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BAT SURVEY REPORT, RIVER CRANE CORRIDOR, HEATHAM ESTATE, TWICKENHAM.

To:

FORCE

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From:
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Abbreviations:

RBAP	Richmond Biodiversity Action Plan
BAP	Biodiversity Action Plan
HAP	Habitat Action Plan
SAP	Species Action Plan
FORCE	Friends of the River Crane Environment
LNR	Local Nature Reserve
SINC	Site of Importance for Nature Conservation
LBG	London Bat Group
DNR	Duke of Northumberland River

1.0 INTRODUCTION

1.1 PURPOSE

Furesfen was asked by Friends of the River Crane Environment (FORCE) to investigate the bat activity along a 500m stretch of the River Crane corridor between the London Road crossing and Craneford Way Depot, incorporating the Craneford West and Craneford East playing fields and Twickenham Junction Rough, centred on TQ156735. The survey was carried out by A. Fure, holder of protected species licences. The investigation was necessary in order to determine how bats: were using the area; the species present and if bats might be affected by local development proposals. The findings were evaluated and recommendations made to aid future management of the corridor.

1.2 SITE DESCRIPTION

The River Crane within the study area is an urban river encased in a concrete channel. Mature trees and overhanging vegetation, help to ensure that the site retains some value for wildlife. At the western end of the site its value is chiefly as a wildlife corridor and for its insect productivity. However, further downstream the river becomes less homogenous and there are surprising niches available for nesting birds etc. The environmental sensitivity increases whenever offsite land is underused or managed for nature conservation such as: to the east at Heatham House where there are a number of mature trees with woodpecker holes overhanging the channel; and further west at allotments and Twickenham Rifle Club where there is active conservation management by FORCE. At Kneller Gardens, 1km to the west, the river passes alongside the Mereway Nature Reserve where it meets the Duke of Northumberland River (DNR).

1.3 DESIGNATION

The River Crane is a Site of Metropolitan Importance with many designated sites along its course. Most notably, it shares a common course with the DNR, a Site of Grade 2

Site of Borough Importance at Kneller Gardens where the di-fluence is situated. Along the bank, lies Mereway, a Local Nature Reserve (LNR) an area of mature trees and bramble scrub. A railway corridor runs almost parallel to the river and there is an area known as Twickenham Junction Rough, a Site of Importance for Nature Conservation (SINC). Craneford Fields (west and east) include a large Recreation Ground, an area of grassland as well as a small copse.

1.4 FEATURES

Nine species of bat have been recorded within two kilometers of the site on account of the presence of a number of features, which include: older trees with rot holes; water providing food resources; and the overall size and connectivity to other sites. Trees and tree lines are used by bats in order to commute between features as well as produce and shelter insect biomass upon which they feed. They also create a shield against light ingress, which is a factor for some of the less common bat species.

2.0 METHOD

2.1 DESK STUDY

A desk study was undertaken using author's data and London Bat Group records. This included several surveys undertaken in recent years:

- Lincoln Fields (2010);
- Heatham House, Whitton Road (2010);
- Kneller Gardens (2005);
- Mereway Nature Reserve (2005);
- Twickenham Rough (2007);
- Bat Conservation Trust, Daubenton's Waterway Survey (various years).

2.2 WALKOVER SURVEY

A walkover of the river was undertaken from the bank and streambed 15.5.14 and 20.6.14 respectively, in order to ascertain any niches, which might be available to wildlife along the corridor in line with Bat Conservation Trust Guidelines (2012) to establish specific features of bat interest, including any flight lines there might be around the site and any roost opportunities. This included an inspection of structures (bridges) and trees using binoculars during sunny weather at 18 degrees centigrade.

2.3 BAT SURVEYS

A site inspection to establish features of bat interest, in line with Bat Conservation Trust Guidelines (2012) including any flight lines there might be around the site and roost opportunities. This included a binocular inspection of the visible tree-holes and buildings. Trees can be classified on roosting opportunities for bats, and the general condition of the tree. Potential bat roosting features can include significant cracks, splits, hollows or holes in the trunk or branches, areas of loose bark, and features such as Ivy. This information can be used to classify individual trees as follows.

- High Bat Roost Potential. Trees with good bat roost potential have numerous or cavities, or sections of hollow trunk. They are likely to be used by bats.
- Moderate Bat Roost Potential. Trees with moderate bat roost potential are those with small holes such as woodpecker nest-holes, or cracks. They could be used by individual bats and might be suitable for a maternity roost or other types of roost.
- Limited Bat Roost Potential. Trees with limited bat roost potential are those with cracks and holes or small sections of loose bark and Ivy growth. They might be used as occasional or transient roosts.

The assessment of structures within the survey site followed a similar assessment procedure to that outlined above for trees.

2.4 BAT EMERGENCE SURVEYS

Two bat activity surveys were undertaken on the evenings of 15.5.14 and 20.6.14 using hand held recordable Bat Box 4 Frequency Division equipment. Static bat detection equipment, notably an Anabat, was situated along the River Crane at Heatham Park, adjacent to Craneford East Field (also known as the College Playing Field) at monthly intervals between May and August. This included 15th-17th May; 20-23rd June; 23rd-27th July; 22-24th August. Recordings were played through BatSound and Analook software and interpreted according to Russ (2012).

3.0 RESULTS

3.1 DESK STUDY

The desk study showed that nine species of bat are recorded locally five of which are roosting nearby. Roosts of both common pipistrelle bats *Pipistrellus pipistrellus* and soprano pipistrelle *Pipistrellus pygmaeus* are known within 500 metres. Daubenton's bats *Myotis daubentonii* are recorded navigating over the river. Surveys undertaken at nearby sites have recorded flying records for Daubenton's bats and there is a known hibernaculum of this species at Cavalry Tunnel near Feltham Marshalling Yards. Brown Long-eared bats have been recorded in surveys within the study area. As this is a sedentary species, which does not move far from their roost sites, it should be considered to be roosting within the vicinity.

