SOUTH LANCASHIRE BAT GROUP

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CONSERVE BATS, CONSERVE HERITAGE

SURVEY OF BAT ACTIVITY OVER MILLPONDS IN SOUTH LANCASHIRE

2004 - 2006

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ABSTRACT

For the Kirklees Valley, Bury

Between 1994 and 2006 the following six/seven species have been detected in the Kirklees Valley: 45 KHz Pipistrelle Bat (*Pipistrellus pipistrellus)*, 55 KHz Pipistrelle Bat (*Pipistrellus pygmaeus)* (Pp), Daubenton's Bat (*Myotis daubentonii)* (Md), Noctule Bat (*Nyctalus noctula)* (Nn), Whiskered/Brandt's Bat (*Myotis mystacinus/brandtii)* (Mm) (the whiskered and Brandt's bats are inseparable when using bat detectors as they both sound the same, it is normal to bracket the two species together), and Brown Long-Eared Bat (*Plecotus auritus)* (Pa).

The average species richness for an individual pond was two; the pond with the highest species richness recorded during the survey was MK16, Island Lodge, in 2004, with four species.

The greatest increase in activity from 1995 to 2006 was in *Pipistrellus* spp. An increase in mean bat activity from 19.48% to 70.3% was observed. *M. daubentonii* was the only other species to have increased activity levels, from a mean of 10.49% to 19.1%

There is a highly significant difference in *Pipistrellus* spp. activity between periods one to six. This mirrors the findings of the National Bat Monitoring Programme, carried out by the Bat Conservation Trust (BCT).

There is no significant difference in *M. daubentonii* activity over the six years, although the numbers of passes appears to be increasing slowly. The National Bat Monitoring Programme has found significant increases in Daubenton's bat activity.

Relatively higher levels of Pipistrelle activity can be observed at ponds in the lower valley, as opposed to the areas in the middle and upper valley. The middle valley appears to be particularly important for *Myotis mystacinus/brandtii* compared with other areas. There is also a concentration of *Myotis daubentonii* in the middle section of the valley.

There is a significant difference in *M. daubentonii* activity between the ponds in the Kirklees Valley.

Pipistrelle activity shows a significant negative correlation with temperature.

A significant positive correlation between both *Myotis daubentonii*, and *Nyctalus noctula* and pond size was also indicated with co-efficients of 0.54 and 0.44 respectively. The larger the pond, the better for these bat species.

No significant difference in Pipistrelle bat activity was found for the different habitat areas between the pond and other habitats such as housing, woodland and recreation. However the greatest activity did occur over the pond.

For *Myotis daubentonii*, it can be said that there is significantly greater activity over millponds than elsewhere, meaning that the bats are selecting the water body in preference to the other habitat types.

General

Pyramid Park in Bury shows the importance of the water body, although no statistical analysis could be carried out. However it was observed that when the pond dried out, the numbers of bat passes dropped considerably.

At the East Lancashire Paper Mill, after three ponds were drained, the bats moved to use the remaining pond. It is considered likely that bats displaced from a pond which has been lost, or where the quality of a pond is reduced, will only remain at a favourable conservation status in the area if there are alternatives within close proximity with suitable habitat connectivity to guide them.

There was a considerable increase in bat activity at the small pond in Redisher Woods, Ramsbottom following some alterations to the pond which involved raising the water level.

The Wigan sites, especially the Wigan Flashes are a stronghold for Noctule bats in the South Lancashire area. The Haigh Hall site is also important for them.

The increase in *Myotis* (Whiskered Bat) activity on the River Spodden at Healey Dell is considered to be of importance on a regional scale.

Bats were found at all the ponds in all the sites of the survey area.

A Brown Long-Eared Bat roost, a Noctule roost, Pipistrelle roosts and a Daubenton's bat roost were located during the survey.

The survey results show how important it is to protect millponds, not only as historical features, as in many cases they are the last remaining fragments of the North West's industrial heritage, but also as important wildlife rich areas.

Since the start of the survey there has been a net loss of ponds, both in the Kirklees Valley, where some ponds have now been completely consumed by reeds and have dried out, and at sites like the East Lancashire Paper Mill, where ponds have been drained for development. The threat of draining and infill is ever present.

1.0 Introduction

At the height of the industrial revolution it was said that Lancashire clothed the world and cotton was king. Industry demanded vast amounts of water and mill ponds were built in their hundreds. Most of this industry has long gone, but a diversity of millponds remain, maintained as a matter of safety, many looked after by fishing clubs, others allowed to gradually fill with vegetation.

Our Heritage

Millponds are not only an obvious reminder of our industrial heritage, but have become remarkable refuges for wildlife. Water from the millponds had to have a certain standard of purity to make it useable during the lifetime of the factories (the streams would have been horribly polluted) and would have allowed some wildlife to hang on.

Top Wildlife Sites

As industry declined, more wildlife would have moved into the deserted sites from the mixed, wildlife-rich farmland nearby. This ex-industrial land now contains some of our best wildlife habitats, especially now that most of the mixed farmland is either more intensively farmed, become a monoculture of grassland, or has become housing, leaving less room for a diverse wildlife.

Bat Heaven

Taking full advantage of the facilities we have left behind are those most intriguing of mammals; bats. All British bats feed on insects, and where there is water and plenty of vegetation there are plenty of insects. Nearby houses provide perfect roosting places for our most common bat, the Common Pipistrelle, and old culverts and cellars produce ideal conditions for hibernation and roosting. Bat heaven indeed!

The South Lancashire Bat Group is a large and active Group working for bat conservation in and around the vice-county of South Lancashire, excluding Merseyside. The area includes Greater Manchester and the south-eastern parts of the present county of Lancashire.

This is a report on a survey initially covering 29 millponds in the Kirklees Valley, Tottington, Bury, as well as a number of additional ponds in the South Lancashire area that have not been previously surveyed to any degree by the Group.

This has been a 3-year project and this is the final report covering the whole of the project period.

Initial surveys were completed only in the Kirklees Valley, Bury, before the three year project commenced:

- Survey 1, 1994-1997
- Survey 2, 1998-1999
- Survey 3, 2003 this was conducted as a pilot survey for the LHI funded 'Conserve Bats, Conserve Heritage' project

1.1 A History of the Kirklees Valley

The first written records of Tottington and the area of the Kirklees Valley were written in the 12th and 13th Century, and the area was mainly regarded as a place for hunting of deer and wild boar in its forests. Land was cleared for agricultural use, and as the forested area diminished, hunting was gradually confined to prescribed areas known as parks.

The first record of a mill in the valley, a little downstream from the now demolished Tottington Mill, is to be found in accounts drawn up in 1295 and 1307 for the Honour of Clitheroe which owned the area at the time. The mills can be verified on maps drawn in 1786. The mills were corn mills, and would have been owned by the Lord of the Manor. Later they passed to the Greenhalgh family, the hereditary bailiffs of Tottington, who let the mill to a miller.

By 1660, the home industries of spinning and weaving wool had begun, but by 1730, this led to the spinning and weaving of cotton, and following the adaptation of Crompton's mule to water power in 1780, cotton spinning mills came into existence.

One of these mills, existing in 1811 was Gorton's cotton spinners and manufacturers at Kirklees and Tottington Mill. It had 9284 mule spindles. Pressure for yarn was greatly increased at this time, and all available buildings were used as loomshops to meet demand. The domestic weaving industry had been transferred from home to factory.

The survey of 1794 shows the presence of Tottington Mill which at that time was owned by John Leigh who used the mill in the manufacture of muslin. The Tottington corn mill was also still in use, both as a mill and smithy. Thomas Woods, fustian manufacturer and tanner also owned Mill House, a tannery, which, by 1800, had been converted to the process of spinning, weaving and bleaching for the cotton industry.

In 1821 Joshua Knowles took over Tottington mill, he extended the site leading to the employment of over 300 people, by far the largest employer in the area. By trade Joshua Knowles was a calico printer, so the mill converted to this process after he took ownership. After his death his brother, Samuel, took on the business. By 1901 the mill had increased in size, from just 7 printers to 19 and with 450 employees. Until the 1860's the mill was run on coal from Affetside. Samuel Knowles was instrumental in the development and construction of the Holcombe Brook to Bury railway line for coal transportation as well as the transportation of goods from the mills to the centre of Bury where goods could easily be transported to Manchester and the wider network.

Tottington Mill also provided gas for the Greenmount area, and coke for the heating of school and church buildings. In 1794 just 6 cottages were located near to the mill, but with the increase in output, a small hamlet grew in the immediate vicinity. The printworks themselves played an important part in the trade. It was the first to use an 8 colour printing machine.

Filter beds were installed in the 1890's to lessen pollution of the Tottington Brook (later renamed Kirklees Brook). In 1887 the streams flowing through Elton and Bury were reported to be highly polluted with dye-water and bleaching refuse, indeed the

printworks at Tottington mill produced more pollution than any other similar character in the watershed. Samples were taken of the brook at source and compared with samples taken at the brooks' confluence with the River Irwell in 1890 and reported in "The River Irwell and its Tributaries A Monograph of Pollution London 1890" by G.E. and A.R. Davies. The results are shown on the next page.

Table 1 : Sample Results From Kirklees Brook

Contents	**Parts per 100,000**	**At Source**	**At confluence with River Irwell**
Suspended Matter	Mineral	-	18.44
	Organic	-	4.71
	Total		**23.15**
Total Soluble Solids		17.14	345.00
Loss of Ignition		5.57	167.57
Total Hardness		13.57	64.30
Permanent Hardness		6.00	52.85
Temporary Hardness		7.57	11.44
Chlorine		3.51	39.55
Alkalinity		3.92	49.00
Free Ammonia		0.01	0.27
Albuminoid Ammonia		0.01	0.88
Absorbed Oxygen		0.59	180.80
Nitrates		0.06	0.23

The mill closed down in 1928, and little now remains apart from a number of unsealed cellars and factory foundations. There are many remains associated with the storage and treatment of water which was the main attraction of industry to the area. There are now just a few filter beds which are in a bad state of repair and mill

lodges; originally 6, now only 4 remain. The processing in the mills needed clean water. The original source of this water was the brook, however as can be seen above the effluents released by the mills made clean water in the brook impossible, hence the need for the mill ponds; the clean water stored in the mill ponds (lodges) was needed for use in the processes, and to drive water wheels.

During the Second World War the remains of the site were used by the home guard as an open air shooting range. By June 1976 the Department of the Environment had sent representatives to survey the area, who agreed it would qualify for a reclamation grant, “being one of the most attractive areas in the Borough, and as such a significant asset and a landscape worth maintaining and enhancing, the area around Island Lodge being like a magnet for many people, attracted by the water, trees, buildings and artefacts, the sense of remoteness and enclosure giving a feeling of peace and seclusion, all these factors being sufficiently strong motivators to over-ride the sense of dereliction”.

The impressive 9 arch viaduct 33 feet high across the western end of Island Lodge carried the railway, which was completed in 1882. The last electric train ran in March 1951, and the line was officially closed by British Rail in August 1963. The line transported raw goods to the mills and the completed product from the mills.

The other large mills to the south of Tottington Mill were Kirklees Mill and the Kirklees Printworks, the latter surviving only until 1824. The Kirklees printworks had 6 waterbodies that stored the water needed for its processing. Now only 4 remain. Kirklees Mill was primarily used as a bleachworks, the mill dating back to 1852. Later Rayon and chemicals were manufactured at the mill until 1962. Courtaulds took over the site in 1962 and some of their signs can still be seen along the paths. The factory, which was then a dyehouse, finally closed in 1980.

There is an interesting story associated with the Bleachworks. In 1884, a French chemist, the Comte de Chardonnay, moved to Tottington to work on a cellulose-based fabric that became known as "Chardonnay silk". It was an attractive cloth, but like celluloid it was very flammable. Eventually, following numerous accidents, it was taken off the market.

Other mills in the valley which used millponds for water storage and treatment were the Stormer Hill Bleachworks, Mill Lane Tottington. This is the pond we have labelled MK18. Britannia Mill closed completely in 2005, most recently in use as a paper mill by the company Olives Activecraft. This site, and the site of the Woolfold Paper Mill at Champale, very near Crostons Road, Bury, is now being developed for housing; ponds at the latter are used currently for recreational angling. The ponds at the former Britannia Mill will be retained when the work is completed on the development.

1.2 Literature Review

Chiroptera (bats) is probably one of the most successful and diverse mammalian orders, and of the worlds estimated 4800 species of mammal, around 1170 - almost one in five - are bats.

Although the majority of bats inhabit tropical areas, the British Isles are home to 17 species, belonging to the families *Vespertilionidae* and *Rhinolophidae*. These are the only two families under the order Chiroptera to contain truly temperate species, (Altringham 2001).

Temperate species usually mate during the autumn, hibernate through winter, and then form maternity colonies throughout spring and summer, where the offspring are born and reared.

All British bats are insectivorous and follow a K-selective life history with females bearing just one offspring per year, and adults exhibiting a life span of up to 30 years. A K-selective regime is an environment where selection pressures favour long generation times, small numbers of off-spring and greater specialisation. It is associated with stable environments. The K-selective life history can leave species vulnerable to environmental changes, if such changes cause reduced longevity or reproductive success.

This may have been partly to blame for the decline in bat populations experienced in Britain over the past fifty years.

Suitable roost sites and foraging areas for bats in England have decreased during the past century. This is due to large-scale deforestation, making way for intensive agricultural practices and the development of new buildings. Now, of the 17 species left, two are endangered and nine threatened. For this reason it has been vital that key roosting and foraging sites be identified and preserved in an attempt to prevent population numbers from falling any lower. Certain measures have been implemented to do this since the 1980's.

In 1981 the Wildlife and Countryside Act afforded protection for bats and their roosts; however the same has not been done for foraging habitats. In a study of habitat use by bats, Carmel and Safriel (1998) recommended that conservation programmes for insectivorous bats should be based on protecting their foraging habitats as well as their roosts.

However according to Warren et al. (2000) there is little quantitative data about bat habitat, often making it difficult to establish suitable management recommendations.

In an analysis of the UK national bat habitat survey, Walsh and Harris (1996) found that broadleaved woodland and water in England were optimal areas for vespers bats. In contrast to this, they stated that arable land, moorland and improved grassland were strongly avoided.

The importance of all water bodies and woodland edge as key habitat sites to bats was highlighted, and it was also emphasised that such areas were comparatively rare within each land class Group. The preservation of such existing habitats is therefore of great importance to the conservation of bat species.

Studies concerning insectivorous species, and their habitat preferences, have shown that foraging preferences and methods of prey capture vary between species. Variation in habitat preference has been related to differences in wing morphology,

flight style and echolocation. This is exemplified in the species *Pipistrellus pipistrellus* and *Myotis daubentonii*. These two species have similar diets, consisting mainly of *Trichoptera* and *Nematocera* (Swift and Racey, 1983, Sullivan et al., 1993). Swift (1985) found that *Ephemeroptera* and *Neuroptera* were also part of both bats diet, however both appeared to be selected for by *P. pipistrellus*. Most of these insects have aquatic larval stages, which explains why water bodies have been found to be an important habitat for both *M. daubentonii* and *P. pipistrellus.*

P. pipistrellus forage in areas of riparian vegetation, over water, and around trees, (Racey and Swift, 1985, Carmel and Safriel 1998). They often forage at least two or three metres above the ground or surface waters.

M. daubentonii have a more restricted feeding niche. Bartonicka and Zukal (2003) found that the highest activity of *M. daubentonii* was in the vicinity of water bodies, as compared to gardens and urban areas. Their enlarged feet enable them to trawl for insects, and feed almost exclusively over water (Warren at al, 2000). The use of their feet to take prey from surface waters was proven by Kalko and Schnitzler (1989) who used photographic methods. This method of prey capture provides *M. daubentonii* with a food source that *P. pipistrellus* cannot access, thus reducing interspecific competition for food.

