TREE-ROOSTING BATS - INSPECTING & ASSESSING PRF

INTRODUCTION

I feel honour bound to open this chapter with a warning: Where I have been unable to support elements of this text with proven science, I have endeavoured to ensure all the hypothesis, suggestions and arguments rest within common sense, and are therefore reasonable and believable. I must stress: **this is not a prescribed method set out by a self-appointed hierophant**. These methods are what work for me on a very general level, I'd very much like to hear if people have a method that they find consistently reliable. Now read on…

Due to multitude of often localised factors (including tree species, prevailing weather, fungal flora, habitat management etc.), it is rational to suppose that Potential Roost Features (PRF) will be a limited resource in the greater percentage of sites. It is also probable that the number of roost features in an area will have some influence on the length of time a colony of bats spend in the vicinity due to the need for predator and parasite avoidance. Furthermore, if we accept that each colony needs a minimum number of roosts (again to avoid predators and parasite build-up etc.), then is it not equally probable that this will influence the number of colonies of the same species that can be present in a given area?

Common sense would suggest that the population of bats that can persist in an area will fluctuate with the number of roost sites available within their typical commuting range.

For the third and final time; British tree-roosting bats do not make the features in the trees in which they roost, so if the number of roost features drops significantly colonies will have to range more widely, or abandon an area altogether. As a result, other than in years of poor recruitment, when a suitable roost feature is created (by whatever means) in, or close to, an area of optimum foraging habitat, it's probable that it will be colonised.

I am a firm believer in the old philosophy that "*if you build it, they will come*" (attributed to Theodore Roosevelt). What I mean is that if a tree in the right habitat, has the right PRF at the right height, it will more often be occupied by roosting bats than not. I stand by this belief. Where the right roost feature exists, it is rarer to find that it hasn't been colonised, than to find that it has. Tree-roosts aren't rare; good PRF are rare, but where they exist in the right habitat, roosts exist.

In my experience, if you want to find tree-roosts using field-craft alone, you have to stop looking for the bats and start looking for the PRF. Furthermore, if you're looking in a specific habitat, it pays to look for the PRF that the bat species known to exploit that habitat are known to favour overall.

How the individual naturalist goes about finding PRF is a matter of personal preference. Most of the PRF I find are initially discovered on family walks. If I feel sufficiently curious I may return to test my hunches, particularly if the PRF is of a form I am particularly interested in.

But I must confess; my family walks are tailored in the hope of something interesting. In his book *Finding Nests* Campbell (1954) set out the following, and I have quoted him here as the words were both heart-warming and reassuring to me in the early stages of a rather lonely quest: "*Finding a nest is rather like playing a hole at golf. Your drive takes you to the locality suitable for the bird, an iron shot see you in the right habitat, a nice approach carries you to the neighbourhood of the site, and your putt is the actual discovery of the nest*".

Finding bat-roosts does, however, also make up a proportion of my professional workload. For this reason I have developed a structured method by which I go about performing surveys. The following text sets out all the methods I use for inspecting and assessing PRF. I would recommend the reader picks and choses what they want to suit their own ends.

Don't forget, there's always something living in a PRF, it might not be a bat but the other beasties are no better understood, so record everything of interest you find and send it to the County recorders for that Taxa!

Happy-hunting, and please do let me know how you get on. It's a lonely life this woodland bat obsession, and it's always nice to hear from fellow enthusiasts.

GENERAL

Lonsdale (2000) suggests that, for a basic tree hazard assessment (typically termed Visual Tree Assessment, or VTA) it is reasonable to view trees from the ground using binoculars, with the caveat that "*if a ground inspection reveals potentially significant features that cannot be properly seen from a distance, it may be necessary to complete the inspection by climbing or from a hoist*".

Greenaway (2001) identified the fact that the outward appearance of PRF often belies their internal conditions, which makes external assessments ineffective when determining roost presence. I have only once seen what I thought might be a dropping on the outer rim of a Hazard-beam before I performed a close inspection. While all the maternity roosts I have seen held droppings in the base, 50% (12 of 24) of the roosts occupied by individual bats I have recorded over the last year held no droppings. To put this in context, how often have any of us looked up at a bat-box and seen droppings, staining or scratch-marks that would confirm occupancy? Furthermore, how many of us would use an ultrasound detector to assess the status of a bat-box?

You can waste a good deal of time with a bat-detector standing under a PRF which actually has no potential whatsoever. Ultimately if you want to find a tree roost without radio-tracking, you're going to have to get up there and look in the hole. Campbell knew this about birds when he wrote *Finding Nests* in 1953, and he devoted 12 of the overall 14 pages of the chapter in his book that deals with nest inspection to arboreal climbing, and this is a guy who

didn't use a rope!

I refer back to Campbell (1953) again, who pointed out in relation to the chaffinch *Fringilla coelebs*, that the more chaffinch nests you find, the better your mental picture of the 'ideal' chaffinch nest; "*after a time your eye is drawn to the likely sites in any habitat*". The same is true of for tree-roosts; after a while your eye is drawn to certain tree shapes, and the logical place for the PRF to occur on that particular tree without even thinking about it, but you have to keep looking in the PRF to drum this 'jizz' into your subconscious.