Table 1: Status of bats recorded in the local catchment.

Species	Frequency in London	Main roost sites
Common pipistrelle	Common	Buildings nearby (LBG) Roosts nearby
Soprano pipistrelle	Common	Buildings and trees especially near water (LBG). Large roosts nearby 2 sites >300 bats Twickenham Early bats were recorded at Heatham Park, 2010
Nathusius's pipistrelle	Rare	Buildings Trees. Has roosted within the catchment but its local status is variable
Daubenton's bat	Becoming less common in the Greater London area (Briggs, et a , 2007)	Trees, structures and underground sites Percy Road, Lincoln Fields, 2010; Hibernation site at Cavalry Tunnel LBG data Bat Conservation Trust Daubenton Waterway Survey transects on the River Crane: Crane Park (route centred around grid ref TQ130728) 1997 Moormead recreation ground passes also. (Briggs, *Pers comm*., 2014)
Natterer's bat Myotis nattereri	Infrequent since 2009 at this location	Trees and structures
Noctule bat *Nyctalus noctula*	Becoming less common in London	Known roosts nearby Recorded: emergence survey Heatham Park, 2010
Leisler's bat *Nyctalus leisleri*	rare	No known roosts in the area flight records only but early registrations Author's data, 2005
Serotine Eptesicus serotinus	Rare in London	Record from the Lensbury surveys along the River Thames at Teddington 2012.
Brown long-eared bat Plecotus auritus	Becoming rare in London	Roosts nearby, difficult to detect in flight Maternity colony at Normansfield. Flight Records at Twickenham Rough C. Nash

Adapted from Mitchell-Jones (2007) LBG=London Bat Group records

3.2 WALKOVER SURVEY

Figs.1 and 2: During the survey, several trees were found with rot holes with high potential for bat occupation. There were several bat boxes within the study area. Seven moorhen nests were found along the streambed.

During the walkover survey along the streambed (20.6.14) the bridges near Heatham House and another at Marsh Farm Lane were deemed of low potential for bat use as roost sites. The right bank (RB) or southern bank of the river exhibited the best habitat on account of the large amount of overhanging vegetation. Trees were found with rot holes which were high potential for bat occupancy (refer to Fig.1). Water levels had dropped substantially since the May bat emergence survey and blanket weed and other mats of algae lay thick over the streambed. Japanese knotweed was present at two locations and although treated had not responded well. There were some surprising results regarding the number of nesting birds (Fig.2).

3.3 BAT EMERGENCE SURVEYS: MAY

During the May hand held detector surveys, two bat species were recorded foraging along a 500 metre stretch of the River Crane corridor in the early part of the evening (refer to Table 1). During the May static bat detector surveys (15^{th}-18^{th}) a total of four perhaps five species were recorded: Common and Soprano Pipistrelle bat; Daubenton's and a possible Natterer's bat; as well as one registration of a Leisler's bat (17.5.14). Bat activity showed a strong affinity with the river corridor and early registrations of Daubenton's bat indicated that it was roosting nearby. Modern LED lights are situated along the footpath (Marsh Farm Lane) that crosses the river and runs between the West and East playing fields. These are designed to restrict light spillage to the path area and avoid overspill onto the grass.

Table 1: Selected bat activity (15.5.14)

Sunset 20.45p.m. Cloud cover 5/8 .Temperature 14 degrees centigrade at start

Time	Details: Duet detectors AF along East Field and Bridge
21.15	2 Common Pipistrelles flew from the east to feed around vegetation along the river
21.17	Followed by prolonged foraging by Soprano Pipistrelles, noted throughout the survey.
21.30	2 x Common Pipistrelles flying along the river and up to the portal at the bridge
21.40	Around five bats foraging around the vegetation particularly the eastern field and bridge
21.50	Pipistrelles entering open areas
Table 1a	
Anabat 15th-17th	Highlights
21.55	First Daubenton's bat (sunset + 40 minutes)
21.6-22.12	6 passes of Daubenton's bat
22.18	Bat pass within the range of a Natterer's bat
22.19	Daubenton's bat foraging activity until midnight
16th May	
00.11	Daubenton's bat foraging activity for one hour, feeding buzzes noted
	Pipistrelle bat activity thoughout the night until 04.32 (soprano)
04.14	One further pass of a Daubenton's bat until the last pass before dawn
21.21	First Soprano pipistrelle pass passes of both species throughout the night
21.54	First Daubenton's bat pass
22.03	Occasional passes of Daubenton's bat until 22.59 where a call within the range of a Natterer's bat was detected 23.17
23.17	Two passes within the range of Natterer's bat
Midnight	Foraging activity of three species: common and soprano pipistrelle and Daubenton's bat
17th	
04.29, 22.27	Last and first Daubenton's registration
23.46	Leisler's bat

3.4 BAT ACTIVITY SURVEYS: JUNE

During the Anabat static bat detector surveys, 20-23rd June, two possibly three bat species were recorded. This included: Soprano and Common Pipistrelle bat as well as recordings most likely to pertain to brown long-eared bat passes. Refer to walkover survey for notes on the water quality.

Table 2: Anabat selected bat activity (20-23rd June).
Sunset 21.30p.m. Cloud cover 6/8 .Temperature 21 degrees centigrade at start

Time	Details: Anabat
22.30 23.16	Common Pipistrelle very late passes may indicate unsuitable weather Soprano pipistrelle first pass (late)
01.42	Possible Brown Long-Eared bat
	Peak activity was after 3a.m.- 4 am and the last bat was a Soprano Pipistrelle at 04.03
21.6.14	Summary of records
	Generally bats arrived later in the evening and the peak foraging time was between 3 and 4 am.
22.6.14	The results were similar. Soprano Pipistrelles were the last bat registrations usually 30 minutes before sunrise indicating that this may be the nearest roost site.

