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mammals

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The State of Britain's Mammals 2008

Written by David Macdonald
and Dawn Burnham

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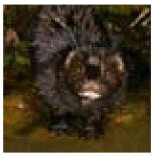
Wildlife Conservation Research Unit



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Preface

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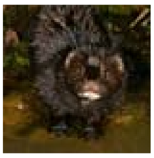
FOR ALL TOO MANY REASONS, 2008 is surely the year to take a global perspective. Climate change – dismissal of the contrarians celebrated by 2007's Nobel prize for the Intergovernmental Panel on Climate Change (IPCC) - trumpets the irrelevance of national borders to environmental processes. And whether one considers the movements of people, resources, money, species or pathogens, globalisation has reached a level that most conservation problems are affected by supra-national forces, and often need solutions at this larger scale too. It is timely, therefore, that 2008 saw a new global assessment of mammal conservation, led by the IUCN[1], and it is not merely knee-jerk doom-mongering to be unsurprised that things have got worse since the last one in 1996. Indeed, of the mammalian species for which there are data, about a quarter (1 141 of 4 651) are in danger of extinction (more like a third of marine species) and, of those, half are declining. However, conservation remains an arena in which it is important to act locally, as well as thinking and acting globally. So what lessons does the global mammal assessment hold for mammal conservation in the UK?

The IUCN report confirmed the general rule that the diversity of mammals is dictated by patterns of energy availability and topographical complexity. In the case of terrestrial mammals, this results in a crescendo of species (and phylogenetic) diversity towards the equator (or, in the case of marine mammals, at about 40° North or South in belts of high oceanic productivity). Importantly, the report also confirmed that patterns of diversity in mammals broadly paralleled those for birds and amphibians; so there's plenty of scope for synergies in the conservation of different types of wildlife. Not surprisingly, larger species are in greater danger of extinction than smaller ones (a total of 188 are critically endangered), although of the 76 mammalian extinctions documented since 1500 there has been no sizist bias. The insidious shifting baseline, for conservation goals, creeps forward as the report does not adequately take account of range shrinkages (the wolf and brown bear are examples relevant to the UK) where earlier losses are generally, but wrongly, consigned to history. Worldwide, habitat loss and degradation remain the greatest threats to mammalian species, with an impact on 40% of them, although over-exploitation comes a close second, especially for large-bodied species, and threatens 90% in Asia, 80% in Africa and 64% in the neotropics (and 52% of marine species).

So, wracking the microscope down to the UK's mammals, two papers published in the last 12 months about British mammals raise issues that resonate with the global assessment. First[2], habitat loss and degradation are writ large in the post-war industrialisation of agriculture that affected at least 40 species of British mammal, and has contributed to population declines of many of them. The UK BAP[3] currently lists 39 mammals (18 terrestrial and 21 marine) as species for conservation concern, targeted due to their declining populations or because of a precarious vulnerability from other factors. The damage of habitat fragmentation, and the exhilarating prospect of radical restoration of habitats and corridors, are as key at the UK scale as they are trans-nationally. And, as globally, an important lever to deliver these goals will lie in the ingenuity with which financial instruments can be devised to foster conservation gain. Thus the second paper[4] argues that it is important to identify priority landscapes and to target Agri-Environment Schemes at them and, within them, at the stakeholders most likely to deliver a difference. Highlighting areas to concentrate on, followed by a close working relationship with landholders, is likely to produce greater, more readily measurable and more sustainable conservation benefits. Since 3.5 billion euros are spent annually on the British farmscape (49.8 billion across the EU) the citizenry has a right to expect the nature (wild mammals included) that it wants from this taxpayer's investment. That said, conservationists working in the developing world have long realised that fostering biodiversity must be balanced with human development, and the 2008 report[5] on the UK's food security raises perplexing questions about how the conservation of farmland wildlife will fare amidst emerging land-use priorities. The UK national per person ecological footprint is currently ranked 15th largest in the world, with our biocapacity (1.6 global hectares per person, gha) outstripped by our national ecological consumption (5.3 gha) by more than threefold[6]. Globally, although it has taken a lifetime for the penny to drop, it has been obvious since Paul Ehrlich's *The Population Bomb* of 1968, that these issues track back with Malthusian inescapability to unsustainable human population. It is not yet too late to conserve wildlife and feed people, but avoiding this looming impasse urgently requires ingenious research and intelligent policy. The same ultimate truth, applied directly to the UK, appeared, as unexpected as it was welcome, in an editorial on climate change in the *British Medical Journal*[7] in 2008. After this year, surely it will be impossible to dodge the reality that the issues facing British mammals, whether as assets or pests, are local acts on a global stage. In this light, many of the news items that follow in this *State of Britain's Mammals 2008* are recast, not as the sectoral interests of a few specialists, but as insights into major societal choices – and generally tough ones!

David Macdonald & Dawn Burnham






UK BAP update

THE UK BIODIVERSITY ACTION PLAN (UK BAP) was first published in 1994 and since then has focused largely on delivering conservation through species and habitat action plans (SAPs and HAPs). The current reporting round ending in December 2008, focuses on the original BAP priorities, and a full report against the Government's Convention on Biological Diversity 2010 targets is expected in mid-2009. In 2007 the UK BAP species and habitats were reviewed, leading to a proposal for an integrated approach to delivering UK BAP conservation action for the new list of 1 150 UK priority species (increasing from 10 to 18 terrestrial mammals)[3]. From 2009 the so-called ecosystem approach will be emphasised, incorporating the wider framework of 'other' conservation work being carried out in the UK, and taking account of devolution (which happened after the UK BAP was published).

The goal is to organise conservation to focus on the priority species while also not neglecting non-priority species – in particular, those that did not quite make the new list. The four Country Biodiversity Groups (CBGs) for England, Scotland, Wales and Northern Ireland will be responsible for the priority actions for the UK BAP species and habitats at the most appropriate level (species, habitat, landscape and policy). Instead of each species being allocated a lead partner, responsibility will be broader including a wide range of experts, from both the statutory and non-statutory sectors, who will take conservation actions that deal with threats to the UK BAP priorities. The single species approach delivered success under the UK BAP, and this approach will be retained where appropriate. However, wider actions for individual species will be delivered through government policy (eg agri-environment schemes) or by habitat action groups, taking more responsibility for species than in the past.

The Joint Nature Conservation Committee (JNCC) is the statutory advisor to the UK Government on national and international nature conservation, acting to unify the conservation efforts of the four CBGs. JNCC attempts to advise on tracking trends in both plant and animal populations, and is currently developing a strategy for marine biodiversity surveillance as part of the UK Marine Monitoring and Assessment Strategy[8]. Surveillance of 35 terrestrial mammals (of which 12 are listed as UK BAP priority species) is coordinated by the Tracking Mammal Partnership (TMP) (consisting of 25 organisations) forming part of the JNCC Terrestrial Biodiversity Surveillance Strategy. The TMP 2008 update reports that populations of 16 of the 35 monitored species are increasing[9]. Of these, only two are BAP species, the lesser horseshoe bat and otter, four are invasive species (rat, grey squirrel, sika deer and muntjac – see page 10 for updated deer distribution maps); 11 are stable (including four BAP species); six are declining (including five BAP species) and two species trends are indeterminate (one BAP species) (see table).

UK BAP Review Assessment Criteria[3]

Terrestrial BAP species	IUCN red list[10] threat category	Marked UK decline	Other important factor(s)#	Latest UK population estimate	Estimated % decline over 25 years	Tracking Mammal Partnership 10 year trend
Water vole	-	Yes	NN (mink)	875 000	88 (9)	Decline
Barbastelle	NT[i]		Deforestation & roost loss	5 000	-	-
Brown hare	-		HP; useful farmland indicator	752 600	8 (6)	Unclear
Hazel dormouse	-	Yes	Climate change	45 000	23 (9)	Decline
Bechstein's bat	NT[i]		Deforestation	>1 500	-	-
Soprano pipistrelle	-	Yes	Limited data; indicator for bats in human habitats	763 400	42 (6)	Stable/decline
Greater horseshoe bat	-		Reduced range	>6 600	(5)****	Stable/increase?
Lesser horseshoe bat	-		Roost loss; population not yet favourable	14 000	(7)****	Increase
Red squirrel**	-		Widespread constant decline; NN (grey squirrel)	121 000	64 (40)	-
Otter	-		Threats receded, recovery in progress, not complete	***74.2%	(27)****	Increase/stable
Hedgehog*	-	Yes	No	1-3 million	21 (4)	Decline
Scottish wildcat*	VU		HP & NN (feral cats)	400 - 4 000	-	-
Mountain hare*	-		Upland habitat indicator; NN (European hare in NI)	442 000	13 (9)	Decline
Harvest mouse*	-	Yes	Habitat loss and fragmentation	1 425 000	71 (18)	-
Polecat*	-		HP; Slow recovery; threat hybridisation (feral ferrets)	38 380	-	Stable
Noctule*	-	Yes	No	50 000	22 (6)	Stable
Brown long-eared bat*	-	Yes	No	245 000	21 (7)	Stable
Pine marten***	-		HP; < 20 10km squares	<3 650	-	-

[i]Status change from VU in 2008 IUCN Red List of Threatened Species (VU, vulnerable; NT, near threatened)[10]

#NN - vulnerable to impact of non-native species: predation, competition or hybridisation; HP - historic persecution

*added to UK Priority list in 2007; **does not include data from Northern Ireland; ***occupation of 10km squares; ****not declining

Terry Whittaker

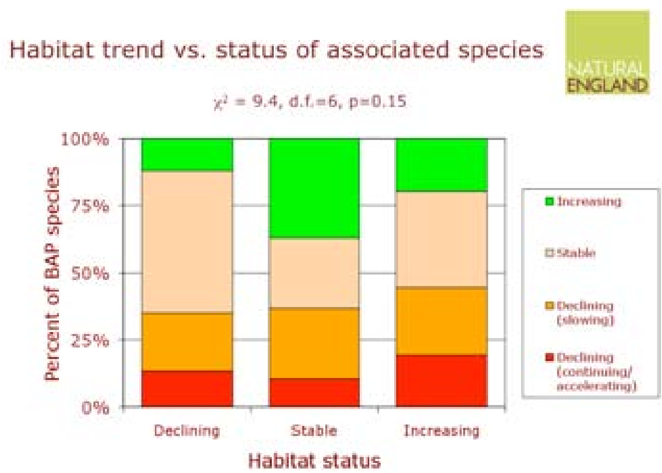
BAP species update: increased legal protection for water vole

In April 2008 the water vole received a welcome increased level of protection under the Wildlife and Countryside Act 1981 (variation of schedule 5) (England) order 2008. The water vole is now fully covered by the provisions of section 9 of the Act and this increased protection means that it is an offence intentionally to kill, injure or capture a water vole; possess or control any part of a live or dead water vole, intentionally or recklessly damage, destroy or obstruct access to any structure or place which water voles use for shelter or protection or disturb water voles while they are using such a place; sell, offer for sale or advertise for live or dead water voles. The maximum penalty for these offences is £5 000 or up to six months imprisonment, or both. Planners and developers of construction projects or riparian management work are required to translocate water voles, under license from Natural England, in situations where water vole disturbance cannot be mitigated through the current recommendations[11]. Licenses are not usually required for ecological surveys.

