PILOT SCHEME FOR MONITORING WOODLAND BATS IN THE REPUBLIC OF IRELAND - 2007

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May 2007

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

Bat Conservation Ireland

A Report Submitted to The National Parks and Wildlife Service of the Department of the Environment, Heritage and Local Government.

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EXECUTIVE SUMMARY

The Habitats Directive (92/43/EEC) requires Ireland to implement monitoring schemes for all its bat species. This report presents the results of trials carried out during the summer 2007 to look at potential methods for monitoring

- Natterer's bat (*Myotis nattereri*)
- Whiskered bat (*M. mystacinus*)
- Brandt's bat (*M. brandtii*)

The following methods were piloted:

- Stationary, remote recording of nightly bat passes by Anabat Frequency Division Detectors at six woodland locations
- Trials with the Autobat Lure and mist nets at woodland locations
- Roost counts at four known Natterer's bat roosts

In addition a field visit was made to The Marble Arch Caves Fermanagh to observe swarming site sampling by staff/students of Leeds University.

Myotid species were recorded at each of the 6 woodland sites tested with Anabat, but these could only be identified to species level in very few cases. Nonetheless, the Anabat, a frequency division detector, has some advantages over time expansion due to ease of analysis and this method could be examined further for potential use by the car-based bat monitoring scheme.

Problems were encountered with the lure, but on the whole it does not appear to hold much potential as a single method for monitoring population trends of woodland bat species in Ireland. It may still prove useful as method for assessing species diversity at specific sites.

Natterer's roost counts were successfully undertaken at 3 trial sites and this approach has some potential. However, due to the small size of most known Natterer's roosts, up to 100 Natterer's summer sites may need to be counted to achieve sufficient statistical power for a robust monitoring scheme. This number could only be confirmed, however, following a large survey and site validation effort, particularly at the initial stages of such a monitoring scheme.

Swarming sites may also offer some alternative monitoring possibilities, however, more work needs to be done to find good swarming sites and to determine trapping rates and species proportions through the swarming season.

INTRODUCTION

An overview of the habitat preferences and ecology of the species targeted by this pilot study is available in Roche and Aughney (2007). The present report presents the results of trials carried out during the summer 2007 to look at potential methods for monitoring

- Natterer's bat (*Myotis nattereri*)
- Whiskered bat (*M. mystacinus*)
- Brandt's bat (*M. brandtii*)

To this end the following methods were piloted in 2007:

- Stationary, remote recording of nightly bat passes by Anabat Frequency Division Detectors at woodland locations
- Trials with the Autobat Lure and mist nets at woodland locations
- Roost counts at known Natterer's bat roosts
- A field visit to observe swarming site sampling by staff/students of Leeds University at The Marble Arch Caves Fermanagh.

MATERIALS AND METHODS

Anabat Detector

The Anabat CF1 bat detector is a frequency division detector. The detector can be programmed to switch itself on and off at desired times. It samples a broad range of frequencies and records bat sounds to a compact flash card. The amount of data collected by the Anabat is limited by:

1. The capacity of the flash card
2. The power supply.

Power can be supplied to the Anabat via 4 AA batteries or, as in the case of remote detecting over an extended time, by a 12V battery pack connected to the Anabat unit. The 12V battery pack is connected to the Anabat unit via a lead with an additional fuse soldered to the connecting lead, which prevents power surges that could potentially damage the unit.

While the Anabat detector is quite robust it was necessary for purpose of this study to construct a weatherproof unit to protect it and the battery while in situ. Staff at Wicklow Mountains National Park made boxes from marine plywood to fit each Anabat with its battery pack. Each box consisted of two slots in the exact dimensions of the two items. The Anabat slot was also equipped with a hole in the exact dimensions of the microphone so that this could protrude from the box. See Figures 1 and 2 for details.

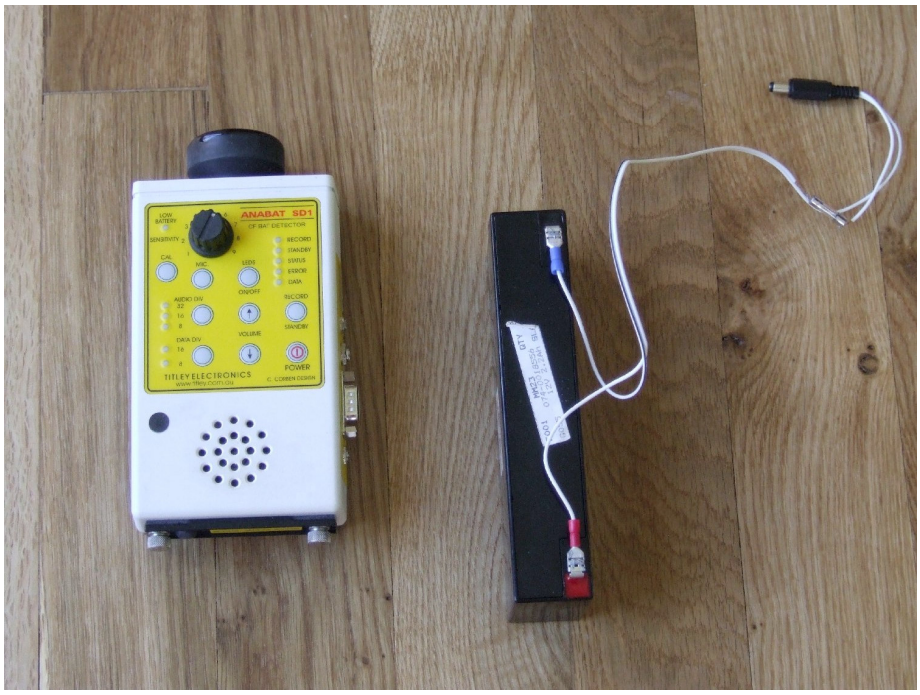

Figure 1: Anabat detector and 12V, 2.2aH battery.

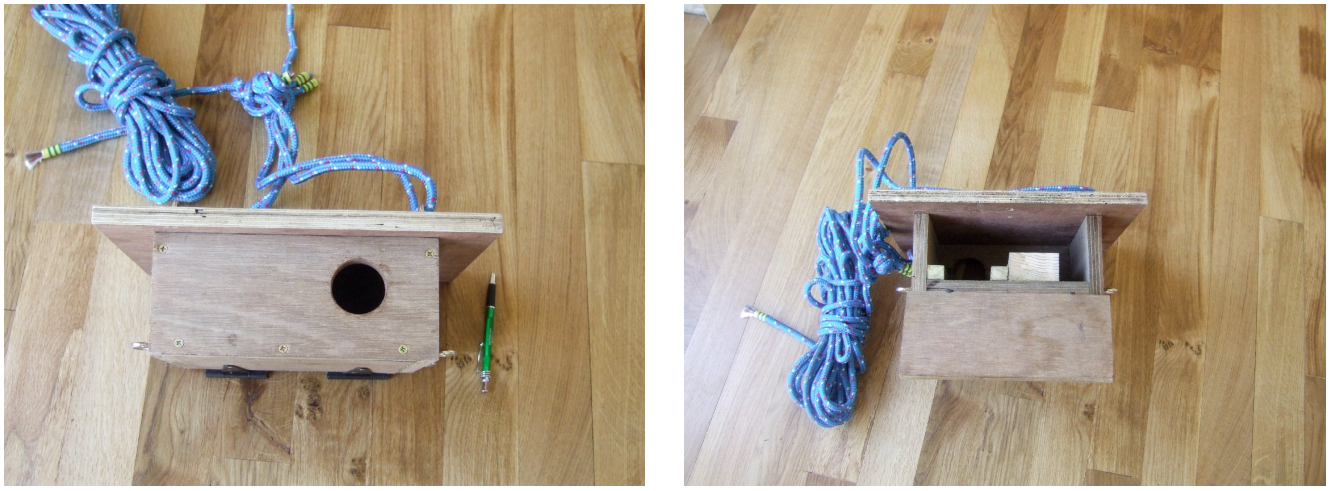

Figure 2: Weatherproof box used to protect the Anabat unit and 12V battery, front on left and rear (open hatch) on right. The image on the left shows the microphone hole. In the image on the right, the slot to hold the Anabat is visible on the left of the box and the slot to hold the battery is visible on the right.

