is growing evidence that bats can be killed at wind turbines. [Photograph: Conor Kelleher]

## 7.3 Main components of mitigation

Mitigation for bats normally comprises the following elements:

- Avoidance of deliberate, killing, injury or disturbance – taking all reasonable steps to ensure works do not harm individuals by altering working methods or timing to avoid bats. The seasonal occupation of most roosts provides good opportunities for this
- Roost creation, restoration or enhancement – to provide appropriate replacements for roosts to be lost or damaged
- Long-term habitat management and maintenance – to ensure the population will persist

- Post-development population monitoring – to assess the success of the scheme and to inform management or remedial operations.

**Figure 23** Post construction monitoring of bat boxes to ensure effectiveness. [Photograph: Conor Kelleher]

# 8 Mitigation and compensation methods

## 8.1 Introduction

This section gives advice on the methods commonly used for mitigation and compensation, paying particular attention to effort and timing. Note that these are not the only methods which could be used, but they are known to be generally effective in appropriate circumstances. They should be applicable to the majority of development schemes. As sites vary in their individual characteristics, and developments differ in their impacts, the information presented is generic rather than prescriptive; consultants may make a case for different techniques and levels of effort on a site-by-site basis.

It is the responsibility of the applicant (normally consultant and client) to make sure that any proposed mitigation meets other legal requirements. For example, the incorporation of bat access points into new or refurbished buildings must comply with planning requirements and building regulations. Additional requirements may also be imposed by insurance or warranty organisations.

## 8.2 Avoidance of disturbance, killing and injury

Although mitigation proposals must meet the test of no adverse effect on the favourable conservation status of populations, the Habitats Regulations are constructed to give protection to individuals as well as breeding sites and resting places. This means that precautions must be taken to avoid the deliberate killing or injury of bats. "Deliberate" has been interpreted by the CJEU as a foreseeable outcome of an action. This means that if an action is likely to kill or injure bats then killing or injuring them is deliberate even if the person did not set out purposely to do so (European Commission 2021 (a) Paragraph 2-34). Disturbance of bats or the destruction of roosts may be permitted under a derogation licence, but conditions are likely to apply.

The most common and effective method of avoiding these offences is to carry out the work at an appropriate time of the year. The great majority of roosts 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. 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 Table 5 below should be modified in the light of site-specific species information. For example, some species, most notably long-eared and lesser horseshoe bats, 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. The period of works may be extended if the way in which the bats use the site is well understood.

**Table 5** Optimum season for works in different types of roosts.

| Bat usage of site | Optimum period for carrying out works (some variation between species) |
|---|---|
| Maternity | 1st October – 1st May |
| 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.

Where the same structure is used throughout the year, the optimum time for works of all types is likely to lie outside the main breeding season, to avoid times when non-flying pups may be present, and 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.

The presence of scaffolding during the active bat season may hamper bat access and this should be considered during siting especially if also using plastic sheeting. Access points of appropriate size may need to be opened in sheeting to allow bats to pass through while the scaffolding is in place (Reiter & Zahn 2006).

The best times for building or re-roofing operations are spring and autumn. At these times of the year the bats will be able to feed on most nights and may be active or torpid during the day, depending on weather conditions, but will not have begun giving birth. 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. 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. Any moving or handling of bats requires a licence.

**Figure 24** Re-roofing operations may require timing restrictions. [Photograph: Conor Kelleher]

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.

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.

Works on other sorts of bat roosts, such as trees, should follow the same strategy of trying to avoid works at a time of year when bats are most likely to be present.

Further guidance on the timing of works and the action to be taken if bats are discovered is given in the Bat Workers' Manual (JNCC 2004).

There is growing evidence that bats can be killed at windfarms (Rodrigues *et al*. 2015). It is important to consider the risk to foraging bats, and not just bat roosts, during windfarm EIAs. Turbines located in or near woodlands, or between roosts and their associated foraging habitats are of particular concern. Careful siting of wind turbines and sympathetic landscape management can help reduce the likelihood of mortality. Increasing cut-in speeds of turbines has also been shown to be beneficial (Rodrigues *et al*. 2015). More data is needed to inform how best to implement this mitigation approach in the Irish landscape.

