The Vincent Wildlife Trust

FORAGING AND ROOSTING BEHAVIOUR OF LESSER HORSESHOE BATS AT THE CILIAU, RADNOR.

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Cover photograph - The Ciliau farmhouse
(photography by H. W. Schofield)

1. ACKNOWLEDGEMENTS

We would like to thank Roger Capps and Ken Briggs the owners of the Ciliau for their permission to undertake this study on their property. Roger's hospitality in allowing us to take over his kitchen made processing the bats far easier and gave us a base to work from on the colder nights. We would also like to thank- Jay Daniels, Jonathan Gilpin (CCW), John Martin, Alan Messenger, John Mitchell, Diane Morgan, Dawn Parry (CCW) and Anna Sommariva for their assistance in the field. Ken Perry (CCW) provided us with digital maps of the area. We would also like to thank Kate McAney (VWT) and Joe Costello for their comments on this report.

2. INTRODUCTION

The first roost of lesser horseshoe bats found in the upper Wye Valley south of Builth Wells was in a stable at the Skreen, a property about 1.5 km north west of the Ciliau. In the late 1970s about 70 bats used this site. Unfortunately the stable was developed in the early 1980s, and a poor understanding of the species' requirements at that time led to the roost being damaged and numbers crashing to single figures.

A further roost at Crickadarn Church is situated in the bell tower with most lesser horseshoe bats roosting in the blocked chimney of the bell room. The roost was first discovered on 13th September 1985 and has been monitored occasionally. There are usually fewer than 10 bats present and on one occasion a mother and baby were seen.

In 1998 another important roost was discovered at the old apple store at Llanstephan House, a property about 1.5 km south east of the Ciliau. This was found to be used by over a hundred lesser horseshoe bats:

30/5/98	93
11/6/98	94
6/6/99	111
16/6/00	174
23/6/00	157

This roost is situated on the first floor of some courtyard buildings from which the estate work is run. The area can be quite busy and noisy at times. The roost was discovered by one of the authors (JM) in March, just after the bats' access points in the cheeks of three dormer type windows had been blocked during routine repairs. Fortunately access was reinstated before the bats returned for the summer. Approaches to the owners to take on this site as a bat reserve have been unsuccessful.

The flight-lines used by the bats have not yet been properly established but vegetative cover around the building is poor and bats use the roof and walls as cover when emerging. Situated as it is in a working yard with comparatively poor connectivity with nearby foraging areas this roost must be classed as "Vulnerable".

Although the Ciliau was visited by one of the authors (JM) as long ago as 1985 and identified as a lesser horseshoe bat roost, its importance as a major maternity roost was not established until the summer of 2000. At this time the Ciliau was being sold and the constant stream of people viewing must have caused considerable disturbance, as suggested by a sudden increase in numbers using the Llanstephan House roost. Despite this, some good emergence counts were obtained:

6/6/00	94
16/6/00	158
23/6/00	196

Prior to the sale, the house had been completely unoccupied for four years, the owner having moved into a nursing home. However, even before this the owner had

occupied only part of the building and in 1985 was perfectly at ease with bats sharing his living area. It is clear that bats made regular use of the first floor of the building aided by the absence of a loft hatch cover.

The building and its immediate environs were notified as a Site of Special Scientific Interest (SSSI) in 2000. However, one of their main emergence points (a broken window pane) has been blocked and essential repairs have affected others. The removal of ivy from the wall in which this access point is situated may also have had some detrimental effect.

The bats now have access to one of the smaller first floor rooms through a newly created loft access point. We understand that this is part of the CCW negotiated management plan. At present the door to this room is open and bats continue to enjoy access to much of the house, rather as they did when the previous owner lived there. Indeed the new occupier is well disposed to the bats and is extremely tolerant of their presence in the living area. Coupled with his comparatively modest and quiet lifestyle this present arrangement appears to be ideal but it is, of course, entirely dependent on his goodwill. It is extremely unlikely that a future occupier would be as tolerant and accommodating towards the bats. Should the building ever be occupied by a family, then the problems of much higher levels of noise, external light spillage etc., coupled with the exclusion of the bats from the living area, would render the building much less suitable as a roost for this species. Consequently, we believe that this roost will almost certainly come under threat again in the future and as such must also be classed as "Vulnerable".

Since the future of both of these roosts is far from guaranteed, it is clear that the long-term future of this population is far from secure. The aim of this study is to gather data that would help make informed choices about future conservation measures, particularly with regards to the construction of a purpose-built bat house. The key objectives of the study are to:

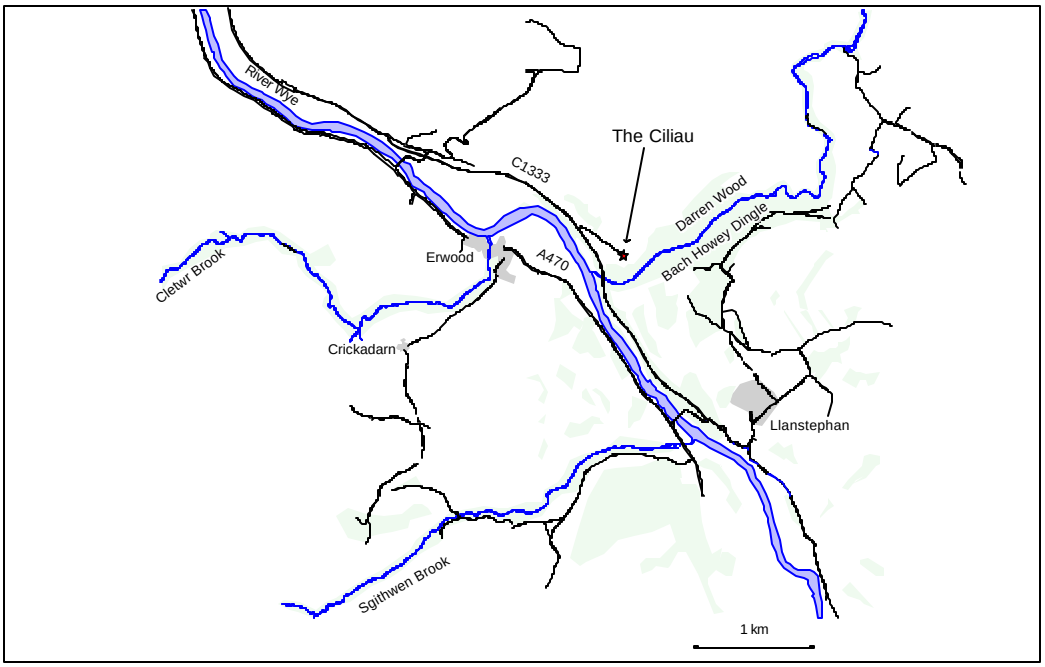
- Identify potential areas for a new bat house
- Identify satellite and night roosts
- Identify foraging areas and commuting routes
- Determine whether there is a relationship between the Llanstephan colony and the Ciliau bats

3. METHODS

3.1 The study area

The Ciliau is situated close to the river Wye, a kilometre east of the village of Erwood (Figure 1). Land use in the area is predominantly pastoral farming with the lower lying valley bottom used for cattle grazing and the more upland areas being sheep grazed. Although there is a high density of broadleaf woodland in the area, especially along the watercourses, some conifer plantations are also present. Three key streams run into the Wye at this point; Bach Howey on the east side and Cletwr and Sgithwen brooks on the west. The Ciliau is situated close to the Bach Howey dingle to which it is connected by hedges and trees.