Though once widespread and familiar in Britain, the water vole has experienced catastrophic decline in the last 20 years due to agricultural intensification and infrastructure development, both resulting in the loss, linearisation and fragmentation of bankside vegetation and, worse still, predation by the invasive American mink. The original SAP target for 2010 aims to restore the water vole population to its 1990 status. So far conservation efforts have been widespread through implementation by 100 Local BAP partners covering England (71), Wales (18) and Scotland (11). A major reintroduction study in the Upper Thames tributaries by Oxford University's WildCRU, alongside their guidance manual for conservation practitioners in the form of the *Water Vole Conservation Handbook* (now in its second edition[11]) concluded that the primary determinant of reintroduction success was sufficient mink control to prevent contact between the released populations and dispersing mink. Where mink control was successful (as in seven of 12 releases undertaken by the WildCRU team), the survival rates and population densities of the reintroduced populations were determined by habitat quality[12]. Work by WildCRU has shown that the quantity of riparian vegetation available is a major determinant of important demographic factors in populations of water voles, including growth rates, survival rates, population densities and range sizes[13,14] (see page 14). The reintroduction study demonstrated both the importance of mink control and of maintaining large quantities of riparian vegetation for water vole conservation. It is hoped that future restoration projects, combined with the new legislation, will improve the chances of achieving the 2010 target level of restoration (for the current national status map see page 13).

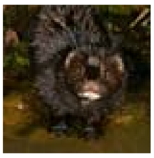
Achieving species conservation through habitat-based approaches

The emphasis for biodiversity conservation in England is changing from separate species and habitat action plans to a more integrated, ecosystem approach, with a greater focus on delivering species targets through habitat-based action. There are nine biodiversity integration groups each led by either Natural England, the Environment Agency or the Forestry Commission, to drive the delivery of habitat and species targets. Overall, the aim is to improve integration of national, regional and local delivery, and links between policy-makers and practitioners. But if we look after the habitats, will species look after themselves? An analysis of the trends of BAP habitats and associated species suggests that this is not necessarily the case: there is currently no difference in the trends of species that are associated with declining habitats and those associated with stable or increasing habitats. This suggests that future conservation management of habitats needs to focus more on generating heterogeneity and creating the niches and features that species need, rather than treating habitat management as an end-point in itself.



Peter Brotherton



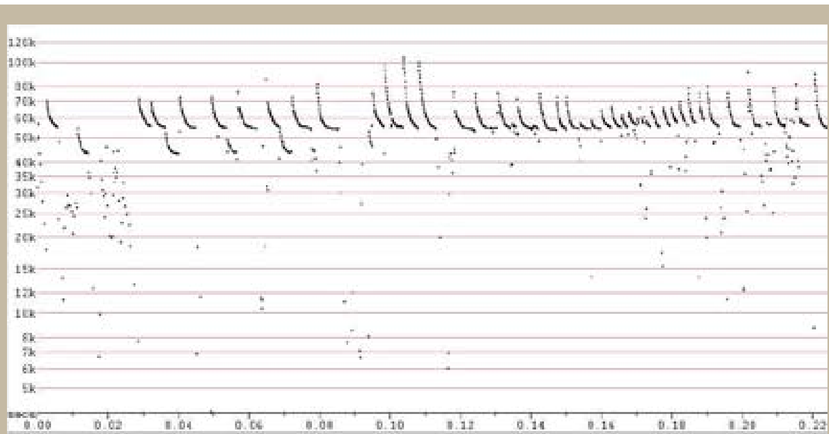



Mammal monitoring

A HOT TOPIC IN THE conservation of British mammals is the role of volunteers. The benefits of volunteer involvement are potentially great, through the contribution that 'citizen scientists' can make, the impact on the volunteer's personal growth and the potential to engage the wider public with nature. A partnership between Oxford University's WildCRU and Environmental Change Institute (ECI), together with CEH and Earthwatch, has designed a four-year research programme into the effects of climate change on the UK's fragmented woodlands. Unusually, this programme has been customised specifically to maximise opportunities for benefitting, and benefitting from, citizen scientists – in this case volunteers from the HSBC. The project is centred in Wytham Woods, near Oxford, and sits within the WildCRU's Upper Thames Project that seeks to integrate research on biodiversity and its conservation with the agroecosystem of the Thames catchment. The volunteers assist with studies of diverse animal species, from moths to woodlice, to understand the linkages between animals and the ECI's complementary research on fundamental carbon dynamics in the woodland. With specific regard to mammals, they focus on the small mammal (mice and voles) and bat populations in Wytham Woods and the surrounding agricultural matrix in Oxfordshire.

The volunteer work force consists of 10 teams, each of 12 HSBC employees per field season (April-October). Teams spend two weeks in the field, and, thus far, the first five teams have contributed around 4 590 hours, equating to about 574 days of a scientist's time. The volunteer teams alternate their efforts between research on the animals' responses to climate change in the context of woodland fragmentation, led by WildCRU, and quantifying carbon cycling in the same context, led by the ECI. The combined effects of habitat fragmentation and climate change are thought likely to significantly affect many species across the UK. Hotter, drier summers, wetter winters and an increase in unpredictable and extreme weather conditions mean that changes in species distributions and behaviour are already apparent. The woods around Oxford provide a model typical of lowland temperate woodland, fragmented by forestry, agricultural practices and urbanisation. Fragmentation, and concomitant reduction in population sizes and dispersal opportunities are, of course, an acknowledged threat to conservation, the effects of which are likely to be worsened by climate change.

Small mammals and bats were selected for study because both groups occur in the core and edges of woodlands, and use the hedgerows and isolated trees connecting fragments, allowing study of how these animals are affected by woodland fragmentation, and creating a framework for predictions of how their populations will be affected by climate change. For example, it is already known that connectivity, provided by hedgerows, is important to small mammals[15], but just how much connectivity, and what type, is needed between woodland patches to enable movement between populations? Wytham is almost uniquely suitable as the site for this study because of a long-term data set on the abundance of small mammals, begun in the 1950s by Charles Elton. These data suggest that rodent populations, particularly those of bank voles are declining. A likely explanation is that this is partly due to the large increase in deer numbers recorded in recent decades[16] and hence a loss of vegetation cover (see page 11). During the last few years deer management within Wytham has reduced their numbers, creating the opportunity to see the rodents' response. However, the obvious expectation that rodent numbers would increase as a response to reduced deer numbers has actually not been supported by the early findings from the volunteers' Longworth trapping programme, raising the possibility that the effects of several wet summers and cold springs may be operating as countermanding pressures on rodent survival



Sonogram of common pipistrelle and soprano pipistrelle bat calls. Once classed as the same species the soprano pipistrelle is now recognised as a separate species, and is easily identified, as its name suggests, by the higher frequency of its calls. While, there may be some overlap between the two species, soprano's usually call at frequencies above 50kh, while common pipistrelles call around 40kh. This makes it easy for volunteers to differentiate the two species.

and reproduction, despite the recovery of the vegetation.

Existing WildCRU research on bats in and around Wytham again provides a foundation for the volunteers' work. A combination of techniques ensures that all species are recorded. Checking of bat boxes positioned on trees throughout the woods is a good way of monitoring the larger bats, such as Daubenton's and Natterer's, which are difficult to pick up with bat detectors (see page 20). However, pipistrelles are seldom found in large numbers in the boxes, but can be monitored using bat detectors. The volunteer teams have recorded large populations of both common and soprano pipistrelle bats (despite the fact that the soprano pipistrelle has suffered a 42% decline elsewhere in the UK over the last six years).

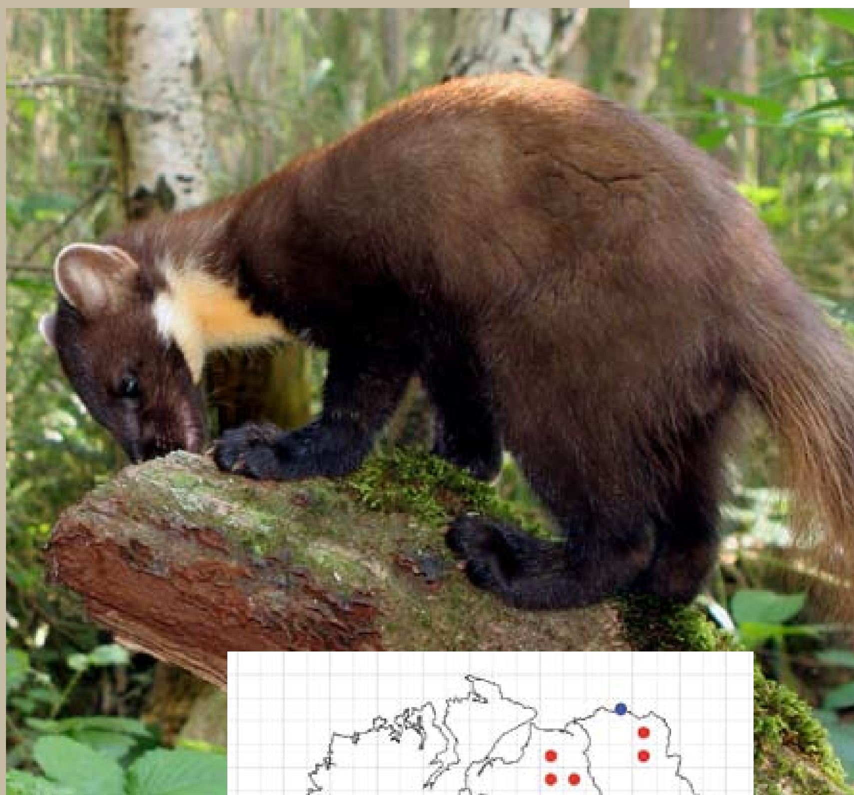
It is already clear that the volunteers have made a significant contribution to the science programme. Furthermore, debriefing sessions reveal that they generally revel in the experience and the relaying of their learning and experiences to family, friends and colleagues in HSBC provides a potentially powerful social tool for the benefit of conservation. However, it is important to study in depth the quality of the volunteer contribution, and how the best can be achieved from their work. Equally, the programme involves research into the lifestyle and attitudinal consequences for the volunteers of this involvement with research and exposure to the associated issues of climate change and biodiversity conservation.

Pine marten in Ireland

Reconciling conflict between human activities and wildlife is a familiar challenge for conservationists, and one worsened by painful irony when the interests of protected species are in conflict. After Scottish wildcat, pine marten is the second rarest carnivore in the UK and was added as a priority UK BAP species in 2007. A happy consequence of the recovering numbers of pine marten is their suspected effect in reducing invasive grey squirrels in at least some parts of Scotland[17]. Less happily, they also prey upon capercaille, one of the fastest declining gamebirds in the UK[18]. At RSPB Abernethy pine marten may be responsible for predating up to 80% of capercaille eggs[19]. Pine marten and their dens are offered full protection under Schedule 5 of the Wildlife and Countryside Act (1981) and the Environmental Protection Act respectively. One ideologically exercising option could be to create a derogation so that pine martens could be killed in the most sensitive carpercaille breeding areas[19].

A new conservation assessment for pine marten in the UK has concluded that the species has favourable status[20]. This rests on their continued existence in England and Wales, as evidenced by recent DNA analysis of scats from Wales[9], and reliable sightings in North Yorkshire Moors, though analysis is still to be confirmed. The pine marten population in Ireland is considered internationally important where it is fully protected under Schedule 5 of the Wildlife Order (NI) 1985. It is also listed as a protected species in Appendix III of the 1979 Bern Convention on the Conservation of European Wildlife and Natural Habitats, and included in Annex V of the European Community's Habitat and Species Directive 1992.

