BATS AND BRIDGES

AN EVALUATION OF SELECTED BRIDGES

IN LAOIS AND OFFALY

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SUMMARY

An assessment of 102 bridges was undertaken in Laois and Offaly for bats over a number of rivers. These bridges were of various construction design and materials and varying ages. Most of these bridges were examined within the same year for the presence of dippers and grey wagtail by Alex Copland of BirdWatch Ireland.

The bridges were examined visually for the presence of roosting bats or for evidence of previous use. A number of bridges were examined repeatedly to determine whether usage altered throughout the study period of May to October.

Examination of some bridges was also supplemented by bat detector assessments.

In total, there were 15 bridges that had evidence of use by bats. 5 bridges in Offaly and 6 bridges in Laois were occupied by bats during the assessment.

Masonry arch bridges are the only bridge type that currently offers suitable roosting opportunities over a wide geographical area due to their abundance, age, state of repair and the manner in which they degrade (loss of mortar, loss of stones creating crevices and cavities).

The largest number of bats was a Daubenton's bat roost in Bay Bridge, Mountmellick, wherein 14 bats were present in May 2007. Approximately 8 bats were still present in September.

The most commonly occurring species was the Daubenton's bat with Natterer's bat being the second most common species. The only other confirmed species was the brown long-eared bat.

One bridge was devoid of bats on the first evaluation but was a Daubenton's bat roost on the second assessment. Another bridge was used by a brown long-eared bat on the first assessment but was empty on the second assessment. Hence, bridges may be used at various times or may be more constantly used.

Using the UK Highways Agency grading system for bats in bridges

15 bridges are of **Grade 5** (7 Offaly, 8 Laois)
20 bridges are of **Grade 4** (11 Offaly, 9 Laois)
23 bridges are of **Grade 2** (8 Offaly, 15 Laois).
44 bridges are of **Grade 0** (25 Offaly, 19 Laois)

Slightly more bridges in Offaly were useless for bats than in Laois. This is partly explained by the materials of bridge used in places such as the Ferbane Power Station bog, Birr Demesne and Kinnitty Castle.

44 of the 102 bridges surveyed within the two counties (43%) are of no value as day roost sites for bats. Approximately 1/3 (34%) of the bridges have high potential for bats, while a further 21% have possible roost potential.

Otter signs were noted at 36 bridges (35%) while mink were noted at 15 bridges (14.7%). Both these species are widespread in the two counties.

This report looks at the issues relating to bats in bridges and methods by which bats may be protected within bridges while essential maintenance can be carried out.

Bridge maintenance must not endanger bats as all species have full legal protection. A survey of a bridge due for repairs should be undertaken in the appropriate season and where there is potential for bats, a survey prior to works must be carried out.

Crevices must be retained and bat boxes should be availed of to provide compensation where there is a loss of potential die to the repairs.

Bat handling must be left to licensed, vaccinated specialists and surveying of bridges must be carried out by a specialist. It is advisable that at the very least repair staff should examine the bridge prior to repairs if there has been any delay after it has been checked by a specialist.

Bat boxes should be used on existing bridges with no roost potential as a means of enhancing sites for bats and increasing biodiversity. These may be concrete or steel and iron bridges as well as masonry arch.

Planting may be desirable around some bridges to provide shelter and access for bats to bridges. Native, local stock should be used fir this purpose.

Engineers and companies with responsibility for bridge repairs must be made aware of the issue of bat conservation and the conflict that may arise with bridge repair.

Examples of roost sites are shown within the report.

INTRODUCTION

Bats

Bats account for one quarter of all Irish mammals and constitute one of the most significant group of vertebrates in terms of the legal protection and conservation status of the entire group. This order of mammals is separate from all others and has been for in excess of 50 million years. The confusion with rodents such as rats and mice is erroneous and results from a superficial similarity between them when they are at rest.

Bats are an elusive group and it is still unknown how many species of bat are found throughout the world. In fact, it is safe to say that there is a reasonable chance that new bat species will be identified in Ireland. Three species have been added to the Irish list in the past two decades. To date, there are ten species of bat known here, nine of which have the potential to be found in Laois and Offaly while the tenth species, the lesser horseshoe, is restricted to the western seaboard.

Eight species are known from Laois with the exception of the Brandt's bat and the lesser horseshoe bat, while Nathusius' pipistrelle has been identified with the aid of a time expansion bat detector in Laois but has not been found or heard to date in Offaly (suggesting that there are seven species in Offaly). This may be a consequence of a lack of survey throughout the county rather than an actual absence.

There have been few studies of bats in Offaly and Laois and most knowledge of the bat fauna is derived from studies undertaken for Environmental Impact Assessments and evaluations of old buildings prior to renovation.

Bats are nocturnal insectivorous mammals that spend much of the daytime asleep within dark spaces, either tucked into crevices or for some species hanging freely in such sites. Bats are the only true-flying mammals and in Ireland all species of bat are dependant upon flies, moths and beetles in particular and all species can catch their prey in flight. Some species have also specialised in gleaning crawling or resting prey from vegetation and walls and from the ground.

Bats are long-lived mammals (with the oldest extant individual a whiskered bat aged 41 in Russia) that reproduce very slowly for such a small vertebrate. In fact, female bats produce one young per year or two years. In comparison, a mouse litter may hold ten young and females may breed several times within a year. It is this slow reproductive rate that has brought about the need to introduce strong legal protection for bats.

Bats avail of many roost types both natural and manmade but it is clearly within the latter category that the largest aggregations of bats occur in summer months. All Irish bat species avail of manmade structures at different times of year and so it can be stated that manmade structures have become crucial to bats to fulfil their annual and life cycles. In order to protect bats properly, it is essential that the sites within which they reproduce, shelter, hibernate and mate are also given protection. It is thus that some structures (including houses, churches, barns, bridges) take on a role not only as a functioning human architectural feature but also as a natural heritage element.

Bats and Bridges

It is well established that bats avail of bridges as a roosting or resting place. The importance of bridges to bats in Ireland has been noted in studies and reports over the past two decades (Smiddy 1991, McAney 1992, Shiel 1999, Keeley 2003). Several bat species have been found roosting in bridges but it has also been established that bats of particular species are more likely to occupy bridges than other species. The Daubenton's bat (formerly known in England by a vernacular name the "water bat") is the greatest beneficiary of bridges.

Daubenton's bats are adapted to feeding low over slow-moving water and using their enlarged feet for seizing upon insects (flies) emerging from the water as well as insects that have fallen into the water and are drowning. There is also an occasional record of the capture of small fish and this has been reported from a related species found throughout continental Europe, the pond bat *Myotis dasycneme.*

Daubenton's bats are very strongly associated with waterways and virtually ubiquitous in Ireland. The 2006 results for the All Ireland Daubenton's Bat Waterway Survey carried out by Bat Conservation Ireland identified the presence of this bat species in the range of counties covered (27 of the 32) and on a total of 122 waterways including rivers and canals. The bat was only absent in sites where the water level was low or lower than a neighbouring water course and in some sites where the species wasn't noted during the survey, it was encountered at a later date at a later time of night.

This has a very significant consequence as it then follows that bridges are of particular importance for some bat species over others. Hence, measures that would interfere with bats within these bridges could have profound effects on the conservation of these species over and above other species.

In relation to bridges, roosting may occur in sections of a bridge where stonework has undergone weathering or heavy vibrations and the grouting between stones has fallen out. In more extreme forms of this, the stonework itself has begun to fall out and large cavities are left.

Where bridges have been subjected to structural damage either through heavy traffic or crashes, sites suitable for bats may also become available.

Other areas where bats may roost include the expansion crack between an old bridge and a new extension (these extensions themselves may be quite old), drainage holes and ivy cover.