Figure 1. The location of the Ciliau in relation to Erwood and the main woodland blocks (shown as stippled areas).



3.2 Catching and tracking protocol

The study was conducted between May and August 2002. Bats were caught using a mist net or a harp trap along flight lines as they emerged from the roost at dusk (no bats were caught inside the roost). In all there were six trapping sessions and a maximum of six adult bats were caught in any session (any juvenile animals were immediately released at the point of capture), two of these adults were selected for radio-tagging. Selection was based on mass, forearm length, sex and reproductive

condition. The largest parous adult females were selected and no heavily pregnant animals were tagged. Following this selection all other animals were released immediately. Bats for tagging were ringed and had the fur on the dorsum between the scapulae trimmed. Either Titley LTM (0.35g) or Biotrack Micro-Pip (0.35g) radio-tags were attached to the dorsum using SkinBond adhesive. The bats were held for 20 minutes to allow the adhesive to cure before being released at the point of capture.

Tracking data were collected in five-minute intervals over a four or five night period using Marnier 57 radio receivers and three element yagi antennae. Bats foraging in less accessible areas were tracked using a four or a five element yagi antenna. Observers recorded their location, the time, type of bat activity (foraging, roosting or commuting) and the bats location. Observer location was determined using a Garmin 12XL Global Positioning System (GPS) and the location of the tagged bat was recorded by taking a bearing with a magnetic compass on the area of strongest signal response. Either two observers triangulated these signals or a single observer estimated the distance to the bat on the basis of signal strength. Data were recorded in the field on a Dictaphone and later transcribed onto Excel worksheets. Daylight checks were made of the location of tagged animals to determine whether they were using alternative roosts.

3.3 Analysis of field data

Data collected by field workers for each bat were compiled into a single Excel worksheet. All alpha-numeric observer grid references were converted to numeric form and the bearings corrected to true north. A Geographic Information System (GIS), *MapInfo*, was used to determine the tracking fixes. Observer locations were imported into *MapInfo* and plotted on 1:10000 scale Land Line Ordnance Survey digital maps of the area. The 'Create Line by Length' tool in *MapInfo* was used to generate a line representing the bearing from each observer location and the 'Ruler' tool was used to determine the distance of the bat from the observer. Each tracking fix was recorded as a point on the map. When all the points had been recorded the range of the bat was determined.

Two methods were used to calculate the animal's range. The first and simplest method involves constructing a polygon around the outlying foraging points, this is known as a Minimum Convex Polygon (MCP). It has the advantage that it allows a direct comparison with data collected from other similar radio-tracking studies. However, the area calculated by this method is strongly influenced by outlying points and so it may include areas never visited by the bat and it gives no indication of the intensity of use. The second method, Kernel analysis, is a more sophisticated method for determining an animal's range. This involves placing a grid over a map of the study area. The number and proximity of radio-tracking fixes to each intersection of the grid are processed producing a value for each of the intersections. This matrix of values can then be further processed to produce a contour map of the animal's activity with areas of greatest intensity of use having the highest contour value. Areas with density of use greater than 50% are regarded as the core areas of activity.

The MCP for each of the bats in this study was generated using 'Range Manager' in *MapInfo*. The maximum foraging distance of the bat was determined by measuring the distance between the Ciliau roost and the furthest edge of the MCP.

Grid references for the foraging fixes were determined in MapInfo and exported to home range analysis software called *Grid*. Kernel estimations were carried out in *Grid* and then exported back into *MapInfo* where they were visualised as 10 contour lines giving the whole range and the 50% contour representing the core foraging areas.

All day and night roosting locations were photographed and their grid references recorded. In addition, general observations were made of the bats behaviour at the Ciliau and the temperature both inside and outside the roost was recorded using a Skye DataHog datalogger.

4. RESULTS

4.1 Biometric data

In all, 31 adult lesser horseshoe bats were caught and handled during the study (Table 1.). Twelve of these were tagged, and data were successfully recorded from eleven (one bat (Bat 8) shed its tag before any meaningful data could be collected). Two of the tagged bats were re-captured and had shown no signs of ill effects from carrying the transmitters.