3.5 BAT ACTIVITY SURVEYS: JULY

During the static bat detector survey over two hundred bat passes were recorded of five bat species on the bat detector: Common and Soprano Pipistrelle, Noctule and Daubenton's bat as well as some calls within the range of Brown Long-eared bat. The majority of bat passes pertained to pipistrelle bats with a lot of social activity. Some of the social calls were not identified to species. There were only two Noctule bat registrations and the majority of Daubenton's bat passes were recorded during 26.7.14. Physically the water levels in the channel were very low and there was a lot of scum on the surface. Blanket weed rose out of the water column in piles along the streambed.

Table 3: Anabat selected bat activity (24-27th July)
Sunset 21.00p.m. Cloud cover 6/8 .Temperature 21 degrees centigrade at start

Time	Details: Anabat
24.7.14	Rain (few bat passes) night of FORCE bat walk at Kneller Gardens
21.58	Noctule bat (see sonogram appendicised)
22.06	Soprano pipistrelle pass
25.7.14	
21.32	First bat Soprano pipistrelle
22.07	First Common Pipistrelle
23.35	Unknown Myotis
26th July	
00.09	First common pipistrelle
00.20	Myotis/long-eared
00.24	Myotis
00.32-04.08	Soprano pipistrelle social activity for the rest of the night
04.05	Noctule bat
04.56 Sunrise **5.17**	Last bat, Soprano Pipistrelle, may indicate that it was roosting nearby, perhaps using bat boxes.
20.59	First bat in the evening was also soprano pipistrelle. This early registration

(Sunset + 3 minutes).	indicated that the bat was roosting nearby. Raises the possibility of an early mating roost.
27.7.14	
00.38	Noctule bat
1.06	Myotis
02.52	Daubenton's bat
	High level of soprano pipistrelle activity until 04.54.

3.6 BAT ACTIVITY SURVEYS: AUGUST

During the static bat detector survey three bat species were recorded that of soprano and common pipistrelle bat as well as Daubenton's bat. The early registration times indicated that there was a nearby Soprano Pipistrelle roost. On this occasion there was slight increase in the number of Myotis/ Daubenton's bat passes, even though there were piles of blanket weed over the surface of the water, two channels were flowing parallel to the weed. However as the registrations were not close together, this was taken for movement along the corridor rather than foraging activity. No feeding buzzes were noted as had been the case during May.

Table 4: Anabat selected bat activity (22-24th August)

Sunset 20.10p.m. Cloud cover 6/8 .Temperature 21 degrees centigrade at start

Time	Details: Anabat
20.20	Soprano pipistrelle registration ten minutes after sunset indicating roosting nearby
21.05	First common pipistrelle bat pass
21.49	First Myotis or Daubenton's bat pass
21.59	Myotis
22.41	Myotis
23.15	Myotis
23.40	Myotis
23.8.14	
01.22	Myotis with lots of pipistrelle activity
01.25	Myotis
02.08	Myotis
03.49	Myotis
05.13	Last Soprano Pipistrelle
20.41	Common pipistrelle
21.14	Soprano pipistrelle followed by constant foraging
22.00	Daubenton's bat lots of pipistrelle activity
01.37	Last Daubenton's bat two soprano passes
03.13	Last bat Soprano pipistrelle

Fig.3 To show the two parallel corridors (river and rail; location of the static bat detector; majority of the bat passes; and important locations.

4.0 EVALUATION

Table: 5 Evaluation Summary Table.

Site Resources	Importance.	Reasons.
Small river with macrophytes	Borough/Region	An important foraging area for two *pipistrellus* species and potential roost site for *P. pygmaeus* in mature trees or existing bat boxes. Foraging area for Daubenton's bat when conditions are suitable. Otherwise acts as a corridor for movement. Bat movement detected throughout the night includes Brown Long-eared bats in closed canopy areas and occasional Noctule bats overhead. Seven water bird nests recorded within 500m. Grey wagtails and herons noted.
Mature oak/poplar trees	District	Important habitat containing structural features of interest to bats. Provide linear features used by commuting birds and bats and provides insect biomass for feeding purposes. Used by great spotted woodpecker.
Rough grassland	District	This is a valuable local habitat and should be extended. It forms part of a link to neighbouring habitats. Generating invertebrate activity. Grasshoppers particularly are an important food resource. Butterflies, bees and hoverflies were recorded 2014. Stag beetles recorded.
Amenity fields	District	A foraging area for flocking birds such as starlings and mistle thrushes. Also used by foraging song thrushes and blackbirds.
Bramble /scrub	Neighbourhood	Important for flocking and nesting birds. House sparrows and greenfinches congregate, nest and feed.

4.1 VALUE.

Overall the river corridor is assessed to be of district-borough value. Low flows create problems for the movement and foraging of Daubenton's bats at certain times of the year. With improvements to flow levels and better vegetation links across open areas, it could be assessed at the higher value for bats.

4.2 SURVEY EVALUATION

- The desk and field survey identified the presence of six/seven species of bat protected by national and international legislation: Common and Soprano Pipistrelle, Noctule and Leisler's bat, Daubenton's and possibly Natterer's and Brown long-eared bats;
- The desk study identified large Soprano Pipistrelle roosts nearby due to their very early emergence times on one occasion this was before sunset;
- On three occasions, Daubenton's bats were considered to be roosting within the study area , this species was recorded 37 minutes before sunrise (16.5.14);
- Surveys identified diversity and abundance of bird species including birds of conservation concern such as house sparrow;
- Macrophytes may have increased in diversity and abundance since the LEU Handbook Survey (1993);
- Surveys identified a variety of invertebrate species including stag beetle.

