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PROTECTION TO FLORA AND FAUNA: THE PROBLEMS FOR CONSTRUCTION - A CASE STUDY OF CHIROPTERA IN THE UNITED KINGDOM

Peter Fenn
Lecturer,UMIST, Manchester, England

ABSTRACT

This paper considers the problems caused to construction by the protection of flora and fauna. Recent strategies of pressure and interest groups in the United Kingdom (UK) have included the tactical use of protective legislation to prevent or halt developments and construction.

As examples case studies are presented; of the problems for construction caused by the presence of bats (Order *Chiroptera*). The paper is concerned with the micro bats (sub order *Microchiroptera*) in Europe and specifically the families *Rhinolophidae* and *Vespertilionidae* (vesper or evening bats) in the United Kingdom. The content of the paper is of general interest to construction professionals wherever bats and construction come into contact.

The paper outlines the protection afforded to bats, and their roosts, throughout the European Union and how it is brought into force in the UK. This protection causes particular problems for construction, and many everyday construction operations that disturb bats and their roosts can be illegal acts. The paper describes research to develop dynamic detectors that will collect and log bat activity, when left in-situ and in the absence of the operator.

It is proposed that as awareness of 'environmental' issues become more widespread there will be both opportunities and threats for construction.

KEYWORDS

Chiroptera, Bats, Legislation, Legal Protection; Detection

1. INTRODUCTION

Recent reports, (The Sunday Telegraph, 5 September 1999), that the planned redevelopment of Wembley Stadium England's National Soccer Stadium could be halted, after reports that bats are roosting in the structure, are a reminder of the possible problems for property and construction caused by the protection of flora and fauna. The UK has seen the tactical use of protective legislation by environmental 'pressure groups' to prevent or halt developments and construction. Recent examples have included: road schemes; airport developments and building redevelopment and refurbishment. Case studies are presented here of the problems for construction caused by the presence of bats; this paper is concerned with the micro bats in Europe and specifically the evening bats in the United Kingdom, but the content of the paper is of general interest to construction professionals wherever bats and construction come into contact.

1.1 Bats and Construction

Bats are one of the most successful mammalian orders Altrincham (1996), and one of the mammalian orders most affected by the most successful mammal *Homo Sapiens.* Bats are among the most threatened groups of mammals throughout the world Stebbings (1988); as man has cleared natural habitats for his own purposes so the bats have lost their natural homes in forests and caves. Bats are now closely associated with man and their close dependence is exemplified by reliance on man-made structures for breeding and roosting sites. As a result bats experience unique and complex conservation problems, and many would argue that mankind therefore has a special responsibility for them. This special responsibility is dealt with in Europe by legislation, which protects both bats and their roosts. This protection brings bats and construction into conflict, since any alteration to an existing building or structure has the potential to destroy or disturb bats and their roosts. In addition any new building or structure has the potential to both create new roosts, via careful design, and to disturb existing roosts during site clearance.

There are sixteen species of bats resident in the UK (one species became extinct in the last ten years), and although details of bat populations are sketchy (a national monitoring programme started in January 1996) many urban and suburban areas have resident populations.

Mitchell-Jones and McLeish (1999) report that apart from some rodents, bats are the only mammals which rely heavily on buildings and structures for shelter. It must be remembered that while bats are commonly associated with churches and houses they can be, and often are, present in any building or structure. In particular many civil engineering structures are often close to suitable bat habitat.

Bats in the UK are exclusively insectivorous and will be attracted to locations where insects are present. Watercourses are often an integral part of insects' life cycles, and therefore attractive to bats. Bridges and culverts and other structures close to water are often used by bats. Other than roosts close to feeding sites bats require suitable sites for raising young, nursery sites, and for hibernation, *hibernaculum.* Once again buildings and structures provide such sites and construction operations can impact on bat roosts.

1.2 Bats and the Law

In England, Scotland and Wales all bat species are fully protected under the *Wildlife and Countryside Act* 1981, as amended by the *EC Habitats and Species Directive* 1992 (brought into force via *The Habitats and Species Regulations* 1994), through Schedule 5. In Northern Ireland protection is afforded via *the Wildlife (Northern Ireland) Order* 1985. All bats are also included in Schedule 2 of *the Conservation (Natural Habitats etc) Regulations* 1994, [Northern Ireland (1995)] which defines 'European protected species of animals'. The pieces of legislation are very similar and taken together the effect is to:

- Make it illegal to deliberately kill, injure or capture (take) bats;
- Deliberately disturb bats (whether in a roost or not);
- Damage, destroy or obstruct access to bat roosts.