Table 1. Biometric data from animals caught during the study

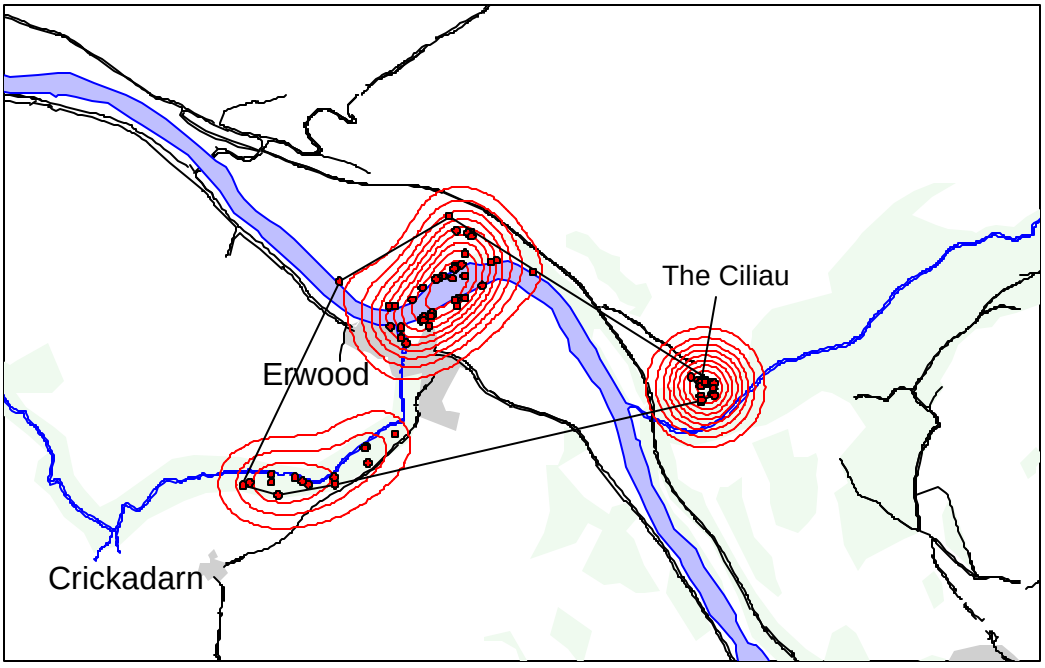
Catch date	Sex	Reproductive condition	Mass/g	Forearm length/mm	Ring no.	Notes
13/05/02	F	Nulliparous	4.2	38.0		
13/05/02	F	Parous	5.0	37.1		
13/05/02	F	Parous	5.4	37.1		
13/05/02	**F**	**Parous**	**6.2**	**38.8**	**T7012**	**Bat 1**
13/05/02	F	Parous	5.6	38.5		
13/05/02	**F**	**Parous**	**6.0**	**38.9**	**T7013**	**Bat 2**
26/05/02	F	Parous	4.9	38.1		
26/05/02	F	Parous	5.6	38.1		
26/05/02	F	Parous	5.8	37.2		
26/05/02	F	Parous	6.3	37.8		
26/05/02	**F**	**Parous**	**6.2**	**39.2**	**T7014**	**Bat 3**
26/05/02	F	Parous	6.1	37.1		
26/05/02	F	Parous	5.6	36.7		
26/05/02	**F**	**Parous**	**5.9**	**38.2**	**T7015**	**Bat 4**
10/06/02	**F**	**Parous pregnant**	**7.3**	**39.0**	**T7016**	**Bat 5**
10/06/02	F	Nulliparous	5.1	38.2		
10/06/02	F	Parous pregnant	7.8	38.4		
10/06/02	F	Parous pregnant	7.0	38.4		
10/06/02	F	Parous pregnant	6.4	37.8		
10/06/02	F	Pregnant	7.0	38.8		
10/06/02	**F**	**Parous pregnant**	**7.2**	**38.9**	**T7017**	**Bat 6**
15/06/02	F	Parous lactating	5.3	38.5		
15/06/02	F	Parous lactating	5.4	37.0		
15/06/02	M	Adult	5.1	36.2		
15/06/02	**F**	**Parous lactating**	**5.6**	**39.6**	**T7018**	**Bat 7**
15/06/02	F	Nulliparous adult	5.7	37.8		
15/06/02	**F**	**Parous lactating**	**4.6**	**39.0**	**T7019**	**Bat 8**
12/08/02	F	Post partum	6.1	38.9	T7017	Recapture of Bat 6
12/08/02	**F**	**Post partum**	**6.0**	**38.3**	**T7020**	**Bat 9**
12/08/02	**F**	**Post partum**	**5.4**	**39.0**	**T7021**	**Bat 10**
27/08/02	F	Post partum	ND	ND	T7014	Recapture of Bat 3
27/08/02	**F**	**Post partum**	**5.5**	**39.1**	**T7022**	**Bat 11**
27/08/02	**F**	**Post partum**	**6.2**	**38.9**	**T7023**	**Bat 12**

4.2 Foraging fixes and range measurements for individual animals

An example of the measures of range used in this study are shown in Figures 2 and 3. The closed red circles are the raw foraging fixes. The Minimum Convex Polygon (MCP) describes the total range of the animal during the tracking period and is shown by the solid black line. The red lines around the foraging fixes are the contours derived from the kernel analysis and describe the foraging range of the bats.

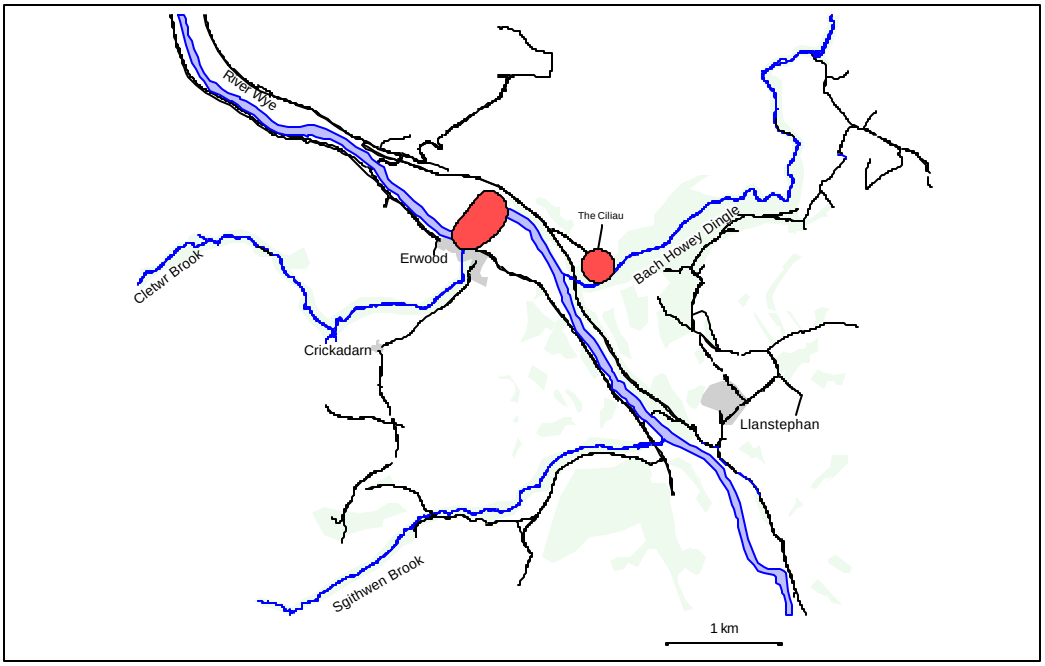
The foraging fixes, MCPs and kernel contours for all the study animals can be found in Appendix 1.

Figure 2. The foraging fixes, MCP and kernel contours for Bat 1



The core foraging range is indicated by the hatched red areas in Figure 3. Some animals have a single core foraging area, others may have two or three preferred areas. The core foraging areas for all the study animals can be found in Appendix 1.