### 8.2.1 Remedial timber treatment

Repair and restoration of old or derelict buildings often requires remedial timber treatment against infestations of wood-boring insects. Although most treatment chemicals now in general use are safe once dry, the application of products must be avoided when bats are present. In most cases, this is a matter of timing the work so as to avoid the summer months, but there may be occasions where small numbers of bats must be persuaded to move away. The Bat Worker's Manual gives further details of the remedial timber treatment process and the precautions to be taken.

### 8.2.2 Breathable membranes

Modern roof linings and breathable membranes that are composed of fibres have been shown to trap and ensnare bats causing mortality. These are commonly called "Non-bitumen coated roofing membranes". The use of these materials should be carefully considered if bats are in the building. Older linings such as mineral felt or rough timber should instead be used where possible to facilitate bat roosting. It may however be acceptable to use breathable membranes and such linings in conjunction with older linings, on the advice of a bat specialist, if it can be ensured that bats will only come into contact with the latter. In some cases breathable membranes can be made safe for bats by adding a layer of Netlon and batons. One specific type of roof membrane has been independently tested in the UK in 2021 for prevention of snagging but it has not yet been recommended by any of the statutory agencies there. This is an area where new solutions are evolving and the best advice is to research products carefully before using them.

### 8.2.3 Lighting

Lighting at or near roost entrances has been shown to disturb bats and should be avoided. A useful review of information on this issue has been published by Eurobats (Voigt *et al*., 2018). In general, artificial light creates a barrier to commuting bats so lighting should be minimised during the active bat season from March to the end of September as it deters some bat species. Where lighting is required, directional lighting (*i.e.* lighting which only shines on access roads and not nearby countryside) should be used to prevent overspill. This can be achieved by the design of the luminaire, the height of the lamp and by using accessories such as hoods, cowls, louvres and shields to direct the light to the intended

area only. Modern LED lighting has also been shown to deter bats but it is available in a range of colours other than white which may be used to avoid or lessen impacts. Warmer colour wavelengths between 2700 and 3000 Kelvin seem to have less impact on bats (Bat Conservation Trust & Institute of Lighting Professionals 2018). Further recent guidance on reducing obtrusive lighting, although not specific to bats, can be found in Institution of Lighting Professionals, 2021.

## 8.3 Avoiding damage to existing roosts

Avoiding damage to existing roosts is the preferred option in all cases. If, in the consultant's opinion, measurable disturbance to bats can also be avoided this would mean that a licence is not required as no offence is being committed. If this appears to the consultant to be the case, then a method statement detailing the work to be carried out and any working practices or precautions necessary to avoid breaking the law should be provided to the client. The existence of this method statement helps to establish a defence against prosecution for intentional or deliberate disturbance of bats or damage to roosts. In such cases, it should be noted that the failure of the client, or anyone working under the client's direction, to follow the method statement may result in a breach of the law and leave the client or others open to prosecution.

## 8.4 Incorporating existing roosts into refurbished buildings

Projects such as the refurbishment of derelict or semi-derelict buildings, barn conversions, alterations to non-domestic premises, including churches, or other structures used by bats can all provide opportunities to incorporate existing roosts into the final structure. This option is generally to be preferred to the destruction of an existing roost and the provision of a new roost in compensation, though there may be physical constraints which militate against this course of action.

Apart from the timing of the works (see Section 8.2), 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.

### 8.4.1 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, lesser horseshoe bats require light-sampling areas where they can fly in and out before finally emerging. The table gives an indication of roost preferences, though there is a great deal of variation; the objective should be to maintain the roost size as close to the original as possible.

