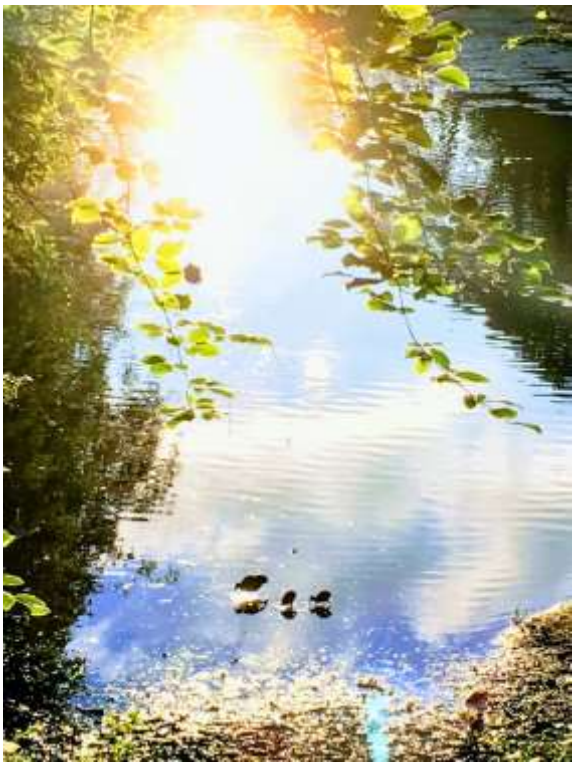
scott cawley

MONITORING OF ECOLOGICAL IMPACTS OF OUTDOOR CONCERTS IN 2016

MARLAY PARK, CO. DUBLIN.



DUN LAOGHAIRE-RATHDOWN COUNTY COUNCIL

Contents

1. INTRODUCTION

Scott Cawley, Ecological Consultants were contracted by Dun Laoghaire-Rathdown County Council regarding the protection of fauna in Marlay Park during the set-up and operation of outdoor concerts over two weekends in July in 2016 and to monitor the response of fauna to the set-up and operational phases of these concerts and the longer terms effects on bat distribution over the summer of 2016.

This is the second year of monitoring of the impacts of similar events in 2015. However the current Report covers two weekends of events, as opposed to just one in 2015. The surveys in 2016 also employed standardised survey techniques to measure bat activity before, during and after the events.

The scope of the surveys covered impacts on breeding birds, bats, badger and otter activity. The National Parks and Wildlife Service were fully consulted during the scoping and undertaking of the surveys and were continually updated on their results.

A Summary Report was circulated to Elected Members in Dundrum on 5th December 2016 which provided the results of the monitoring carried out in 2016. This Main Report cover covers the same scope as the Summary Report but in greater detail. Appendices to this Report also include the following information:

Appendix A: Results of Bridge Inspections.
Appendix B: Results of Building Inspections
Appendix C: Static Detector data and Analyses
Appendix D: Transect Data and Analyses
Appendix E: Bat Capture Data

2. MONITORING OF BREEDING BIRDS

2.1 Scope of Monitoring

In 2015, monitoring of water birds took place prior to, during and following the concerts. It was concluded that birds such as Little Grebe and Moorhen were able to breed successfully and avoided areas of disturbance when the concerts were in place. In 2016 there was an increased emphasis in recording nest locations, breeding success and protecting nesting birds from risk of disturbance during installation of the hoarding and the pontoons across the main lake.

2.2 Methodology

Surveys took place from public paths and vantage points around the lakes and woodland to allow surveillance of nesting sites. Notes were taken on the location and general behaviour of birds. Surveys for breeding birds identified waterfowl using the lake and surrounding trees for breeding and roosting.

Surveys were undertaken on the following dates:

- 21st June 2016
- 1st July 2016
- 5th July 2016
- 7th July 2016

- 8th July 2016
- 9th July 2016
- 11th July 2016
- 15th July 2016
- 16th July 2016
- 17th July 2016
- 28th July 2016

The results are presented below.

2.3 Results of Breeding Bird Monitoring

2.3.1 Overview of Results

Species including Mallard *Anas platyrhynchos*, Moorhen *Gallinula chloropus*, Coot *Fulica atra* and Little Grebe *Tachybaptus ruficollis* were recorded breeding successfully during the summer of 2016 whilst Tufted Duck *Aythya fuligula* and Mute Swan *Cygnus olor* were noted to be present but not breeding.

Prior to the events on 8th and 9th July and the installation of any infrastructure, Little Grebe, Mallard and Moorhen were noted to be sitting on eggs in nests in the main lake. At least one juvenile Little Grebe on the main lake indicated that a breeding attempt had already been successful.

The installation of the pontoon on 5th July 2016 was supervised by an ecologist (following checks for nests in the vicinity of the pontoon locations) and whilst a juvenile Moorhen was present in the area of the pontoon, no disturbance or distress to this individual or other birds was observed. Birds were seen to use the bankside and even dive under the pontoon on occasions to reach the other side.

During the concerts on 8th and 9th July, Little Grebe eggs in another nest near the seating platform had hatched and nestlings were seen on the water and in the nest seemingly unaffected by the concerts. Moorhen were also noted breeding nearby. It was noted that birds did not swim close to the pontoons and that most birds congregated at the eastern end of the lake. The nests were also located in this area.

During the concerts on 15th-17th July 2016, the same species were noted in the same locations. The Coot that was seen prior to the event was seen with fledglings on the water on 17th July. Its nest was not found but was not thought to be near the pontoon locations as this area was thoroughly searched. Little Grebe were also nesting to the west of the pontoon over the Longitude weekend.

The large rookery in the Park to the south of the main lake was monitored before, during and after the events. During sound checks on the 7th July 2016, little disturbance of the rookery was noted but on the night of the concerts themselves the flock was noted being disturbed and settling in the same locations or slightly to the east or south. No nestlings were seen prior to the events and it is not thought that the disturbance would have affected breeding activity.

Kingfisher were regularly recorded in the main and lower lakes all the way north to the wetlands at the northern edge of the Park. Kingfisher were recorded before the events on either of the lakes and were recorded hunting on Bushnell HD cameras within the lower lake on two occasions in August 2016. This species is listed on Annex I of the EC Birds Directive.

Plate 1: Pair of Tufted Ducks seen on the main lake.

Plate 2: Single Kingfisher perched on branch in middle of picture. Dating from 14th August 2016.

Plate 3: Kingfisher diving for fish (left foreground of picture) on 14th August 2016.

Other notable species using the woodland area included Sparrowhawk, Grey Heron, Woodcock, Treecreeper, Jay and a range of typical woodland birds commonly found in the surrounding suburban landscape.

2.3.2 Bird observation diary

Table 1 below sets out the notes taken during the bird monitoring visits:

LG= Little Grebe
MH= Moorhen
CO= Coot
MA=Mallard
MS= Mute Swan
H. = Grey Heron

Table 1: Bird Observation Diary

Date	Observation
21/06/2016	Main lake: LG sitting on eggs near waterfall, frequent pair swap. 2 x Juvenile LG feeding in middle. 1 x CO. 45 x MA hybrid at eastern end. Some with chicks. Kingfisher flushed. Lower lake: 2 x juvenile LG. 2 x MS. Kingfisher flushed.
01/07/2016	Main lake: LG sitting on eggs near waterfall, frequent pair swap. 1 x Juvenile LG sleeping/preening in middle. 1 x CO. 3 x MH, one with 2 chicks. 63 x MA hybrid at eastern end. Some with chicks. 1 x H. Lower lake: 2 x juvenile LG feeding. 2 x MS (no nest?)

04/07/2016	Main lake: LG nest near waterfall. 1 x CO. 3 x MH, one with 2 chicks. 50 x MA hybrid at eastern end. Some with chicks. Lower lake: 2 x juvenile LG feeding. 2 x MS (no nest?)
05/07/2016	**Installation of Pontoon across main lake – all monitored by ecologist.** Main lake: LG sitting on nest near waterfall but chicks may have hatched as no eggs now seen. New LG nest near seating platform to east in sunken branches of trees. 1 x CO. 2 x MH, one juvenile. 65 x MA hybrid at eastern end. Most chicks mature. Lower lake: 2 x juvenile LG feeding. 2 x MS (no nest?). Kingfisher flushed. MH juvenile inquisitive at pontoon works. Moved to east after installation. No disturbance noted.
07/07/2016	**Sound checks 1815 – all monitored by ecologist.** No change in behaviour of birds. Main lake: LG nest with 3 chicks newly hatched near seating platform. New MH nest near old LG nest at waterfall. 1 x juvenile LG. 1 x CO. 3 x MH, 1 x MH juvenile. 65 x MA hybrid at eastern end. Lower lake: 3 x juvenile LG feeding.
08/07/2016	**Concert (Kodaline) – all monitored by ecologist.** Rookery took flight at approx. 21:23 and moved east and settled in trees nearby but gradually returned to rookery over 20 minutes. Main lake: LG nest with 3 chicks newly hatched unaffected with chicks seen feeding on pondweed during concerts. New MH nest near old LG nest at waterfall unaffected. 1 x CO. 3 x MH, 1 x MH juvenile. 65 x MA hybrid at eastern end stayed at shallow end with birds coming within 30m of the pontoon. Lower lake: 3 x juvenile LG feeding. Kingfisher flushed.
09/07/2016	**Concert (Stone Roses) – all monitored by ecologist.** Main lake: LG nest with 3 chicks newly hatched unaffected with chicks seen feeding on pondweed during concerts. New MH nest near old LG nest at waterfall unaffected. 1 x CO. 3 x MH, 1 x MH juvenile. 56 x MA hybrid at eastern end stayed at shallow end with birds coming within 30m of the pontoon. Lower lake: 2 x juvenile LG feeding.
10/07/2016	**Separation of main pontoon and relocation of section to second crossing location – all monitored by ecologist.** Main lake: LG nest with 3 chicks newly hatched unaffected with chicks seen feeding on pondweed. New MH nest near old LG nest at waterfall unaffected. 1 x CO. 3 x MH, 1 x MH juvenile. 64 x MA hybrid at eastern end stayed at shallow end with birds coming within 30m of the pontoon during the movements. Lower lake: 2 x juvenile LG feeding.
15/07/2016	**Longitude– all monitored by ecologist.**

	Main Lake: 1 LG on nest near waterfall and another in the water in the vicinity; One MH on nest near waterfall; 3x MH and two chicks in water towards west of lake near boat house; *c*. 65x MA hybrid, 1 x CO, one Moorhen, and 2 x male H.(fighting) in tree at south end of lake Lower Lake: 2 x MS; 2x LG; 1x MH. Rookery took flight at approx. 20:30 and moved southwards from location adjacent to *cottage.*
16/07/2016	**Longitude– all monitored by ecologist.** Main Lake: 1x LG on nest near waterfall and another in the water in the vicinity; 1 x MH on nest near waterfall; *c*. 65x MA, 1x CO, 1x MH, 1x H. Lower Lake: 2x MS; 2x LG; 1 x MH.
17/07/2016	**Longitude– all monitored by ecologist.** Main Lake: 1 x MH on nest near waterfall, 1x LG on nest with fledgling near waterfall; 1 x CO and chicks. New LG nest noted west of pontoon (2 x LG present); 1x adult MA with 2x chicks west of pontoon near boathouse; 68 MA and 1x H. ar eastern end of lake. Lower Lake: 1 x MS, 1x MA.
28/07/2016	Main Lake: MO no longer occupied. 2x LG on new nest to west of pontoon location. 70x MA observed within southern part of lake. Lower Lake: 2x MS; 2x LG (1x adult, 1x juvenile).

3. MONITORING OF BATS

3.1 Scope of Monitoring

Currently there are nine species of bat known to breed in Ireland, while two other species have been recorded on a single occasion (See Table 2.)