There are other effects to do with the possession, selling and transportation of bats that, whilst important, should not concern construction professionals much. These effects clearly raise important issues for while it would appear that few would deliberately kill etc; many would disturb or obstruct. The absence of intent, also means that technically a Surveyor, for example, entering a roof space that includes a roost, does not need to be aware of the roost to be committing an offence. If the roost is damaged an offence has occurred.

The problem is exacerbated by the lack of any definition of roost; it is clear what a bat is but what is a roost? In one interpretation a bat roost is: "any structure or place which a wild animal uses for shelter or protection". Further since bats often use roosts for brief periods and return over time, there may be a case for the argument that roosts are protected whether or not the bat(s) is/are present. It would appear that any roost is protected at any time.

There are three defences in the law allowing what would otherwise be illegal acts:

1. Injured bats may be taken and cared for;

2. Within dwelling houses bats may be disturbed and bat roosts damaged, destroyed or obstructed;

3. Killing, injuring, taking or disturbing bats or damaging, destroying or obstructing roosts are not offences if these were the incidental result of a lawful operation and could not reasonably have been avoided.

However 2 and 3 **cannot** be relied on (except in the living area of a dwelling house) unless the appropriate Statutory Nature Conservation Organisation (SNCO) has been notified and allowed a reasonable time to advise on the proposed action and the method, if allowed, to be used.

1.3 Bat Facts

Bats roost in many different locations over a season depending on species. Often males are more solitary and roost alone, sometimes visiting more than ten roosts a night before choosing a roost for the daylight hours when they become torpid. Females on the other hand choose maternity roosts in the spring and summer to raise young; sometimes congregating in large numbers. It is these maternity roosts which are most noticed by building occupants. Females and young too become torpid in the daylight hours. All bats hibernate through the winter months, and knowledge of hibernation roosts is particularly scant.

A great deal of ignorance exists about bats, and their place in mythology means that bats and their mere presence produce irrational fears. Common examples are shown at Table 1.

Table 1: Bats Common Myths

Comment	Reality
Bats make nest	Bats hide in small spaces or (rarely) hang free upside down
Bats gnaw structures, cables etc	Bats are mammals but do not need to gnaw like rodents
Bat droppings smell and pose a threat to health	Bat droppings are mostly the residues of insects, seldom smell and pose little threat to health. Sometimes in churches and similar properties bat faeces and urine can cause damage to delicate and fine fixtures and fittings (see English Nature and English Heritage (1997)).
Bats will enter the occupied part of buildings and could bite	Bats found within buildings are often juveniles who have yet to master flight and will often leave via an open window or door. Few bats are capable of biting humans
Bats affect property values	In houses bats rarely have a deleterious effect indeed many sympathetic conversions attract bats as a selling point.
Bats will get entangled in your hair	Bats often fly and hunt within trees and canopies; their powers of echolocation are too sophisticated to allow them to make this mistake
The presence of bats plus the protective legislation makes development/construction impossible	In most circumstances work will not be prevented, but advice given on the least disturbing way of doing it, both for the property owner or developer and the bat

2. BATS AND BUILDINGS AND STRUCTURES

Before deforestation when Britain was largely tree-covered, bats roosted in holes in trees and caves. Some species of bats have sought alternative roosts and are often found in buildings and other structures. The common perception is that bats will be found in a roof-space hanging from roof timbers by their feet, or in bridge soffits. This is seldom how bats are found since, during daylight hours in particular, the animals hide in very small spaces and crevices seldom entering roof spaces or bridge soffits. During daylight throughout the summer months, and almost

permanently during the winter, bats become torpid and enter a state of hibernation. While in a torpid state bats' body temperature drops and they are very lethargic and unable to fly; if disturbed they may simply try to scuttle away, eventually when their body temperature raises they may fly. Disturbing torpid bats, particularly during winter, can often cause injury and death.