Figure 3: Anabat in situ, Gorteenacusha, Co. Tipperary, July 2007.

In addition a number of screw-in hooks were added to the lid and sides of the box so that it could be hoisted up a tree and stabilised with ropes tied to the sides. See Figure 3 for an illustration of the box in situ.

The detectors were programmed to start recording around dusk and finish recording around dawn.

The Anabat was placed at heights of approximately 5 to 7m in locations that were considered to have a low threat of vandalism, e.g. out of sight of regularly used forest tracks. Additional measures to protect against the possibility of vandalism included tying the main and guy ropes at a height of 3-4m to trunks of trees so the box could not be loosened without first climbing the tree or using a ladder.

A data sheet was used to record the vegetation and habitat characteristics of the area surrounding the Anabat location. The composition of canopy, shrub and field layer vegetation within a 30m square in front of the Anabat was recorded using a DAFOR (dominant-abundant-frequent-occasional-rare) scale. Overall % cover abundance of each layer was also recorded. Total numbers of trees and shrubs of different DBH (diameter at breast height) categories were also recorded.

The Anabat detectors were removed following a recording period of 1-2 weeks. On the CF card, files are automatically labelled with date and time and can then be downloaded to computer via a USB connection using a flash card reader. Files were downloaded and analysed using Analook software. Call parameters such as those described in Vaughan *et al*. (1997) and Russo and Jones (2002) were used to facilitate identification to species level. Where identification to species level was not possible, as in the case of many *Myoti*s spp. calls, the species were grouped. Otherwise a call or call sequence was labelled as unidentified. Using Analook software it is possible to label each bat pass and, following analysis for each site, feed the data automatically to Microsoft Excel. A separate spreadsheet with results, categorised according to species, time and date, can be saved for each site.

Autobat Lure & Mist Netting

An Autobat lure (Hill and Greenaway, 2005) was purchased by Wicklow Mountains National Park as part of its programme of bat research and was kindly loaned to Bat Conservation Ireland for the purposes of the woodland pilot study. The lure was used according to the instructions included with the equipment.

The lure is powered with an internal rechargeable battery and is programmed with a number of simulated bat social calls. Any selection of these calls may be used during a sampling session although the social calls of certain species are recommended as attracting larger numbers and diversity of bats. In the UK, for example, good results have been obtained by using Bechstein's calls (*Myotis bechsteini*). The microphone was plugged in to the lure and attached to a 2m pole. A 6m and 9m bat mist net by Avinet Inc. were used in conjunction with the lure. Additional nets were supplied on occasion by Conor Kelleher and Enda Mullen (NPWS). Mist nets were set up at locations that were considered to have a high likelihood of catching bats on each occasion. Nets were spaced at a distance of 20m to 40m apart. The lure microphone was held at a distance of approximately 30cm from the mist net and surveyors were as quiet and still as possible during its use. The lure was switched on for a count of 10 and switched off for a count of 5 and used for 10 minutes at one mist net, then moved to another. The lure microphone was rotated by twisting the pole around 360˚ while switched on. This was done to maximise the chances of bats in the surrounding area hearing the lure.

Approximately 1.5hrs to 3hrs post dusk were spent mist netting and luring at each site. At least one bat detector was used in each site to elucidate roughly the level of bat activity and diversity of species present.

Where bats were caught, the individuals were identified to species level, sexed and forearm length was measured. For *Myotis* bats a wing punch sample was taken and forwarded to the bat research laboratory in University College Dublin.

Natterer's Bat Roost Counts

As part of the present pilot study National Parks and Wildlife Service regional staff in four locations with known Natterer's roosts were contacted and asked to voluntarily carry out a count of Natterer's bats emerging from the site. All of the staff responded favourably to the request and carried out surveys at the following sites:

- Cootehill Church of Ireland Church, Co. Cavan
- Kylemore Abbey Gothic Church, Co. Galway
- Glenview Church of Ireland Church, Ardagh, Co. Limerick
- Liskenfere Church of Ireland, Co. Wexford.

Guidelines for how to complete the survey were emailed or given to the surveyors (see Appendix). On-site daytime meetings took place at two of the sites (Limerick and Cootehill). These were followed by evening emergence counts. At the two other sites counts were carried out without any prior meetings or training. At the Wexford site one of the two where no prior training was given, the surveyor had a high level of bat experience. At the Galway site, Kylemore, the second roost where no training was given, surveyors were somewhat less experienced in bat identification using detectors, thus hampering identification of emerging bats.

Swarming

A swarming study was not undertaken as part of the present pilot project although a visit to Fermanagh was made while staff and students from the University of Leeds were catching bats at cave entrances to facilitate further DNA analysis of European *Myotis*. Swarming has not been investigated in the Republic of Ireland to-date. The author accompanied Prof John Altringham as a field assistant on one survey night in August. Prof Altringham also kindly made data available from other night's work at Fermanagh caves (*pers.comm.*).

RESULTS

Anabat Detector

The 12V, 2.2Ah battery used for this pilot study was found to last approximately 3 weeks with the detector programmed to switch on every evening at 10pm and switch off at 3am (5 hours of recording per night). However, the 512mb flash cards were filled to capacity within 1-2 weeks depending on the level of bat activity in the woodland.

The Anabat boxes did not suffer from vandalism or disturbance during their stays at any of the six locations around the country. One box was colonised with earwigs when it was taken down. These were easily removed. Water ingress was not problematic with any of the boxes, despite the high rainfall levels experienced in July and August 2007.

Finding suitable receptor trees was occasionally difficult and the initial stage of hoisting the Anabat was time consuming in places (2-3 hours x two persons).

On one occasion the detector could not be used because the fuse blew between the battery and Anabat and needed to be re-soldered, on another occasion the fuse (made from glass) was stood on and needed to be replaced and re-soldered.

In total, the Anabat detectors recorded bat sounds for 293 hours on 67 nights from May to August at various locations in Cavan, Meath and Tipperary, see Table 1 for details of dates and locations.

Analysis of the recordings made from the six sites (293 hours) took 25 hours. In other words, data from approximately 11.5 hours of recording could be analysed in approximately 1 hour. The time taken depended, to a large extent, on the number of bat passes recorded on the site. Recordings from Tankardstown, for example, were analysed very quickly due to the low number of bat passes recorded there, while Deerpark took considerably longer due to the very high number of passes.

Table 1: Locations, dates and number of hours spent recording by each Anabat detector in 2007.