5.0 DISCUSSION

5.1 SPECIES

The surveys generated a robust set of data over the summer months between May-August. At least six and possibly seven bat species were recorded during the surveys: Common and Soprano Pipistrelle, Noctule and Leisler's bat, Daubenton's and possibly Natterer's as well as Brown Long-eared bats. No bats were recorded emerging from structures or trees. The spread of bat registrations and the early emergence times are suggestive of the presence of a colony of Soprano Pipistrelles within the study area. The activity recorded on the static bat detector, indicated the importance of the corridor for bat commuting and foraging purposes. Whilst no bats were recorded emerging from the trees during the survey, it is likely that both the *Nyctalus* (Noctule and Leisler) and *Myotis* (Daubenton's and Natterer's bat) species were using trees for roosting. Brown Long-eared bats may be roosting in trees or historic buildings to the east of the corridor.

5.2. BATS: PIPISTRELLE ECOLOGY

The “common” pipistrelle is now considered as two separate species *Pipistrellus pipistrellus* that echolocates around 45 kHz and *P. pygmaeus* that calls around 55 kHz. The 45 kHz pipistrelle can use a wide range of habitats, but frequents the more open situations, such as woodland edges, parkland, recent plantations, watersides and gardens. It will fly up to 5km from the roost to forage but most stay with 2km. Colonies, usually of 30-60 bats; they frequently use buildings for roost sites, but are rarely found in bat boxes. Emergence of both species is usually twenty minutes after sunset and the early arrival of soprano pipistrelle bats at the site of the static bat detector (sunset + 3 minutes July; sunset + 10 minutes August) indicated they had not travelled far and therefore were roosting nearby.

5.3 BATS: NYCTALUS BAT ECOLOGY

Noctule bats are one of Britain’s largest species, they are adapted to fast flying above the treetops and can cover large distances from roost to feeding areas, 10km or more being frequent. Their fast flight makes them less vulnerable to predatory birds and so they can emerge in good light, at times even before sunset. Noctules normally feed on larger beetles and moths but will take much smaller prey such as chironomids when these occur in large swarms. Groups are observed feeding above lakes and rivers. Noctule roosts are almost invariably in hollow trees, woodpecker holes being a favourite site. Leisler’s bats are classed as a rare species (Focus on Bats, T. Mitchell Jones). It is thought as Noctules become less common in our urbanising landscapes this closely related species is able to take advantage of the niches vacated by the larger Noctule. Trees abutting the study area offer suitable roosting conditions for both Noctule and Leisler’s bats and the latter have been recorded in recent years (Author’s data, 2005).

5.4 BROWN LONG-EARED BAT

This species rarely leaves the canopy of woodland and is common in the wooded counties of Kent and Surrey but much rarer in urban settings. This light shy species emerges much later in the evening than other bats. It often uses the large roof voids of older or historic buildings as well as tree holes and may operate in a solitary fashion, moving from tree to tree. It predates on moths and is difficult to detect in the field unless feeding perches or roosting bats are located. It does not echolocate to find its prey, hence also known as the whispering bat. There are records of this species from a survey

at Twickenham Rough, 2007. The surrounding area has records of this species at some of the larger parks where they have been radio-tracked (Hampton Court Park, 2013) and a maternity colony at the former Normansfield Hospital (2.5 miles).

5.5 DAUBENTON'S BATS

The greatest activity by Daubenton's bats, was recorded during May, with many feeding buzzes, indicating successful foraging. Reduced registrations ranged from: none in June; to passes with little foraging evidence, during August. The water quality/ lack of water/ extent of blanket weed on the water surface at the time of most of the surveys were likely limitations for Daubenton's bat, which requires clear and unobstructed water to trawl over the surface (the feeding strategy of this family). The water of the Crane at Heatham Park was > 40% cluttered with algal bloom between June and August 2014, although the water was relatively clear during the May survey. Studies indicate that Daubenton's cannot feed under these cluttered conditions. It is estimated the average distance at which Daubenton's bats can detect their prey to be only 128 cm. The water surface, therefore, seems to have an important influence on the acoustic environment. For this reason clutter on the water surface, such as plant cover, could exert a negative effect on the hunting behaviour of any trawling bat species (Booman, A., et al 1998).

5.6 BATS: MOVEMENT AND FORAGING.

The canopy of trees towards the east of the corridor around Heatham House created a perfect environment for bats, with the presence of rot and woodpecker holes as well as creating a linear feature used by bats for movement. As the river corridor continued west there were breaks in the tree line, which could be strengthened in the future as there are many species, which prefer not to venture into open areas. Vegetation, particularly mature trees, is used by bats for a variety of functions:

- roosts: e.g. the Noctule and Leisler's bats;
- commuting routes: in order to avoid open areas;
- cover: especially during the early part of the evening and in areas where light levels are high such as the; as well as
- foraging areas: the trees are both an insect breeding habitat and offer a sheltered microclimate.

Protection of these features is key to the persistence of local bat colonies.

5.7 LOW FLOWS

Low flows during the summer, 2014 were a limiting factor on the ability of Daubenton's bat to forage. The problem arises from most (and sometimes all) of the low flow being transferred into the DNR during dry summer periods. For the most part, from June onwards this year, there was only a minor bypass flow entering the main river below Mereway Weir at the top end of the study area. The Environment Agency is reported to be investigating this low flow issue and due to report at the end of the year. Blanket weed is able to proliferate in the nutrient enriched and warm conditions interrupting the surface of the water.

5.8 BAT RESPONSE TO LIGHT

A light level of 14 lux can be a better indication of pipistrelle emergence in urban areas than minutes after sunset. In areas affected by light pollution, bats can emerge late in the evening. This means that the dusk peak for insects may have passed and our urban bat populations may be feeding at a suboptimal time. The regional reduction in the numbers of Daubenton's bat is thought to pertain to the increase in light pollution (Briggs *et al*, 2007). Light pollution combined with another limiting factor; that of the nutrient enrichment of water, are the likely reasons for the loss of local foraging sites. In its Guidance on 'Preparing for Climate Change for Wildlife' 2011, Defra has highlighted the need to protect corridors used by bats for commuting purposes. Bat behaviour patterns are changing with the changing climate and hibernation times are being reduced; with bats being forced out to feed there is a duty to strengthen and protect wildlife corridors and commuting routes from light pollution.