Table 2 – Bat species in Ireland: Status and distribution

Species	Status	Distribution
Common pipistrelle *Pipistrellus pipistrellus*	Resident	Widespread
Soprano pipistrelle *Pipistrellus, pygmaeus*	Resident	Widespread
Nathusius' pipistrellus *nathusii*	Resident	Widespread
Leisler's bat *Nyctalus leisleri*	Resident	Widespread
Brown long-eared bat *Plecotus auritus*	Resident	Widespread

Whiskered bat *Myotis mystacinus*	Resident	Widespread
Natterer's bat *Myotis nattereri*	Resident	Widespread
Daubenton's bat *Myotis daubentonii*	Resident	Widespread
Lesser horseshoe bat *Rhinolophus hipposideros*	Resident	Restricted to the western seaboard
Brandt's bat *Myotis brandtii*	Vagrant	Single confirmed record from Co. Wicklow
Greater horseshoe bat *Rhinolophus ferrumequinum*	Vagrant	Single confirmed record from Co. Wexford

All species and their roost sites are strictly protected under both European and Irish legislation including:

- *Wildlife Act 1976 and Wildlife (Amendment) Act, 2000 (S.I. No. 38 of 2000)*;
- *Council Directive on the Conservation of Natural Habitats and of Wild Flora and Fauna 1992 (Council Directive 92/43/EEC)*;
- *European Communities (Birds and Natural Habitats) Regulations, 2011, S.I. 477 of 2011*.

It is an offence under Section 23 of the *Wildlife Acts 1976-2012* and under Section 51 of the *European Communities (Birds and Natural Habitats) Regulations, 2011* to kill a bat or to damage or destroy the breeding or resting place of any bat species. Under the *European Communities (Birds and Natural Habitats) Regulations* it is not necessary that the action should be deliberate for on offence to occur. This places an onus of due diligence on anyone proposing to carry out works that that might result in such damage or destruction.

Furthermore, as a signatory to the EUROBATS Agreement (Agreement on the Conservation of Populations of European Bats, 1994), Ireland is required to protect their habitats and important feeding areas from damage or disturbance. All Irish bat species are listed in Appendix II of the Bern Convention (1979), as species requiring protection.

Finally, all but two bat species in Ireland are listed as internationally important in the Irish Red Data Book (2009). Natterer's and the whiskered bat are both listed as indeterminate. In the updated red list, common, soprano and Nathusius' pipistrelle, brown long eared, Natterer's and whiskered bats are listed as "least Concern", while Leisler's bat is listed as "Near Threatened" and Brandt's bat is listed as "data deficient". (Marnell et al., 2009). The Greater Horseshoe Bat status is not yet determined in Ireland as only one record has been confirmed.

Building upon last year's surveys of bat activity before, during and after the events, studies of bats using Marlay Park were more comprehensive and standardised to allow more robust scientific analyses. The following survey types were undertaken:

1. Surveys of bridges, trees and structures to determine if bats were using them as roosts.
2. Surveys of bat activity in three fixed positions from 15th June to 28th July 2016.
3. Surveys of bat activity along four fixed walking routes around the events area before, during and after the events.

3.2 Methodology

The design of the surveys and the protocols for identification of bat calls and making impact judgements are based on the following documents:

- Bat Surveys for Professional Ecologists: Good Practice Guidelines (Collins, 2016);
- Bat Mitigation Guidelines for Ireland (Kelleher and Marnell, 2006).

3.2.1 Surveys of bridges, trees and structures.

Bridges

A visual assessment of the interior and exterior of each bridge was undertaken during daytime hours by Scott Cawley ecologists.

A full examination of each bridge was undertaken to search for the presence of bats and identify potential roost sites. Bat activity is usually detected by the following signs:

- bat droppings (these will accumulate under an established roost or under access points);
- insect remains (under feeding perches);
- oil (from fur) and urine stains;
- scratch marks;
- pupae of bat parasites such as *Nycteribia kolenatii* and
- bat corpses.

Surveys involved examination of crevices with a strong narrow-beamed torch (LED Lenser) and binoculars. In all cases the clean, square nature of the crevices allowed full exploration without the use of more invasive methods such as an endoscope.

The results were written up by hand in the field and then transferred to an Excel database.

Occupation of roosts in bridges may be very transient and one-off surveys usually have to draw cautious conclusions as to bat presence/absence. It is important to realise that all these surveys represent a snapshot of bat activity within each structure at that point in time. Experience of bat surveys of bridges has suggested that at any such time, surveys record bat presence in 10-15% of bridges that are deemed suitable for bats.

The standard approach to bridge assessments uses four simple grades to describe the presence, or likely presence of bats. It follows Billington and Norman (1997) and has been used by Shiel (1999) and other bat workers in surveys of river bridges in Cork, Sligo, Longford, Leitrim, Laois and Offaly.

Grade 0 = no potential for bats.

These are bridges where there are no opportunities for bats to roost in crevices or under mats of dense ivy. Modern concrete bridges and masonry bridges that have been well-pointed often fall under this category.

Grade 1 = crevices possibly of use to bats.

These are bridges that have small and a limited number of crevices that maybe sub-optimal perhaps due to dampness or localised disturbance. The possibility that bats could use these crevices cannot be entirely ruled out but is regarded to be low.

Grade 2 = ideal crevices but no bats.
These are generally more substantial crevices, often more than 150mm deep, dry and sheltered that offer good roosting opportunities. No evidence for bats is confirmed. The possibility that bats could use these crevices is regarded to be likely.

Grade 3 = evidence of bats.
Bats are seen *in situ* or their droppings or other field signs are seen.

Buildings

The daytime building inspection involved a full examination of the internal and external areas of the structure in order to search for the presence of bats and identify potential roost sites. Bat activity is usually detected by the following signs:

- Bat droppings (these will accumulate under an established roost or under access points)
- Insect remains (under feeding perches)
- Oil (from fur) and urine stains
- Scratch marks
- Bat corpses

Four of the locations deemed to be suitable for bats were then surveyed at dusk and dawn and then a repeat survey carried out at dawn to determine if they were being used by bats. These included:

- Farm yard buildings (currently the DLRCC depot for the Park);
- Gate Lodge at Ballinteer Avenue;
- Lodge near western gate; and
- Toilet Block.

Trees

20 no. deciduous and coniferous trees within the Park that were scheduled for removal due to their dangerous condition were assessed for their potential as bat roosts. The suitability of each tree to support roosting bat was classified using the categories outlined in Collins (2016).

The trees were surveyed at ground level 6th April February 2016 by Paul Scott BSc., MSc., CIEEM, Colm Clarke, Caroline Kelly., and Kate Bismilla of Scott Cawley Ltd. Due to the lack of access to survey at height a conservative approach was adopted to the classification of trees.

The focus of the visual assessment was to identify trees with potential bat roost features or evidence of bats such as crevices, cavities, staining around holes or droppings. The *Bat Tree Habitat Key (2013)* was used to help identify potential bat roost features. An endoscope was used to identify potential roost features under licence DER/BAT -2016-09 on 6th April 2016. Trees with potential bat roost features were assessed to have potential for roosting bats.

3.2.2 **Surveys of bat activity.**

Static bat detectors

Three static bat detectors were deployed in the park to record bat activity from 15th June until 28th July 2016. Locations for detectors was chosen on the basis of habitat suitability for foraging bats (i.e. within woodland or at the edge of a woodland), and relationship with the concerts within the park. The locations of the static detectors are illustrated in Figure 1. Static detector locations were as follows:

1. East Woods – An SMZC static detector was deployed approximately 3m above the ground on a Holly tree within a clearing. This area was heavily utilised by concert-goers as a causeway between the main stage to the east and a smaller stage to the west;
2. Lakeside – An Anabat, and later a SongMeter2 bat detector were deployed 2m above ground level amongst trees at the edge of the main lake. This detector was within 100m of a secondary stage at Laurelmere Cottage; and,
3. Control – An SMZC static detector was deployed 3m high on a tree adjacent to a stream in an area of woodland south of the main lake. This was determined to be outside of the main zone of influence of the concerts

In order to assess whether there was a significant difference between static detectors deployed in the East Woods and the South Woods (Control), the total bat index for each location was compared using statistical analyses (two-tailed t-test). The data from the Lakeside static was not considered to be comparable with that from the other statics due to the use of different detector models.

Data from the survey period was further interrogated to compare levels of activity between nights before, during and after the concerts in Marlay Park. For this, the following data from each static detector was organised/utilised:

- "Pre-concert" – Data included in this category included the 10 nights between 28th June and 7th July 2016 inclusive;
- "Concert" – Data included in this category included the 10 nights between 8th July and 17th July 2016 inclusive; and,
- "Post-concert" – Data included in this category included the 10 nights between 18th July and 27th July 2016 inclusive.

Comparisons were tested for significance between each of these subcategories using a two-tailed t-test assuming equal variance, in the case of data from the East Woods and Lakeside, and a two-tailed t-test assuming unequal variance in the case of the Control static.

Manual bat detector surveys (walked transects)

Manual transect surveys were undertaken along three routes within the park. The routes are illustrated in Figure 1, and comprise the following:

1. East Woods – A 1km route beginning at the duck pond adjacent to the Grange Road car park in the north of the park, moving southwards past the lower lake, and skirting the main lake before ending in woods just west of the dog circuit in the southern part of the park;;
2. West Woods – An 800m route beginning just south of Marlay House, running though woods past Laurelmere and the main lake, before ending just south of the main lake; and,
3. Car Parks – A 700m route beginning south of the entrance to the model train track, running west to the western boundary of the park, skirting this boundary and that of the current playground before ending at the off-ramp to the College Road car park.

Surveys commenced 30 minutes after sunset, and were walked at a slow and steady pace (less than 3km/hour). The transects were undertaken by Paul Scott MCIEEM, Róisín Nig Fhloinn MCIEEM, Kate-

Marie O'Connor ACIEEM, Kate Bismilla and Colm Clarke, all of whom have previous experience undertaking bat surveys with Scott Cawley. Surveyors used Elekon Batlogger M detectors, which record bat calls in addition to GPS information and temperature data. Timing of surveys, along with weather data for survey dates and the model of detector used along each transect are presented in Table 3.

Table 3 – Details of transect surveys undertaken at Marlay Park

Survey Date	Sunset Time	Transect Walked	Start	Finish	Surveyor	Bat Detector	Temperature (degrees Celsius)
04/07/2016	21:52	East Woods	22:22	22:47	Colm Clarke	Batlogger 2486(M)	14-15C
04/07/2016	21:52	West Woods	22:22	22:47	Paul Scott	Batlogger 2578(M)	14-15C
04/07/2016	21:52	Car Parks	22:50	23:10	Paul Scott	Batlogger 2578(M)	14-15C
08/07/2016	21:50	East Woods	22:20	22:45	Paul Scott	Batlogger 2486(M)	18C
08/07/2016	21:50	West Woods	22:20	22:45	Kate Bismilla	Batlogger 2578(M)	17-18C
08/07/2016	21:50	Car Parks	22:50	23:10	Kate Bismilla	Batlogger 2578(M)	17C
09/07/2016	21:49	East Woods	22:19	23:10	Paul Scott	Batlogger 2486(M)	17-18C
09/07/2016	21:49	West Woods	22:19	22:48	Kate Bismilla	Batlogger 2578(M)	17-18C
09/07/2016	21:49	Car Parks	22:50	23:10	Kate Bismilla	Batlogger 2578(M)	16-17C
15/07/2016	21:43	East Woods	22:13	22:55	Róisín Nig Fhloinn	Batlogger 2486(M)	20-21C
15/07/2016	21:43	West Woods	22:13	22:35	Colm Clarke	Batlogger 2578(M)	20-21C
15/07/2016	21:43	Car Parks	22:40	22:55	Colm Clarke	Batlogger 2578(M)	20-21C
16/07/2016	21:42	East Woods	22:12	23:05	Róisín Nig Fhloinn	Batlogger 2486(M)	15-17C
16/07/2016	21:42	West Woods	22:15	22:40	Kate-Marie O'Connor	Batlogger 2578(M)	15-16C
16/07/2016	21:42	Car Parks	22:45	23:50	Kate-Marie O'Connor	Batlogger 2578(M)	15-16C
17/07/2016	21:41	East Woods	22:13	22:50	Colm Clarke	Batlogger 2486(M)	20-21C
17/07/2016	21:41	West Woods	22:15	22:40	Kate-Marie O'Connor	Batlogger 2578(M)	19-20C
17/07/2016	21:41	Car Parks	22:40	23:00	Kate-Marie O'Connor	Batlogger 2578(M)	20C
28/07/2016	21:25	East Woods	21:55	22:15	Colm Clarke	Batlogger 2486(M)	18-19C
28/07/2016	21:25	West Woods	21:55	22:15	Paul Scott	Batlogger 2578(M)	17-18C
28/07/2016	21:25	Car Parks	22:20	22:40	Paul Scott	Batlogger 2578(M)	17C
01/09/2016	20:12	East Woods	20:40	21:00	Paul Scott	Batlogger 2486(M)	17C
01/09/2016	20:45	West Woods	21:05	21:20	Paul Scott	Batlogger 2486(M)	17-18C
01/09/2016	20:05	Car Parks	21:20	21:30	Paul Scott	Batlogger 2486(M)	16-18C

3.3 Results of Bat Monitoring Surveys

3.3.1 Bridge Surveys

Bridges that cross the two watercourses that flow through the Park were examined where safely accessible. Only two bridges were rated as *Grade 2 = ideal crevices* but no bats or roosts were recorded. Two bridges (8a and 9) were also surveyed at night to determine if bats were using them on June 21st using infra red cameras to record bats even when it was dark but no bats were detected.