Site Name	Location	Grid Ref	Dates	Hours	Woodland Type, main canopy species
Deerpark	Virginia, Co. Cavan	N595872	13/8/7-21/8/7	58	Broadleaved, beech
Glengarra Site 1	Cahir, Co. Tipperary	R9291218765	17/7/7-23/7/7	35	Broadleaved, oak
Glengarra Site 2	Cahir, Co. Tipperary	R9246519925	25/7/7-6/8/7	65	Conifer, Scots pine
Gorteenacusha	Cahir, Co. Tipperary	R9264816198	18/7/7-23/7/7	30	Broadleaved, ash
Headfort Demesne	Kells, Co. Meath	N7590076995	29/5/7-4/6/7	35	Broadleaved, mixed
Tankardstown	Slane, Co. Meath	N914788	4/6/7-17/6/7	70	Broadleaved, beech

Table 2: Bat passes recorded and identified from Anabat detectors at specified locations, 2007.

	Leisler's	Long-eared	Common pip	Soprano pip	50kHz pip	Natterer's	Myotis spp.	Unid.	Total
Deerpark	6	0	68	2391	123	6	130	32	2756
Glengarra Site 1	22	0	107	174	2	1	44	29	379
Glengarra Site 2	0	0	0	11	0	0	18	7	36
Gorteenacusha	0	0	10	3	0	0	176	42	231
Headfort Demesne	0	0	13	71	0	0	56	6	146
Tankardstown	0	2	803	111	46	0	22	15	999
TOTALS	**28**	**2**	**1001**	**2761**	**171**	**7**	**446**	**130**	**4546**

By far the greatest number of bat passes was recorded at Deerpark, Virginia. However, most of these are accounted-for by soprano pipistrelles. An illustration of typical Anabat recorded soprano pipistrelle echolocation calls is shown in Figure 4.

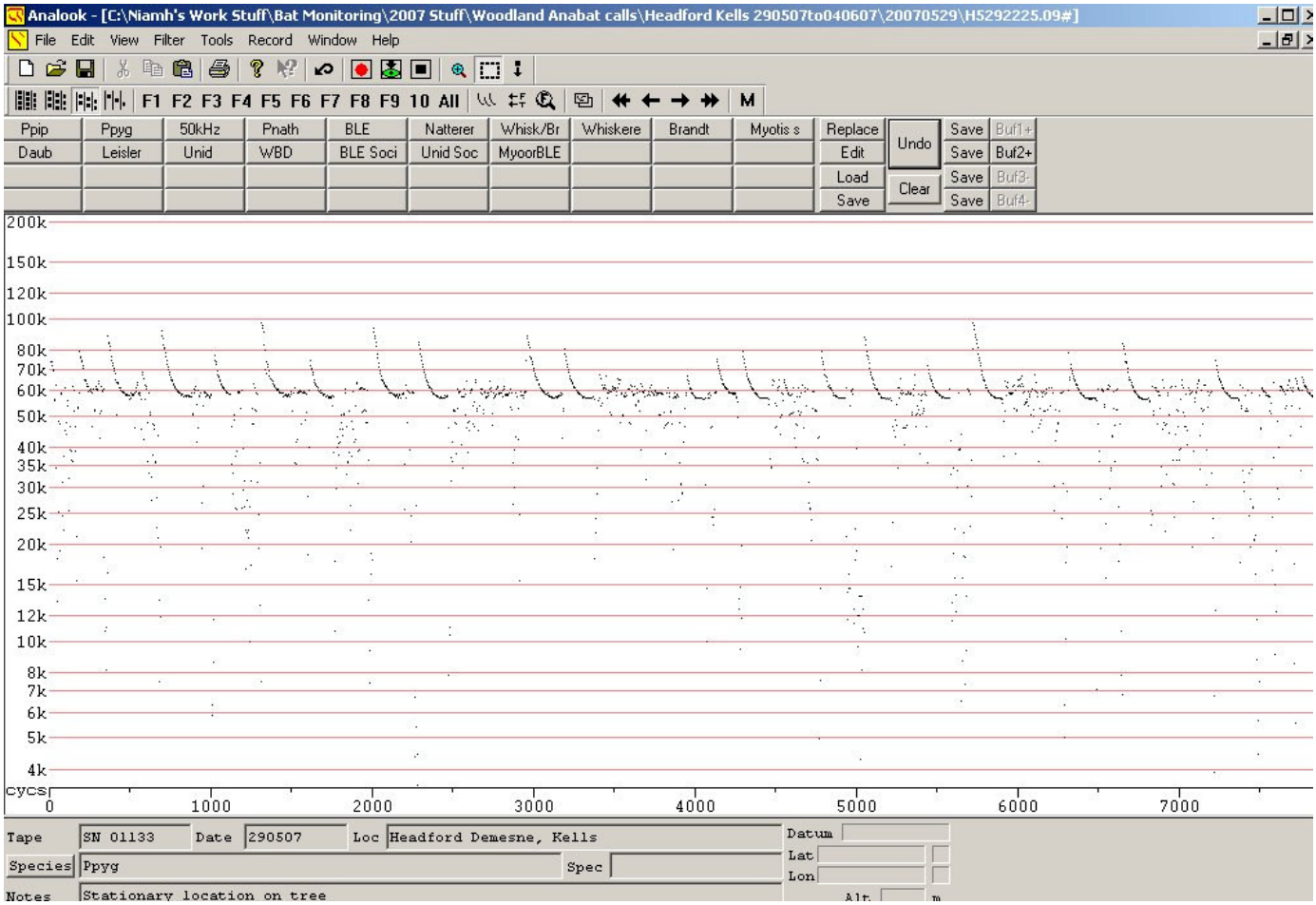

Figure 4: Typical soprano pipistrelle echolocation pulses, recorded by Anabat and analysed using Analook software.