The first systematic survey of pine marten presence in Northern Ireland[21] was recently undertaken by the Ecological Management Group, funded by PTES. The survey confirmed that occupancy rates for pine marten in Northern Ireland are relatively high (57% of 10km squares surveyed), and that the region is important for pine marten in both the UK and Irish contexts. The identity of pine marten scats was confirmed by DNA analysis (ruling out the dishearteningly large number of fox scats erroneously attributed to pine marten in past surveys). Marten scats were found in forest or scrub that ranged in extent from 45ha to >6 000ha of contiguous (mainly coniferous) habitat. No obvious relationship was established between pine marten occupancy and transect or habitat variables at the scale of investigation. The researchers point out that in some of their 10km survey squares, pine marten at low population density may have eluded detection. Nevertheless, Fermanagh, and South and West Tyrone emerge as strongholds for pine marten in Northern Ireland[21] (see map below[21]). The species was also detected in South Armagh, South Down and North and South Antrim. Historically, pine marten may have occurred in all the counties in Northern Ireland up to 1905, but by 1975 they occurred only in Tyrone, Fermanagh and Down. A more intensive survey is needed to be confident of current trends in their distribution and abundance.



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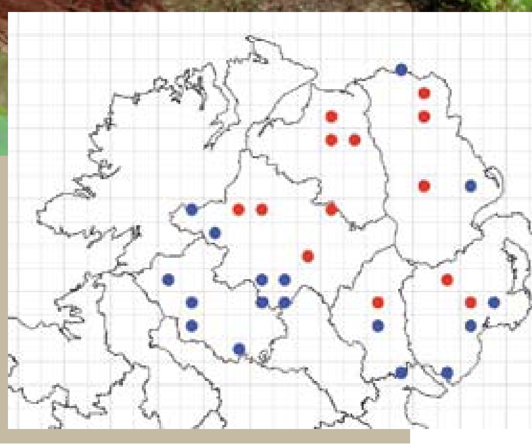
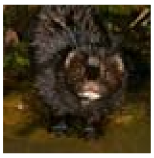


Distribution of pine marten in Northern Ireland from 30 survey squares (10km) where presence was detected (blue) or not (red).






British deer

RED DEER ARE BRITAIN'S largest terrestrial mammal so, not surprisingly they, and their impact on the landscape they inhabit, are the objects of divergent opinions. From one vantage point, red deer epitomize the beauty and resilience of nature, are a valuable source of venison and an attraction for tourists and trophy hunters. From another, they are a scourge of vegetation, a threat to biodiversity and a sink for money. Their population density and individual quality are therefore important concerns for those involved with red deer management.

A testament to the value of long-term data is the almost four decades of detail recorded for the red deer of Rum - a small island off the west coast of Scotland. These data have yielded some of the most penetrating insights of modern mammalian biology. A recent addition to these discoveries is how complex environmental and genetic factors interact to affect both the population and the individuals that comprise it (in the latter case, effects exerted even before they are born). For example, higher temperatures during a narrow four-week window between mid-March and mid-April can increase birth weights[22] which results in better survival rates. This relationship has far-reaching consequences because heavier males tend to achieve increased mating success.

The impact of these climatic factors is interwoven with the size and genetic profile of the population. If conditions are suitable, for example when the weather is good and survival rates high, the population will increase and at high densities the proportion of males born each year will decline. Now it emerges that rising population density is associated with reduced birth weight of male calves, but only to those born to medium quality hinds[23]. In this context, 'quality' is defined in terms of an individual's life-time contribution to population growth. In contrast, rising population density has no apparent impact on the birth weights of the sons of high or low quality mothers, presumably because the status of both these categories of hind is less affected by population pressure (high quality females, for example, retain their monopoly on the best grazing[23]). This cascade of effects means that at high population densities only high quality females will be producing high quality sons, and relatively fewer males will be produced.

Although one might have expected high quality to run in the family, that is not necessarily so. Conventionally, one might predict that genes promoting high quality would be favoured by natural selection. However, genetic variation in quality may persist if genes promoting high quality in one sex also result in reduced quality for any offspring of the opposite sex – a phenomenon known as sexually antagonistic selection. In the case of Rum's red deer, male quality (as for hinds, defined by lifetime contribution to population growth) is negatively related to the quality of their daughters with selection favouring males that will produce, on average, lower quality females[24]. Selection for higher quality males will therefore reduce the quality of the females produced, and potentially that of their subsequent male offspring.

Preferential harvesting of hinds or stags, either to reduce numbers, for venison or for trophies, can obviously have profound influences on the remaining deer population and the quality of the remaining deer. An unharvested red deer population will maintain a ratio of about 1.5-2 females per male. Harvesting is often focused on the males, which increases the relative number of females in the population. Yet, if hinds are left unculled, or are only harvested at low levels, this has implications for stags. Furthermore, elective harvesting of females can change their evolutionary trajectory, causing them to tend towards lighter weights when they first reproduce[25], with consequences for hind survival and the quality of their offspring. The complexities of the genetic and environmental relationships within red deer mean that management to retain high quality males and females, together with a robust genetic lineage, is an intricate task.

Roe deer

Roe are a widespread, but secretive, woodland deer. They are managed as game for venison, and sometimes as a pest of forestry and agriculture (see woodland SSSIs, page 11). In contrast to red deer, males and females are similar sizes, and studies of their breeding system have unearthed interesting contradictions. Sex allocation theory[26] predicts that, for systems where males compete for access to mates, high quality females should be more likely to produce sons, whereas poor quality females should favour daughters. This is because mothers capable of better nourishing their sons will produce larger, heavier males, which eventually should be successful at gaining access to mates and father more offspring over their life history, compared with a well-fed daughter. Roe mothers most commonly carry twin pregnancies, but sometimes singletons, and are therefore potentially able to influence how many offspring they carry, as well as the sex of their offspring. Recent analysis of 1 544 roe females shot on Ministry of Defence (MoD) estates across the UK, found that male embryos are favoured in single pregnancies, particularly so for mothers in good condition (as predicted by theory). However, at the population level twin pregnancies with one embryo of each sex occurred more than would be expected by chance

(known as sub-binomial variance), and this was also most clearly the case when the average condition of the does was high[27]. The researchers suggest an explanation that 'pigeon pairs' of roe deer fawns allow their mothers to maximise their investment in their offspring when future conditions are unpredictable. That is, if the mother's condition remains high then her investment in her son will 'pay off' in grandoffspring, but if through environmental stress the mother suffers a loss in condition, then she has a 'safe bet' in her daughter. The argument, therefore, is that sex allocation in roe deer is condition-dependent.

Because roe deer are so widely shot, there have been other opportunities to study their unborn litters, notably in studies in France, Sweden and Britain. Intriguingly, these results contrast with those from the MoD estates, in that does in good condition have had a preponderance of daughters, and tend to produce sons predominantly when in poorer condition, under circumstances of environmental stress[28]. These results support an alternative interpretation of sexual selection in roe deer models since, unlike other deer species, males are not strongly territorial and are thought to mate with relatively few females. This reduces the variation between male and female reproductive success, and therefore the difference in the potential advantage of investment by mothers in sons over daughters. This leads to the opposite argument that good quality females maximise their reproduction success by producing good quality daughters when environmental conditions are favourable, and therefore optimal numbers of grand offspring. Roe male juveniles disperse from their natal range more commonly, and at an earlier age, than do females, especially at high population densities with increasingly limited resources. Under these circumstances mothers may avoid future local resource competition by favouring sons, whereas daughters would increase environmental stress.

These diverse results pose a fascinating life history conundrum, but one that is not at all surprising given the effect of environmental variation on mammalian societies. Resolving this conundrum is likely to require more empirical data on male paternity success, and possibly experimental data under controlled conditions. As is the case for red deer, the explanation will probably be affected by the relationship between environmental conditions and the differential response of males and females.

Changes to deer legislation

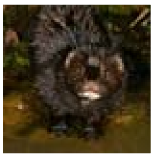
Until 1 October 2007 under the Deer Act 1991, all wild deer with the exception of muntjac and Chinese Water Deer (CWD) were protected by close seasons. The Regulatory Reform (Deer) (England and Wales) Order 2007 (No.2183) amends the original Act to improve deer management and welfare, and introduces new licensing provision. The close seasons for all female deer (except muntjac which breed all year round) is shortened to a common start date of 1 April until 31 October; both sexes of CWD are included in the close season as the sexes are difficult to distinguish. Changes to the order permit the use of smaller centre-fire rifle calibres for small deer (namely muntjac and CWD), and stationary vehicles as a shooting platform.

The amendment also allows the use of any reasonable means to dispatch a suffering deer, and the shooting of dependent young if they are deprived (or about to be deprived) of their mother. Natural England and the Welsh Assembly can issue specific licences to named stalkers to allow deer to be shot during the close season, or at night, where there is a serious risk of deer causing public health or safety problems, or for conserving natural heritage, or for the prevention of serious damage to property.

Robini Hamilton

Red deer and Japanese sika hybrids

Red deer and Japanese sika are known to hybridise, especially in captivity, but hitherto the general assumption has been that in the wild, the two species remain genetically distinct because hybridisation only occurs occasionally. The population of hybrids that lives free in County Wicklow, Ireland, is thought to have descended in part from escapees that were themselves captive-bred hybrids. However, new genetic evidence raises the possibility that hybrids may exist undetected amongst Britain's wild deer. A recent survey of 735 sika and red deer culled on the Kintyre Peninsula used genetic analysis to reveal 6.9% of them as hybrids[29]. Although these hybrids occurred throughout the study area, they were concentrated at one site to the west of Loch Awe, where 43% of deer were hybrids. This is the first documented case of a hybrid swarm of red and sika which definitely formed in the wild in the British Isles. Currently the Kintyre hybrid swarm appears to be contained by Loch Awe to the east (and the Atlantic ocean to the west), but there are no obvious geographical barriers to its spread to the north and south. Indeed, the sample revealed hybrids in adjacent forestry blocks in these directions. These genetic hybrids were mostly recorded as 'pure' red or 'pure' sika by the rangers that shot them. Currently the effect of hybridisation on physical appearance is unknown, but given the apparent difficulty of detecting hybrids by eye, and since sika now overlap with approximately 36% of the red deer's range in Britain, it is possible that considerable genetic mixing between the two species is going undetected elsewhere.



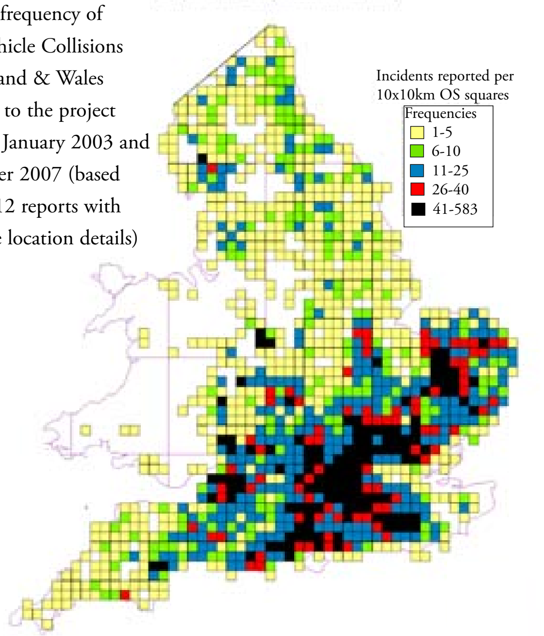
Deer issues

Deer vehicle collisions

The Deer Initiative (DI) has monitored reports of deer vehicle collisions (DVCs) since 2003, amassing information on over 40 000 incidents of deer road casualties and related vehicle collisions in the UK (England: 32 000; Scotland: c7 500 in Scotland; Wales: c500), including evidence indicating that the figures are rising each year (see table below). The DI estimates that records logged in the DVC database are likely to represent fewer than 20% of all the deer-vehicle incidents that occur, as there is no legal obligation to report or record deer road casualties or related vehicle collisions. Their best current estimates suggest that the annual toll of DVCs is likely to lie above 34 000 in England and 8 000 in Scotland. Comparative figures for Germany now exceed 220 000 per annum. Data on human injury road traffic accidents involving deer are not readily available, but extrapolation of data to all local authorities provides an estimate of 425 per year, including 65 'serious' casualties and around 10 fatalities annually.