5.9 EFFECT ON INSECT PREY

All bats in the UK feed upon insects and the smaller the bat the greater the number of prey items so that textbooks attest that a pipistrelle bat requires up to 3,000 insects per night. Lighting can affect the abundance of their insect prey. As the wavelength of light decreases, the attractiveness to insects increases. As low pressure sodium light has wave lengths in the region of 555nm, it does not attract insects. High pressure sodium does attract some insects but on average 57% fewer insects than a Mercury vapour light source. This can lead to demographic insect losses and a third of the insects that fly around light will damage themselves or die leaving less prey for foraging bats (Eisenbeis, 2006; Bruce White and Shardlow, 2011).

5.10 SUMMARY AND RECOMMENDATIONS

Several bat species use the River Crane corridor as a foraging area, especially in the early part of the evening. During the study they were detected shortly after their emergence period, this means that bats have not travelled far from a roost site. It is important that the corridor remains dark in order that roost sites will not be impacted by light spillage, which might delay emergence, as well as to retain the light shy species.
The following recommendations are made:

- Address the issue of low flow: comment on new abstraction licences;
  Rationale: This is currently seen as the greatest limiting factor on the ability of Daubenton's bats to move and forage. It greatly diminishes the river and the species associated with it. It increases the likelihood of waterbird egg predation (refer to 5.7).

- Undertake 'gapping' of treelines where possible;
  Rationale: Bats use treelines as navigation aids in order to move between sites. Trees create shelter, harbour insect biomass and act as light shields (refer to 5.6 and 6.3).

- Resist additional lighting along the river corridor;
  Rationale: light-shy bats exist within the study area. These are declining in the London region. Lighting causes fragmentation of habitat and may affect many species (including prey species) and increase the growth of unwanted vegetation in the river bed (refer to 5.8, 6.2, 6.3 and 6.4).

- Design and undertake a protocol to monitor bat activity (and quality of riparian habitats) with resident participation during 2015.
  A PowerPoint training session may identify barriers to bat conservation, which may exist across some of the private gardens.

- N.b. Japanese Knotweed is present within the study area (although it has been treated).

6.0 LEGISLATION AND POLICY

6.1 EUROPEAN AND UK LAW PERTAINING TO BATS

All species of bat are fully protected under the Wildlife and Countryside Act 1981 (as amended) through their inclusion in Schedule 5. All bats are also included in Schedule 2 of the Conservation (Natural Habitats, & c.) Regulations, 2010. The Act and Regulations make it illegal to:

- intentionally or deliberately kill, injure or capture (take) bats;
- deliberately disturb bats (whether in a roost or not);
- damage, destroy or obstruct access to bat roosts;
- possess or transport a bat or any other part of a bat, unless acquired legally; or
- sell, barter or exchange bats or parts of bats.

6.2 AMENDMENTS TO THE CONSERVATION OF HABITATS REGULATIONS (2010)

Moves to strengthen the protection of features of importance that protected species are reliant upon. This applies where there may be ANY disturbance to bats or a disturbance affecting:

- The ability of a group of animals of that species to survive, breed or rear or nurture their young;
- In the case of migratory species, impair their ability to hibernate or migrate or
- The local distribution or abundance of the species

This may preclude fragmentation of corridors caused by **light pollution** and a useful discussion of this is provided by Garland and Markham (2007). If a bat roost is to be affected by development activities, a licence from Natural England will need to be obtained.

6.3 UK HABITATS AND SPECIES OF PRINCIPLE IMPORTANCE NERC 2006 AND THE ROLE OF CONSERVATION UNDER BIODIVERSITY ACTION PLANS (BAPS)

Section 40 (1) of the NERC Act (2006): lists principle habitats and species, which are often included in Local, Regional and National Biodiversity Action Plans (BAP's). For example, the UK Biodiversity Action Plan (BAP) contains a Bat Species Action Plan (SAP). The BAP aims to increase the number of this species within the district by

protecting certain habitats; securing appropriate management for them and by halting the factors leading to their decline such as:

- Loss of maternity roost sites through damage or destruction resulting from a lack or a misunderstanding of the legislation protecting bats ;
- Loss of hibernation and other seasonally used roost sites;
- Lack of insect rich feeding habitats such as wetlands, woodlands and grasslands;
- Losses of linear landscape elements (flight line features) such as tree lines; and
- Excessive lighting, such as in streets and some open spaces.

6.4 ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION (2009)

The Royal Commission on Environmental Pollution, reported on the nuisance caused by badly designed lighting and the effects of artificial light on nature and ecosystems. It concluded that there was an urgent need for government to recognise that artificial light in the wrong place at the wrong time is a pollutant, which can harm the natural environment.