**Table 6** Species-specific roost types.

| Species | Summer/maternity roosts | Hibernation sites |
|---|---|---|
| Lesser horseshoe bat *Rhinolophus hipposideros* | Horseshoe bats require large roost areas with flight access into them, where they hang free. Normally require associated sheltered light-sampling areas. | Most dependent on underground sites. May use cellars or other areas with appropriate temperature and humidity |
| Daubenton's bat *Myotis daubentonii* | Hole dweller. May enter roof voids and roost at apex. Relatively rare in houses, but may use castles, tunnels *etc.* | Found hibernating underground, though many individuals probably elsewhere |
| Whiskered bat *Myotis mystacinus* | Crevice dweller, but may enter roof voids and fly around | Found hibernating underground, though most individuals probably elsewhere |
| Natterer's bat *Myotis nattereri* | Crevice/hole dweller; may require light-sampling areas. Frequent in crevices in timbers in old barns. | Found hibernating underground, though most individuals probably elsewhere |
| Nathusius' pipistrelle *Pipistrellus nathusii* | Crevice dweller. | Rarely recorded. In buildings? In quite exposed places |
| Common pipistrelle *Pipistrellus pipistrellus* | Crevice dweller, but sometimes enters roof voids. Does not normally require light-sampling areas | Hibernates in a variety of places, which may be quite exposed. Frequently in cavities in buildings, rarely underground |
| Soprano pipistrelle *Pipistrellus pygmaeus* | | |
| Leisler's bat *Nyctalus leisleri* | Crevice/hole dweller. Sometimes in buildings, but unlikely to fly inside. | Little known; probably tree cavities, occasionally underground |
| Brown long-eared bat *Plecotus auritus* | Hole dwellers. Readily fly within roof voids. Often in crevices by day, although sometimes in the open and clustered against ridge beams. | Found in tree holes, roofs and underground. |

For species that fly within roof voids, notably lesser horseshoe and brown 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. 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 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).

### 8.4.2 Roost entrances

Lesser horseshoe bats generally prefer entrances they can fly through (see the Bat Workers' Manual, 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. External lighting, such as security lights or road or path lighting, close to roost entrances must be avoided and it may be necessary to make arrangement to prevent the later erection of external lighting through the use of restrictive covenants.

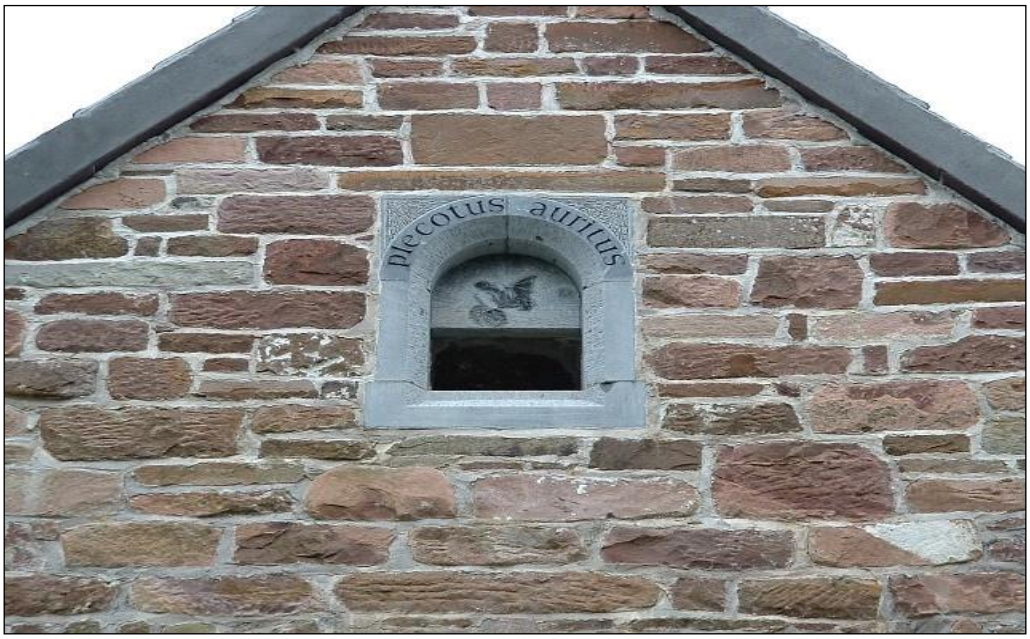


**Figure 25.** Roost entrance for brown long-eared bats but also large enough for lesser horseshoe bats. [Photograph: Conor Kelleher]

## 8.5 Providing new roosts

### 8.5.1 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 lesser horseshoe and long-eared bats, careful attention must be paid to the design in order to provide a suitable roof void. See Section 8.4 for guidance on roost size and construction and note that trussed rafter construction should be avoided (unless specified so as to leave a large roof void). For species that typically roost in crevices, roosting opportunities can be provided in a variety of ways including:

- access to soffit boxes and eaves via a small gap (15-20 mm) between soffit 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 30°C and 50°C, 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.