A seasonal change in foraging tactics by M. *daubentonii* was noted by Jones and Rayner, (1988). Before June *M. daubentonii* foraged by both aerial hawking (insects captured in flight) around trees and gaffing (prey taken from surface waters), however throughout June and after this month gaffing predominated.

It was observed that *M. daubentonii* spent all of their time within 30 cm of the water surface, away from clutter.

The studies above establish the general habitat preferences of these bat species, but do not consider the effects of abiotic variation within such areas.

Myotis daubentonii may be especially vulnerable to such variation due to its limited habitat preference, restricting its foraging range.

Vaughan et al. (1996) found that for the conservation of *P. pipistrellus* the maintenance of high standards of water quality may be important, but *M. daubentonii* may be able to benefit from eutrophication due to increased chironomid numbers.

On average an individual bat can consume up to 3500 insects per night, therefore areas of high insect abundance are of great importance to the survival of these species.

Racey and Swift (1985) stated that '…*It thus appears that foraging habitat is determined by insect abundance*…'.

Other environmental factors have been proposed to affect activity levels over foraging areas.

Russ and Montgomery (2002) found that the margins of lakes or reservoirs were selected for, and it was also noted that water bodies with no vegetative edge were usually avoided.

Bank-side vegetation is suggested to provide shelter from wind and concentrate insects (Verboom and Spoelstra, 1999).

Warren et al. (2000) monitored *Pipistrellus* spp. and *Myotis daubentonii* activity levels in relation to small-scale variation in riverine habitat. They found that both species significantly preferred sections of river with smooth surfaces and trees on both banks.

Although many studies point to the factors that influence insect density to be of primary importance to bat activity levels, other factors have also proven to have an effect.

Boonman et al. (1998) found that *Myotis daubentonii* avoided foraging over ponds covered with duckweed, a factor that is related to echolocation rather than insect density.

It has been demonstrated by Siemers et al. (2001), that '…success in capturing prey from surfaces in trawling *Myotis* spp*.* depends on the acoustic properties of the surface on which the prey is presented'.

Perception of prey by echolocation was shown to be easier if the prey is presented on a smooth surface (such as calm water), than on a structured surface (such as vegetation or the ground).

2.0 Method

2.1 Preliminary Survey in the Kirklees Valley

A survey by map (Pathfinder 700, Bolton North & Horwich) and by walk-through was carried out to find where ponds survive or have been lost since the map data was collated. It was found that 10 ponds shown on the map (compiled 1953-1984) were already missing. One additional pond was found and two other ponds were considered inaccessible.

The valley was divided into three sections:

- Lower Kirklees (LK)
- Mid Kirklees (MK); and
- Upper Kirklees (UK)

Each pond was given a reference number with prefixes LK (12 ponds), MK (16 ponds) or UK (4 ponds) placing them in a particular section.

Above: Mid Kirklees Pond used by Kirklees Mill (ref MK9).

2.2 Daylight Survey

In 1994, the main habitat types around each millpond were recorded within:

a) 10 metres of the pond
b) 50 metres of the pond

They were recorded as a percentage of each of the following types:

1. Buildings, brickwork, bare ground etc.
2. Still water
3. Flowing water
4. Improved pasture and arable
5. Unimproved and semi-improved pasture, hay meadow
6. Hedgerow and scrub - less than 5m tall
7. Broadleaved woodland - more than 5m tall
8. Rank herbage, rough grassland
9. Marsh, reed bed
10. Parks, gardens, playing fields
11. Other- specified

An estimate of the degree of wind shelter (by valley sides, high banks, trees etc.) around the pond was made:

0 = exposed
1 = slightly sheltered
2 = moderately sheltered
3 = highly sheltered

The following were noted:

- Height above sea level
- Approximate area of open water

- A position from which to carry out the evening survey close to the pond edge with regard to accessibility, safety, and where possible to the south-east of the pond in order to make best use of the light north-western sky after sunset.

2.3 Other Ponds and Water Bodies Included in the Survey

We decided to include other water bodies within the scope of the project, specifically choosing those that may have been in danger of development, and those associated with industry, such as canals, and subsidence flashes. Requests from a number of organizations to survey millponds or lodges were made to the Group in order to collect data on bat activity. These were:

- **The Parkers & Whitehead Lodges** – The Friends of Cockey Moor and Whitehead Lodges
- **Hollins Vale** – Hollins Conservation Group
- **Healey Dell** – Friends of Healey Dell
- **Cliviger** – Pond Conservation Trust
- **East Lancashire Paper Mill** – Angling Club & Local Residents.
- **Wigan Flashes** – Wigan Countryside Service
- **Philips Park** – Bury MBC
- **Worsley Basin** – Salford MBC
- **Redisher Woods** – Friends of Redisher Woods and Bury LNR Officer
- **Pyramid Park** – Bury MBC

In addition we carried out surveys at a number of other ponds purely for interest and in order to quantify bat activity at the site. Other surveys were conducted as members were keen to determine which bat species were using their local pond, or to see which bats were using previously un-inspected areas.

2.4 The Dusk Bat Survey

In order to minimise the effects of large fluctuations in numbers of feeding bats such as may occur when young begin to fly in early and mid-summer, and when the

autumn weather takes it's toll, late July to September was chosen as the survey period.

Each pond was surveyed avoiding heavy rain, high winds and unusually low temperatures.

On the survey evening, at 15 minutes after sunset, the following were recorded:

1. Temperature (ºC) at waist height at the observation point.
2. Approximate wind strength (Beaufort) waist height at observation point.
3. Approximate wind strength (Beaufort) and direction generally.

At the same time, a Batbox III, Duet, or Petterson bat detector was tuned to 45 KHz, and turned to full volume.

- The time of first contact with each bat species was noted.
- The details of any observed behaviour such as commuting or squeaking was also noted.
- Any identification doubt was noted. Bats were recorded to species level where possible, although genus was commonly used, especially for *Pipistrellus* bats.
- Between 60 and 75 minutes after sunset the number of bat passes was counted for each species. In the case of continuous contact, a count of one pass was made for each 10 seconds of contact.
- Therefore, a continuous contact for 15 minutes would give a count of 90 (per species).
- The survey ended 75 minutes after sunset.

2.5 Comments on Method

1. A tuning of 45 kHz will register all bat species likely to be found in the Bury area, and it is possible, with practice, to identify these species with a fair degree of accuracy.

2. The period of time between 60 and 75 minutes after sunset was chosen for counting, as this is likely to be part of the most active time for foraging bats, including late emergent species.

3. It is almost impossible to count the number of bats foraging over a pond; less possible to measure the time each bat spends there, so counting every time a bat passes through the range of the bat detector was considered the best way of gauging bat activity. The count numbers, therefore, do not directly relate to bat numbers but to the level of bat activity, which relates to the importance of the pond to bats during the counting period.

A suggestion that a count of feeding buzzes (that is a rapid increase in click rate heard as a “raspberry” on a bat detector when a bat homes in on an insect) be used as a gauge of bat activity was not taken up because:

- It may produce a bias in favour of bats hunting small prey items. A large prey item may be worth several passes, whereas a bat taking midges may produce several feeding buzzes in a single pass;
- The number of feeding buzzes would generally be less, often much less than the number of passes and would be statistically less significant;
- Ponds may be important to bats for reasons other than foraging, e.g. drinking, commuting, male breeding territories and social activities.

3.0 Comments on Results

3.1 Species Distribution

3.1.1 Bats in the Kirklees Valley

Data collected over the 12 year study period was analysed, taking into consideration individual ponds, species, and looking at the valley as a whole, to try and determine any trends in bat activity.

Due to limited volunteers early on in the survey, the whole valley could not be completed in one year, and therefore the study has been split into 'survey periods' that are as follows:

- Survey period one (1994-1996)
- Survey period two (1997-1999)
- Survey period three (2003)
- Survey period four (2004)
- Survey period five (2005)
- Survey period six (2006)

Above: Island Lodge in the middle of the Kirklees Valley.
Previously part of the Tottington Mill complex (ref MK16).

3.1.2 Species Richness in the Valley

Between 1994 and 2006 the following six/seven species have been detected in the Kirklees Valley:

- *Pipistrellus pipistrellus*,
- *Pipistrellus pygmaeus* (Pp),
- *Myotis daubentonii* (Md),
- *Nyctalus noctula* (Nn),
- *Myotis mystacinus/brandtii* (Mm), and
- *Plecotus auritus* (Pa).

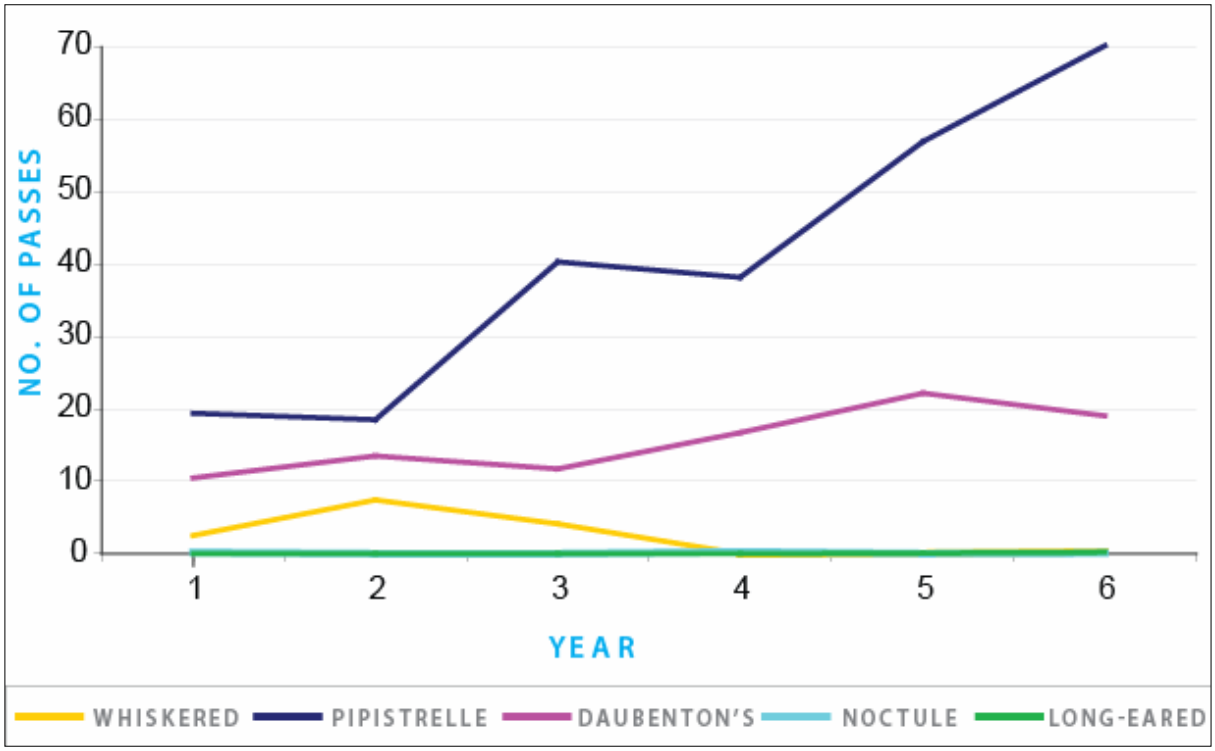
The average species richness for an individual pond was two; the pond with the highest species richness recorded during the survey was MK16 in 2004, with four species.

3.1.3 Changes in Bat Activity over Time

Due to difficulties in species determination for Pipistrelle species, these were determined to genus level only (abbreviated to Pp). *M. mystacinus* and *M. brandtii* are collectively abbreviated to Mm due to similar difficulties in identification to species level.

It can be seen in graph 1 (overleaf) that over the survey period *Pipistrellus* spp. were the most abundant species throughout the valley, however it should be taken into consideration that the data does include the two species, *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus.*

Graph 1: Mean bat species activity in the Kirklees Valley over time



Graph 1 illustrates that the greatest increase in activity from 1995 to 2006 was in *Pipistrellus* spp. An increase in mean bat activity from 19.48% to 70.3% was observed. *M. daubentonii* was the only other species to have increased activity levels, from a mean of 10.49% to 19.1% (see appendix 2 for figures).

In order to find whether the differences in bat activity between survey periods one to six were significant, the Kruskal-Wallis test was applied using the SPSS statistics package.

***Pipistrellus* spp.**

Appendix 2 shows the test data for *Pipistrellus* spp.

The calculated chi-squared value (46) exceeds the critical value (15.09), (at 5 df., and at P = 0.01). It can therefore be concluded that there is a highly significant difference in *Pipistrellus* spp. activity between periods one to six.

Although these results do not allow the assumption of which years are significantly different from each other, it can be said that overall, there has been a significant increase in activity over the survey period.

M. daubentonii

Appendix 2 shows the test data for *M. daubentonii.*

The calculated chi-squared value (4.8) is less than the critical value (11.07), (at 5 df., and P = 0.05), therefore it can be concluded that there is no statistically significant difference in *M. daubentonii* activity over the six years. This implies that the observed increase in activity in graph one is not significant.

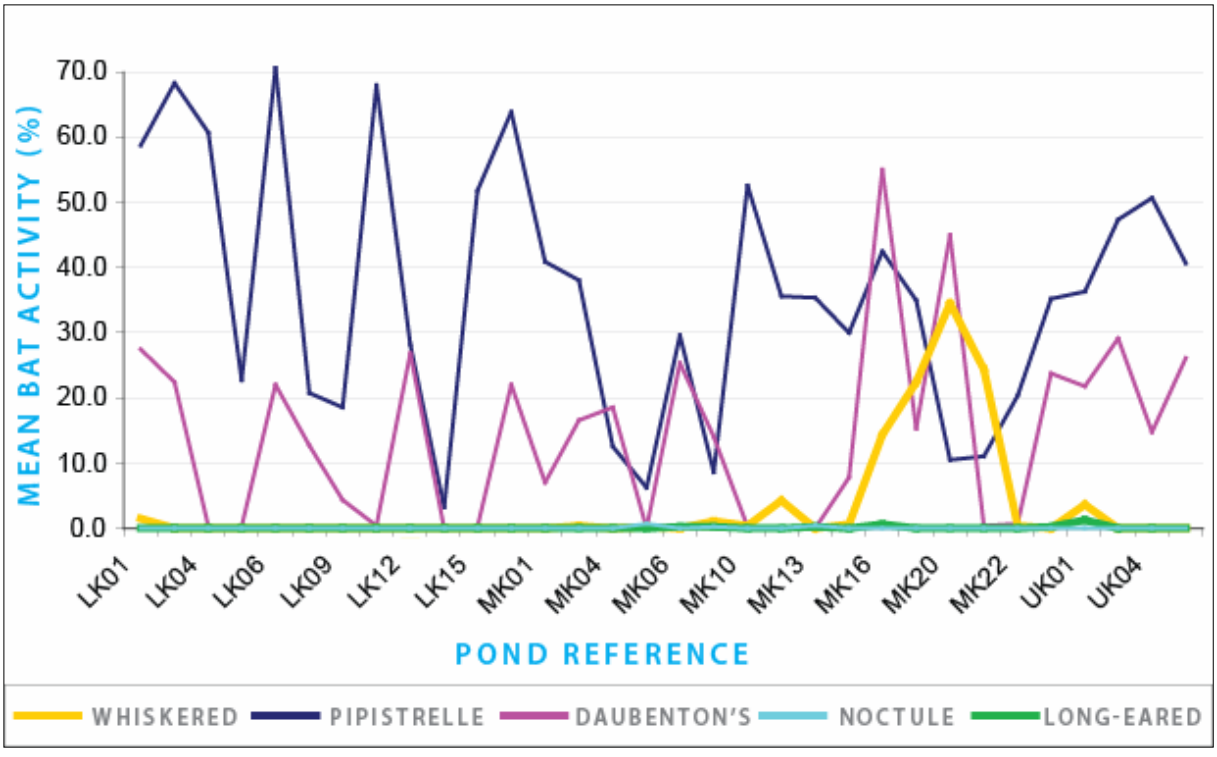
Activity levels for the other species in the study were found not to vary significantly.

