



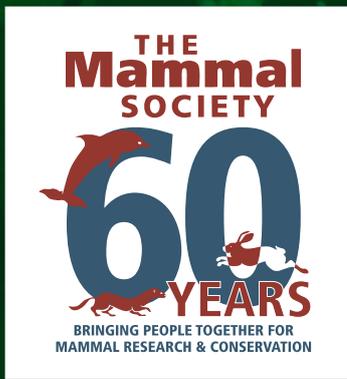
MAMMAL NEWS

www.mammal.org.uk

Autumn 2015 • Issue 173



**MUNTJAC • BAT MITIGATION • FAMILY MURIDAE • RED SQUIRRELS
DOMESTIC CATS • IRISH BADGERS • SPOTTED SOUSLIKS**



Mammal Matters

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It's been a very busy summer at The Mammal Society. As part of our restructuring, our Chief Executive, Marina Pacheco, left us at the end of August. Marina has set up her own business and we wish her every success in her new venture.

For the next year, The Society will be run more directly by Council and we will be supported in this job by our fantastic core staff. We are currently interviewing for a new member of the team who will deal with day to day enquiries from members, the media and the public. This new way of running the organisation will not only generate cost savings, but allows us to focus on The Society's primary role of being the leading source of science-based advice, training and information on British mammals.

I am delighted to announce that we have been selected by Natural England, Scottish Natural Heritage and Natural Resources Wales to review the population size and conservation status of Britain's mammals. It is more than 20 years since the last assessment (led by former Mammal Society Chair, Stephen Harris) and the information is needed desperately. As many of you will know, 'Red lists' have recently been published for a range of other groups, ranging from birds to butterflies to fungi), leaving us wondering what was happening with mammals. Such assessments are extremely important as they form the basis for policy and funding decisions. They are also vital to interpreting scientific research: having just finished a large assessment of bat fatalities at wind farms, I can tell you that trying to understand the likely effects is virtually impossible without decent information on the size of the population to start with. Of course, for some species, coming up with good estimates will be challenging: here our job will be to highlight how the 'data gap' can be filled and to prioritise future research. We will be continuing our successful collaboration with the Biological Records Centre/

CEH and recruiting a scientific officer very soon. I appeal to everyone to keep up the good work of sending in records, which form the basis of our work, and I thank in advance the many members that we will be calling on for expert input as the review progresses.

It is also nearly time for the first of our new autumn scientific symposia. This 2-day event explores the potential of Biodiversity Restoration schemes to deliver benefits for people as well as for wildlife and we have a fantastic line up of speakers. On the first day, we will look at a wide range of examples including upland heath restoration to improve water quality, pine marten reintroduction and 'rewilding' schemes. We will also challenge you and our speakers to thrash out some tricky issues: how do we actually measure 'ecosystem services'; is 'diversity per se' important; is it better to reintroduce rare species or secure more common ones; and how can projects get public and political support? The second day will be all about beavers – fittingly the conference is just down the road from the new population in Devon I was telling you about in the last *Mammal News* – and we'll be hearing about the current monitoring of those animals as well as the Scottish populations. So can beavers really help stop floods? And how can we resolve the potential conflicts with fisheries? Come to Exeter on 27th and 28th October and find out!

www.mammal.org.uk/events/mammal-societys-autumn-symposium



Dr Fiona Mathews
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Mammal Atlas: UPDATE

All enquiries to Derek Crawley,
atlas@themammalsociety.org
All photographs by Derek Crawley

As we are coming towards the end of the collecting records period for the National Atlas, some trends in distribution are becoming clearer, such as the decline in range of water vole but an expansion in deer and polecat records. Roe deer, in particular, are moving into the Midland void.

Field signs can be confusing with deer species, as footprints may belong to adult roe or young fallow, or even mature muntjac or young roe. We all know that ground conditions can leave just one good print, so looking for other field signs like droppings can help in identification. With the rut in full swing for our bigger deer, it's a good time to brush up on your field skills so you can record deer in other locations after the rut.

Although 31st December 2015 is the last date we will use records for the current Atlas, please keep recording after this date as it is important that we constantly monitor populations. Please ensure all records for 2015 are sent in as soon as possible in the New Year so we can finalise the maps for the Atlas.



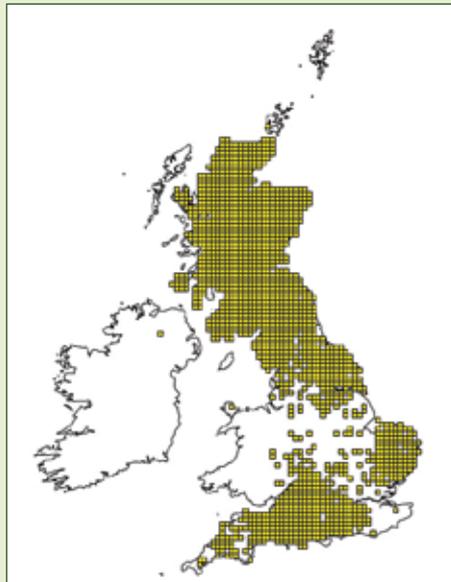
Fallow droppings.



Roe droppings.

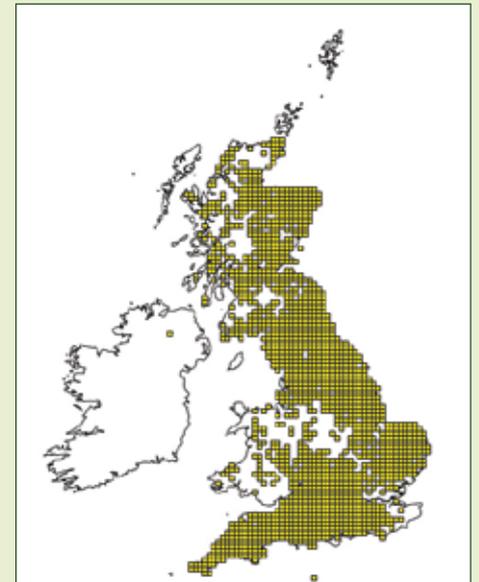


Roe slots.



Records for roe deer (*Capreolus capreolus*) in Great Britain & Ireland between 1960-1999.

© Crown & database rights 2011. Ordnance Survey.



Records for roe deer (*Capreolus capreolus*) in Great Britain & Ireland between 2000-2015.

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National Mammal Week: 24 October -1 November

So what are you doing for National Mammal Week?

Ideally, we should all be doing "More for Mammals". It does not matter whether it is a public event, some survey work or learning more about mammals at The Mammal Society's Autumn Symposium. As we still want and need more actual records for the Atlas, why not have an extra push to find mammals this week wherever you are.

A bit of competitiveness never hurts, so we will give a free copy of the Atlas to whoever sends in the most records taken that week. One prize for an individual and another for a group. A record is one species per 1 km². So you could win with just mole records or a combination of another species.

Please provide the details we need on an excel spread sheet:

Species	Detail of Identification Field Sign etc	Date	Location Name	Grid Ref

Send to: atlas@themammalsociety.org

Titled: Mammal Week Competition

Date: needs to be received by 7 November 2015.

Financial Review

Statement of Financial Activities for the year ended 31 December 2014

	2014	2013
INCOMING RESOURCES	£	£
Incoming resources from generated funds		
Donations	9,648	11,307
Subscriptions	43,655	48,622
Legacies	12,500	41,935
Sponsorships	1,000	4,135
Investment income	325	178
Incoming resources from charitable activities		
Grants	47,342	74,410
Training workshops	29,016	30,455
Publication sales	67,198	110,018
Events	31,953	42,272
Other income	355	3,103
Total incoming resources	242,992	366,435
RESOURCES EXPENDED		
Costs of generating funds		
Costs of generating voluntary income	54,449	35,522
Charitable activities:		
Surveys & monitoring	81,710	56,695
Training workshops	24,857	42,469
Publications	33,888	76,442
Events	57,620	52,236
Information Dissemination	21,732	12,258
Programme & activity development	35,613	45,968
Other expenditure	1,745	5,615
Governance Costs	3,941	4,754
Total resources expended	315,555	331,959
Net incoming/outgoing resources for the year	-72,563	34,476
Total funds brought forward	179,095	144,619
Total Funds Carried Forward at 31 October	106,532	179,095

These Summarised Accounts are an extract from, and are consistent with, the Statutory Accounts but may not contain sufficient information to allow for a full understanding of the financial affairs of the Society. Our Independent Examiners, David Hancock & Co have reported on the full Statutory Accounts following their Independent Examination and the accounts were approved by the Trustees on 27th March 2015. They will be presented for approval of the members at the Extraordinary General Meeting on 28th October 2015. These accounts have been prepared in accordance with the Statement of Recommended Practice (SORP 2005) – Accounting and Reporting by Charities, issued March 2005.

Copies of the full Statutory Accounts will be lodged with the Registrar of Companies and the Charity Commission. The full accounts may be inspected at the offices of The Mammal Society at 3 The Carronades, New Road, Southampton, SO14 0AA and copies are available to members on request.

Signed on behalf of the Council

Johnny Birks, Chair
27th March 2015

Statement of Funds as at 31 December 2014

	2014	2013
CURRENT ASSETS	£	£
Operating Fixed Assets	0	
Current Assets		
Stock	37,131	47,788
Debtors	47,924	61,321
Cash	31,638	75,525
	116,693	184,634
Creditors		
Amounts falling due within one year	-10,161	-5,539
Net Current Assets	106,532	179,095
Analysis of Funds		
Unrestricted funds	92,416	149,168
Restricted funds	14,116	29,927
Total Funds	106,532	179,095

Independent Examiners' Report to the Trustees of The Mammal Society
We have examined these summarised financial statements.

Respective responsibilities of the Trustees and Independent Examiners
You are responsible as Trustees for the preparation of the summarised financial statements. We have agreed to report to you our opinion on the summarised statements' consistency with the full financial statements on which we reported to you on 27th March 2015.

Basis of opinion
We have carried out the procedures necessary to ascertain whether the summarised financial statements are consistent with the full financial statements from which they have been prepared.

Opinion
In our opinion the summarised financial statements are consistent with the full financial statements for the period to 31st December 2014.

31st February 2015
David Hancock & Co
Chartered Accountants & Business Advisers
Webb House, 20 Bridge Road, Park Gate,
Southampton, SO31 7GE





THE MAMMAL SOCIETY

Bringing People Together For
Mammal Research & Conservation



27 & 28th October 2015, Rougemont Hotel, Exeter.