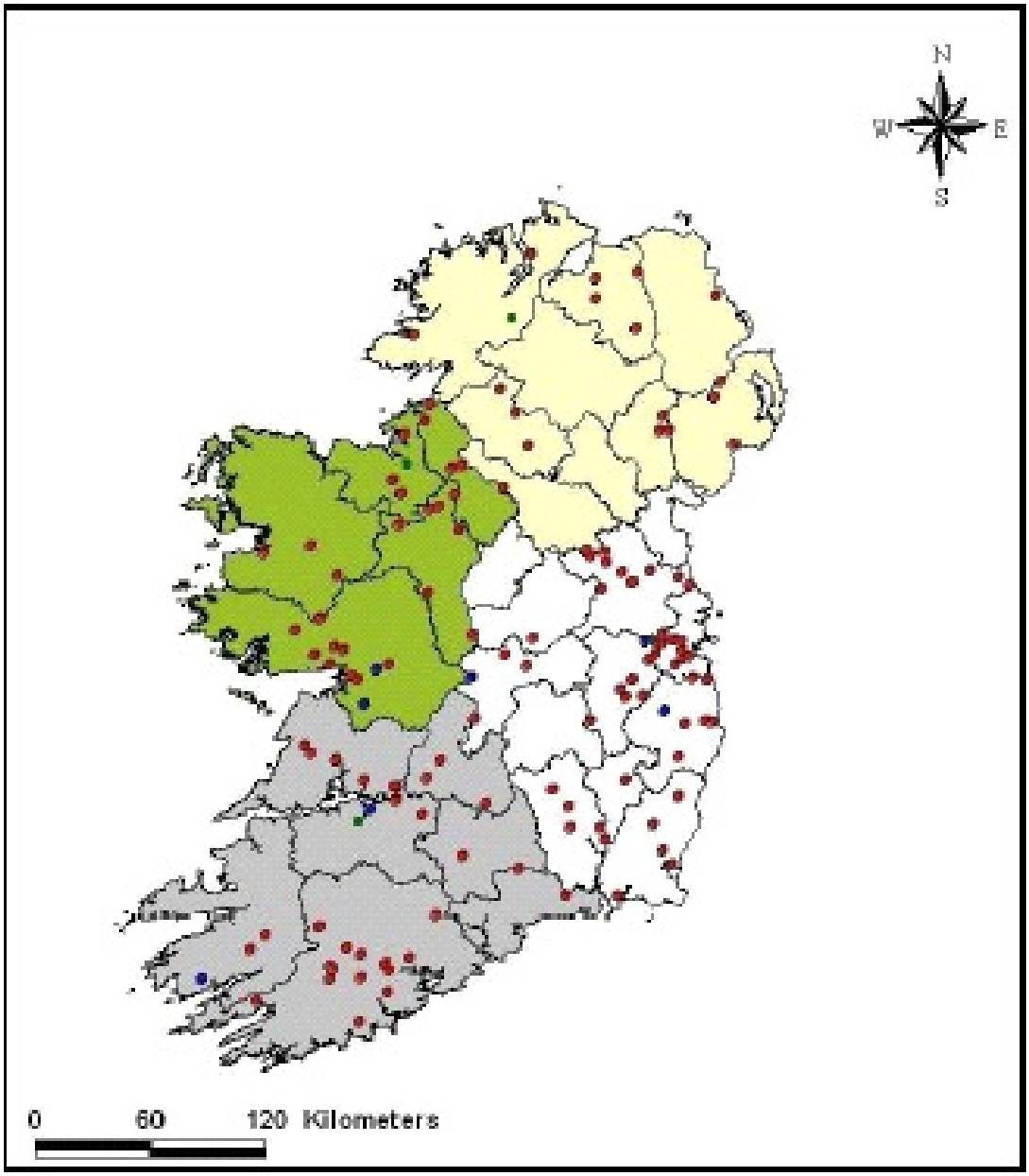

Figure 1: Daubenton's bats and Irish Waterways

Results of the All Ireland Daubenton's Bat Waterway Survey 2006 results

Courtesy of Bat Conservation Ireland

Sites where Daubenton's bats were present are indicated by the red, green and blue dots.

The only sites where Daubenton's bats were absent are indicated by a yellow dot.

Hence, it can be seen that this species is present on many watercourses throughout Ireland and encounters bridges regularly.

It is important to identify at this point what risks bats may face within bridges.

Firstly, the greatest risk to bats roosting within bridges is that of entombment, mechanical crushing, suffocation or accidental injury leading to flightlessness and death that arise from repair work to the bridge roost. Repairs to bridges are clearly essential to the safety of the structure and include the following procedures: pressure grouting, shotcreting, saddling and hand grouting.

All of these procedures create the risk of death or injury to bats and even if undertaken when bats are absent from the bridge, they all certainly lead to the loss of roost sites.

A rarer form of risk was highlighted in county Galway in 2007 when a bat roost in a road bridge in Craughwell was deliberately burned by an unknown individual in an effort to eradicate the roosting bats and presumably to speed up roadworks and bridge repairs that had been publicised in the national media as having been delayed by the presence of bats. Persecution of bats in bridges is likely to be very rare but nonetheless it can occur.

Bats and the law

All Irish bats are protected by Irish and European law and are afforded a status of Annex IV protection for nine of the ten species and Annex II protection for the tenth species, the lesser horseshoe bat.

Of Irish mammals, no group is afforded higher protection than the bat species and there are strict measures in place to protect bats and the sites upon which they depend.

Under the transposition of the Habitats Directive (also known as the Habitats and Species Directive in the UK to overcome the misunderstanding that the legislation deals only with habitats) into Irish law, all bats *and their roosts* are protected.

In the case of the lesser horseshoe bat, there is a requirement to designate Special Areas of Conservation if numbers of bats in any one site are deemed to be a significant population or sub-population. For the purposes of designation in Ireland, 100 bats in a summer site and 50 bats in a winter site are deemed to be the qualifying numbers for the National Parks and Wildlife Service.

On the basis of this, buildings and caves have been designated as Special Areas of Conservation.

Lesser numbers may still be given the special designation of Natural Heritage Area. Lesser horseshoe bats are not the only species to have been given protection in their roost under this category.

A number of roost sites in churches have been designated as Natural Heritage Areas for the protection of Natterer's bats (*Myotis nattereri*) including Clogh Church in Wexford and Kylemore Abbey in Galway.

Lesser horseshoe bats are not associated with bridges but one example of lesser horseshoe bats in a small bridge was found by the author in Killadysart in Care. As has been discussed above, bats and their roost sites are afforded protection as outlined in the wording below (even if the structure concerned has not been provided specifically for bats as is true of bridges):

23. (1) The Minister shall take the requisite measures to establish a system of strict protection for the fauna consisting of the animal species set out in Part I of the First Schedule prohibiting—

(a) all forms of deliberate capture or killing of specimens of those species in the wild,

(b) the deliberate disturbance of those species particularly during the period of breeding, rearing, hibernation and migration,

(c) where relevant, the deliberate destruction or taking of eggs of those species from the wild,

(d) the deterioration or destruction of breeding sites or resting places of those species.

(2) A person who in respect of the species set out in Part I of the First Schedule—

(a) deliberately captures or kills any specimen of these species in the wild,

(b) deliberately disturbs these species particularly during the period of breeding, rearing, hibernation and migration,

(c) deliberately takes or destroys the eggs from the wild, or

(d) damages or destroys a breeding site or resting place of such an animal, shall be guilty of an offence.

31.—Section 23 of the Principal Act is hereby amended—

(5) Any person who—

(*d*) wilfully interferes with or destroys the breeding place or resting place of any protected wild animal,

shall be guilty of an offence.

There is ample evidence throughout Ireland of bridges that had been noted as bat roosts being repaired, modified or power washed with inadequate efforts to protect the resident bats or their roost sites. It is impossible to assess the death and injury that this has caused to bats in particular Daubenton's bats while it still may be possible to calculate the scale of roost loss.

Based on the legislation cited, the repair of bridges without regard for the presence of bats and the destruction and deterioration of their roost sites would be an offence under the Wildlife Act (2000) and the statutory instruments that transcribe the Habitats Directive into Irish law (S.I. 94 of 1997 and 2005). With greater inspection by the European Commission, it is likely that bridge repair and bat conservation conflicts will become a greater issue for Ireland.

SURVEY METHODOLOGY

The bridges examined in this assessment were mostly presented as a proposed list and had been examined by Alex Copland of BirdWatch Ireland for the presence of dippers and grey wagtails. The bridges were chosen based on the watercourse crossed and are shown in Tables 1 and 2 of this report. The identity of the bridges is less critical than the overall evaluation of a subsection of the bridges of the two counties as a sample of the entire network of bridges. In the case of both Laois and Offaly, one each of the bridges proposed for assessment was no longer in existence. A substitute bridge was assessed to provide an assessment of a minimum of 50 bridges in each county. The Laois bridge list varies from the bird survey as it does not include the River Nore but concentrated on bridges over the River Owenahallia.

The means of assessment was an examination of each bridge externally and under the bridge arch for the presence of roosting bats or signs of former bat occupancy. This was undertaken with a hand torch, a penlight and a fibrescope to allow examinations of deeper crevices and cavities.

Signs may include staining, droppings or Nycteribiid fly eggs. In most situations staining can be difficult to separate from the weathering brought about by seeping water and Nycteribiid eggs are difficult to identify in bridges if bat numbers are low, if the arches are high or if bats are tucking into a bridge and are generally a poor field sign.

Hence, the determination of the presence of bats is most heavily dependant upon the discovery of bat droppings or of bats themselves. Bats may be well concealed within a cavity or may be relatively superficial in their position under a bridge.

Identification of bats when roosting may be dependent upon a small number of visual cues. Alternatively, the bats must be subjected to the disturbance of extraction from the bridge and manipulation to allow examination of the features most useful in the separation of species.

Bat ears are a good means of species identification as well as a number of facial characteristics that allow easy separation. In addition to this, fur colour and texture may allow identification for well concealed bats.

If bats are relatively exposed, the foot and ankle (a small cartilaginous spur on the ankle known as the calcar is a diagnostic feature for most bats) are important features to separate bats.

All species may be determined in most cases by the ear which may be obscured in some roosting places.

In the case of tall bridges, the examination of bat features may be further complicated as it is necessary to examine the small structures such as the ear tragus, calcar, foot etc. by shining a light unto the bat through a crevices in the bridge.

A hand lamp was used to examine all crevices, cavities or indentations that might allow a bat to avoid direct sunlight and weather conditions.
These were primarily under bridges but in some cases were also on external surfaces such as piers, abutments, voussoirs and supporting wing walls.

For three bridges in Offaly and for one bridge in Laois, a bat detector emergence survey was also carried out to determine whether bats were present. This involved the use of a heterodyne bat detector (QMC Mini 3) and a dual heterodyne and time expansion bat detector (Pettersson D240x). These bridges (see Plate 1) were surveyed by this method for four separate reasons and these will be outlined here.

The first bridge in Offaly examined by bat detector was a bridge in Birr, county Offaly (Bridge Street Bridge, 035-008). As will be discussed in the Results section, this bridge was host to a Daubenton's bat. To confirm that there were no hidden bats within the bridge, a survey with a bat detector was undertaken at emergence time on a subsequent visit to the bridge. The bridge was examined on four occasions overall.

The resulting bat detector survey identified the presence of a soprano pipistrelle bat roost in a National School within the town upriver of the bridge under examination.

The second bridge in Offaly examined with a bat detector was the Sharavogue (038-003). This bridge was over a watercourse that was deemed to be potentially unsafe to examine alone and it was clear that there were no suitable crevices in the arch with the exception of large square holes in the upright that were impossible to assess from the level of the river.

The third Offaly bridge surveyed was Ardara Bridge (032-002) in Cadamstown. This bridge and the wing walls have a considerable array of cavities and crevices and it would be extremely difficult to check all of these (especially given the dangerous state of the structure) or to rule out bats from the bridge even after such an assessment.

The only Laois bridge examined was Bay Bridge (004-001), Mountmellick. This bridge has a number of suitable cavities for bats but no bats could be seen when the bridge was first examined in daylight. A night-time assessment was more suited to determining the presence of bats.

The first bridge assessments were undertaken in May and there were surveys carried out in late July, August, September and finally October to ensure that bridges were examined in a range of months but avoiding the month of June.

All of the bridges examined with a bat detector followed a similar procedure. A vantage point from which it was possible to see whether bats emerged from the bridge was sought and occupied prior to sunset. The bat detector was directed upwards towards the bridge and all ultrasound was examined to identify whether it was a bat call and if so, which species.