It should be noted that at the start of the study 32 ponds were present/accessible, and by 2006 only 24 of these were present. The possible implications of this will be considered in the discussion.

3.2 A Graphical Representation of Bat Activity through the Valley

Below, graph 2 displays the mean bat species activity at each pond throughout the valley, in an attempt to highlight any differences from lower (LK) through to upper (UK) areas of the valley.

Graph 2: Mean bat species activity over the valley



Relatively higher levels of Pipistrelle activity can be observed at ponds in the lower valley, compared to the areas in the middle and upper valley.

The middle valley appears to be particularly important for *Myotis mystacinus/brandtii* than other areas. There is also a concentration of *M. daubentonii* in the middle area of the valley. The location of the ponds in the mid section (MK) is shown below.

3.3 Summary of Rarer Species

During survey periods four and five, no *M. mystacinus/brandtii* activity was recorded, apart from 1.1% at MK16 in 2004.

Noctules (*Nyctalus noctula*) were observed at UK01 in 1996 (5.56%), and then not recorded again until 2004. During the 2004 survey, they were noted at ponds in the middle of the valley, but only at activity levels below 5%.

Plecotus auritus (Brown Long-Eared) were only recorded in 2004, 1.1% at MK05, and 2005, at 2.22% at MK13.

In survey period six (2006), Noctules and Brown Long-Eared bats were again observed in the middle of the valley, however at levels below 5%.

3.4 Differences in Bat Activity between Individual Ponds

Ponds were subject to Kruskal-Wallis analysis in an attempt to see whether there was a significant difference in mean bat activity between ponds for *Pipistrellus* spp. and *M. daubentonii*. Appendix 2 shows the test data for activity levels.

***Pipistrellus* spp.**

The calculated Chi-square value (54.7) is less than the critical value (55.76), (at 32 df., and P = 0.05). It can therefore be concluded that there is no significant difference in mean *Pipistrellus* spp. activity between the ponds.

M. daubentonii

The calculated Chi-square value (76.6) is greater than the critical value (63.69), (at 32 df and P = 0.001), indicating that there is a significant difference in *M. daubentonii* activity between the ponds.

The greatest difference in activity levels for *M. daubentonii* occurred between ponds MK16 (mean of 55%) and LK04, LK05, LK11, LK14, LK15, MK05, MK10, MK12, MK13, MK21, and MK22 (all had a mean of below 1%).

3.4.1 Possible Factors Affecting Bat Activity

Along with data on bat activity levels, measurements of temperature, amount of shade, pond size, and wind at time of survey were also recorded. Abiotic factors such as these are known to affect biotic factors including insect abundance, which in turn may possibly affect bat activity levels.

In order to ascertain whether bat species activity levels were associated with any of the recorded factors, correlation coefficients were obtained, which can be viewed in table 2.

Table 2: Correlation coefficients

	Variable			
Bat Species	**Temp. (^{o}C)**	**Shelter**	**Wind at site**	**Area (m^2)**
Pp	-0.44	-0.32	0.36	0.21
Md	-0.09	-0.30	0.13	0.54
Mm	0.29	0.15	-0.07	0.03
Nn	0.00	0.12	0.24	0.44
Pa	0.04	0.23	-0.22	-0.15

The calculated Spearman's coefficient between Pipistrelle activity and temperature of -0.44, exceeds the critical value (0.43) at P=0.01, thus indicating a significant negative correlation.

A significant positive correlation between both *Myotis daubentonii*, and *Nyctalus noctula* and pond size was also indicated with co-efficients of 0.54 and 0.44 respectively**.** All other species/factor combinations did not show any significant associations.

Above: Mill pond for the former Kirklees Mill (ref MK6).

3.5 Other Survey Sites

Data has been collected in previous pilot surveys in the Kirklees Valley allowing trends to now be visible, however under the remit of the ‘Conserve Bats, Conserve Heritage’ project the South Lancashire Bat Group was able to survey ponds and water bodies outside of the Kirklees Valley. We decided to include other water bodies within the scope of the project, specifically choosing those that may have been in danger of development, and those associated with industry, such as canals, and subsidence flashes. Requests from a number of organizations to survey millponds or lodges were made to the Group in order to collect data on bat activity. These were: -

Parkers and Whitehead Lodges, Ainsworth Bolton	3 ponds
Healey Dell, Rochdale	5 ponds
Wigan Flashes, Wigan	7 ponds
East Lancashire Paper Mill Radcliffe, Manchester	4 ponds
Cliviger, Todmorden	1 pond
Starmount Lodges, Bradley Fold, Bury	4 ponds
Burrs County Park, Bury	4 ponds
Moses Gate Country Park, Farnworth Bolton	2 ponds
Jumbles Reservoir, Bolton	1 pond
Pilsworth Fisheries, Bury	8 ponds
Whitley Reservoir, Wigan	1 pond
Worsley Delph, Worsley Manchester	3 ponds
Hollins Vale, Bury	1 pond
Yarrow Valley, Chorley	2 ponds
Philips Park, Whitefield Manchester	2 ponds
Pyramid Park, Bury	1 pond
Ponds at Haigh Hall, Wigan	2 ponds
Redisher Woods, Ramsbottom Bury	3 ponds

In addition to these ponds, increased volunteer surveyors enabled the Group to carry out additional surveys on water bodies during 2006.

These sites are as follows and the results can be seen in Appendix 1.

Littleborough, John Street Pond & Ealees Pond	2 ponds
Sennicar, Haigh	1 pond
Wallsuches, Horwich	1 pond
Myrtle Street Lodges, Middleton	2 ponds
Belfield Lodges, Rochdale	2 ponds
Clegg Hall Mill, Rochdale	1 pond
Water Lane Pond, Milnrow	1 pond
Upper Town House Fishery Rochdale	1 pond
Birtle Lodge, Bury	1 pond
Pennington Flash, Leigh	4 positions
Greggs Lake, Bury	2 ponds
Doctor Dam, Norden Rochdale	1 pond
Wigan Haigh Canal, Wigan	6 positions

4.0 Conclusions

4.1 The Kirklees Valley

- The string of millponds in the Kirklees Valley provides one of the most important foraging sites for bats in South Lancashire Bat Group's area.
- Bats were recorded on every millpond. Bats use ponds whether they are sheltered or exposed, large or small, well vegetated or bare, in a Group or relatively isolated.
- Areas of longstanding industrial dereliction are vital refuges for bats in largely urban and intensely farmed rural areas.
- Whiskered and Daubenton's bats were confined to certain areas of the valley, however in most recent years Daubenton's bats were spread throughout the valley which has contributed to the 50% increase in activity overall. The disturbance of a roost site may have accounted for the decline in Daubenton's records in the northern part of the valley in 2003.
- Noctule activity is low in the count period, however they are recorded before this period. This is likely to be due, at least in part, to the fact that Noctule bats emerge early from their roosts, just after sunset, and commute elsewhere. Although foraging records are occasionally made, it is likely that the Valley is used as a commuting route to a main foraging site.
- Millponds are still being lost at an alarming rate.

4.2 Other Survey Sites

Surveys have now been carried out at the other survey sites for three consecutive years (2004, 2005 and 2006) using the same methodology. It is now possible to comment on the survey results and discuss the possible conclusions.

4.2.1 Wigan Flashes

The flashes formed after mining activities caused the land to subside. Water filled the sinking areas causing flash floods which turned into permanent lakes. Seven areas of water (flashes) were surveyed during the project. This area is now a Nature Reserve.

Above: The Leeds/Liverpool canal (foreground) with Pearson's Flash behind (ref WF2).

During the three years of survey three species of bat have been recorded at Wigan Flashes including Noctule, Common Pipistrelle and Daubenton's bat.

Pipistrelle activity was recorded at all flashes. Pipistrelle activity was recorded for the longest period within the 15 minute count over Ochre Flash, Bryn Marsh, Waddicar Flash and Westwood Flash.

Daubenton's bat activity has been recorded at Scotsman's Flash in all three years. Scotsman's Flash is the largest of all seven surveyed flashes and the survey evidence collected suggests the Daubenton's bats are selecting the larger pond; this observation supports the conclusion made (and supported by a significant statistical test) that Daubenton's bats are more frequently recorded over larger water bodies. Daubenton's bats have also been recorded at Westwood Flash in 2004 and 2005. In 2006, Daubenton's bat was recorded at Waddicar Flash and Bryn Marsh SSSI during the 15 minute count for the first time in the three years of survey.

Of exceptional significance at Wigan Flashes is the high amount of Noctule activity. The Noctule activity at Wigan Flashes during the 15 minute count is noticeably greater than that recorded at all other surveyed sites in the whole project. Noctule activity has been recorded at all flashes with the exception of Ochre Flash.

The length of the Leeds and Liverpool Canal, a known wildlife corridor, between Haigh Hall (and Whitley Reservoir) in the north and Wigan Flashes, is only approximately 4 kilometres. Pipistrelle species will forage between 3 to 5 kilometres from their roosts whilst bat species such as Daubenton's bat and Noctule are reported to forage long distances (up to 7-10 kilometres). All three species of bat have been recorded at both sites and whilst further surveys along the canal are essential to determine whether the bats are definitely foraging along the canal habitats between the two sites, it seems the proximity of Haigh Hall and Wigan Flashes to the canal is an important factor in the abundance of bat activity recorded at both sites.

4.2.2 Yarrow Valley Park, Chorley

The park was created on land previously used for bleaching, dyeing, calico printing and mining. The Birkacre area of the park is of local historical importance with its restored mill lodges and watercourses.

Above: Yarrow Valley large pond (ref YV1).

A total of four species of bat have been recorded at the Yarrow Valley survey site including 45 KHz Pipistrelle, Daubenton's bat, Noctules and Whiskered bat. Importantly, Yarrow Valley is the only surveyed site outside the Kirklees Valley which supports four bat species.

Not all ponds have been surveyed in the 2004-2006 survey period, those ponds which were not surveyed in 2004 (YV3 and YV4) were surveyed twice in 2006 in order to get three sets of results. It is therefore difficult to discuss any changes/consistencies in the bat activity over the three survey years.

All four ponds support Pipistrelle and Daubenton's bat activity, the greatest abundance of both these species activity was recorded at pond YV2 in 2005 and YV1 in 2006.

Of huge interest are the records of Whiskered bats at ponds YV1 and YV2, Whiskered bats were recorded over both of the ponds in 2005.

There are a few Noctule records, but Noctules did not forage for long periods of time at Yarrow Valley during the survey period, and they had generally moved off before the 15 minute count. No one pond appears to be used significantly more by Noctule bats and it must be concluded that the complex of habitats across the whole site is of importance to the attraction of this species.

Again, pond area seems to be a noticeable feature in the attraction of Daubenton's bat. Daubenton's bats were present for the whole 15 minute recording period at YV1 (the largest pond at approximately 12000m^2) in 2006. In 2004 and 2005 a high abundance of Daubenton's bat was also recorded at YV2, but the percentage of Daubenton's bat activity at YV2 decreased in 2006. This pond is colonised by marginal reedbed which may be encroaching over the whole water area, thus reducing the value of the pond to Daubenton's bat which prefer to forage over open water habitats. Interestingly, in 2006 the Daubenton's bat activity over Pond YV3 increased in comparison with 2005, suggesting the bats displaced from YV2 because of the decreased habitat value have found an alternative pond to forage.

4.2.3 Jumbles

The large reservoir at Jumbles was surveyed in 2004, 2005 and 2006; two species of bat (Daubenton's bats and Common Pipistrelles) were recorded on all occasions.

In 2004 the recorded bat passes for Daubenton's and Pipistrelle bats were fairly high and almost equal, however in 2005 Daubenton's appear to be more active during the survey period and Pipistrelles less so than in 2004. 2006 saw a reversal of fortunes with a low Daubenton's count, well down on 2005, with a slight recovery of Pipistrelle activity.

In 2006 the water level was very low, leaving the bank-side vegetation high and dry. These conditions would not suit many aquatic insects, and Daubenton's may have sought better foraging areas. Bradshaw Fisheries, 500 metres down the valley, would be worth investigation.

At the edge of a large reservoir such as this, the slightest change in wind speed or direction is likely to send the bats to a more fruitful spot around the reservoir or elsewhere, which could account for the variable Pipistrelle activity.

The Group has previously noted incidental records of feeding Noctule and Brown Long-Eared bats at this site but none were recorded during the survey.

Jumbles Reservoir is a site well used by the public, and the SLBG have run many successful bat walks here.

Above: The Jumbles Reservoir (ref J1).

4.2.4 Philips Park Whitefield

Six ponds were surveyed for bat activity, at the site of the old bleach works and dye works. The mills are no longer at the site but the water bodies are still present. Five ponds were surveyed over four years, and one for three years.

Dams Head Lodge (PP1) and Kingfisher Lodge (PP2) were surveyed twice in 2004 – once in May and again in August.

Two species of bat were found – Common Pipistrelle and Daubenton's bat. At (PP1) the activity of Pipistrelles was highest in 2003 and in May of 2004, but decreased dramatically by 2005 and 2006.

Daubenton's bat numbers followed a similar pattern. One factor that may account for this decline is the proliferation of water weed over this time period, resulting in less open water.

At Kingfisher Lodge (PP2), Pipistrelle activity fluctuated over the four years, though always with a fair count, having a particularly good year in 2005. Daubenton's bats were not present in 2003, April 2004 or 2006 but were detected at low levels in late 2004 and 2005.

There are several alternative foraging sites nearby, including the river and large lagoons of the old sewage works, which were not surveyed, PP3 and PP4. Slight changes in weather conditions may account for this fluctuation as bats are likely to take advantage of the best pond on the night.

Kingfisher 1 (PP3), Kingfisher 2 (PP4) ponds both had gradual reduction of Pipistrelle activity over the four years. Daubenton's bat activity was only detected on (PP3) in 2003. They were not found at (PP4), (PP5) or the North Wood Pond (PP6).
Pipistrelle activity at (PP6) was generally low.

Occasional records of Daubenton's bats at (PP3) and (PP2) may be bats passing through whilst searching for the best foraging sites.

Overall, there was a reduction in bat activity over ponds in Philips Park over the past 4 years. This may indicate a genuine decline in bat numbers, or that bats are finding better foraging sites; possibly the large lagoons and even the river are becoming cleaner and better vegetated.

There are known Daubenton's bat roosts in the viaduct, aqueduct and road bridge about 200 metres to the south-west of the Kingfisher Lodges. There is also a significant commuting route for Common Pipistrelle from east to west through the site, passing close by (PP2), (PP5) and (PP3) and leading under the viaduct towards the large lagoons and the river.

Philips Park was Bury's first Local Nature Reserve.

The whole park was surveyed by the SLBG at the request of Bury MBC, and a great deal of bat data was gained, including the discovery of Common Pipistrelle, Daubenton's and Brown Long-Eared roosts.

This is a site well used by the public, and the SLBG have run many successful bat events here.

4.2.5 Redisher Wood, Ramsbottom

A corn mill, a cotton mill and Redisher bleachworks were using water from Holcombe Brook around 1893 in Redisher Wood. The lodges and ponds were created for the Redisher bleach works owned by the Ainsworth family.

Above: Simons Lodge, Redisher Woods (ref R2).

During 2005, a survey of bats was carried out at Redisher Wood Local Nature Reserve. Three species of

bats were detected; Noctules, 45 KHz Pipistrelles and Daubenton's bat. Noctules were absent the following year, however, numbers of Pipistrelle passes and Daubenton's bat passes increased for the site as a whole.