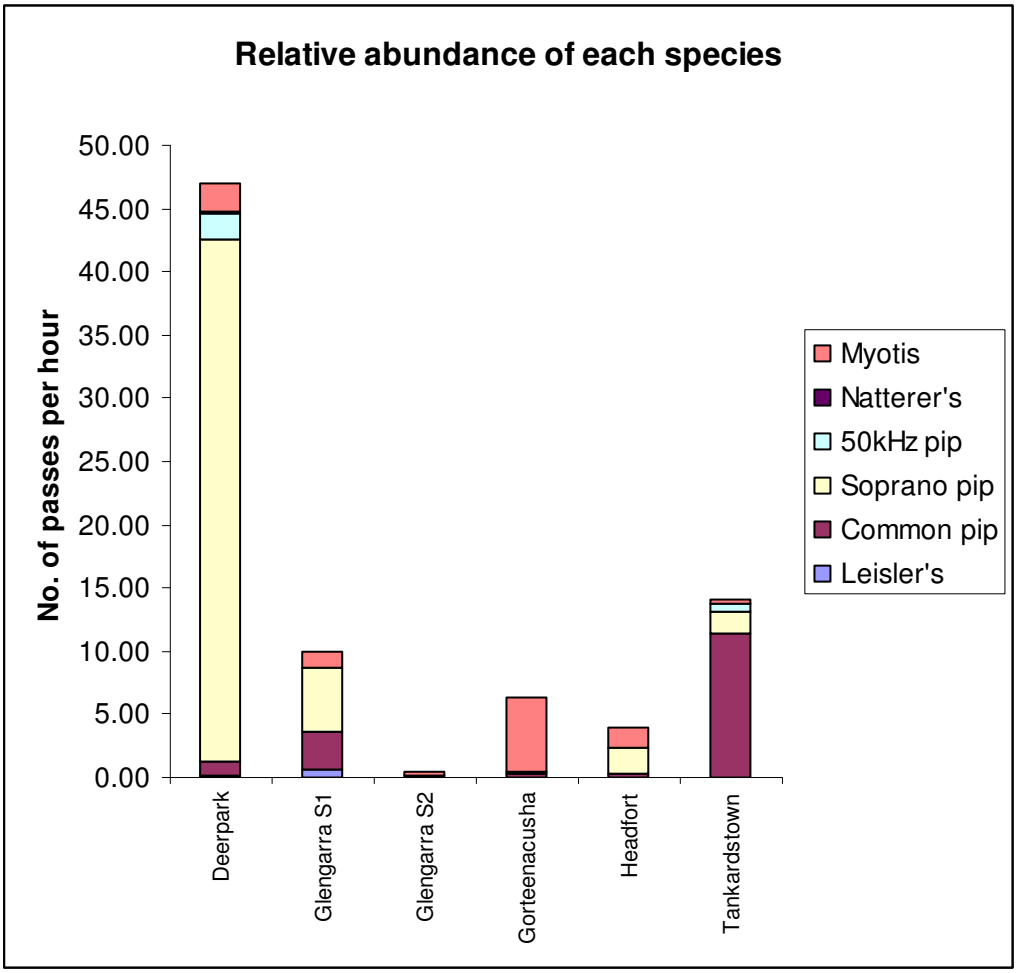

Figure 5: Number of bat passes per hour recorded to stationary Anabat detector in each survey woodland, categorised according to species or species group.

Among the *Myotis* bats, the greatest number of passes per hour was recorded at Gorteenacusha, Co. Tipperary (see Figure 5 above). The rate of *Myotis* spp. bat passes at this location was 5.87 per hour, compared with 2.24 at Deerpark, which had the second highest *Myotis* bat pass rate of the six sites surveyed. The overall average *Myotis* bat pass rate for all six sites was 1.69 passes per hour. In very few cases was it possible to discriminate between *Myotis* species. Occasional Natterer's bats were recorded (see Figure 6). Of the 453 *Myotis* bat passes recorded just seven of these were positively identified as Natterer's bats, mainly in Deerpark, Virginia. The remainder were identified as either *Myotis* spp. or a category grouped as whiskered / Brandt's / Daubenton's. While whiskered/Brandt's may be more likely to occur in woodland than Daubenton's, all of the sites were located within 1km of a water body, in some cases as little as 15m, in which case, the possibility of Daubenton's bats commuting, roosting or even foraging close-by cannot be ruled out.

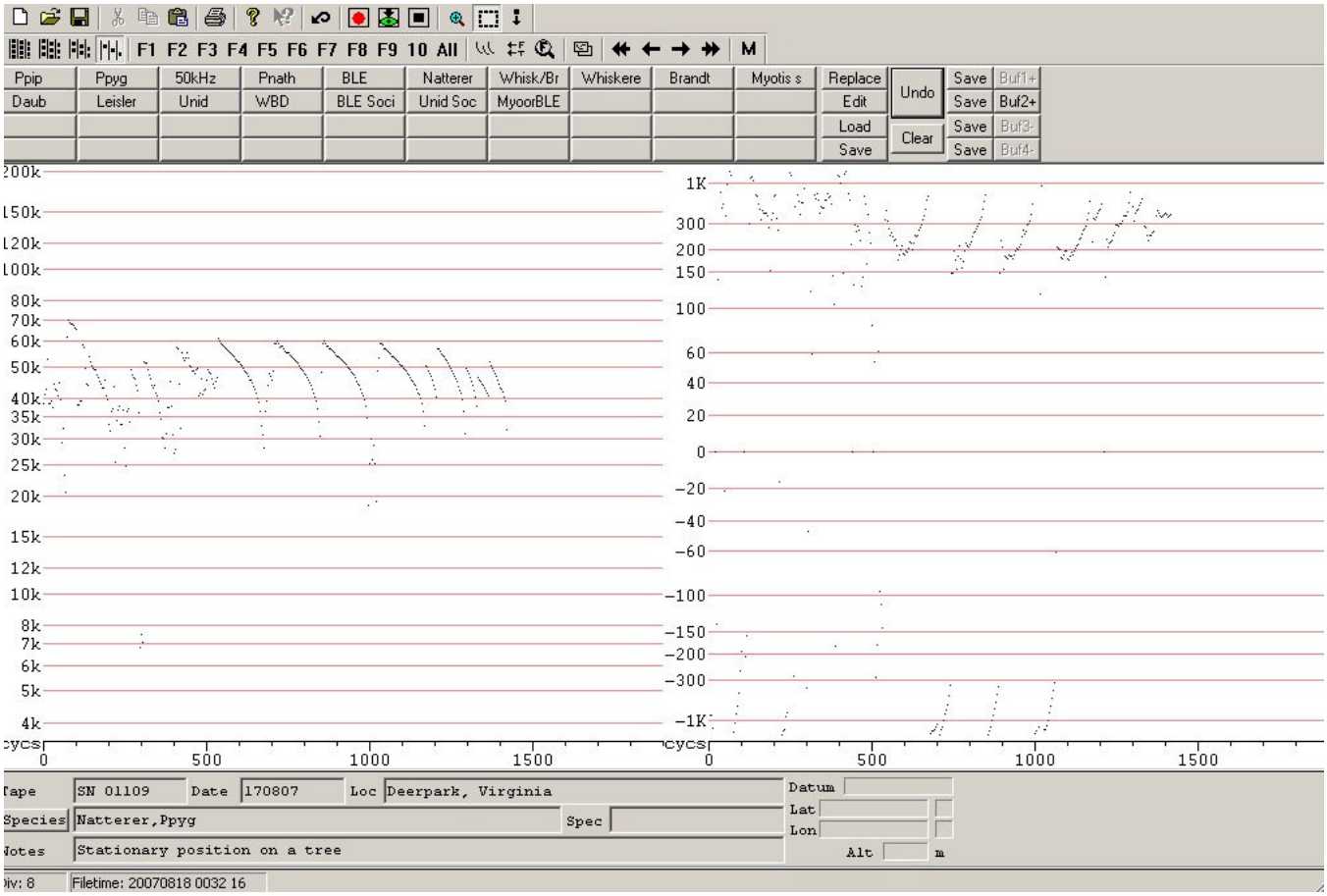

Figure 6: An example of a Natterer's bat call recorded by Anabat at Deerpark, Virginia. The sonogram can be seen on the left hand side, with the slope of each echolocation pulse visible on the right. The √ pattern of the slope is typical of Natterer's bat calls.

Myotis bat temporal activity varied from site to site (see Figure 7). Similar patterns were visible at Glengarra Site 1 and Gorteenacusha, where high levels of *Myotis* bat activity early in the evening were followed by a dip in activity and a second increase in activity prior to dawn.

At Headfort Demesne, Kells, there was a gradual increase in activity of *Myotis* bats during the night. These recordings were made in late May and early June. The other two sites, Deerpark and Tankardstown, show more random distribution of activity, through much of the night, except for the initial hour of recording at Tankardstown when slightly more passes were recorded. Very few *Myotis* bat passes were recorded at Glengarra Site 2, a location approximately 1km up a river valley from Glengarra Site 1. This was the only site dominated by conifers, mainly Scots pine.