The future strategy for monitoring will focus on the most reliable information for assessing DVC risk in the countryside; the five most valuable sources being police records, trunk road uplift data, RSPCA/SSPCA, insurance data, major Forestry Commission and Community Forest areas. Research into roadside deterrents continues, though current progress from trialling ecopillars (which emit a range of low and ultrasonic signals) and wegu acoustic deterrents (which emit a high pitched whistle) is disappointing in terms of efficacy (poor trigger performance) and practicality (frequent damage from errant vehicles, impracticable for areas with high traffic density or human habitation due to noise pollution). The DI's priority for mitigating DVCs is influencing driver behaviour and earlier this year they set up a Driver Awareness Working Group.

Relative frequency of Deer-Vehicle Collisions for England & Wales reported to the project between January 2003 and December 2007 (based on 24 312 reports with adequate location details)



Matthew Pitts

ABOVE: The incidence of deer vehicle collisions has been increasing annually on UK roads since 2000.

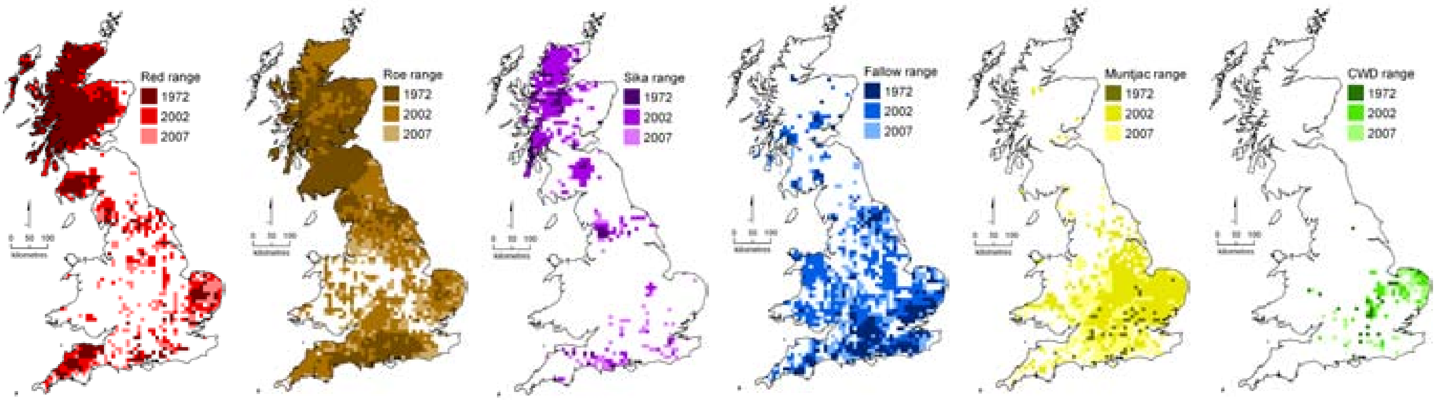
BELOW: The majority of national sources which are able to provide consistent data from year to year indicate that the frequency of DVCs has continued to rise over recent years for the country as a whole: for example RSPCA call-outs to live injured deer road casualties for England.

Year	2000	2001	2002	2003	2004	2005	2006	2007
RSPCA callouts	1216	1406	1592	1862	2360	2592	3020	3300

Deer diseases

Concern that wild mammals other than badgers might be involved in the transmission of bovine tuberculosis (bTB) to cattle has prompted two major studies. One focused especially on live-testing 4 393 small mammals and concluded that they were unlikely to be significantly involved[30], whereas the other, based on more than 4 800

BELOW: Current distribution of Britain's deer[34].



mammal carcasses[31] has led Defra to commission a project on the specific risks to cattle from deer as a source of bTB[32]. Deer are also hosts to ticks and their pathogens, which affect cattle, sheep, grouse and sometimes people. Ticks are vectors for a suite of microbes causing redwater fever in cattle (called babesiosis in people), tick-borne fever in sheep, which manifests as granulocytic anaplasmosis in people, and the louping-ill virus which infects sheep and grouse[33]. Ticks themselves cause skin irritation and wounds which can disrupt the foraging of livestock and game birds, thereby reducing productivity and fitness. Of these tick-borne ailments, Lyme disease and bTB represent, respectively, the greatest threats to human health and economics, making their distribution and prevalence in deer a topical issue.

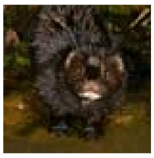
All the deer species present in Britain, except Chinese water deer, have been diagnosed bTB positive and have the potential to act as a source of bTB to cattle. The Deer Initiative participated in the national monitoring of the incidence of bTB and Lyme disease in deer, in partnership with Defra, Animal Health (formerly the State Veterinary Service), the Forestry Commission and with private landowners. This included sampling deer for bTB by staff and stalkers in the south west region. A successful pilot survey for bTB in deer, undertaken by Forestry Commission Rangers in the Peninsula Forest District from January to February 2006, was extended to include three private estates in the Cotswolds. The pilot survey demonstrated that the collection of samples by stalkers, during carcass inspection, was feasible and yielded good quality samples. The results indicate that fallow deer are the most likely of all the species of deer to be infected with bTB, with prevalence as high as 26% in one population on the Cotswold Estates[32]. Elsewhere in the south west bTB prevalence was very low, usually less than 1%. Visible lesions seem to be a reasonably good indicator of infection, but lesion free deer cannot be assumed free of bTB. The role deer play in the transmission of bTB infection remains uncertain, but these new data will inform disease modelling and the assessment of future risks to cattle.

All six species of wild deer have increased their distributions in Britain over the past 30 years[34] (see maps page 10). As one of the most important tick hosts in woodlands, their increasing distribution and abundance is linked to findings recently published by a team of researchers from Oxford University and the Game and Wildlife Conservation Trust (GWCT). For roe deer, tick infestation prevalence nearly doubled from 45% in 1993-94 to 81% in 2002-03, but remained constant for red (90%) sika (85%), and muntjac (60%)[33]. The researchers highlight the caution required when interpreting public perceptions, but nonetheless their public survey reported perceived increases in tick numbers at 73% of survey locations which coincided significantly with perceived increases in deer numbers; 41% of the respondents also reported the presence of tick-borne diseases, most commonly louping-ill and Lyme disease in tick areas[33]. These perceptions were corroborated by data showing increased tick infestation on grouse on three Scottish estates and on deer at 77% of MoD estates. Similar increases in ticks were reported by The Game & Wildlife Conservation Trust across 13 grouse moorlands in Scotland.

Impact of deer on woodland SSSIs

Deer can cause damage to woodland, agriculture and natural heritage through grazing, browsing and trampling. Together with lack of appropriate management, deer are diagnosed as the major cause of woodland Sites of Special Scientific Interest (SSSIs) being in poor condition. Given the continued expansion of the distributions of all six species, this situation will likely worsen if left unchecked. After upland heaths and bogs, and estuaries, lowland woodland is the fourth largest contributing habitat type of SSSIs in 'unfavourable' condition. Natural England is bound by a Public Service Agreement (PSA) target to bring 95% of England's SSSIs, by area, into 'favourable condition' by 2010[35]. The Deer Initiative is working with a range of partners in order to mitigate the detrimental impact of deer in woodland SSSIs, targeting resources in priority areas agreed by Natural England and the Forestry Commission. In 2005, of the 22 000 ha of woodland SSSI in England in unfavourable condition, 8 000 ha (36%) was due to damage by deer. By 2008, this figure had dropped encouragingly, to 4 000 ha (22%), largely a result of regional activity led by the Deer Initiative[35]. Practical measures include the creation and management of cleared deer lawn, fencing to protect young, establishing or coppiced, trees, deer gates, and deer population management.

Robin Hamilton



Managing invasives

Mink control in the UK

Britain is required under the Convention on Biological Diversity to 'control or eradicate those alien species which threaten ecosystems, habitats or species', yet until recently a formal, coordinated approach to tackling the problem of invasive species has been lacking. In May 2008, Defra launched the Invasive Non-native Species Framework Strategy for Great Britain, making Britain one of the first countries in Europe to develop a comprehensive national policy framework on invasive species. Although the highest priorities come under 'prevention' and 'early detection', control or eradication of those species already established must also be considered and a key action of the framework is to 'develop and resource key GB level action programmes that are cost-effective and evidence-based'.

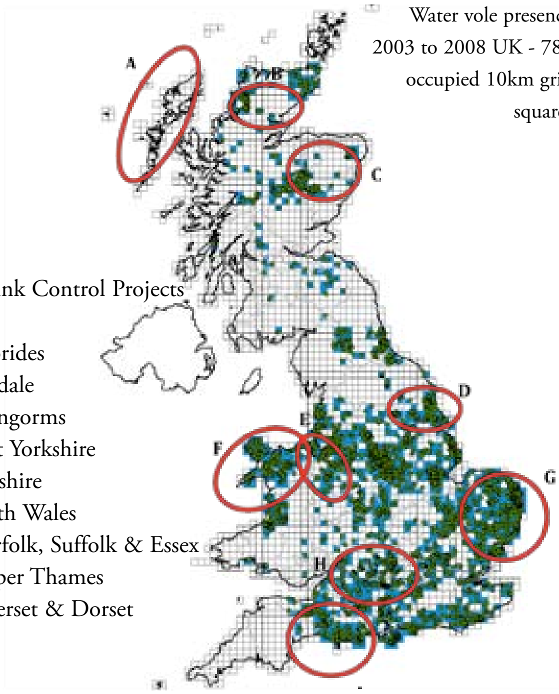
Amongst the 3 000 or so non-native species of animals and plants estimated to be present in the UK, American mink are one high profile example. Mink have proven impacts on populations of ground-nesting birds (particularly colonial seabirds), frogs and water voles, and mink control is a listed action in the water vole Species Action Plan. Accordingly, a multitude of local mink control programmes, operated largely by the local Wildlife Trusts, in partnership with the British Association for Shooting and Conservation (BASC), angling clubs, game keepers and local landowners, have developed throughout the UK. Whilst over a decade of research demonstrates that mink control is a prerequisite to conserving water voles and vulnerable seabirds, until quite recently it was not clear whether or not mink trapping could effectively reduce mink numbers in the long term. Most local projects attempt to clear mink from a relatively small area, surrounded by much more extensive sources of replacement mink. High levels of immigration not only increase costs and perpetuate welfare concerns, but also doom control programmes to an endless commitment.

Dave Bevan

The introduction of the GCT Mink Raft by the Game and Wildlife Conservation Trust (GWCT, formerly the Game Conservancy Trust) in 2002 provided not only a very efficient means of trapping mink, but also a method for monitoring their presence. Through a series of demonstration projects, the GWCT showed that continuous use of the system allowed mink presence to be held at very low levels at geographical scales up to at least 45km of river corridor. This control effort was accompanied by a documented increase in water vole distribution in two studies, and the persistence and spread of reintroduced water voles in a third.

Guided by computer simulations[36] researchers at the University of Oxford's WildCRU set out to corroborate the GCWT findings, through a controlled and replicated field experiment using the GCT mink raft to assess the effectiveness of mink trapping on 20km stretches of river. They found that with only four months or less of trapping per year mink presence could be held down locally, with mink completely absent for a third of the year[37]. However, continual monitoring and flexibility (ie being able to respond quickly to the presence of incoming mink and trap as necessary) were crucial at this scale to protect small, newly released populations of water voles (see water vole box, page 14).