The greatest amount of bat activity was recorded at Simons Lodge which is the biggest of the three ponds surveyed. Total bat passes increased year on year for this pond, in line with the results for the small pond, near the entrance to the site, where Pipistrelle passes were fairly constant during the first two surveys. Only Pipistrelles were present, but, interestingly this pond had a very low water level, so possibly a lower emergent insect population, during the first surveys. In the latter survey there was a significant increase in Pipistrelle passes. During the winter of 2005 this pond was restored to become a dipping pond for the local community. As we know from the literature it is the water body itself which is important to bats, so numbers of bats using the pond were expected to rise. Further work is planned around the pond as it is heavily enclosed with trees. By removal of some of these trees, it is hoped that the clearing created around the pond will allow access for more bats and create the important edge environment that Pipistrelle bats, in particular, select. We will continue to monitor this site to determine if the ponds, now being managed, improve for bats.

4.2.6 Starmount Lodges

Starmount Lodges are at the site of the former Starmount bleachworks and Lomax papermill, at Blackshaw Brook Valley in Little Lever, Bolton. The site has been derelict for a number of years; however an angling club manages all four ponds, and has done for some time.

Above: Starmount Lodge (ref SM1).

Pipistrelle bats were recorded on all four ponds and interestingly the number of passes during 2004 and 2005 were virtually identical, for the site as a

whole. Numbers of Pipistrelle passes, however dramatically dropped in 2006. This was especially evident at SM2 and SM4 where high numbers of passes had been recorded in previous years.

During 2006, Daubenton's bats were recorded for the first time at the site, since the survey began, albeit in small numbers. The bats arrived towards the end of the survey and appeared to be feeding sporadically over 3 of the ponds. The low numbers of Daubenton's bats feeding at this site is likely to be due to low availability of suitable roosts in the immediate area. However there are linear connecting features, such as roads and a small river valley, between this site and some of the other sites surveyed during this project, so it is possible that bats are moving between these sites, or others nearby.

Due to the proximity of housing which virtually encircles the whole site it was expected that high numbers of Pipistrelle passes would be recorded, and this has shown to be the case. It is not unusual to see the fluctuation in Pipistrelle passes in the final year, as Pipistrelles, are more generalist feeders than Daubenton's bat, which relies heavily on water bodies, so it is quite possible that they may have been feeding elsewhere on the night of the survey.

4.2.7 Parkers and Whitehead Lodges, Ainsworth

The mid-1800s was England's finest time for engineering with excellent examples to be found in the construction of the reservoirs at Lowercroft and Elton Vale. Built for the Elton Cop Mill, they were the lifeblood of the cotton and bleach works they served in Bury. Today, these magnificent waters exist under constant threat of closure since the mills closed. During 2005 it was noted that the water levels on all three of the reservoirs were well below previous years and this may have affected bat activity. For this reason it was not possible to survey the large reservoir (A3) from the usual position on the bridge, so an alternative vantage point was chosen.

The interesting statistic to come from this set of three ponds is that there is an increase in activity of both Pipistrelle bats and Daubenton's bats with increasing altitude.

Of the three ponds A1 exhibits the lowest numbers of overall bat passes. This pond is at 125m, whilst A2 has an altitude of 140m, and the largest of the 3 ponds (A3) has an altitude of 150m. This reservoir has a marked increase in the numbers of bat passes and this has shown to be the case consistently for the three years of the survey period.

Noctule bats have also been recorded at the site, however, they are low in pass numbers during the 15 minute count. This is likely to be due to Noctules being recorded commuting before the count as they are early emergents. The site and layout of the ponds is suitable for Noctule bats to use it as a landscape feature for commuting purposes. From the time recordings made for Noctule passes, they appear to be commuting in a south to south-easterly direction, possibly flying on to Elton Reservoir in Bury where Noctules are known to feed.

Overall there are differences in the numbers of passes recorded each year and this is likely to be due to the availability of a large number of water bodies close to this site; bats may be selecting different ponds. It is however, very clear that this is an important site for 3 species of bats, especially the larger water body. The availability of the three water bodies also allows bats to select their preferred pond for feeding.

4.2.8 Healey Dell Rochdale

The land which is currently designated as the Healey Dell Nature Reserve once contained many woollen mills during the industrial era, but only remnants of these now remain.

A total of four ponds and one section of the River Spodden have been surveyed over the past three years. Three species of bat have been recorded, although the recorded bat activity has varied between years and between the different ponds.

Pond HD1 is a sheltered pond flanked by woodland edge habitat. No bat activity was recorded in 2004 (this was attributed to poor weather conditions). In the following years the bat activity at this pond had not improved significantly, very low

occurrences of Daubenton's bats (2.2%) were recorded in 2005, and in 2006 Pipistrelle activity was only recorded over 37.8% of the 15 minute count.

In 2004 and 2005 at Pond HD2 there are consistent records of low Pipistrelle activity (11% in 2004 and 14% in 2005) and Daubenton's bat (7.8% in 2004 and 3.3% in 2005). Interestingly, in 2006 whilst the Daubenton's bat activity during the 15 minute count remained consistent with previous years (6.7%) the Pipistrelle activity increased to 100%. Amazingly, this increase in Pipistrelle activity at pond HD2 (and all other ponds at Healey Dell) coincided with the detection of three previously unrecorded roosts in houses in close proximity.

The recorded bat activity at Ponds HD4 and HD5 has been consistent, both of these ponds supported low to moderate numbers of Pipistrelle and Daubenton's bat activity in 2005. In 2006, recorded bat activity of both species in the 15 minute count increased, this is attributed to the more favourable/warmer weather conditions and the possible proximity to a number of roosts.

Of substantive interest on a regional scale is the presence of a *Myotis* species likely to be a Whiskered Bat on the River Spodden. First recorded in 2005 for a low number of passes (4.4%), the *Myotis* species was present for the whole of the 15 minute count in 2006. This river corridor will definitely be the focus of further surveys in future years.

4.2.9 East Lancashire Paper Mill

These ponds, located in Radcliffe Manchester, are the only remains of a former paper mill, as the site name suggests. The mill closed in 2001. During 2004 we were asked to conduct a survey on the site as the whole area had recently obtained planning permission for a development, which, amongst other aspects, included the

Above: East Lancashire Paper Mill pond (ref EL1).

draining of the 3 largest ponds on the site. Local site users, such as residents and the angling club were understandably concerned, and following surveys in 2004, so were we.

After the survey carried out in 2004, three of the ponds were drained for development, so only the smaller remaining fishing pond, (EL1) was surveyed in subsequent years.

High Pipistrelle activity had been recorded during 2004 on all the ponds, but EL1 only showed Pipistrelle activity. Daubenton's bats were recorded on EL3 the large pond behind the cricket ground, and records of Noctule bats had been made in the area previously.

Records obtained during the 2005 survey showed an increased Pipistrelle activity, all being 45 KHz Pipistrelles, with a very high count of 85 passes, Daubenton's bat activity had also increased from no passes the previous year to 34 passes, whilst the surprise was a foraging Noctule bat which made 67 passes.

The survey carried out in 2006 confirmed the results from the previous year. A maximum count of Pipistrelle passes, together with increases in Daubenton's bat and Noctule bat passes were recorded. Overall the site is considered to be highly important for foraging bats. Very high numbers of Pipistrelle passes have been recorded at the site, and numbers of passes have increased year on year. This however is more than likely due to the bats needing to feed in a more concentrated area rather than increasing in number. However numbers of Noctule and Daubenton's bat passes appear to have increased for the site as a whole over the survey period

Although it is unfortunate that three ponds have been drained it appears that the bats may have adapted to feed on the remaining pond. Another local bat worker has also surveyed the River Irwell which runs adjacent to the site, and has recorded high bat passes on one occasion, but virtually none on another. It does however remain to be seen whether the population of these protected species can be sustained at a favourable conservation status, as the overall reduction in pond area may mean a

reduced amount of emergent insects. Further surveys will aim to determine how sustainable the changes have been for bat activity.

4.2.10 Cliviger Ponds, Todmorden

These two ponds were surveyed following a request from the Pond Conservation Trust. Both ponds are fished and partially covered with lilies. They are very close to each other but some distance from any other substantial water bodies.

The south pond (CL1) was surveyed in 2004, 2005 and 2006. Very high Pipistrelle numbers were recorded in all years, and a good number of Daubenton's bat passes were recorded in 2004 and 2006, slightly lower Daubenton's bat passes were recorded in 2005.

The Northern pond (CL2) was surveyed in 2005 and twice in 2006, in August and September. Maximum counts of Common Pipistrelles were recorded in 2005 and August 2006, with about half that count recorded in September 2006.

Pond at Cliviger (ref CL1).

Daubenton's bats followed the same trend with two high counts followed by a low count in September 2006. Perhaps there was something special happening over (CL1) in September 2006!

The relative consistency of the results here indicate that alternative foraging sites are not readily available, and perhaps the whole colony of Daubenton's bats rely heavily on these two ponds. It also indicates that isolated ponds can support a colony of bats.

4.2.11 Burrs Country Park, Bury

Burrs Park is an example of reclamation of a derelict former mill site. Water at the site was exploited by the Peel family to use in the mills, resulting in two mill communities; Burrs and Higher Woodhill. Higher Woodhill Mill was a cotton mill which went into paper making during the 1860's cotton famine. Neither mill remains although some old workings are still visible, and these are used as an attraction to the site. Information boards have been erected on the history of the site.

Only Pipistrelle bats of the 45 KHz variety and Daubenton's bats were recorded at the site. All sites surveyed had very high numbers of Pipistrelle passes. This is unsurprising due to the surrounding housing estates providing plenty of roosting opportunities, indeed a roost of 262 Pipistrelle bats is known within a few hundred metres of the site. Over the full survey period, the numbers of Pipistrelle bat passes has been consistently high, which shows the importance of the site for this species. This is especially so, as there are a large number of alternative ponds in the nearby Kirklees Valley as well as the River Irwell which flows through the park, which the bats could select instead.

Daubenton's have been absent from the canoe pool for a number of years. They were recorded foraging and feeding on this pool in 2004, after it appeared to have been cleared of submerged weed, and it was good to see they had returned in both subsequent surveys. They were, however, recorded in greater number on a smaller pond at B4, near Stock Street. Daubenton's bat passes appear to be relatively consistent, and appear to be concentrated on the two ponds mentioned.

On the night of the survey in 2006, a bat walk was held in order that the public could watch the survey actually taking place. During the survey both Daubenton's bats and Pipistrelle bats were recorded feeding over the River Irwell; Daubenton's bats have not been recorded here for some time, as they have not been seen on other bat walks that we have carried out at the site.

4.2.12 Moses Gate Country Park Farnworth

Above: Mill pond at Moses Gate (ref MG3).

This site was developed on an area of past industrial development, including a bleachworks, chemical tips and gravel workings. As a country park the site is already well used and protected, however it is interesting to compare what is happening to the sites that are already managed to those that are currently classed as derelict or brownfield sites. Future surveys may provide more of an insight into this.

There are three central ponds at the site, and the bat Group has previously arranged bat walks here.

A dramatic difference was noted between the results of the first two years and the results in 2006. During the first two years all species counts of bats were on the low side and this was consistent between the two survey years. The highest number of Pipistrelle passes was just 35 on the smaller, most easterly of the three ponds

(MG3). Daubenton's bats were not recorded on MG1 at all, MG2 only had one pass in 2004, none in 2005, whilst MG3 had two passes in 2004, and three in 2005.

However, this changed massively in 2006. Noctule bats were recorded for the first time, and continued to feed during the 15 minute count on MG1 and MG3. Noctules have not been recorded during the surveys, or the bat walks, previously held at the site. Daubenton's bat counts were also low, but a significant increase in activity was recorded in the final year. But the change in Pipistrelle activity was the most dramatic. For the site as a whole, Pipistrelle bats appear to be increasing, from a mean of just 2.5 passes in the first year, to 22.0 passes in 2005, to a high of 51.48 passes in the final year. The highest number of passes was recorded at MG1.

Again in this case the availability of suitable alternative foraging areas for all the bats species recorded could be the factor contributing to these results. The proximity of the River Croal with heavily vegetated banks, as well as the close availability of water bodies at the Darcy Lever Gravel Pits and other ponds close to Burnden, Bolton, provides bats with plenty of choice of foraging sites.

4.2.13 Pilsworth Fisheries, Bury

Above: Pilsworth Fisheries (ref PF4)

Although the area of Pilsworth and Unsworth was predominantly a farming area, by the nineteenth century small industries had begun to grow up. By the middle of the nineteenth century larger mills were in evidence, the majority of these being involved in the bleaching of cotton fabrics. The largest of these was Buckley Brennands sited along Castle Road. Remains of the mill can still be found at the end of Castle Road, in front of Pilsworth Cottages.

Six ponds, now used for angling, are all that remains from this industrial past. Of the others, one seems to be an old farm pond (too overgrown in 2006 to be worthy of the name pond, when it was not surveyed), and one was built specifically for angling.

Moderate to good numbers of Common Pipistrelle passes were recorded at all ponds (except PF1, on the low side), and these were the only species encountered during the 15 minute count, apart from occasional Noctules passing through.

In total, 5 bat species were located at Pilsworth fisheries but these were mainly prior to the 15-minute count. Interestingly the large reservoir had good numbers of Noctule passes and it became apparent that Noctules use the road and line of the ponds to navigate for commuting purposes. In fact 11 individual Noctules flew from the woodland at the north-eastern corner, across the main pond (PF4) so it is likely that this woodland contains a roost. Also, some ponds were favoured by *Pipistrellus pipistrellus* whilst others were foraged solely by *Pipistrellus pygmaeus*. These species tend not to mix well, and feed at the same location, so this result is not unexpected.

Overall Pipistrelle activity was remarkably steady over the three years. This indicates that the local bats rely heavily on this site and rarely forage elsewhere.

The pond with the consistently highest counts was (PF2). This pond was dug out and planted about ten years ago, which goes to show that new ponds can become very valuable to foraging bats very quickly.

4.2.14 Whitley Reservoir Wigan

Whitley Reservoir is an interesting pond as it is relatively isolated from other large ponds and surrounded by housing. Three species of bat have been recorded at Whitley Reservoir between 2004 and 2006. Pipistrelles have been abundant in all years except the first survey in 2004; the abundance of Pipistrelles is not unexpected owing to the proximity of suitable houses which are known to be a preferred roosting site for this species during the summer.

Daubenton's bats have been recorded in abundance every year which is good news but quite surprising given the isolation of the pond from habitats typically used by Daubenton's bats such as canals.

Noctules were present in 2004 for almost the whole of the 15 minute count (60%), this recorded activity was significantly lower in 2005 (4.4%) and no Noctules were recorded in August 2006. When considering Noctule activity, the proximity of Haigh Hall (an area where Noctule activity has been frequently recorded) is an important factor. Whitley Reservoir is located approximately 600 metres to the west of Haigh Hall and associated woodland habitats. Perhaps there is a Noctule flight route to the woodland habitats on the western side of Wigan between Standish and Shevington, and if so this flight route may pass over Whitley Reservoir and may provide an important feeding station along the way.

The comparison between the results above is based on the three surveys conducted in August in each year. As a contrast, in 2005, the pond was also surveyed twice in March, when interestingly, only Pipistrelle activity was recorded. As March is very early in the bat active season it is suggested that Whitley Reservoir also has importance in providing an early source of food during periods of mild weather at the start of the bat active season. The reservoir may play an important part in the attraction of Pipistrelles to the housing estates in this area which may lead to the seeking out and occupation of suitable roosts in the houses prior to the maternity season.

4.2.15 Worsley Canal Basin

Increasing demand for coal from the growing city of Manchester required an efficient means of production and transportation. Francis Egerton, 3rd Duke of Bridgewater, the famous Canal Duke, commissioned the building of the Bridgewater Canal from Booth's Bank to Worsley, and on to Manchester. The Canal Act was passed in 1759, and the canal into Manchester was operational by 1765. It is regarded as an 18th century masterpiece, and was engineered first by John Gilbert, then by James Brindley.

It was decided to look at three parts of the basin in Worsley just off the A572. The water is distinctly orange due to iron salts in the rock and this is one of the reasons we wanted to look at the area, to consider water quality, and its effect on bat activity.