LEGAL CONSIDERATIONS

In the British Isles all species of bats and their roosts are protected against under the *Wildlife & Countryside Act 1981 (& as amended)* and *The Conservation of Habitats and Species Regulations 2010*, which implements the provisions of EC Directive 92/43 ("The Habitats Directive").

Common dormice *Muscardinus avellanarius*, pine marten *Martes martes* and red squirrels *Sciurus vulgaris* are also protected under the *Wildlife & Countryside Act 1981 (& as amended)*, with the former receiving additional protection under *The Conservation of Habitats and Species Regulations 2010*.

Finally, the nests of the 30 species of bird that use PRF are also protected under the *Wildlife & Countryside Act 1981 (& as amended)*, with barn owl *Tyto alba* and crested tit *Lophophanes cristatus* listed on Schedule 1, making it an offence to disturb the birds while they are on the nest.

I would hope anyone searching for tree-roosts would apply common sense, assume something will be living in the hole and, even if it isn't a bat, proceed with due care to ensure the inspection results in only a minor disturbance effect and no breach in legislation.

<u>If the PRF cannot be reached without potential damage, then inspection should not be performed.</u>

<u>If surveyors are not licensed to disturb bats by the relevant Statutory Body, inspection should stop at the entrance.</u>

HEALTH & SAFETY

Caution: as well as bats, smaller birds and mice etc. tree cavities are also used by nesting owls, bees and wasps (Hymenoptera) and hornets *Vespa crabro*.

Tawny owl *Strix aluco* nest in hollow trees in parkland (Simms 1971) and, in particular, appear to favour the interior of decayed trunks (Thomson & Rankin 1923), but may also take

shelter behind ivy (Sparks & Soper 1970). A female tawny owl on a nest will attack repeatedly if disturbed and will not cease until the threat is well out of range. There is at least one recorded instance of an experienced ornithologist having been blinded in a tawny owl attack. If you're getting into the canopy you should also be aware that long-eared owls *Asio otus* nest within old squirrel *Sciurus* spp. dreys and display a comparable aggression to the tawny owl when defending young (Thomson & Rankin 1923).

Bees and wasps will readily swarm and sting and hornets will also drop and sting the unwary surveyor, the effects of which can cause very dangerous allergic reactions.

INSPECTION OBJECTIVE

The objective during PRF inspections is to make a comprehensive examination and record of the PRF. The purpose of the inspection is to:

- determine whether or not bats are present; and
- if bats are not present, whether the PRF is nonetheless suitable; and if so
- for which species, when and for what purpose.

The inspection should be performed with sufficient sensitivity to avoid:

- disturbing bats (or birds etc.) if they are present;
- damaging the PRF or any birds nest etc.; or
- in any way altering the conditions (such as by snapping an overhanging branch or removing debris, including mud deposited during nest-making by nuthatch *Sitta europaea*).

INSPECTION EQUIPMENT

To adequately perform the PRF inspection the following equipment will be needed:

- Mechanical Elevating Working Platform (MEWP), ladder and/or arboreal climbing equipment;
- Fibre-optic endoscope;
- Small torch;
- Long-handled cocktail spoon for the retrieval of droppings (optional);
- Specimen tubes for droppings;
- Digital camera;
- Diameter tape-measure;
- Standard tape-measure;
- Compass;
- Clinometer; and
- Egg-carton sections or similar for dropping traps (optional).

Barrett-Hamilton (1910) suggests the "*insertion of a flexible stick* [which] *sometimes dislodges a surprising number of bats*", but I'm pretty confident that would be in breach of legislation!

In most woodlands the terrain and the spacing of the trees themselves precludes the use of a Mobile Elevating Work Platform (MEWP). Furthermore, past experience has shown that it is very often impossible to manoeuvre the cage into sufficient proximity with the PRF without the surveyor being in breach of Health & Safety best-practice by hanging over the edge. However, wherever possible it is advisable to work from a MEWP to inspect PRF as by their very nature, they comprise weakened areas in the trees structure.

Where access to a PRF is impossible due to safety restrictions, I have found that one surveyor equipped with a 2-million candle-power torch and another with a good pair of binoculars can, from the ground at dusk, often perform a sufficient assessment to give a yes or no answer as to whether or not a PRF has any potential. The method is most effective with the torch being shone directly over the observers shoulder, but it may be necessary to alter angles and both surveyors get up into an adjacent tree or structure to get a better angle. It is surprising just how effective this method can be once a team gets the hang of it. **However, if bats are present this method results in a high level of disturbance, so it should only be used where the tree is to come down, and the team is licenced**.

Endoscopes

A surveyor proficient in the use of an endoscope is highly unlikely to any more than a low level momentary disturbance. The technique is not noisy and done well results in minimal disruption, typically over within one minute. I have a Ridgid C300 with an inbuilt camera; I can inspect and photograph anything I find within 20 seconds, and then identify it away from the roost.

I have never perceived abandonment due to endoscope survey activity. Furthermore, I would argue that the only way you get good at something is by doing it, and if you have a bat-licence you really should be out there practicing until you're competent to confidently assess tree-roosts, otherwise how are you to know what the inside of a tree looks like and where the bats will be?

INSPECTION METHOD

Much (if not all) of the following text is common sense, but to emphasise which parts of the inspection are most important I have underlined specific aspects. This is because I wish to save you the frustration of my own past mistakes.