Whilst local, small-scale removals can be valuable in, for example, the protection of key areas for water voles, the next logical step is to explore the feasibility of mink removal at a larger geographical scale. At the moment it remains unclear what the limits are to the successful control of mink at larger scales, and different delivery models – ranging from fully professional to fully volunteer-based – offer different blends of success and cost. Several projects are already expanding their geographical scope. The Hebridean mink project, run jointly by Scottish Natural Heritage (SNH) and the Central Science Laboratory (CSL), and funded by EU LIFE, has already successfully eradicated mink from the islands of North and South Uist, and Benbecula (a total area of approximately 700 km^2), and SNH is now continuing the project in the larger islands of Harris and Lewis[38]. The efforts on these islands, where mink removal is necessary to protect vulnerable ground-nesting seabirds, are enormous – 12 full-time trappers currently operate 7 000 traps, over a linear distance of 10 000km of water's edge, and traps are flown in to inaccessible areas by helicopter! The goal is total eradication over remote and difficult terrain. The Environment Agency (EA), in collaboration with BASC, has a similar vision for the west country, where mink have already undergone fairly substantial 'natural' population declines. Here, the EA wants to protect the area from further colonisation to help the survival of water voles in the area and so, with the help of BASC's Somerset Levels Green Shoots project and others in East Devon and Dorset, have established a trapping 'cordon sanitaire' that stretches from the Bristol Channel to the Dorset coast[39]. Individual projects run by Wildlife Trusts, government agencies and NGO's currently undertake mink control over a high proportion of Norfolk and Suffolk, and have formed a consortium approach to 'join-up' these efforts across the entire eastern region. Similar plans are afoot in the Thames region. The



Water vole presence 2003 to 2008 UK - 783 occupied 10km grid squares

UK Mink Control Projects

A Hebrides
B Alladale
C Cairngorms
D East Yorkshire
E Cheshire
F North Wales
G Norfolk, Suffolk & Essex
H Upper Thames
I Somerset & Dorset

GWCT, in their River Monnow demonstration project (Herefordshire; 2006-ongoing) are also expanding their mink-control zone (now 260km river, catchment area 380km^2), in an attempt to create longer-term sustainability of reintroduced water vole populations.

The distribution and abundance of mink is not so well understood in the uplands and the spread of mink appears to have been slow in these areas. Nationally important breeding populations of water voles still exist in the Cairngorms National Park (CNP) and in the northern highlands. It is therefore crucially important that mink are removed from these areas and further invasion prevented. The Cairngorms Water Vole Conservation Project (a partnership between the CNP, SNH and the University of Aberdeen) aims to create a 'mink free' zone within the CNP through a large-scale community-based trapping programme[40]. Covering an area of 5 500km^2, this is currently the largest mink control project in mainland Britain. The project is just over a year old and has so far successfully recruited 85 community volunteers to monitor 70% of the approximately 400 mink rafts across the area. Researchers at the University of Aberdeen are also investigating the dispersal patterns of mink using DNA extracted from mink hair (collected in hair traps) with a view to understanding better the invasion biology of mink. Preliminary results show that mink frequently disperse long distances with some parent–offspring and sibling pairs recorded over 100km apart - further supporting the need for large-scale coordinated mink control. In the northern highlands records of mink are sparse, suggesting either that mink have not yet reached the area or that they occur at very low density there. A new project between SNH and WildCRU, is currently investigating the northern limit of mink distribution in the highlands, and assessing the feasibility of using a 'cordon sanitaire' approach, similar to that set up in south west england, to prevent mink invasion into the northern highlands.

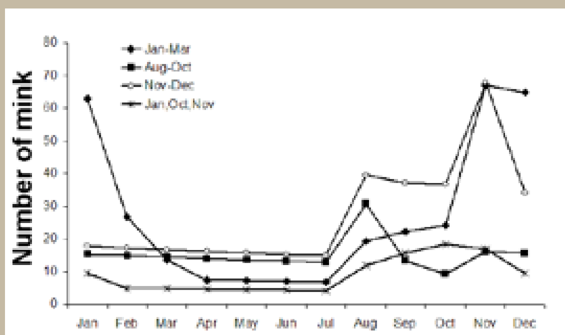
One of the key outcomes of the GB non-native species framework will be 'making the most of existing capacity and expertise, and closing as many gaps as possible through more effective co-ordination of existing management activities'. A consortium of NGOs, governmental agencies and universities, led by the GWCT, are doing just that by developing, and seeking funding for a sustainable GB mink control strategy that will build on and expand existing regional projects (with a long-term view of assessing the feasibility for eradication at some point in the future). The bid for funding will be developed over the next few years.

Using models to assist trapping efforts

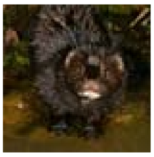
Field experiments, particularly with wide-ranging carnivores such as mink, are often limited by scale and therefore, there is usually little scope for comparing, for example, various alternative trapping scenarios. In such cases, modelling can be used alongside (or prior to) field experiments in an adaptive management approach. This involves using models to investigate alternative hypothetical management scenarios, whereupon field experiments can then be used to see how particular model predictions match with reality, and data gathered in the field can be used to improve the model (or the model parameters), and so on.

Researchers at the University of Oxford's WildCRU, used a spatially explicit, individual-based model to identify an 'optimal' strategy (in terms of effectiveness and efficiency) for controlling mink populations. Criteria explored by the model, included questions such as: how often do trappers have to trap? And, what is the best time of year to trap to minimise mink numbers? The optimal strategy identified by the model predicted that, to achieve an 80% reduction in the abundance of mink, it is necessary to remove mink for at least three months a year, every year, during the mating, late juvenile dispersal and winter seasons.

This model was based on the River Thames catchment; it is currently being further developed and adapted to investigate the feasibility of a cordon sanitaire approach to protect the northern highlands from mink invasion.



ABOVE: The graph shows the predicted number of mink in the control area throughout the year, depending on the period of the year that trapping is carried out. All strategies result in fairly low numbers of mink in the spring and early summer, but trapping only in January-March, or only in November - December (for instance), results in high numbers of mink in the autumn. Kits (young mink < 3 months old) are not included in the model calculations, juveniles (> 3 months old) are included[36].



Wildlife management

Managing water vole populations

Vegetation is crucial for water voles, as it provides them with both food and shelter from predation. The relationship between population processes and vegetation abundance is, however, not simple. Increased food and shelter typically lead to greater densities in small mammal populations. In many species of rodent, however, maturation rates decrease with increasing population density. This slows the rate of population expansion when the population is nearing its carrying capacity. Researchers from Oxford University's WildCRU examined the relationship between available forage, survival rates, individual growth rates and time to sexual maturity in eight reintroduced and three naturally-occurring populations of water voles[12,13].

Increasing the abundance of vegetation increases survival rates and population densities in water vole populations (Fig.1[12]). In turn water voles' range sizes at a site vary inversely with population density (the higher the density, the smaller the range sizes; Fig.2[13,14]). The amount of forage available to each water vole increases with its range size (Fig.3[13]). Water voles became sexually mature at the same weight at all sites (approx. 112g for females and 115g for males) and so the time taken to reach this weight was a function of the growth rates of the water voles and varied inversely with the size of their ranges (ie water voles with small ranges had slower growth rates and took up to 18% - or seven days - longer to reach sexual maturity). Evidence from this study suggests a possible mechanism by which increased population densities may reduce maturation rates in water voles through a reduction in mean range size, thereby limiting the availability of forage to each individual.

Implications of this study for site management are straightforward: management for increased abundance of vegetation would be expected to result in increased population densities of water voles due to increased survival rates. However, increased densities can lead to a decrease in maturation rates as a feedback mechanism.

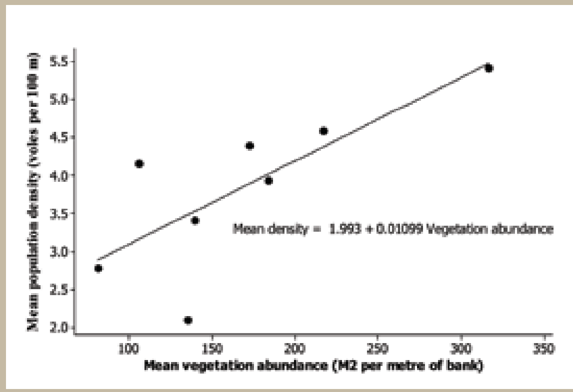


Figure 1. The relationship between mean population density and mean vegetation abundance for reintroduced populations[12].

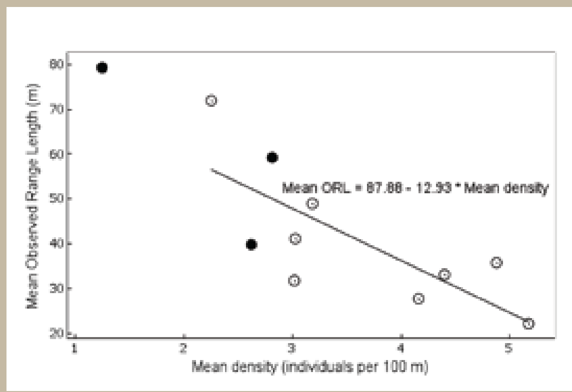


Figure 2. The relationship between mean observed range length (ORL) and mean population density for the reintroduced (open circles) and naturally-occurring (filled circles) populations[13].

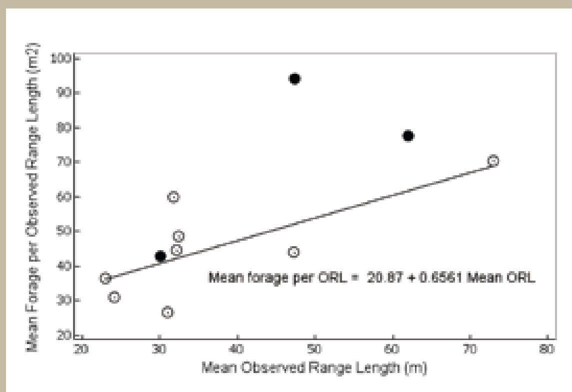


Figure 3. The relationship between mean observed range length (ORL) and mean forage available per observed range length for the reintroduced (open circles) and naturally-occurring (filled circles) populations[13].

Controlling badger damage to crops

Mammals damage crops all over the world. This can prove frustrating and costly for the farmer or grower concerned. In Britain crop damage is often attributed to deer or rabbits. However badgers also make a significant contribution to farmers' losses of cereals such as wheat, barley, oats, and maize. In a 1996 study almost a third of cereal farmers in England and Wales reported badger damage to crops, then estimated to cost £6.5-12.5 million per annum[41]. Badgers damage cereals by eating and flattening them, either by rolling on them or pulling them down with their jaws or forelegs. The proportion damaged varies (3-5% of an area on average) but can be considerable (up to 50%)[41]. Cereal damage is greater in south-west England, where badger density is greatest, but damage also depends on availability, weather conditions, land use and alternative food supplies.

Finding non-lethal methods of reducing badger damage to crops is a priority[41]. Researchers at the University of Oxford's WildCRU have tested learned food aversions involving 'second order conditioning' as a possible solution[42]. Second order conditioning is a two-stage process: first, animals learn to avoid the taste of a food through 'conditioned taste aversion' (a process thought to have evolved to prevent poisoning); then they associate this aversive taste with another cue, such as an odour. Animals subsequently avoid the then aversive odour. After creating an aversion to an odour in this way the odour might then be used to protect untreated foods. The researchers conditioned wild badgers using maize cobs treated with a combination of a repellent, ziram, and a benign odour cue, clove oil, after which badgers avoided untreated maize cobs in the presence of clove odour[42]. A clove oil control did not condition badgers[42]. The success of this experiment suggests that a full-scale field trial would be worthwhile to evaluate the potential of this technique for protecting growing crops on a wider scale.