Above: Worsley Canal Basin (ref WB3).

Low numbers of bat passes were recorded consistently for the three years of the survey period. Surprisingly three species were recorded, Pipistrelle, Daubenton's bat and Whiskered bats. Both Pipistrelle bats and Daubenton's bat passes showed highly consistent results year on year. Whiskered bats were also recorded in 2005 and 2006 and the passes were again very consistent showing identical results. During the 2004 survey we were asked by Salford council to determine whether the bridge between the three sections of canal was being used by bats. From the low numbers of bats recorded it was considered possible, but probably unlikely that the bridge contains a roost.

Contributing factors to the low count are thought to be low water quality, the proximity of a main road, running above the bridge on this relatively small site, plus the probable light pollution was having a negative effect, particularly in the case of Daubenton's bats as this species is especially vulnerable to light disturbance. There are few alternative foraging areas, such as the Manchester Ship Canal, however as the results are consistent over the three years of the survey, the canal at Worsley Basin is not considered, in it's current condition, to be an important bat foraging habitat.

4.2.16 Hollins Vale, Bury

Bury's third Local Nature Reserve is home to Hollins Brook, and a parallel canal-like reservoir, known as "The Cut" where bats are known to feed. There is also an additional pond at the entrance to the site.

Although effectively the same water body, ponds HV2, HV3 and HV4 were surveyed separately from widely spaced observation points, once in 2005 and twice in 2006. Recorded activity included an odd passing Daubenton's bat, and a Noctule outside the count period. Common Pipistrelles were recorded at all points, but nowhere was there a high count.

The pond at the entrance to the Vale (HV1) was surveyed in 2004, 2005 and 2006, and although numbers of Pipistrelle passes increased in 2005, they were still on the low side.

The Hollins Conservation Group has planted many trees and hedges in the Local Nature Reserve, and they are planning to create many ponds throughout the Vale. This is primarily to encourage amphibians, but it should be interesting to see if this has an effect on bat activity in the future.

The SLBG, in conjunction with the Hollins Conservation Group, have held several successful bat walks here.

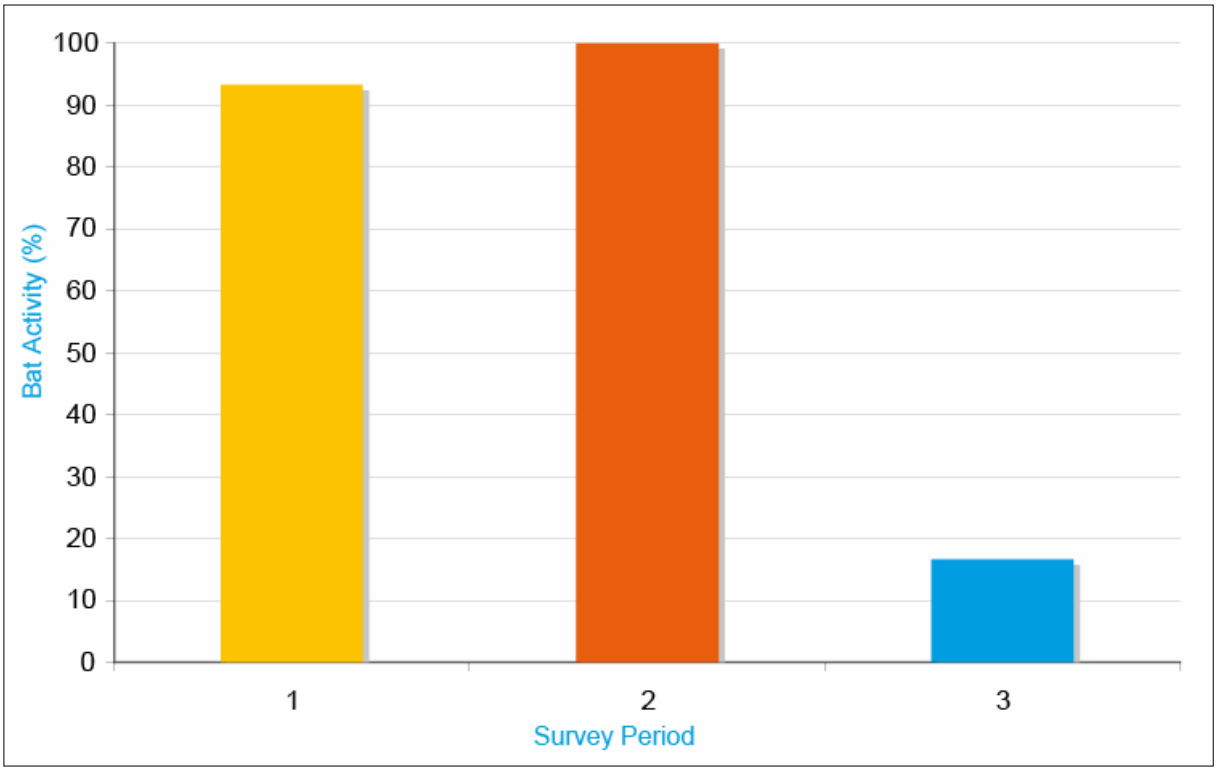
4.2.17 Pyramid Park, Bury

This site, very close to Bury town centre encompasses an open green space complete with a reasonably size pond, which could soon be replaced by houses, offices or even an ice rink under development proposals. The pond is known to be highly important for amphibians. The first two surveys found large numbers of Pipistrelle bats, *Pipistrellus pipistrellus*, foraging over the pond. The high numbers of bats meant that very high numbers of passes being recorded, both times in 2005.

On returning to the site in 2006, we discovered that the pond was completely empty. Initially we feared that it had already been drained for development, however, due to the very hot summer it is now considered that the water had simply evaporated and due to lack of rain the pond had not refilled. During November, we were pleased to note that the pond has now refilled.

The ‘dry’ pond did however provide the opportunity to determine, albeit by a one night snapshot survey, what impact the lack of water had on bat activity. Numbers of Pipistrelle passes dropped from 100% pass rate the preceding year to a pass rate of just 16.1%. This is a significant difference. As water bodies support higher insect densities than dry land with poor vegetation, this result is not surprising. This can easily be interpreted, to suggest that the water body itself is the important feature, and without it bat numbers are likely to drop. Graph 3 (overleaf) demonstrates the differences between the three survey periods, period 3 being the one when the pond was dry, and the dramatic effect this has on bat activity.

Graph 3: Pipistrelle activity per survey period for Pyramid Park



4.2.18 Haigh Hall Wigan

Two ponds within the woodlands associated with Haigh Hall have been surveyed on three occasions, these are Swan pond (HH6) and Kitchen Maid pond (HH7). Whilst these two ponds were not surveyed in 2004, one survey was carried out in September 2005 and the survey was repeated in July and August 2006.

As expected, Pipistrelle activity was good during the 15 minute count at both ponds and the habitats are assessed as suitable for this species which prefers ponds with some shelter from overhanging trees.

No Daubenton's bat activity was recorded at either pond with the exception of one pass at Kitchen Maid pond (HH7) in August 2006. Both ponds were covered with Duckweed. The survey of other ponds during this project has indicated that ponds with a cover of Duckweed or algae are not typically used by feeding Daubenton's bat and this one pass could be attributed to a single Daubenton's bat (possibly a

juvenile) searching for a suitable feeding area. Daubenton's bats have been recorded within the Haigh Hall site particularly associated with the Leeds and Liverpool Canal which extends through the centre of the site.

4.2.19 Island Lodge Surrounding Area

After the end of the 2004 survey it was quickly realised that there was no comparative data for other habitat types adjacent to the millponds, to determine, if, as the literature suggests, that riparian habitats are prime, optimal foraging sites for bats.

We decided to survey the area around one of the most well used millponds in the Kirklees Valley, Island Lodge. We chose a number of different habitat types surrounding the pond, and surveyed all of these on the same night at the same time. The results are shown in table one below.

4.2.19.1 How important are ponds?

In order to gain a relative idea of how important ponds are to bats in the Kirklees Valley, five adjacent habitats were also surveyed. The results of this can be seen in table 3 below

Table 3: Island Lodge and surrounding area

	Mean bat activity				
Habitat	**Pp (%)**	**Md (%)**	**Mm (%)**	**Nn (%)**	**Pa (%)**
Mill Lodge	91.5	76.6	0.0	0.3	0.0
Woodland	21.8	0.0	3.3	0.0	0.0
Pasture	10.7	0.0	0.7	0.0	0.0
Recreation	45.2	0.0	0.0	0.0	0.0
Housing (Urban)	18.9	0.0	0.0	0.3	0.0
Meadow	11.1	0.0	0.3	0.0	0.0

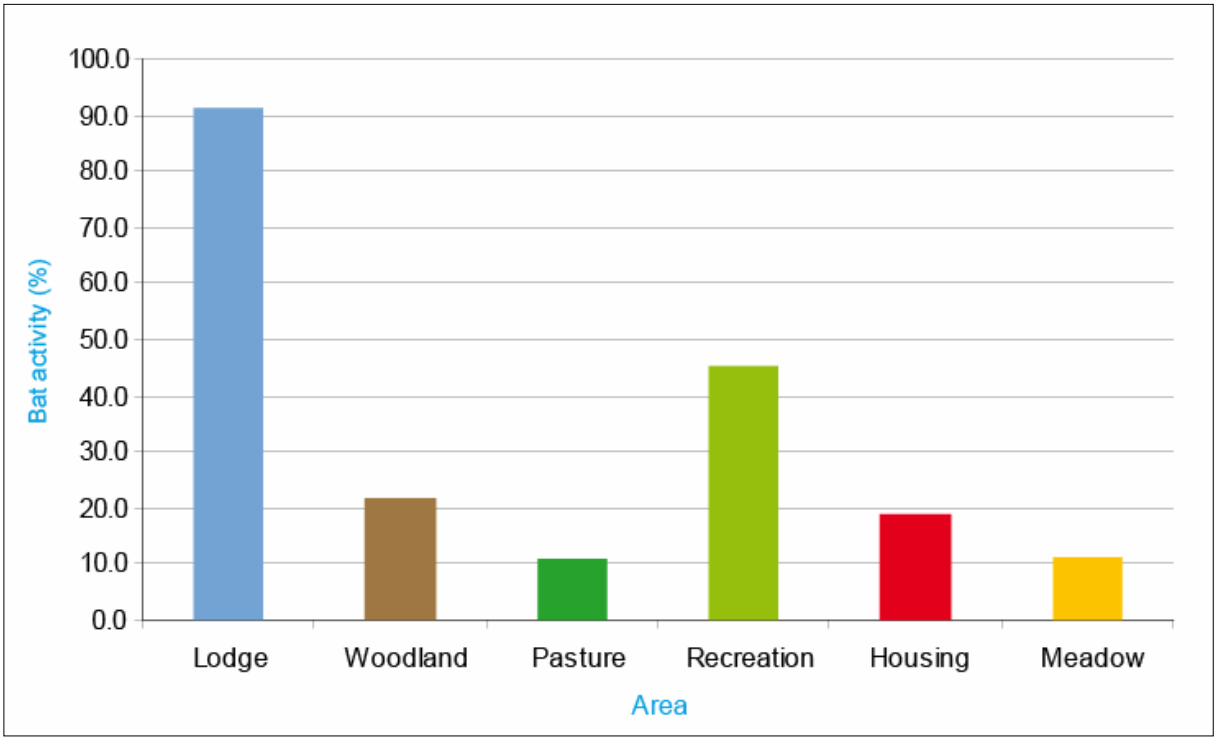
Each habitat was compared to the other using the Kruskal Wallis test, (which can be seen in appendix four). Only data for *Pipistrellus* spp. and *M. daubentonii* was used, as the others had insufficient counts in all areas.

For *Pipistrellus* spp., the calculated Chi-square value of 10.2 does not exceed the calculated value of 11.07, (P=0.05 at 5df.), and therefore there is no significant difference in bat activity between the areas. It can however be observed from table 3, and graph 4 that the greatest activity did occur over the lodge.

For *M. daubentonii*, the calculated Chi-square value of 16.8 exceeds the critical value of 15.09 (P= 0.01, 5 df.). It can therefore be said that there is significantly greater activity over the lodge than elsewhere (as is obvious from table two).

Where Pp = Pipistrellus spp, Md = Daubenton's bats,
Mm = Whiskered Bats and Nn = Noctule bats.

Graph 4. Mean Pipistrelle activity at Island lodge and surrounding area



4.3 Sites Surveyed Less Than 3 Times

Some sites were surveyed either only once or twice during the survey period. This was due to new ponds being located and interest by the local Bat Group members, for example, Sonia Allen carried out a number of surveys on ponds not covered by the Bat Group. This additional surveying was one of the original ideas behind the project, in that the Bat Group trains its members and people new to conservation to be able to carry out their own survey by a standard method, which allows more ponds to be fully surveyed, and compared to each other over time. A number of new Bat Group members obtained through the surveys have used the training to survey ponds close to them. Steve and Fiona Parker were thrilled to find Noctules feeding within easy walking distance of their house. They are now very keen to ensure that these ponds are well protected and managed, to ensure the favourable conservation status of these bats. In addition Sonia was able to contribute to a planning decision through Rochdale Metropolitan Borough Council, based on the surveys of a former mill Lodge, close to her, on land between John Street and Featherstall Brook in Littleborough. Ultimately, planning permission was refused on the grounds of the site's biodiversity. Doubtless, these bat surveys have been able to contribute to this, and the lodge has now been retained, both as a site of our former industrial heritage, but mainly due to the importance of the wildlife including bats which use these mill ponds.

This section covers those ponds surveyed only once or twice, which we could not, therefore perform any statistical analysis on the results (a minimum of three years data is required for this). The results in full for each pond surveyed are shown in Appendix 1.

4.3.1 Pennington Flash

The flashes were formed as a result of the subsidence of mining areas, and the subsequent filling of the depressions created by water.

Due to the size of the Flash at Pennington we have only been able to survey particular sides of the Flash for bat activity, within the area of the Nature Reserve.

Certain survey points that were surveyed in 2004 were not accessible in 2005; however surveys were conducted at 3 points. Both Pipistrelles and Noctules were recorded, which was unexpected as large numbers of foraging Daubenton's bats have been recorded in the past at the site, on numerous bat walks we have held there. We also have records of Natterer's and Brown Long-Eared bats at the site, but again these were not encountered during the surveys. Most Noctules were recorded on the main Flash, with very low numbers being recorded on the small offshoot at P2.

4.3.2 Haigh Hall Canal

Originally the Leeds/Liverpool canal was used to transport coal and goods such as cotton from the mining and milling areas of the North West to other parts of the country. The section of the Leeds and Liverpool Canal at Haigh Hall has only been surveyed in 2005 but some interesting results have been collated.

Two species of bat (Pipistrelle and Daubenton's bats) were recorded foraging over the canal in 2005, although it is known from other surveys that Noctule bats are also active at this section of the canal, using it as a commuting route and foraging area.

The section of canal at (HH1) supported the greatest amount of Daubenton's bat activity in 2005. At other sections a high amount of Pipistrelle activity was reported.

Kitchen Maid pond (HH7) and Swan pond (HH6) were surveyed 3 times, however as two of the surveys occurred during the same year, statistical analysis was not available.

Only one Daubenton's bat pass was recorded in the final survey in 2006 over Kitchen Maid pond. The rest of the passes recorded at both ponds were Pipistrelles. Noctules were recorded, however this was prior to the 15 minute count, and they did not stay to feed. Pipistrelle numbers were relatively constant although there were notable increases at Kitchen Maid pond in 2006, during the second survey in 2006. Although only a snapshot in time, this could be showing that this pond is more important later in the year, and less important in early July, when female bats are likely to stay relatively close to the roost when they may have a baby to feed at regular intervals.