Some bridges were in a state of disrepair with gaps in mortar and missing stones offered good potential for bats but no bats were found *in situ* and no evidence for use by bats was confirmed. Nevertheless, some of the stone bridges were highlighted as offering the best roosting opportunities for bat alongside trees in the Park.

Appendix A presents the full results of the surveys.

Plate 4: Bridge with crevices suitable for bats.

3.3.2 Building Surveys

Daytime building inspections were carried out on June 15th 2016 by Paul Scott CEnv, MCIEEM and Kate Bismilla. Internal (where possible) and external areas of the following buildings were examined for signs of use by bats or for suitability for bats:

- Farm yard buildings (currently the DLRCC depot for the Park);
- Laurelmere Cottage (external only)
- Walled Garden Sheds
- Gate Lodge at Ballinteer Avenue (external only);
- Lodge near western gate; and
- Toilet Block.

These structures were selected based on their location and building type which, combined, were deemed to offer the best suitability for bats. Particular attention was paid to buildings close to the area of the outdoor events such as the Laurelmere Cottage and Farm Yard. The Marlay House and courtyard were not re-surveyed after surveys in 2015 did not record bats using the structures.

Four of the locations deemed to be suitable for bats were then surveyed at dusk and dawn and then a repeat survey carried out at dawn to determine if they were being used by bats. These included:

- Farm yard buildings;
- Gate Lodge at Ballinteer Avenue;
- Lodge near western gate; and
- Toilet Block.

The results in full are presented in Appendix B and are summarised below.

The Farm Yard buildings, Toilet Block, Gate Lodge near the western gate and Laurelmere Cottage were deemed to be highly suitable for bats but strong security floodlighting (Plates 5 and 6) may deter bats from using some of these structures despite being recorded nearby. Recommendations have been made as to how these structures can be improved so as to provide suitable roosting opportunities.

Plate 5: *Security Lighting at Farm Yard buildings*

Plate 6: Security Lighting at Farm Yard buildings.

3.3.3 Tree Surveys

The full results of the tree surveys are included in Appendix C.

No bats were found in the trees upon inspection.

Eleven trees out of the 20 surveyed were regarded to offer features suitable for bats. Prior to the events in summer 2016 two of these trees were felled under the terms of a derogation licence ref DER-BAT-2016-34 (since been extended to cover felling into 2017 as required).

3.4 Bat Activity Surveys

Two different types of surveys were undertaken to record the diversity of bat species using the Park and to record their foraging and flight activities. These comprised use of unattended static bat detectors and walked transects. The locations of the surveys are shown overleaf in Figure 1.

Static Bat Detectors
Three static monitoring locations were used to record bat activity each night from 15th June to 28th July 2016. Two of these were placed in areas within the zone of influence of the outdoor events, near the edge of the main lake and in the woods near a crossing point used during the Longitude festival. The third static monitoring location was in the woodland area near the stream to the south of the event area near the "Fairy tree".


West Woods
East Woods
East Woods
Lakeside
Car Park
Control
Figure 1: Survey Area
Marlay Park Concerts
Dún Laoghaire-Rathdown CoCo
160046
1:200,000 @ A4
CC
PS
00
13/10/2016
scott cawley
Legend
Static Detector
Transect
Marlay Park
N

These detectors monitored bat activity each night from prior to the setting up of the event infrastructure during the concerts themselves and then until the end of July after all the event infrastructure had been removed.

Bat activity was measured as a bat activity index or "passes" per hour. This does not relate to numbers of individual bats.

Bat species recorded by this survey method included Common and Soprano Pipistrelle bats, Leisler's bats, Brown Long-eared bats, Daubenton's bats, Natterer's bats and unidentified bats of the Myotis genus- which are known to be difficult to distinguish.

The full results of the static bat detector surveys are presented in Appendix D and are summarised below.

- Over 3400 recordings of bats using the three recording locations were made and analysed as part of the studies.

- The bat activity during the entire period was higher at the "east woods" location than the south woods (control) and was dominated by Pipistrelle bats and Leisler's bats.

- Bat activity at the "lakeside" location was low over the entire survey period although the habitat was deemed to be suitable for foraging. The low level of usage by bats was corroborated by direct observation made during the walked surveys as very few bats were noted in this location.

- At the "east woods" location, the mean bat activity index prior to the events was 4.88 passes/hour which fell to 3.95 over the period of the events and then rose to 12.22 passes/hour. After analysing the patterns during this period it was determined that there was no statistically significant levels of variation noted over the period. However there was no activity recorded at this location during the Longitude festival. Whilst the Longitude festival included lighting and pedestrians in this location, bats were still recorded in this area during the walked transects suggesting that the detector may have not accurately recorded all activity in the general area or that signals of bats were masked from the microphone.

- At the "lakeside" location, mean activity levels were much lower with 0.96 passes/hour which then fell to zero calls over the concert period and then back to 0.45 passes/hour. Similarly, the analyses of the activity determined that there was no statistically significant levels of variation noted over the period.

- At the "south woods" or "control" location – where it was assumed that there would be no perceptible change in light or noise environment as a result of the events, the mean activity levels prior to the events was 0.9 passes/hour which reduced to 0.6 passes/hour during the events and then increased to 1.14 passes/hour after the events. No comparisons of pre, during and post event activity were deemed to be statistically significant.

Figure 2 – Bat activity before (1), during (2), and after (3), concerts at the East Woods Static Detector. Average values are marked in red.

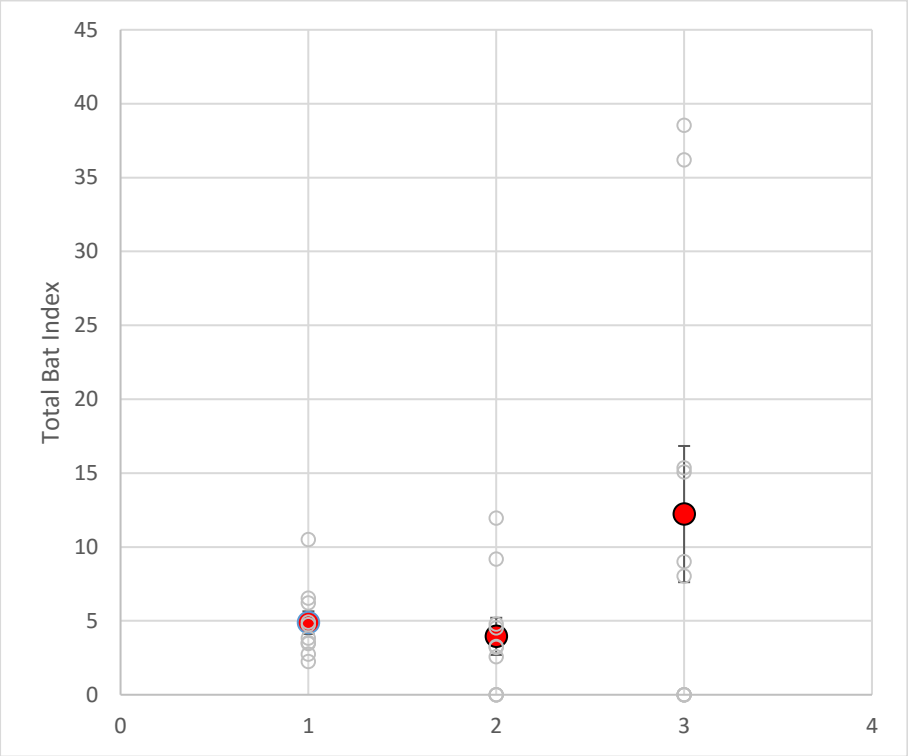


Figure 3- Bat activity levels before (1), during (2), and after (3), concerts at the Lakeside Static Detector. Average values are marked in red

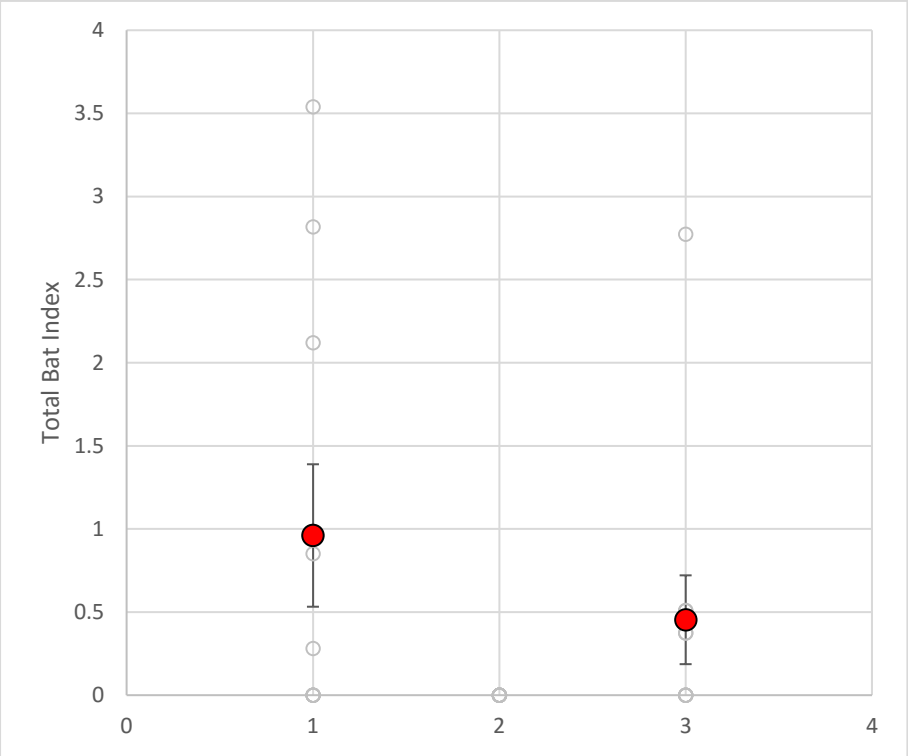
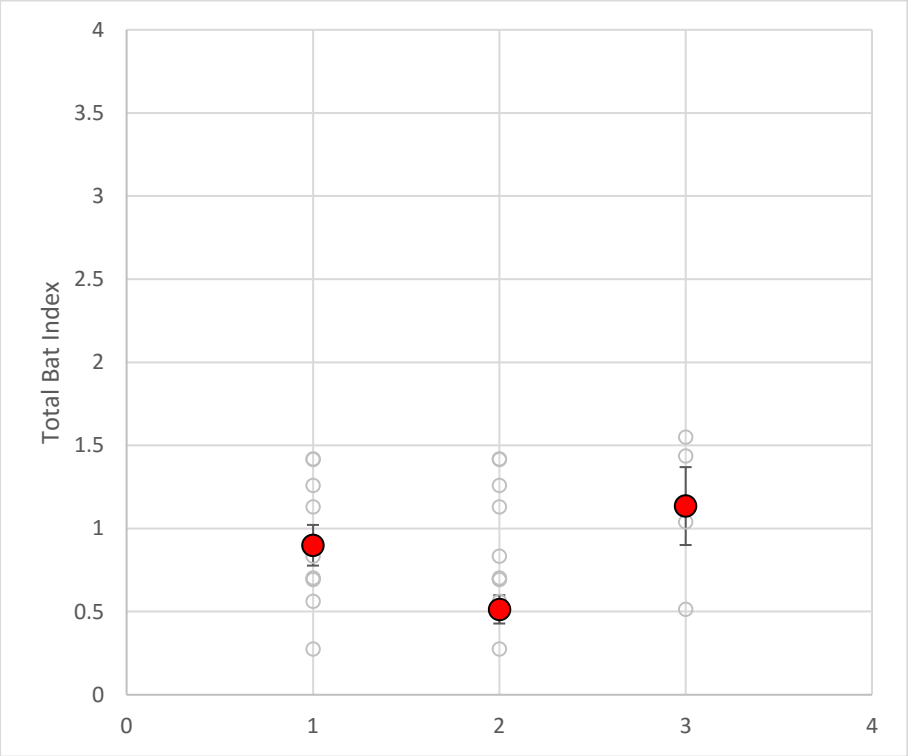