Audible sounds were also sought as these may be emitted by bats prior to emergence. Large roosts are often heard long before bats finally begin to emerge and even individuals of some species may become very vocal prior to emergence (e.g. Leisler's bats).

A number of bridges (both “suitable” and “unsuitable” types) were re-assessed on a second or third visit to determine whether bats were present in bridges that had previously had or had not been a roost site.

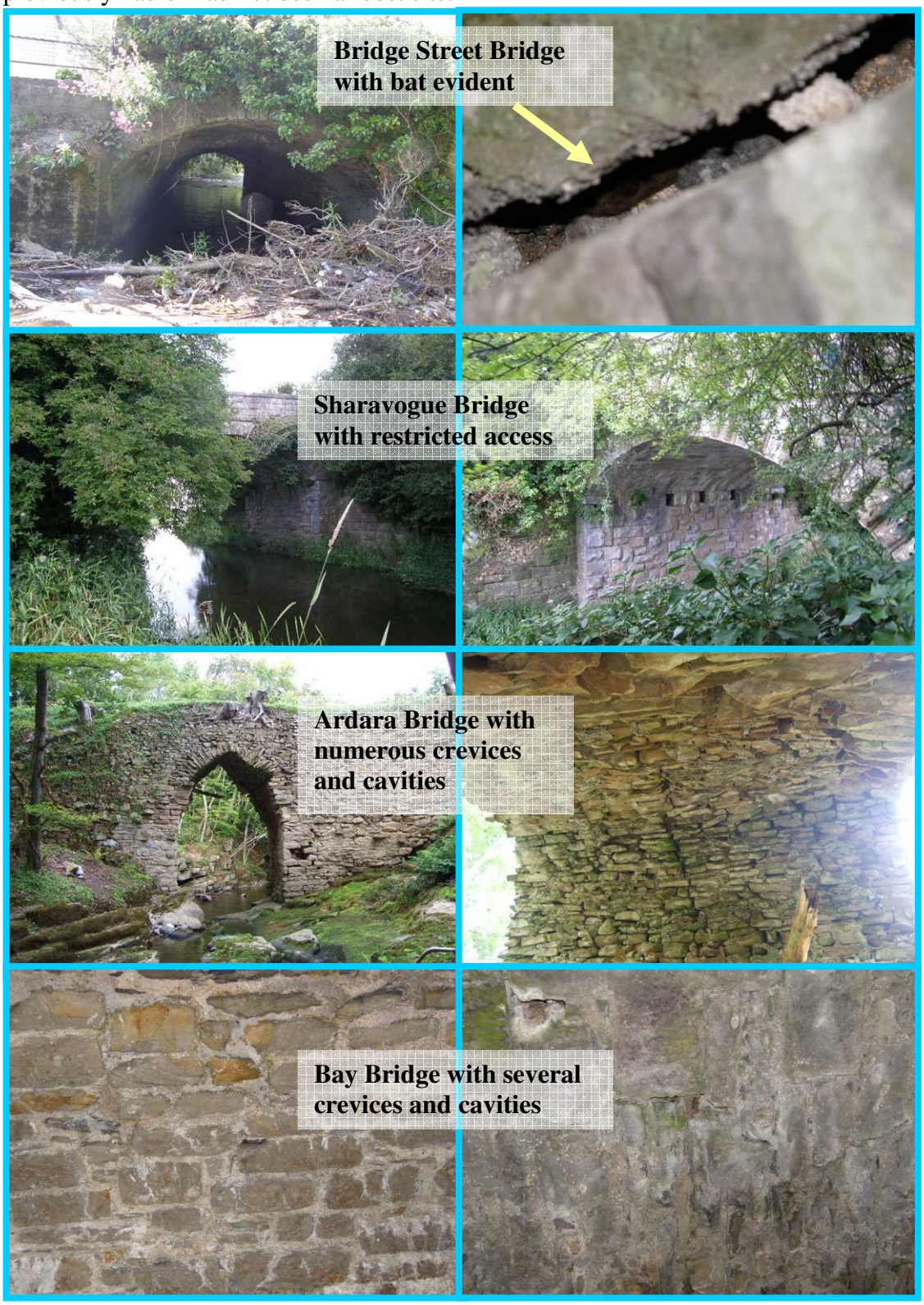

Plate 1: Bat detector surveys of bridges

The above bridges were examined using bat detectors (Pettersson D240x and QMC Mini 3 heterodyne bat detector) at dusk to determine if bats were present deep within the stonework. Two of the bridges were bat roosts at the time of examination. A bat can be seen in the crevice of the second photograph

No bats were removed from the bridges examined. The disturbance caused was the brief arousal of some bats from torpor and this resulted in some cases (but not in most) in a withdrawal deeper into crevices for some bats.

The bridges were considered in terms of a variety of features put forward in a form by the North Yorkshire Bat Group and implemented with the county council authorities of the region to deal with bridge repairs and bat protection. The main headings have been retained in the spreadsheet that accompanies this report.

Bridge arches were not measured and dimensions given in the spreadsheets for each county are estimates. Furthermore, the author has a reasonably good knowledge of bridges and their construction but does not purport to be an expert on the technical features, construction or maintenance of bridges. The descriptions of the bridges are broadly correct but are obviously open to fine-tuning by specialists in architecture and engineering.

The bridges have been graded in accordance with the system in use at the time of the Bats in Bridges of Sligo and Leitrim (Shiel 1999) and the categories are shown below:

Grade 0 = no potential for bats
Grade 1 = crevices possibly of use to bats
Grade 2 = ideal crevices but no bats
Grade 3 = evidence of bats

An evaluation of the vegetation growing around the bridge and in the broader landscape has been made. It must be stated that overall there is a greater uniformity to the landscape around bridges with small differences in the species composition in some cases and the level of cover leading to the bridge may vary especially in urban areas.

Vegetation corridors are considered to be vital elements of the landscape for bats and such features have been sought around bridges in the current study. As has been stated, where there is a lack of growth by way of trees or shrubs, it can be seen for most bridges that there are relatively steep banks that provide an edge feature along which bats might navigate.

Any signs of other mammals around each bridge (the principle signs expected would be otter and mink) were also noted including observations by residents of mammals at any of the bridges at which a local was encountered.

RESULTS

In the current assessment undertaken in the counties of Laois and Offaly on 112 bridges split equally among the two counties, three species of bat were confirmed with one further species possible:

- Daubenton's bat
- Natterer's bat
- Brown long-eared bat

Unidentified possibly Leisler's bat or Daubenton's (restricted view).

Of these three species, Daubenton's bat was the most commonly encountered and the most numerous species in both counties.

Of the 51 bridges examined in Laois, six bridges contained bats at the time of assessment. Of the 51 bridges examined in Offaly, five bridges contained bats. In total, 11 bats were occupied out of 102 bridges analysed.

The largest number of bats encountered within the bridges examined was 14 Daubenton's bats in a masonry arch bridge close to Mountmellick This is greater than the number of bats found in an October assessment of bridges in Carlow and Kilkenny by the author in 2003, wherein a maximum of three bats were encountered.

An ongoing survey of bridges in Cork by Cork County Bat Group of Bat Conservation Ireland (at time of writing October 2007) had shown 3 roosts in over 60 bridges and only one bat was noted in any one of the bridges (Daniel Buckley *pers. comm.*).

However, in a bridge assessment in Kilmacow, county Kilkenny in 2006, a total of 24 Daubenton's bats was noted in a cavity in the central arch of a masonry arch bridge due for repair. This bridge still held bats in different crevices in November 2006 but significantly not within the main and most obvious cavity.

None of the bridges in Offaly held significant numbers of bats. The largest number of bats present was five in a bridge at Rahan (016-008, (see Plate 2)). Three dry arches were in use and droppings indicated that another arch was briefly used on one occasion.

4 Daubenton's bats and 1 Natterer's bat were present in these dry arches. When re-examined five weeks later, only one bat (a Daubenton's) remained in the dry arches within which these bats were found.

Daubenton's bats and Natterer's bats were found within wet and dry arches while the largest number of bats noted in any of the bridges (14 at Bay Bridge) was in a wet arch directly over the full flow of the river.

Bats in all cases within this assessment were under the arch of the bridges. Furthermore, bats were not found in any bridge constructions other than masonry arch bridges with crevices and cavities.

The mobility of bats into and out of bridges was clear in a number of the bridges considered. The dry arch close to Mucklagh Bridge held no bats when examined on October 2nd 2007, having held 3 bats on the previous visit. Again on October 17th, a Natterer's bat and a brown long-eared bat were present.

A bridge over the Little Brosna at Lisnageeragh (042-021) was one bridge where a bat (a single Daubenton's) was noted in the second assessment but not in the first assessment.

Another bridge over the Little Brosna (Weir Bridge) was a roost site for a single brown long-eared bat. This crevice within the central arch of three arches was quite deep and the bat would be very difficult to find in a superficial examination. A number of other similar cavities also occur within this bridge. No bats were present when this bridge was examined on October 2nd 2007.

Brown long-eared bats were thus found both in a dry arch and in a wet arch over a river in this assessment (see Plate 3).

A dry arch at Mucklagh, Tullamore (this may be a deer or pedestrian underpass adjacent to the river bridge and part of the Charleville Demesne) is a roost site to Natterer's bats throughout the year including the months of May, August, September, December and January. Two Natterer's bats and a brown long-eared bat were present in August 2007 and Natterer's bats and brown long-eared bats were present in mid October as noted above.

Additionally, while it is most commonly a Natterer's bat roost, it has also harboured Daubenton's and brown long-eared bats at different times. Natterer's bats and brown long-eared bats share similar feeding habits, roosting habits and may occasionally be mistaken in roosts especially when the latter species folds away its ear pinna behind its forearms when at rest (see Plate 3).

Mucklagh Old Bridge (016-029) itself showed no evidence of bat usage. However, this bridge was occupied by a single Natterer's bat in one of the wet arches in an examination by Tina Aughney in 2006 while droppings were present in the dry arch.

The dry arch has no roost opportunities as there are no crevices or cavities and it is almost certain that bats were availing of the arch as a night perch rather than as a daytime roost site.