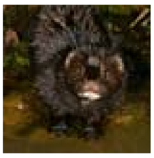

Steve Newby


Dave Bevan

Rats on the island of Canna
The small Scottish island of Canna supports breeding colonies of seabirds such as common guillemots, manx shearwaters and a large population of shags which is of European importance. However several of the species, in particular the manx shearwater, have shown dramatic declines in the numbers of breeding pairs since the 1990s. Birds such as shags and razorbills seemed to be deserting their traditional boulder area nesting sites for inaccessible cliffs and crags which are by far less common on the island. The main cause of this is thought to be predation of eggs and small chicks by brown rats, so in 2005 the National Trust Scotland, along with Scottish National Heritage and funding from the EU, started a programme to remove rats from Canna. Eradicating rats using traps and poison was complicated by the presence of a unique race of wood mice, the Canna woodmouse (*Apodemus sylvaticus*). It was feared that the mice would be poisoned along with the rats so, prior to the rat eradication programme, 158 mice were trapped and established as breeding colonies in Edinburgh Zoo and Highland Wildlife Park. After an intensive eradication programme in 2005 and 2006, monitoring using bait stations has shown no signs of rats but plenty of signs of woodmice[43].

Uist hedgehogs
Hedgehogs were introduced to South Uist, part of the Western Isles archipelago off the west coast of Scotland in 1974. By 2000 the four individuals had multiplied to an estimated 4 000-10 000, and had spread throughout South Uist and onto Benbecula and the southern tip of North Uist. Mrs Tiggywinkle and friends were having a drastic impact on nationally important ground-nesting bird colonies, such as dunlin and ringed plover, by predating eggs. The Uist Wader project, funded by Scottish National Heritage, RSPB and the Scottish Executive investigated the impacts of hedgehogs on bird populations and the feasibility of protecting the birds by fences, culling the hedgehogs or translocating them to the mainland. Fences were only a short term solution and welfare concerns about translocated animals[44] resulted in a cull of over 500 hedgehogs in three years between 2003 and 2006. Continuing concerns about animal welfare issues led to the translocation of over 1 000 hedgehogs to the Scottish mainland by the Uist Hedgehog Rescue Coalition[45]. In spring 2008 the trapping programme resulted in the removal of only one hedgehog from North Uist, a promising sign for the removal programme which is still ongoing on Benbecula.






Wildlife disease

Badgers and bovine tuberculosis

The publication by the Independent Scientific Group (ISG) of the final report from the UK government's Randomised Badger Culling Trial (RBCT, or Kreb's Trial), on 18 June 2007, and the Government's subsequent response has put at least a semi-colon into the debate about badgers and bovine tuberculosis. In last year's report, we outlined the key findings of the RBCT and the immediate reactions of the UK Government and stakeholder groups. Since then, several major debates have come and gone, culminating in a decision, bravely evidence-based, by Defra, which essentially rules out a badger cull in England.

Already, some dramatic twists along the road to this decision are receding in the political rearview mirror, but they delivered a roller-coaster ride during the past year and so we briefly recall them now. First, in a surprise turn of events, at the end of July 2007, the Government's then Chief Scientific Advisor, Sir David King, submitted a report entitled *Bovine Tuberculosis in Cattle and Badgers*. This challenged the ISG's conclusion that "*badger culling cannot meaningfully contribute to the control of cattle TB in Britain*"[46]. As a reminder, the ISG had concluded that, although badgers contribute significantly to the cattle disease in some parts of the country, no practicable method of badger culling can reduce the incidence of cattle TB to any useful extent, and culling may make matters worse. In contrast, the King Report concluded: "*the removal of badgers could make a significant contribution to the control of cattle TB in those areas of England where there is a high and persistent incidence of TB in cattle*"[47]. Part of the difference can be explained by the breadth of factors considered. King emphasised that his brief had been solely to comment on scientific issues, and not to set these in frameworks of either economics or practicalities, both of which the ISG had taken into account. The general reaction of the scientific community to the King Report appeared to be captured in a critical editorial in *Nature*[48], and after due consideration the ISG responded robustly that they had found nothing to persuade them against their original conclusions.

Considerations within Defra continued until July 2008, when Hilary Benn, the Secretary of State, made the forthright statement to Parliament that Government policy will be not to issue any licences to farmers to cull badgers for TB control, while leaving open the possibility of revisiting this policy under exceptional circumstances, or if new scientific evidence were to become available. Against a background of mounting optimism that badger vaccination might be effective within a few years, the Secretary of State also announced increased investment in vaccine development, and the establishment of a bovine TB Partnership Group with industry.

The farming industry's reaction has been sceptical, to the extent that Peter Kendal, the President of the National Farmers Union (NFU), opined: "*This is a disgraceful abdication of responsibility by Secretary of State Hilary Benn*"[49] and there are murmurings of an application for a judicial review. Meanwhile in Wales the Minister for Rural Affairs made an announcement on their bovine TB Eradication Programme. The statement made on 8 April 2008, highlighted the Government commitment to "*vigorously pursue a programme of TB eradication*" including an additional £27.7 million of funding over the next three years. Further statements clarified that 'targeted' badger culling could be part of the programme, if the scientific evidence supported that and probably within an initial pilot area in the first instance. In short, the Welsh government policy viewpoint is that "*Initiatives taken against wildlife (badgers) have to be part of a comprehensive approach to eradicating bovine TB.*"[50].

The Scottish Government is not pursuing badger culling as a policy option: "*...there is no evidence yet to suggest that badgers are a reservoir for the disease in Scotland.*" [51]. In Northern Ireland, the Badger Stakeholder Group submitted a report in February 2008. They made no commitment to badger culling within the bTB control strategy, and were unconvinced by the King Report and experiences in Republic of Ireland ("*The scientific evidence from ROI and GB around the impact of the removal of badgers on TB in cattle is complex, and it is not certain from the available scientific evidence that removing badgers will necessarily result in a further decline in TB in cattle across NI*"[52]). Within NI TB herd incidence has declined since 2002 from 9.92% to 5.35% in 2007, and the group acknowledges this has occurred without any official intervention in badger populations.

Overall, and despite the twists in the road, Defra's decision is an historic endorsement of evidence-based decision-making. No sensible person can be oblivious to the anguish of farmers whose herds are blighted, and nobody with even a glancing acquaintance with the issues and evidence can believe there is a simple solution. The reality is harrowing, a problem that is, for the time being, largely insoluble. Under these circumstances it takes courage not to do something just because desperation makes it seem that something must be done. This generation of Defra decision-makers deserve to be saluted for acting on the evidence.

Dave Bevan

Genetic analyses of badger populations

The findings of the Randomised Badger Culling Trial (RBCT) relied on knowledge of the ecology of the badger. Recent advances in molecular genetic techniques have enhanced this knowledge insofar as it has been possible only recently to determine the mating system and social structure of the European badger, through the use of microsatellite loci. Microsatellite loci are used in genetic fingerprinting (see box) which enables determination of who an individual's parents are, and the relatedness of individuals.

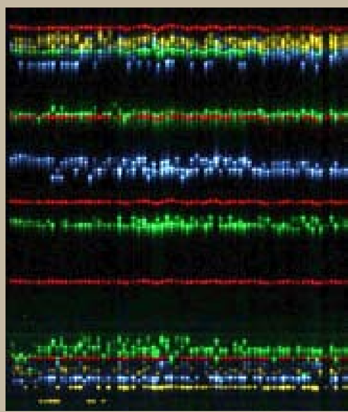
Two studies[53,54] in high-density badger populations, have shown a polygynandrous mating system: males mate with more than one female, and females mate with more than one male. Within social groups more than one male and more than one female may breed. Indeed, individuals do not always breed with mates from the same social group – around half of the cubs in these high-density populations were sired by males from outside the cub's group. These extra-group paternities were assigned primarily to males from neighbouring groups (see map). This suggests a high level of contact between badgers in different social groups, which has implications for the spread of diseases such as *Mycobacterium bovis* (which causes TB).

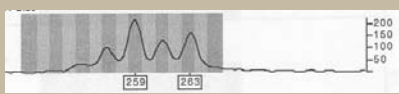
Using genetic data researchers from WildCRU have also shown that one third of group members are more likely to be full-siblings or parent–offspring than to be unrelated[55]. Social groups therefore consist of closely and more distantly related individuals. Additionally, badgers within a social group and in neighbouring groups, are more closely related than you would expect by chance. This leads to clustering of relatives within social groups and between neighbouring groups, the latter probably results from the high levels of paternity gained by neighbouring males.

Genetic studies can help explain the effect that culling has on badger social groups. One such analysis revealed an increase in badger movement as a result of the RBCT culling, at the genetic level[56]. Furthermore, badgers infected with *M. bovis* tended to move further than uninfected individuals. Detailed research into the intricacies of individual badger life histories enhances our understanding of badger societies and informs future work on the control of TB in cattle.

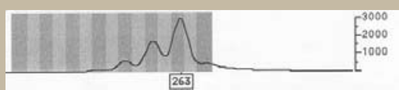
Extra-group paternity

The map shows the colour-coded badger social groups in Wytham Woods, Oxford. An arrow points from the father's social group to the cub's group, with the size of the arrow representing the number of assigned paternities.





Cub with alleles 259 & 263



Adult female with alleles 263 & 263

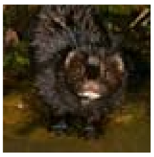
Genetic fingerprinting

Microsatellites are short sequences of DNA that vary in length. Each individual has two copies, or alleles, of each microsatellite. These alleles can be labelled with a fluorescent dye and run through a gel to determine their size (see picture above). This works on a similar basis to colour chromatography – shorter alleles run through the gel quicker than longer alleles and appear lower down. Individuals inherit one allele from their mother and one from their father. In the graphs (above) both the adult female and the cub have an allele of the same length (263). The adult female could therefore be the mother of the cub. By looking at whether the cub has alleles of several microsatellites in common with other badgers in the population we can work out who its mother and father are.

New Bovine TB Eradication Group for England

Defra and the English Cattle Industry have agreed to form a joint group to advise the government on developing a plan for reducing the incidence of bTB from cattle in England and moving towards eventual eradication. The Bovine TB Eradication Group[57], which will include representatives from Defra's Food and Farming Group, Animal Health, the farming industry and the veterinary profession, will also draw on the advice of the European Commission's TB Task Force, which will be invited to visit Britain in early 2009. The group will look at the options available to address infection and transmission in cattle and wildlife, including the use of vaccination in cattle and badgers. It will consider any exceptional circumstances or new scientific evidence that relate to the established policy on badger culling, recognising that the terms of this policy are currently subject to judicial review. The group will also assess options to help farmers in high incidence areas maintain viable businesses when under disease restrictions. The group will aim to develop a series of measures that can be submitted to the European Commission for approval as part of a formal eradication plan.






Reintroducing extinct mammals

IN 1995, THE QUESTION WAS POSED as to whether reintroducing European beavers was better considered as nostalgic meddling or restoring biodiversity[58]. Thirteen years of thorough, if occasionally tortuous, deliberations had passed when, in May 2008, the Scottish government granted a conditional licence to the Scottish Wildlife Trust (SWT) and the Royal Zoological Society of Scotland (RZSS) to undertake a trial reintroduction of up to four families of beavers[59]. The release, scheduled for spring 2009 and part funded by PTES, will be the first formal reintroduction of a native mammal to the UK. The beavers will be liberated on the Knapdale Forest estate, mid-Argyll, as part of a seven year project which includes an exit strategy[59].