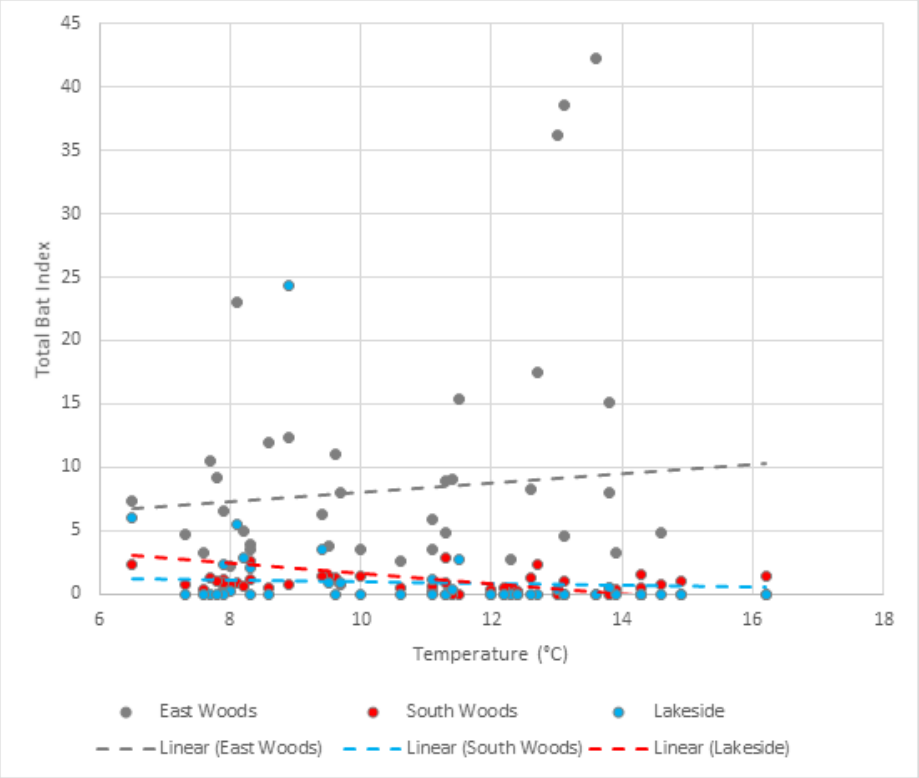
Figure 4 - Bat activity levels before (1), during (2), and after (3), concerts at the South Woods Static Detector. Average values are marked in red.



These results would suggest that whilst there was a depreciation in bat activity levels during the concert period (7th-17thJuly) not only was this not statistically significant but there was a noticeable increase in bat activity in late July.

Figure 5 shows the relationship between temperature and bat activity index which was investigated via linear regression to show if there was a relationship between the two factors. As can be seen below, the level of bat activity was not related and the trendlines shown have a weak association with the spread of values:

Figure 5 - Bat activity levels compared to Temperature.



Walking transects

The static detectors recorded bat activity within a relatively small[1] monitoring area over a long period of time. It was also important to employ a methodology that could record foraging bats across larger areas of the Park in a systematic manner.

Manual bat activity surveys were carried out along three fixed walking routes (transects) using a standardised approach that traversed the perimeter of the event site and the car parking areas. By recording and comparing bat activity along these same routes before, during and after the events it was possible to draw conclusions as to the evidence for any changes attributable to the events.

Maps showing the density of bat calls at a location are illustrated for the transect surveys in Figures 6-9. Records of the transect results and call analyses are included in Appendix E.

The three transects recorded the same six species as the fixed monitoring locations. The two Pipistrelle bat species and Leisler's bats were recorded widespread along each of the transects. Daubenton's bats were recorded on the lower lake and the Main Lake whilst Brown long-eared and Natterer's bats were recorded close to the Main Lake. The results of the transects are summarised below:

- The results of the transects along the "eastwoods" route prior to the events in early July 2016 recorded Soprano Pipistrelle bat and Brown Long Eared bats species with a total of 7 bat passes on 5th July. No bat passes were recorded on the night before- demonstrating the variability of usage of this area. During the events on the 8th and 9th July, species recorded included Soprano and Common Pipistrelle bat, Leisler's bats and Daubenton's bats with a total of 15 passes on the 8th and 36 passes on the 9th July. During the Longitude festival events on the 15, 16th and 17th July species included the same five species as on the previous weekend species but a much higher level

[1] The detection range varies with species: 50m for Leisler's bats down to 10m for Brown long-eared bats.

of bat passes recorded over the transect period (108, 33 and 18 passes on each night respectively). The post-event transects undertaken after the events on 28th July 2016 recorded included Common Pipistrelle Leisler's bats, Daubenton's bats, Natterer's bats and Brown Long eared bats with a total of 43 bat passes. The final transect undertaken on this route on 1st September recorded Common and Soprano Pipistrelle, Leisler's bats and Daubenton's bats. Bats were recorded on all of the nights when events were being held and there was no evidence of bats being displaced from areas where they had been recorded previously.

- The results of the transects along the "westwoods" route prior to the events in early July 2016 recorded Soprano Pipistrelle bat, Leisler's bats and Daubenton's bats species with a total of 17 bat passes on 4th July and similar patterns on the following night. During the events on the 8th and 9th July, the same species were recorded at similar levels of activity. Slightly lower levels of bat activity were recorded over the Longitude festival but species included Soprano and Common Pipistrelle bat, Leisler's bats and Daubenton's bats. The post-event transects undertaken after the events on 28th July and 1st September were higher (34 and 42 passes respectively) and included Common Pipistrelle Leisler's bats, Daubenton's bats and Brown long-eared bats. Bats were recorded on all of the nights when events were being held and there was no evidence of bats being displaced from areas where they had been recorded previously.

- The results of the transects along the "car park" route prior to the events in early July 2016 recorded Soprano and Common Pipistrelle bats, Leisler's bats, Daubenton's bats and Natterer's with a total of 9 bat passes on each of the two pre-event surveys. During the events on the 8th and 9th July, species recorded included Soprano and Common Pipistrelle bat and Leisler's bats with a total of 12 passes on the 8th and 65 passes on the 9th July. During the Longitude festival events on the 15, 16th and 17th July species included the Soprano and Common Pipistrelle bats, Leisler's bats, Daubenton's bats and Natterer's bats (65, 17 and 18 passes on each night respectively). The post-event transects undertaken after the events on 28th July 2016 recorded included Common and Soprano Pipistrelle and Leisler's bats with a total of 38 bat passes. The final transect undertaken on this route on 1st September recorded Common Pipistrelle bats.

Figure 6: Pre-event Bat activity.

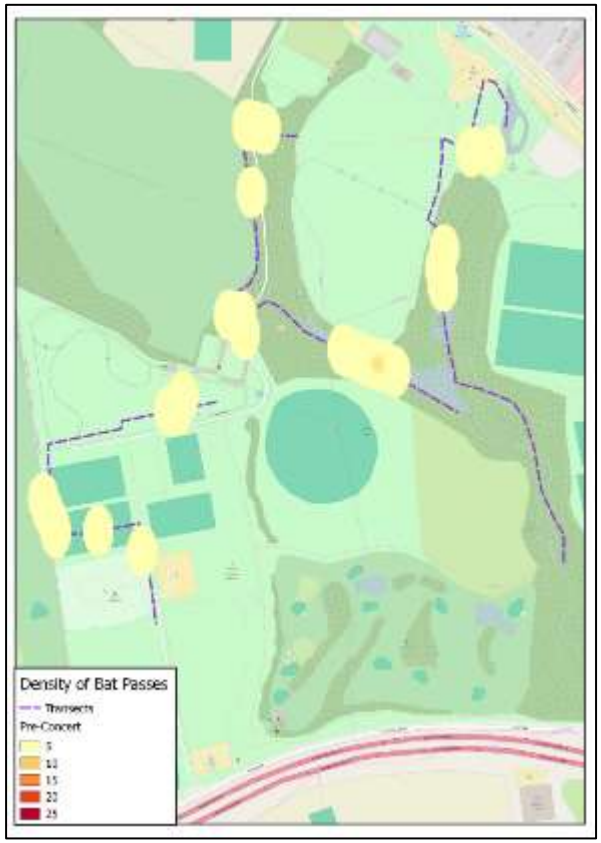


Figure 7: Bat Activity 8-9th July Events

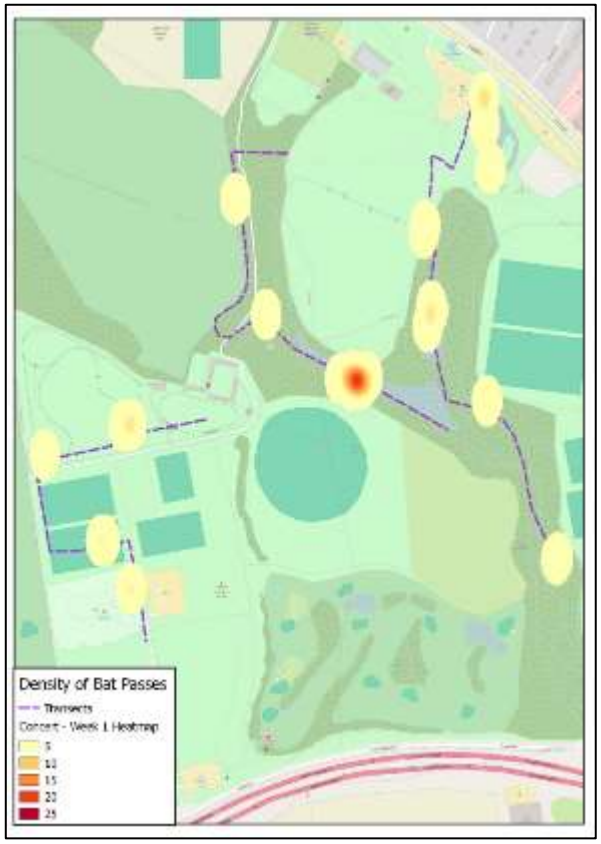
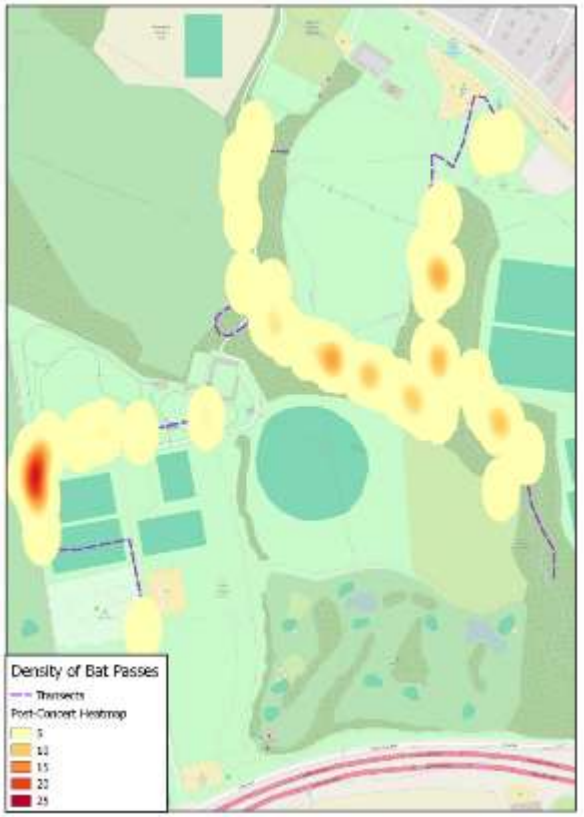


Figure 8: Bat Activity 15th-17th July Events

Figure 9: Bat Activity post-event



Visual observation of bats during the events was important data to collect, as “bat passes” is not an indication of numbers of bats or what they are doing. In the case of the “eastwoods” transect it was repeatedly noted that small numbers (1-2) of Pipistrelle bats were consistently found around the pond closest to the Grange Road whilst Daubenton’s bats and Brown Long eared bats were recorded on several nights crossing the path flying toward the lower lake. At the “westwoods” transect, Daubenton’s Bat activity was consistently recorded along the main lake east of the boathouse and in the case of the “Car Parks” transect a hotspot for Pipistrelle activity was located along the hedgerow separating Marlay Park from the Grange Golf Club. The latter hotspot generally consisted of two to three Pipistrelle (both Common and Soprano) foraging parallel to the hedgerow. Bat passes in this specific area were relatively high but do not reflect higher densities of bats.