Bats will roost in many locations and all types of buildings and structures in rural, suburban and urban settings. It is safest to start from the premise that all buildings and structures are potential roosts and that checks for bat presence are always required; and not forgetting that other activities e.g. mining; site clearance; tree felling and demolition entail liabilities for bat presence.

Much damage has been caused to bat populations by the widespread treatment of roof timbers with toxic chemicals and this has been improved recently with the use of safer chemicals for remedial timber treatment. Permethrin and cypermethrin are least harmful to mammals - that includes resident *Homo Sapiens* and pets, as well as bats. Bridge soffits are favoured by some species and detection at these locations is especially difficult; sprayed grouts often raise problems, Highway Agency (1999).

2.1 Checks for the Presence of Bats

A variety of techniques are available for the detection of bats, but these are often laborious and labour intensive and bats are often present with little, or no, evidence. It is essential that where any work on a building or structure is planned, including site clearance, tree felling and demolition, the relevant SNCO is contacted for advice.

Detection techniques include:

- Sign surveys:
    - Faeces and urine particularly at roost entrances. Bat faeces looks like mouse droppings but are dry and powdery, containing insect exoskeletons;
    - Food remains; in some species the wings of butterflies, moths and other food may be found;
- Visual location: bats may be seen at dusk and dawn entering and exiting roosts, but many bats are timid and may not be seen;
- Audible location: some bats emit audible social calls;
- Building occupants; often building occupants are aware of bats and may provide useful data;
- Ultrasonic location: detectors are available which make the inaudible ultrasound emitted by bats as echolocation audible to humans.

It must be reiterated that the legislation that protects bats is wide-ranging; a prudent premise is that all buildings, either existing or planned, are potential roosts and therefore entail liability. The best assumption is that there are bats present until proved otherwise.

2.2 Ultrasonic Location and Detection

Scientists had observed for some time that bats were able to avoid obstacles when flying in the dark; but real explanation was impossible since the presence of ultrasound was not known or understood. The problem was referred to as *Spallazani's bat problem* after an Italian scientist who carried out many incisive experiments; a fascinating account can be found in Griffin (1958). It was Griffin who cracked the code of echolocation in a series of masterly experiments in the 1930s.

A simple definition of echolocation is … *the analysis by an animal of the echoes of its own transmitted sound waves, by which it builds up a sound-picture of its immediate environment…* Altrincham (1996). A number of animals use sound in this way, and some use high frequency, or ultrasound, beyond the range of human hearing. These ultrasonic echolocators include: bats; whales and dolphins; shrews and birds.

British bats produce ultrasonic echolocation between approximately 20 and 110 kHz, with the great majority in the range 25-55 kHz. Depending on age and sex humans hear up to 20 kHz, females have a higher range and the high frequencies become less audible with age. This makes the bottom end of the bat echolocation just about audible to some humans; in addition bats emit audible social calls. British bats emit two distinct classes of ultrasound: continuous frequency (CF) produced by the rare horseshoe bats (*Rhinolophidae*) and downward swept or frequency modulated (FM) produced by the *Vespertilionidae* (vesper or evening bats).

The ultrasound produced by bats can be transformed into audible sounds by different conversion techniques, the common techniques are: heterodyning; frequency division and time expansion. Heterodyning and frequency division are real-time methods i.e. the sound from the electronic detector is heard at the same time it is emitted by the bat. Time expansion might be described as making a high speed tape recording of the ultrasound and replaying it slowed down. This has the effect of reducing the frequency to within the audible human range. Time expansion can be used to analyse bat echolocation, and identify species since species emit characteristic profiles of frequency and duration. These analyses are often shown as sonograms see for example Russ (1999).

Heterodyne detectors are similar to a radio with a tuning control. The heterodyne detector is tuned to a frequency and by a series of electronic operations the input frequency is converted to an audible output. The detector only converts within the tuned range and therefore only bats emitting at that frequency will be detected. The output is usually a series of clicks, ticks and tocks for the FM bats and a warbling sound for the CF bats. Since the British bats emit across a broad band such a detector would be of limited use as a data-logger since, many bats would be missed.