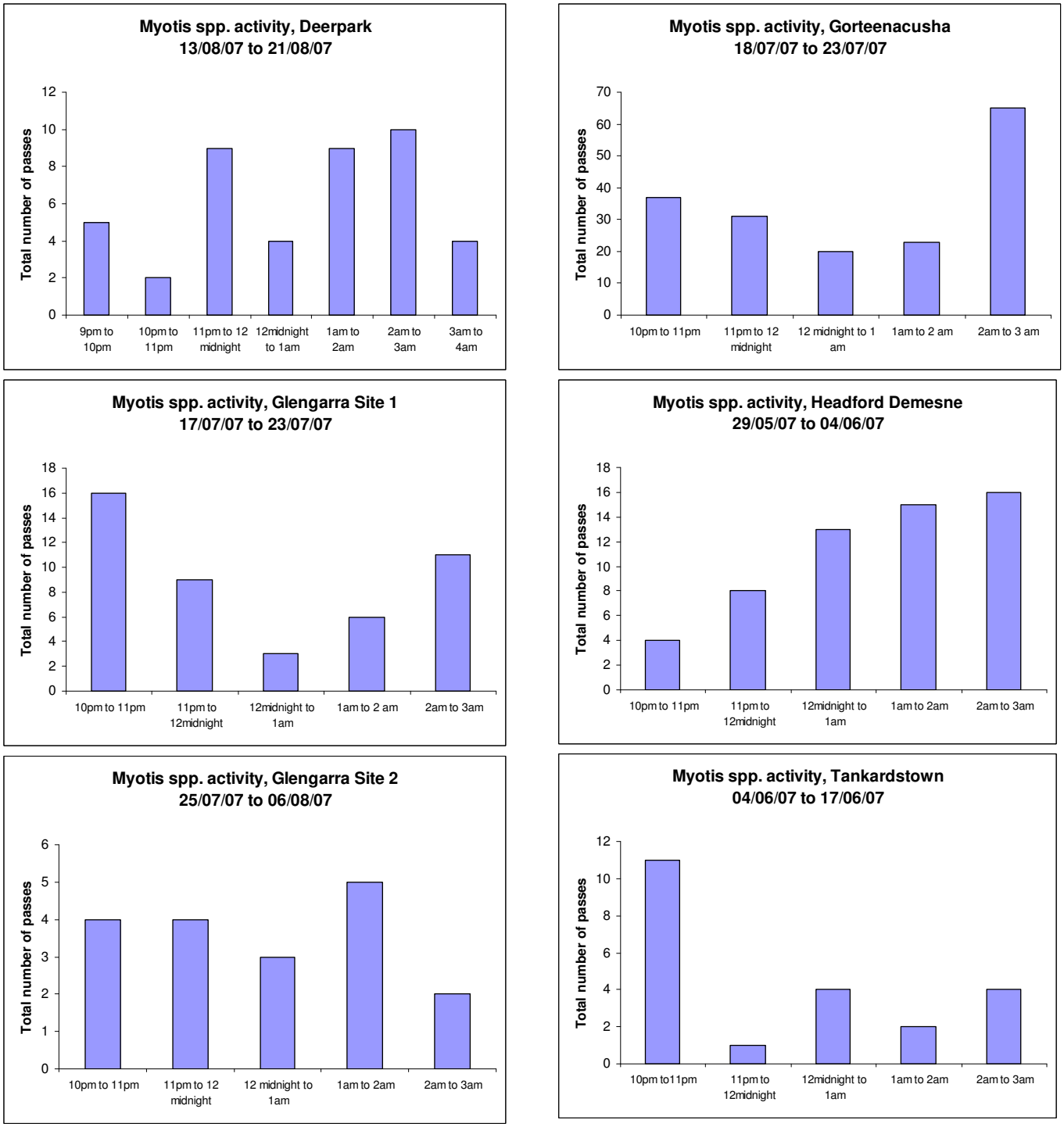

Figure 7: Temporal activity levels of *Myotis* species in each woodland study site in 2007.

Autobat Lure & Mist Nets

The Autobat Lure and mist nets were used on seven nights in various locations around the country (see Table 3). The lure was also used on an additional survey night during the Bat Conservation Ireland Bat Detector Workshop in Killarney National Park in June '07. Several problems arose while using the lure. On the first four nights when the lure was used bats observed in flight in the vicinity showed little interest in the device and, although one or two bats flew close to the microphone, no bats were

attracted into the nets. The two bats that were caught, at Glengarra, were actually caught in nets when the lure was not present. These were a male Natterer's bat and a male Leisler's bat.

Table 3: Locations, dates and results from lure and mist net field work, summer 2007.

Location	Grid Ref	Date	Time	Mist nets	Bats flying	Bats in nets
Headfort Kells Night 1	N759769	29/5/7	22:30 to 23:45	1 x 9m	Yes	0
Headfort Kells Night 2	N759769	5/6/7	22:45 to 24:00	2 x 9m	Yes	0
Glengarra	R9282919007	17/7/7	23:01 to 01:30	1 x 9m 2 x 6m	Yes	2
Gorteenacusha	R927163	18/7/7	23:00 to 00:30	1 x 9m 2 x 6m	Yes	0
Deerpark, Virginia	N595872	8/8/7	21:30 to 24:00	1 x 9m 2 x 6m	Yes	2
Glendalough, Green Road	T11649619	15/8/7	22:10 to 23:40	2 x 9m 1 x 6m	Yes	0
Laragh	T143948	23/8/7	22:00 to 23:30	2 x 9m 1 x 6m	Yes	0

Upon discussing problems with the manufacturers the lure was reprogrammed and on the first evening of field work following reprogramming, at Deerpark, two bats were caught. These bats were caught in the mist nets while the lure was in use and at locations where bats would not normally be anticipated in nets, due to the openness of the site. Deerpark woodland has little understorey cover and is not a typically suitable mist-netting site. The two bats caught in Deerpark, a male soprano pipistrelle and a male Natterer's bat, displayed very aggressive behaviour typical of lure-attracted, mist-netted bats (Lothar Bach *pers.comm.*).

On the following field work occasions in Glendalough the switch on the lure broke, rendering it impossible to determine which social call was in use. No bats were attracted to the nets on this or on the subsequent netting foray as part of the woodland pilot study.

Based on the minimal resulting bat catches it is not possible to 'ground-truth' the bat calls recorded by the Anabat or work out, even approximately, the proportions of different *Myotis* species present in each woodland. Natterer's bats were confirmed as present in two of the woodlands.

Natterer's Bat Roost Counts

Counts were carried out at four known Natterer's bat roost sites. These locations are shown in Table 4 and illustrated in Figures 8 to 11.

Table 4: Name, locations and results from daytime and evening emergence counts at Natterer's bat roost sites, 2007.