Inspection should begin from the ground. **When a ladder is being used try to rest it well below the PRF in the first instance so any droppings that may be present are not disturbed**, it can always be moved again once this stage is complete. If you're climbing then **wherever possible approach from the opposite side** until you can swap sides and descend

to the PRF with the minimum disturbance.

Begin looking without touching. Check the surface of the tree for droppings below the PRF and on either side. If the tree is of a species and age with rough bark, such as oak *Quercus* spp., ash *Fraxinus excelsior*, sweet chestnut *Castanea sativa* or poplar *Populus* spp., look carefully at any fissures in the bark surface, droppings can sometimes be present even in winter. In the case of lifting bark, look at bark lips below the break for trapped droppings.

Regardless of the form of the PRF, **it is vital that you work inward, downward and finally upwards** to avoid disturbing material that may fall down and obscure evidence in the bottom of the cavity.

British bats are often found asleep in summer positions where they are exposed to moderate or even bright light (Barrett-Hamilton 1910), so **don't be so focussed on the dark apex that you fail to look on either side of the entrance**.

Inspecting Decay PRF

With a hollow PRF such as a woodpecker hole, knot-hole etc., start by shining the torch in and look at the interior edge of the rim and the interior walls to inspect for droppings and assess the overall condition. If the entrance is discontinuous and you can perform the entire inspection without the use of a torch or endoscope then it can be discounted as a potential day-roost. If however, the entrance opens into a darkened void, then the PRF has potential.

Assuming the entrance rises into a dark hollow, then the key attributes from here on are whether the internal walls are dry (although some that are wet in winter are bone dry in summer), clean (as opposed to dusty and cobwebbed), firm (as opposed to corky or spongy) and smooth (as opposed to rough with loose sinew and dead wood tissue). All the time you should be quiet so that if bats are there you don't disturb them.

In the vast number of cases you won't find any evidence of occupation other than the bat itself. However, if you do find any droppings try to lift them off with the cocktail spoon and drop them in a sample tube for DNA analysis. Warwick University offers this service (http://www2.warwick.ac.uk/fac/sci/lifesci/research/bats/).

If the PRF descends into a bowl-section then work downwards very carefully. This will usually need an endoscope. Keep looking for droppings on the internal walls. When you get to the base look for evidence of occupation by other animals; birds nest, leaves brought in potentially by wood-mice *Apodemus sylvaticus*, dormouse *Muscardinus avellanarius* nest etc. Then look on the top of the pile for any discernible bat droppings: this is often frustrating because you can't get them out and just have to make a judgement on whether they are bat droppings or not by eye.

Finally, come back to the entrance and work upward very slowly. Again you're looking at the overall condition of the interior and whether it looks inhabited. This may sound strange but it helps to think along the lines of - is this hole clean, dry and smooth enough that would I put my head up it to look around if I could? If the answer is yes then you're on to something. Photos B5.1 and B5.2 show the interior appearance of two cavities inhabited by bats, Photos B5.3 and B5.4 show cavities definitely not inhabited by bats.

Photo B5.1. Daubenton's bat *Myotis daubentonii* maternity roost. Note the smooth dry interior, entirely lacking in dust, debris or invertebrates – the 22 bats had just left when this was taken.

Photo B5.2. Cross-section of Tear-out on a sycamore *Acer pseudoplatanus* stem that had held two Daubenton's bats *Myotis daubentonii* males. Note the smooth surface, typical of inhabited cavities.

Photo B5.3. Looking up into an unoccupied cavity more or less identical to the one in Photo B5.1 above, and only 6 m away from it. Note the rough surface and debris on the interior wall.

Photo B5.4. An obviously unoccupied rot-hole in a beech *Fagus sylvatica*.

In the case of hollow PRF the next question is; is the cavity one individual tube, or is it chambered? Beware: it is very easy to overlook chambers for which the opening is just above the main entrance and opens toward the surveyor (see Figure B5.1). Then is the PRF sealed, or a tube? Turn off the endoscope light and look – can you see light? Then there is another entrance hidden further up the stem or branch and this will also need inspection.