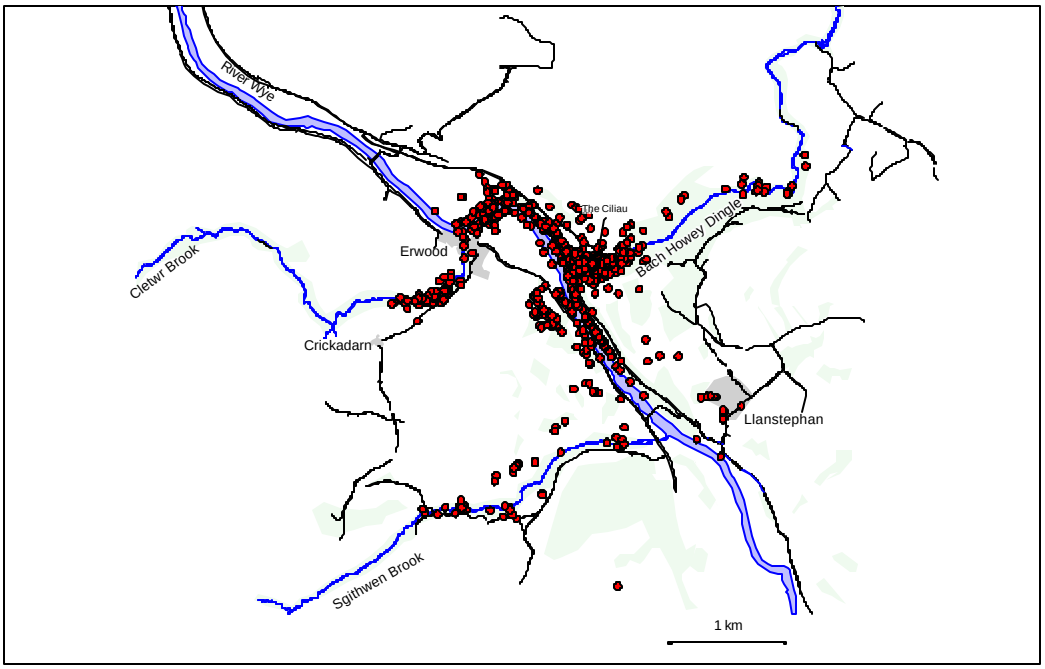
Figure 3. The core foraging area of Bat 1.



4.3 Foraging areas used by the study animals

The bats from the Ciliau foraged mainly in broadleaf woodland along the banks of the Wye and its tributary streams (Figure 4). Individual bats were recorded feeding in the conifer plantation between the Ciliau and Bach Howey Dingle, and

Figure 4. Foraging fixes for all the study animals



along the hedgerows to the north of the Ciliau. Some bats used the small blocks of woodland with inter-linking hedgerows on the west side of the Wye and around Llanstephan apple store.

Variations in transmitter signal characteristics indicated that the bats were mainly feeding by aerial hawking, although we also recorded perch hunting behaviour.

4.4 Range Analysis

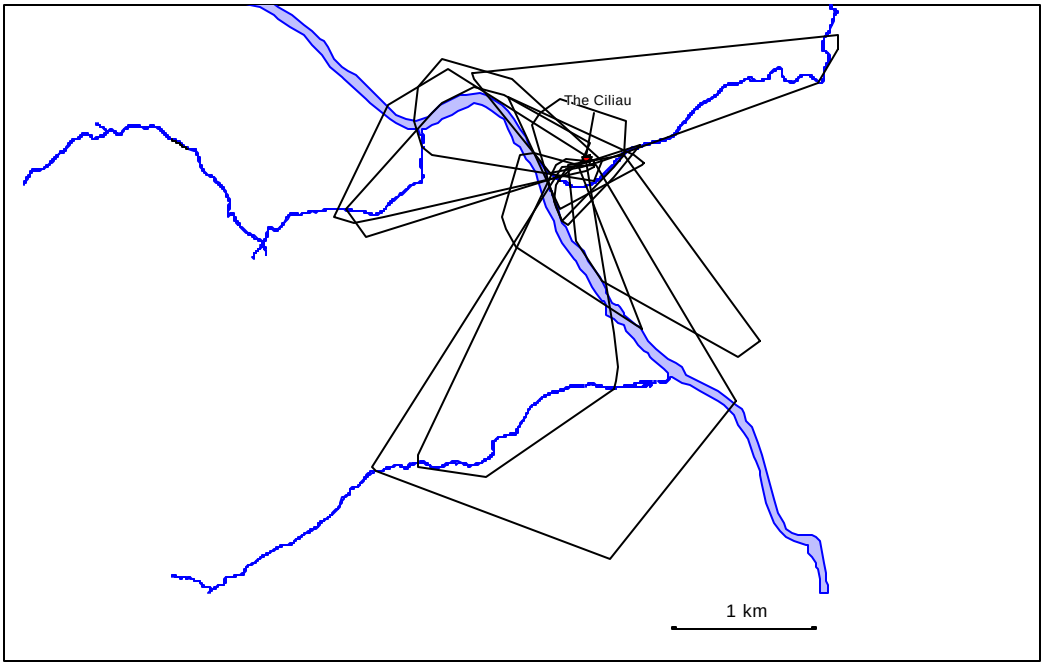
The range of all the bats determined by the MCP varied between 11.84 – 353.00 ha (mean 96.737 standard deviation 94.48 n = 11). The area of the total MCP for the colony was 851.70 ha. Core foraging area size ranged between 8.33 – 34.68 ha (Mean = 20.67 standard deviation 8.34 n = 11). The maximum distances the bats foraged from the Ciliau ranged from 0.440 – 2.695 km (Mean = 1.4 standard deviation 0.74 n = 11). (Table 2)

Table 2. Spatial data recorded during the study

Bat ID	MCP area/ ha	Core area/ ha	Max dist/ km
Bat 1	95.23	20.66	1.745
Bat 2	118.9	34.68	1.880
Bat 3	151.80	33.89	2.380
Bat 4	85.53	21.93	1.655
Bat 5	76.37	17.58	1.686
Bat 6	28.59	12.06	0.675
Bat 7	11.84	8.33	0.461
Bat 9	31.61	13.97	0.445
Bat 10	60.46	18.14	1.235
Bat 11	50.78	19.61	1.199
Bat 12	353.00	26.5	2.695
All bats	851.7	44.86	