Site Name, Address	**Grid Ref.**	**Date**	**Equipment used**	**No. of bats (day count)**	**No. of bats (evening count)**	**Number of Natterer's**
Cootehill Church (C of I), Cootehill, Co. Cavan B:1818	H60301440	18/6/7 28/6/7 10/7/7 23/7/7	Heterodyne	1 dead specimen	27-55 Additional common pips emerged from rear but are not included	55 total
Kylemore Gothic Church, Kylemore Abbey, Co. Galway B:1880s	L753585	16/8/7	None	n/a	651	Approx 650??
Rathronan Church (C of I), Glenville, Ardagh, Co. Limerick	R273402	8/6/7 (daytime) 12/6/7 (evening emergence)	Detector type unknown	7-8 adults +others unseen 6 babies	12-15	12-15
St. Luke's (C of I), Leskinfere, Clogh, Co. Wexford	T1222456132	4/7/7	Detector	n/a	125	Approx. 100-124

At three of the sites, Cootehill, Leskinfere and Rathronan, it appears that counting the Natterer's bats is a feasible prospect. At Kylemore, greater investigation may be needed to be sure of exact species identifications. At Ardagh and Cootehill the wildlife conservation rangers found that emergence took place from at least two locations on the buildings in question. None of the emergence counts were followed by internal investigations so it is unknown whether, as is often the case with brown long-eared bats, adult individuals failed to emerge on the particular survey evenings.

Figure 8: Cootehill Church (Church of Ireland). The main exit point for the bats was from the left hand side of the belfry.

Figure 9: Kylemore Gothic Church. Over 600 bats emerged from this church. There are many exit points. Further work confirming species identifications is necessary before current Natterer's bat numbers can be confirmed at this site.

Figure 10: Rathronan Church, Ardagh. Bats emerged from two locations, one at the belfry and one at the rear of the church.

Figure 11: St Luke's Church, Leskinfere. Over 100 bats emerged from this church. © Jonathan Billinger

Swarming

Bats entering and leaving cave sites in Fermanagh were caught using harp traps and mist nets by staff and students from the University of Leeds. Figure 12 illustrates the harp trap set-up from a survey at Boho Cave, Fermanagh on August 28th 2007. From four nights of field work at two locations, 21 Natterer's bats were caught (J. Altringham *pers. comm.*). In addition 27 Daubenton's bats, two whiskered and six brown long-eared bats were also caught (J. Altringham *pers. comm.*). On another trapping occasion in October (during a field trip associated with the 5th Irish Bat Conference) an additional four Natterer's bats were caught at the Marble Arch caves.

Figure 12: Two harp traps set up at the entrance to Boho Cave, Fermanagh as part of University of Leeds pan-European swarming study.

DISCUSSION

Anabat Recordings

Approximately 12 hours of recordings from the Anabat could be analysed in approximately 1 hour so this method is much more efficient time-wise compared with, for example, Time Expansion sonogram analysis for the Car-based Bat Monitoring scheme. For TE sound analysis the time taken tends to be roughly similar to the amount of time spent recording (N. Roche, *unpublished data*). In addition, the data from time expanded sonogram analysis must be then be entered by hand since there is currently no mechanism to label sounds using Bat Sound or other software, therefore adding to the time spent. With Analook, bat passes can be labelled and species information automatically downloaded to Excel for subsequent analysis, therefore removing data entry requirements of the project. From the point of view of other monitoring projects, as well as a woodland bat monitoring one, Anabat appears to have some advantages:

- in-built flash card means there is no need for a secondary recording device (e.g. minidisc), and potential problems linking the two devices (e.g. problematic leads)
- continuous recording so no data is lost (compared with TE which just records for $1/11^{th}$ of the time)
- using the Analook software the length of time spent analysing data can be reduced significantly
- data entry is not necessary.

This method could be examined further for potential use by the car-based bat monitoring scheme.

The calls recorded by the Anabat showed similar temporal patterns in nightly *Myotis* spp. activity at Glengarra Site 1 and Gorteenacusha, both in Tipperary, where high activity levels were recorded early in the evening and these were followed by a dip and a second increase prior to dawn. Two different hypotheses may explain this pattern in activity:

1. If both sites were located close to maternity roosts, in late July female bats would have been lactating and returning to the roost to feed young before a second foraging bout prior to dawn.
2. Alternatively, the higher rate of bat passes at dusk and dawn at these sites may indicate that the *Myotis* species predominantly recorded at these locations were dependent on swarming aerial insects, which tend to be most abundant at these times

Without further onsite survey work there is no means of confirming which hypothesis, or if a combination of both, holds true. *Myotis* species compositions cannot be confirmed since the Autobat lure, used in both sites, was not functioning correctly and few bats were caught in the mist nets. In support of the lactating female hypothesis is the high number of *Myotis* bat passes in Gorteenacusha, which may also point to the close proximity of a maternity roost of one of the *Myotis* spp. If the pattern in temporal activity has arisen simply because of the composition of *Myotis* species present then this

may indicate that, at Glengarra Site 1 and Gorteenacusha, Whiskered or Brandt's bats are the main species present because, although these species do consume gleaned prey (e.g. Beck 1995; Berge and Jones *in prep*.; Taake 1992, 1993; all cited in Harris and Yalden (2008)) they do so to a lesser extent than Natterer's bat and swarming diptera constitute a relatively large proportion of their prey items. Between 68% and 81% of the diet of Natterer's bat is composed of gleaned prey (Geisler and Dietz 1999; Shiel *et al*. 1991). Species that glean the majority of their prey are not dependent on dusk and pre-dawn swarms of insects. The Natterer's bat was confirmed at Deerpark, Virginia where *Myotis* bats showed a more even activity rate during the night but it may not be the main species present in Glengarra Site 1 or Gorteenacusha. Natterer's bats were, however, also confirmed at Glengarra when a male Natterer's was caught in a mist net without the use of the lure.

Species identification

While the Anabat has some advantages over time expansion due to ease of analysis, *Myotis* species identification is no easier than for time expanded sonograms. *Myotis* bats could only be identified to species level in very few cases. It is also doubtful whether these species could have been identified with any greater accuracy by time expanded recordings. Problems with *Myotis* species identification are well documented (e.g. Vaughan *et al*. 1997). There is currently no solution to identification problems unless the bat species can be verified in the hand.

The Autobat Lure

Clearly the lure was not functioning properly for most of the field work carried out in the summer of 2007. However, additional factors may have resulted in a poor catch rate. These include:

- lack of experience on the part of the surveyors in the use of the lure. This may have resulted in a poor choice of locations or unsuitable use of the lure and/or simulated calls.
- unseasonably cool and wet weather resulting in low bat activity overall. F. Greenaway (*pers. comm*.) suggested that poor catch rates may be expected on evenings following bad weather because bats must concentrate on foraging, rather than territorial behaviour which would cause bats to react to the lure. Given the consistently cool wet weather experienced in the summer of 2007 this may explain the low catch rates.

The potential for using the lure as part of an overall woodland bat monitoring strategy in Ireland is still relatively unknown due to the problems experienced with the device during the 2007 season. In a recent publication (Hill and Greenaway, 2008), the lure was recommended, when used in repeated systematic surveys, as a method for assessing woodland bat population trends. However, the total number of Natterer's bats caught in 52 broadleaved woodlands in southern England totalled 25 in 2005 and 15 in 27 sites in 2006. For whiskered bats, numbers caught were lower still, 11 in 52 sites in 2005

and 13 in 27 sites in 2006 (Hill and Greenaway, 2008). Average catch rates for brown long-eared bats were much higher (Hill and Greenaway, 2008), but this species was not the subject of the present woodland pilot study. Assuming similar *Myotis* catch rates in Irish sites (which may not be the case) it seems clear that these numbers would be too low for lure and mist-netting to prove a feasible single method for assessing population trends, except if a very large number of woodland sites were surveyed each year. This kind of study would require man power and expertise beyond that which is currently available on the island. The lure may still prove useful as method for assessing species diversity at specific sites, but on the whole it does not appear to hold much potential as a single method for monitoring population trends of woodland bat species in Ireland.