4.3.3 Littleborough, John Street Pond & Ealees Pond

Ealees Lodge

The first available record of the Mill or Lodge is from the 1950's when Fothergill and Harvey Ltd acquired it. The site was used to develop highly specialised finishing processes for industrial fabrics, and water from the ponds was used in the processing.

Ealees pond was surveyed twice; once in April 2005, and again in July 2006. Pipistrelle bats were encountered on both surveys, however no other species were heard during the 15 minute count or preceding this. There were large counts during both surveys, both with the maximum of 90 passes, so the ponds are obviously important for foraging Pipistrelles.

John Street/William Street Lodge

This remnant of an industrial past lies amidst modern housing, yet is a small oasis of calm for wildlife. It is a small lodge with a fast-running open culvert along one side and with good tree cover along one-third of the site. It was first surveyed in April 2005 – early in the season for bat activity – but was found to have continuous use by a small number of Pipistrelle bats feeding over the site giving a maximum count of 90 passes. It was surveyed again in October – rather late in the bat season, yet found to be still occupied by a small number of bats, most notably by what appeared to be a lone Pipistrelle male calling in territorial flights along the tree-lined edge. A further survey undertaken in September 2006, found Pipistrelles feeding over the lodge, though the rather windy conditions made for a poor count.

4.3.4 Senicar, Wigan

Senicar was surveyed in September 2005 and the survey was not repeated. 42 Pipistrelle passes were recorded, with no other species noted during the survey period.

4.3.5 Wallsuches, Horwich

In 1777, the Ridgway family leased the Wallsuches site and within a few years their bleachworks employed the majority of people from Horwich as well as from Blackrod and Adlington. Wallsuches Bleachworks closed in 1933. Plans are under consideration to redevelop the area for hotel and leisure use.

75 Pipistrelle bat passes were recorded at Wallsuches. Horwich is known for a good number of Pipistrelle roosts so it was expected that a high number of passes would be recorded. Previous surveys nearby have recorded other *myotis* species and Brown Long-Eared Bats.

4.3.6 Myrtle Street Lodges, Middleton

There are two lodges at Myrtle Street in Middleton, close to the Rochdale Canal. The northern lodge was surveyed in April 2005, the southerly, in October 2005. It is therefore not possible to compare the results which both showed maximum counts of bats. This would suggest that the site containing the two lodges is important for Pipistrelle bats. No other species were recorded at this site.

4.3.7 Belfield Lodges, Rochdale

There are three ponds in the complex, one is a private fishing lodge and was not surveyed. The smallest lodge was surveyed in April 2005, and exhibited a maximum count of Pipistrelle passes. The survey was not repeated on this pond. The larger of the two ponds (BEL2) was surveyed in April 2005 and September 2006. The results for this pond were markedly different between these two dates. Whilst the first survey had large numbers of Pipistrelle bats feeding, and therefore producing a maximum count, the survey later in the year reduced the count to just 4 passes. This may be interpreted to mean that this pond is important for bats early in the season, and may be populated by insects that emerge during the spring. It is also possible that bats are feeding on just one of the ponds each night. There may be a roost in nearby housing which would have dispersed by September. Further survey work on the pond may shed some light on this.

4.3.8 Clegg Hall Mill Rochdale

The ownership and fortunes of the Clegg Hall Mill changed over time. It is likely that the mill was used to manufacture flannel. There are weavers' cottages nearby that were probably built by Fenton as part of his flannel business. It became a cotton mill in the middle of the 19th century when it was purchased by James Tweedale. It provided employment to 41 people.

In 1879 Thomas Wilson bought the mill and used it to spin cotton waste. Then during World War I production switched to wadding and absorbent cotton wool. After the war, cotton production at Clegg was replaced with the manufacture of flannelette.
Surveyed just the once in September 2005 on a warm evening this pond had a good number of Pipistrelle passes, again producing a maximum count, suggesting it may be an important foraging site. This pond is also very close to the very large Hollingworth Lake which is known to have feeding Noctule and Daubenton's bat. It is therefore unsurprising that neither of these species were recorded at Clegg Hall Mill, even given the large size of the millpond and good amounts of bank side vegetation.

4.3.9 Water Lane Mill, Milnrow

This is a relatively small square pond immediately adjacent to a cutting on the M62 motorway. There are a number of reservoirs within close proximity. Only 4 Pipistrelle passes and 1 Daubenton's bat passes were recorded during the survey, and it is possible that this is due to traffic noise and the large availability of suitable alternative foraging sites.

4.3.10 Upper Town House Fishery Littleborough

This pond has an altitude of approximately 200m, and is of large size with little bank-side vegetation. A low Pipistrelle count was made during September 2005, during the single survey. The pond has not been surveyed since, so no conclusions could be drawn from the results of the survey, except that bats were foraging over the water body.

4.3.11 Birtle Lodges, Bury

Another relatively high site at 150m in altitude on the exposed side of a hill. The pond surveyed was the largest of the three at the site, and the pond was surveyed twice, once in September 2005 from the embankment at the eastern end of the lodge, and again in June 2006. Maximum counts of Pipistrelle bats were recorded on each occasion showing that the site is very important for Pipistrelle bats. Noctules were also recorded during both surveys; however the earlier survey had lower numbers recorded with just 2 passes. Later it was found that the Noctules were mostly feeding over the western end of this large expanse of water, and that the huge numbers of Pipistrelles feeding along the embankment helped drown out any other bat calls. The following June, the survey position was moved to a more central location, whereupon a maximum count of both Noctules and Pipistrelles was made. It is possible that the preference of Noctules to feed over the centre and western end of this large water could be influenced by the presence of a nearby roost, where lactating females at the end of June would feed and be able to regularly return to their baby.

4.3.12 Greggs Lakes, Bury

Whilst these ponds were only surveyed for the first time at the end of August 2006, they complete a number of pond systems around the south-east of Bury. They are very close to the Pilsworth Fisheries and Hollins Vale, so we were keen to determine what was feeding there, if anything. Both Pipistrelles and Daubenton's bats were recorded, and Noctules were recorded commuting and feeding before the start of the 15 minute count. They did, however, move off before the 15 minute count started. A maximum count of Pipistrelles was recorded at the more southerly pond (GL2) and 16 Daubenton's bat passes were recorded. Only one Daubenton's bat was noted at GL1, but 30 Pipistrelle passes were made. It appeared that bats preferred the larger of the two ponds on the survey night; however, further conclusions could not be made as only one survey has been carried out.

4.3.13 Doctor Dam, Norden Rochdale

This reservoir was surveyed in late September 2006, and was the only survey carried out at the site. Only Pipistrelle bats were encountered during the survey, but a high number of passes at 84 means that this is an important feeding site for Pipistrelles. It is likely that the bats found feeding here form roosts in the nearby housing estate, indeed a roost of 56 Pipistrelle bats is known, immediately adjacent to the reservoir.

4.4 Other Project Work

One of our members, Jennifer Lord, has now completed a University degree course. For her dissertation she elected to compare the Pond Conservation Trusts system for indexing 'pond quality' against the data the Group collected during this millpond project.
In this experiment 6 ponds were selected, two in each section of the Kirklees Valley, each displaying different physical attributes such as area, percentage shade and altitude.

A number of readings were taken to determine the physical characteristics, and these are displayed in the table 4.

Table 4: Physical Characteristics of Kirklees Ponds

Pond ref	LK01	LK02	LK12	MK02	MK10	MK16	UK02	UK06
Grid ref	SD796114	SD796115	SD790122	SD784131	SD781135	SD779136	SD760144	SD761144
Altitude (m)	100	100	105	120	120	125	190	190
Area (m^2)	1200	2000	2000	6000	700	9500	900	1800
PH	7.44	7.33	7.05	6.68	6.72	8.34	7.2	7.32
Conductivity	489.8	563.4	289.9	200.6	270.6	320.3	166.2	159.6
Shade (%)	17	5	8	2	65	15	4	25
Inflow	1	1	1	1	0	1	1	1
% Margin Grazed	0	0	0	0	0	0	0	0
% E. Plant Cover	4	20	3	4	3	3	6	5

The millpond survey techniques were then used on a number of nights to determine the number of passes and compare the results. They indicated a positive correlation between number of aquatic plants and *Myotis* spp. bat activity. Other correlations, relating to Noctule bats, were discounted as this species was so rarely encountered during the survey period that the statistics would be skewed.

Extrapolating this data to include the survey results from the whole of 2004 and the previous Kirklees surveys, we were able to compare additional factors with the activity of foraging bats. This full data set highlighted a positive correlation between foraging Daubenton's activity and altitude. Interestingly when just these 6 ponds were compared a significant correlation between the foraging activity of Daubenton's bat, whiskered bats and Noctule bat, and the factors of pond area and pH, was found. Pond area and pH also appear to have a direct positive correlation on total bat activity on these ponds. The percentage of emergent plant coverage was also compared and it was expected that this could be a contributing factor to the activity of foraging bats, as the bats' prey, emergent insects, feed on and cling to, these plants. More emergent plants could indicate higher abundance of emergent insects, and this increased amount of prey could support a larger number of foraging bats. The results from the ponds surveyed, showed that this was possibly not the case, the exception being a positive correlation between Pipistrelle activity and percentage of emergent plant cover.

4.4.1 Aquatic Invertebrate Survey

An aquatic invertebrate survey was undertaken on 13.08.2006 by members of the South Lancashire Bat Group of three mill lodges and a section of the Kirklees Brook as part of a greater project to investigate the importance of mill lodges for bats.

The purpose of the survey was to see if there was any correlation between the numbers and species of bats recorded at each lodge that comprise the Kirklees Valley, a potential new local nature reserve, and the numbers and variety of aquatic invertebrates found in the lodges.

The larval or nymph stage of many flying insects are water dwelling, emerging as adult insects during mid-summer. In some cases the larval stage lasts up to three years, for example dragonflies, before undergoing metamorphosis. As there are larvae of many insect species at different stages of development at any one time in a water body, this should ensure a steady supply of adult insects, year on year. However, external environmental factors, like pollution introduced to the watercourse will have a devastating effect on these insect populations.

All adult British bats feed on insects and a steady supply is vital to ensure their survival especially during late autumn, when bats build up fat reserves for the hibernation period. We would expect that a large number of winged insect larvae found in the ponds sampled would yield a high number of adult insects for bats to feed on.

As this was the first survey carried out by the South Lancashire Bat Group for this purpose, the data collected can only be used as a snapshot of the insect life within the lodges at the time. Further repeated studies will generate more information on the population numbers and species found in each lodge.

In addition to this, only one team was assembled to carry out the survey so a comprehensive record of each mill lodge was not possible on the day in question. Three lodges were chosen as representative of the types of waterbody present along the Kirklees Valley. The invertebrates found were identified to family and not to individual species and the numbers in each sample recorded.

All the lodges that have been surveyed by the SLBG have been given a reference code.

The three lodges surveyed were MK 16 (known as Island Lodge), MK 10 and MK 2.

Each lodge was sampled five times, the species present recorded and a count of the numbers of each present. The sample tray was emptied and fresh water collected from the lodge for each sample round.

MK16 - Island Lodge

The largest of the water bodies surveyed, the majority of the surface is open water with willow and other deciduous trees surrounding it. Blue-green algae is present in the water and the lodge is fished by a local angling club. There was little emergent aquatic vegetation present and the presence of submerged aquatic vegetation was not evident in the location sampled. (See Appendix 3 for results)

MK 10

A much smaller pond, very densely shaded by willow and alder with some willow growing in the water and the surface of the lodge covered with duckweed (*Lemna sp*.). (See Appendix 3 for results).

MK 2

A large open pond, surrounded by farmland. Good emergent vegetation along the bank edges with lily plants covering large areas of the surface and dense stands of submerged vegetation.

Note: due to time constraints this pond was only sampled twice. (See Appendix 3 for results).

Kirklees Brook

An opportunity was taken to sample the tributary stream that runs parallel to Island Lodge (MK16). This stream eventually joins the River Irwell.

Note: the stream was sampled twice only. (See Appendix 3 for results).

4.4.1.1 Summary of results

It is clear that from the brief snapshot sample of the three lodges surveyed that the number and species of the aquatic invertebrates found varies considerably.

MK 16

MK 16, also locally known as Island Lodge, is by far the biggest waterbody sampled. In total, 18 species of aquatic invertebrates were recorded, 6 of these were pollution indicator species[1]

The samples taken from this lodge yielded the lowest number of winged insect larvae. Single numbers were recorded for Stonefly nymph, and uncased caddisfly, one chironomid larva was recorded in sample three and two individuals in samples one and four.

Of the pollution indicator species only the water hoglouse (a detritus feeder) was recorded in all five sample rounds. Flattened mayfly nymph, cased caddis fly, freshwater shrimp, and rat-tailed maggot were all absent. The Rat-tailed maggot is only found in severely polluted water so was not expected to be present in any of the lodges. The absence of the other three species mentioned above and very low numbers of the other indicator species could indicate the presence of pollution in the water or an indication of a pollution incident. Further investigation is required to prove this.

MK 10

MK 10 is a much smaller pond than the other two and the only one that is densely shaded by willow and alder.

In total, 19 species of aquatic invertebrates were recorded, 6 of these were pollution indicator species.

Of the pollution indicator species, stonefly nymph, flattened mayfly nymph, uncased caddis and rat-tailed maggot were all absent. Flattened mayfly nymphs are adapted to living in flowing water, so the presence of these in the lodges was not expected.
Two swimming mayfly nymphs were recorded in sample four only; one cased caddis was recorded in sample three. Water hoglouse were recorded in very high numbers, present in all five sample rounds and sample five had 1000+ individuals counted.

[1] Pollution indicator species are those used in the Trent –Biotic Index to indicate the level of pollution present or absent in a body of water. Species that are intolerant of any pollution are often absent or present in very low numbers, those with a much higher tolerance to pollution or adaptations to live in polluted water can be found exclusively or in much higher numbers in polluted water.

Chironomid larvae were recorded in all five sample rounds, and phantom midge larvae were recorded in all except sample round two. Also of note was the presence of dragonfly nymphs in sample one and three.

MK 2

MK 2 is a large pond surrounded by farmland. In total, 20 species of aquatic invertebrates were recorded, 7 of these were pollution indicator species.

Although only two sample rounds were undertaken, a contrast can be seen between MK16 and MK10, in that the pollution indicator species were all present with the exception of stonefly nymph and flattened mayfly nymph, which, as stated previously, are found in flowing water.

This pond had the highest number of cased caddis fly larva and it was noted that many of the same species were at different growth stages. The highest numbers of swimming mayfly nymph (25) were also recorded in this pond.

This pond was the only one sampled which had damselfly nymph present (27)

Kirklees Brook

Evidence has been documented of the importance of streams and rivers for feeding and commuting by bats and, therefore the opportunity was taken to survey a section of Kirklees Brook during the aquatic invertebrate survey.

As a different waterbody to the lodges a direct comparison is not relevant, but all the pollution indicator species (with the exception of the rat-tailed maggot) were recorded and the pollution intolerant species were present in higher numbers than those more tolerant of pollution, water hoglouse and bloodworm.

As expected many of the aquatic invertebrates that live in still water were absent, although alderfly larva were recorded in the brook and had been absent from MK16, MK10 and MK2. Alderfly larva can also be found in ponds and lodges.

4.4.1.2 Discussion: Aquatic Invertebrate Survey

The results of the aquatic invertebrate survey represent a snapshot of the invertebrates present at the time. Before any significant data can be produced, further sampling will be required of all the ponds that were surveyed as part of the South Lancashire Bat Groups project and at different times of the year.

This is particularly important as the stages in the life cycle from larva to adult insect of many species occurs at different times of the year and are initiated by varying environmental factors. For example, the low numbers of mayfly nymphs in two of the ponds could be explained by the transformation into adult earlier in the year, and this year's eggs not yet hatched into nymphs.

The correlation between the numbers and species of bats using a pond and the numbers and variety of flying insect larvae cannot be established from this survey. Further sampling is required, and will be undertaken, to look at species population variation over the year and from year to year to be able to tie it in to bat activity.