7.0 REFERENCES

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8.0 APPENDIX

Bat Sonograms of particular interest over the recording period May-August

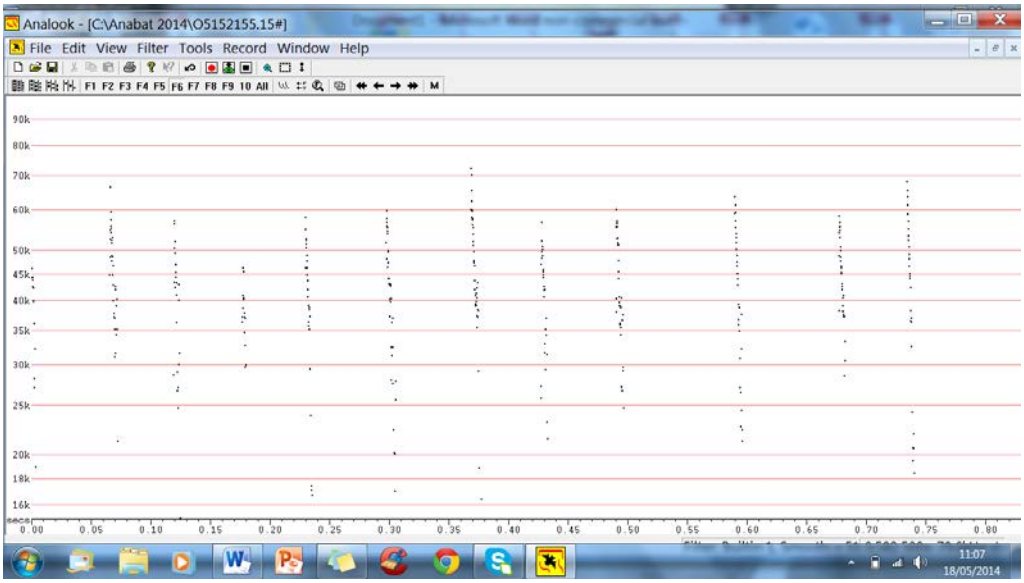

Fig.4 Screenshot of the sonogram of the first Daubenton's bat 15.5.14 at 21.55

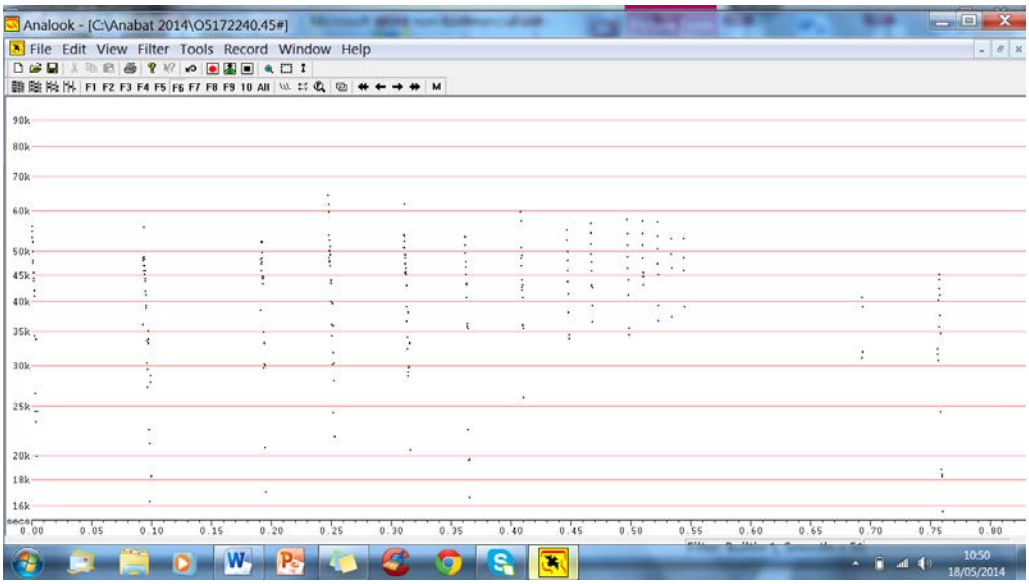

Fig.5 Screenshot of the sonogram of a Daubentons bat with feeding buzz 22.40pm 17.5.14

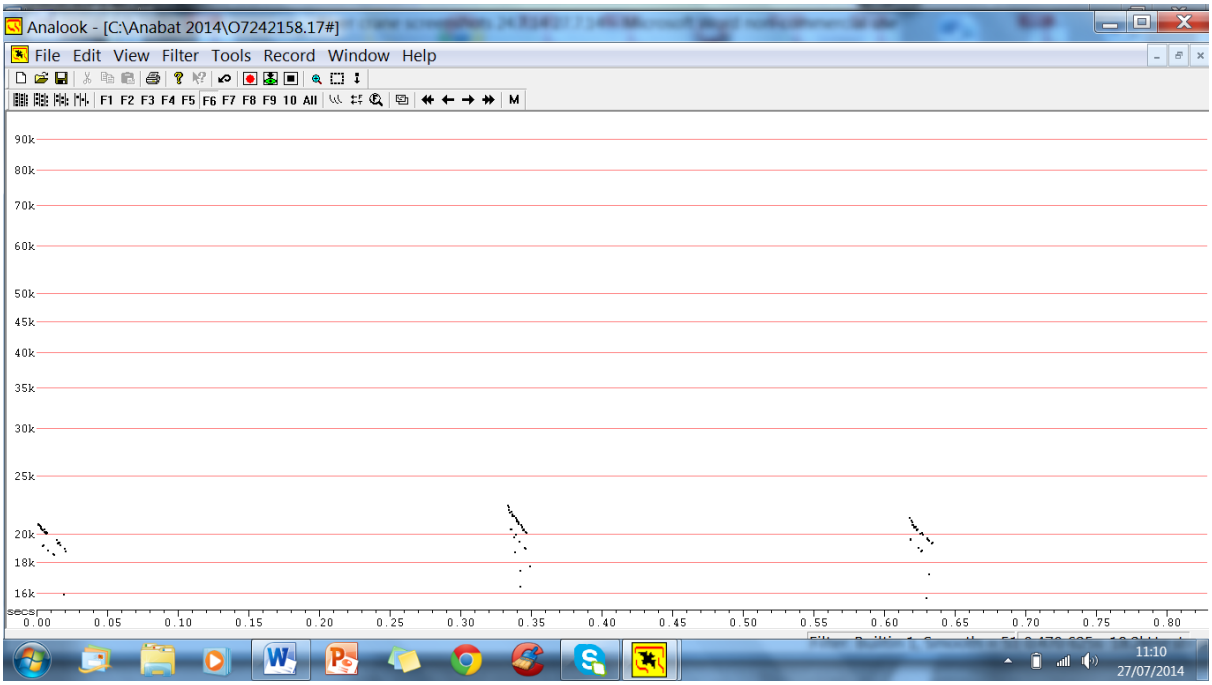

Fig 6 Screenshot of a Noctule bat 21.58 24.7.14 (night of the bat walk at Kneller Gardens)