Does Restoring Biodiversity Deliver Ecosystem Services?

Using beaver reintroduction as a case study, this meeting brings together policy makers, academics and practitioners to discuss the costs and benefits of biodiversity restoration to water quality, flood control and other services.



Eurasian beaver.
Photograph by
Rhona Forrester



For further details or to book
www.mammal.org/events

Notice of an Extraordinary General Meeting (EGM)

At the Annual General Meeting (AGM) at Lancaster University on 28th March 2015, there was a failure to circulate in advance of the meeting the relevant papers. These papers included the minutes of the previous AGM on Saturday 5th April 2014 at Aston

University, the accounts for 2014–2015 or the Annual Review. A summary of the minutes and accounts is presented to the membership in this edition of *Mammal News*.

Full copies of these documents will be presented at an **Extraordinary General**

Meeting on Tuesday 27th October at The Society's Autumn Symposium at the Rougemont Hotel in Exeter.

These reports will be presented by the President who will ask the membership to vote to accept them.

Summary of 2014 AGM minutes

Minutes of the previous AGM were accepted, as were the CEO and treasurer reports. Last year's accounts came in the black, due to an unforeseen legacy. The CEO made a plea for legacies. The financial year has now changed to January – December (previously November – October). Council officers changed as Hon Secretary

Kate Williamson retired and was replaced by Kate Hills. Fiona Mathews was elected as the second Vice Chair. Ordinary member Ed Wells retired and John Gurnell was elected. It was agreed that David Hancock & Co would be kept on as the independent examiners. There was no AOB. Informal business was raised by John Gurnell;

Mammal Communications is being revamped with peer reviews, an editorial board, with a dedicated website to come. It is open to anyone to submit papers of 2000 words.

Full copies of these minutes will be available at the EGM.



Camera Trapping of Muntjac in the Forest of Dean

Joshua Humphries and Dr John Dutton,
joshuaharryhumphries@hotmail.com

Reeves' Muntjac in the UK

Reeves' muntjac (*Muntiacus reevesi*) originate from China, but are believed to have been released outside of Woburn Park (Bedfordshire) around the beginning of the past Century. According to four national surveys by the British Deer Society, muntjac have significantly expanded their range over a 39 year period (1972–2011). Muntjac apparently spread from four 10 km grid-squares (in the 1920s) to 473 (by the 1990s) (Chapman *et al.*, 1994). Out of all deer species, muntjac are also believed to be expanding the fastest, at around 8.2% per year.

The dramatic spread of muntjac potentially has economic, public and ecological implications. In particular, muntjac are known to damage both coppice and woodland flora, thereby negatively affecting higher trophic levels. To inform the effective management of deer, density estimation and species detection are necessary goals for woodland ecologists. Twenty-one types of deer surveys are currently used in the UK, but only faecal accumulation rate, faecal standing crop and thermal imaging (distance sampling) are the most practical within a woodland setting. All three have their advantages, but the small size (males have a maximum mean shoulder height of 52 cm, about the size of a springer spaniel) and notoriously elusive nature of muntjac potentially renders them inaccurate.

Camera trapping and the Random Encounter Model

Camera-traps are a non-invasive surveying technique and have been proven to detect elusive species. Using camera-traps, researchers traditionally calculate the density

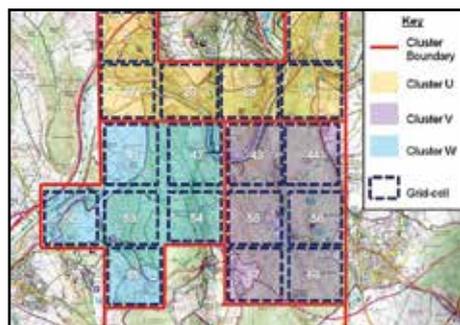


Fig.1. A portion of the Forest of Dean, separated into three (of the 18) clusters.
© Crown & database rights 2011. Ordnance Survey.

of their target species via mark-recapture, yet this method is only possible if the target species possesses a unique pelage. In 2007, the Zoological Society of London outlined the Random Encounter Model (REM), which enables the estimation of species density without individual recognition.

Background and aim of the study

This study was undertaken as an undergraduate dissertation. The data used was a subset of a wider pilot landscape-scale camera-trapping project, carried out by Dr John Dutton and Miss Hayley Clayton. The overall aim of this study was to determine the current status of muntjac in the Royal Forest of Dean. To complete this aim, the study attempted to 1) measure the local distribution of muntjac, 2) estimate the density of muntjac for the study area and, 3) to establish whether camera trapping (and the REM) is suitable to survey for muntjac. To the authors' knowledge, no other study in the UK has applied the REM at a landscape scale.

Method

The study was conducted in the Forest of Dean, an area of woodland (approx. 11,000 ha in size) located in the South-West of England (SO 625 104). The whole of the forest is comprised of a mixture of coniferous and broadleaved species, which are more or less

present in a 50:50 ratio. Camera-trapping was carried out for a period of seven weeks, between the months of February and April in 2014. The study site was divided into 108 numbered 1 km² grid-squares using the OS grid system. These grid-squares were clustered into 18 sample clusters, each of which incorporated six of the grid-squares (Fig.1).

Eighteen remote Moultri cameras (Model M-990i) were used for this study, on the basis of their detection characteristics, infrared flash and good night imagery. A single Moultri camera was assigned to each cluster, and randomly allocated to one of six grid-squares. Cameras were placed as near to the centre of each grid square as practicable. Each camera was left in position for a 7-day period before being re-allocated to a subsequent grid-square, with a clean SD card being inserted at each re-positioning.

Cameras were set to take four photos per trigger (the maximum this model allowed), to obtain several photos of the same individual. This was necessary, to calculate the distance moved for each individual (a variable of the REM).

Results

In total, only 90% of all grid cells were actually surveyed (97 out of 108), primarily due to camera failure and unsuitability of the habitat within some grid-squares. Over the course of the study, the cameras yielded a total of

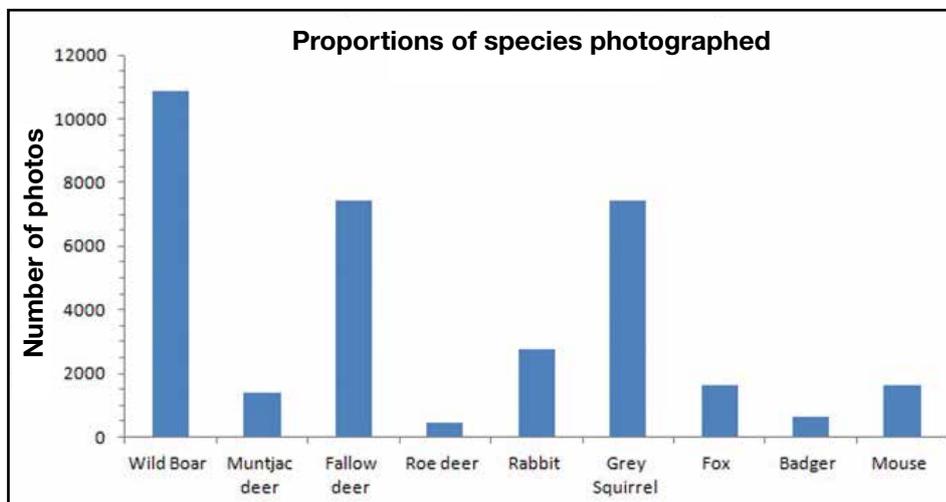


Fig.2. The nine species of mammal captured on camera-trap in the Forest of Dean, and the number of photos taken.

59,500 photos, 34,141 (57.4%) of which 'captured' around nine mammal species (Fig.2). Out of these photos, wild boar (*Sus scrofa*) were the most photographed species in the Dean (31.8%), whereas muntjac deer were one of the least photographed (4%). Out of the 97 grid cells surveyed, muntjac were detected in 42 (43%) of these. Sightings stretched from Penyard and Chase Wood, down to Bream (from North to South). From East to West, sightings stretched from Flaxley Woods, across to Highmeadow Woods and the Wye Valley (Fig.3).

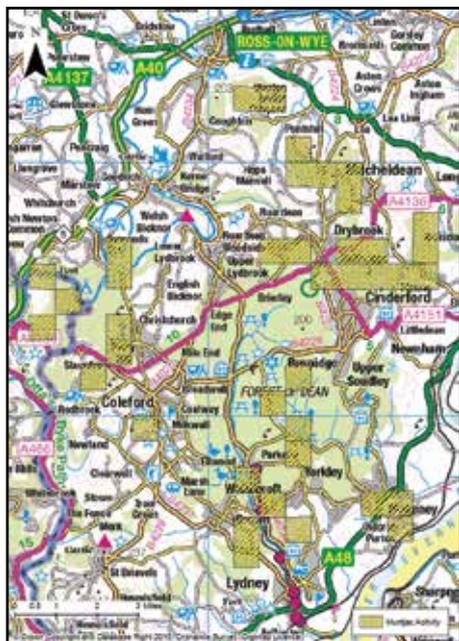


Fig.3. Distribution of muntjac sightings in the Forest of Dean, captured during this study.
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Out of the 42 grid cells where muntjac were detected, data from only 13 (31%) could be used for the REM analysis. In total, 41 muntjac sequences (strings of photographs in which muntjac appeared and left as a discrete event) were obtained over the course of 123 days, which equates to a trap rate of 0.33 independent sightings per day. Muntjac were active for about 35.2% of the day, but sightings were considerably higher between 01:00 and 02:00. Analysis also revealed that

muntjac travelled (on average) 0.38 km/day-1, during this study. By applying the REM, the density of muntjac (using data from these 13 grid-cells), was estimated at 163.6 (SE +/- 90.5) individuals/km².