Examinations of the single dry arch (underpass) at Mucklagh by the author since March 2005 show that the bats use some crevices most commonly but it is possible to find bats in a number of the other crevices if the bridge is examined over a sustained period. This was true of an evaluation of this bridge on 11th September 2007, when two of the three Natterer's bats present were in crevices within which no bat was noted previously. No bats were present on October 1st 2007. A single Natterer's bat was present on 8th October 2007 and again on 17th October 2007.

The movement of bats into and out of bridges and the use of different crevices have a major significance in considering the impacts of bridge repairs on bats. If only the

crevices or cavities within which bats are noted prior to repair are maintained, there will still be a loss of alternative roost sites.

It is not understood why bats would choose to alter their resting location within a structure but it may be a response to different temperatures, air currents, humidity or another factor that renders one site more beneficial at any one time over another.

The microclimate for the roost site is clearly a crucial feature for bats and it is probable that the combination of the physical conditions is more favourable in one site over another. This combination may alter due to a weather variable and lead to one crevice having a better overall milieu for an individual bat at a particular time.

The ranking system clearly places most emphasis on bridges where bats have been identified during the assessment. Bridges where there is evidence of bats from droppings (see Plate 5) would also be worthy of consideration as a bat roost as one can appreciate from the possibility that at any one time a bat may or may not be within a particular bridge. The result of the evaluation of each bridge is given in Tables 1 and 2.

Bridges with bat droppings but no bats have been afforded a Grade 2 but they are by the very presence of droppings categorically a roost site, whether this is a temporary perch or longer term roost.

Hence, a bridge that serves a role as a bat roost sporadically or seasonally may be dismissed as of no merit to bats.

This may lead to the loss of a roost when mitigation is overlooked for the bridge concerned.

The proportion of bridges within which bats were found is lower than for a study carried out by Caroline Shiel on Sligo and Leitrim bridges. 11 bridges were used by bats at the time of survey out of a total of 102 bridges assessed in Laois and Offaly as opposed to 66 out of a total of 174 bridges examined in Sligo and Leitrim.

A number of bridges within which there were bats were devoid of droppings. This may be simply that no droppings have become attached to the stonework, that they have been washed away or that they are too high to be seen.

Conversely, one or two bridges that had no bats within them had bat droppings on the stonework or in crevices. In the grading system as applied, bridges with no bats present have been given a number based on the suitability of the structure as a roost rather than having been categorised as a roost. In at least one case, the availability of crevices would indicate a Grade 1 site but bat droppings were noted. It is possible that such droppings are evidence that the bridge is at the very least a perch and in most cases it is appropriate to accept these to be roosts.

For example, bat droppings at Derrynaseera Bridge, Esker II in Laois and Derrinasallow and Milltown Bridges in Offaly all indicate the presence of bats and are most likely to be roosts rather than perches while Ballymacrory is a perch and has no proper roost sites for bats (see Plate 5).

One can take it that this is evidence of the use of the bridge as a bat roost but it does not fully answer whether the bridge is a day roost or night perch. It can be assumed that the more likely explanation if the bat is roosting relatively deep into the bridge that it is a day roost and within the parameters set out in this report, the bridge is therefore a Grade 3 bat roost.

This would thus bring the number of roost bridges in the study set in Laois and Offaly to 15 bridges out of the total of 102 bridges. This equates to a total of 14.7 % of the assessed bridges for the combined counties or 15.7 % of Laois bridges and 13.7 % of Offaly bridges.

Bridge Name	Watercourse	Offaly Code	Grid Ref (Eastings)	Grid Ref (Northings)	Suitability Grade
Mucklagh Old underpass	Clodiagh	016-029	2311	2227	3
Rahan	Clodiagh	016-008	2256	2256	3
Bridge Street	Camcor	035-008	2058	2046	3
Weir (Black River)	Little Brosna tributary	042-014	2036	1917	3
Lisnageeragh	Little Brosna	042-021	2095	1905	3
Mucklagh Old	Clodiagh	016-029	2310	2227	2
Kinnitty Castle Grounds	Camcor	036-024	220357	205655	2
Drumcullen	Camcor	036-008	2177	2061	2
Castletown	Camcor	036-010	2200	2062	2
Birr Castle Grounds	Little Brosna	035-061	2053	2054	2
Bunow	Little Brosna	042-023	2109	1902	2
New	Little Brosna	029-014	2017	2090	2
Derrinasallow	Little Brosna	035-002	2032	2079	2
Wooden	Silver	031-001	2126	2144	2
Ballynacarrig	Silver	032-001	2225	2137	2
Ardara	Silver	032-006	2230	2090	2
Clonad	Clodiagh	025-006	2313	2194	2
Annamoe	Clodiagh	016-025	2291	2243	2
Oxmantown	Camcor	035-011	2062	2047	1
Riverstown	Camcor	035-028	2052	2035	1
Sharavogue	Little Brosna	038-003	2205	2196	1
Milltown	Little Brosna	042-019	2069	1909	1
	Silver	031-003	2182	2141	1
Millbrook	Silver	023-008	2135	2187	1
Gorteen	Clodiagh	025-006	2340	2171	1
Charleville Aqueduct	Clodiagh	016-020	2285	2248	1
Elmgrove	Camcor	035-012	2066	2049	0
Springfield	Camcor	035-014	2080	2046	0
Bagnall's	Camcor	035-063	2061	2045	0
Birr Castle Grounds	Camcor	035-036	2054	2049	0
Birr Castle Grounds	Camcor	035-030	2056	2049	0
Fortel	Camcor	035-015	2099	2042	0
Kinnitty Castle Grounds	Camcor	036-026	2202	2060	0
Kinnitty Castle Grounds	Camcor	036-023	2203	2057	0
Carrig	Camcor	036-006	2159	2158	0
The Walk	Camcor	036-009	2190	2065	0
Coneyburrow	Camcor	036-012	2208	2047	0
	Little Brosna	042-024	2109	1905	0
	Little Brosna	042-041	2102	1918	0
Brosna	Little Brosna	042-031	2079	1939	0
Croghan	Little Brosna	035-006	2054	2056	0
Barnaboy	Silver	031-002	2175	2147	0
Kilnagall	Silver	031-021	2181	2141	0
Kilgolan Lower	Silver	031-006	2186	2141	0
Lumcloon BNM	Silver	023-020	2137	2200	0
Lumcloon Bridge	Silver	023-019	2139	2197	0
Mucklagh New	Clodiagh	016-053	2310	2228	0
Ballindara	Little Brosna	035-058	2035	2061	0
	Silver	037-001	2227	2084	0
Coolcreen	Silver	037-003	2236	2073	0
	Silver	023-021	2126	2173	0

Table 1: Offaly Bridges and their suitability as roosts.
3 denotes a definite bat roost while 2 and 1 denote decreasing value as a roost. 0 indicates that there is no value in the bridge as a daytime roost.

Dark shading denotes a roost and lighter shading indicates the presence of droppings indicating a roost or a previously

Bridge Name	Watercourse	Laois Code	Grid Ref (Eastings)	Grid Ref (Northings)	Suitability Grade
Townparks	Owenass	008-072	2453	2079	0
Birchgrove	Tonet	015-001	2233	1948	0
Cloncanon	Owenass		2431	2056	0
Clonygowan/Esker	Owenahallia		2415	2039	0
Barkmill	Owenass	007-006	2403	2047	0
Clonehurk	Owenahallia		23912	20366	0
Longford hill	Killeen		2283	1962	0
Garrafin drain	Delour		2287	1958	0
Cummer	Killeen(trib)		2249	1999	0
Lacca	Delour	011-009	2292	1981	0
Ballymacrory	Glenlahan	002-006	2339	2099	0
Owenass rail	Owenass		2443	2066	0
Portlaoise Rd	Owenass	008-012	2450	2074	0
Borness	Owenass	004-003	2464	2094	0
The Ridge	Barrow	003-027	2345	2098	0
Wooden	Barrow	003-001	2375	2147	0
Farm road bridge	Barrow		2361	2130	0
Longford	Killeen	016-034	2279	1956	0
Farm footbridge	Barrow	003-024	2373	2141	0
Mounthall	Killeen		2263	1990	1
Ballyclare	Barrow	003-002	2385	2147	1
Northgrove	Delour		2291	1980	1
Ballyfin demesne	Owenahallia		2370	2018	1
Owenass road	Owenass	007-004	2442	2066	1
Aghamore	Glenlahan		2341	2104	1
Tinnahinch	Barrow	003-014	2352	2105	1
Mill Quarter	Barrow	003-028	2356	2097	1
Rossnaclonagh	Tonet	016-004	2264	1932	1
Clarahill	Glenlahan	003-012	2341	2103	1
Derrynaseera	Delour	016-007	2295	1925	1
The Ridge West	Barrow	003-026	2430	2101	1
Mucklone	Barrow	003-004	2405	2134	1
Convent	Owenass	008-016	2455	2074	1
Pluck's	Tonet	016-001	2260	1946	1
Rathcoffey	Barrow	003-011	2347	2111	2
Anatrim	Delour mill race	016-009	2944	1923	2
Delour	Delour	016-002	2280	1947	2
tributary	Delour		2275	1949	2
Garrafin	Delour		2290	1955	2
Dooley's	Delour	011-003	2302	2004	2
Esker II	Owenahallia		24015	20418	2
Lady's	Owenahallia	007-010	2382	2028	2
Cathole	Owenass	007-005	2377	2049	2
The Oak	Owenass		2420	2044	2
Twomile	Barrow	003-010	2423	2117	3
Bay	Owenass	004-001	2455	2092	3
Cardtown	Killeen	011-008	2272	1979	3
Esker	Owenahallia		241232	203760	3
Mill	Tonet	016-010	2292	1922	3
Annagh	Delour	016-005	2291	1935	3

Table 2: Laois Bridges and their suitability as roosts

Note that the bridges are ranked in this case in increasing suitability as a roost up to the highlighted box with 6 bat roosts confirmed. Lighter shading denotes the presence of bat droppings indicating a day roost but with no bats present.