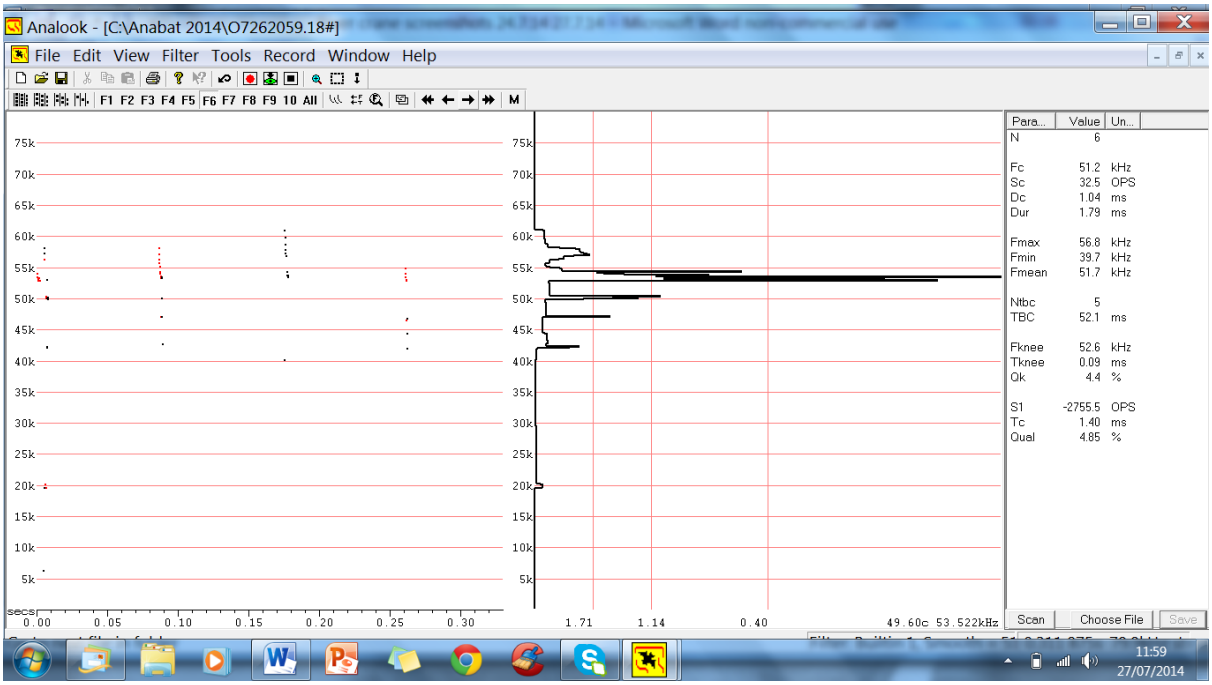

Fig. 7 Screenshot of a Pipistrelle Bat before sunset indicating a roost nearby time and date as headed. (27.7.14).