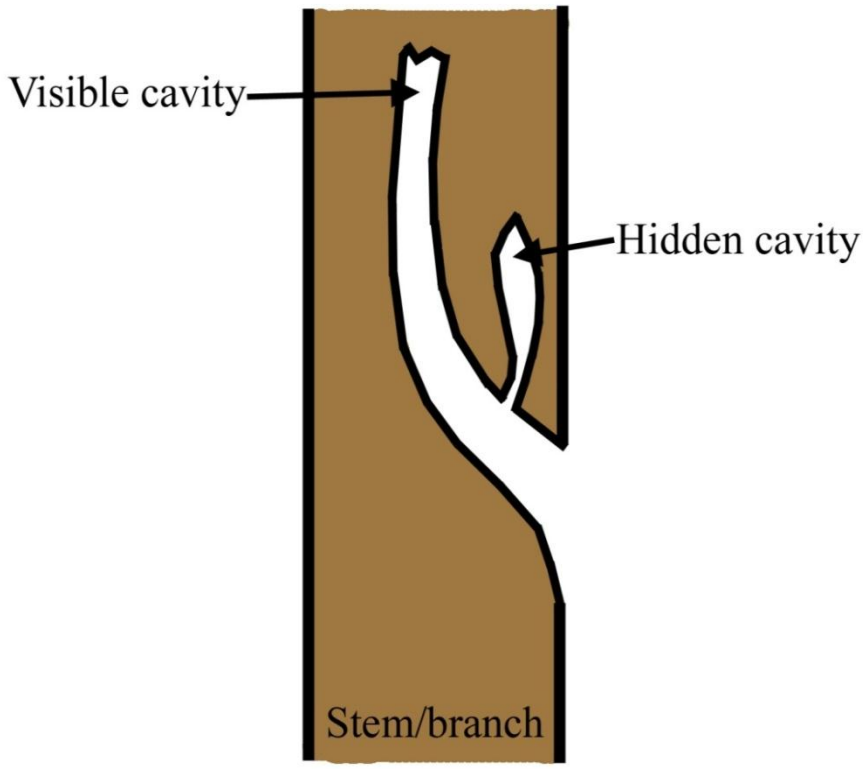

Figure B5.1. An example of a chambered Tear-out in a sycamore *Acer pseudoplatanus* in which two male Daubenton's bats *Myotis daubentonii* regularly roosted in the hidden cavity on the left, but never in the visible cavity despite its superficial suitability.

Finally inspect the accessible areas carefully. The rule of thumb here is that if you have to withdraw the endoscope and clean the end regularly to remove sludge, moist dust or cobwebs from the end, then it is unlikely there are bats present today. If you're knocking down little congregations of woodlice, or if the cavity is dusty with fungal hyphae visible then it is unlikely there are bats present today. No bats today does not however, mean there will be no bats tomorrow.

If the PRF is clean and dry, bear in mind that any bats present will be head down and often eyes shut, as such you're looking for little brown fluffy blob, with two little black knobbles (all you can see of the elbow), one on either side. If only one bat is present this may be very obvious, if more than one bat is present it can be very difficult to pick them out. However,

they'll often be squashed tightly into the cavity apex. Don't try to identify them just make a quick head count and withdraw. This part of the survey is now complete.

If the PRF is higher than your endoscope then you have to judge probability on internal condition. If you judge the PRF has any potential to hold roosting bats then ultrasound survey will be necessary. However, In the case of PRF with a bowl-section it may be helpful to insert an egg-carton section as a dropping trap to aid in identification. A head count and DNA analysis is invariably more cost-effective and, particularly in the case of Myotids, a more conclusive method of identification.

Inspecting Damage PRF

The Damage PRF that are longitudinal in nature can be complex and their inspection will depend upon the orientation; vertical or horizontal.

While I accept that this contradict the advice I gave in relation to Decay PRF (i.e. work up from the bottom), I find it far easier to assess vertical splits with an endoscope from the top working down-ward. Where the top of the crack/split extends up into a hollow stem or limb this should be inspected in the same way as a woodpecker-hole or rot-hollow but do not be seduced into discounting the lower areas of the split if the hollow is vacant or unsuitable, a full inspection should always be made.

Unfortunately, the important areas are those which are least accessible, typically behind lips of callous growth on either side, which may extend under bark. These can be particularly fiddly to inspect and it is often necessary to approach from much higher up on a very shallow angle in order to work the tip of the endoscope adequately in and behind. However, once a satisfactory view is achieved this can be followed all the way down. Do not however be surprised if the crevice extends round remaining heart-wood into a depth greater than can be inspected with a torch or an endoscope, where this happens it will be necessary to perform ultrasound survey.

Pay particular attention to areas where bark still bridges the crack/split and/or callous growth has partially repaired damage.

Inspection of a horizontal split is often most practical working from the centre outward. Even more or less horizontal branch cracks will still have an upper and a lower end. In all cases the upper end of the crack is that which in which bats will roost as any rain ingress would flow downward waterlogging the base of the split. A split that is suitable for occupation by day-roosting bats will extend upward into a dark crevice, in older cavities occlusion around the edges may form an envelope of callous providing a dark 'pocket' in which bats may hide. Alternatively it may be that the split is as a result of decay (for whatever reason) in the Heartwood and the crevice extends up into a deep and dark hollow. In any case the same

inspection principals will apply to the potential roost 'pocket' or hollow in a longitudinal split as would in a Woodpecker-hole or rot-hollow.

As always, you're looking for a dark, clean and dry internal environment in which you would be prepared to spend the night yourself if you were small enough. If the internal areas are mucky, dusty, damp and/or full of inverts such as slugs, snails and woodlice then the cavity is not occupied. But remember, vertical cracks/splits are typically extensive so look for the anomaly; if you suddenly find a nice dry clean pocket in an otherwise unsuitable split, then something has to be keeping it clean.

Inspection of a Transverse-crack will depend upon the situation, as the primary consideration is one of safety. Very often the feature will be at the base of an unstable stem which may be hung-up above. It is up to the individual how and indeed if, they proceed. The principals, however, that apply to Woodpecker-holes and rot-hollows also apply to Transverse-cracks; if you can perform the entire inspection and see all the internal areas without using a torch or endoscope then the cavity will not hold a day-roost of any bat species.

For loose-bark to comprise a Potential Roost Feature it must, as with all other PRF's extend into a dark, and secure internal space. As such, depending on what caused the initial failure in the bark, and how the bark has subsequently lifted, the internal areas may be similar to the 'pocket' or crevice of a longitudinal split.