If one considers the Laois bridges examined, 19 out of 51 are of no use to bats while only 6 bridges were occupied by bats at the time of survey (12% (11.76%) of all bridges checked). Nonetheless, if this were to represent the actual proportion of bridges with resident bats in Laois, this would no doubt increase the tally of bats dependent upon bridges considerably.

Furthermore, there are another 16 bridges of the 51 that have some potential for bats by way of a small number of crevices or cavities and 10 bridges that have very high potential for bats in the variety of crevices and or the nature of these crevices and cavities. This comes to a total of 32 bridges out of 51, 63% (62.74%) of the bridges in all, that may provide roosting opportunities for bats.

If one considers that all studies have shown that masonry arch bridges hold the highest potential for bats and that masonry arch bridges accounted for 35 of the 51 bridges examined, then one can appreciate that the level of usage of these bridges may be even higher.

Of the 35 masonry arch bridges, only 6 were deemed to have no potential for bats. If one examines this group more carefully, the reasons for their unsuitability may be due to the stonework being in good condition or due to repair work.

For example, one of these 7 bridges has been gunited and has no roost potential as a result (Birchgrove Bridge). Townparks Bridge has one or two small crevices within the stonework but none suitably deep for bats and the immediate surrounding environs are poor in terms of feeding opportunities for bats.

Bridges provide the greatest benefit to bats if they allow daytime roosting but bats may also take advantage of even the most perfectly pointed masonry arch bridge and concrete bridge as a night-time roost or perch.

One concrete bridge with no potential for day roosting bats was clearly used on one recent occasion as a perch for a bat as evidenced by the presence of bat droppings both on the bridge pier and on the ground below the pier. These bridges may serve as an important perch for night-time bats to rest and avoid heavy rain or simply an easy landing place if they are far away from their daytime roost.

Bridges and stonework may serve as a perch for calling bats including male bats prospecting for partners and defending territories (Russ, 1995). This would include such species as the soprano pipistrelle.

The largest number of bats was found under and within the arch of the bridges concerned, i.e. the section of the bridge sheltered from direct illumination and within the curve of the stonework rather than in the lower vertical section of the bridge.

The bats at highest altitude in this assessment were noted at Cardtown Bridge at the start of the Slieve Bloom range. Here there were two bats, a Natterer’s bat and a probable Daubenton’s bat.

It has been found in studies in Yorkshire that the bats found in upland areas (especially in the case of Daubenton's bats) are more commonly male bats that have been restricted to poorer feeding areas that the adult females who establish themselves in high quality habitat that will provide sufficient food for the newborn bats to be suckled and later for these young to fend for themselves.

The bridges of Offaly show a similar trend in the occupancy and the use by bats of masonry arch bridges.

Of the 51 bridges examined in Offaly, 5 bridges were occupied by bats at the time of survey. This included a bridge with Daubenton's and Natterer's bats (Rahan dry arches), Natterer's bats and a brown long-eared bat (Mucklagh Old Bridge underpass), a solitary brown long-eared bat (Weir Bridge) and single Daubenton's bats (Bridge Street and Lisnageeragh).

If one just considers the 51 bridges that are extant, 10% (9.8%) were occupied by bats during this study, 26% (25.5%) were deemed of high roost potential for bats. A further 16% (15.7%) were considered to have roost potential. Based on other data, one of the bridges with high roost potential (Mucklagh Old Bridge 016-029) has been noted as a Natterer's bat roost. This would raise the percentage of actual roosts to 12% (11.7%) and there is a further 24% with high roost potential.

Overall, this would suggest that if this is a representative sample of bridges in Offaly, 52% of all bridges have bat roost potential. All of the bridges with bat potential in this assessment are masonry arch bridges.

48% of the bridges examined in the list of bridges under consideration had no potential for bats. 38% of the bridges with no bat roost potential were made up of the various bridge types including suspension, concrete and metal girder bridges. These bridges typically have no cavities or crevices.

12% of the bridges with no bat roost potential were masonry arch bridges (6 bridges). Of these, 50% were rendered useless by guniting of the arches.

It is clear from the proximity of some of these bridges to good habitat that they would be beneficial to bats if they had cavities or crevices.

For example, Croghan Bridge (035-006) is located on the edge of the Birr Castle Demesne. Guniting has rendered it impenetrable to bats. Bridge Street Bridge in Birr (035-008) which is located on the perimeter of the estate but with suitable crevices was noted as a roost site for Daubenton's bats.

This is despite the urbanisation surrounding it and a relative paucity of vegetation within the built environment surrounding it (albeit that there is good cover around the bridge and that the river flows into Birr Castle Demesne) in comparison to Croghan Bridge's location where there is little urbanisation.

Of the rivers examined in Offaly, representative bridges over the Clodiagh, Camcor and Little Brosna were all occupied, while no bridges over the Silver were occupied by bats.
Of the 18 bridges deemed to have good to high potential (or occupied by bats), only 3 bridges were over the Silver River, 5 were over the Clodiagh, 4 were over the Camcor and 6 were over the Little Brosna. The reason for the low potential for the Silver River bridges may lie in the diversity of bridge types over the Silver, many of which are metal or concrete especially in the vicinity of the boglands of the Ferbane Power Station. Daubenton's bats do feed along this river and were noted here at night even in this study.

Bat detector assessments

As indicated in the Survey Methodology section, three bridges were examined with bat detectors at a time typical of emergence time for bats (from sunset to thirty minutes after).

Of the three bridges examined, bats emerged from one of these only; Bay Bridge, Mountmellick. This was noted to be a Daubenton's bat roost.

Bay Bridge, Mountmellick
Bats commenced to squeak within the bridge at 9.21 pm and the noise had hugely intensified by 10.08 pm. This was one minute after the first bat (a soprano pipistrelle) was identified and three minutes after the first bat was seen but not identified.

The first Daubenton's bat emerged at 10.14 pm and the last bat had emerged by 10.41 pm. The maximum to emerge together was two (on two occasions) while all other emergences (10) were of individuals. Observations at the bridge ceased at 11.15 pm.

Insect abundance was high and in daylight hours swifts, swallows and grey wagtails were busy at this bridge. The level of activity of insectivorous birds (particularly the species mentioned) in the daytime is often a good indicator that the site will provide good feeding for bats after sunset.

Feeding on the river under the bridge and adjacent to it was noted during the next hour after emergence and was principally attributable to Daubenton's bats but was also of soprano pipistrelles and Leisler's bats for the first few minutes of observations after 10.00 pm. Two Leisler's bats were present at one stage in the assessment.

When this bridge was re-examined in September, 8 bats were visible in the bridge, 7 in an entirely separate cavity in a different arch and 1 in a crevice leading from the original cavity roost site.

Bridge Street Bridge, Birr
This bridge was noted to be the roost site for a solitary Daubenton's bat. The bat was roosting in a cavity that appears to be beside a voussoir under the arch and would suggest that this is a point at which the bridge was expanded historically.

This bridge was examined with a bat detector on August 2nd 2007 (more than two months after the first examination of the bridge) to determine whether one or more bats were present within the bridge following on from the greater number of bats that emerged from Bay Bridge discussed earlier than had been expected.

No bats emerged but it was clear from observations that a soprano pipistrelle roost was present in Birr town within relatively close proximity to Bridge Street Bridge. Tracking back along a line of bats from the bridge and past the renovated mill buildings indicated that the bats were emerging from the Mercy Primary School adjacent to the public park and in close proximity to the river.

Once the school had been identified as the roost site, it was watched until all resident bats had emerged. At this time, 15 bats were seen to leave the school attic.

As a consequence of this discovery, the school was re-examined prior to emergence time on August 22nd 2007 to establish whether a large roost is present here. This date is late within the summer period and it is a time when some roosts have dispersed entirely but when there are still typically a proportion of bats present (often the number within the roost is still high).

In all, 255 soprano pipistrelles were counted leaving the attic of the school from the gable end of the building closest to the Bridge Street end of the school (the west end). Almost all bats flew immediately to the right of the building (when looking at the gable end) towards the river. Bats were audible prior to emergence and it was possible to trace the movement of the bats along the roof to a high point close to the apex at which they emerged.

This roost may well be in excess of this number earlier in the month of August or in late July.

Ardara Bridge, Cadamstown
This bridge is one of the oldest extant bridges in Offaly and has an incredibly unstable appearance. It would be indicated from scaffolding and loose stones that this is more than a superficial instability but a real danger of collapse. The number of crevices and cavities within the bridge, under the arch and in the wing walls is considerable and it would be extremely difficult even with scaffolding to fully examine this bridge with a lamp.

It was deemed more appropriate to examine some elements of the bridge with safety a priority and then to observe the bridge with a bat detector for emerging bats.

This was undertaken in September 2007 on a mild night on which bat activity was high and there was no rain.

It was difficult to fully ascertain whether bats emerged from the bridge or were simply first noted while flying under the arch of the bridge. However, it is most likely that the latter is the case and that the bats were in flight and approached the bridge rather than emerged. This is based on the flight behaviour and signals of the bats when noted.

If the bats had emerged from Ardara Bridge, one would hear an initial burst of signals from the roost site before the first bat had launched itself into the air. This may continue for several minutes for some bats and even up to an hour when a bat has experienced some form of disturbance prior to emergence. The second bat could then follow immediately without such a build-up.

Two soprano pipistrelles were seen and heard around the bridge. A Leisler's bat was heard feeding and flying high over the river. Upriver in the village of Cadamstown, a Daubenton's bat could be heard feeding in the section of river close to the old mill. This mill could easily be a roost site for bats of several species.

Bridges, bat roosts and vegetation

Most masonry arch bridges would appear to have some level of vegetation cover leading to them. Even urban bridges such as that at Bridge Street in Birr have good vegetation even if this would not constitute a hedgerow in the true sense. Species of tree such as ash, alder, willow and birch are commonly found on either or both sides of the older bridges. In addition to this, there may also be hawthorn, blackthorn, bramble and hazel.

It is unusual to find a bridge with no vegetation surrounding it. However, the level of cover would appear to be important for some species. For example, in the assessment of Sligo and Leitrim Bridges undertaken by Caroline Shiel, Natterer's bats were dependant upon scrub close to the bridge.