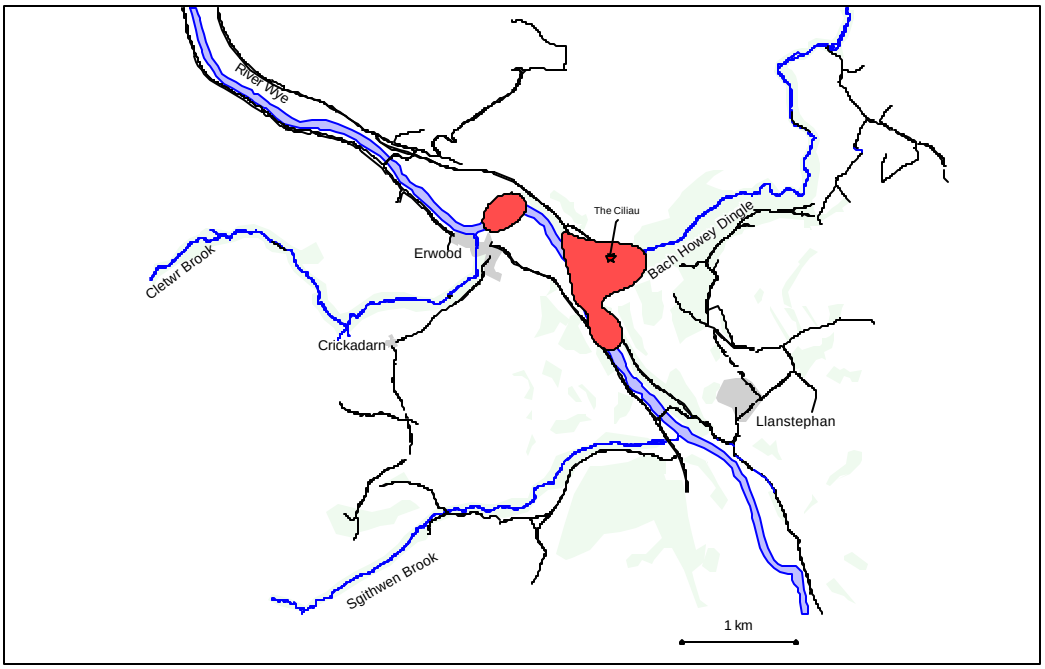
The organisation of the individual MCPs showed a large amount of overlap between the study animals, with their location being strongly influenced by the presence of watercourses (Figure 5).

Figure 5. The Minimum Convex Polygons for all study animals in relation to the main watercourses in the study area.



The core area for the whole colony is represented by the 50% contour of all foraging locations (Figure 6).

Figure 6. The core areas used by the Ciliau colony

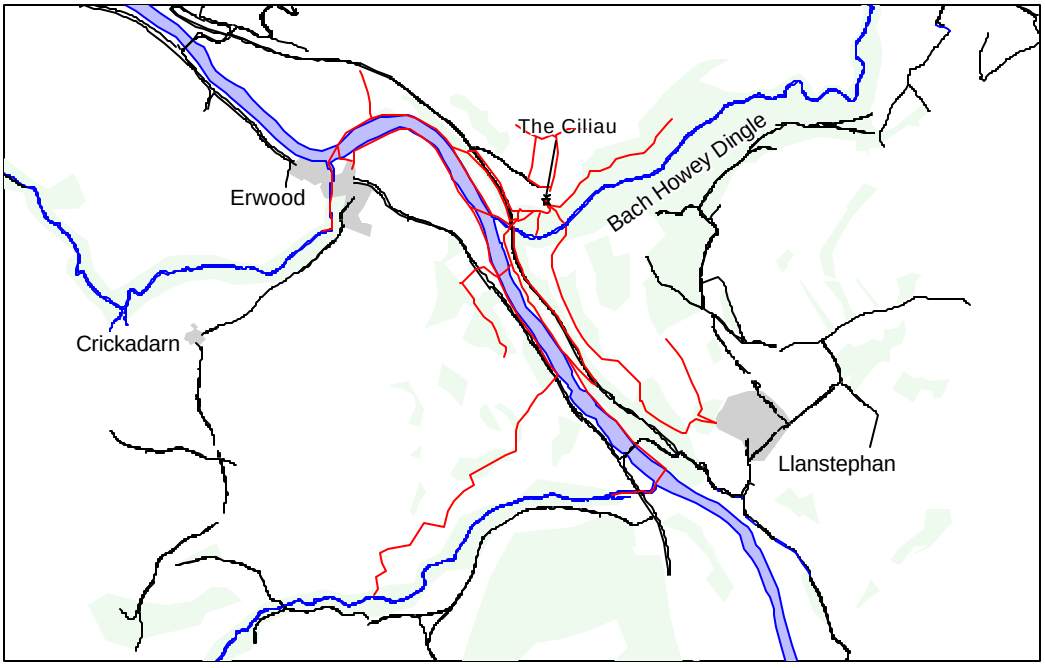


4.5 Commuting routes

During the study, observations were made of the bats main commuting routes (Figure 7). Nearly all the animals left the Ciliau and followed the hedge around the garden and then the track adjacent to the conifer plantation in Bach Howey Dingle. Some used the cover of the conifer plantation to head down to Bach Howey stream. The majority of bats headed up or down the valley following the riparian trees on the banks of the Wye or the strips of wet woodland running adjacent to the Cwrt-y-graban track. Once near the river, animals that had foraging areas on the Brecknock side crossed the river when it became fully dark. We recorded two of the bats passing under bridges on the main A470 to access the Cletwr and Sgithwen brooks. Lesser horseshoe bats were also recorded commuting along the green lane leading north from the Ciliau farmyard and along the hedgerows to the north of the Ciliau. One bat was recorded commuting along the track in Darren wood leading to Darren Cottage.

A larger scale map of the commuting routes can be found in Appendix 2.

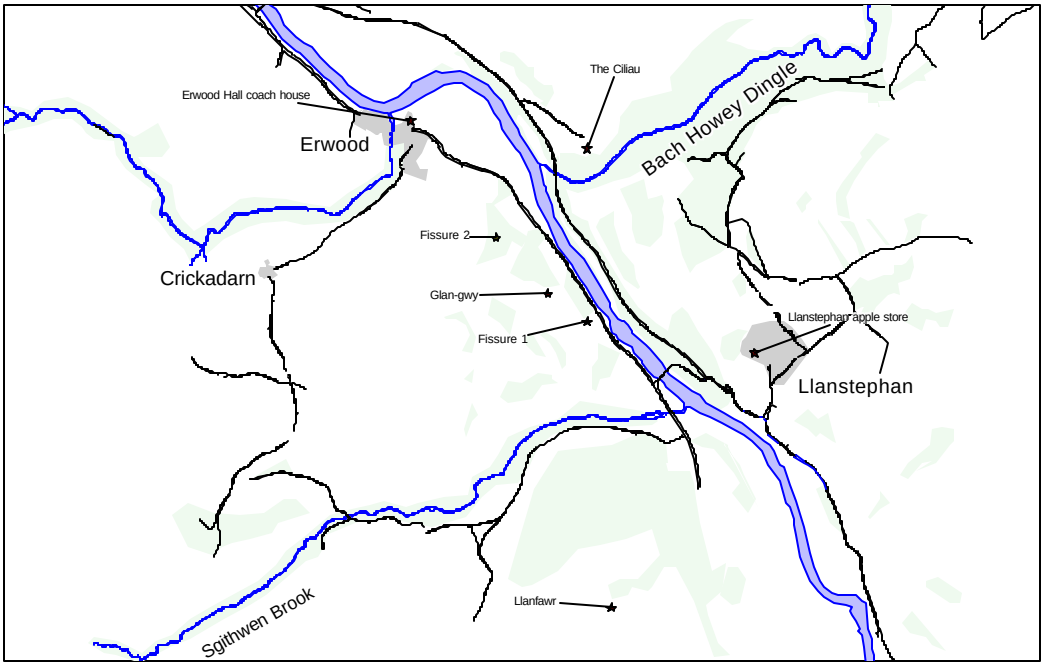
Figure 7. Commuting routes (shown in red) used by the Ciliau colony



4.6 Roosts used by the Ciliau colony

During the study, four of the radio-tagged bats used alternative roosts (Figure 8). Bat 5 used the apple store at Llanstephan (SO091431) for both day and night roosting. Although no other tagged bats were recorded roosting at this site, Bat 12 was recorded foraging close-by. In addition to the apple store, five new roosts were discovered. Three of these were in buildings and two in small caves.