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. However, a review in Scotland showed only limited success for such works (Lintott & Matthews, 2018). They may be more suitable for pipistrelles than for other species.

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. An excellent guide to incorporating bat roosts as well as bird nesting sites in buildings is *Biodiversity for Low and Zero Carbon Buildings: a Technical Guide for New Build* by Williams (2010).

### 8.5.2 Bat boxes

**Bat boxes are generally inappropriate substitutes for significant roosts in buildings and do not constitute 'like for like' replacement.**

Where roosts of low conservation significance (see Section 7.2) are to be lost to development, bat boxes may provide an appropriate form of mitigation, either alone or, preferably, in combination with the provision of new roosts in buildings. In such cases, the type of bat box provided should be appropriate to the species.

Woodcrete (cement and sawdust) bat boxes, such as those manufactured by *Schwegler* (available from NHBS at www.nhbs.com) appear to be at least as successful as wooden boxes in attracting bats and have the advantage of being far more durable and thus needing less maintenance. They should be considered wherever standard sized boxes are being specified. A mixture of bat box types, perhaps 3 per tree should be specified to cater for seasonal and species requirements.

An outdoor, wall mounted, heated bat box is commercially available. It uses ceramic heaters within the box which maintain the temperature in the 20° C range. It requires connection to the main electricity supply via a 10m cable. This box is suitable for pipistrelles because of the small crevice size.

**Figure 26** This structure was built at Errit Lake, Co. Roscommon to compensate for an old house which was demolished in 2010. There are six Schwegler bat tubes built into the structure. A small number of Daubenton's bats had been recorded roosting in the house. Last time it was checked the bat tubes were being used by Soprano pipistrelles. [Photographs: Caroline Sheils]

Mullen (2012) compared the conditions in five makes of bat box against those in an attic roost in the same building during the breeding season. None of the bat boxes reached the temperatures found in the attic and no bats attempted to roost in them during that season.

McAney & Hanniffy (2015) reviewed the use of bat boxes in Ireland. Eight of our nine species have been recorded from bat boxes (lesser horseshoe bats cannot use bat boxes due to their need to fly, rather than crawl, into roosts), but the review identified significant differences in usage and also identified some inter-species differences in bat box choice. That said, further monitoring of bat box usage is needed before a full understanding of their value and application as a mitigation tool can be reached.

At present, there are few data about the conservation value of large crevice-type bat-boxes intended for use as maternity roosts, such as the 'bat houses' developed in the USA (Tuttle & Hensley, 1993) but a trial in Co. Roscommon showed that pipistrelles used one of these boxes about 3 years after the destruction of their roost. In two trials in Wicklow bats continued to use their favoured roost over the maternity box. Further studies are required to assess their value as replacement roosts.

A number of more recent studies have shown that there is a poor uptake of bat boxes or alternative roosts when compared with retaining the original roost or entrances (Mackintosh, 2016; Bat Conservation Trust 2017; Garland *et al.* 2017). Ultimately the best solution for the bats is to retain their original roost.

**Table 7** The types of bat box used by different species.

| Species | Summer/ maternity | Summer/non breeding | Hibernation* | Notes |
|---|---|---|---|---|
| *Rhinolophus hipposideros* | N/A | N/A | N/A | Horseshoe bats cannot use bat boxes |
| *Myotis daubentonii* | H | H | | |
| *Myotis mystacinus* | H | H | | |
| *Myotis nattereri* | H | ? | | |
| *Pipistrellus nathusii* | H | H | | |
| *Pipistrellus pipistrellus* | C | C/H | C | H are rarely used as maternity roosts. |
| *Pipistrellus pygmaeus* | C | C/H | C | |
| *Nyctalus leisleri* | H | H | H? | |
| *Plecotus auritus* | H | H | | Maternity roosts |