There were few Natterer's' bats noted in this survey with individuals being noted at Cardtown and Esker Bridges in Laois and Mucklagh and Rahan Bridges in Offaly (four bridges in all). In all, this accounts for a maximum count of four Natterer's bats in Offaly bridges and 2 in Laois bridges.

Certainly, the arch at Mucklagh at Charleville Demesne, Tullamore has good scrub and woodland cover and this also has the highest usage by Natterer's bats.

The highest count of Daubenton's bats was at a bridge north of Mountmellick, Bay Bridge (004-001, see Plate 4). This bridge was flanked by sycamore, ash, alder and copper beech in order of cover. The cover would not appear to be different from many or most of the bridges in this assessment.

The size of the cavities in the arches would be exceptional as they would appear to be in the region of 20 centimetres wide. As noted earlier in the Results section, a bridge at Kilmacow, Kilkenny with a relatively large Daubenton's bat count shared this phenomenon of missing stones from the apex of the arch.

Vegetation cover varied in constitution to some extent and analysis was complicated by the number of combinations and hence no link was evident between vegetation and bat presence.

Plate 2: Bat bridge roosts and bats
a) Mucklagh Old Bridge and underpass with b) and c) roosting Natterer's bats
d) Rahan dry arches with e) Daubenton's bat close-up
f) Bridge at Lisnageeragh with g) Daubenton's bat

Plate 3: Brown long-eared bat in bridge.
Once the ear is folded, the tragus (see arrow) may look deceptively like an ear and lead to misidentification. Natterer's bat is the species with which it is most commonly confused

In a study in Cumbria, bats were more strongly associated with bridges close to broadleaved woodland (Geoff Billington *pers. comm.).* Native woodland is much more available in England and this association would be quite constraining for Irish bats.

Bats, bridges and lighting

Light levels are a key factor in the choice of long-term stable roost sites. Bats will not choose roost sites whereat the roost entrances/ exits are directly illuminated by artificial light. Illumination of roost entrances/ exits may interfere with the emergence activity of bats, leading to a vital loss of feeding opportunities at dusk and consequences for survival and reproduction.

Traditional roosts to which bats may remain faithful for decades may be abandoned if the roost is lit up or else become less beneficial to the local bat fauna.

Personal observations by the author would support this generally accepted assertion. Daubenton's bats within illuminated historical priories for example will typically occupy all areas of the ruins where artificial light (such as decorative spotlights) is absent.

Illumination of bridges for display purposes has the potential of destroying bat roosts and affecting the ecology and possibly the success rate of local bat populations. Species such as Natterer's bat, whiskered bat, Brandt's bat, brown long-eared bat (and where they occur in Ireland) and lesser horseshoe bats are very rarely encountered in brightly lit situations.

Only the urban bridges in this assessment are exposed to artificial lighting. Bridges such as those in Mountmellick and Kilcormac are in bright conditions.

The Bridge Street Bridge was not illuminated during three night-time examinations of this bridge (August and October 2007) and ***it is vital that this remain so if it is to continue to serve as a roost site***.

Bats are typically found in dark sites but this should not rule in or out their presence as different situations may provide sufficient if not ideal conditions to allow usage by bats.

For example, included in Plate 6 is a photograph taken by the author near Dublin whereat a Daubenton's bat was perched on a smooth 30 metre long (minimum) concrete culvert that was adequately bright to negotiate without using light. The picture above this was taken in the bridge at Rahan in this study.

Bats, bridges and repairs

The bridge that hosts the largest roost site noted (Bay Bridge, Mountmellick, see Plate 4) and all bridges where stones have become dislodged are clearly a concern for those engaged in protecting the structure particularly in terms of safety let alone the architectural heritage.

Where such areas of collapse have commenced, it is a matter of time before more stones, having been freed of the frictional and physical barrier constraint on their movement, fall from the bridge. This in turn may create a minor or even major risk to traffic passing overheard.

Bridges of eighteenth and nineteenth century origin were not constructed with the traffic of the twentieth or twenty first century in mind. The width and tonnage of vehicles would have been inconceivable to engineers and stone masons pf the time. Hence, the bridges were intended to deal with horse drawn principally localised traffic.

While the bridges may have coped well with such loads, the progress of time, continuous vibration and frequent load-bearing have all lessened the capacity of these bridges to carry traffic without strain.

Damage to bridges through reckless driving or excessive wide loads may jeopardise the stability of the upper bridge while the high humidity under the arch from the river may affect the mortar, not to mention simple decay or displacement over time.

It is ironic that the commencement of collapse provides many of the opportunities for bats to roost in bridges and it is the continuation of this process that introduces the risk to bats of roost loss and more disturbingly entombment or death through other accidental causes such as crushing, or blows from stonework or machinery.

For dippers and grey wagtails, the proximity to water is hugely advantageous and bridges provide an opportunity to nest close to good feeding. This is most especially true for dippers. The requirements for these bird species and for bats from a bridge are however quite different. Dippers and grey wagtails will make use of a bridge with little or no cavities or crevices once there are ledges upon which nests may be built.

In this and other bridge examinations, dipper nests have been found built on pipes and in drainage holes. Many of these sites would be entirely useless to bats. This was evident in the current evaluation where a number of bridges that had nests of either dippers or grey wagtails or both were of no benefit to bats. Bridges of concrete design, for example, may provide suitable foundations for nests while there are no crevices within bats could avoid direct sunlight.

The results do indicate that the masonry arch bridge provides a particular opportunity for bats that most other bridge construction designs and materials widely employed in Ireland does not; the presence of a variety of crevices and cavities and in addition to this darkness and shelter from the elements.

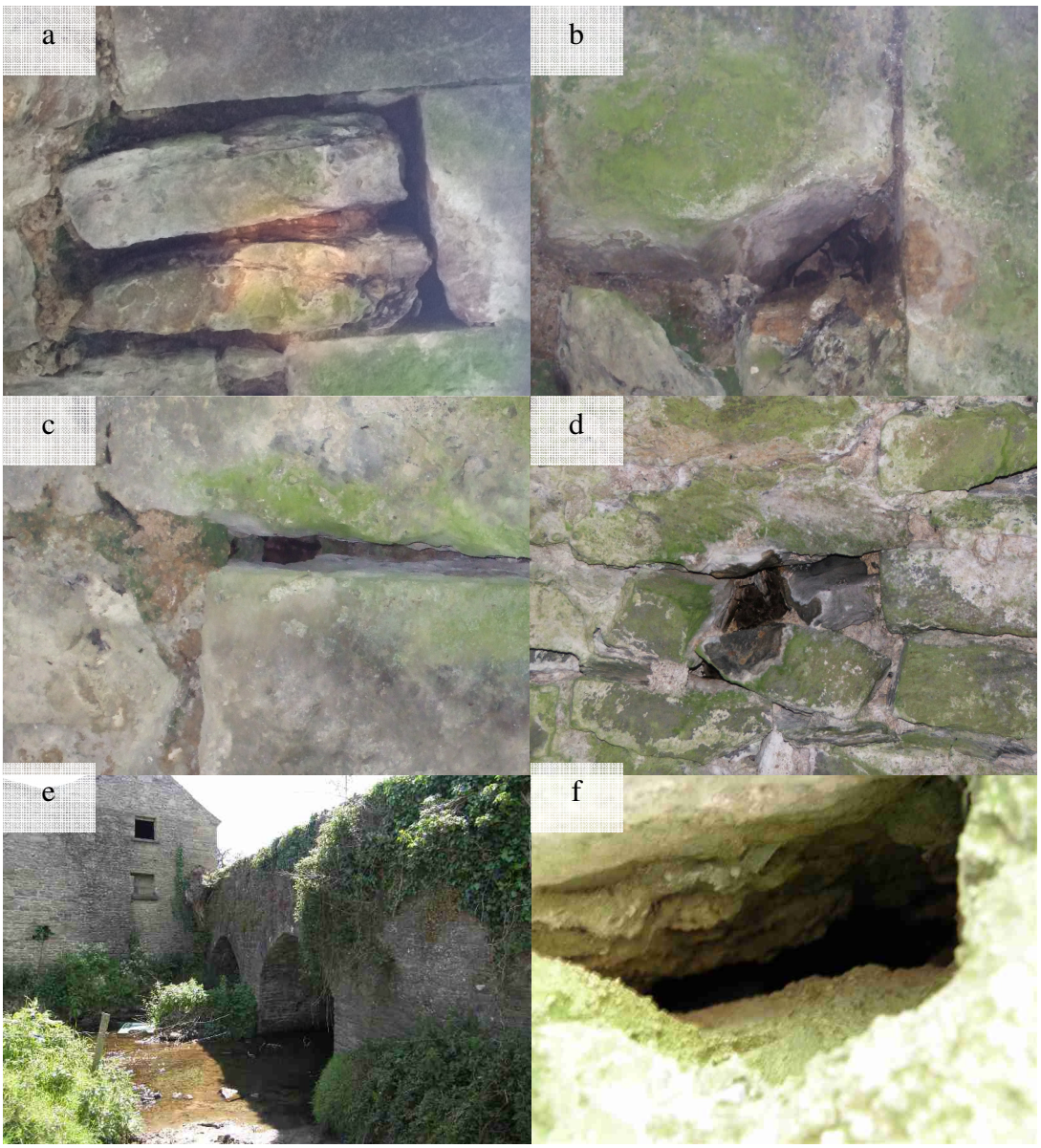

Plate 4: Bats in bridges. Roosting behaviour
Bats avail of masonry arch cavities such as these at Bay Bridge, Laois, a), b) and c) and Dangan Bridge Kilkenny, d) in a similar fashion. The wide cavities are most suitable for large numbers of bats while smaller crevices are used by individuals.

However, there are variations on roosting location and visibility to the observer as the roost crevice at Mill Bridge, e) indicates. The bat is deep within the crevice on the right, f).

Plate 5: Bridges with bat droppings but with no bats present

a) and b) Derrynaseera, c) and d) Esker II, e) and f) Derrinasallow,
g) and h) Ballymacrory Bridge had bat droppings on the bridge but this is clearly due to perching on, rather than roosting within the bridge

Plate 6: Roosting Daubenton's bats at different levels of visibility
Daubenton's bats are most often tucked out of view in a cavity (a) but may on rare occasions be visible externally (b) as in this modern culvert on the Meath / Dublin border.