Figure 8. The location of the roosts used by bats during the study



4.6.1 Erwood Hall coach house (SO091431)

This was the most important alternative roost used by the Ciliau colony during our study. The coach house is located at the back of Erwood Hall, some 80 metres from the banks of the Wye. It is well maintained (constructed of stone with a slate roof), but we understand that it has recently been sold, and therefore may be subject to conversion into a dwelling in the future. Three of our study animals were recorded roosting here, Bat 1 used it as both a day and night roost and Bats 4 and 10 night roosted in the site.

Erwood Hall coach house

4.6.2 Glan-Gwy (SO106421)

Glan-Gwy is an L-shaped stone barn with a tin roof close to woodland on the Brecknock side of the Wye. This building is very open and consequently there are high light levels inside. Bat 3 was recorded day roosting at the site. We conducted a daytime inspection, following this discovery, but failed to discover any bats or piles of droppings. Therefore we concluded that bats use this building only occasionally.

Glan-Gwy

4.6.3 Llanfawr (SO109403)

The furthest distance any of our study animals flew was to Llanfawr, some 2.6 kilometres south-west of the Ciliau. Llanfawr is an isolated farm house with a

Llanfawr

number of outbuildings. Bat 12 used the site as a day and night roost, although we could not determine exactly where in the buildings she was roosting; the barn attached to the main house seems the most likely site.

4.6.4 Rock Fissures

Two roosts were discovered in fissures in rock faces, these sites were far too narrow for us to gain access to them. The first, at SO108419, was in a rock outcrop above the A470 and was used as a day roost by Bat 3 and a night roost by Bat 12. The second, at SO103424, was in Pant-y-Coed wood, and was used as a night roost by Bat 11.

Rock outcrop at the location of fissure 1

Rock outcrop at location of fissure 2

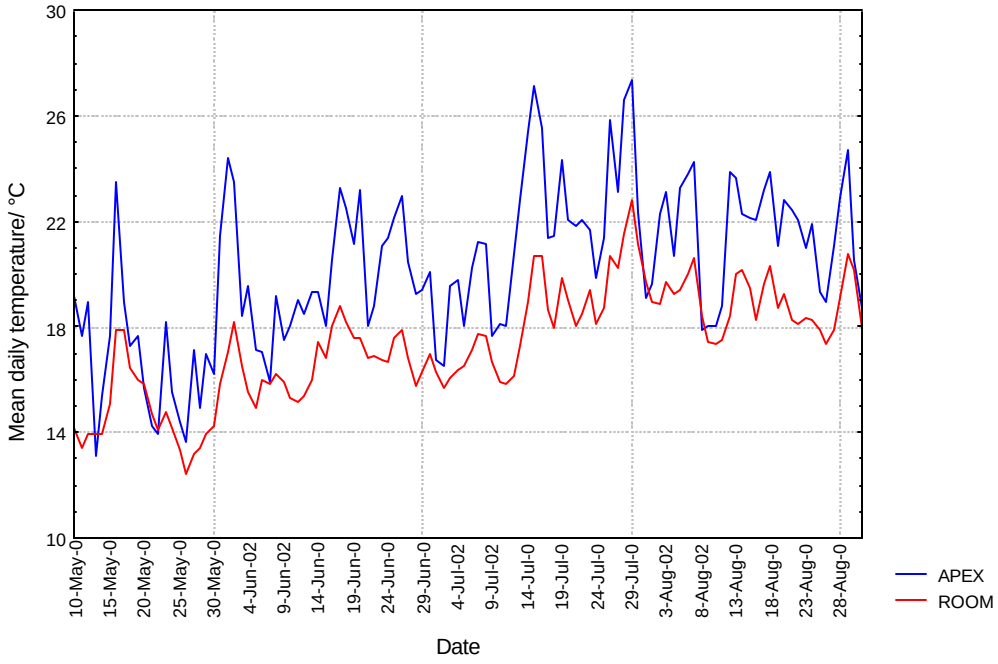
We strongly believe that Bat 2 also used a rock crevice in the Bach Howey dingle as a night roost. On repeated nights this animal foraged for an hour or two in the dingle and then suddenly disappeared in the vicinity of Craig Pwll-du, a particularly inaccessible part of the dingle when radio-tracking at night. The rock faces in this area have many cracks and crevices and the sudden loss of signal is consistent with an animal flying into an underground site.

4.7 General observations of the Ciliau colony and roost temperature data

The main bat access point is at the apex on the south gable wall. However, when provided with an alternative entrance, such as an open first floor window, the majority of the colony leave the roost by the latter. On occasions when the internal doors and the loft hatch are left open, lesser horseshoe bats can be observed flying throughout the building and will even exit the roost through the front door.

The temperatures in the apex of the roof of the Ciliau varied between 7.4 – 41.3°C, and those in the first floor bat room between 10.8 – 25.8 °C. The mean daily temperature between May and August at each location is shown in Figure 9.

Figure 9. The mean daily temperatures in the roof apex and the first floor bat room at the Ciliau between May and August 2002.



5. DISCUSSION

5.1 Foraging areas

The findings of this study are broadly similar to previous radio-tracking studies of this species; lesser horseshoe bats primarily forage in broadleaf woodland within 2 km of their maternity roost. The most important foraging areas in this study were riparian woodland in the valley bottom and the well woodland tributary streams running into the Wye. Interestingly, the previous radio-tracking study of this species in Wales by the VWT at Penallt Old Church in the lower Wye valley showed much less dependence on riparian woodland than we found for the Ciliau colony.

In addition to riparian areas, bats also foraged in the smaller blocks of woodland on the west side of the valley. These are well inter-connected with hedgerows and some bats moved between woodland blocks during foraging bouts. However, some of this woodland is open to sheep grazing, and the long term effects of this practice on the woodland regeneration need to be considered.