Inspection of Association PRF

Aside of the difficulty in accessing some Unions, their inspection is very straightforward, and very often achievable with a torch alone; simply look up.

For ivy to provide an environment suitable for occupation by roosting bats it has to have attained significant age. Typically the stems should be a minimum of 50 mm diameter (ideally some even larger) and form a network, intertwining and crossing up the stem and into the crown. This network will have sections that have therefore formed pockets into which bats sidle into or crawl up under to rest against the bark of the mature tree. In the vast percentage of cases these stems will lack foliage.

This text has been revised in light of information from Dr. Geoff Billington. Originally I had suggested ivy was easily inspected by working from the ground upward despite the high number of PRF's that it may encompass. This was my genuine belief but I have subsequently learnt that barbastelle *Barbastella barbastellus* use ivy *Hedera helix* from 4 m up to 18 m (Natural England 2012), so I have now revised my approach; if the ivy is over 50 cm and visual assessment suggests it is suitable to conceal a bat, and the tree is located or on the edge of ancient semi-natural woodland, the only practical assessment tool will be a series of dawn-return surveys.

PRF Cataloguing

Regardless of the form of the PRF I record the features to an established criteria first defined by Sedgeley & O'Donnell (1999), then refined by Ruczyński & Bogdanowicz (2005), and finally altered to suit my agenda.

The criteria comprise:

1. Date;
2. Ordnance Survey grid reference;
3. Site name;
4. Tree species;
5. Habitat (see Table B3.2);
6. Tree alive or dead;
7. PRF location: stem or limb;
8. PRF type;
9. Entrance facing (compass direction);
10. Tree height (clinometer reading)
11. Diameter at Breast Height (DBH - Diameter tape reading)
12. PRF height (Clinometer reading);
13. Diameter at PRF height (DPH - Diameter tape reading);
14. PRF entrance height & width;
15. Internal height, width & depth;
16. Internal conditions (see Table B3.2);
17. Comments; and
18. Photographs

This list of features may appear onerous but experience has shown that two surveyors working together can rattle them off very quickly. Reference to Table B5.1 will show that the criteria are divided between the Groundsman and the Climber.

I would however urge that one person is given overall responsibility for ensuring the form is completed. This is logically the Groundsman. The most effective system is for the Groundsman to direct the climber and also act as the scribe. The Groundsman has responsibility for ensuring the forms are completed in their entirety and filed in an ordered fashion in the field. They should therefore be a strong personality with a powerful voice who can bark each criterion in order and then fill them in.

The Groundsman completes all his section whilst the climber ascends to make the inspection. When the Climber is in place the Groundsman reads each criterion in turn loudly, and as the Climber provides the answers the Groundsman completes the inspection sheet. By this method the whole job can be performed by one Groundsman and two absolute novices with minimal instruction. N.B. Where arboreal climbing is required, a minimum of two CS38 certified climbers are in any case required to satisfy Health & Safety best practice, one of whom must be on the ground to act as grounds-man/rescue.

Table B5.1. PRF recording form

GROUNDSMAN	DATE									
	GRID REF									
	SITE									
	TREE SPECIES									
	HABITAT (see form base)									
	TREE ALIVE/DEAD									
	PRF STEM/LIMB									
	PRF FORM									
	ENTRANCE FACING									
	TREE HEIGHT									
	DBH									
	PRF HEIGHT									
CLIMBER	DPH									
	ENTRANCE	Height								
		Width								
	INTERNAL DIMENSIONS	Height								
		Width								
		Depth								
	INTERNAL CONDITIONS	SUBSTRATE	Smooth		Bobbly		Rough		Dusty/debris	
		HUMIDITY	Dry		Damp		Wet		Flooded	
		APEX SHAPE	Dome		Spire		Wedge		Chambered	
			Sludge		Unknown					
		APEX CONDITION	Dry		Damp		Wet		Sludge	
		COMPETITORS	Slugs		Woodlice		Bees etc.		Spiders	
			Dormice		Mice misc		Squirrels		Birds	
	COMMENTS									
	PHOTOS									

Habitats:

1. **Woodland: wet/dry broadleaved or mixed/coniferous – distance from woodland edge and riparian habitat;**
2. **Riparian – distance from woodland;**
3. **Hedgerow: continuous or discontinuous – distance from woodland; or**
4. **Isolated**

While most of the recording is very straightforward and the process will be identical from tree to tree, the recording of the entrance and internal dimensions often throws junior surveyors. I have provided the following passages to soothe trouble minds.

Entrance hole dimensions

First, **bear in mind that you have defined the type of PRF you are recording, so if you propose to analyse your data you will be analysing the types together and not a mixed bag of different types**.

When recording PRF you should record all the internal dimensions from the access-hole. The internal height is the distance from the top of the entrance hole outer rim to the top of the void (see Figure B5.2 - a), the width is the distance from the outer entrance lip to the back of the void on a horizontal line (see Figure B5.2 - b), and the depth is the distance from the bottom of the entrance outer rim to the bottom of the void (see Figure B5.2 - c).