Feasibility of Natterer's Roost Counts

Similar to the brown long-eared bat monitoring scheme (Aughney and Roche 2008) it appears that there are volunteers willing to count bats emerging from roosts. With Natterer's bats in Ireland there are far fewer known roosts and the emergence behaviour of the species is less well-known. In addition, data from O'Sullivan (1994) indicated that most records for the species were for smaller numbers, fewer than five individuals. Large roosts of more than 50 individuals appear to be the exception rather than the rule. A rough calculation of averages, based on data from O'Sullivan 1994, indicates that the average roost size for the Natterer's bat is 1-10 individuals, compared with 10-20 individuals, on average, for brown long-eared. With brown long-eared bats at least 30 roosts need to be counted regularly in order to run a statistically viable monitoring programme for the species (e.g. Aughney and Roche 2008). Therefore, assuming that average numbers at Natterer's bat sites are indeed lower than for long-eared bats, a great deal more than 30 roosts of Natterer's bats may need to be counted every year in order to fulfill requirements for statistical power. In the UK, Natterer's summer colony counts are carried out from a pool of 73 sites but usually far less than the total number are actually counted, with between 24 and 40 sites monitored each year. The average number of individual bats per roost was 38 in 2006 (BCT 2007).

For Ireland, depending on the true average number of Natterer's per site, it is possible that counts at 50-70 Natterer's summer sites would be sufficient to achieve sufficient power. A very large survey and site validation effort would, however, be required at the initial stages of such a monitoring scheme in order to secure a large enough sample size for population monitoring.

Natterer's bats in buildings in Ireland do fulfill other requirements to render them suitable for population trend monitoring using roost or colony counts. According to the BCT (2006) colony counts are viable only if it is rare for new colonies to become established. This is because sampling all roosts and not all potential roosts means that there is no measure of the rate of establishment of new colonies

or their effect on population trends (BCT 2006). Pipistrelles, for example, regularly roost in new buildings. Therefore, it is impossible to deduce from colony counts of these species whether the population is increasing or declining when new colonies are regularly established and old sites may go out of use. This problem is less applicable to Natterer's bats since Natterer's bats tend to colonise old structures (e.g. Allen *et al.* 2001) and can be considered to be faithful to the same site over time. This assumption would have to be worked into any statistical analysis of the data collected.

Feedback provided by surveyors carrying out Natterer's roost counts highlighted the importance of prior training and supply of equipment such as detectors. At Cootehill and Rathronan, where no counts had been carried out before, a trial on at least one night or at least one day visit was necessary before the survey proper could take place. In addition, at Cootehill, the presence of at least one other person would have helped improve the accuracy of the count. At a site like Kylemore where there are numerous exits and potential for the presence of other species it would be desirable to carry out daytime surveys or simultaneous internal evening counts to help identify the species present.

Some data could certainly be collected from emergence counts at these and other known Natterer's roost sites around the country. This data could be included in an analysis of population trends, even if it did not constitute the entire dataset for the species.

Swarming Site Counts

From approximately four nights of field work in August in County Fermanagh by staff from the University of Leeds and field assistants, 21 Natterer's bats were caught, i.e. an average of 5 per night. Lower numbers of whiskered bats were caught and no Brandt's.

For the whole of the island, more work needs to be done to find good swarming sites and to determine trapping rates and species proportions through the swarming season. However, the trapping rate from this occasion was certainly reasonable, and higher than trapping rates in woodlands with the Autobat lure. Much field work will need to be carried out before good locations can be found around the country, however. If sites can be located, as with all trapping studies, the ensuing work will be intensive and considerable expertise would be required. Further work on swarming is planned from the Irish Centre for Bat Research.

ACKNOWLEDGEMENTS

Many thanks to the following for providing field assistance, surveying and providing administrative support and advice:

Julie Agate
John Altringham
Daniel Buckley
Ian Davidson-Watts
Frank Greenaway
Seamus Hassett
Rob Holloway
Austin Hopkirk
Stefan Jones
Conor Kelleher
Liam Lenihan
Dave McDonagh
Tom McOwat
Ferdia Marnell
Enda Mullen
Ger O'Donnell
Melinda Swann
The owners of Rathronan Church for providing access

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APPENDIX I: ROOST SURVEY FORM FOR NATTERER'S BAT COUNTS

Dear Surveyor

Thank you very much for agreeing to conduct a colony count at a known Natterer's Bat roost during the summer. We are very much at the trial and error stage of this project and since we know of relatively few Natterer's bat roosts in Ireland with good numbers of bats we have asked people in specific locations to conduct counts. Over time, if this turns out to be a feasible survey, we hope to build up the number of sites counted so that the data can contribute to our knowledge of countrywide population trends. In turn, the data will feed in to domestic and EU-wide policy decisions and IUCN threat lists. On a local level it will also vastly improve our knowledge of Natterer's bat numbers and behaviours in specific areas. Hopefully you won't mind playing 'guinea pig' for this project and ALL feedback and comments will be very welcome.

Your safety is of primary importance during any field work. Please make sure you take extra care when working at night:

- Wear warm clothing and sturdy footwear
- Always carry a mobile phone
- Tell someone at home where you are going and when you expect to return
- Bring a torch and spare batteries
- Always bring a field work partner
- Be aware of safety and never put yours or anyone else's safety at risk
- Please contact the roost owner and request access and tell the owner when you are likely to be in the area conducting your counts.

Equipment

Equipment you will probably find useful if you have it available:

1. two tally counters (one to count emerging bats and one to count returning bats)
2. a bat detector
3. a torch with a red filter
4. clipboard

Table 1: Proposed survey dates for site visit and emergence counts

Natterer's bat colony counts	**Survey Period**	**Sheet No.**
Site Visit and roost description	Early Summer 2007	Sheets 1 & 2
Emergence Count 1 (External)	1st June – 14th June	Sheet 3
Emergence Count 2 (External)	15th June – 14th July	Sheet 3
Emergence Count 3 (External)	15th July – 31st July	Sheet 3

1 Site Visit

Site visit will be undertaken in early summer 2007 to record the following:

1. The internal and external features of the roost site to be recorded. Complete Sheets 1 and 2 for each roost site including the following information: OS grid reference, name, address and county of site and a simple sketch of roost site with accompanying photographs (where possible).
2. Record habitat types within 500m radius with the approximate percentage of each habitat type. In relation to linear habitats please indicate if a number of these lead from the building in question into the surrounding area (e.g. write 2 treelines and 1 stonewall if these are the linear features that connect the building to the landscape).
3. Undertake an external emergence count to determine the number of exit points used by Natterer's bats. One surveyor may be needed to observe at each exit. Exit points are to be marked on sketches included on Sheets 1 & 2.

2 Emergence Counts

Where possible, a minimum of two emergence counts will be conducted. Heterodyne bat detectors (with headphones) and if available, infra-red filter lamps should be used to reduce disturbance to roosting and emerging bats.

Methodology

1. Emergence count will begin 30 minutes after sunset. A minimum of two surveyors will locate themselves in a suitable position to observe emerging bats without causing an obstruction to the exiting bats, this may be as far away as 20m from the roost exit (each exit will be monitored by one surveyor).
2. Counting will continue until no bats have left the roost for duration of 10 minutes or when returning bats and the swarming of bats around the exit makes it too difficult to assess whether more bats are emerging. At this point, if possible, a final internal roost count should be made of any remaining bats.