Although continuous broadleaf woodland was the primary foraging habitat, bats also fed along hedgerows and green lanes. Three bats used the conifer plantation between the Ciliau and the Bach Howey stream for short periods of time. Lesser horseshoe bats foraging in this habitat has not been previously reported, however it should not be assumed that this is highly suitable foraging habitat for this species. The number of bats involved was small, as was the overall time spent in the plantation. It is likely that its close proximity to the broadleaf woodland and to the Bach Howey stream generates suitable insect prey that may be migrating through the plantation. Its close proximity to the Ciliau may also be a factor, as pregnant or lactating bats would reduce their energy expenditure by foraging so close to the roost. Although not highly suitable foraging habitat, the plantation is excellent cover for the bats from the Ciliau, and is worth protecting for this reason alone.

5.2 Commuting routes

Commuting routes are important features of the landscape for lesser horseshoe bats, as they generally avoid flying across open spaces. These routes are difficult to determine in continuous woodland by any means other than radio-telemetry. The extent of suitable woodland habitat on the east side of the valley means there are few breaks in the vegetative cover, and as long as this habitat is maintained, the bats commuting routes from the Ciliau will be well protected. Moving up the valley side above the Ciliau areas of pasture start to predominate. The hedgerows and green lanes in this area were found to be commuting routes during our study. It is important that the continuity of these features, and where possible, the well-developed structure of the hedgerow trees are maintained.

On the west side of the Wye, bats avoided crossing the main road (A470) by flying underneath the bridges at Erwood and Trericket Mill, although one bat did cross the A470 between these two locations. The woodland on the west side of the Wye, especially between Glan-Gwy and Sgithwen Brook, is more fragmented. It is important that the links between these smaller blocks of woodlands are maintained.

5.3 Alternative roosts

Although female lesser horseshoe bats are highly faithful to their maternity roost, returning over many years and generations, they do use alternative roosts. These are generally night roosts where bats hang up to rest and groom, and are particularly important to heavily pregnant bats. Occasionally, animals will remain in their night roosts during the day before returning to the main maternity colony the following night. This usually happens during the early stages of pregnancy or following the weaning of young. Sites that are used as night roosts during the summer are sometimes used as day roosts during the autumn, winter and early spring. Consequently, it is not unusual to find lesser horseshoe bats night roosting during the summer in their hibernacula.

The importance of night roosts to heavily pregnant bats cannot be overestimated. They probably allow the females to feed in areas some distance from the maternity roost. If the bats are excluded from them, their ability to use outlying suitable foraging habitat may be reduced.

Prior to this study four lesser horseshoe bat roosts were known from the area; the Ciliau, Llanstephan apple store, the Skreen and Crickadarn Church. Although none of the radio-tagged bats roosted in either the Skeen or Crickadarn Church, we recorded foraging activity within 220m and 350m of both sites respectively and their use by the bats from the Ciliau cannot be ruled out.

Of the new sites discovered during this study, Erwood Hall coach house was the most important. Our understanding is that this site may be redeveloped as a dwelling in the future. A full assessment of the site is needed to determine the numbers of animals using the building, their points of access and roosting location. Should the site be redeveloped, then a suitable alternative night roost would need to be constructed.

Our study revealed little about how bats use Llanfawr. It is relatively far from the Ciliau but may be used more by the bats from Llanstephan. This site needs further investigation.

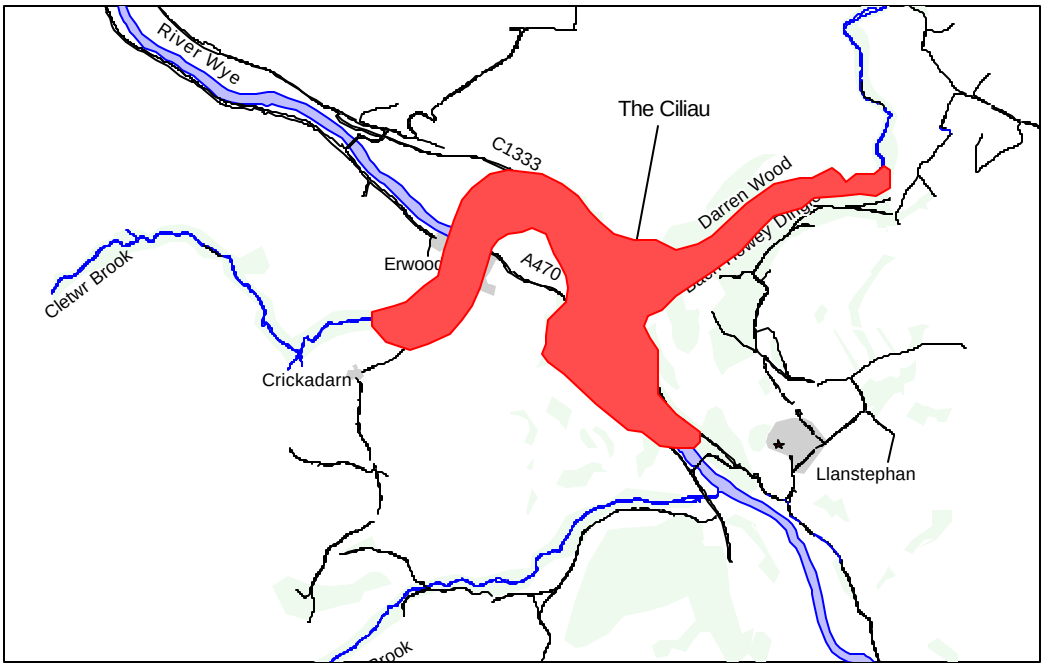
There seems little possibility that Glan-Gwy would ever be re-developed. It is too isolated and there is no road access to the site. It lies too far from the Ciliau to make it viable as a new roost for the colony. We would recommend that the landowner is informed of the presence of the bats and that the structural integrity of the building is reviewed from time to time.

The roosts discovered rock fissues during the study are most interesting. Although we have suspected that this species used such sites, it has never been established before this study. As there are no other obvious hibernacula in the area it seems credible that hibernating lesser horseshoes from the Ciliau use sites such as these. Their structure makes it impossible for humans to access the sites and consequently they are ideal undisturbed roosts.

5.4 Overview of the area for notification

The data gathered during this study clearly indicates that the current boundary of the Ciliau SSSI is inadequate. Although it gives some protection to the maternity roost, no statutory protection is given to alternative roosts, foraging areas or commuting routes. The lesser horseshoe bat interest could be added to the current SSSI designation for the river Wye, Bach Howey, Cletwr and Sgithwen Dingle s. However, the boundaries of these sites do not incorporate the important woodland areas in the valley bottom or on the east side of the Wye above the A470. We would suggest using the boundary from the kernel estimations and including all the alternative roosts. A suggested boundary is shown in Figure 13. Within this area, all broadleaf woodland, hedgerows, tree lines and the conifer plantation close to the Ciliau should be considered for inclusion in the SSSI.