On the night of the 9th July 2016, Daubenton’s bats using the main pond were recorded using infra-red illumination and a Sony DVR video camera using Nightshot function. This footage can be found on youtube using the link https://youtu.be/ZigBfL-bLqE . Echolocation calls from Daubenton’s bats can be clearly heard and bats can be seen flying within up to 10m from the pontoon despite large crowds passing over the bridge. The camera was positioned approx 20m from the pontoon. All footage was taken under photography licence from the National Parks and Wildlife Service permitting the use of non-intrusive infra-red illumination. Other bats including Leisler’s and Pipistrelle bats can be heard on the detector near the end.

After the events finished on the nights of 8th and 9th July, a small number (1-2) of Leisler’s bats were noted feeding above the main stage canopy, presumably on the insects attracted by the lighting.

It was concluded from the results of the detector surveys and based on statistical testing of data that the events were not resulting in any perceptible displacement of bats from suitable foraging habitats within the park. This is supported by findings from the transect surveys where there was no clear reduction in bat activity on the nights of the concerts.

Plate 7: Area of illumination from Pontoon

3.5 Bat Sampling

The final set of surveys for bats were carried out in late August and aimed to record the post-event activity using detectors but also to sample the local bat population to determine the age, sex and species of bats using the Park. Two nights of sampling using mist net and harp trap (under Section 35 Wildlife Act licence from the National Parks and Wildlife Service Ref 026/2016) took place and recorded adult and juvenile Soprano Pipistrelle bats, Leisler's bats, Daubenton's bats and a single Whiskered bat. The latter species has not been recorded in the Park before and brings the tally of species using the Park to seven out of the nine Irish resident species. The only two species that have not been recorded are the Lesser horseshoe bat (found only in the west of Ireland) and the Nathusius' Pipistrelle bat, which has not been recorded in the locality but has been found occasionally in Co. Dublin.

Plate 8: Whiskered bat

4. SUPERVISION AND MONITORING PRIOR TO AND DURING INSTALLATION/REMOVAL OF EVENT INFRASTRUCTURE

Scott Cawley Ecologists were involved in carrying out the following supervision/monitoring prior to and during the events in 2016:

- Pre-event meeting with Festival Republic and DLRCC staff to discuss lighting, pontoon installation and access.
- Checking of light spill after installation of lighting at pontoon and adjustment of lighting.
- Monitoring of pontoon installation and re location for Longitude weekend to ensure no breeding birds or nests were disturbed.
- Checks of barriers in streams to ensure free passage of otters and badgers.

Plate 9: Adjustment of lighting at pontoon.

Plate 10: Monitoring of installation of Pontoon

There was no evidence that birds were adversely affected by the events in 2016. Indicators such as successful breeding, sustained use of nesting sites and maintenance of diversity of species were upheld during and after the events. It is likely that the breeding population are habituated to human disturbance and able to tolerate short periods of disturbance. The timing of the events late in the breeding season of most birds is also likely to be factor in the avoidance of adverse impacts at a population scale.

5. SURVEYS FOR OTTERS AND BADGERS

5.1 Survey Methodology

The surveys of the bridges in the Park noted field signs of otters (spraints) in several locations mainly in the north-eastern quarter. Subsequent discussion with the National Parks and Wildlife Service following the bridge surveys led to dedicated otter and badger surveys being undertaken in mid-June 2016.

Camera traps were deployed at two locations within the park where otter spraints were observed during pre-concert ecological surveys. The locations were:

1. Under concrete bridge approximately 50m east of the East Woods static detector; and,
2. Under a bridge separating the upper and lower lakes.

Cameras were deployed from 28th June and were collected on 15th August 2016. Footage from cameras was reviewed by an ecologist for activity, and results tabulated.

Manual searches for badger setts and paths were undertaken on 28th June and 4th July 2016 by Paul Scott. The lands covered by the survey includes the 3-par golf course to the south as well as all accessible lands within the Park.

5.2 Survey Results

Otters were recorded on motion-activated camera no. 2 on eight occasions. Only one sighting was recorded on 4th July prior to the events and the remainder was concentrated between 25th July and 10th August 2016, with otters recorded twice on 1st August and 9th August. No activity was recorded on camera no. 1.

Otter(s) appeared to visit the camera location to mark territory. No otter holts were recorded in the area although the presence of a holt in the dense vegetation in inaccessible areas of the park in the south east quarter cannot be ruled out.

Table 4: Results of camera monitoring

Date	Time	Location	Observation
25/07/2016	04:11	Bridge between Upper and Lower Lake	Swimming under bridge
01/08/2016	05:27	Bridge between Upper and Lower Lake	Swimming from rocks to outside of field of vision. V. brief footage of animal
01/08/2016	06:35	Bridge between Upper and Lower Lake	Circling between rocks and camera under bridge
03/08/2016	03:38	Bridge between Upper and Lower Lake	Swims from camera towards rocks in background, stops and scratches head
09/08/2016	04:31	Bridge between Upper and Lower Lake	Sprainting on rock in front of camera
09/08/2016	22:59	Bridge between Upper and Lower Lake	Circling and potentially sprainting on rock in front of camera, swims back towards camera
10/08/2016	01:39	Bridge between Upper and Lower Lake	Potentially sprainting adjacent to camera, before swimming back towards lower lake

Plate 11: Otter entering water after sprainting (scent marking) stone in centre of picture.

Plate 12: Otter Spraint

Badger setts were found located in three locations although only one sett showed any evidence of recent activity.
The locations of the setts are not being disclosed in this Report to protect them from disturbance.

Badgers and their setts are legally protected under the Wildlife Act 1976 as amended. None of the setts were regarded to be within the disturbance zone of the proposed works and the main sett was noted to be in excess of 80m from the event area and not subject to disturbance. Badgers were not encountered on any of the surveys and no feeding signs were noted in the events areas. Therefore it was unlikely that the events were causing loss of foraging or direct disturbance.

Plate 13: Badger sett entrance

6. CONCLUSIONS

The following conclusions have been drawn based on the scientific data collected prior to, during and following the events:

a) Marlay Park is used by several protected fauna species *some* of which are not commonly recorded in the surrounding area and are rare at a County-geographic scale.

b) None of the surveys that were carried out provided scientific data that would suggest a significant adverse impact to any of these species of note at the level of the local population.

c) Breeding waterfowl and foraging bats in particular showed remarkable tolerance to noise and lighting and increased human presence during the events.

d) Whilst there may be impacts at the individual scale (e.g. bats moving to other darker locations for feeding, waterfowl moving further away from pontoons) during the events, these impacts are of short duration and highly localised –i.e. bats and birds do not leave the Park but temporarily re-orient themselves and then quickly return to their previous orientation when the stimulus is removed.

e) The diversity of bird and mammal species using the Park (including some disturbance-sensitive species) would also suggest that there are unlikely to be long-term impacts, although the absence of long-term scientific data means that conclusions on the long-term impacts cannot be made with absolute confidence.

7. RECOMMENDATIONS

7.1 Event Management, Supervision and Monitoring

The following recommendations are made regarding ecological supervision and monitoring:

- Ecologist should ensure that breeding bird checks are undertaken at least twice in the 3 weeks prior to the installation of the pontoon;
- Ecologist should be on site to supervise/monitor the installation, relocation and removal of the pontoons;
- Ecologist to inspect floodlighting orientation and liase with organisers to re-orient luminaires if required;
- Ecologist to carry out pre- and during-event manual transects of bat activity to determine if bats are using the same areas as before- this will inform further lighting changes if required.
- Lighting in the woodland during future events will also be checked and adjusted where necessary.
- Any further expansion of the events should be in open grassed areas rather than woodland to minimise need to fell trees or erect safety lighting close to previously undisturbed areas.
- All barriers erected in the streams to prevent unauthorised entry need to be passable for otters and will be inspected by the ecologist;

- No works within 50m of the main badger sett will be permitted checks will be undertaken in 2017 to verify that no new setts or holts are present.

7.2 Ecological Management and Enhancement

The following recommendations are made regarding taking steps to enhance the biodiversity resources in Marlay Park:

- Carry out proposed lake management including phased removal of aquatic macrophytes outside of the bird breeding season;
- Carry out litter removal in the Lakes in February and September;
- Erect another 20 bat boxes over the next 2 years to enhance roosting opportunities (all of the species recorded will use bat boxes);
- Monitor bat box usage of the 6 boxes erected in 2016 (Plate 14-15) in March and August 2016 and then every year thereafter;
- Consider radiotracking and/or ringing bats using the Park to determine population data and identify roosts for the rarer species of bats such as Whiskered Bats;
- Consider signs, leaflets, website etc to educate visitors, children and other users of the Park;
- Consider integration of bat friendly measures in future renovation and repair of structures;
- Implement Bridge Repair and Tree Felling protocols – see Appendix G and H:

Plates 14-15 Bat Boxes erected in 2016 as per recommendations.

8. References

Andrews, H., *et. al.,* (2013). *Bat Tree Habitat Key 2nd edition. AEcol, Bridgwater, UK.*

Billington, G.E. and Norman, G.M. (1997*) The Conservation of Bats in Bridges Project - A report on the survey and conservation of bat roosts in bridges in Cumbria.*

Kelleher, C. & Marnell, F*. (2006)* Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Keeley, B. (2007) *Bats and Bridges: An Evaluation of Selected Bridges in Laois and Offaly*. Laois County Council

McAney, K. (1992) *Bats and Bridges, A report on the importance of bridges to bats.* NPWS, Dublin.

Shiel C. (1999) Bridge usage by Bats in County Leitrim and County Sligo. Heritage Council.

Appendix A: Results of Bridge Inspections.

Bridge Number	Description	Bat Roost Category	Crevices	Veg/Ivy suitable for roosting bats?	Recommendation
BH-28 – Bridge number 1	The river exits from the Marlay demesne via a bridge that carries Grange Road. The full extent of this bridge was not investigated for this study, inspection being confined to a view of the southern face of the bridge. The deeper interior of the culvert was unsafe to enter but appeared to be filled with branches and debris washed down the stream.  	0/ unknown	Mostly fully sealed as far as could be seen at the entrance.	Not dense enough but suitable for breeding birds.	Clearance of debris and inspection of stonework. Very suitable for erection of bat tubes for Duabenton's bats.
BH-29 – Bridge number 2	Single-arched bridge with voussoirs of rock-faced granite. 	0	Mostly fully sealed.	No	None.
BH-30 – Bridge number 3	Single-arched bridge of mass concrete faced with granite.	0	Mostly fully sealed.	No	None.

Bridge Number	Description	Bat Roost Category	Crevices	Veg/Ivy suitable for roosting bats?	Recommendation
					
BH-31 – Bridge number 4	Single-arched bridge of granite; barrel of arch is plank-centred and has a significant amount of concrete. 	0	Mostly fully sealed.	No	None.
BH-32 – Bridge number 5	Beam bridge of steel and timber with tubular-steel balustrades. 	0	No suitable crevices. Otter spraints found.	No	None.
BH-33 – Bridge number 6	Single-segmental-arched bridge of red and buff-coloured brick.	0	No suitable crevices. Otter spraints found.	No	None.

Bridge Number	Description	Bat Roost Category	Crevices	Veg/Ivy suitable for roosting bats?	Recommendation
					
BH-34 – Bridge number 7	Single-arched bridge of granite; arch ring is of roughly-squared granite, while spandrels, abutments and the barrel of the arch are of rubble granite. 	0	Mostly fully sealed.	No	None.
BH-35 – Bridge number 8	Single-arched bridge with elliptical brick arch. 	1	Some small crevices and voids at edge of arch.	No	Maintain checks.
BH-35a – Bridge number 8a	Single-arched bridge with elliptical brick arch.	2	Large cracks and voids in barrel. Some subsidence and collapse of stone on northern end.	No	Maintain checks. This bridge has the highest potential for bats.

Bridge Number	Description	Bat Roost Category	Crevices	Veg/Ivy suitable for roosting bats?	Recommendation
	  				
BH-36 – Bridge number 9	Single-arched rustic bridge with irregular arch of large granite stones and similarly large irregular stones in spandrels and abutments.  	2	Large cracks and voids in barrel. Most too large and open for bats.	No. Breeding bird evidence in voids.	Maintain checks.
BH-37 – Bridge number 10	Single-arched bridge with shallow segmental arch. Abutments are of granite rubble, span is of steel and parapets are timber railings. 	0	None	No	None
BH-38 – Bridge number 11	Single-arched bridge with segmental arch of roughly-squared granite voussoirs and with dropped keystone.	0	Mostly fully sealed.	No	None.