Key

* Large well-insulated hibernation boxes may be more successful

N/A -not applicable; bat boxes should not be considered as replacement roosts

H – tree hollow-type box, providing a void in which bats can cluster

C – tree crevice-type box, with 25-35mm crevices

? – few data on which to base an assessment

### 8.5.3 Bat houses or 'bat barns'

Where a careful appraisal of the options indicate it is not feasible to maintain roosts in situ, purpose built bat houses or bat barns may be considered as an alternative. In view of the limited experience of the use of this compensation technique, it is essential that the risks of non-adoption by bats are minimised through careful design and site selection. One option might be to translocate an entire roof, or part of a roof, as this may have a good chance of success. Monitoring of success is built into the method statement and is important because it contributes to our understanding of the factors that determine success or failure.

The following design principles need to be considered when developing a proposal for ex-situ roost conservation.

- The replacement roost should normally be situated as close as possible to the roost to be lost and match it closely in terms of size, height and aspect. However, indications are that a replacement roost with a footprint of less than about 5 m x 4 m and a total height of less than 5m seems unlikely to be successful.
- The location of the replacement roost should be chosen to maximise the chances of the bats finding and adopting it. Ideally, it should be close to existing flight paths and have an entrance close to appropriate habitat. Many bat species prefer to fly in dark areas straight into vegetation, so external lighting on the site should be avoided.
- The roosting areas should be designed to take account of the requirements of the species concerned. For example, crevice-dwelling species should be provided with suitable crevices of an appropriate width whereas species which fly within roof voids require a large unobstructed void with a floor to apex height of at least 2 m, preferably more. The roosting areas should match those to be lost as closely as possible.
- The building should be designed so as to provide a suitable thermal regime (42°C is optimum). For maternity sites, this is likely to require a fairly steeply pitched roof with one pitch facing south, so as to achieve high temperatures (up to 50°C maximum) in summer but with a choice of roosting temperatures. Dark-coloured roof coverings, such as black slates, will help to produce high temperatures. In certain cases, artificial heat sources may need to be considered. Hibernation sites should be sufficiently large to achieve stable winter temperatures of 0-6°C for Vespertilionid bats and 6-10°C for Rhinolophid and need to be sufficiently large for bats to fly and turn comfortably.
- Opportunities should be taken to provide a variety of roosting opportunities and thermal regimes so as to maximise the value of the building to bats. For example, buildings can be designed with an upper part suitable for use as a maternity site and a lower part suitable for hibernation.

**Figure 27** Old school house renovated for lesser horseshoe bats, Ennis, Co. Clare. [Photograph: Conor Kelleher]

- Consideration should be given to making the building as resistant to damage by vandalism as possible. Doors can be reinforced and sited some way above ground level to make it difficult to attack them; rainwater goods can be carried internally; flammable materials that can be reached

from ground level should be avoided. Planting thorny shrubs around the building may help to discourage trespass by making access difficult.

- Consideration should be given to installing remote monitoring systems to facilitate detailed follow-up monitoring with minimal disturbance.
- Arrangements must be in place for securing the long term integrity and security of the replacement roost. This may require planning agreements or the transfer of ownership of the building to a suitable organisation such as the National Parks & Wildlife Service or *Vincent Wildlife Trust*.
- In developing proposals for replacement bat roosts, due regard must be paid to any planning requirements. If planning permission is needed, this may take time to acquire and conditions may be imposed by the planning authority. Such requirements need to be clarified and any planning issues resolved before a replacement roost can be proposed as part of a mitigation proposal. In addition, replacement roosts, depending on their position and construction, may be subject to the requirements of the Building Regulations. Again, any such requirements should be clarified before a licence application is made.
- The Vincent Wildlife Trust have extensive experience with the development and maintenance of purpose-built roosts for horseshoe bats. Their guidance document should be consulted if a bat house for lesser horseshoe bats is being planned (Schofield, 2008).