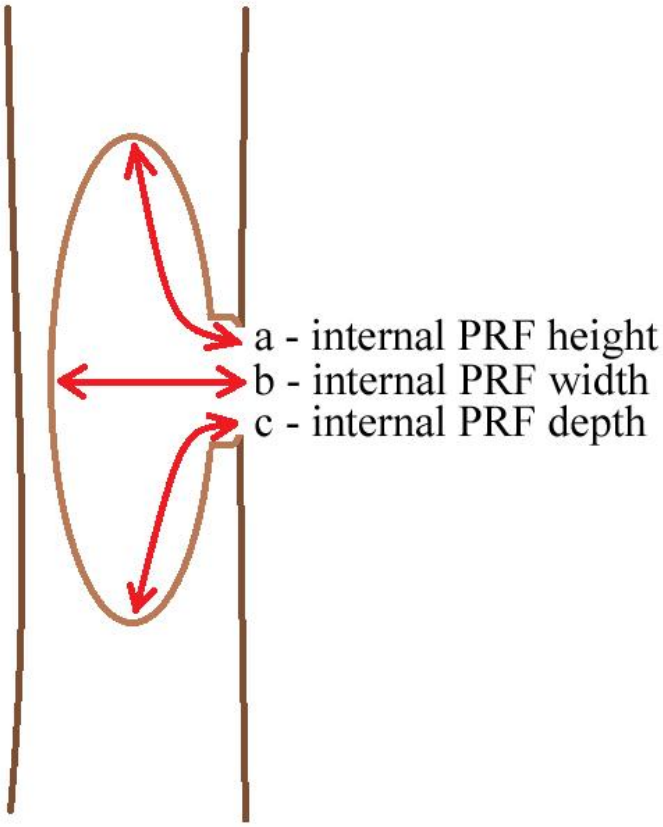

Figure B5.2. Measuring internal dimensions of PRF.

Confusion appears to arise from the distinction of exactly which point defines the entrance on individual PRF, and whether or not the location in which bats can be predicted to roost is a single clearly defined void. For example; Frost-cracks have what at first sight appears to be a

tall and narrow entrance. However, although the crack might appear to be the entrance, in fact the entrance is technically the point at the apex where the crack stops and the darkened void begins. This is true, but this is a point that can be drawn-out at the analysis stage as you will still have the relevant measurement on the form, only it's filed under internal width (and obviously the internal void has not depth so this is recorded as N/A).

If the internal width has is obviously uneven; on the horizontal the front to back is distinctly different from side to side (very often the case with Hazard-beams where inside the split the internal top-to-bottom width of the pocket is less than the horizontal width) then just say so on the form (i.e. top-to-bottom: 4 cm, side-to-side: 12 cm).

I hope this clarifies the situation, but if you're still confused then email me and I'll explain.

TIMING

General

Unlike roosts in houses, churches, caves and tunnels which, on the whole, tend to be occupied by bats during set periods of the year and for specific purposes, trees are occupied year round but different cavities are used for different purposes by different species, so a cavity that did not hold bats in high summer when nesting birds were present may do in winter, and vice versa. In addition some species (such as noctules *Nyctalus noctula*, Natterer's bat *Myotis nattereri*, barbastelle and to a lesser extent pipistrelles *Pipistrellus* spp.) are nomadic (Kronwitter 1988, Smith & Racey 2005) using a high number of roosts, but occupying each roost for only a very short period of time.

While it might appear sensible to target presence/absence surveys to the time of year when population densities are at their highest, and it might be logical to suppose that with all species of bats this period is the autumn; when young disperse and there are therefore greatest numbers of bats on the wing (before the inevitable winter mortalities of the sick, old, inexperienced and just plain unlucky), it would in fact appear that different species occupy trees at different times and in widely varying numbers.

In 2001 a study looking at barbastelle ecology in Somerset (Natural England 2012) found that in July, whilst the colony foraged outside the woodland, they roosted exclusively within one woodland; Horner Woods. When the study was continued in September five nights trapping drew a complete blank, and although barbastelles were again present in October, radio-tracking found that they were no longer exclusively using Horner Woods, but also roosts in three other woods in the locality. Furthermore, of the total 10 trees the bats were found to be occupying, only one had previously been recorded, so although they returned to the same wood, they didn't occupy the same trees. A similar situation was again recorded in 2002, this time in Pengelli Woods, Pembrokeshire, where trapping in September failed to record a

single barbastelle, despite the fact the species was successfully trapped in the summer months (Natural England 2012). An autumn survey visit would therefore be likely to draw a blank for barbastelles.

A study performed in Czechoslovakia from 1978 to 1987 by Červený & Bürger (1989) found that Daubenton's bats *Myotis daubentonii*, noctules and Leisler's bats *Nyctalus leisleri* occupying tree-roosts exhibited variations in the date of arrival; Daubenton's bats and Leisler's bats arriving in April, but noctules arriving a month later. All, however, left around mid-September. An autumn and winter visit would therefore have been likely to have drawn a blank for Daubenton's bats, Leisler's bats and noctules.

I have two winter roosts occupied by noctules that are not occupied in any other season, by either the noctules or any other species. A spring or summer visit to these trees would draw a blank for Bechstein's bats.

In their long-term study of Bechstein's bats *Myotis bechsteinii* Dietz & Pir (2011) found great tits *Parus major* and starlings *Sturnus vulgaris* nesting in roost sites during May and June, that were subsequently occupied by maternity colonies and individual males at the full range of heights. They considered that, as some PRF encompass a set of characteristics favourable to several species of birds and mammals; the breeding time of different animal species is temporally adjusted to avoid inter-specific competition. Whatever the reason, an early summer visit to these trees would be likely to draw a blank for the bats.