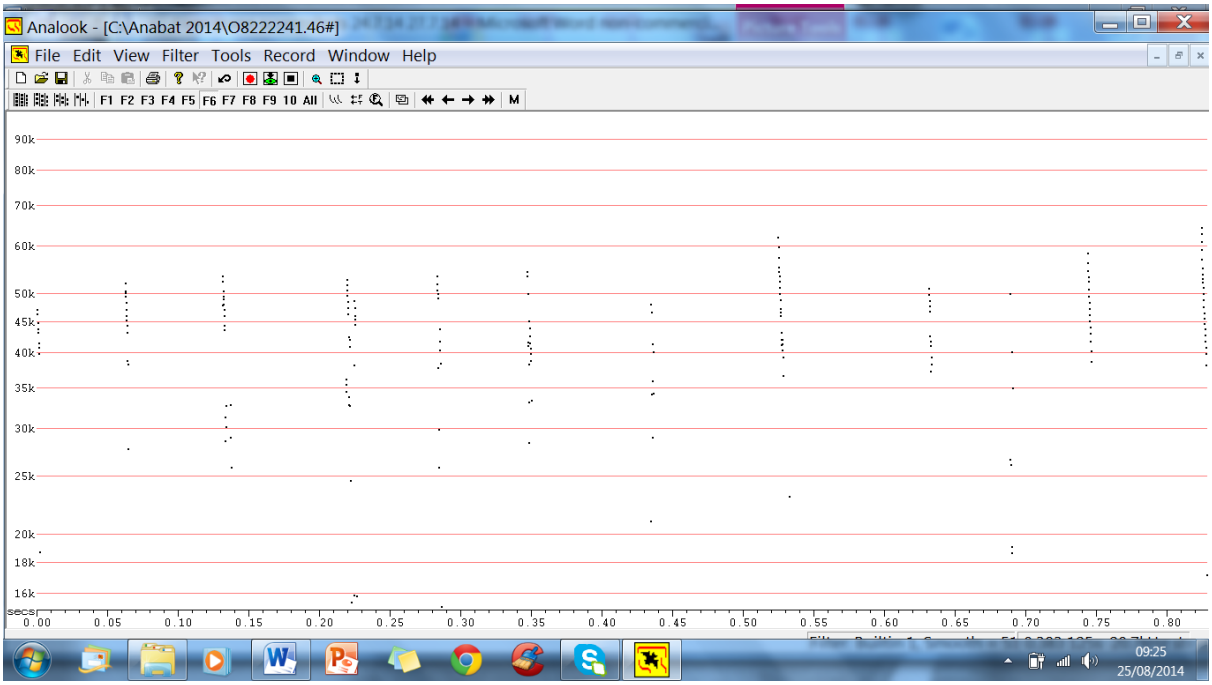

Fig. 8 Screenshot of the sonogram of a *Myotis* bat 22.41 22.8.14

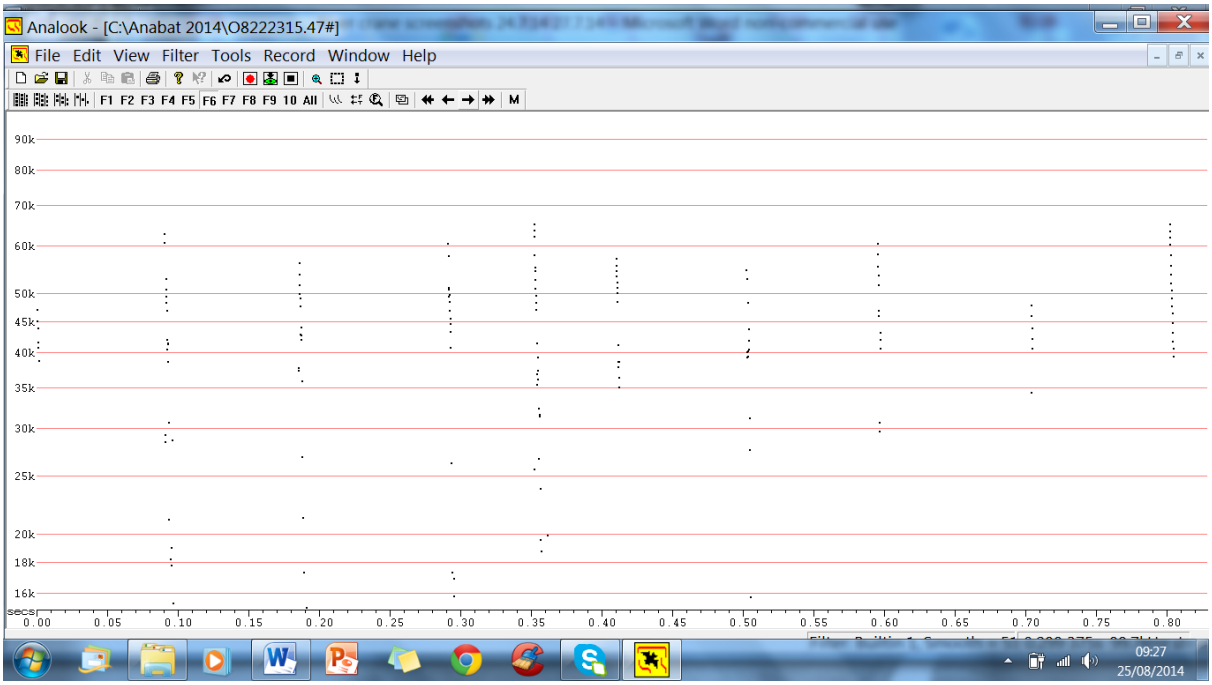

Fig. 9 Screenshot of the sonogram of more than one Daubenton's bat 23.15 22.8.14

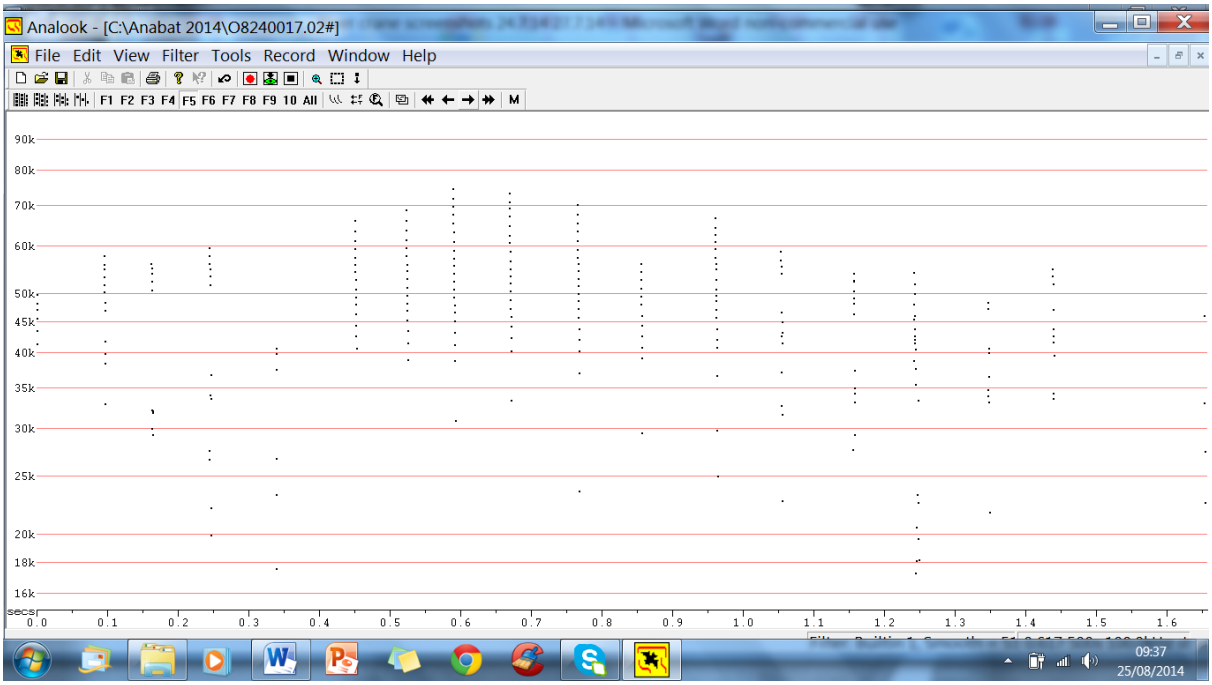

Fig. 10 Screenshot of the sonogram of a Daubenton's bats 00.17 24.8 14