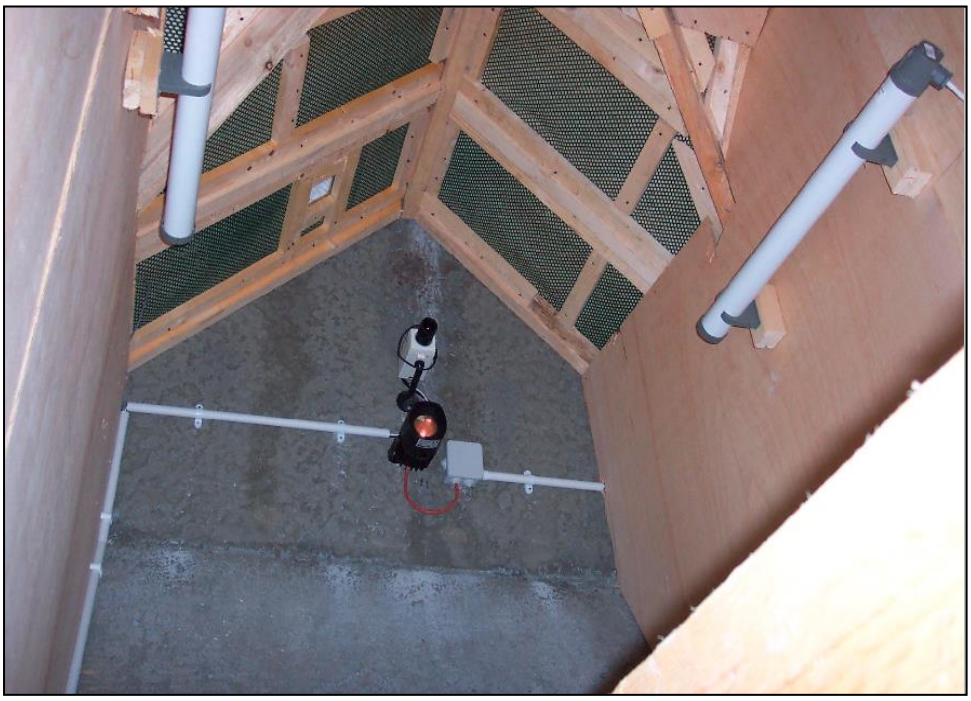

**Figure 28** Roof apex of bat house showing two thermo-statically controlled infra-red heaters and remote controlled CCTV monitoring system. [Photograph: Conor Kelleher]

## 8.6 Green bridges

Green bridges are successfully used in many parts of the world, notably the Netherlands, to reduce collisions between wildlife and traffic in transport projects. They reduce habitat fragmentation allowing movement between breeding or resting places and foraging areas. In addition the movement they permit can prevent genetic isolation when populations are split by road infrastructure. Further details can be found in Green Bridges – A Literature Review Natural England (2015) which was commissioned as a review of green bridges worldwide.

In Ireland, at the time of writing, there is one green bridge which is on the M17/18 near Gort, Co. Galway. It was designed to fit into the landscape and to provide a new commuting route for lesser horseshoe bats between a winter roost at Kiltartan and summer roost and foraging areas at Garryland Nature Reserve now on the other side of the motorway. Monitoring in 2019 showed that it was used by the bats as well as by other mammal species. Further monitoring is required to determine the level of success when the vegetation on the bridge becomes more mature.

**Figure 29** Ireland's first green bridge built over the M17/18 to mitigate against the barrier caused by the road to lesser horseshoe bats commuting to their feeding grounds. It is a dual purpose green bridge and farm overpass. (Acknowledgements Galway Co. Co and Tina Aughney)

## 8.7 Post-development site maintenance and population monitoring

### 8.7.1 Site maintenance

If the deployment of bat boxes or the construction of roosts forms part of a mitigation proposal, consideration should be given to the lifespan of the proposed roosts and the maintenance requirement during this lifespan. Wherever possible, maintenance requirements should be minimised through careful design and any outstanding requirements should be addressed through appropriate planning agreements or similar mechanisms.

For bat boxes, a design life, including essential maintenance, of about 10 years would be appropriate, as this would be comparable with the lifespan of the tree roosts that bat boxes mimic. This lifespan can be achieved with good quality wooden boxes and exceeded by woodcrete bat boxes or other types of construction that ensure any softwoods are protected from the weather and attack by squirrels.