Bridge Number	Description	Bat Roost Category	Crevices	Veg/Ivy suitable for roosting bats?	Recommendation
					
BH-39 – Bridge number 12	Single-arched bridge with three-centred shallow segmental brick arch. 	2	Some small crevices and voids under barrel.	No	Maintain checks.
BH-40 – Bridge number 13	Single-arched bridge with segmental granite arch with prominent granite keystone with carved motif. 	1	Some small crevices and voids under barrel.	No	Maintain checks.
BH-41 – Bridge number 14	Single-arched bridge with segmental granite arch and prominent carved granite keystone.	2	Some small crevices and voids under barrel.	No	Maintain checks.

Bridge Number	Description	Bat Roost Category	Crevices	Veg/Ivy suitable for roosting bats?	Recommendation
					
BH-42 – Bridge number 15	Inaccessible for survey. 	-	-	-	-
BH-43 – Bridge number 16	Single-span bridge with segmental steel arch. Parapets are timber fences. 	0	None	No	None
BH-44 – Bridge number 17	Steel beam bridge with timber deck and tubular steel rails.	Steel beam bridge with timber deck and tubular steel rails.			

Bridge Number	Description	Bat Roost Category	Crevices	Veg/Ivy suitable for roosting bats?	Recommendation
					
BH-45 – Bridge number 18	Semi-buried tunnel 	1	Potentially useful for bats but no crevices of note.	No	Maintain checks.
BH-46 – Bridge numbers 19 to 21	Three steel beam bridges with timber decks and tubular steel rails. The bridges cross the ha in the parkland to the south of the main house.	1	Central bridge has some crevices of potential value.	No	Maintain checks.

Appendix B: Results of Building Inspections

Structure Name and Ref	Interior survey	Exterior Survey	Dusk/Dawn	Conclusions
BH-03 - Farm yard	Many suitable loft spaces and open sheds suitable for bats but no evidence found. Occasional bird droppings but most buildings well-sealed from ingress.	Most sheds covered with natural slate or asbestos sheeting. Entry points at eaves or lifting slates	Strong floodlighting within the yard and at the main entrance gate is likely to act as a deterrent to bats. No bats recorded emerging from any structures or returning at dawn. Occasional Pipistrelle bats and Leisler's bats flying to the north.	Parks Staff report seeing bats flying in the courtyard in the past and the introduction of floodlighting may be acting as a deterrent. Replacement of lighting with lower intensity directional lights to be discussed with DLRCC staff. Numerous lower level lights may be more friendly toward bats.
BH-04 - Laurelmere Cottage	Interior not accessed.	Natural slate roof but appeared to be recently refurbished and no obvious points of entry.	Strong floodlighting at the gable end is likely to act as a deterrent to bats.	Replacement of lighting with lower intensity directional lights to be discussed with DLRCC/RIHS staff. Numerous lower level lights may be more friendly toward bats.
BH-05 - Ballinteer gate lodge	Interior not accessed.	Natural slate roof. Some potential entry points at edge of gutter.	No bats recorded emerging from any structures or returning at dawn. Occasional Pipistrelle bats and Leisler's bats flying to the north.	Residents have not encountered any bats internally or aware of any roosts.
BH-07 - Gate lodge	Interior used for storage. No signs of bats, some parts of the roof are collapsing making it less suitable for bats.	Natural slate roof. Some potential entry points at edge of gutter.	Several Soprano Pipistrelle bats flying in front of Lodge but no bats recorded emerging from any structures or returning at dawn.	Any restoration should include roost opportunities and roost access locations if possible.
BH-09 - Toilet block	Not entirely accessible but no signs of bats.	Natural slate roof and old barge boards and soffits offer good roost access.	Several Soprano and Common Pipistrelle bats and Leisler's bats flying in front of Lodge but no bats recorded emerging from any structures or returning at dawn.	Any restoration or repair works should include roost opportunities and roost access locations if possible. Repeat surveys may be worthwhile in 2017 due to the suitability of the building for bats.

Structure Name and Ref	Interior survey	Exterior Survey	Dusk/Dawn	Conclusions
Walled Garden Sheds	Not all rooms entirely accessible but no signs of bats.	Natural slate roof and old barge boards and soffits offer good roost access.	Not surveyed.	Any restoration or repair works should include roost opportunities and roost access locations if possible. Repeat surveys may be worthwhile in 2017 due to the suitability of the building for bats.

Appendix C: Results of Tree Inspections

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Pinus sylvestris	1		O 15602 26632	10-30	N	/	/	/	No PRFs noted and no birds nests noted, however a single squirrel drey was noted on the northernmost Scot's pine tree in this row	**Single Scot's pine containing squirrel drey should be left intact at northern end of stand. Remainder may be cleared**
Cupressus macrocarpa	2		O 15487 26268	30-50	N	/2	/	/	Standing dead Monterrey cypress amongst holly trees close to lower lake. No birds nests noted	**Felling can proceed without the supervision of an ecologist**

[2] Age 0-10, 10-30, 30-50, 50-100, 100+

[3] Roost Features (Bat tree Habitat Key 2013): Decay features: (1a) Woodpecker holes, (1b) Knot holes, (1c) Flush cuts, (1d) Tear outs, (1e) Double leaders, (1f) Wounds and canker, (1g) Butt rot. Damage features: (2a) Hazard beams, (2b) frost cracks, (2c) subsidence (shearing and helical splits), (2d) lightning strike, (2e) impact shatter, (2f) desiccation fissure, (2g) transverse snaps, (2h) lifting bark, (2i) unions, (2j) ivy

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
										
Cryptomeria japonica	3		O 15325 26208	Oct-30	N	/	/	/	Leaning part-dead Japanese cedar	**Lies directly underneath a rookery with active nests. Any felling or vegetation clearance should not be undertaken during bird breeding season between 1st March and 31st August. Once breeding season has finished, felling can proceed without the supervision of an ecologist**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Fs	4		O 15332 26204	50-100	N	/	/	/	Dead beech behind house in woods. No potential for bats, however there were nesting rooks in the locality, and therefore tree should not be removed	**Lies directly underneath a rookery with active nests. Any felling or vegetation clearance should not be undertaken during bird breeding season between 1st March and 31st August. Once breeding season has finished, felling can proceed without the supervision of an ecologist**
Chamaecyparis lawsoniana	5		O 15314 26210	30-50	N	/	/	/	Dead Lawson's cypress with rooks nesting in the surrounding trees	**Lies directly underneath a rookery with active nests. Any felling or vegetation clearance should not be undertaken during bird breeding season**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
										**between 1st March and 31st August or until the period of dispersal of young birds has finished (determined by ecologist).**
Fs	6		O 15454 26180	30-50	Y	2J	Entire tree	All	Dead beech north of summer cricket pitch and south of main pond	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Fs	6		O 15454 26180	30-50	Y	2h	3-15m	S	Dead beech north of summer cricket pitch and south of main pond	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Fs	6		O 15454 26180	30-50	Y	1b	3m	S	Dead beech north of summer cricket pitch and south of main pond	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Cs	7		O 15620 26149	50-100	Y	1d	5-25m	All	Standing dead sweet chestnut. Neighbouring tree (Also Cs) has hanging limb and a number of PRFs	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Cs	7		O 15620 26149	50-100	Y	1c	5-25m	All	Standing dead sweet chestnut. Neighbouring tree (Also Cs) has hanging limb and a number of PRFs	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Cs	7		O 15620 26149	50-100	Y	2g	5-25m	All	Standing dead sweet chestnut. Neighbouring tree (Also Cs) has hanging limb and a number of PRFs	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Cs	7		O 15620 26149	50-100	Y	2h	5-25m	All	Standing dead sweet chestnut. Neighbouring tree (Also Cs) has hanging limb and a number of PRFs	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Pinus sylvestris	8		O 15710 26097	50-100	Y	1b	3-15m	All	Standing dead Scot's pine tree between path and stream. Dense holly immediately beneath	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Pinus sylvestris	8		O 15710 26097	50-100	Y	1d	3-15m	All	Standing dead Scot's pine tree between path and stream. Dense holly immediately beneath	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Pinus sylvestris	8		O 15710 26097	50-100	Y	1g	3-15m	All	Standing dead Scot's pine tree between path and stream. Dense holly immediately beneath	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Pinus sylvestris	8		O 15710 26097	50-100	Y	2h	3-15m	All	Standing dead Scot's pine tree between path and stream. Dense holly immediately beneath	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Fs	9		O 15744 25902	50-100	Y	2g	8m	S	Standing part dead beech with some small live branches. Main trunk has sheared away leaving scar and potential BRFs	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Fs	10		O 15753 25918	Oct-30	Y	2g	2m	W	Small tree leaning over stream	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
?	11		O 15766 25745	30-50	N	/	/	/	Standing dead tree. Indeterminate species, with ivy covering it, adjacent to stream and accessed off path in woods	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Fs	12		O 15891 25887	50-100	Y	1b	2-15m	All	Beech with large precarious branch overhanging close to entrance to dog circle	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
										
Fs	12		O 15891 25887	50-100	Y	1c	2-15m	All	Beech with large precarious branch overhanging close to entrance to dog circle	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Fs	12		O 15891 25887	50-100	Y	2e	2-15m	All	Beech with large precarious branch overhanging close to entrance to dog circle	**Suitable for bats. Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Fs	12		O 15891 25887	50-100	Y	2g	2-15m	All	Beech with large precarious branch overhanging close to entrance to dog circle	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Quercus ilex	13 (tree 918)		O 15888 25969	50-100	Y	1d	1.8m	N	Large holm oak tree with multiple BRFs along main trunk from close to ground level to the canopy. BRFs include butt rot, desiccation fissures, wound and canker, flush cuts and tear outs.	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Quercus ilex	13 (tree 918)		O 15888 25969	50-100	Y	1c	3m; 10m	All	Large holm oak tree with multiple BRFs along main trunk from close to ground level to the canopy. BRFs include butt rot, desiccation fissures, wound and canker, flush cuts and tear outs.	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Quercus ilex	13 (tree 918)		O 15888 25969	50-100	Y	1g	0-10m; 20m	All	Large holm oak tree with multiple BRFs along main trunk from close to ground level to the canopy. BRFs include butt rot, desiccation fissures, wound and canker, flush cuts and tear outs.	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Quercus ilex	13 (tree 918)		O 15888 25969	50-100	Y	2g	2m	All	Large holm oak tree with multiple BRFs along main trunk from close to ground level to the canopy. BRFs include butt rot, desiccation fissures, wound and canker, flush cuts and tear outs.	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Quercus petraea	14		O 15899 26212; WP013	Oct-30	N	/	/	/	Young standing dead oak tree close to perimeter wall and gatekeeper's cottage at E side of park	**Felling can proceed without the supervision of an ecologist**
Fraxinus excelsior	15		O 15299 26424; WP015	Oct-30	N	/	/	/	Young dead beech by stream at edge of lawn	**Felling can proceed without the supervision of an ecologist**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
										
Alnus glutinosa	16		O 15299 26432	Oct-30	N	/	/	/	Dead Alder? By stream. Covered in ivy, but not considered to contain suitable BRF	**Felling can proceed without the supervision of an ecologist**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Quercus petraea	17		O 15241 26284; WP016	50-100	Y	1f	2-15m	All	Prominent tall dead oak in grove near depot and house in woods. Lifting bark noticeable along the entire trunk. Multiple features that are PRFs	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Quercus petraea	17		O 15241 26284; WP016	50-100	Y	2f	2-15m	All	Prominent tall dead oak in grove near depot and house in woods. Lifting bark noticeable along the entire trunk. Multiple features that are PRFs	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Quercus petraea	17		O 15241 26284	50-100	Y	2g	2-15m	All	Prominent tall dead oak in grove near depot and house in woods. Lifting bark noticeable along the entire trunk. Multiple features that are PRFs	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
Quercus petraea	17		O 15241 26284	50-100	Y	2h	2-15m	All	Prominent tall dead oak in grove near depot and house in woods. Lifting bark noticeable along the entire trunk. Multiple features that are PRFs	**Derogation licence required for felling. Felling to be undertaken under supervision of ecologist to assess presence of bats and need for translocations.**
Prunus sp.	18		O 15291 26756	30-50	N	/	/	/	Partially dead ornamental cherry tree bordering the walled garden	**Felling can proceed without the supervision of an ecologist**

Tree species	Id		Grid ref	Age[2]	Suitable Y/N	PRF type[3]	PRF height	PRF aspect	Comments	Recommendations
										
Chamaecyparis lawsoniana	19		O 15307 26798	30-50	N	/	/	/	Row of Lawson's cypress trees along avenue between walled garden and three rock rovers hockey club. No PRFs notes, and no active bird nests noted	**Felling can proceed without the supervision of an ecologist**

Approximate location of trees

APPENDIX D Static Detector Data

Table D1: Values for bat activity at the East Woods Static Detector.