Frequency division detectors are wide-band detectors capable of looking at the whole of the ultrasonic frequency range at once and do not require tuning. If ultrasound is detected the detector locks on to the signal and divides it down in frequency to bring it within the audible human range. This type of detector would be useful as a data-logger since it would capture the ultrasound emitted by all bats. However the output is not suitable for analysis to identify species since the amplitude of the transformed signal is not usually retained.

Time expansion detectors are also wide-band detectors capable of looking at the whole of the ultrasonic frequency range at once and do not require tuning. Time expansion records all bat calls and then plays back at a slower rate that brings the frequency to within the audible human range. Time expansion detectors offer a major advantage over frequency division in that the output can be analysed and an objective assessment is available for determining species. The sound of the time-expanded signal has often been likened to whale songs, but the whale song is speeded up and the bat call slowed down.

Electronic detectors of the above types are widely available and extremely useful, but they all limited in their use in that the observer and detector need to be in-situ when the bat emits the ultrasound. Since many bats visit differing roosts each night, and many are timid and will avoid human contact, the detection of bats in buildings and structures with these commercial detectors is laborious and erratic.

3. THE RESEARCH

In 1999 the Education Trust of the Royal Institution of Chartered Surveyors (RICS) part-funded research which sought to:

- Improve detection techniques;
- Raise awareness;
- Evaluate the problems to construction;
- Consider sympathetic construction techniques.
- Survey construction professionals to assess knowledge and determine training needs
- Survey of the prosecuting authorities as to the prosecutions

3.1 Improved Detection Techniques

The research developed a frequency division detector with an attached data-logger. The equipment can be left in-situ at a building or structure, and will alert the operator to bat presence when collected later. A decision can then be made as to further investigation and the need to refer to relevant SNCO. The equipment is cheap, easy to use, and has proved robust, efficient and successful in field trials. A major advantage of a *frequency division* detector is that it is a wide band device that means it will 'hear' all detectable bat sounds without the need to *tune* the detector to any particular frequency. The equipment was left for up to 12 hours in some locations, the battery life of the detector was never exceeded and the recorder seldom filled the standard tapes. The equipment was left in areas and locations with known bat populations and never failed to record bat activity; it was also left in areas where bats were not expected and often recorded bat activity. There were some occasions where interference from unknown ultrasonic sources swamped the detector; but these were rare and in every case were apparent immediately.

However existing sign-surveys remain important and construction professionals must use all available technique. A recent case in Leicestershire County Council (Bat Conservation Trust 2000) showed that there is a duty to check for the presence of bats in all cases.

This research concludes that the law protecting bats requires construction professionals to start from the premise that bats are present in every case. The use of all the available detection techniques from sign surveys to ultrasonic detection will allow the professional to demonstrate that all reasonable efforts have been taken to show that bats are not present.

3.2 Raise Awareness

The issue of raising awareness goes some way to comply with the UK Government's commitments. In 1995 the government sponsored the Agreement of the Conservation of Bats in Europe and at the first session of the meeting of the parties passed resolution 20 which stated: *those who come into contact with bats in the course of their work … should be targeted to receive appropriate training.* The construction industry is often at the front line when contact with bats is made and has a vital role to play.

This research has been widely reported and dissemination continues; the conclusion has to be that there are no current initiatives to meet the requirements of resolution 20 and that initiatives must be commenced. That there exists widespread ignorance is widely accepted and the survey carried out for this research discovered some alarming misconceptions.

3.3 Evaluate the Problem to Construction

Glendell and Bullock (1999) report that their survey of National Trust properties showed that bats use *'virtually all'* the buildings and structures owned and operated by the National Trust. What then of other structures? Again the premise for all construction professionals to start from has to be that all buildings and structures have the potential to be bat roosts and the safest starting point is that there are bats unless shown otherwise.

The survey carried out for this research, included the collection of qualitative data on the effect of bats on construction projects and property after construction. The results may be summarised as: 12% of respondents reported bats affecting construction projects at various stages. The effects ranged from carefully designed and detailed projects which worked around bats to projects where work had been stopped for many months. The delay to projects is intriguing and further work is required to evaluate this. If contractors are being prevented form working how is the delay compensated? Standard forms of contract do not address the issue: the standard for of construction contracts (e.g. JCT 98) include a force majeure provision; else the injured party would look to frustration perhaps.

There were few reports of bats affecting property values. Two reports that value decreased (due to restrictions on loft conversions); one report that value was unaffected and one report that value increased (due to snob value).