For buildings, or parts of buildings, intended as replacement roosts, a design life of at least 50 years and preferably 100 years should be aimed for. Although this is shorter than the lifespan of many houses, it is more appropriate to the simplified construction methods used for bat houses. For example, it may be preferable to build bat houses without damp-proof membranes in order to provide a high humidity level in parts of the structure.

If sites used by bats require maintenance, remember that any disturbance of bats or alterations to roosts may need to be carried out under licence. If the derogation licence has expired, personnel may require a further NPWS licence in order to carry out any works legally.

### 8.7.2 Population and usage monitoring

A monitoring plan should be put in place to assess whether the bat population has responded favourably to the mitigation, and to inform ongoing roost management. If consistent methods are used pre- and post-development, it will be easier to compare trends. The level of monitoring required depends on the population assessment and the impact of development. For some small schemes, no monitoring may be required, while for developments which will result in significant impacts, a considerable monitoring commitment can be expected. Figure 20 gives guidance on the minimum requirements, though developers and consultants are urged to arrange for longer monitoring periods for important or novel mitigation schemes as these can then inform future mitigation projects. The contribution of such case studies to publications such as this mitigation manual is welcomed.

Follow-up monitoring is a standard requirement of most derogation licences. Monitoring may also be incorporated into (and used to inform the implementation of) the management and maintenance plan. It should clearly outline who is responsible for undertaking the monitoring, when and by what methods. Where follow-up monitoring is a requirement of a derogation licence, the results should be sent to the National Parks and Wildlife Service as specified in the licence conditions. The NPWS also welcomes the submission of post-licence monitoring data. These should be sent to the Licensing Section at NPWS, 90 North King Street, Dublin, D07 N7CV or emailed to wildlifelicence@housing.gov.ie. It would be helpful if the original derogation licence reference could be included.

## 9 Conclusion

These guidelines update and replace the original *Bat Mitigation Guidelines for Ireland* (Kelleher & Marnell, 2006).

These guidelines provide generic information and advice and are not meant to be taken as a rigid set of rules. Individual sites vary considerably and decisions should be informed and made on a site-by-site basis. The methods described are those considered to be practical and effective based on past experience, but this does not mean that other methods are ineffective, inappropriate or unlawful. Similarly, the levels of mitigation effort suggested above are based on available information, and do not necessarily constitute a statement of the lawful minimum. Mitigation proposals will vary from site to site, but should always be based on scientific expertise and practical knowledge.

Notwithstanding the above caveats, in developing these guidelines, we have drawn on a wide range of expertise, from Ireland and elsewhere in Europe, and believe that the advice given reflects current best practice. It is strongly recommended that developers and consultants take them into consideration at the earliest opportunity in their proposal development.

The publication and application of these guidelines is expected to stimulate the collection of more information about the success or failure of mitigation plans that can in turn be used to further improve mitigation and conservation measures for bats. We encourage developers and consultants to make such information publically available to help inform future best practise guidelines.

Although changes to both the planning system and wildlife legislation are made from time to time, many of the principles of survey and mitigation will continue to apply. Nonetheless, developers should always satisfy themselves that their proposals comply with current legislation.

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## Appendix 1 Recommended Bat Survey and Mitigation Report Structure

The Bat Survey and Mitigation Report forms the basis for EIA, AA, planning applications, derogation licence applications, method statements and work plans amongst others. These reports will often need to be understood, and commented on, by several organisations or individuals. As mitigation can be complex, it is important that the reports contain sufficient material and that the proposals are clear, allowing the reader to quickly understand the key points. This will facilitate the processing of the various licence applications. This appendix proposes a structure with section headings which would be appropriate for most typical schemes. Further details on the kind of information required are given in the appropriate section in these guidelines.

It is important to provide clear plans and diagrams' showing the current situation and what is proposed. Plans and diagrams should be no larger than A3. Photographs, maps and diagrams should be in colour since monochrome copies of colour images can make it very difficult to pick out detail. The front cover of the plan should show the author and revision history (the latter being useful for assessing how previous consultation comments have been incorporated).