The decision comes a decade after Scottish Natural Heritage's (SNH) public consultation on reintroducing beavers, which was largely supported by the public, and three years after the first licence application to undertake a trial in Knapdale was refused. SNH's species action framework includes European beavers as a species for conservation action and the 'Scottish beaver trial' (licensed under section 16(4) of the Wildlife and Countryside Act 1981, as amended), satisfies the requirements on the UK government to consider the desirability of reintroducing native species listed in Annex IV of the EU Habitats Directive. The European, or Eurasian, beaver was hunted to extinction in Britain by the 16th–18th centuries, and though it came close to its demise elsewhere in Europe by the 1900s, beavers have been successfully reintroduced into 21 European countries. The encouraging scale of the European recovery is reflected in the Eurasian beaver's change in status on the IUCN red list of threatened species from 'near threatened' to 'least concern'[10].

All the trial adults will, for the period immediately after release, be individually tagged with VHF radio or GPS devices for the purposes of identification and tracking. The tagged beavers will be retrieved if they stray beyond the study area or otherwise cause problems. SNH will, as a requirement of the licence conditions, coordinate independent monitoring for the trial, and report on whether the conditions of the licence are being fully addressed on the ground, as well as inputting to more detailed conditions. Of course, SNH's and the RZSS/SWT local consultations found that some people had concerns, but the hope is that these are allayed by the conditions of the licence, which include measures to avert conflicts of interest with the local community, a compensation scheme, public health monitoring, and dam management should it become necessary.

Nevertheless, the reintroduction raises the prospect of beavers impacting woodland ecology for the first time in 400 years. For example, aspen woodlands and the various red data book insects and lower plants uniquely associated with them are limited in Scotland principally to the Spey valley, which could bring any beaver activity in those areas into the spotlight. Much attention has been rightly devoted to health-screening beavers for release, but a perhaps slightly rarefied philosophical notion is that the loss of the beaver to Britain's fauna is in principle no more regrettable than that of the invertebrate parasites to which they were once hosts. An interesting example is a beetle, *Platypsyllus castoris*, thought to graze, as an obligate parasite, on the beaver's dandruff. Insofar as these beetles cause no risk to other organisms, a purist might have them next on the list for reintroduction. Ultimately, we anticipate beavers will contribute to the creation of wetland habitat in Scotland, and thus perhaps enhance the diversity of invertebrates colonising these habitats. Thought is certainly being devoted to monitoring the beavers, but it might be worthwhile to plan also monitoring of the other colonists for which they prepare the way.

It may be more fruitful to think about reintroductions in terms of building a future environment rather than reconstructing a bygone one. Any change will bring both pros and cons, but overall the evidence is that beavers will bring more benefits than costs in their effects on Scotland's biodiversity. Not only are they fascinating in themselves, and likely to generate revenue through ecotourism, but their foraging and engineering activities create valued wetland habitats. Anyway, the all-too-vivid lesson of history is that beavers are easily eradicated, so if it turns out that all the careful preparations have failed to anticipate some unforeseeable major problem, it seems unlikely that there would be much technical difficulty in removing the problem beavers. The risks seem small, the remedies accessible, and so the return of beavers to Britain seems a moment for rejoicing.

Scottish wildcat

The Scottish wildcat is Britain's only surviving native felid. Previously widespread across the UK, it had disappeared from southern Scotland, England and Wales by the mid to late 19th century as a result of habitat loss, in particular loss of forested areas, hunting for fur and persecution. The development of sporting estates in Scotland from the mid-19th century led to a further decline and by the early 20th century the wildcat was believed to be on the brink of extinction and restricted to the far north-west Highlands. The last estimates, of 1 000 to 4 000 wildcats in Scotland, are now long out of date, and were always questionable, and possibly as few as 400 individuals with classical wildcat


Vic Sharratt www.vicsharrattwildlifeimages.com

pelage may survive[60]. As a result of its precarious position, the wildcat is protected under both European law (Annex IV of the EC Habitats Directive) and British law (Schedule 5 and 6 of the Wildlife and Countryside Act 1981 as amended in 1988).

The main threats to the Scottish wildcat, albeit in unknown order, are human persecution and hybridisation with, and disease transmission from, domestic and feral cats[60]. Hybridisation is particularly problematic because the difficulty of distinguishing Scottish wildcats from hybrids complicates enforcement of protective legislation. Pivotal work in 2005 revealed that seven pelage characteristics could be used to identify, indeed to define, the Scottish wildcat in the field[61]. Along with the increased importance of wildcat conservation as demonstrated by its incorporation into both the UK BAP list and SNH Five Year Species Action Plan, a new phase of practical work was begun in 2006 when SNH initiated a survey of sightings and road-killed cats using the new pelage classification. The results, anticipated in 2009, will help identify any hotspots of wildcat persistence.

In early 2008, WildCRU and its collaborators at the National Museums of Scotland (NMS) (commissioned by SNH) began a series of scoping studies. The first of these assessed the feasibility of feral cat management in the Cairngorms National Park[62], with the aim of establishing a control methodology that could eventually be rolled out across Scotland in areas where feral cats threaten wildcat conservation. Aside from worries about the welfare of feral cats, they are perceived worldwide as a threat to wildlife, so both lethal and non-lethal techniques are deployed against them. In Scotland, while the threats to wildcats from disease or genetic dilution, remain unquantified, any reduction in their numbers may be regarded as reducing risk, and enhancing responsible cat ownership.

The report recommended an intensive trap-neuter-return programme of feral cats and subsidised or enforced neutering of domestic cats in wildcat hotspots. It is necessary to neuter 75-80% of a feral cat population to deliver a long–term decline. A further recommendation was to develop a programme of live-trapping and culling of feral cats in wildcat conservation zones. Although game-keepers already kill feral cats legally (using live traps and lamping), any control initiative should be backed by training based on the critical pelage characteristics, erring on the side of caution by sparing any cats where the diagnosis is uncertain. The report, highlighting the dearth of data on feral cats in Scotland, also emphasised the need to involve all stakeholders and to secure public support, and to work closely with organisations promoting responsible cat ownership. SNH announced a small pilot study to test the proposed neutering and culling methodologies at the Wildcat Conference hosted by the Cairngorms National Park Board in April 2008.

The two other WildCRU/NMS collaborative projects are still underway. One concerns the feasibility of enhancing wildcat conservation through captive breeding and re-stocking or reintroduction, and associated habitat improvement. The second involves using museum specimens, and those being collected under the current SNH survey, to check the concordance between wildcats diagnosed by the seven pelage pattern characteristics and the new genetic markers for Scottish wildcat. Step by step, studies like those reported here lay the foundation for evidence-based conservation action for the Scottish wildcat.

Potential lynx habitat in Scotland

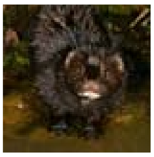
Eurasian lynx

The Eurasian lynx qualifies under the EU Habitats Directive Annex IV as a candidate for reintroduction to Britain. Previously the lynx was thought to have become extinct due to climatic change between 10 000 and 4 000 years ago, but evidence from radio-carbon dating bones and from ancient literature raises the possibility that lynx survived in Britain until Medieval times[63]. In that case, perhaps their demise owed more to anthropogenic factors, such as deforestation, declining deer numbers and persecution[63]. A prerequisite for reintroducing any species is that the causes of its original loss have been understood and mitigated. In Scotland, the abundance of woodland prey, such as deer, and the large scale of afforestation, are two candidates amongst the causes of lynx extinction that have been removed.

Against this background, rule-based models, populated with data from Swiss lynx populations, and fine-tuned with expert advice, were used to explore whether afforestation has provided suitable habitat to support a viable lynx population in Scotland[64]. The analysis suggests that there is enough suitable habitat in Scotland and northern England to support a population of 450 lynx. However, the pattern in which the habitat is connected is important, especially in terms of facilitating dispersal between sub-populations. A so-called connectivity analysis revealed that the potential lynx habitat is split into two main networks of connected patches: the Highlands (c.15 000km^2), potentially supporting around 400 lynx, and the Southern Uplands (c. 5 000km^2, but also connected to a further 800km^2 of habitat in northern England) potentially supporting around 50 lynx. A further 360km^2 of habitat in the far north was only weakly connected to the Highland network but these linkages could be improved by reforestation planned to create 'stepping stones' between the two areas. The major barrier to dispersal between the two main networks is the major roads of the Central Belt (the highly populated part of Scotland between Glasgow and Edinburgh). Of course, around the world, technology is developing to create under-and over-passes for wildlife to cross major road systems, so even this barrier is not beyond solution if there was a will to do so.

Of course, a computer simulation is just that, but nonetheless it provides a stimulating background to debate this provocative societal choice regarding denizens of our own backyard. The estimate that some 450 lynx might be sustained in Scotland also raises the unexpected thought that this could make Scotland's putative lynx population the fourth largest in Europe.






British bats

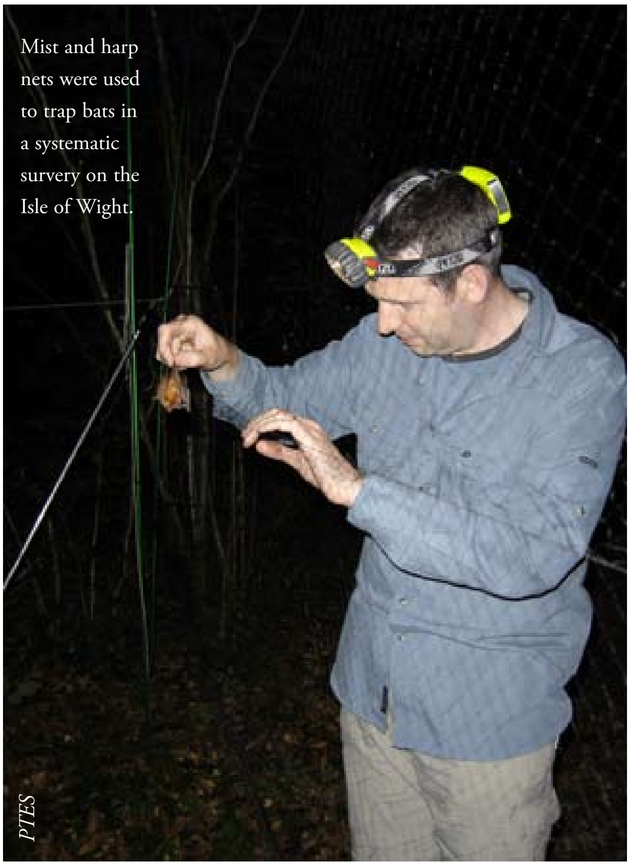
Bats announced as wildlife indicators
Almost one third of mammalian species in the UK are bats and, because they are sensitive to the pressures experienced by many other taxa, they make good indicators of environmental quality. As top predators of nocturnal insects, bats can reflect changes to invertebrate populations, are sensitive to land use practices, development and building work, and changes in water quality. In May 2008, on International Biodiversity Day, Defra announced that 6 of the UK's 17 bat species will be adopted as indicators of the health of the UK's wildlife[65]: the noctule, lesser horseshoe bat, common pipistrelle, soprano pipistrelle, serotine and Daubenton's bat. All British bats are under threat from habitat loss and during the last century many suffered severe declines, though some populations are increasing now[9].

The whole idea of using indicator species assumes that trends in their numbers will be monitored adequately to provide the yardstick for comparison. This is, in general, a problem in the UK where there is no national monitoring scheme for mammals. However, there is a National Bat Monitoring Programme (NBMP) and in recent years this has reported significant increases in the number of lesser horseshoe bats, in terms of colony counts and hibernation surveys (compared with the rest of Europe where this species has suffered severe declines). Lesser horseshoes are included in the UK BAP, and conservation efforts in stronghold areas are being prioritised to nurture this encouraging trend. The 'Landscape for Lessers' project (a partnership between the Bat Conservation Trust (BCT) and the Countryside Council for Wales (CCW))[66] is underway in Wales. This emphasises a landscape-scale approach,


Ian Davidson Watts

linking work in urban, semi-urban and rural environments, and providing many opportunities for people to get involved in conservation.