Discussion

The apparent distribution of muntjac (documented by the National Biodiversity Network) reveals that muntjac have only been sighted in five 1 km grid-squares, since 2010 (Fig.4). This contrasts entirely with the findings from this study, as muntjac presence was confirmed in 42 grid-squares. The estimated muntjac distribution also differs from reported sightings by the Forestry Commission, as it was believed that muntjac only inhabit the east of the Forest of Dean. The pattern of distribution was not compared with any environmental variables in this study, however it can be inferred that muntjac may be distributed according to habitat preferences. Muntjac are known to feed on broadleaved woody browse and mast, thus individuals may aggregate in areas with broadleaved trees (which may explain the 'clumped' distribution). Considering that the Forest of Dean is around 222 km from Woburn (and the fact that the

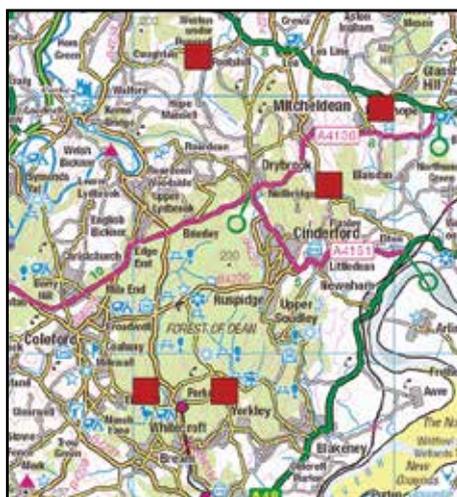


Fig.4. The apparent distribution of muntjac in the Forest of Dean (from 2010 to 2015), according to the NBN.
© Crown & database rights 2011. Ordnance Survey.

River Severn may pose a barrier to dispersal), the widespread distribution recorded in this study can probably be attributed to releases. According to Chapman *et al.* (1994), muntjac were intentionally released near Lydney during the late 1950s. These individuals may have formed a founder population, whose descendants may have colonized the rest of the Dean.

Via application of the REM, the study also obtained an estimate of muntjac density. The estimated density in the Forest of Dean appeared to be similar to the density in Monks Wood, Cambridgeshire (120 muntjac/km²), but was much higher than in Thetford Forest, Norfolk/Suffolk (64 muntjac/km²). However, an issue with the camera calibration may have over exaggerated the density estimate, by underestimating the speed of muntjac (a variable in the REM).

Current Work

Through a summer research assistantship, we are currently investigating the issue regarding camera calibration. We are also carrying out a similar study on fallow deer (*Dama dama*) and wild boar in the Forest of Dean, and hope to estimate their distribution and density (Fig.5).

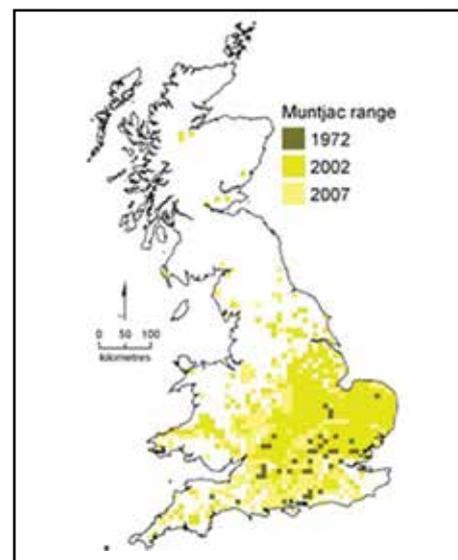


Fig.5. Muntjac Range Expansion



Opportunities for volunteers

In 2016, John plans to repeat the study, through a citizen science project. Volunteers local to the Dean could help obtain valuable data for the study by monitoring a particular area of woodland. Camera traps can be borrowed, or volunteers can use their own. Should anyone wish to become involved, please email John at: j.dutton@worc.ac.uk.

Thank you to Hayley Clayton, who supported me during this project.

References:

Chapman, N., Harris, S. & Stanford, A. (1994). Reeves' *Muntjac Muntiacus reevesi* in Britain: their history, spread, habitat selection, and the role of human intervention in accelerating their dispersal.

Bat Mitigation

Are we working in the dark?



Brown long-eared bats in roof void.
Photograph by Lisa Kerslake

Concern is growing among some involved in bat conservation that the current approach to bat mitigation in England is not delivering a good deal for bats; this article explores some of the problems.

The creation of new bat habitat in the form of replacement roosts is more or less standard practice as part of European Protected Species (EPS) mitigation licence applications for bats. Roost provision can include everything from bat boxes through to dedicated bat lofts.

Although this work is done with the best of intentions, data on its effectiveness are limited, because post-development monitoring is not always undertaken for long enough or in enough detail – or at all. Nor are the results of monitoring routinely collated and made available to practitioners so they can understand what works and what fails. Indeed, it can be argued that decisions on the techniques for roost creation and on the mitigation that it is appropriate to employ are being made on the basis of out of date, limited, or no evidence. Most consultants for example refer to English Nature's Bat Mitigation Guidelines; a document that is now 11 years old.

There have been two recent changes in the bat licensing system in England – one obvious and the other less so – that highlight the problem.



How not to install Schwegler 1WI integrated box.
Photograph by Mike Sharp

Lisa Kerslake CEcol FCIEEM,
Managing director/Principal Ecologist
Swift Ecology Ltd
Lisa.kerslake@swiftecology.co.uk

Firstly Natural England (NE) have recently rolled out BLICL – the Bat Low Impact Class Licence. This is, in principle, a positive move, being a more proportionate approach to developments that are genuinely low impact in terms of their effects on bats. However, there are no compulsory requirements for mitigation, compensation or monitoring under this licence; all may be included (e.g. if the planning authority has stipulated it) but they are not considered necessary in order to obtain a licence.

Secondly, where no maternity colonies are present, NE often reject licence applications that make provision for a dedicated bat loft for species such as brown long-eared



Breathable roof membrane installed in bat loft. Photograph by Johnny Birks

and Natterer's, on the grounds of over-compensation.

Whilst the reasoning for both changes is understood, we simply do not know what the cumulative impact of the lack of compensation is on bat populations at a landscape scale; and without monitoring we never will know.

As well as the issues around the design and monitoring of mitigation, experience shows that despite the existence of a written method statement as part of a licence, problems at the construction stage are alarmingly frequent; causes are varied, but they often result in compromises in the design of the mitigation, which is in many cases likely to be to the detriment of the bats and therefore to conservation.

There are few published papers or other



Barbastelle boxes in loft.

data available on the success or otherwise of mitigation schemes. In researching the talk that preceded this article, I utilised the following seven sources of information in an attempt to locate evidence of the success or otherwise of mitigation schemes post-development, whether licensed or unlicensed:

1. Conservation Evidence website: <http://conservationevidence.com/>
2. Stone, E.L., Jones, G. & Harris, S. (2013) Mitigating the effect of development on bats in England with derogation licensing. *Conservation Biology*, 27, 1324 – 1234
3. Snowdonia Bat Mitigation Project, 2011
4. An unpublished report for a local authority in south-west England, 2011
5. A study carried out by the National Trust, 2012
6. Roost website: <http://roost.bats.org.uk/>
7. Swift Ecology internal company data from 2007 – 2014.

A summary of the conclusions from the above sources is given in **Table 1**.

It is difficult to draw any firm conclusions from the table above due to difficulty of comparing different data sets, and because of small sample sizes and inconsistency of data.

However, it is clear that there are problems both with the level of success of mitigation and with monitoring to assess success. From experience in my own company where we go to considerable effort to make clear to clients,



Removal of roof coverings under supervision.
Photograph by Lisa Kerslake

Table 1

Resource	Sample Size	Summary of results	Comments
Conservation Evidence	n/a	<ul style="list-style-type: none"> Some evidence in relation to the use of bat boxes, with varying results from <50% to 100% of boxes utilised. No data at all in relation to residential or commercial development. 	Few results related to UK.
Stone <i>et al</i>	389	<ul style="list-style-type: none"> 68% roosts destroyed under licence. 67% of licensees submitted no post-development report. Monitoring carried out at only 19% of sites. 	Relates to data from 2003-2005 so already out of date.
Snowdonia bat mitigation project	20	<ul style="list-style-type: none"> 75% had some evidence of bat use. Only 35% were compliant with the required planning conditions. 65% would need further work to be made compliant. 23% fulfilled specification and had moderate degree of success. Only 10% had a high degree of success or were fully successful 	
Unpublished local authority study	11	<ul style="list-style-type: none"> Problems with original surveys and consultation with LPA. Incorrect construction/installation of mitigation, or missing entirely. Lack of compliance checking or monitoring. Bat signs found at 5 of the sites. 	No specific figures provided
National Trust	50	<ul style="list-style-type: none"> Only 19/50 had monitoring data. Sites divided into low (12), moderate (5) and high (2) impact. Of these, high level of success with low and moderate level impact. No success with high impact. 	
Roost website	24	<ul style="list-style-type: none"> 20 had monitoring data. 18/20 deemed successful. 	Very likely to be unrepresentative, in that successful schemes far more likely to be publicly shared.
Swift Ecology	119	<ul style="list-style-type: none"> 32% had problems with mitigation. Of monitored schemes (64). <ul style="list-style-type: none"> 31% had fewer bats than before development, or none. 8% had problems gaining access for monitoring 	

developers and builders what is required, things still go wrong. Extrapolated across the country, and factoring in those ecologists who possibly have less experience and may be less assertive with their clients, what is clear even from these patchy data is that the problem is potentially significant.

The key issues can probably be summarised as follows:

1. Poor or inadequate original design of mitigation

This may be due to inexperience of the ecologist or pressures from the client or architect, as well as the paucity of evidence upon which to base sound mitigation design.

2. Work starting in the absence of an ecologist or a licence

This can affect the proper implementation of mitigation at the outset, which can then lead to greater problems further down the line.

3. Incorrect or non-installation of mitigation features

This is a frequent issue; for example integrated bat boxes installed externally, or the use of breathable roofing membranes.

4. Lack of compliance checking, monitoring or enforcement

This not only results in any problems remaining uncorrected, but also means

that we do not have information on success and failure that we can learn from in the future.

Notwithstanding the above, in many cases the design is not the main issue, and the ecologist is usually present to supervise the roof removal; typically, problems arise later in the process, when the ecologist is no longer on site. By the time the development takes place, the client might have spent considerable sums of money on surveys and is unwilling or unable to pay the ecologist to be on site every day to ensure the mitigation measures are correctly installed. The current system is good at ensuring that the client commissions the work that leads up to the licence or method statement, but falls seriously short after this point, and it is hard to avoid the conclusion that if the mitigation/compensation is substandard or does not work for reasons that may be unclear and, if adequate monitoring is not conducted, so we do not learn from experience in order to do better in the future, then the money spent on survey and licence applications is completely wasted.

My belief is that the way the legislation is currently interpreted and administered in England is actually counterproductive to bat conservation; it was not intended to punish householders, for example, but in many cases that is the perception of clients, and the hostile reports that appear frequently in the press are

the result. Never mind that we know these are in most cases one-sided and distorted; the damage is done.

In most cases clients have little problem with mitigation and compensation for bats and are often very positive about the idea. What they often take issue with is the surveys, as these are mostly needed prior to planning permission being granted, so they might have to spend a lot of money before they know the outcome of their application.