Night	Night-time hours	*Pipistrellus pygmaeus* Index	*Pipistrellus* Index	*Pipistrellus* sp. Index	*Nyctalus leisleri* Index	*Plecotus auritus* Index	*Myotis daubentonii* Index	*Myotis* sp. Index	Unidentified bat Index	Total index
15/06/2016	07:01:24	0.427149631	0	0	0	0	0	0	0	0.42715
16/06/2016	07:00:51	7.413743941	0.142571999	0	4.847447961	0	0	0	0	12.40376
17/06/2016	07:00:25	19.12400634	0	0.28543293	2.140746978	0.713582326	0.28543293	0.428149	0	22.97735
18/06/2016	07:00:05	4.999285816	0.285673475	0	1.285530638	0.714183688	0	0	0	7.284674
19/06/2016	06:59:53	7.716490426	0	0.142897971	8.43098028	0.714489854	0.428693913	0	0	17.43355
20/06/2016	06:59:46	5.145797599	0.285877644	0	1.715265866	0.428816467	0.571755289	0.142939	0	8.290452
21/06/2016	06:59:47	6.57518582	0	0	1.429388222	0	0.571755289	0.142939	0.142938822	8.862207
22/06/2016	06:59:54	7.859388397	0.285795942	0	1.571877679	1.000285796	0	0.142898	0.142897971	11.00314
23/06/2016	07:00:08	2.570694087	0.428449015	0	0.428449015	0.142816338	0.142816338	0	0.142816338	3.856041
24/06/2016	07:00:29	1.997716895	0.428082192	0	1.141552511	0	0	0	0	3.567352
25/06/2016	07:00:56	1.567956667	0	0.142541515	2.850830304	0.142541515	0	0.142542	0	4.846412
26/06/2016	07:01:30	3.84341637	0	0	1.708185053	0.284697509	0	0	0	5.836299
27/06/2016	07:02:11	5.400795907	0.284252416	0	2.131893121	0	0.142126208	0	0	7.959068
28/06/2016	07:02:58	2.411689601	0.141864094	0	0.993048659	0.283728188	0	0	0	3.830331
29/06/2016	07:03:51	4.388448471	0.424688562	0.141562854	0.849377123	0.141562854	0	0	0.283125708	6.228766
30/06/2016	07:04:51	2.118644068	0.423728814	0	0.988700565	0	0	0	0	3.531073
01/07/2016	07:05:57	3.944217495	0.281729821	0	0.704324553	0	0	0	0	4.930272
02/07/2016	07:07:10	1.685630004	0	0	0.561876668	0	0	0	0	2.247507

Night	Night-time hours	*Pipistrellus pygmaeus* Index	*Pipistrellus* Index	*Pipistrellus* sp. Index	*Nyctalus leisleri* Index	*Plecotus auritus* Index	*Myotis daubentonii* Index	*Myotis* sp. Index	Unidentified bat Index	Total index
03/07/2016	07:08:28	8.542220977	0.700182047	0	0.980254866	0	0.140036409	0	0.140036409	10.50273
04/07/2016	07:09:53	2.093802345	0	0	2.233389168	0.139586823	0.279173646	0	0	4.745952
05/07/2016	07:11:23	4.312143553	0.139101405	0	1.808318264	0	0.139101405	0.139101	0	6.537766
06/07/2016	07:13:00	1.662971175	0.138580931	0	1.247228381	0.277161863	0	0	0.138580931	3.464523
07/07/2016	07:14:42	0.966183575	0.138026225	0.27605245	1.38026225	0	0	0	0	2.760524
08/07/2016	07:16:30	0.137457045	0.274914089	0	4.12371134	0	0	0	0	4.536082
09/07/2016	07:18:23	2.189980838	0	0	2.600602245	0	0	0	0	4.790583
10/07/2016	07:20:22	2.316391879	0	0	0.817550075	0	0	0.136258	0	3.2702
11/07/2016	07:22:26	1.356116084	0	0	1.084892867	0.135611608	0	0	0	2.576621
12/07/2016	07:24:35	5.938723175	0.404912944	0	2.429477662	0.269941962	0	0	0.134970981	9.178027
13/07/2016	07:26:49	8.8638195	0.268600591	0	2.417405318	0.134300295	0	0	0.268600591	11.95273
14/07/2016	07:29:08	2.271209085	0	0	0.534402138	0.133600534	0	0.133601	0.133600534	3.206413
15/07/2016	07:31:32	0	0	0	0	0	0	0	0	0
16/07/2016	07:34:00	0	0	0	0	0	0	0	0	0
17/07/2016	07:36:33	0	0	0	0	0	0	0	0	0
18/07/2016	07:39:10	0	0	0	0	0	0	0	0	0
19/07/2016	07:41:51	0	0	0	0	0	0	0	0	0
20/07/2016	07:44:36	0	0	0	0	0	0	0	0	0
21/07/2016	07:47:26	0	0	0	0	0	0	0	0	0
22/07/2016	07:50:19	1.275835672	0.127583567	0	6.379178362	0.255167134	0	0	0	8.037765
23/07/2016	07:53:16	6.593127932	0.126790922	0	7.86103715	0.126790922	0.126790922	0	0.253581844	15.08812
24/07/2016	07:56:16	7.559531309	0	0	7.181554744	0.125992188	0.125992188	0.125992	0.251984377	15.37105
25/07/2016	07:59:20	1.627441162	0	0	7.135703555	0.125187782	0.125187782	0	0	9.01352
26/07/2016	08:02:27	2.860696517	0	0	30.2238806	1.616915423	0	0	1.492537313	36.19403
27/07/2016	08:05:37	1.235635735	0.247127147	0	35.70987273	0.37069072	0	0	0.988508588	38.55183
28/07/2016	08:08:51	5.031909671	0.122729504	0	34.60972018	0.490918017	0.245459008	0.613648	1.104565538	42.21895

Table D2 - Values for bat activity at the South Woods (Control) Static Detector.

Night	Night-time hours	*Pipistrellus pygmaeus* Index	*Pipistrellus pipistrellus* Index	*Pipistrellus* sp. Index	*Nyctalus leisleri* Index	*Plecotus auritus* Index	*Myotis daubentonii* Index	*Myotis* sp. Index	Unidentified bat Index	Total index
15/06/2016	07:01:24	0.42714963	0	0	0	0	0.14238321	0.569533	0	1.139066
16/06/2016	07:00:51	0	0	0	0	0	0.142571999	0.570288	0	0.71286
17/06/2016	07:00:25	0.28543293	0	0.14271647	0	0	0	0.428149	0	0.856299
18/06/2016	07:00:05	0.57134695	0	0.14283674	0	0.42851	0	0.999857	0.142836738	2.285388
19/06/2016	06:59:53	1.71477565	0	0	0	0	0	0.285796	0.285795942	2.286368
20/06/2016	06:59:46	0.28587764	0	0	0	0.428816	0	0.142939	0.428816467	1.286449
21/06/2016	06:59:47	1.71526587	0	0	0	0.142939	0	0.428816	0.571755289	2.858776
22/06/2016	06:59:54	0.57159188	0	0	0	0	0	0.71449	0	1.286082
23/06/2016	07:00:08	1.57097972	0	0	0	0	0	0.714082	0.285632676	2.570694
24/06/2016	07:00:29	0.28538813	0.142694064	0	0.142694	0.142694	0	0.428082	0.285388128	1.426941
25/06/2016	07:00:56	0.14254152	0	0	0	0	0	0.570166	0.142541515	0.855249
26/06/2016	07:01:30	0.14234875	0	0	0	0	0	0.142349	0	0.284698
27/06/2016	07:02:11	0.42637862	0	0	0	0	0	0.284252	0	0.710631
28/06/2016	07:02:58	0.85118457	0	0	0	0	0	0.567456	0	1.418641
29/06/2016	07:03:51	0.42468856	0	0	0	0	0.283125708	0.707814	0	1.415629
30/06/2016	07:04:51	0.98870056	0	0	0	0	0.141242938	0	0	1.129944
01/07/2016	07:05:57	0.14086491	0	0	0	0	0.422594732	0	0	0.56346
02/07/2016	07:07:10	0	0	0	0	0	0.702345835	0	0	0.702346
03/07/2016	07:08:28	0.56014564	0	0	0.140036	0	0.560145638	0	0	1.260328
04/07/2016	07:09:53	0.13958682	0	0	0	0	0.558347292	0	0	0.697934
05/07/2016	07:11:23	0.41730421	0.139101405	0	0	0	0.27820281	0	0	0.834608
06/07/2016	07:13:00	0.13858093	0	0	0	0	0.415742794	0.138581	0	0.692905
07/07/2016	07:14:42	0	0	0	0	0	0	0.276052	0	0.276052
08/07/2016	07:16:30	0.13745704	0	0	0	0	0	0.824742	0	0.962199
09/07/2016	07:18:23	0	0	0	0	0	0	0.821243	0	0.821243

Night	Night-time hours	*Pipistrellus pygmaeus* Index	*Pipistrellus pipistrellus* Index	*Pipistrellus* sp. Index	*Nyctalus leisleri* Index	*Plecotus auritus* Index	*Myotis daubentonii* Index	*Myotis* sp. Index	Unidentified bat Index	Total index
10/07/2016	07:20:22	0	0	0	0	0	0	0.408775	0	0.408775
11/07/2016	07:22:26	0	0	0	0	0	0	0.542446	0	0.542446
12/07/2016	07:24:35	0	0.134970981	0	0	0	0	0.944797	0	1.079768
13/07/2016	07:26:49	0	0	0	0	0	0.134300295	0.402901	0	0.537201
14/07/2016	07:29:08	0.13360053	0	0	0	0	0.133600534	0.133601	0	0.400802
15/07/2016	07:31:32	0	0	0	0	0	0.132890365	0.265781	0	0.398671
16/07/2016	07:34:00	0	0	0	0	0	0	0.528681	0	0.528681
17/07/2016	07:36:33	0	0	0	0	0	0	0.262847	0	0.262847
18/07/2016	07:39:10	0	0	0	0	0	0	1.437533	0	1.437533
19/07/2016	07:41:51	0.51968299	0	0	0	0	0.259841497	0.259841	0	1.039366
20/07/2016	07:44:36	0	0	0	0	0	1.291489087	0.258298	0	1.549787
21/07/2016	07:47:26	0	0	0	0.12837	0	0.385109114	0	0	0.513479
22/07/2016	07:50:19	0	0	0	0	0	0	0	0	0
23/07/2016	07:53:16	0	0	0	0	0	0	0	0	0
24/07/2016	07:56:16	0	0	0	0	0	0	0	0	0
25/07/2016	07:59:20	0	0	0	0	0	0	0	0	0
26/07/2016	08:02:27	0	0	0	0	0	0	0	0	0
27/07/2016	08:05:37	0	0	0	0	0	0	0	0	0
28/07/2016	08:08:51	0	0	0	0	0	0	0	0	0