Figure 10. Suggested boundary for SAC/SSSI designation



5.5 The link with the Llanstephan colony

Little is known of how geographically close maternity colonies of lesser horseshoe bats relate to one another. Although the typical roosting strategy of this species in Britain and Ireland appears to indicate that all the females from one local population gather at a single key maternity roost, on the continent, where summer temperature conditions may be more optimal, local populations use a number of roosts in a small locality. We also see this behaviour in areas of this country where no single roost in an area is entirely suitable. This was clearly demonstrated by the VWT in the Tanat Valley, Montgomeryshire where prior to the renovation of one roost, the local population was dispersed between four or five less suitable sites. On completion of the renovation, all the bats from the surrounding roosts occupied the site.

One other consideration when looking at colonies in close proximity to one another is competition for food resources. Where colony size is large, the competition for food resources close to the roost will increase. It is noticeable that when colonies of this species attain sizes of four or five hundred bats, this is rarely sustained for long and the colony appears to split. Notable examples are the colonies at Caerwood in Gloucestershire and Penallt Old Church in Monmouthshire.

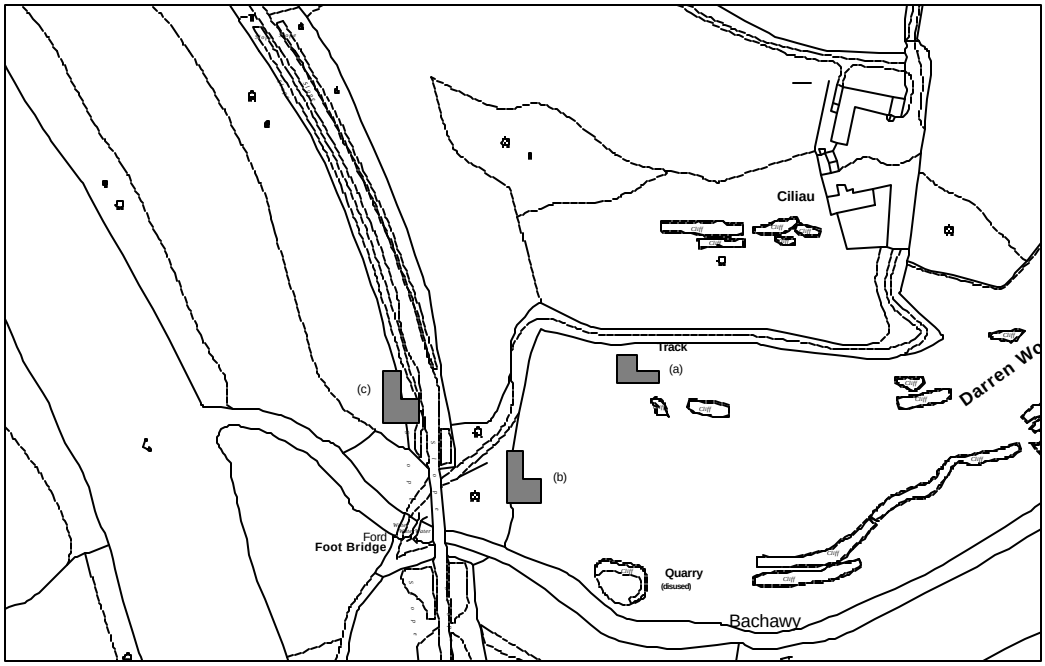
During this study we established a link between the Llanstephan colony and the bats in the Ciliau, supporting observations made in the past that the dynamics of the numbers in both sites seemed to be related to one another. However, at no time have we seen all the bats gathering in just one of the sites. We would suggest that although this is the same population of bats individuals generally remain faithful to one or other of the sites, unless they experience excessive disturbance. The foraging areas of the bats from the Ciliau are concentrated along the Wye and Bach Howey Dingle within 1.7 km of the maternity roost. There was relatively little activity recorded in the woodlands around Llanstephan or along the riparian woodland to the south of the apple store, although the habitat in these areas is highly suitable for lesser horseshoe bats. We suspect that there will be some over-lap in the foraging areas of both colonies but that the bats from Llanstephan avoid competing with the Ciliau bats by using different areas, probably to the south of Llanstephan. The implication of this is that although the bats are from the same population, the suggested protection of the Ciliau colony will have limited benefit for the bats at Llanstephan. This site should be considered separately and needs further investigation along the lines of this study.

5.6 Location of a suitable bat house

There are a number of considerations in suggesting a suitable site for a bat house. The chances of success are greatly increased if it is located close to continuous cover, in an area used by many bats and along a key commuting route. The building needs to be located where it benefits from sunlight in order to maintain high roost temperatures and ideally it should be protected from casual disturbance.

The 50% kernel contour for all foraging fixes describes areas where most bat foraging activity is concentrated (Figure 6). The smaller core area to the west of the Ciliau is too far away from the present roost for a new bat house, leaving the region around the maternity roost as the most suitable general location. As few bats commute out to the north of the roost, it would be best to site the new building along the main commuting routes to the south west of the Ciliau. Taking these factors into account potential sites include, (a) within or on edge of the conifer plantation, (b) close to the old railway bridge or (c) in the woodland between the Cwrt-y-graban track (C1333) and the Wye (Figure 14).

Figure 11 Three possible locations for a new bat house



There are advantages and disadvantages to all these sites. Building in the conifer plantation would involve purchasing a plot of land. We would also have to negotiate the long-term future of any logging operations as clear felling may leave the site isolated from woodland cover. The alternative site in the vicinity of the old railway bridge is close to the Wye Valley Walk, popular with ramblers, and consequently at risk of casual disturbance.

In our opinion, the most suitable area to create a new roost would be site c in the woodland between the C1333 and the Wye.

SUMMARY OF RECOMMENDATIONS

- The SSSI boundary for the Ciliau should be extended as shown in Figure 13 to include important foraging habitat not currently protected
- The SSSI designation should include- Erwood Hall coach house, Glan-Gwy Llanfawr, Llanstephan apple store and the two caves
- Commuting routes within the SSSI boundary should be protected and their continuity and structure maintained or improved.
- The sheep grazed woodlands on the west bank of the Wye valley should be fenced to reduce grazing pressure and allow woodland regeneration
- An inventory of the cavities in the rock outcrops within the proposed SSSI boundary should be undertaken. External monitoring of these caves with bat detectors could determine their level of bat use.
- Erwood Hall coach house requires further investigation and monitoring.
- Consideration should be given to undertaking a similar radio-tracking study at Llanstephan apple store
- The bat access points at the Ciliau need extending and improving.
- Negotiations should be entered into with landowners to identify an area with a view to building a new bat house.