The emphasis of the current system is heavily 'front-loaded' on surveys to inform planning and EPS licence applications; mitigation, compensation and post-works monitoring feel like the poor relations; and when things do go wrong, there is rarely any enforcement. We have detailed guidance on surveys: the Bat Conservation Trust (BCT) guidance was originally produced in 2007, revised in 2012 and is being revised again as I write – yet there has been no systematic guidance published on mitigation/compensation since 2004.

Whilst a level of survey is clearly essential, are we focusing too much on the process at the expense of getting the best end result for bats? Because it is the end result that matters; the surveys, in themselves, do not benefit bats.

Waring, P. (2011) Snowdonia Bat Mitigation Pilot Project. Snowdonia National Park Authority.

Bones of the Family Muridae

Mice and Rats



Skeleton preparation of brown rat, *Rattus norvegicus* by Gerrard Biological Centre. (Author's collection).

Ric Morris, Ric_morris@hotmail.co.uk

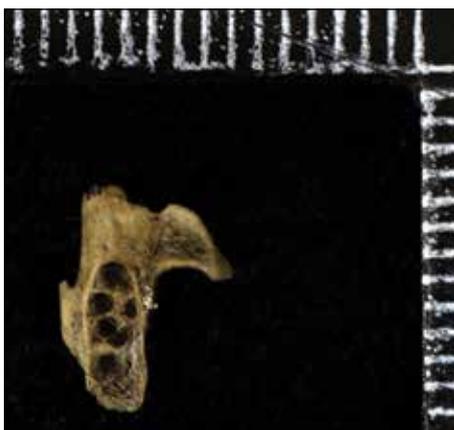
Photography access to rat and mouse bones by kind permission of Tony Parker, Zoology Department, World Museum, Liverpool, apart from where otherwise credited.

These rodents are some of our most common British mammals. Estimates of UK populations fluctuate wildly between 7 and as many as 60 million for brown rat (*Rattus norvegicus*); 38 million for wood mouse (*Apodemus sylvaticus*) and around 5 million for house mouse (*Mus musculus*), so there should certainly be no shortage of specimens for the osteologist to collect and compare.

Most of us encounter the bones of mice and rats via owl pellet analysis and mammalogists are fortunate in that there are several excellent reference works and keys to aid identification in this context – notably Derek Yalden's *The Analysis of Owl Pellets*, published by The Mammal Society and available from NHBS.

The general structure of the Murid skeleton is similar to that of voles, which themselves are probably the major prey item of tawny, barn and short-eared owls. All are small quadruped, plantigrade mammals, though mice and rats have longer tails and therefore many more caudal vertebrae than voles. In the fur matrix of owl pellets the bones of prey mammals are often found in close proximity to the respective skulls, therefore careful dissection (rather than wholesale soaking and sieving out bones) can often enable links to be made between the skulls and the post-cranial bones. Wood and yellow-necked mice (*Apodemus spp.*) bones are commonly found in this context; the house

mouse, less often, and any appearance of the harvest mouse (*Micromys minutus*) may only reflect a local abundance. In my experience, rat bones (generally *Rattus norvegicus*) are much less common in pellets than either *Mus* or *Apodemus* and, when they are found, they are often juveniles. Therefore, for the most part, the pellet analyst will be looking to differentiate between *Apodemus* and *Mus*. Bones of both genera are usually slimmer and more graceful than the voles, although they are generally not as numerous in the pellets of most owl species.



A fragment of the left maxilla of a harvest mouse (*Micromys minutus*) sourced from an owl pellet. The anterior of the bone is at the top of the image. Note the five roots from the missing first molar. The final root toward the lower part of the image is from the second molar.

Skulls:

Mouse skulls are noticeably more fragile than those of voles and the cranium will probably be crushed in the process of ingestion and digestion (as opposed to disintegrating in the process of dissection of the pellet, as is

usually the case with the more robust vole skulls). It is also quite common for these skulls to split along the midline of the palate and also fracture along the join of the maxilla and premaxilla bones, separating the incisor teeth from the cheek teeth, so all that may be left are a couple of maxilla bones. Fortunately there are simple methods of telling apart *Mus* and *Apodemus* from these fragments alone.

Mice and rats (and also voles) have a single upper incisor on each side of the upper and lower jaws, with an orange enamel surface to the anterior. The cutting edge of the upper incisors are chisel shaped while the lower incisors end in a point. Canines and premolars are absent, with just three molar cheek teeth on each side in the upper and lower jaws, making a total of 16 teeth in all; the dental formula for all species being $i\ 1/1; c\ 0/0; pm\ 0/0; m\ 3/3$. A gap named the diastema separates the incisors from the three molars and, conveniently, there is a notch in the upper incisor of *Mus*, with this feature being absent for both the *Apodemus* species and also *Micromys*. This is, of course, a rule of thumb which may in very rare cases vary between individuals depending on diet, tooth breakage or attrition and therefore may not be a one hundred per cent definitive distinction. However, as with all identification features, it is advisable to consider the



This shows the diagnostic notch in the upper incisor of the house mouse *Mus musculus* (indicated) compared to *A. sylvaticus*, which lacks the notch.

Overall, *Apodemus* skulls are generally larger than those of *Mus*, the cranium is likely to be rounder laterally, with a more curved top surface to the frontal and parietal bones.



Note the larger size of the *Apodemus* skulls and the longer, more flared nasal bones when compared to *Mus*. The parietal bones also appear proportionally larger. Access to these skulls for photo by kind permission of Paolo Viscardi, Horniman Museum, London.



This image shows the more parallel cranial ridges of the brown rat *R. norvegicus* (left) in comparison to the curved ridges of the black rat *R. rattus* (right).

specimen in its entirety in order to draw the most accurate conclusions.

A further distinctive ID feature is offered by the first or anterior molar of the three in each upper tooth row. Remove this tooth with a pair of fine tweezers and examine the root holes. *Apodemus sylvaticus* and *A. flavicollis* should display four roots, with just three in *Mus musculus* and an incredible five in *Micromys* (the skulls of which will probably be distinguished by size alone in any case). Once again, this is subject to the caveat of individual variation and other osteologists have noticed that the molar root sockets of *Apodemus* skulls will sometimes merge on one side giving the impression of three roots. Turning to the lower jaws, again the number of tooth roots in the whole jaw will identify the mandibles to species level. Six in *Apodemus*, five in *Mus*, and seven in *Micromys* – with

the anterior lower molar in the latter species having three root holes.

Overall, *Apodemus* skulls are generally larger than those of *Mus*, the cranium is likely to be rounder laterally, with a more curved top surface to the frontal and parietal bones. They also have longer nasal bones which flare slightly at the anterior end and overhang the premaxilla bones slightly at the anterior tips. The distinction between *A. sylvaticus* and *A. flavicollis* skulls is much more challenging and the perceived opinion is that it is very difficult to tell them apart. *A. flavicollis* is a larger mouse, of course, and this is reflected in the more robust skeleton. It appears from the *Handbook of British Mammals* (2nd edition, ed. Corbet & Southern) that the dimension of the upper incisor tooth is key to identification, although because of the tiny size

it is always going to be challenging to measure accurately. The anterior-posterior thickness of the upper incisor is between 1.1 mm and 1.3 mm in *A. sylvaticus*; between 1.45 and 1.65 in *A. flavicollis*.

The caveat is that:

‘Skulls with the incisors measuring about 1.35 and 1.40 mm should be treated as unidentifiable unless the molars are heavily worn, in which case they will be old wood mice, or particularly unworn, in which case they will be young yellow-necks’.

So that's straightforward, then!

Turning to rats, we are all aware just how scarce the black rat (*Rattus rattus*) is in the UK today, with perhaps only two remaining colonies. This means that in the vast majority of cases, rat bones found in this country are always going to be *R. norvegicus* and these can be distinguished from mice and smaller vole bones by their much larger adult size. The very distinctive cranial ridges are a reliable identification characteristic between the two rat species. These ridges flare outward on the posterior upper edges of the frontal bones on both species then run almost parallel along the edges of the parietal bones of *R. norvegicus*, while they are curved on *R. rattus*. Once again there is a noticeable size difference with *norvegicus* skulls being larger than *rattus*.

Scapulae:

Post-cranially, the scapulae of mice will be distinguished from voles by a more graceful D shape, while the typical vole scapula is more heavily built, triangular in shape and with a much more pronounced spine. There is an excellent illustration of these and of all of the mouse and vole species pelvic bones



Scapulae comparison of black rat *R. rattus* to the left and brown rat *R. norvegicus*, right. Note fracture damage to the brown rat scapula; the metacromion process is shown lying separately.

in Lawrence and Brown's second edition of *Mammals of Britain: Their Tracks, Trails and Signs* (1973) and in the space available here, I can't do better than to refer you to that definitive work to learn more.



Pelvic and right rear limb bones of *Rattus* spp., with brown to the left and black to the right. Note the size differences and shorter shaft of the pelvis on the black rat.

Pelvis:

It is also possible for our smaller rodents to be not only identified to species level but also to be sexed via a comparison of the pelvic bones, and there is a helpful set of illustrations in Lawrence and Brown based on the work of Brown J.C. and Twigg G.I. (1969). The rule of thumb is that if the obturator foramen (the hole in the P shaped pelvic bone) is oval or trapezoid then this suggests a mouse; if semi-circular, then the likelihood is a vole. The foramen found on the pelvic bones of the two *Rattus* species tend to be more kidney shaped and again the typical *R. norvegicus* bones are larger than those of *R. rattus*. Sexing tips are beyond the scope of this short article, but the information is out there!

Long bones:

Briefly, the limb bones of Murids are proportionate to the size of the animals, with the humerus having a muscle attachment spine on the anterior orientation of its shaft. The spine rises gradually from the proximal end of the bone and having reached its greatest width



***Apodemus sylvaticus* long bones** – from left: clavicle and right scapula; left scapula (damaged) humerus, radius and ulna and forefoot. To the right is femur, with epiphysis unfused, patella, tibia and foot. Note the fibula fused to tibia at the distal end but snapped off. The tibia itself is also fractured at the distal end and remains attached to the foot with dried tissue.



Right forelimb and left hindlimb of house mouse *M. musculus* for comparison with *A. sylvaticus*.