The problems caused by bats are unclear; the law protecting bats is clear and strong but there is little evidence of enforcement. The literature supports the intuitive feeling that bats are widespread in buildings and structures and therefore cause a problem to construction. A survey of construction professionals did not find any strong evidence to support this; however the potential for problems is clear.

3.4 Consider Sympathetic Construction Techniques

Sympathetic construction techniques might be split into two areas: the programming of construction to minimise disturbance; and the introduction of materials and techniques to encourage bats.

The programming of work to minimise disturbance will normally be appropriate on existing buildings and structures, work may be delayed to avoid the presence of maternity or nursing colonies or hibernating bats. The problem raised by such programming is that hibernation might extend from October to April and maternity from June to September; allowing almost no window for work to be carried out. There have been examples of listed buildings with rare residents bats where construction work has been carried out around roosting and hibernating bats see http://www.bats.org.uk/.

Materials and techniques to encourage bats includes development of chemicals for remedial timber treatment, (Permethrin and cypermethrin) which are least harmful to mammals, and the development of techniques which allow bats to access roof spaces via bat roof tiles and bricks. Mitchell-Jones and McLeish (1999) give useful examples and many proprietary specials are available.

The earlier comments concerning duty to check for bat presence bear repetition. The Leicestershire County Council case showed that there is a duty to check for the presence of bats in all cases. This research concludes that the law protecting bats require construction professionals to start from the premise that bats are present in every case. The use of all the available detection techniques from sign surveys to ultrasonic detection will allow the professional to demonstrate that all reasonable efforts have been taken to show that bats are not present.

3.5 Survey Construction Professionals to Assess Knowledge and Determine Training Needs

A survey of construction professionals was carried out to explore attitudes amongst the professions and to investigate the need for further training, and to identify key sectors. A questionnaire survey was fielded to 800 construction professionals; replies were received from 104 individuals 33% Architects and 67% Surveyors working in a variety of organisations: private practice; central and local government and construction firms.

When asked to indicate where they had received training, or education, about bats and legislation; 68% reported no training.The replies indicate a widespread ignorance about bats and the law and the need for training and education. If the UK government is to meet its commitments then initiatives need to be started immediately. Professional Institutions can help in this with CPD courses; and accredited courses at Universities can be encouraged to include these issues in curriculum.

3.6 Survey of the Prosecuting Authorities as to the Prosecutions Executed will Further Identify Key Sectors.

Childs (1999) reports that there had been 14 prosecutions related to bats in 1999, 11 were successful, two were overturned on appeal and 1 was inconclusive on the grounds of jurisdiction. Childs (1999) asks why there are so few actions (when compared to cases involving birds) and concludes that there are three reasons:

1. Confusion over the correct prosecuting authority, [the police are responsible for enforcement and therefore the correct authority although anyone can take out a private prosecution];
2. The problems and confusion with the term ‘intentional’ in the Wildlife and Countryside Act 1981.
3. Misunderstanding with prosecutions in the Magistrates Court

There was evidence that conservation groups were considering the issue of prosecutions; and that guidelines would be amended to include revised instruction for Bat Workers when possible offences were discovered. This research also produced its own anecdote about the strategy and tactics of pressure groups. It was made clear that they see the legitimate use of existing legislation to prevent construction and developments as a powerful weapon.

4. CONCLUSION

This paper describes the problems caused to the United Kingdom construction industry by bats. The overall conclusion of the research is that bats and construction are under-researched; that more work must be done and that construction professionals exhibit ignorance of the law. Bats are protected by law, and although there has been little enforcement of the law there is evidence that this is changing. In addition the legislation protecting bats is seen as a potentially valuable tactic by activist and pressure groups. In any event ignorance is no defence and few would argue against the protection offered to bats; construction professionals must be educated and must not break the law.

The conclusions can be extended to other fauna and flora, and other jurisdictions. However bats are in a special class of animals, they live close by humans and share their structures for breeding and roosting. If construction fails to give bats the respect they deserve, it may be that pressure groups will use protective legislation tactically. Then construction may be forced to deal with the issue; it is suggested that it is better to be prepared rather than surprised.

5. ACKNOWLEDGEMENTS

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