The type, character and size of crevices would all appear to be of very high significance for roost usage. This prediction is also shared by Geoff Billington, one of the principal surveyors of bridges in England (*pers. comm.*).

The greatest number of bats in one English survey in Cumbria was in excess of 100 Daubenton's bats, which would rate as one of the largest Daubenton's bat roosts in Ireland if it were to occur in a bridge here. Bats were even found in bridges as low as 70 cm in height.

Another bridge in the same study held 50 soprano pipistrelles (*Pipistrellus pygmaeus*) and 10 Daubenton's bats.

In this assessment, soprano pipistrelles were found over rivers and in roosts close to rivers but none were noted in bridges themselves.

In this assessment, there was no increase in the number of bats within the bridges re-examined in September and October, a period when the Cumbrian study showed an increase in bridge usage.

There would not appear to be any reason in the Irish context to assume that the autumn period is the best time to survey for bats in bridges. Consequently, it is not necessarily the worst time to carry out repairs. Bridges should be considered on an individual basis for the timing of repair work.

Other mammals noted: Otter and mink

Otters visited 36 of the 102 bridges examined (over 1/3 of all bridges) and there were some bridges where the level of sprainting was especially high such as at Moneyguyneen, Kinnitty along the Camcor River (036-009). Otter spraints, footprints and food remains were all noted at various bridges. There was one report of an otter predating geese in Cadamstown (River Silver) and a request by the poultry owner to have the animal shot by a local hunter.

Otters were seen by residents of Mountmellick in the town rivers and spraints were noted at Townspark Bridge and at Bay Bridge (River Owenass).

Remains of an eaten rat and a nestling were found beside the bridge at Moynure (Little Brosna) and fresh spraints were present at Lisnageeragh bridge further downriver.

Overall, otters were noted on the Camcor, Clodiagh, the Little Brosna, the Silver Rivers in Offaly and the Owenass, Barrow, Glenlahan and Killeen in Laois.

One of the food items noted in both counties was the freshwater crayfish (*Austropotamobius pallipes*). One live crayfish was noted at Longford Bridge in Laois (see Plate 7).

Mink signs were noted at 15 of the 102 bridges and were often found at the same bridges as otter signs. This species is still apparently widespread in the two counties. The lower number of bridges used by mink compared to otter may mirror the less aquatic habits of this species rather than a lesser abundance.

There were mink signs on the rivers Owenass, Barrow, Glenlahan, Killeen , Delour and Tonet in Laois and on the Clodiagh and Silver in Offaly. Mink were also reported from Birr Castle Demesne on the Camcor but no signs were present during this assessment.

Both mink and otter were noted at the following bridges:
Laois-

- Bay (Owenass River)
- Owenass Road (Owenass)
- Mucklone (Barrow)

Offaly-

- Mucklagh (Old) (Clodiagh River)
- Gorteen (Clodiagh)
- Ballynacarrig (Silver)
- Kilgolan Lower (Silver)

Two other mammals of the mustelid family were noted at bridges: pine marten and badger.

A dead pine marten was found on New Bridge north-west of Birr. Another dead pine marten was noted on the R437 at Derrybrat approximately 1.5 km from the Silver River and equidistant to the south of the level crossing.

A pine marten scat was noted on the suspension bridge at Birr Castle.

Pine martens were reported as being seen historically from the Lisnageeragh Bridge within the grounds of the Abbey at Mountheaton.

Badger dung and tracks were noted in a number of places but this as for the pine martens is an incidental use of the bridges rather than a specific utilisation of bridges.

Plate 7: Mustelids: Otter and mink signs and pine martens

a) Freshwater crayfish are a prey item of otter and remains were found in and with several otter spraints, b).
c) Otter spraints were widespread in the two counties
d) Mink spraints were noted at 15 of the 102 bridges and were present in both counties
e) The rat tail and f) nestling deposited under a bridge and are most probably otter discards
g) and h) Pine marten on New Bridge and northwest of Kilcormac respectively

DISCUSSION

It is vital that the conflict between the safe maintenance of bridges and the protection of bat roosts be dealt with in a sensible way that neither endangers human safety nor affects the conservation of several mammal species, namely Daubenton's bats, Natterer's bats, brown long-eared bats and possibly other species.

Bats depend on their roost sites for a number of reasons but principally it is a haven from which they can shelter from the elements and predation. Bat roosts are selected for a number of different reasons including their proximity to the essential parameters such as feeding sites, other bat populations, other alternative and inter-linking roosts that may form a corridor between summer and winter sites and the degree of protection that the roost affords the bats concerned.

Bats may select a bridge based on the availability of suitable crevices and cavities but it is important in most situations that the bridge is close to good feeding opportunities.

Minimising on travel to and from feeding areas is important as it reduces the energy consumption and time loss between emergence from the roost and feeding.

The most commonly encountered bat in bridges is the Daubenton's bat, a species that is very heavily dependent upon water for its prey. This species gaffs flies, beetles and moths from the water surface of rivers, ponds and lakes. The availability of crevices within a bridge close to such a feeding site would reduce the distance that this species would need to travel enormously.

In the largest roost bridge in this survey, Bay Bridge, the Daubenton's bats fed under the bridge as well as flying out of view. Daubenton's bats may commute several kilometres along rivers and canals to find feeding. This is essential for large roosts of bats as the area required to provide adequate prey for all of the bats and to reduce crowding of the watercourse increases with the number of bats present.

Bridges may serve as roosts for local bats but they may also feature in a chain of roosts that allow bats to travel between important sites in different parts of the island. Such long distance travel has not been determined to date in Ireland but the distances over which bats may travel has been shown in studies in England and Wales to be increasingly greater than had ever been anticipated.

For example, Natterer's bats have been recorded to travel almost 70 km to reach a cave or caves in Yorkshire to mate (Parsons, . Migration or long-distance movement in Natterer's bats has been established from studies on these caves and has shown that bats avail of the same caves faithfully.

Equally, bats avail of summer roosts with the same level of fidelity. Roosts are a critical asset for bats and they will return to safe roosts annually and seasonally.

Daubenton's bats exhibit swarming behaviour at sites within 27 km of their day roost (Parsons & Jones, 2003). The swarming sites are probably important for genetic mixing or outbreeding. Daubenton's bats generally use swarming sites in parkland, open water habitats and woodland. Daubenton's bats appear to be faithful to a single swarming site.

Bats in Britain and Ireland are often thought to be sedentary. However, as outlined above, there is some evidence of long distance flights. Another example is the movement of a greater horseshoe bat found in Wales that had travelled from a roost in the south of England.

With little ringing information available in Ireland, such data would be difficult to confirm. The discovery of a lesser horseshoe bat by the author sixty kilometres away from its most northerly and easterly distribution in one autumn survey would indicate that long distance movements are a possibility for this species and others.

Hence, a bridge may not only serve as a local resource for local bat populations but the availability of roosts such as bridge cavities may be used by bats moving along natural features from one site to another. This may include mating roosts and swarming sites as well as summer sites.

Rivers would be an ideal corridor by which to migrate and it is an essential part of the behaviour of species such as the Daubenton's bat in its nightly activity.

Bridges are clearly performing a role as summer sites (including maternity roosts) as well as autumnal sites (roosts for dispersing summer roosts), winter roosts (possibly including hibernating bats as at Mucklagh) and spring roosts. Such usage would clearly indicate a pivotal role for such structures in some areas.

Masonry arch bridges offer bats the best opportunities of existing bridges. This is due to the level of deterioration that has set in to many of these bridges. The design of the bridge is also of small discrete units and the potential for several crevices to develop is much greater than for a single concrete base or an iron bridge.

The retention of crevices can be problematic when works including shotcreting, guniting, pointing or pressure injection. However, it is possible, if the cavity or crevice is temporarily closed and the work continues around it. When all the works that would infill the cavity have been completed, it should then be possible to remove the block used (this could be card, paper, expanding foam (if this can be removed easily)) and the cavity is retained while the deeper cracks have been sealed.

For some bridges, it is possible to attach a bat box to the bridge as an additional roost provision. A number of designs exist for this and it is important that any box be placed adequately high and away from disturbance.

Some bridges in the current assessment offered no roosting opportunities to bats due to the absence of crevices or cavities but were in areas where such crevices would have been beneficial to bats.

For some, this was due to their construction materials and design (e.g. Coneyburrow Bridge, Cloncanon and Ballymacrory). For others, this was due to the spraying of the under-arch and the removal of suitable crevices (e.g. Clonehurk near Ballyfin, Croghan Bridge, Birr, Cadamstown Bridge, Elmgrove Bridge, Birr and Brosna Bridge).

Bridges such as those listed above would clearly offer roosting opportunities to bats if they were fitted with bat boxes. Structures with high bridges such as Coneyburrow and Monicknew could easily facilitate a variety of boxes and aid in exploring the bat box design that is most successful for bats at bridges in the Irish context.

While, it is clearly the case that in Ireland the masonry arch bridge type holds the best roost potential, it is obvious that more modern bridges could accommodate bats given minor modifications or even where particular bridge designs are employed.

In countries such as the USA, bat roosts of hundreds, thousands and even millions have been identified in bridges. The principle is the same, the availability of a crevice into which bats can crawl and avoid predation and weather conditions.

The two main differences between the US situation and Ireland are the different climatic conditions of the two and the species of bat concerned.

But in theory, it is possible that modern bridges could facilitate bats without significant alteration or cost and that this would provide future roosting opportunities as masonry arch bridges are replaced over time.

Bats in Texas that have been recorded in bridges are highly social and at considerably higher numbers than Irish bats (Mexican free-tailed bats may form roosts of several million and one bridge roost is in excess of 1.5 million).

However, some Irish species form much higher aggregations in continental Europe at some stages in the annual cycle. In hibernacula in the Czech Republic, Daubenton's bats may number several thousand. This may be due to the differences in social structure and ecological needs of overwintering animals but it does show that even species that are considered to form small roosts may aggregate to greater levels in certain circumstances.