Forelimb bones of *Rattus* spp., with brown to the left and black to the right. Note the size differences; the difference in the shapes of the humerus spines, and the more curved radius and ulna bones of the brown rat.

about a third of the way down the length of the bone, it terminates suddenly. The angle at which the profile of the spine rejoins the shaft of the bone may be one means of distinguishing the two *Rattus* species. The radius and ulna

bones of the lower front limb may as a rule be more curved in *R. norvegicus* than *R. rattus*. In all Murid rodents the rather slim and delicate fibula is almost always fused with the tibia at its distal end.

The Mammal Society's

5th Student Conference

8th April 2016 | Yarnfield Park, Staffordshire

Our 5th student conference will also be held at Yarnfield Park, the day before the annual Spring Conference. The event will focus on providing opportunities for students at all stages of study to network with each other and mammal experts, get careers advice, learn more about mammal research and gain some new practical skills in breakout sessions.

Lunch can be purchased from the Yarnfield Park restaurant.

Book online at:

www.mammal.org/student_conference

Student members – £20

Non-members – £40 (which includes a year's membership)



The Mammal Society

62nd Spring Conference

9th–10th April 2016 | Yarnfield Park, Staffordshire

Our 62nd Spring Conference will act as a forum for mammal experts and enthusiasts to meet in a friendly and relaxed atmosphere to hear the results of new research, discuss contemporary issues in conservation and network with other like-minded people.

The conference will begin on Friday evening, with a chance to view the winning images from the 'Mammal Photographer of the

Year' from 7pm, followed by the prize-giving.

The prestigious Cranbrook lecture will be held at 8pm and is open to the public.

The scientific sessions are opened with the Keynote Lecture on the Saturday morning, followed by further fascinating presentations over 2 days. Join the gala dinner on Saturday evening to mingle, relax and enjoy our fun raffle and quiz.

Prices

Full Weekend Package*

Members £250

Non-members £295

Restricted Weekend Package*

Members £210

Non-members £260

Day Delegate

Members £80/Non-members £110

Gala Dinner £35

*Full package includes 2 nights' accommodation, breakfasts, teas/coffees and lunches. Restricted package is Saturday night accommodation, teas/coffees, lunches. Evening meals on Friday can be purchased from the venue restaurant.

To assist members in spreading the cost of attendance we are offering the option to pay for attendance over 3 monthly payments (the final payment being made in February 2016). Please call the office on **02380 010984 or email training@themammalsociety.org.

Call for Papers

This is the first call for papers or posters for the spring conference 2016. We are keen to hear from as wide a range of speakers as possible; academic research projects, interesting results from consultancy work and amateur surveys conducted by local groups and members. Please share your experiences and findings.

The deadline for submission of abstracts is 15th December 2015. Further information on submission requirements, the formats for abstracts and student bursaries are available on the website, www.mammal.org.uk/conference.

You can also email tms2016springconference@gmail.com with 'Spring Conference Presentation' in the subject line. We will endeavour to answer your queries as soon as possible.

Any delegate accepted to deliver a paper will be given a gratis place at the gala dinner on the Saturday night; charges for the rest of conference still apply.



Notice of the

62nd Annual General Meeting

of The Mammal Society 9th April 2016

The AGM will be held on Saturday 9th April 2016 at 4.15pm in the Knighton Suite, Yarnfield Park Training and Conference Centre, Stone, Staffordshire, ST15 0NL.

Any members wishing to have an item on the agenda for the AGM are requested to notify the Honorary Secretary in writing no later than 14th February 2016.

Nomination of Council Members for The Mammal Society

Officers and Ordinary members of Council: All officers must retire each annual meeting. With exception of the vice-chair, all officers and ordinary members of

Council offer themselves for re-election. A new vice-chair will be chosen at the AGM.

A reminder from The Mammal Society Articles of Association: 'Any two members (of The Mammal Society) shall be at liberty to nominate any other full member to serve as a member of the Council. The proposer shall ascertain that the person nominated by him is willing to be so nominated. The name of each full member so nominated, together with the names of his proposer and seconder, shall be sent in writing to the Secretary of the Society at least fourteen days before the Annual General Meeting.'

Nominations for Officers and Ordinary members of Council, duly proposed and seconded in writing and countersigned by the nominee should be sent to:

The Honorary Secretary,
The Mammal Society,
3 The Carronades, New Road,
Southampton, SO14 0AA
or emailed to:

info@themammalsociety.org

Nominations must be received no later than 14th February 2016



Nutkin Ventured, Nutkin Gained: Red Squirrel Recovery on Anglesey

Craig Shuttleworth, Craig.shuttleworth@rsst.org.uk

High in the Snowdonia mountains, there is a small and unobtrusive slate plinth. The inscription simply reads 'Esmé & Peter'. It is a gentle memorial to the lives of Esmé and Peter Kirby, two pioneering conservationists who, when they were in their late 80s, set in motion an ambitious programme to restore the fortunes of the native red squirrel (*Sciurus vulgaris*) in north Wales. Twenty years later and the project they started has succeeded beyond expectation. Red squirrels are now a common sight in parks and gardens, the grey squirrel (*Sciurus carolinensis*) which was once abundant has been eradicated, and scientific studies have revealed patterns of genetic change following red squirrel translocations, have illuminated the threat posed by pathogenic viral infections, and have evolved best practice in invasive species management.

In 1997, the red squirrel was close to extinction on Anglesey. Mark recapture and genetic studies had both revealed that the remaining 40 adults shared a single maternal bloodline and had worryingly low levels of genetic diversity. This remnant population was restricted to spruce dominated stands within the 250 hectare Mynydd Llwydiarth conifer plantation and was threatened not only by the presence of grey squirrels, but also by unsympathetic forest management practices. Conservation efforts often reflect ecological understanding, resource availability and the influence of political factors, and on Anglesey this was a reality too.

Press campaigns and political lobbying led to a dialogue with Forestry Commission Wales and eventually to changes in forest planning to accommodate the habitat requirements of red squirrels. In parallel, the eradication of grey squirrels from the plantation facilitated high juvenile red squirrel recruitment rates and the progressive colonisation of the whole woodland area by red squirrels. The adult red squirrel population had doubled by 2002 and small numbers of individuals were also found to have dispersed out into adjacent hazel and oak dominated broadleaved habitats.

It may come as surprise, but this was the first documented case of a red squirrel population recovery following the removal of grey squirrels.

However, although grey squirrels were now absent from one part of Anglesey, across the 720 km² island as a whole, the pattern of grey squirrel control remained patchy because the project lacked the resources to implement a more comprehensive programme. The fragmented nature of the 2500-3000 hectares of Anglesey woodland, hedgerow and wooded garden habitats was also viewed as being prohibitive to any rapid red squirrel re-colonisation; project managers felt strongly that the presence of red squirrel would be a major catalyst to attract funding for, and galvanise community participation towards, widespread grey squirrel control.

An obvious solution to quickly improve population distribution, abundance and genetic diversity would be to translocate red squirrels onto the island. With technical guidance from Professor Robert Kenward and the late Dr Derek Yalden, plans were prepared to

Red squirrel. Photograph by Mark Hows



reintroduce captive bred animals obtained from the Zoological Society of Wales. The 700 hectare pine forest at Newborough was selected as the release site and with a programme of intensive grey squirrel control in place, red squirrels were released over a four year period. Ultimately the scheme was successful but this headline belies significant disease outbreaks in captive stock and the fact that project resources were partitioned into dealing with one of the most controversial forest removal proposals in Wales - plans seeking to clear-fell 50% of Newborough forest in order to return the land to open sand dune with pockets of birch dominated scrub. Adenovirus infection produced pathological disease in Newborough with an epidemic outbreak during the summer of 2005. The discovery soon afterwards that grey squirrels can carry the virus obviously raised the possibility that, as is the case with the squirrel pox virus, we might have an infection spread from grey to red squirrels. However, as the virus is also found in woodmice, and individual red squirrels appear to have the infection but show no signs of ill health, there is much still to understand. Putting these uncertainties aside, the fact that adenovirus had proved so problematic in Newborough meant that a precautionary principle was central in shaping the approach taken in future reintroductions. Captive red squirrels were screened for this infection prior to their arrival on the island and animals were housed for shorter periods, amongst smaller groups and within enclosures with proactive mouse control in place. Though occasional deaths were recorded, these had limited impact upon a phased release programme that now focussed upon broadleaved habitats.

By 2007, red squirrels were to be found across a broad spectrum of woodland habitats. As it became easier for the public to see animals, the squirrel population had a measurable socio-economic value as a tourist attraction. Accessibility facilitated greater opportunities for public participation and learning and these were major levers to attract funding. With sufficient resources, grey squirrel eradication became more of a tangible

objective. Therefore, a more systematic and intensive approach was taken to culling, and the last grey squirrel was caught in 2013. Funding also meant that greater surveillance of causes of mortality in red squirrels could be undertaken.

A variety of diseases and infections have been recorded in Anglesey's red squirrels but never squirrel pox virus. This virus presented an inherent risk within a conservation strategy that had deliberately sought to increase red squirrel range well before grey eradication had taken place. And in retrospect, grey squirrels proved much harder to remove than had ever been anticipated; there was frequent population overlap and grey/red interactions were observed. This begs the question why was squirrel pox never recorded in these red squirrels?

An unexpected but exciting discovery which helps explain this is that as the grey squirrel population was culled the residual population started to show greatly reduced levels of exposure to the infection.

The infection then disappeared from surviving grey squirrels before the last animals were caught. In effect our intervention to limit the competitive threat represented by grey squirrels also dramatically reduced the disease risk that they posed.

Today, there are an estimated 700 red squirrels on Anglesey and as the genetically diverse population has grown, animals have dispersed across the Menai Straits into the mainland county of Gwynedd. This scenario means that we not only have to prevent grey squirrels from crossing the sea strait back onto Anglesey but face the challenge of managing a mainland red squirrel population that is exposed to resident grey squirrels with high recorded pox infection rates. Consequently, plans were drawn to eradicate grey squirrels from a 90 km² landscape, an initiative to push grey squirrels well away from Anglesey and the Gwynedd coast. It is just one of the exciting elements in the developing EU Life plus *Sciuriosity Project*. This is the first UK-wide collaborative programme of red squirrel re-establishment, through grey squirrel control that involves three regional eradications and parallel research into stratified culling.

The findings from Anglesey are not a blue print for wider red squirrel conservation but they have offered the *Sciuriosity Project* a invaluable insight into the realities of landscape-scale squirrel management. Anglesey also highlights factors that can lead to inefficient use of conservation resources, and of course reinforces the now common view that community participation is an essential element for local project success. Esmé & Peter would have been delighted.