The complexities don't end there as tree-roosting species are nomadic, moving between a number of trees within their home range. For example Dietz & Pir (2011) recorded 57 tree-roosts occupied by female Bechstein's bats, and seven roosts occupied by males and found the maternity colonies transient with duration of occupancy increasing during pregnancy; averages:- pregnancy: 1.5 days, lactation: 3.3 days and post-lactation 4.8 days (Dietz & Pir 2011). Furthermore, although the males were less transient and this decreased over the course of the active year, they still moved roosts on average every 6.6 days (*ibid*).

So when is the best time to inspect PRF and how often should they be inspected? Well, the truth is we really don't know as no studies have been performed that might give a hint as to what the optimum season and intensity of such a survey might be.

The following sections are provided as a repository for development as more information becomes available, in the hope that they will illicit information from readers. I have also included some very basic guidelines that I follow in my own work.

Winter

Winter roosts may occur in sheltered wooded valleys where temperature and humidity

fluctuations are small (Harris & Harris 1991). Valleys may certainly yield rewards, even if it isn't what you were expecting; that ideal low-level Natterer's/brown long-eared bat *Plecotus auritus* PRF that you kept checking with a nil result in summer, can turn out to have a noctule in it come winter providing there is a sufficient drop for them to pick up speed (i.e. a tree above a railway-cutting, in a beech hangar, or on a ravine side).

Mitchell & Kirby (1989) cite Steele (1975) who suggested "*several bat species roost or hibernate in hollow trees which are liable to be removed under commercial forest management…*" I may be reading too much into this but it's interesting that Mr. Steele says "*roost OR hibernate in hollow trees…*" I'm beginning to wonder whether pipistrelles don't really use trees much in the summer, but mate in them in the autumn, and hibernate in them in the winter; does Mr. Steele know something we don't!?! I couldn't get his paper so if you know him, you might ask…

My approach

I map PRF in winter. However, **unless the tree is; in a perilous state or position, scheduled to be felled and/or subject to a planning application I do not perform internal inspections in the period December through March**.

This restriction does not however prevent a close inspection of the external features of a PRF, and this may yield valuable information. Figure B5.3 on the following page shows droppings found in tree-roosts in winter. However, **hibernation roosts may not ever hold any evidence of occupation save the bats themselves**.

Spring

Červený & Bürger (1989) made a good deal of the discovery of a male bat with two young females in a tree-roost in April suggesting that the species may breed early in the year as well as in the more normal autumn period.

My approach

I begin my inspections in April and have found small roosts holding individual barbastelle, Natterer's bats and brown long-eared bats at this time (and I mean individual, not low numbers, single bats). I don't know whether they were males (my endoscope isn't that good), but one wonders whether mating may play a part.

Figure B5.3. Top left: Characteristic furry mould on top of old brown long-eared bat *Plecotus auritus* droppings. Bird droppings don't appear to develop this mould and it is distinctive in the early winter (December through January). Top right: not all white droppings are bird droppings; these are brown long-eared bat so it pays to look closely. Bottom: Natterer's bat *Myotis nattereri* droppings caught in a spider's-web. Webs are the bat surveyors friend, they trap the droppings but also appear to preserve them intact for long periods (if we could synthesise webbing it would be a superb survey tool).

Summer

Simms (1971) found that most hole-nesting birds, not just summer migrants, desert woodlands after the close of the breeding season.

In their study, Červený & Bürger (1989) found the highest number of tree-roosts occupied by bats in July, when the large maternity colonies of Daubenton's bats began to break up as the young began flying. They suggested that, as this period is also the end of the bird-nesting season (which does tie in with our British timings), this might be the result of reduced competition with hole-nesting birds, and in particular starlings, making reference to the paper: Mason C & Stebbings R 1972. Noctules (*Nyctalus noctula*) and starling (*Sturnus vulgaris*) competing for roost holes *J. Zool*. Lond 166: 467, if anyone out there has a copy of this I'd love to see it so it can be added in.

Dietz & Pir (2011) found that a single Bechstein's bat maternity 'colony' occupied two or more tree holes during the pregnancy and lactation period, so a minimum of two PRF were needed every day. However, this isn't the end of it; after weaning the colony may be divided between three or more PRF, all of which were nearby (unfortunately they didn't define 'nearby', so if anyone reading this is lucky enough to meet them they might ask). This situation may be repeated for other species, which would suggest that targeting survey effort toward the weaning period would be sensible, as more trees will be occupied so you might strike lucky and find the maximum number of roosts with the minimum effort.

<u>My approach</u>

I try to check PRF in June, July and August but where I'm restricted to only one visit I go for late July (see the Autumn text re: swarming for why August is not ideal).

Autumn

Autumn appears to be a time of change.