Another of the indicator species is Daubenton's bat, which has a stable population and is therefore not priority listed. It is a reservoir of European lyssavirus type 2 (ELBV-2). Recent genetic research[67] revealed that since the retreat of the Pleistocene ice sheet, Scotland has been recolonised twice by Daubenton's bats from the continent. DNA and gene sequence variation has also revealed two distinct phylogeographical clades (that is, groupings descending from a single common ancestor). The researchers deduce, from the persistence of these distinct populations and the characteristics of their mitochondrial DNA, that the high mountain ranges in northern Scotland and the hills of southern Scotland are barriers to colonisation for female Dabenton's but seemingly not for males.


Mist and harp nets were used to trap bats in a systematic survery on the Isle of Wight.
PTES

Natterer's bats
The UK supports an internationally significant population of Natterer's bat which is widespread, though Natterer's bats are probably the least known of European bat species. They emerge from their roosts well after dusk flying in and over woodland, which makes direct observation difficult. Linked with this, their relatively weak echolocation calls, which are similar to other Myotis species, tend to make this bat

Bat-wind farm collisions
In 2006 we reported that bat-wind farm collisions, widely documented in America were seemingly increasing in Europe, although the exact nature of the problem was unclear. It now seems that part of the problem lies with barotrauma; that is, rapid or excessive changes in pressure causing damage to anatomical structures containing air[69]. A recent study reported that direct contact with turbine blades accounted for only about half of the fatalities, whereas 90% of bats examined post mortem had internal haemorrhaging consistent with barotrauma.

Hope for mitigating bat collisions with wind turbines lies with the use of radar. Evidence in a report to Defra by the University of Aberdeen (co-funded by MTUK)[70], suggests that bat activity and foraging effort is significantly reduced in habitats exposed to an electromagnetic field (EMF) strength of greater than 2V/m, compared with control sites of EMF 0V/m. A possible explanation is that bats avoid exposure to electromagnetic radiation which may result in tissue heating. They may also hear the radar (as do some human radar operators).

species under-recorded during ultrasound surveys.

Recent findings show that Natterer's bats prefer to forage in both semi-natural broad-leaved woodlands and river corridors, but avoid dense conifer plantations[68]. In terms of management and conservation, the dependence of Natterer's on semi-natural broad-leaved woodland indicates that woodland management will affect their distribution locally. Management recommendations include the retention of this habitat type (which will also benefit other BAP species such as the dormouse), avoidance of clear-felling large blocks of broad-leaved woodland and that conifers should not be used for reforestation, tree cover along river banks should be protected and promoted and lastly improved grassland may be of benefit (although grassland does not appear to be a limiting factor).

Andrew Harrington

Bechstein's Bat Project

The Bechstein's bat is one of Britain's rarest mammals and a UK BAP priority species. Until now it has been difficult to detect, as it rarely leaves the canopy of its favoured broadleaf woodland habitat. A new National Bat Monitoring Programme (NBMP)[66] project has been launched to survey woodlands and produce more accurate distribution records of Bechstein's bat in southern England and south Wales using a sonic lure technique which relays ultrasonic social calls to locate this secretive bat.

It is hoped that four-five counties will be surveyed during each year of the project, with volunteers from bat groups in these areas being trained in the technique. Latest news from the Bat Conservation Trust (which is running this project), is that this year has been a very bad year for Bechstein's bats, and there are fears that, at least in some localities, breeding success may have been very low.

Barbastelle and Bechstein's bats on the Isle of Wight

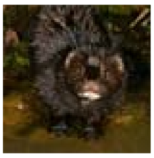
This year's IUCN assessment saw barbastelles and Bechstein's bats change status from vulnerable to near threatened[10], though their position as Britain's rarest and little-known woodland species remains firm. In 2005 there were only six breeding populations of Bechstein's bats and nine of barbstelles known in the UK, although more have been recorded since then. The Bechstein's current distribution, which may well be impoverished compared with their historic one, across southern England is now the subject of systematic survey. In addition, the Isle of Wight is an important stronghold with, potentially, European-wide importance. Since 2004, the Isle of Wight Woodland Bat Project, funded by PTES, has mapped the distribution and breeding status of the island's woodland bat population, locating important roost sites and investigating the relationship between their distribution and woodland habitat types[71]. In 2006 and 2007 harp traps and mist nets, and also ultrasonic lures (The Sussex Autobat) were used to assess sex and breeding status of captured bats, and some bats were then fitted with radio-transmitters for tracking back to roost sites. Infrared imaging equipment was used at roost sites located by radio-tracking to count bats as they emerged around sunset.

Bat activity was recorded at all 42 woodlands sampled. Bechstein's bats were captured in 28 woodlands and radio-tracking located 21 roosts with breeding females. Most maternity roosts were located in ash trees (two were in oak), and over 90% of them were in ancient semi-natural woodland or wooded streams. Female Bechstein's bats appeared to avoid secondary woodland habitats, and woodland habitats with public access, with possible higher levels of disturbance. Woodpecker holes seem to be important for maternity roosts on both the Isle of Wight and on the mainland (where most such roosts were found in oak trees), but for the most part the roost selection of Bechstein's bats remains a mystery.

Barbastelles were captured in 11 of the 42 sample woodlands and six roosts were located with breeding females. Barbastelles were using a range of woodland types, and all but one roost were in oak trees, with roosting sites in splits or under loose bark. One tree roost supported 115 bats – the largest on record for barbastelle's.

These findings provide a valuable baseline for future monitoring of bats on the Isle of Wight, where the Woodland Bat Project has logged the presence of 12 species of bat in the woodlands, nine of which were breeding. The study confirms the Isle of Wight as one of the most important areas for woodland bat species in Europe and the best county in the UK for Bechstein's and barbastelles. Factors such as a warmer climate, sensitive woodland management and woodland connectivity, the lack of invasive species such as grey squirrels and the absence of deer (and their tendency to eat the woodland understorey – see page 11) in woodlands across the island, are all potential reasons.






People's Trust for Endangered Species

During the year we awarded over £147 000 from the Mammals Trust UK fund for research into species including pygmy shrews, harvest mice, bats, water voles, dormice, red squirrels, pine martens and hedgehogs. Six recent graduates were awarded internships to spend time based in conservation-related NGOs researching dormice, bats, badgers, water voles and red squirrels.

Following several applications for work concerning harvest mice, we supported a seminar organised by WildCRU on the current state of knowledge of these tiny creatures to help inform research priorities. The participants remain in touch through a discussion forum.

Systematic monitoring and surveillance of mammals over long periods ensures that we look beyond short-term population fluctuations and concentrate our efforts where it most matters. We support monitoring schemes run by some other conservation organisations, including the Bat Conservation Trust and WildCRU, as well as maintaining our own multi-species mammal surveys, *Living with Mammals* and *Mammals on Roads*.

Twenty-three mammal species were identified by volunteer surveyors in last year's sixth *Living with Mammals* survey of urban and built environments, in addition to groups of species such as bats and mice. Fifteen of these were Species of Conservation Concern (SoCC) and included eight priority species, highlighting the importance of the urban environment in conservation and the need to understand how biodiversity can be supported in the green spaces around our homes and places of work and recreation. Both of our annual mammal surveys are part of the Tracking Mammal Partnership surveillance and monitoring programme.

Following the success of *HogWatch* last year with over 20 000 records received and a species distribution map created, we launched *MoleWatch* in the spring to map the distribution of molehills in the nation's gardens. These surveys provide useful basic data on distribution and encourage people to get involved with conservation on their doorstep. By autumn we had collected 5 338 records and provisional results showed that 38% of the 2 799 tetrads in the UK had positive records for molehills.

Mammal research funded in the UK

Dr Michael Pocock, University of Bristol, is studying the potential of hair tubes as a monitoring tool for pygmy shrews.

Dr Ben Garnett and Jenna Buss of Just Ecology are looking at the effect of radiocollar and backpack radiotransmitters on activity level and food intake of the harvest mouse, and Professor David Macdonald from WildCRU & Dr Callum Rankine of The Mammal Society are examining harvest mouse distribution and status in the UK and the role of citizen science.

Adrian Lloyd Jones is coordinating the North Wales dormouse project for the North West Wildlife Trust.

Julia Hanmer of the Bat Conservation Trust is monitoring Bechstein's bats in a new national survey; Steve Laurence of Wiltshire Bat Group, is working with bats in Savernake Forest; Sally Phillips is enhancing bat habitat with purpose-built bat boxes in modern agricultural sheds; Emma Stone, University of Bristol, is assessing the impact of artificial light on behaviour of lesser horseshoe bats; and Amy Coyte is monitoring bats and roadside mammals at the Bat Conservation Trust.

Professor Xavier Lambin, University of Aberdeen, continues the community-based water vole conservation project in NE Scotland; Wiltshire Wildlife Trust continues to coordinate the Wiltshire water vole recovery initiative; Dr Paul Bright and Jenny MacPherson, Royal Holloway University of London, are well into the third phase of the national key sites for water voles project that creates safe and appropriate refuge areas; and Nick Rowles is restoring water voles at the Wildwood Trust in Kent.

The spatial ecology and habitat utilisation of pine marten in commercial forests in Ireland is being monitored by Dr Declan O'Mahony of the Ecological Management Group.

The project to develop informed, practical strategies to reverse the hedgehog decline continues with Dr Paul Bright and Anouschka Hof, RHUL.


Mike Ewart

Mammal species in the UK: student projects

Alison Looser, Suffolk Wildlife Trust, is creating a 'living landscape' for Suffolk's dormice.

Andrea Barden, Central Science Laboratory, is implementing farm husbandry measures to reduce the risk of bovine tuberculosis (Myobacterium bovis) transmission between badgers (Meles meles) and cattle.

Cally Quigley, University of Cumbria, is assessing wildlife corridors for red squirrels by defining and modelling contiguous and non-contiguous habitat for connecting woodland patches.

Jennifer Skinner, University of Aberdeen, is investigating whether electromagnetic radiation can act as a deterrent to prevent bats from approaching turbine blades.

Mark Chambers is prioritising potential water vole (Arvicola terrestris) reintroduction sites in the area surrounding Durham Wildlife Trust.

Rosie Trodden, University of Stirling, is studying the influence of farming practices on bat populations within agricultural landscapes.

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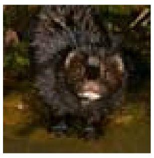


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Seven years ago, People's Trust for Endangered Species began to focus particular attention on conserving wild mammals and their habitats throughout the British Isles by creating a special fund called Mammals Trust UK (MTUK). Through this fund we support and commission practical conservation research and we raise awareness by involving people in conserving mammals. We work in partnership with other voluntary organisations, wildlife experts, government and industry. Our aims in conserving our wild mammal populations are:

- to raise funds for research and practical conservation based on sound scientific understanding
- to increase public awareness, bring together those with an interest in mammal conservation and share knowledge
- to create opportunities for people to participate actively in mammal monitoring and conservation projects across the UK
- to manage key conservation sites to protect them for the future and to create opportunities for education, recreation and enjoyment of our natural heritage.

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WildCRU

The Wildlife Conservation Research Unit's mission is to undertake original research on aspects of fundamental biology relevant to solving practical problems of wildlife conservation and environmental management.

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The State of Britain's Mammals 2008 is the seventh of the annual updates following the publication of *Britain's Mammals: The Challenge for Conservation* for the launch of Mammals Trust UK in 2001. Copies of both publications can be obtained by contacting the People's Trust for Endangered Species at the address and phone number above.

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