Grey squirrel. Photograph by Mark Hows





Examining actual and perceived rates of predation by domestic cats

Jenni McDonald, j.mcdonald@exeter.ac.uk

Few invasive species fuel as much controversy and debate as the domestic cat (*Felis catus*). There are over 10 million owned cats in the UK, which live at higher densities than any natural UK predator. Cats are hunters and, despite being well-fed at home, will still have the instinct to chase and prey on wild animals. A study conducted by The Mammal Society, published in 2003, estimated that owned domestic cats in the UK were responsible for killing 92 million animals within a five month period.

However, this is far from the full story. Unlike any other UK invasive species they are also an important part of family life, loved by one in four households in the UK. The domestic cat, it seems, has two sides; a beloved family member and an invasive predator. As an owner of a much loved cat myself and an ecologist by vocation, this clash of roles inspired a project, with colleagues at the University of Exeter, examining the predatory behaviour of cats alongside the perceptions and attitudes of their owners.

We looked at three main questions:

Are cat owners aware of the predatory behaviour of their cats?

58 households owning 86 cats spanning two UK rural villages (one in the county of Stirling, Scotland and one in Cornwall, England) volunteered for this study. Owners predicted the number of animals their cat would return home per month. Subsequently, owners recorded every prey item their cat brought home (for four months in Cornwall, 14 months in Scotland). We then compared the

average number of animals the cats brought home per month with the predictions made by their owners.

29% of all cats did not return any animals and the maximum prey caught was an average of ten animals per month for one cat. The average amount of prey returned was between one and two animals per month. Younger cats, those that spent longer outside and those closer to farmland killed and returned more prey. Mammals made up the majority of the prey, making up 59%, and 73%, of all animals returned at the Cornish site and Scottish site respectively. Most of these (Cornwall 84%; Scotland 94%) were native to the UK. Non-native species included the brown rat and European rabbit.

Cat owners were aware whether their cat was predatory or not. However, there was no association between the number of animals predatory cats returned home and what their owners predicted (Fig.1). Cat owners both over- and underestimated their cats' predatory behaviour.

What are the attitudes of cat owners towards the impact of domestic cats on wildlife and to proposed control strategies?

We conducted a questionnaire of 45 cat owners in the Cornish village to gauge their opinions on the impact of cats on wildlife and their views on different types of management. Owners assessed their agreement or disagreement towards five

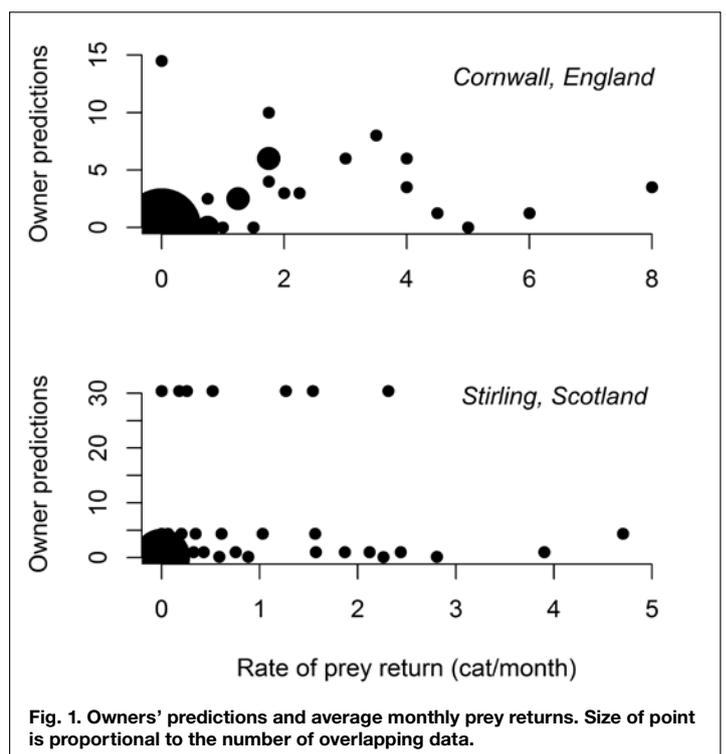


Fig. 1. Owners' predictions and average monthly prey returns. Size of point is proportional to the number of overlapping data.

key questions using scores 1–4 in response to each question (with 1 = strongly agree, to 4 = strongly disagree).

- 1 Domestic cats killing wildlife is a serious problem.
- 2 All cats should be neutered.
- 3 Domestic cats are harmful to wildlife.
- 4 I would be happy to keep my cat(s) on my property between sunset and sunrise.
- 5 I would be happy to keep my cat(s) on my property at all times.

Cat owners largely disagreed with all statements, with the exception of neutering. 73% of cat owners disagreed that cats killing wildlife is a serious problem, of which 20% strongly disagreed. The majority (60%) of cat owners also disagreed that cats are harmful to wildlife. There was strong opposition to the suggestion that cats should be kept in at all times: 98% of owners disagreed with this control strategy, of which 46% strongly disagreed. The only statement to which the majority (62%) agreed was neutering, which is broadly seen as a welfare issue.



Does the predatory behaviour of their own cat(s) influence their responses?

Having established the opinions of cat owners, the next step was to determine whether these attitudes were influenced by the predatory behaviour of their cat. We looked at whether the willingness of owners to agree or disagree with survey questions was associated with the average number of animals their cat(s) brought home.

The views of cat owners were irrespective of whether their cat was predatory or not. Owners of cats that were prolific hunters were just as likely to disagree with suggestions of management as the owners of cats that returned no prey. Similarly, this was found for the proposition that cats harmed wildlife.

Conclusions

Cat owners were unable to perceive the ecological impact of their cat, with a clear divide between how many animals were killed and owners' predictions. However, perhaps this doesn't matter. Owners' views on the wider issue and possible control measures are not swayed by their own cats' behaviour, making it unlikely that challenging their



perceptions of their cat will influence their broader point of view.

Owners in this study reject the suggestion that cats are a threat or problem to wildlife. Given that the majority of cats only return one or two prey home per month, it may be difficult to comprehend that cats are impacting wildlife when focused on any one individual. Therefore, not only would owners need to appreciate their own cat's predatory behaviour, but they would also have to grasp how individual predation rates scale up with increased cat densities to fully recognise the potential impact.

The idea that cats can be kept indoors was controversial, and our results suggest that highlighting the benefits to wildlife is unlikely to be a persuasive tool for the majority. In this study neutering, a largely welfare driven strategy, was the most favoured statement. Perhaps focussing on welfare advantages and emphasizing the hazards that cats face when roaming freely would be a more favourable motivational tool. For example, keeping a cat indoors eliminates road traffic accidents, reduces stress, prevents poisoning, lowers the risk of infectious disease and prevents fighting related injuries.

This study provides a snapshot of the attitudes of cat owners in the UK which largely see their individual pet doing what comes naturally. Therefore, should control ever be

deemed necessary, conservationists need to account for the interests of cat owners and this is more likely to be successful if solutions are beneficial to both cat welfare and wildlife.

Future Work

The question still remains, what impact (if any) are cats having on wildlife populations? This is an extremely complex question to answer; experimental studies of cat and prey populations would be a substantial challenge. Additionally, cats may be killing animals that are already in poor condition and likely to die anyway and/or cats could be having increased impact due to sublethal effects whereby the mere presence of a cat may alter the behaviour of their prey. It is also unknown how many animals are killed away from home and not returned because they have been either consumed or abandoned at the capture site. Despite these difficulties, some countries, such as Australia, are taking precautionary measures including cat curfews and exclusion zones to protect their native wildlife. If such action were required in the UK then further consultation with cat owners is a necessary step. Specifically, we recommend exploration of opinions of owners in the UK with a specific focus on the effectiveness of cat welfare as a motivational reason for owners to engage with controls on predatory behaviour of domestic cats.

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This article is based on the following publication:

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On the trail of the Irish badger

Aoibheann Gaughran, gaughra@tcd.ie
Photography by Aoibheann Gaughran and Peter Maher

In 2008, plans to upgrade a major road in County Wicklow, Ireland, provided a unique opportunity to study the effects of this kind of disturbance on the behaviour of badgers. Badgers are nocturnal and live in underground setts and as a result they are rarely encountered and can be difficult to study.

A GPS tracking study was established in 2010 by The Department of Agriculture, Food and The Marine (DAFM), and the National Parks and Wildlife Service (NPWS). Trinity College Dublin (TCD) was asked to assist with the analysis of the data. Over five years researchers have collared over 75 individual badgers, which together have sent more than 61,500 GPS locations or “fixes”, the largest ever study of its kind in Ireland.

As in the UK, tuberculosis (TB), which can also affect humans, is endemic in

Irish badgers and the species has been implicated in the transmission of the disease to cattle, although how this happens is not fully understood. Consequently, the national bovine TB eradication programme includes the removal of badgers where they have been associated with a TB breakdown. The badger is a protected species in Ireland and its conservation is also of concern. Therefore, it is recognised that culling is not a permanent solution to the TB problem and research into the development of an oral vaccine to clear TB from the badger population is underway. The success of any control or conservation programme is dependent upon a full understanding of the ecology of the species involved. In relation to badgers, understanding their normal ranging, territorial, foraging and dispersal behaviour and how these respond to disturbance is critical. It is these areas that the

GPS study is investigating.

The study area is approximately 42 km² of rolling agricultural land interspersed with patches of woodland and residential areas. The N11 and its associated roadworks bisect the area. An initial environmental impact study revealed several setts in the vicinity of the proposed roadworks. After a bait-marking study, live-trapping of badgers to fit GPS collars began in spring 2010. Trapping takes place every six months to replace old collars and fit new ones. Peanut-baited cages are set, left overnight and checked early the following morning. Captured animals are anaesthetised, given a thorough health-check, a BCG vaccine against bTB (something that the local farmers are very happy about), weighed, examined and blood and tissue samples are taken. Examination of tooth wear allows us to estimate age. Each new individual



Anaesthetised badger wearing a GPS collar.



Roadworks bisecting the study area.

is microchipped and tattooed for easy identification in the future. They sometimes have bite wounds to their rump, ears and cheeks, which are cleaned and swabbed, with antibiotics administered if necessary. A GPS collar is only fitted if the badger has a large enough head-to-neck ratio so that the collar will not slip off, and the animal is heavier than 8 kg to ensure the collar is a very small proportion of body weight. Finally, we mark them with sheep spray so that if recaptured, we can release them with minimum stress.