In the August to November period bats of several species may be encountered in mating swarms in the vicinity of hibernation cave and tunnel entrances (Stebbings *et al.* 2005). Swarms typically consist of several species but, occasionally, may only consist of one species. Natterer's bats are generally the most common visitors to swarming sites, although Daubenton's bats are also common and seem to peak their swarming activity slightly earlier in the season (Altringham 2003). Brandt's bat *Myotis brandtii* and brown long-eared bats are also present in smaller numbers throughout England whilst Bechstein's bat and barbastelle can be found swarming in the south (Altringham 2003). Swarming is most conspicuous in mid-August to mid-September (Parsons *et al*. 2003a, Glover & Altringham 2008).

Swarming behaviour would suggest that tree-roosts would be deserted by the greater percentage of tree-roosting bats from mid-August onwards, just as Leisler's bats, noctules, Nathusius' pipistrelles *Pipistrellus nathusii*, common pipistrelles *Pipistrellus pipistrellus* and soprano pipistrelles *Pipistrellus pygmaeus* are beginning to look for mating sites.

Late in the summer, as nursery colonies fragment, the male pipistrelles appear to advertise their presence to females with a song flight from such mating roosts (Altringham 2003). They fly backwards and forwards in the vicinity of their roost, emitting a distinctive call every few seconds (Altringham 2003). Continuing with Professor Altringham; migration between summer and winter quarters is most common in tree-roosting bats because trees offer poor insulation against intense cold but males may remain in the summer territory over the winter months (Altringham 2011). Furthermore, male Nathusius' pipistrelles, Leisler's bats and noctules appear to set up mating roosts on these migration routes (often on river corridors) which are followed year on year (Altringham 2011).

My train of thought was hijacked one evening by Green (2010) who says of mushrooms "*the soft, fleshy annual mushrooms usually appear from the end of summer through the autumn and into early winter…*" then goes on to say "*…the insects, often flies, are emerging from the fruit-bodies at the time when the bulk of other insects are finished for the year. Therefore they provide a succession of food, especially for birds, bats and small rodents, at a period when other insect food is declining.*"

We know that dormice *Muscardinus avellanarius* bulk up on hazel prior to hibernation, why wouldn't bats breed and bulk at the same time…?

I have this hypothesis that in the autumn mating bats occupy PRF in close proximity to aggregations of fruiting mushrooms (more specifically the abundance of flies which egg-lay in mushrooms) the abundance of which varies in location from one year to the next. I just thought I'd put it in here in case someone else proves it; I can then say "*I told you so…*" and look really sagely.

It is as yet unknown whether the 'quality' of the roost has any bearing upon mating success or whether there is any hierarchy in the features occupied; i.e. do the strongest bats occupy the best holes, and do they re-occupy them year on year?

Schober & Grimmberger (1987) suggest noctule and Nathusius' pipistrelle males often retain their mating territories for several years, and Altringham (2011) suggests that common pipistrelle males also defend preferred mating roosts for up to five successive years.

I've never seen a Leisler's bat or Nathusius' pipistrelle tree-roost so cannot even begin to discuss their attributes. I have however found noctule lekking-roosts, occupied by individual males during the day, but with no females present; both were Woodpecker-holes. Schober & Grimmberger (1987) suggest that noctule and Nathusius' pipistrelle males live alone and accumulate a harem of up to ten females. I'm confused; if they live alone then we're looking for an individual, if they accumulate a harem surely they aren't on their own?

Finally, having several times found song-flying common and soprano pipistrelles at night

with an ultrasound detector, I have failed to relocate them a dawn by the same method and searched for the roost in vain the following day. Whether they were exposed features only used for night-roosting or, whether the bats had retired early to inconspicuous atypical PRF, I cannot say.

My approach

I try to get autumn visits in both late August and early September. If I've only got one visit then I go for the end of August.

PRF ASSESSMENT

Assessment objective

Where bats are recorded within the cavity on the initial visit or where certain evidence can be collected for analysis (such as droppings for DNA analysis) the survey may be considered fortuitous and this section is consequently redundant.

However, in the vast majority of cases bats will not be present on the first visit, and the objective is to perform a reasoned assessment of:

- Whether or not the PRF is suitable to hold roosting bats at all; and if so
- Which species might be present;
- In what numbers;
- For what purpose; and
- When.

PRF Assessment

When assessing the suitability of a particular PRF to hold bats, a sliding scale of potentiality from low, through moderate, and up into high is subjective between surveyors and unhelpful to any third party reading a report.

I always think that where low/medium/high are used they should be quantified by a percentage score, for example low: 0-33%, medium 34-66% and high 67-100%. Where this is impossible, then the use of low, medium and high appears to me to be nonsense. Aside of anything else, a PRF that is of low potential to one bat species is often of high potential to another.

The situation is simple; either the PRF is suitable to hold roosting bats or it isn't and, if it is suitable, then the surveyor should have sufficient knowledge of the tree-roosting ecology of bats to put forward a reasoned hypothesis as to which species might be present, when, and for what purpose in order that the survey can then target that period to search for the specific species and demonstrate their status to within reasonable doubt.

Bat Tree Habitat Key

Using the information you recorded on the PRF recording form, you can process unoccupied (but suitable) PRF through the Bat Tree Habitat Key provided at Chapter B5 which is based on the literature review provided in Chapter B1.

Bat Tree Habitat Key will provide a reasoned prediction as to:

- **WHICH** bat species might occupy a particular Roost Feature; in
- **EACH** habitat; and for
- **WHAT** purpose; thereby allowing survey to be targeted
- **WHEN** the species is most likely to be present.