5.0 Further Work

5.1 Daylight Survey

The original daylight survey undertaken in 1994 needs updating with a current reassessment of habitat before further dusk surveys to search out possible overgrown ponds in daylight and to assess the changes in surrounding habitat types and degrees of shelter.

5.2 Further Surveys of the Sites

Most of the mill ponds will continue to be surveyed annually through continuing the work of the Conserve Bats, Conserve Heritage project.

5.3 Survey Methods

Surveys of other similar valleys, isolated lodges, canals and even rivers would make interesting comparisons.

It will be useful to continue the survey within different habitat areas surrounding Island Lodge, generally choosing a night when sufficient number of surveyors are available to determine whether bats are using the ponds in preference to other areas, such as woodland or pasture or meadows within the confines of the valley. We know that this is the case for Daubenton's bats, with their affinity to water, however, it would be good to check if, over time, Pipistrelles select in the same manner, perhaps separating the Pipistrelle species too. This will enable us to determine if the bats are continuing to select the ponds as preferred feeding sites, rather than other features of the valley. If this is the case the significance of protecting these ponds will increase.

Selecting different times of year on a few ponds should allow us to compare bat activity throughout the year, apart from winter when bats will be hibernating.

Although bats are known not to favour strong winds and heavy rain, bats have been observed foraging on nights of very poor weather in the mid section of the Kirklees

Valley. To determine the effects of weather on foraging activity and behaviour, we hope to survey under different weather conditions.

Due to funding from the Local Heritage Initiative/Heritage Lottery Fund, we have been able to purchase more advanced equipment to help with this. We now are able to use Petterson D-230 frequency division bat detectors, which allow differentiation of the two species of Pipistrelle.

It is also intended to look at emergent insect abundance in a number of ponds to determine if there is a correlation between this factor and bat foraging activity.

It would be useful to continue the invertebrate survey to determine, if, over time, bats are selecting those ponds with high numbers of emergent insects.

5.4 Lobbying

It would be well worthwhile lobbying to prevent any further loss of millponds and even restore lost ponds in a sensitive manner where there is no adverse ecological impact. It is of note that Ordnance Survey maps produced in 1851 show the presence of 40 mill ponds, and numerous filter beds. To our knowledge only 2 sets of filter beds now exist, and only 29 ponds are left in the valley.

The publicity gained from the present project, funded by the Heritage Lottery Fund, which aims to involve the public in bat survey over water bodies, will help us achieve this aim.

Bury MBC are considering Local Nature Reserve status for a large part of the Kirklees Valley; including most of the mid and lower sections. The Bat Group needs to continue to be involved in this process to prevent any undue ‘improvements’ and ‘tidying’, and push for the conservation, restoration and careful management of these important mill lodges.

5.5 Publicity

In order to gain support for our lobbying it will be helpful to publicise present and future results. This was the main aim of the Conserve Bats, Conserve Heritage Project.

This will involve the wider membership of the South Lancashire Bat Group, the public and other interested groups (e.g. heritage groups, fishing clubs) in the surveys to raise a general awareness of the value of these areas to wildlife.

It also involves distributing as widely as possible the final report and leaflet on the results of the surveys.

It will also means giving presentations to interested parties. Some presentations have already taken place and more are planned for the future.

6.0 Project Outputs: Diary of Events

In addition to the survey work which has led to the production of this report and the associated leaflet and display, we agreed as a Group, to carry out a number of training events, and events for the public such as country shows, bat walks and talks. The following list details the events that the project has enabled us to achieve.

Training Sessions

15/02/2004	Introduction to Bats Day	12 Attendees
04/04/2004	Bats and the Law	10 Attendees
09/04/2004	Fiberscope Training	6 Attendees
18/04/2004	Injured Bat Training	12 Attendees
23/07/2004	Mist Netting, Sussex	2 Attendees
19/09/2004	BCT Conference Reading	7 Attendees
12/10/2004	Regional Bat workers Meeting	10 Attendees
16/01/2005	Hibernation Visit, Wales	4 Attendees
23/01/2005	Hibernation Visit, Wigan	4 Attendees
13/02/2005	Introduction to Bats	10 Attendees
27/02/2005	Bat Law	9 Attendees
05/03/2005	Hibernation Visit, Wales	3 Attendees
17/03/2005	Bat Identification	15 Attendees
16/04/2005	Injured Bat Training	16 Attendees
07/05/2005	Noctule Roost Visit	7 Attendees
14/05/2005	Bat Biology & Ecology	13 Attendees
15/05/2005	Bat Detector Workshop, Leeds	2 Attendees
25/05/2005	Health, Safety and PR	11 Attendees
18/06/2005	Bat Detector Workshop	15 Attendees
02/09/2005	BCT Conference York	7 Attendees
10/12/2005	Hibernation Visit Wales	4 Attendees
22/01/2005	Hibernation Visit Wales	4 Attendees
25/02/2006	Training Weekend (Law/ID)	15 Attendees
26/02/2006	Training Weekend (HS, PR, Case)	6 Attendees
04/03/2006	Hibernation Visit Wales	4 Attendees
07/03/2006	Regional Bat workers Meeting	4 Attendees
20/05/2006	BCT Regional Forum	6 Attendees

03/06/2006	Bat Detector Workshop	11 Attendees
12/09/2006	Regional Bat workers Meeting	5 Attendees
22/09/2006	BCT Conference Reading	3 Attendees
09/12/2006	Hibernation Visit Wales	4 Attendees
13/01/2007	Time Expansion Workshop	15 Attendees
20/01/2007	Hibernation Visit Wales	4 Attendees
Totals	**33 Training Session**	**258 Attendees**

Bat Talks

19/02/2004	Nantwich Natural History Society	30 Attendees
08/06/2004	Bradshaw Guides, Bolton	18 Attendees
29/06/2004	Elton Youth Club Bury	55 Attendees
05/10/2004	Egerton Brownies, Bolton	40 Attendees
20/10/2004	Bolton Beavers and Parents	15 Attendees
25/01/2005	Bolton Beavers and Parents	13 Attendees
28/01/2005	Abram Cubs	35 Attendees
19/05/2005	St Maxentius Brownies Bolton	30 Attendees
21/09/2005	Whitefield Guides Manchester	23 Attendees
16/11/2005	Heaton Cubs, Bolton	25 Attendees
28/11/2005	Harwood Guides, Bolton	25 Attendees
30/11/2005	Elton School Bury	60 Attendees
07/12/2005	Elton School Bury	60 Attendees
30/01/2006	Edgeworth Cubs Bolton	29 Attendees
25/04/2006	Bradshaw Cubs, Bolton	40 Attendees
02/05/2006	Ladybridge High School	10 Attendees
08/05/2006	Heaton Cubs, Bolton	25 Attendees
27/09/2006	Harwood Brownies & Guides	40 Attendees
31/10/2006	Radcliffe Brownies and Guides	30 Attendees
10/11/2006	Shuttleworth Cubs, Bury	35 Attendees
23/11/2006	Darwen Scouts	15 Attendees
29/11/2006	34th Rochdale Brownies	25 Attendees
04/12/2006	Elton High School Bury	120 Attendees
05/12/2006	Elton High School Bury	60 Attendees
Totals	**24 Talks**	**858 Attendees**

Bat Walks

28/05/2004	Burrs Bat Walk	25 Attendees
11/06/2004	Healey Dell Rochdale	25 Attendees
06/08/2004	Island Lodge, Kirklees Valley Bury	37 Attendees
28/08/2004	Jumbles Eurobat Night, Bolton	140 Attendees
17/10/2004	BBC Walk Through Time, Bury	150 Attendees
21/05/2005	Pennington Flash, Leigh	30 Attendees
18/07/2005	Dunham Massey	60 Attendees
20/07/2005	Dunham Massey	60 Attendees
23/07/2005	Pennington Flash Leigh	30 Attendees
25/07/2005	Dunham Massey	60 Attendees
27/07/2005	Dunham Massey	60 Attendees
29/07/2005	Pennington Flash, Leigh	32 Attendees
07/08/2005	Philips Park Whitefield	23 Attendees
20/08/2005	Pennington Flash Leigh	31 Attendees
27/08/2005	Jumbles Eurobat Night, Bolton	95 Attendees
02/09/2005	Bat and Burgers Oldham	40 Attendees
10/09/2005	Hopwood Middleton	30 Attendees
11/09/2005	Hollins Bat Walk	10 Attendees
17/09/2005	Daisy Nook Oldham	40 Attendees
20/09/2005	7 Aces Bolton	15 Attendees
25/09/2005	Healey Dell Nature Reserve	45 Attendees
27/09/2005	Broadfield Park Rochdale	40 Attendees
21/07/2006	Yarrow Valley Chorley	120 Attendees
22/07/2006	Reddish Vale Stockport	90 Attendees
29/07/2006	Philips Park Whitefield	45 Attendees
09/08/2006	Burrs Bat Walk	110 Attendees
26/08/2006	Jumbles Eurobat Night	30 Attendees
02/09/2006	Brownhills, Oldham	30 Attendees
08/09/2006	Healey Dell, Rochdale	30 Attendees
17/09/2006	Hollins Vale Bury	15 Attendees
Totals	**30 Walks**	**1548 Attendees**

Surveys

08/03/2004	Day Site Survey	4 Attendees
12/06/2004	Training Survey Darcy Lever Bolton	32 Attendees
16/06/2004	Training Survey Manchester Airport	13 Attendees
25/06/2004	Training Survey Yarrow Chorley	12 Attendees
03/07/2004	Training Survey, Wigan Flashes	7 Attendees
06/08/2004	Millponds Survey starts	33 Attendees
23/09/2004	Lowry Art Centre Salford	3 Attendees
09/06/2005	Pyramid Park, Bury	5 Attendees
30/07/2005	Millponds Survey Starts	30 Attendees
23/09/2005	Wigan Flashes	7 Attendees
29/07/2006	Millponds Survey Starts	22 Attendees
09/08/2006	Burrs Survey	8 Attendees
13/09/2006	Invertebrate Survey	4 Attendees
Totals	**396 Survey Nights**	**180 Attendees**

Shows

02/05/2004	Burrs Open Day, Bury	300 Estimated attendees
30/05/2004	Pennington Flash Open Day	200 Estimated attendees
27/06/2004	Thompson Park Open Day Burnley	200 Estimated attendees
11/07/2004	Woodland Fest Moses Gate Bolton	5000 Estimated attendees
12/07/2004	Salford Mayors Show	200 Estimates attendees
01/08/2004	Philips Park Show Whitefield	100 Estimated attendees
12/09/2004	Hollins Go Wild, Bury	100 Estimated attendees
25/09/2004	Bury Environment Fair	150 Estimated attendees
10/10/2004	Townley Park Burnley	1000 Estimated attendees
10/03/2005	Countryside Live! Haydock Wigan	2000 Estimated attendees
05/06/2005	Hope Carr, Leigh	100 Estimated attendees
19/06/2005	Diggle Fete Oldham	200 Estimated attendees
26/06/2005	Thompson Park Burnley	300 Estimated attendees
17/07/2005	Woodland Fest Moses Gate Bolton	5000 Estimated attendees
07/08/2005	Philips Park Show Whitefield	100 Estimated attendees
11/09/2005	Hollins Go Wild, Bury	200 Estimated attendees
25/09/2005	Animal Magic Martin Mere	1500 Estimated attendees

02/10/2004	Townley Park Burnley	2000 Estimated attendees
19/03/2006	Hoddleston, Darwin	100 Estimated attendees
04/06/2006	Springwatch Manchester	500 Estimated attendees
16/07/2006	Woodland Fest Moses Gate Bolton	6000 Estimated attendees
06/08/2006	Philips Park Show Whitefield	150 Estimated attendees
27/08/2006	Yarrow Valley Show, Chorley	250 Estimated attendees
17/09/2006	Hollins Go Wild Bury	150 Estimated Attendees
01/10/2006	Townley Park Burnley	2000 Estimated attendees
28/10/2006	Oldham Museum & Art Gallery	400 Estimated Attendees
Totals	**26 Shows**	**28200 Estimated**

Bat Box Sessions

09/07/2004	Hollins Grundy, Hollins Bury	50 Attendees
02/10/2004	Philips Park Whitefield	9 Attendees
05/02/2005	Philips Park Whitefield	6 Attendees
03/04/2005	Viridor Pilsworth Bury	9 Attendees
10/04/2005	Allotment Didsbury Manchester	4 Attendees
05/10/2006	Redisher Woods Ramsbottom Bury	12 Attendees
Totals	**6 Sessions**	**90 Attendees**

TV

03/11/2004	BBC 1 British Isles; A Natural History
03/11/2004	BBC 4 British Isles; A Users Guide
02/02/2006	ITV 1 Locks & Quays

All three programmes have been shown subsequently as repeats on digital channels; Discovery and UKTV

Other

22/02/2006	Bat Law PowerPoint Presentation
22/02/2006	Bat ID PowerPoint Presentation
28/01/2007	End of Project Celebration night (50 + Invities!)

7.0 Further Information

More information on the Conserve Bats, Conserve Heritage is available on our website at www.slbg.org.uk

More information of the Local Heritage Initiative can be found at www.lhi.org.uk
The Local Heritage Initiative has now been superseded by the Heritage Lottery Fund www.hlf.org.uk

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Appendix 1: Summary Bat Activity Sites Surveyed less than 3 times

Date	Ref/Yr	G ref	Area M2	Shelter	Wind	Temp	Pipistrelle	Daubenton's	Whiskered	Noctule	Total
LITTLEBOROUGH											
21.4.2005	LIT1 2005	SD930162	400	2	1	10	90	0	0	0	90
2.10.2005	LIT1 2005	SD930162	400	2	0	14	57	0	0	0	57
21.05.2006	LIT1 2006	SD930162	400	2	2	13	43	0	0	0	43
24.4.2005	LIT2 2005	SD943163	2000	2	1	10	90	0	0	0	90
11.07.2006	LIT2 2006	SD943163	2000	2	0	19	90	0	0	0	90
HAIGH HALL CANAL											
20.9.2005	HH1 2005	SD595079	120	1	1	12	38	34	0	0	72
20.9.2005	HH2 2005	SD594081	120	2	0	12	0	0	0	0	0
20.9.2005	HH3 2005	SD594080	120	1	1	10	6	3	0	0	9
21.08.2006	HH3 2006	SD594080	120	1	1	12.8	90	4	0	0	94
20.9.2005	HH4 2005		120	2	1	10	30	3	0	0	33
20.9.2005	HH5 2005	SD596078	120	1	1	12	65	1	0	0	66
24.9.2005	HH6 2005	SD602081	1000	2	1	11	64	0	0	0	64
09.07.2006	HH6 2006	SD602081	1000	2	1	14.5	34	0	0	0	34
21.08.2006	HH6 2006	SD602081	1000	2	0	12.6	42	0	0	0	42
24.9.2005	HH7 2005	SD598086	150	2	2	11	3	0	0	0	3
09.07.2006	HH7 2006	SD598086	150	2	2	14.5	10	0	0	0	10
21.08.2006	HH7 2006	SD598086	150	2	1	12.9	55	1	0	0	56
24.9.2005	HH8 2005	SD585085	120	1	1	11	9	0	0	0	9

Date	Ref/Yr	G ref	Area M2	Shelter	Wind	Temp	Pipistrelle	Daubenton's	Whiskered	Noctule	Total
SENNICAR											
3.9.2005	S1 2005	SD590086			1	20	42	0	0	0	42
WALLSUCHES											
3.9.2005	WS1 2005	SD657114			0	17	73	75	0	0	148
MYRTLE ST LODGES											
28.4.2005	MRY1 2005	SD882065	3300	2	0	10	90	0	0	0	90
10.10.2005	MYR2 2005	SD883066	4200	2	1	20	90	0	0	0	90
BELFIELD LODGES											
27.4.2005	BEL1 2005	SD913136	1120	3	1	13	90	0	0	0	90
30.4.2005	BEL2 2005	SD913136	2240	2	0	18	90	0	0	0	90
30.09.06	BEL2 2006	SD913136	2240	2	0	15	4	0	0	0	4
CLEGG HALL MILL											
18.9.2005	GH1 2005	SD924145	4000	2	0	18	90	0	0	0	90
WATER LANE MILL MILNROW											
24.9.2005	MR1 2005	SD934123			1	10	4	1	0	0	5
UPPER TOWN HOUSE FISHERY											
5.9.2005	THF1 2005	SD935174	3900	1	0	22	14	0	0	0	14