**Recommended mitigation plan structure**
Not all sections listed below will be applicable in all cases, however, if insufficient information is contained in the report any decision-making process may be delayed while further information is sought. If using the report to apply for a derogation licence under Regulation 54 of the EC (Birds and Natural Habitats) Regulations you will need to send the report to NPWS along with a completed application form. The structure of the report has been updated from the earlier version of the Bat Mitigation Guidelines to take account of changes in the derogation application process. Please ensure that the form you are using is the current version.
https://npws.ie/licensesandconsents/disturbance/application-for-derogation-licence

**A Table of Contents**

**B Introduction**

B1 Background to activity including location, ownership, type of and need for the proposed development, planning history, land allocation in Local Plan (or equivalent), *etc.*

B2 Full details of proposed works on site that are to be covered by the licence (including a site plan at Section E7). The site may be inspected by an NPWS representative, so the details given should clearly reflect the extent of the project and leave no room for doubt. This information will be used to compare site conditions with the Method Statement.

**C Survey and site assessment**

C1 Pre-existing information on species at survey site

C2 Status of the species in the local/regional area

C3 Objective(s) of survey

C4 Survey area

C5 Habitat description [based on daytime visit(s); to include the roost and surrounding area for context]

C6 Field survey

C6.1 Methods

C6.2 Timing

C6.3 Weather conditions

C6.4 Personnel

C7 Results (to include raw data, any processed or aggregated data, and negative results as appropriate)

C8 Interpretation and evaluation

C8.1 Presence/absence

C8.2 Population size class assessment

C8.3 Site status assessment (combining quantitative, qualitative, functional and contextual factors)

C8.4 Constraints (factors influencing survey results)

C9 Map(s) of survey area (with habitat description, marking structures or features examined; summary of survey results marked on map if appropriate. Map should show area on an Ordnance Survey (or similar) base-map)

C10 Cross-referenced photographs of key features (if appropriate)

**D Impact assessment**

D1 Pre- and mid-activity impacts

D2 Long-term impacts [roost or habitat loss, modification, fragmentation, *etc.*]

D3 Post-activity interference impacts [disturbance *etc.*]

D4 Other impacts

D5 Summary of impacts at the site level

D6 Summary of impacts in a wider context

D7 Plans or maps to show impacts (clear indication of which areas would be affected and how)

**E Alternative solutions examined**

E1 List of alternative solutions examined

E2 details of each alternative and how it addresses the impacts described in Section D. Include any residual impacts which the solution does not address

E 3 Feasibility of each alternative in the context of the overall development

E4 Reasons for accepting/rejecting each alternative solution

E5 Conclusions regarding alternative solutions. (Any remaining mitigation measures arising from a chosen alternative solution may be addressed in Section F below).

**F Mitigation and compensation**

F1 Mitigation strategy (overview of how the impacts will be addressed in order to ensure no detriment to the maintenance of the population at a favourable conservation status)

F2 Replacement roost site selection

F2.1 Existing species status (give survey data)

F2.2 Location, ownership and status

F2.3 Habitat description, size, boundaries

F3 Habitat creation, restoration and/or enhancement (as appropriate)

F3.1 Terrestrial habitats

F3.2 Integration with roads and other hard landscapes

F3.3 Integration with other species/habitat requirements

F4 Capture and exclusion

F4.1 Timing, effort, methods, capture/exclusion methods

F5 Post-development site safeguard

F5.1 Roost management and maintenance (either set out details here, or if complex then give outline here and give details as an annexed stand-alone plan)

F5.2 Population monitoring

F5.3 Mechanism for ensuring delivery (who will undertake the work and reporting details)

F6 Timetable of works (phasing diagram to include all works associated within section E, and to indicate construction works timing)

F7 Site plan to show all work covered by the licence

F8 Map to show the extent of each parties interest on site (if appropriate)

F9 Map to show location of receptor site in relation to development site

F10 Map to show habitat creation, restoration and/or enhancement

F11 Map to show post activity management (if appropriate)

F12 Diagram to show exclusion apparatus (only required if non-standard techniques are proposed)

**G Summary**

G1 Summary of development and mitigation (NB to include overall consideration of the three main licensing criteria: effect on conservation status, purpose, and alternatives) [for details see 2. Legislation and licensing]

**H References**

**J Annexes**

J1 Management and maintenance plan

J2 Pre-existing survey report(s)