Table D3 - Values for bat activity at the East Woods Static Detector

Night	Night-time hours	*Pipistrellus pygmaeus* Index	*Pipistrellus pipistrellus* Index	*Pipistrellus* sp. Index	*Nyctalus leisleri* Index	*Plecotus auritus* Index	*Myotis daubentonii* Index	*Myotis* sp. Index	Unidentified bat Index	Total index
15/06/2016	07:01:24	0	0	0	0.284766	1.993365	0	0	0	2.278131
16/06/2016	07:00:51	24.09466781	0	0	0	0	0.285144	0	0	24.37981
17/06/2016	07:00:25	3.85334456	0	0	0	0	1.712598	0	0	5.565942
18/06/2016	07:00:05	5.142122554	0.857020426	0	0	0	0	0	0	5.999143
19/06/2016	06:59:53	0	0	0	0	0	0	0	0	0
20/06/2016	06:59:46	0	0	0	0	0	0	0	0	0
21/06/2016	06:59:47	0	0	0	0	0	0	0	0	0
22/06/2016	06:59:54	0	0	0	0	0	0	0	0	0
23/06/2016	07:00:08	0	0	0	0	0	0	0	0	0
24/06/2016	07:00:29	0	0	0	0	0	0	0	0	0
25/06/2016	07:00:56	0	0	0	0	0	0	0	0	0
26/06/2016	07:01:30	0.711743772	0.427046263	0	0	0	0	0	0	1.13879
27/06/2016	07:02:11	0.284252416	0.568504832	0	0	0	0	0	0	0.852757
28/06/2016	07:02:58	0.425592283	0.425592283	0	0	0	0	0	0	0.851185
29/06/2016	07:03:51	0.70781427	2.123442809	0	0	0	0.707814	0	0	3.539071
30/06/2016	07:04:51	1.412429379	0.706214689	0	0	0	0	0	0	2.118644
01/07/2016	07:05:57	1.831243837	0.422594732	0	0	0	0	0.56346	0	2.817298
02/07/2016	07:07:10	0.280938334	0	0	0	0	0	0	0	0.280938
03/07/2016	07:08:28	0	0	0	0	0	0	0	0	0
04/07/2016	07:09:53	0	0	0	0	0	0	0	0	0
05/07/2016	07:11:23	0	0	0	0	0	0	0	0	0
06/07/2016	07:13:00	0	0	0	0	0	0	0	0	0
07/07/2016	07:14:42	0	0	0	0	0	0	0	0	0
08/07/2016	07:16:30	0	0	0	0	0	0	0	0	0

Night	Night-time hours	*Pipistrellus pygmaeus* Index	*Pipistrellus pipistrellus* Index	*Pipistrellus* sp. Index	*Nyctalus leisleri* Index	*Plecotus auritus* Index	*Myotis daubentonii* Index	*Myotis* sp. Index	Unidentified bat Index	Total index
09/07/2016	07:18:23	0	0	0	0	0	0	0	0	0
10/07/2016	07:20:22	0	0	0	0	0	0	0	0	0
11/07/2016	07:22:26	0	0	0	0	0	0	0	0	0
12/07/2016	07:24:35	0	0	0	0	0	0	0	0	0
13/07/2016	07:26:49	0	0	0	0	0	0	0	0	0
14/07/2016	07:29:08	0	0	0	0	0	0	0	0	0
15/07/2016	07:31:32	0	0	0	0	0	0	0	0	0
16/07/2016	07:34:00	0	0	0	0	0	0	0	0	0
17/07/2016	07:36:33	0	0	0	0	0	0	0	0	0
18/07/2016	07:39:10	0	0	0	0	0	0	0	0	0
19/07/2016	07:41:51	0	0	0	0	0	0	0	0	0
20/07/2016	07:44:36	0	0	0	0	0	0	0	0	0
21/07/2016	07:47:26	0	0	0	0	0	0	0	0	0
22/07/2016	07:50:19	0	0.510334269	0	0	0	0	0	0	0.510334
23/07/2016	07:53:16	0.507163687	0	0	0	0	0	0	0	0.507164
24/07/2016	07:56:16	2.51984377	0.125992188	0	0.125992	0	0	0	0	2.771828
25/07/2016	07:59:20	0.375563345	0	0	0	0	0	0	0	0.375563
26/07/2016	08:02:27	0	0	0	0	0	0.373134	0	0	0.373134
27/07/2016	08:05:37	0	0	0	0	0	0	0	0	0
28/07/2016	08:08:51	0	0	0	0	0	0	0	0	0

Appendix E: Transect Data and Analyses

Car Parks	04/07/2016	05/07/2016	08/07/2016	09/07/2016	15/07/2016	16/07/2016	17/07/2016	28/07/2016	01/09/2016
Pipistrellus pipistrellus	0	4		53	42	3	7	29	22
Pipistrellus pygmaeus	7		6	5	14	4	7	2	
Pipistrellus spec.					1				2
Nyctalus leisleri	2		6	7	1	8	4	7	
Myotis daubentonii		1				1			
Myotis nattereri		4			7				
Plecotus auritus						1			
Total Bats	9	9	12	65	65	17	18	38	24

East woods	04/07/2016	05/07/2016	08/07/2016	09/07/2016	15/07/2016	16/07/2016	17/07/2016	28/07/2016	01/09/2016
Pipistrellus pipistrellus	0		2		8	1	0	0	1
Pipistrellus pygmaeus		6	3	25	25	7	17	2	12
Pipistrellus spec.			9		0	0	0	0	2
Nyctalus leisleri				8	73	20	0	34	1
Myotis daubentonii			1	3	0	5	1	4	1
Myotis nattereri					0	0	0	2	0
Plecotus auritus		1			2	0	0	1	0
Total Bats	0	7	15	36	108	33	18	43	17

	04/07/2016	05/07/2016	08/07/2016	09/07/2016	15/07/2016	16/07/2016	17/07/2016	28/07/2016	01/09/2016
Pipistrellus pipistrellus		5				3		9	3
Pipistrellus pygmaeus	3	1	4	6	13	4	4	1	15
Pipistrellus spec.									3
Nyctalus leisleri	8	2	5	1		4	2		
Myotis daubentonii	6	2	8	13	1	1	1	24	20
Myotis nattereri									
Plecotus auritus						1			1
Total Bats	17	10	17	20	14	13	7	34	42

Appendix F: Bat Sampling data

Date	Location	Trapping method	Species	Sex	Age	Weight	Forearm length	Breeding Status
16.8.16	Lower Lake near seat	Harp Trap + Sussex Autobat lure	Whiskered bat *Myotis mystacinus*	Male	Juvenile	5.5g	35mm	Non breeding.
26.8.16	Weir on Main Lake	Mist net	Daubenton's Bat *Myotis daubentonii*	Female	Adult	8.9g	37.2mm	Nulliparous.
26.8.16	Path next to lakeside seating platform	Harp Trap + Sussex Autobat lure	Soprano pipistrelle bat *Pipistrelle pygmaeus*	Male	Adult	Not measured	Not measured	Not breeding.
26.8.16	Path next to lakeside seating platform	Harp Trap + Sussex Autobat lure	Soprano pipistrelle bat *Pipistrelle pygmaeus*	Male	Adult	Not measured	Not measured	Not breeding.
26.8.16	Path next to lakeside seating platform	Harp Trap + Sussex Autobat lure	Soprano pipistrelle bat *Pipistrelle pygmaeus*	Male	Adult	Not measured	Not measured	Not breeding.
26.8.16	Path next to lakeside seating platform	Harp Trap + Sussex Autobat lure	Soprano pipistrelle bat *Pipistrelle pygmaeus*	Male	Adult	Not measured	Not measured	Not breeding.
26.8.16	Weir on Main Lake	Mist net	Daubenton's Bat *Myotis daubentonii*	Male	Adult	8.6g	36.1mm	Not breeding.

Date	Location	Trapping method	Species	Sex	Age	Weight	Forearm length	Breeding Status
26.8.16	Woods near Fairy Tree	Harp Trap + Sussex Autobat lure	Leisler's Bat Nyctalus leisleri Nl null	Female	Adult	16.2g	43,4mm	Nulliparous.
26.8.16	Woods near Fairy Tree	Harp Trap + Sussex Autobat lure	Soprano pipistrelle bat *Pipistrelle pygmaeus*	Male	Juvenile	Not measured	Not measured	Not breeding.
26.8.16	Woods near Fairy Tree	Harp Trap + Sussex Autobat lure	Soprano pipistrelle bat *Pipistrelle pygmaeus*	Male	Juvenile	Not measured	Not measured	Not breeding.
26.8.16	Woods near Fairy Tree	Soprano pipistrelle bat *Pipistrelle pygmaeus*	Soprano pipistrelle bat *Pipistrelle pygmaeus*	Male	Juvenile	Not measured	Not measured	Not breeding.

Appendix G: Bridge Repair Protocol

Since several of the bridges will require repair works by the Council in the future, the main report includes a recommended **protocol** to be followed by the Council when scheduling such repairs to ensure that potential impacts on Bats are addressed.

A series of pre-, during and post-construction procedures are recommended below and follow best practice in bat mitigation.

1. **Is Bridge Graded 0?**
    - if yes go to 3.
    - If no go to 2.
    -
2. **Are the proposed works likely to conflict with bat using crevices (this must be based on the advice of an ecologist)?**
    - if yes go to 4
    - If no go to 3.

3. **These bridges may be worked on immediately. If any bats are encountered during works then the "*Procedure to be followed in the case of unforeseen discovery of bats*" – see below, will apply.**

4. **All bridges that could contain bats at risk require a minimum of a visual check of crevices for evidence of bats by a qualified bat worker, prior to any works commencing. Such checks must be scheduled in advance of any proposed works to provide enough time to respond to the results of the survey.**

5. **Are bats present in any crevices or is there reasonable doubt as to their presence/absence?**

    - If Yes, go to 6.
    - If No, go to 7.

6. **If bats are suspected to be *in-situ*, then certain works cannot take place near them (this includes power washing, vegetation removal and pointing). Each case will be appraised based upon the location of the occupied crevice and the type of works taking place. As a minimum measure, the crevice will be marked with coloured chalk to a distance of 2m surrounding the crevice.**
    - **Ecologist to advise on with ongoing works.**

7. **Where checks have indicated that bats are not present then works can proceed immediately but crevices will need checking each morning if works overrun into the following day. Crevices can be blocked with material to prevent reoccupation if required.**

8. **It is advisable that crevices are retained in Category 2 bridges where possible. An ecologist will advise on how certain crevices may be sealed without losing the internal void, using removable fillers. It is recommended that 3-4 crevices per Category 2 bridges are retained where possible.**

Procedure to be followed in the case of unforeseen discovery of bats

1. If the bat can be covered up with cloth or timber sheeting to protect it from further disturbance then this should be done carefully to avoid crushing the bat.
2. Works should be suspended as other bats could be present, the NPWS local Conservation Ranger should be contacted for advice on how to proceed. This may include:
    a. Temporary/localised suspension of works in area of bat until inspected by a bat worker or similar qualified person.
    b. Leave overnight to allow bat to escape (in mild weather only – not usually possible in cold conditions)
    c. Relocation of the bat by a bat worker to a bat box to be mounted on a tree or abutment.
3. Works can recommence only when the NPWS or authorised bat worker agrees.

Appendix G: Tree felling/Pruning Protocol

The following mitigation measures are proposed in relation to those trees identified as having the potential to support roosting bats:

- Trees confirmed to have had bats present or are considered to have good bat potential, where either obvious potential roosting features are present or where obscured by dense ivy cover, the tree is of an age and condition that there is a high chance that roosting features are present. Bats could occupy suitable roosting features at any time prior to the commencement of works. Therefore there is an inherent risk that bats could be affected by felling or pruning.

- Tree felling will generally be undertaken during the period September –October as during this period bats are capable of flight and may avoid the risks of tree felling if proper measures are undertaken but also are neither breeding or in hibernation. Where such trees are to be felled, an emergence survey using infra-red illumination and video camera(s) and bat detectors may be required to be carried out on the night immediately preceding the felling operation to determine if bats are present. Use of detectors alone may not be sufficient to record bat emergence and re-entry in darkness.

- Where it is safe and appropriate to do so for both bats and humans, such trees may be felled using heavy plant to push over the tree. In order to ensure the optimum warning for any roosting bats that may still be present, the tree will be pushed lightly two to three times, with a pause of approximately 30 seconds between each nudge to allow bats to become active. The tree should then be pushed to the ground slowly and should remain in place until it is inspected by a bat specialist.

- Trees should only be felled “in section” or “soft felled” where the sections can be rigged to avoid sudden movements or jarring of the sections. In all cases all reasonable steps must be taken to avoid felling trees when bats may be present inside of them.

- Where remedial works (e.g. pruning of limbs) is to be undertaken to trees deemed to be suitable for bats, the affected sections of the tree will be checked by a bat specialist for potential roost features before removal. For limbs high in the tree canopy, this will necessitate the rigging and lowering of the limb to the ground (with the potential roost feature intact) for inspection by the bat specialist before it is cut up or mulched. If bats are found to be present, they will be removed by a bat specialist licenced to handle bats and released in the area the next night.

- If a bat roost is confirmed, and will be removed by the proposed works, then appropriate alternative roosting sites will be provided in the form of Schwegler bat boxes Type 1F (or similar) erected on suitable trees or structures in the vicinity. The type and siting of any bat boxes required will be determined by the bat specialist at that time.