Date	Ref/Yr	G ref	Area M2	Shelter	Wind	Temp	Pipistrelle	Daubenton's	Whiskered	Noctule	Total
BIRTLE LODGES											
21.9.2005	BIL1 2005	SD834123	16000	0	1	19	90	0	0	2	92
29.06.2006	BIL1 2006	SD834123	16000	0	1		90	0	0	90	180
GREGGS LAKES											
20.08.2006	GL1 2006	SD817097	1500	1	0	14.4	30	1	0	0	31
20.08.2006	GL2 2006	SD817094	3000	1	0	14.4	90	16	0	0	106
DOCTOR DAM											
25.09.2006	DD1 2006			3	0	17	84	0	0	0	84
PENNINGTON											
13.9.2004	P1 2004	SJ642992	2000	3	4	14.1	29	0	0	7	36
20.8.2005	P1 2005	SJ642992	2000	3	2	14.5	37	0	0	67	104
15.9.2004	P2 2004	SJ643993	5000	3	0	13.3	3	0	0	3	6
20.8.2005	P3 2005	SJ644990	50000	1	4	16.5	18	0	0	81	99
20.8.2005	P4 2005	SJ644995	1000	2	0	15.4	15	0	0	2	17

Appendix 2: Statistical Analysis

One
Mean bat activity levels in the Kirklees Valley

	Mean Bat Activity				
Survey period	**P (%)**	**Md (%)**	**Mm (%)**	**Nn (%)**	**Pa (%)**
1	19.5	10.5	2.5	0.2	0
2	18.6	13.6	7.4	0	0
3	40.4	11.8	4.1	0	0
4	38.3	16.8	0	0.3	0
5	57.1	22.3	0	0	0.1
6	70.3	19.1	0.3	0.1	0.2

Two
Kruskal Wallis between year test statistics

***Pipistrellus* spp.**

Ranks			
	VAR00004	**N**	**Mean Rank**
VAR00005	1	32	56.65625
	2	32	56.71875
	3	30	93.91666667
	4	30	87.93333333
	5	23	111.9565217
	6	24	126.9791667
	Total	**171**	

Test Statistics(a,b)	
	VAR00005
Chi-Square	46.09831953
df	5
Asymp. Sig.	8.67299E-09

a	Kruskal Wallis Test
b	Grouping Variable: VAR00004

M. daubentonii

Ranks			
	VAR00004	**N**	**Mean Rank**
VAR00006	1	32	77.0625
	2	32	84.53125
	3	30	76.9
	4	30	93.03333333
	5	23	99.15217391
	6	24	89.85416667
	Total	171	

Test Statistics(a,b)	
	VAR00006
Chi-Square	4.822097635
df	5
Asymp. Sig.	0.437975353

a	Kruskal Wallis Test
b	Grouping Variable: VAR00004

Three
Kruskal Wallis between ponds test statistics

***Pipistrellus* spp.**

Ranks			
	VAR00001	**N**	**Mean Rank**
VAR00002	1	6	99.58333333
	2	6	124.0833333
	3	4	120.125
	4	4	69.625
	5	6	129.5833333
	6	4	70.625
	7	4	53.25
	8	6	128
	9	6	70.58333333
	10	2	15.25
	11	6	102.5833333
	16	6	125.4166667
	17	6	103.1666667
	18	6	88.16666667
	19	6	51.58333333
	20	6	27.91666667
	21	6	72.91666667
	22	6	33.91666667
	23	6	110.1666667
	24	6	84.08333333
	25	6	87.91666667
	26	6	69.58333333
	27	7	85.14285714
	28	6	83
	29	2	47.75
	30	3	45.33333333
	31	3	54.33333333
	32	6	81
	33	6	89.5
	34	6	104.5833333
	35	6	109.9166667
	36	6	94.5
	Total	**171**	

Test Statistics(a,b)	
	VAR00002
Chi-Square	54.72840653
Df	31
Asymp. Sig.	0.005357629

M. daubentonii

Ranks			
	VAR00001	**N**	**Mean Rank**
VAR00003	1	6	93.08333333
	2	6	95.25
	3	4	47.25
	4	4	47.25
	5	6	115.6666667
	6	4	66.625
	7	4	72.125
	8	6	45.41666667
	9	6	95
	10	2	36.5
	11	6	43.66666667
	16	6	99.5
	17	6	86.16666667
	18	6	115.8333333
	19	6	119.4166667
	20	6	36.5
	21	6	124.8333333
	22	6	105.1666667
	23	6	43.66666667
	24	6	43.66666667
	25	6	36.5
	26	6	90.83333333
	27	7	146.7142857
	28	6	101.4166667
	29	2	100.25
	30	3	50.83333333
	31	3	54.33333333
	32	6	111.5833333
	33	6	117.5
	34	6	110.5
	35	6	83.41666667
	36	6	111.5833333
	Total	**171**	

Test Statistics(a,b)	
	VAR00003
Chi-Square	76.61608112
df	31
Asymp. Sig.	9.83293E-06

Four
Kruskal Wallis test statistics for Island Lodge and surrounding area

***Pipistrellus* spp.**

Ranks			
	VAR00009	**N**	**Mean Rank**
VAR00010	1	3	16.66666667
	2	3	9.333333333
	3	3	4.833333333
	4	3	12.33333333
	5	3	8
	6	3	5.833333333
	Total	**18**	

Test Statistics(a,b)	
	VAR00010
Chi-Square	10.21992416
df	5
Asymp. Sig.	0.069238288

M. daubentonii

Ranks			
	VAR00009	**N**	**Mean Rank**
VAR00011	1	3	17
	2	3	8
	3	3	8
	4	3	8
	5	3	8
	6	3	8
	Total	**18**	

Test Statistics(a,b)	
	VAR00011
Chi-Square	16.83374083
df	5
Asymp. Sig.	0.004826148

Appendix 3: Invertebrate Survey Results

MK16 Island Lodge

Sample Round (no. individuals present) x = absent	1	2	3	4	5
Pollution Indicator Species					
Stonefly nymph					1
Flattened mayfly nymph	x	x	x	x	x
Swimming mayfly nymph		3		2	
Caddisfly larva (cased)	x	x	x	x	x
Caddisfly larva (uncased)			1		
Freshwater shrimp	x	x	x	x	x
Water hoglouse	1	7	10	11	5
Bloodworm		1			
Sludgeworm	11	6	5		
Rat-tailed maggot	x	x	x	x	x
Other species present					
Chironomid larva (non-red midge)	2		1	2	
Phantom midge larva			1	1	5
Blackfly larva	x	x	x	x	x
Great diving beetle larva	x	x	x	x	x
Great diving beetle	x	x	x	x	x
Alderfly larva	x	x	x	x	x
Leech	2	7	2	3	3
Flatworm			1		
Wandering snail/bladder snail			1		
Ramshorn snail				1	
Cranefly larva	x	x	x	x	x
Cyclops	500+	500+			5
Water mite	1	1	1		2
Daphnia (common water flea)	1	2		1	1
Lesser waterboatman			1		
Greater waterboatman		1	3		
Fish or fish fry	x	x	x	x	x
Fish lice	1	1	1		

MK10

Sample Round (no. individuals present) x = absent	**1**	**2**	**3**	**4**	**5**
Pollution Indicator Species					
Stonefly nymph	x	x	x	x	x
Flattened mayfly nymph	x	x	x	x	x
Swimming mayfly nymph				**2**	
Caddisfly larva (cased)			**1**		
Caddisfly larva (uncased)	x	x	x	x	x
Freshwater shrimp	**1**			**3**	**11**
Water hoglouse	**160+**	**150+**	**140+**	**300+**	**1000**
Bloodworm	**12**		**11**	**3**	**18**
Sludgeworm					**1**
Rat-tailed maggot	x	x	x	x	x
Other species present					
Chironomid larva (non-red midge)	**4**	**12**	**9**	**3**	**14**
Phantom midge larva	**16**		**15**	**70**	**25**
Blackfly larva	x	x	x	x	x
Great diving beetle larva	x	x	x	x	x
Diving beetle	**1**	**1**			
Alderfly larva	x	x	x	x	x
Leech	x	x	x	x	x
Flatworm					**1**
Wandering snail/bladder snail	x	x	x	x	x
Pea shell cockle	**14**	**9**	**24**		**6**
Ramshorn snail					**1**
Cranefly larva	x	x	x	x	x
Cyclops	x	x	x	x	x
Water mite	**8**	**6**	**7**	**3**	**6**
Daphnia (common water flea)	x	x	x	x	x
Lesser waterboatman	**4**	**2**	**1**		**11**
Greater waterboatman	**1**	**8**	**1**		**11**
Fish or fish fry	x	x	x	x	x
Water measurer	**1**				
Dragonfly nymph	**1**		**1**		
Pond skater		**1**			
Whirligig beetle		**1**			

MK2

Sample Round (no. individuals present) x = absent	**1**	**2**	**3**	**4**	**5**
Pollution Indicator Species					
Stonefly nymph	x	x			
Flattened mayfly nymph	x	x			
Swimming mayfly nymph	**25**	**5**			
Caddisfly larva (cased)	**22**	**20**			
Caddisfly larva (uncased)	**3**				
Freshwater shrimp		**1**			
Water hoglouse	**2**	**4**			
Bloodworm	**1**				
Sludgeworm		**12**			
Rat-tailed maggot	x	x			
Other species present					
Chironomid larva (non-red midge)	**1**	**4**			
Phantom midge larva	x	x			
Blackfly larva	x	x			
Great diving beetle larva	x	x			
Diving beetle	**1**				
Alderfly larva	x	x			
Leech NB. 2 species recorded	**5**	**4**			
Flatworm	x	x			
Wandering snail	**3**	**19**			
Pea shell cockle		**1**			
Ramshorn snail	**60+**	**6**			
Cranefly larva	x	x			
Cyclops	x	x			
Water mite	**16**	**20**			
Daphnia (common water flea)	**500+**	**500+**			
Lesser waterboatman	x	x			
Greater waterboatman	**2**				
Fish or fish fry		**1**			
Damselfly nymph	**27**				
Giant pond snail	**1**				
Biting midge larvae		**2**			

The Brook

Sample Round (no. individuals present) x = absent	**1**	**2**	**3**	**4**	**5**
Pollution Indicator Species					
Stonefly nymph	**9**	**25**			
Flattened mayfly nymph	**2**	**3**			
Swimming mayfly nymph	**1**				
Caddisfly larva (cased) 2 species	**6+1**	**8**			
Caddisfly larva (uncased) *Rhyacophila*	**1**				
Freshwater shrimp	**4**	**1**			
Water hoglouse	**6**	**1**			
Bloodworm	**2**	**2**			
Sludgeworm	**8**				
Rat-tailed maggot	x	x			
Other species present					
Chironomid larva (non-red midge)	**1**	**4**			
Phantom midge larva	x	x			
Blackfly larva	x	x			
Diving beetle	x	x			
Alderfly larva		**3**			
Leech	x	x			
Flatworm		**1**			
Wandering snail	x	x			
Pea shell cockle	x	x			
Ramshorn snail	x	x			
Cranefly larva	x	x			
Cyclops	x	x			
Water mite	x	x			
Daphnia (common water flea)	x	x			
Fish or fish fry	**3**	**8**			
Fish lice		**1**			
Biting midge larvae	x	x			

Appendix 4: Locations of All Ponds Included in the Survey

KIRKLEES VALLEY	
LOWER KIRKLEES	
LK1	SD796114
LK2	SD796115
LK4	SD794116
LK5	SD794116
LK6	SD794116
LK8	SD789119
LK9	SD790119
LK11	SD791122
LK12	SD790122
LK14	SD790123
LK15	SD791123
LK16	SD787128
MIDDLE KIRKLEES	
MK1	SD783130
MK2	SD784131
MK4	SD781131
MK5	SD782132
MK6	SD781132
MK9	SD782135
MK10	SD781135
MK12	SD780135
MK13	SD781136
MK14	SD750136
MK16	SD779136
MK18	SD776136
MK20	SD781136
MK21	SD780137
MK22	SD780132
MK23	SD783127
UPPER KIRKLEES	
UK1	SD759148
UK2	SD760144
UK4	SD759146
UK6	SD761144

EAST LANCS PAPER MILL	
EL1	SD792075
STARMOUNT LODGES	
SM1	SD757088
SM2	SD756086
SM3	SD757086
SM4	SD758086
AINSWORTH	
A1	SD775110
A2	SD772109
A3	SD766113
BURRS	
B1	SD789127
B2	SD799126
B3	SD801125
B4	SD802215
B5	SD798125
JUMBLES	
J1	SD737142
PILSWORTH FISHERIES	
PF1	SD835088
PF2	SD832087
PF3	SD831086
PF4	SD830085
PF5	SD828084
PF6	SD827084
PF7	SD825084
PF8	SD824084
PHILIPS PARK	
PP1	SD789035
PP2	SD794039
PP3	SD795039
PP4	SD795039
PP5	SD796036
PP6	SD799042
PP6	SD799042
WORSLEY BASIN	
WB1	SD748005
WB2	SD747004
WB3	SD748004

PENNINGTON FLASH	
P1	SD642992
P2	SD643993
P3	SD644990
P4	SD644995
MOSES GATE	
MG1	SD741065
MG2	SD742066
MG3	SD744066
WHITLEY RESERVOIR	
WR1	SD582074
WIGAN FLASHES	
WF1	SD582041
WF2	SD583040
WF3	SD581039
WF4	SD584032
WF5	SD578040
WF6	SD586027
WF7	SD581027
HEALEY DELL	
HD1	SD878156
HD2	SD879157
HD3	SD880159
HD4	SD878166
HD5	SD878164
YARROW VALLEY	
YV1	SD572152
YV2	SD573148
YV3	SD571152
YV4	SD571151
YV5	SD569154
CLIVIGER	
CL1	SD880277
CL2	SD879279
MYRTLE STREET LODGES	
MRY1	SD882065
MRY2	SD883066
BELFIELD LODGES	
BEL1	SD913136
BEL2	SD913136

HOLLINS VALE	
HV1	SD841064
HV2	SD816088
HV3	SD817086
HV4	SD818086
AROUND ISLAND LODGE	
IL1	SD779139
IL2	SD780137
IL3	SD778138
IL4	SD779136
IL5	SD779133
IL6	SD778135
LITTLEBOROUGH	
LIT1	SD930162
LIT2	SD943163
PYRAMID PARK	
PY1	SD806104
HAIGH CANAL	
HH1	SD595079
HH2	SD594081
HH3	SD594080
HH4	
HH5	SD596078
HH6	SD602081
HH7	SD598086
HH8	SD585085
SENNICAR	
S1	SD590086
WALLSUCHES	
WS1	SD657114

CLEGG HALL MILL	
CH1	SD924145
REDISHER	
R1	SD776155
R2	SD775155
R3	SD774155
WATER LANE MILL	
MR1	SD934123
UPPER TOWN HOUSE FISHERY	
TFH1	SD935174
BIRTLE LODGES	
BIL1	SD834123
GREGGS LAKE	
GL1	SD817097
GL2	SD817094
DOCTOR DAM	
DD1 2006	SD856149

South Lancashire Bat Group
c/o 14 Kent Drive
Bury
Lancashire
BL9 9DL

Tel: 0161 764 8850
Email: enquiry@slbg.org.uk
Website: www.slbg.org.uk