FEEDBACK FORM

Please complete the feedback form and return it, along with your datasheets, to:

Niamh Roche, Grangegeeth, Collon, Co. Meath or alternatively email it to niamh.roche@demersal.net
tel 087 8173073

THANKS VERY MUCH IN ADVANCE FOR YOUR INPUT

SHEET 1 **Natterer's Roost Count Data Sheet: Internal Examination of Roost**

Grid reference of site:	Surveyors names:
Roost name:	Surveyors address:
Roost address:	Tel. no.: Email:
Roost owner/manager details:	Approx. age of building: Type of building: Building owner and contact details if known:
Date of visit:	Roost temperature (indicating time):

Draw internal dimensions of roof space

Features	**Tick**
Brick	
Cavity block	
Stone	
Rubble fill	
Mortise joints	
Roof felt	
Compartments	
Chimney breast	
Sarking boards	

Notes

Characteristics	**Tick**	**Details (mark on drawings where possible)**
Droppings		
Urine staining		
Scratch marks		
Visible bats		Bats roosting individually or clustering?
Corpses		
Light gaps		
Insect remains		
Other		

SHEET 2 **Natterer's Roost Count Data Sheet: External Examination of Roost**

Grid reference of site:	Surveyors names:
Roost name:	Surveyors addresses:
Date of visit:	Tel. no.: Email:

Draw roost building indicating exit points	**Exits**	**Facing**
	Notes	

Characteristics	**Tick**	**Details (mark on drawings where possible)**
Droppings		
Urine staining		

Habitat and Flyways within 500m radius of roost

Habitat	**% / m**	**Description**
Semi-natural woodland		
Semi-natural grassland		
Conifer plantations		
Mixed woodlands		
Linear woodland/scrub		
Scrub/transitional woodland		
Lakes/ponds/watercourse		
Buildings		
Other		
Linear features (stonewalls etc.)		

Notes

SHEET 3 **Natterer's Roost Count Data Sheet: Emergence Count**

Grid reference of site:	Surveyors names:
Roost name:	Surveyors address:

Date of visit:				Tel. no.: Email:		
Cloud (circle one)	Clear (0-1/3) Patchy (1/3-2/3) Full (3/3)	**Wind** (circle one)	Calm Light Breezy	**Rain** (circle one)	Dry Drizzle Light rain	**Temp (^{o}C)** (external) Start: Finish:

External Emergence Counts	
30 mins after sunset	
Start Time:	**Finish Time:**
No. of exits:	
No. of bats emerging at each exit monitored	
Exit 1	
Exit 2	
Exit 3	
Exit 4	
FINAL COUNT	
Notes	

NATTERER'S ROOST COUNT FEEDBACK FORM

How easy/difficult did you find it to count at this roost?

Was there a possibility that you were counting more than one species, if so, what other species may have been present?

What information would have been useful for you to have available prior to the count?

Would you have found training in the field prior to the count helpful?

What equipment that you did not have would have aided your counts?

Was access an issue?

Did the bats fly in and out alot making the count more difficult?

How many people were needed to count this site accurately?

Would an internal visit (if not carried out) have been helpful?

Did you enter the roost following the count to see if any bats remained?

If so, was this information useful?

OTHER COMMENTS/SUGGESTIONS:

APPENDIX II: AUTOBAT LURE AND ANABAT RECORDING SHEETS

LURE TRIAL 1					
DATE ____/____/ 07 **Sundown Time:**			**Grid ref of Lure:**		
Playback Start Time: **End Time:**			**No of mist nets:**		
Size of nets:			**Distance between nets:**		
Temp		^{0}C	**Wind *(circle)***		Calm Light Breezy
Cloud *(circle)*	Clear (0 - ⅓) Patchy (⅓ - ⅔) Full ($^3/_3$)		**Rain *(circle)***		Dry Drizzle Light rain
Bat Number	**Species**	**Sex**	**Forearm length**	**Rep Status/Condition**	**Biopsy**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

LURE TRIAL 2					
DATE ____/____/ 07 **Sundown time:**			**Grid ref of Lure:**		
Playback Start Time: **End Time:**			**No of mist nets:**		
Size of nets:			**Distance between nets:**		
Temp		^{0}C	**Wind *(circle)***		Calm Light Breezy
Cloud *(circle)*	Clear (0 - ⅓) Patchy (⅓ - ⅔) Full ($^3/_3$)		**Rain *(circle)***		Dry Drizzle Light rain
Bat Number	**Species**	**Sex**	**Forearm length**	**Rep Status/Condition**	**Biopsy**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

11					
12					
13					
14					
15					

LURE TRIAL 3					
DATE ____/____/ 07			**Grid ref of Lure**		
Playback Start Time: **End Time:**			**No of mist nets:**		
Size of nets:			**Distance between nets:**		
Temp		^{0}**C**	**Wind *(circle)***		Calm Light Breezy
Cloud *(circle)*	Clear (0 - ⅓) Patchy (⅓ - ⅔) Full ($^{3}/_{3}$)		**Rain *(circle)***		Dry Drizzle Light rain
Bat Number	**Species**	**Sex**	**Forearm length**	**Rep Status/Condition**	**Biopsy**
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					

National Bat Monitoring Programme
Woodland Survey 2007
ANABAT TRIALS

Site Code
Office Use

Grid Reference of site:	**County site is in:**	**Owner:**
Woodland Name:		
Site Name (office use) **:**		
Surveyor Names:		
Surveyor Address:	**Mobile:**	
	Day Tel:	
	Email:	
Is the site (or any part of it) on NPWS land?	Yes / No	
Is the site a SAC, National Park, pNHA?	SAC / NP / pNHA/ None / Don't know	
Has the site been surveyed as part of BEC/NPWS Native Woodland Survey? yes / no / don't know		
If yes, what is the NWS site code (office use)?		
Description and Grid Ref Location of Anabat: **Date Recording Started:** **Recording Ended:** **Start time and end time of recording each night:**		

ANABAT LOCATION DETAILS

General Woodland/Scrub Characteristics
Tree Species: Is the woodland predominantly?
☐ oak ☐ beech ☐ ash ☐ sycamore ☐ conifer ☐ other (please state)_____

Fossitt (2000) Habitat Classifications for all of woodland area
_____

Habitat Classification for area directly in front of Anabat microphone
_____

Area of 40x20m in front of Anabat Location (where Anabat is at centre of 40m):

Canopy species	DAFOR	Shrub species	DAFOR	Field layer species	DAFOR	LAYER	% cover
						Canopy	
						Shrub	
						Field	

40x20m	Total Number:	DBH <10cm	DBH >10<20	DBH >20<30	DBH >30
No of trees:					
No. of shrubs					

Standing Dead	Standing Damaged	Uprooted/Root Plate	Coarse Wood/Debris	Snags/Snapped
D A F O R ab	D A F O R ab	D A F O R ab	D A F O R ab	D A F O R ab

Distance of anabat to edge or woodland/forest tracks, indicate direction (e.g. behind anabat or in front etc)?

Water Features: Is there a waterbody near the site? ☐ Yes (If yes, please tick relevant box) ☐ No
☐ stream ☐ river ☐ lake ☐ pond ☐ other (please state)_____