The collars are programmed to transmit four GPS fixes each night when the badger is above ground. This allows a picture of their movement to be built up over time that is not possible with traditional radio-tracking methods.

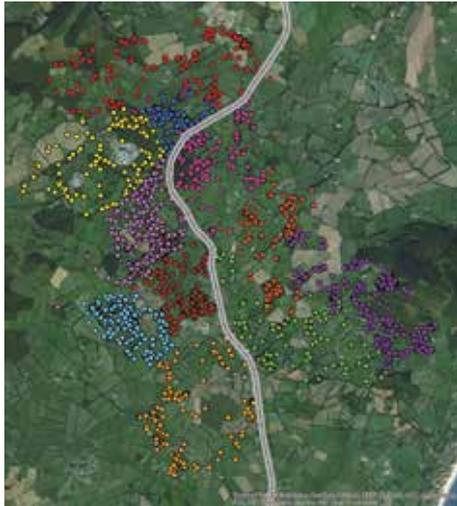


Fig.1. GPS fixes for a single month. Each colour represents a different badger.

Throughout most of their range, badgers live in social groups that maintain exclusive territories. The group will actively defend that territory by patrolling the perimeter, scent-marking at latrines and occasionally by fighting. Although several studies in the UK have revealed badgers to be highly territorial, maintaining strict and stable territory boundaries over time, the GPS data reveals our population to be quite dynamic in this respect (Fig.1). There is a seasonal ranging pattern that is evident across all of the social groups, with home range area



Fig.2. Fluctuating home ranges – December 2010 (orange line), June 2010 (green line), June 2011 (red line), and June 2012 (blue line). Winter ranges are smaller than summer ranges, but summer ranges shift in location year on year. Black dot represents the main sett.

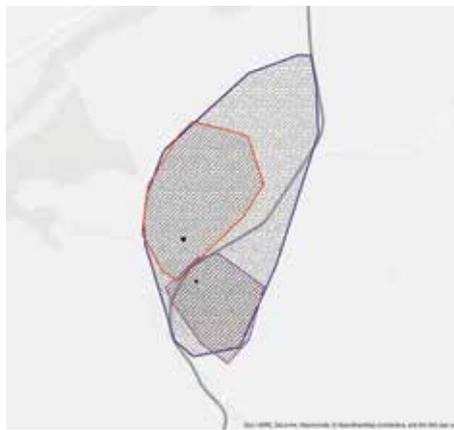


Fig.3. Douglas' "super-territory" (blue), Lily (red) and Gina (pink) in April 2012. Black dots represent main setts.

being greatest in summer and smallest in winter. The delineation of home range boundaries shifts from month to month which is unsurprising given the seasonal fluctuation. However, the delineation of these boundaries also shifts from year to year. The core areas are reasonably constant, but the edges of territories appear to be quite fluid (Fig.2). Over time, we have seen some social groups' borders shift position completely, with contraction on one side and/or expansion on the other. It would be not possible to see such patterns with studies of short duration.

Furthermore, several males have even held "super-territories" that encompass the ranges of females from completely different social groups (Fig.3). The GPS data have revealed badgers making forays into neighbouring territories or going even further afield, presumably in search of mating opportunities. On one occasion a female badger made a 9 km round-trip to another sett in three hours. This February, one male badger was recorded visiting the main setts of four neighbouring groups. Although social groups generally consist of two adults and cubs/yearlings, these youngsters are not necessarily sired by the resident male. Indeed, English studies have shown that up to 40% of cubs in a sett were the offspring of a non-resident male, often a neighbour.

Social groups are usually formed or maintained as badger cubs stay with their parents, even after reaching maturity. However sometimes badgers will disperse from the natal sett. Our study has revealed several different types of dispersal movement. This can involve expanding the current range, moving next door or crossing a few territories to settle down in a completely new area. It is hoped that, together with the GPS data, genetic analysis will tell us who is related to who, how to predict which badgers disperse and how non-dispersing badgers manage to avoid inbreeding.

Results of investigations into nightly ranging behaviour have direct implications for our understanding of the transmission of TB between badgers and cattle. Our data shows us where the badgers like to forage. A local cattle farmer that operates a rotational system keeps detailed grazing records. In combination with the GPS data, these records allowed us to compare the badgers' use of the paddocks when cattle were present against when cattle

were absent. We found that badgers avoided foraging in paddocks when cattle were present. This demonstrates that free-ranging healthy badgers are unlikely to come into direct contact with cattle in pasture and that strategies to prevent cross-infection of TB between the species should focus on more indirect routes, such as contamination of drinking and feeding troughs.

To explore transmission opportunities further, we investigated how often badgers visited the 58 farmyards within the study area. Farmyards were digitally mapped and categorised. GPS collars were tested to ensure that they functioned accurately even when inside yard buildings. Analysis of three years data showed that collared badgers avoided entering all types of farmyard (Fig.4). Of the 30,764 GPS fixes, only 66 (0.21%) were located within farmyard perimeters. The 17 farmyards which were visited by the badgers tended to be either equestrian or disused farms, whereas the badgers tended to avoid cattle yards. This demonstrates that these badgers are not avoiding all large animals, but cattle in particular. Compared to Irish studies, British research has found higher levels of badger activity in and around farmyards. Using different methods, our results support other Irish findings, and lend credence to the thinking that badger-cattle TB transmission is indirect. While it is unclear whether the behaviour of tuberculous badgers may influence TB transmission, this is something we have been unable to investigate.



Fig.4. Cattle farmyard, outlined in yellow, alongside three years of GPS data. Each dot of a different colour represents a different badger.

The Wicklow project is ongoing, the roadworks were recently completed and the new motorway is now open. Analysis of the data for the periods before, during and after the roadworks should show to what extent a major physical disturbance of this kind affects badgers in this area, and continue to give further insights into the behavioural ecology of the badger in Ireland. This information will be used to inform future TB control policy with direct implications for farm biosecurity and vaccination of badgers.

Research team: Teresa MacWhite, Peter Maher and Margaret Good (DAFM), Enda Mullen (NPWS), David Kelly, Aoibheann Gaughran and Nicola Marples (TCD).

Photo credits: Aoibheann Gaughran and Peter Maher. Many thanks to the farmers and landowners of Wicklow for facilitating this study.

Spotted Sousliks – Rescue from the Brink

Mark Hows visits a conservation success story in south east Poland.

Photographs by Mark Hows, Mark@hows.org.uk

The spotted souslik (*Spermophilus suslicus*) is found across Russia, Ukraine and Belarus but, in Europe, it is only found in Poland. It is one of only two ground squirrels found in Europe; the other being the European souslik (*Spermophilus citellus*). Its habitat in Europe differs from the rest of its range where it prefers steppe grasslands, which are not present in Poland, where instead it utilises grazing pasture.



We drove to the small Souslik Hills (Susle Wzgórza) reserve close to the Ukrainian border. We quickly found burrows, runs and evidence of crop damage in the bordering fields; fortunately this crop is used as a buffer to the commercial crops. The small reserve holds in excess of a thousand sousliks and being diurnal it was not long before we spotted our first heads poking out of the burrows.

Krzysztof explained the lifecycle of the souslik and also explained about the history

Changing farming practices since Poland emerged from communism have adversely affected the souslik's preferred habitat and by the mid 1990s, its population had dropped markedly with Europe's total population down to under 100 individuals. Although already on Poland's endangered list, it was only then that a recovery plan was initiated.

I recently contacted the leader of the recovery project, Krzysztof Próchnicki, through a mutual friend and he invited me over to see the project reserves, translocation and hopefully the sousliks themselves.

Sousliks hibernate from October to April so my wife and I planned a holiday for August and arranged to meet up with Krzysztof for a guided tour during our stay. We had perfect weather for our visit and we met up with Krzysztof and his son, who interpreted for us, in the small town Tomaszów Lubelski.



of the project and how the last remnants of habitat were protected in the 1990s creating the 8 current souslik reserves. Some of these reserves have been re-populated by translocating individuals from the largest

population at Popówka and there are now approx. 10,000 sousliks distributed between the reserves. The success of the project is largely due to the careful cattle grazing management of the reserves and the continued legal protection of the sousliks. While we were there we saw harriers, one of the major predator of these animals. Their other main predators are domestic cats and dogs.

We spent some time quietly watching the sousliks from the edge of the reserve and easily saw dozens of them. Krzysztof mentioned that this would have been difficult if they had not mown the reserve especially

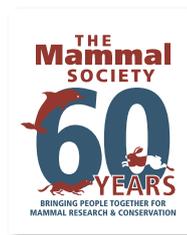


Burrow entrance.

for our visit.

We also visited Popówka to see the translocation process in action. Here we saw an unmown reserve where cattle had just been brought in to graze and we did not see any sousliks apart from those trapped for translocation, because of the height of the vegetation. The individuals caught for translocation are being added to some very small colonies outside the main 8 reserves. With time moving on we bid our host farewell knowing the future of the spotted souslik in Europe was in safe hands and our host gave us a whole selection of books and information on the souslik project so now I just need to brush up on my Polish a bit before reading them. Many thanks to Krzysztof for his hospitality in

Training 2015



This year we ran 17 courses enjoyed by over 130 attendees. The most successful courses this year were Dormouse Ecology and Conservation and the Mammal Identification Weekend. The Mammal Identification weekend is a residential course that is always a popular choice with people attending from hobbyists to professionals in the ecological field.

Not only do the courses provide an excellent education – both practical and theoretical but they gives those that attend a chance to network with like-minded people and take their interest forward to a more regular surveying level.

With 2015 nearly over, we only 3 courses left on the calendar. For more information and to book any of our courses visit www.mammal.org/training.



Photograph by Adam Mulcahy

Water Vole Ecology & Conservation

Date: 24th October 2015
Venue: Wildwood
Cost: TBC

This course is suitable for all levels of experience. This informative one day event focuses on one of our most iconic river dwelling mammals, the water vole.

The course includes information on identifying field signs, habitat requirements, their ecology, legal protection and their predators/threats. The course will also include an opportunity to see captive water voles in situ at The Wildwood Trust and handle/sex the water vole under supervision.



Photograph by William Richardson

Owl Pellet Analysis

Date: 7th November 2015
Venue: Wildwood
Cost: Mammal Society Member Ticket £59
 Student Member & Concessions £50
 Non-members £89

This one day course will help you to learn which mammals are the most popular food sources for a range of owl species.

Find out why owls produce pellets and how to collect and dissect owl pellets.

With our trainer's expert guidance you will practise identifying a range of mammal remains from your dissected pellets and learn how to record and use your findings.