Thus, in principle modern bridges could be a future source of roosts for bats if suitable roost features are incorporated. Among these, a variety of crevices from 100 to 1500 mm in depth and 13 to 40 mm width would benefit bats. As Daubenton's and Natterer's bats most often use crevices 30–400 mm wide and 300–500 mm deep, these should be represented in the span of the bridge.

In masonry arch bridges, bats used the highest point of the arch and hence the underside of the bridge is the best area to provide mitigation.

Bridges should thus be considered for their potential as a facilitator of biodiversity and roosting opportunities should be developed in new bridges as well as existing bridges.

This should not be a difficulty in comparison to the retro-fitting of roost options to established bridges (i.e. creation of cavities).

Other features of a bridge that would benefit bats would be an absence of light and hence illumination and distance to the outside edge of the bridge would be considerations.

The issue of illumination and the fashion of floodlighting apply to all bridges and structures. This is generally achieved by high intensity lights set back several metres from the bridge and directed indiscriminately. This may lead to brightly lit arches and hence to illuminated bat roost sites and it is not beneficial ecologically in a number of ways.

Firstly, it may inhibit the use of bridges or buildings by the less light tolerant bat species which also numbers some of the less common species.

Secondly, it may interfere with the movement of light intolerant bats past the bridge or other structure. This could lead to wasted effort in reaching a desired feeding area or roost site.

Thirdly, it is an utter waste of electricity in a time when means of reducing the "carbon footprint" is sought. Spotlights are extremely high on energy consumption and are in use every night. They are not provided an essential safety or security function and have a limited period during which they are noticed by residents. Hence, they have a role in attracting the attention of visitors by creating a spectacle. This may have been a curiosity in an age before such widespread use of the technique.

There are better means by which a structure may be lit for effect but where the possibility of protecting a roost site exists. Lights upon a structure in line with the stonework may show up attractive features but may also be more easily restricted to specific regions.

Overall, it is preferable that light pollution be avoided and that bridges are admired during daylight. Means of making masonry arch bridges more attractive would include hand-pointing of stonework (where essential) rather than shotcreting or guniting, removal of pipes from the abutments and the use of sympathetic materials during repair (sparing concrete).

Grading bridges based on the presence of bats

In this report, bridges have been graded in accordance with the system used by Caroline Shiel and proposed initially by Billington and Norman. This grading system has been revised and it has been proposed by the UK Highways Agency that the following system be universally applied in the UK:

0 No crevices with potential for day roosting
2 Possible suitable crevices for day roosting (indicates uncertainty about suitability of crevices)
4 Crevices suitable for day roosting
5 Evidence of bats using the site for day roosting

On the basis of this system, of the 102 bridges examined in Laois and Offaly:

15 bridges are of **Grade 5** (7 Offaly, 8 Laois)
20 bridges are of **Grade 4** (11 Offaly, 9 Laois)
23 bridges are of **Grade 2** (8 Offaly, 15 Laois).
44 bridges are of **Grade 0** (25 Offaly, 19 Laois)

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RECOMMENDATIONS

For Relevant Bodies and Groups (e.g. Councils, Irish Rail) for Bridges and Bats

Mitigation by way of the retention of crevices (retention is always the first line in mitigation) and bat boxes must be provided *unless* there have been a number of surveys of a given bridge that prove that it is not used by bats
This measure is proposed for all bridges that have suitable crevices for bats and it addresses the inevitable response once a one-visit survey has ruled out bats that no mitigation is required. This can only be satisfactorily proven by repeat examinations of a bridge.

Prior to bridge repairs it is the legal responsibility of the County Council or Bridge Owner to determine whether bats are present
As outlined in this report, all bats have strict legal protection and it is an offence to knowingly or recklessly kill or injure them or damage or destroy their roosts. Some species are heavily dependent upon bridges but the range of bat species found in bridges may actually include over half of the national species.

Budgets for bridge and road repair and maintenance should include the environmental and ecological responsibilities of the national government for protected fauna such as bats, dippers or grey wagtails.
Survey work on bridges may be overlooked because it is seen as an unexpected expense. Intentionally ignoring the requirement to protect bats roosting in bridges is not a defence against prosecution for the destruction of a roost.

Measures that allow bridge strengthening procedures to be successful without any risk to bats should be designed or sourced.
Engineers within Counties Offaly and Laois would have the expertise to design procedures and solutions by which cavities and crevices can be retained without a risk to the stability of the bridge. In addition to this, it would be possible to contact other agencies that have carried out bridge repairs while protecting bat roosting sites including the Roads Authority of Northern Ireland and the council roads section of North Yorkshire.

All bridge records for bats should be collected by the relevant engineer in each county from Conservation Rangers and other interested parties.
Information on bridges may be gathered but not utilised in the most effective manner.

Bridges known to have bat roosts should be checked off against the list of bridges designated for repair work or other maintenance.
Imminent repairs pose a real risk to roosts and this step will ensure that last-minute delays or cessation of work is avoided and most importantly for bats, that they are neither entombed nor injured.

Bridges should not be illuminated
The aesthetic benefit of lighting a bridge is outweighed by the ecological and environmental damage of light pollution and energy wastage with the additional potential for destroying the roosting capacity of a bridge or building.

Bridge data should be collated with reference to the features of each bridge of use to bats, presence of bats and all other useful data.
Attached to this report is a spreadsheet outlining features that may allow for bat roosts to be recorded and for a communication between engineers and ecologists to be established and continued ensuring that bat protection is a tangible consideration in the lead up to any repairs.

Also, recommendations may be drawn up and relayed based on a history for each bridge, especially for those in need of repair.

The spreadsheet would also form the basis for a survey form that could be brought for each bridge visit and assessment.

Consultation should be sought with National Parks and Wildlife Service regarding bridge repair work and any recent records not yet transferred to the County Council to determine:

1. **Whether bats are known to roost in any bridge proposed for repair**
2. **Is there specific advice for the bridge in question**
3. **Sources of expertise from government agencies, consultants, NGOs**

Where maintenance is proposed for late May, June and July, it is essential that the bridge under consideration be ruled out as a maternity roost.
If it is not possible to exclude the possibility of a breeding population of bats, work should be deferred until after breeding would be certain to be complete i.e. late August.

Survey work must be carried out to check for bats well in advance of any intrusive works (grouting, re-pointing, saddling).

Where there has been a delay between an initial survey and repair work the bridge must be re-assessed if it has potential as a bat roost (i.e. it is not a Grade 0 bridge in the classification used in this report)
As indicated in this report, bats move into and out of bridges regularly and may not be present on an initial search.

It is most appropriate that a specialist undertake all surveys and at the very least that repair staff examine the bridge for any bats within crevices. The survey should be documented and be available for inspection by National Parks and Wildlife Service if so required to avoid prosecution under the Wildlife Act and Habitats Directive.

Vegetation should not be removed from around bridges unless it is affecting the bridge or is creating land drainage problems.
Bats such as Natterer's bat avail of scrub for feeding and commuting and its removal may impair the maximal utilisation of the surrounding habitat and isolate bridge roosts.

Hedgerow should be retained or introduced around bridges to provide feeding and commuting conditions for bats
Mature hedgerow can even be planted from Irish stock to reduce the time required for establishment. One specialist in this procedure is resident in Offaly.

Advice on habitat enhancement for bats is provided in a Heritage Council booklet written by Donna Mullen of the country's voluntary bat conservation organisation.

Bridges should be fitted with specifically designed elements to provide bat roosts in parts of the bridge that are not prone to structural decay.
Bat boxes or houses or individually designed cavities should be provided on parts of any bridge in good repair or on formerly repaired bridges to allow bats to roost within a safe structure that can be easily manipulated by a bat specialist to prevent roosting when bridge repair work is under way.

This may be one way in which bridges that have been rendered useless to bats (until wear-and-tear creates crevices at a much later date) may be restored as bat roosts.

All bat species in Ireland (except lesser horseshoe bats) have been found in bat boxes and indeed numbers within boxes may be as high as sixty bats in a box the size of a typical bird box.

New bridges should incorporate bat roosting features
The provision of roosting sites requires a range of crevices and cavities that could be provided without any structural deterioration to new bridges by extension of areas of concrete or by facing bridges with stone. Crevices and cavities should ideally include some with dimensions of 100 mm and up to 1500 mm in depth and 13 mm up to 40 mm width. As Daubenton's and Natterer's bats have most often been noted in crevices between 30 mm to 400 mm wide and 300 mm to 500 mm deep, these should be given priority.

Stonework should not be smooth leading in to these cavities to allow bats to grip on to them (scored concrete or bumps would allow attachment).

Engineers with responsibility for bridges should meet with a bat specialist to exchange advice
A field visit to bridges would provide useful training for engineers in the likely locations of bats in bridges.

Bridges with good clearance upon which bat bridges may be attached to create roosting opportunities should serve as a study area for identifying the most attractive roost option for bats
Some bridges in this evaluation have no inherent roost potential for bats but could serve as a site for attaching a variety of bat boxes e.g. Coneyburrow in Kinnity or Monicknew in the Slieve Blooms.

Provide bat boxes at bridges that have previously been gunited or otherwise rendered useless to bats
E.g. Croghan Bridge at Birr Demesne, Elmgrove Bridge, Riverstown Bridge, Birchgrove Bridge, Clonehurk Bridge.

CAUTION

1) If bats are found during or immediately prior to repair works, work must cease until the bats are given adequate protection

It is essential that no bats are handled by any staff without a licence to handle bats or without vaccination appropriate to dealing with bats and other wild mammals.

Bridges with bats must not be repaired if the bats are placed at risk. If bats are at risk even when work has ceased (e.g. wet plaster, concrete etc. within which they would be trapped is close to the roost site), a licensed bat handler must be contacted to deal with the situation.

Handling wild animals creates a risk of being bitten and consequent risk of infection that should be avoided.

2) **If a bridge is known to be a bat roost the information should be treated carefully to avoid acts of vandalism or malice that would endanger the bats**

Where a bridge under repair brings about local road closure, it may be seen as a means of expediting the delay if the bats were removed from the bridge.

The negative publicity or exposure may be retrograde for bats and it is best that such information is made available (if necessary) once the bridge has been repaired.

Alternatively, acts of cruelty are documented in which bats are targeted specifically. Knowledge of an accessible bat roost may assist in such actions.

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