There will be an opportunity to visit the small mammals at Wildwood to see living examples of the species you have identified.

This course has good availability.

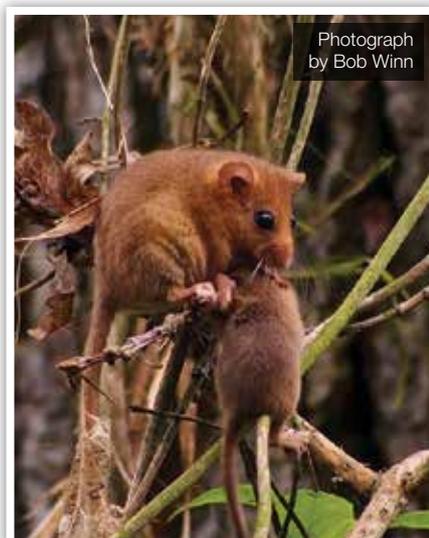


Dormice and Development

Date: 30th October 2015
Venue: Sutton Veny
Cost: Mammal Society Member Ticket – £99
 Student Member & Concessions – £84
 Non-members – £129

Designed for consultants or those needing to learn about dormouse legislation and how to detect and protect dormice on potential development sites.

This classroom-based course includes the essentials of dormouse ecology as well as how to survey for protected species. Using case studies of potential scenarios, it covers what must be done if dormice are found on a site; from licence requirements and suitable mitigation, to ongoing monitoring.



Photograph by Bob Winn

This course has limited space.

Book Reviews

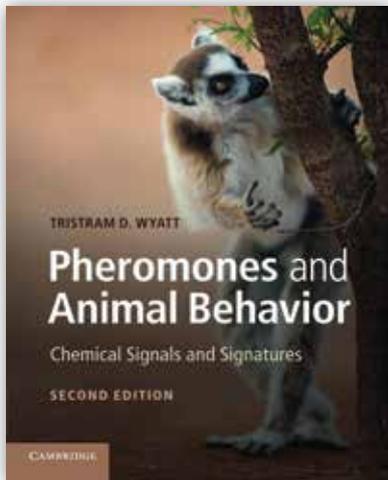
Pheromones and animal behaviour: Chemical signals and signatures

By **Tristram D Wyatt**. ISBN no. is 978-0-521-13019-6.

This book looks at the importance of olfactory communication in the animal kingdom, investigating how the pheromones and individual odours given off by animals

can affect other members of their species, their predators, and their prey. The book focuses on mammals and social insects such as bees, ants and termites, as these are animals that use pheromones most extensively. In particular, the authors examine the ways in which social insects use pheromones to self-organise their highly complex societies in fascinating detail. The chapter on mate choice touches on many aspects of behavioural ecology and explains well the role of pheromones in sexual selection in many species. The book also contains an interesting discussion of the evidence for human pheromones (spoiler: those pheromone perfumes you can buy won't get you a hot date).

Although the chapter explaining how olfaction works was thorough and illuminating, it could have benefited from being placed much earlier in order to lay the groundwork for understanding much of the content in the rest of the book. Additionally, there was at times a slightly bewildering array of complex diagrams and figures that might be off-putting for all but the keenest biochemists. Despite this, the book was well-written and accessible enough for biology undergraduates to get their teeth into. I would also recommend this book for anyone with a life science background who is interested in animal communication, olfaction or pheromones.



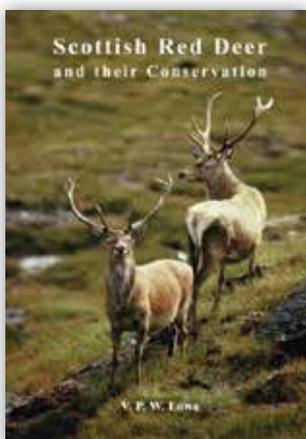
Book Review by Emma Grocutt

Scottish Red Deer and their Conservation

By **V. P. W. Lowe**.

The author's objective is to provide the reader with a brief introduction to the long standing research project of the red deer in Scotland and more specifically on Rum. By culminating previous years' data, this book manages to paint a clearer picture of how this research can be used to more successfully manage red deer populations.

The information is set out in large font, with clear chapters and coloured photos in a way that makes the scientific jargon easily digestible to the layman. But where this book is most unique is the underlying personal experience and obvious love of '... Britain's largest surviving wild terrestrial mammal' which Lowe portrays through his words, whilst keeping true to his scientific background and providing evidence and a balanced view throughout.



Book Review by Keira Washtell

Otters of the World

By **Paul Yoxon and Grace Yoxon**.

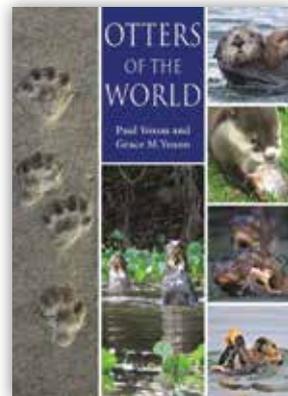
Did you know that there are 13 species of otter in the world?

If you didn't, 'Otters of the World' by Paul and Grace Yoxon is the book to read. From the Hairy-nosed otter to the Congo clawless otter this book focusses on the identification, ecology, and conservation status of each species, as well as the threats that they each face.

Each species has its own dedicated chapter making it easy to read and return to and each chapter is full of wonderful photos. Separate chapters are also dedicated to the rescue and rehabilitation of otters, taken from the author's experiences of caring for over 170 otters in the last 20 years; the issues of otters and fisheries; the illegal trade in otters and what the future holds for these mammals.

The book is detailed but not overwhelming and includes some lovely features such as the appendix devoted to the local names of otters given to them in different countries around the world. If you are heading off otter spotting around the globe don't leave home without this book!

For lovers of the Eurasian otter you won't find the detail on this species that other books such as 'Otters' by Paul Chanin contain. However, what the book does offer is a great introduction to all the otter species of the world and it certainly helps raise awareness for the plight of otters across the globe. At £18.99 the book may seem expensive but the proceeds from the sale go to support the work of the International Otter Survival Fund.



Book Review by Dr Phoebe Carter

The Mouse Stranglers: Britain's War on Wildlife

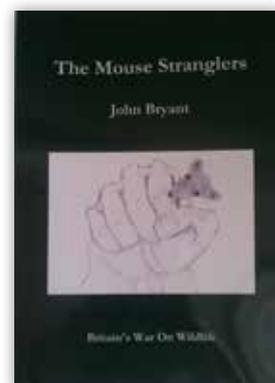
By **John Bryant**.

Provocatively titled 'The Mouse Stranglers: Britain's War on Wildlife' by John Bryant focuses on animals persecuted under the guise of 'pest control'.

Well structured, the book takes the reader on a species by species journey. Grey squirrels and feral pigeons are discussed, as are badgers and foxes (urban and rural). Reflecting upon his experiences interspersed with well-researched information this is clearly a comprehensive review. It certainly gave me pause to think and reflect upon some of my own thoughts and feelings on the subject.

The author doesn't pull punches when it comes to chipping in with his opinion. Although clearly impassioned by the issue - noticeable through the use of emotive language and 'sarcastic' quotation marks throughout - arguments are almost always backed up by often damning references and figures.

John Bryant runs a humane urban wildlife deterrence business (www.jbryant.co.uk) and what better way to drum up a little extra business by publishing his expose of this established multi-million pound industry. So anyone with a vested interest in wildlife and 'pest control' should certainly consider this book. Don't be dissuaded by the - somewhat amateurish - image on the front cover, it is well worth a read.



Book Review by Alex Dittrich

Here at CJ Wildlife we understand the importance of helping out the Wildlife in our gardens. Now that the colder weather is drawing in some hedgehogs, particularly orphaned ones, may well struggle in the autumn/winter months. Here are some of our top tips to help them out this time of year.



Make sure nutritious food is available for as long as the hogs keep coming for it (typically into mid or late November).

At CJ's we have developed a moisture rich pate that the hedgehogs will love as well as a hedgehog delicacy mix and a standard hedgehog food mix.



- Look out for 'autumn orphans' – hedgehogs that were born late in the year and are struggling to gain enough weight to successfully hibernate. They need to weigh around 600g to have a good chance so any hedgehogs that cause concern, for instance by being out during the day, during cold weather or that look noticeably small, need to be weighed and possibly taken into care.
- Provide quiet, undisturbed places in the garden for hedgehogs to hibernate in, and ideally provide shelter. At CJ's we have developed cosy and safe eco-friendly hedgehog houses to provide that quiet place for hibernation.



19025
Hedgehog Food



19026
Egel Delicatessen



- Fallen leaves are the main material used to make hibernation nests so leave some out in the garden. If you worry about your lawn, gather the leaves into piles near likely hibernation sites so that the hogs still have some access to them.
- Bonfire materials should be kept off the ground if at all possible or, as a minimum, the materials moved carefully before lighting. If you find a ball of leaves or a hedgehog, replace some of the material and leave it until spring.
- Hedgehogs need to be able to move between gardens so a few access holes at ground level can make quite a difference. The holes only need to be about the size of a CD case (13 cm or 5 inches) so the fences will still keep the majority of pets in – or out!
- Make sure that anything that could act as a trap for a hedgehog has a gentle escape ramp fitted. For cattle grids this is usually a roughened plank, but for formal ponds a beach of pebbles on top of submerged planters can be a more elegant solution.
- Try to find space for an area of unmown grass that will provide a safe feeding and loafing area for hedgehogs and lots of other garden wildlife, and always be extra vigilant when using garden machinery, particularly strimmers.
- As much as possible reduce the use of garden chemicals, particularly slug pellets, and be very careful with loose netting around kitchen gardens as their spines make hedgehogs very vulnerable to entanglement. Netting should ideally be kept away from the ground or at least pegged down and kept taut.

For all of our products, to order and for more information please visit www.birdfood.co.uk/hedgehogs and for a 10% discount enter code UKHOG15. Alternatively call Freephone 0800 731 2820

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Mammal Society Book Deals

The Eurasian Beaver is for those with a specific interest in beavers and their reintroduction, and for anyone with a general curiosity in natural history, ecology or animal behaviour. It can be used as a field guide to identify beaver field signs and observe beavers in the wild by wildlife surveyors or general land users, or as an introductory guide for anyone with an interest in beavers and how to recognise them.

The Mammal Society's books can be bought through the NBHS: <http://www.nhbs.com>

Members of the Mammal Society can get a 10% discount on these purchases.

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